APPENDIX D: DETAILED IMPACT ASSESSMENT

Jindal Melmoth Iron Ore Project
Appendix D - Impact Assessment

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EXECUTIVE SUMMARY

The Jindal Melmoth Iron Ore Project (MIOP) biophysical and socio-economic impacts are summarised for all the phases: construction, operational and decommissioning/ closure in Table 1, Table 2 and Table 3.

Table 1 Summary of Construction Phase Impacts

Potential Impact	Unmitigated	Mitigated
Biophysical		
Impact on groundwater quantity	**Very low -**	**Insignificant -**
Impact on groundwater quality	**Low -**	**Insignificant**
Reduced surface water quality	**Medium -**	**Low -**
Alteration of natural drainage patterns and flow	**Medium -**	**Low -**
Impact of flooding	**Medium -**	**Low -**
Direct - Impacts to vegetation communities and implications for threatened ecosystems and biodiversity conservation	**Very high -**	**High -**
Indirect - Impacts to vegetation communities and implications for threatened ecosystems and biodiversity conservation	**High -**	**Medium -**
Direct - Impacts to species and threatened species conservation	**High -**	**Medium -**
Indirect - Impacts to species and threatened species conservation	**Medium -**	**Medium -**
Direct - Impacts to local and regional ecological processes	**High -**	**High -**
Indirect - Impacts to local and regional ecological processes	**Medium -**	**Medium -**
Physical loss or modification of freshwater habitat	**Medium**	**Medium**
Alteration of hydrological and geomorphological processes	**Medium**	**Low -**
Impacts to wetlands and aquatic ecosystems due to reduced water quality	**Medium**	**Low -**
Impacts to ecological connectivity and/or ecological disturbance impacts	**Moderate-Low**	**Low -**
Impact on ambient air quality	**Medium**	**Low -**
Impact on ambient noise levels	**Low -**	**Very low -**
Impact of change of land use from subsistence farming to mining	**Medium -**	**Low -**
Impact of loss and/or reduction of current land capability	**High -**	**Low -**
Impact of increased soil erosion	**High -**	**Medium -**
Impact of soil compaction	**High -**	**Medium -**
Impact of soil pollution	**High -**	**Low -**
Impact on landscape and visual aspects	**High -**	**High -**
Impact of the project on climate change	**Low -**	**Low -**
Socio-economic		
Loss of palaeontological resources	**Insignificant**	**Insignificant**
Impact of changing farming practices, market options and sources of nutrition	**Very high -**	**Medium -**
Exposure to vector-borne and zoonotic disease	**Medium -**	**Low -**

Changes in access to healthcare	Very high -	Very high +
Loss of cultural heritage resources	Very high -	Medium -
Relocation of graves	Very high -	High -
Impact on road users and traffic safety	Low -	Low -
Labour influx / in-migration of jobseekers	Low -	Very Low -
Resettlement and relocation	High -	Medium -
Community development and lifestyle	Medium -	Low -
Business and enterprise - impacts -on the agricultural sector	High -	Medium -
Business and enterprise - impacts on tourism	High -	Medium -
Impact on the local and regional economy	High +	High +

Table 2 Summary of Operational Phase Impacts

Potential Impact	Unmitigated	Mitigated
Biophysical		
Impact on groundwater quantity	Very high -	High -
Impact on groundwater quality	Insignificant	Insignificant
Reduced surface water quality	High -	Medium -
Alteration of natural drainage patterns and flow	Medium -	Low -
Impact of flooding	Medium -	Low -
Direct - Impacts to vegetation communities and implications for threatened ecosystems and biodiversity conservation	High -	Medium
Indirect - Impacts to vegetation communities and implications for threatened ecosystems and biodiversity conservation	High -	Medium -
Direct - Impacts to species and threatened species conservation	High -	Medium -
Indirect - Impacts to species and threatened species conservation	Medium -	Medium -
Direct - Impacts to local and regional ecological processes	Medium -	Medium -
Indirect - Impacts to local and regional ecological processes	Medium -	Medium -
Physical loss or modification of freshwater habitat	High	High
Alteration of hydrological and geomorphological processes	High	Medium
Impacts to wetlands and aquatic ecosystems due to reduced water quality	High	Medium
Impacts to ecological connectivity and/or ecological disturbance impacts	Medium -	Low -
Impact on ambient air quality - community health	High - to Medium	Medium - to Low -
Impact on ambient air quality - commercial crops	Low -	Very Low -
Impact on ambient air quality - blasting	Medium -	Low -
Impact on ambient noise levels	High -	Medium -
Impact of change of land use from subsistence farming to mining	High -	Low -
Impact of loss and/or reduction of current land capability	Medium -	Low -

Impact of increased soil erosion	Medium -	Very Low -
Impact of soil compaction	High -	Medium -
Impact of soil pollution	High -	Low -
Impact on landscape and visual aspects	Very high -	High -
Impact of the project on climate change	High +	High +
Impact of ground vibration, air blast and fly rock due to blasting activities	High -	Low -
Socio-economic		
Impact of changing farming practices, market options and sources of nutrition	Very high -	Medium -
Exposure to vector-borne and zoonotic disease	Medium -	Low -
Changes in access to healthcare	Very high -	Very high +
Loss of cultural heritage resources	Very high -	Medium -
Relocation of graves	Very high -	High -
Impact on road users and traffic safety	High to Medium -	Medium to High +
Labour influx / in-migration of jobseekers	Medium -	Low -
Community development and lifestyle	Medium +	High +
Business and enterprise - impacts on tourism	Medium -	Medium -
Impact on the local and regional economy	High +	High +

Table 3 Summary of Decommissioning and Closure Phase Impacts

Potential Impact	Unmitigated	Mitigated
Biophysical		
Impact on groundwater quantity	Low -	Insignificant -
Impact on groundwater quality	Insignificant	Insignificant
Reduced surface water quality	Medium -	Low -
Alteration of natural drainage patterns and flow	Medium -	Low -
Impact of flooding	Medium -	Low -
Direct - Impacts to vegetation communities and implications for threatened ecosystems and biodiversity conservation	Medium -	Low -
Indirect - Impacts to vegetation communities and implications for threatened ecosystems and biodiversity conservation	High -	Medium -
Direct - Impacts to species and threatened species conservation	Medium -	Low -
Indirect - Impacts to species and threatened species conservation	Medium -	Low -
Direct - Impacts to local and regional ecological processes	Medium -	Medium -
Indirect - Impacts to local and regional ecological processes	Medium -	Low -
Physical loss or modification of freshwater habitat	Medium -	Medium -
Alteration of hydrological and geomorphological processes	Medium -	Low -

Impacts to wetlands and aquatic ecosystems due to reduced water quality	Medium -	Low -
Impacts to ecological connectivity and/or ecological disturbance impacts	Moderate-Low -	Low -
Impact on ambient air quality	Medium -	Low -
Impact on ambient noise levels	Low -	Very low -
Impact of change of land use from subsistence farming to mining	High -	Low -
Impact of loss and/or reduction of current land capability	Medium -	Low -
Impact of increased soil erosion	High -	Medium -
Impact of soil compaction	High -	Medium -
Impact of soil pollution	High -	Low -
Impact on landscape and visual aspects	High -	Medium -
Impact of the project on climate change	Not assessed	
Socio-economic		
Impact of changing farming practices, market options and sources of nutrition	Very high -	Medium -
Impact on road users and traffic safety	Low -	Low -
Labour influx / in-migration of jobseekers	Low -	Very Low -
Community development and lifestyle	Medium -	Low -
Business and enterprise - impacts on tourism	High -	Medium -
Impact on the local and regional economy	Medium -	Low -

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

Acronym/abbreviation	Definition
ABET	Adult Basic Education And Training
AMD	Acid Mine Drainage
AOI	Area Of Influence
BMP	Best Management Practices
CAPEX	Capital Expenditure
CBA	Critical Biodiversity Area
CHMMP	Community Health Monitoring And Management Plan
CIT	Company Income Tax
CO	Carbon Monoxide
DMRE	Department Of Mineral Resources Nd Energy
DOL	Department Of Labour
DWS	Department Of Water And Sanitation
ECO	Environmental Control Officer
EIS	Ecological Importance And Sensitivity
EKZNW	Ezemvelo Kwazulu Natal Wildlife
EMPR	Environmental Management Programme
EPC	Engineering, Procurement And Construction
EO	Environmental Officer
FTE	Full Time Equivalent
GCL	Geosynthetic Clay Liner
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GNR	Government Notice Regulation
GVA	Gross Value Added
HDPE	High Density Polyethylene
HDV	Heavy Duty Vehicle
IAP	Invasive Alien Plant
IAQM	Institute Of Air Quality Management
IDP	Integrated Development Plan
IEMA	Institute Of Environmental Management And Assessment
IOA	Institute Of Acoustics
KZN	Kwazulu Natal
LED	Local Economic Development
LM	Local Municipality
LOM	Life Of Mine
MIOP	Melmoth Iron Ore Project

Acronym/abbreviation	Definition
MR	Mining Right
NAAQS	National Ambient Air Quality Standard
NCR	Noise Control Regulations
NEM:BA	National Environmental Management: Biodiversity Act
NEM:WA	National Environmental Management: Waste Act
NFA	Nkwalini Farmers Association
NHRA	National Heritage Resources Act
NO_2	Nitrogen Dioxide
OPEX	Operational Expenditure
PES	Present Ecological State
PAOI	Project Area Of Influence
PCD	Pollution Control Dam
PM	Particulate Matter
RAP	Resettlement Action Plan
RWD	Return Water Dam
SACNASP	South African Council For Natural Scientific Professions
SANS	South African National Standard
SASS	South African Scoring System
SCC	Species Of Conservation Concern
SDP	Skills Development Plan
SEI	Site Ecological Importance
SLP	Social And Labour Plan
SMME	Small, Medium and Micro Enterprises
SR	Sensitive Receptor
SSP	Shared Socio-Economic Pathway
STD	Sexually Transmitted Disease
SWMP	Stormwater Management Plan
TB	Tuberculosis
TSF	Tailings Storage Facility
VAC	Visual Absorption Capacity
VAT	Value Added Tax
WRD	Waste Rock Dump
WWTW	Wastewater Treatment Plant

A) IMPACT ON BIOPHYSICAL ENVIRONMENT

1. GROUNDWATER

1.1 IMPACT ON GROUNDWATER QUANTITY

1.1.1 Description of Impact

The hydrogeological conditions in the area are complex with varied water levels measured over short distances. Based on the conceptual model developed (Figure 1-1), ingress to the open pit is expected to be low (< 5 l/s) at elevations above 440 mamsl, with increasing depth the ingress is expected to gradually increase over time (Median Scenario - Peak groundwater inflows: 60 l/s).

Dewatering of the open pit during the operational phase of the Jindal Melmoth Iron Ore Project (MIOP) would result in a cone of depression around the pit. The extent of drawdown would affect up to 2.5 km in a westerly direction, 1.6 km in a southerly direction, 1.2 km in a northerly direction and 1 km in an easterly direction. Groundwater users that fall within this area are expected to have a notable drawdown in water level in supply boreholes (Figure 1-3). The farm areas on which drawdown, exceeding 5 m, is expected to occur includes: Ntembeni 16921, Kromdraai 6110, Lot No 5 1038, Lot No 5 10383 GU, Lot 7 Umhlatuzi 10870, Lot 9 Umhlatuzi 10872, Hillcrest 15900, Loudwaters 11258, Lot 8 Umhlatuzi 10871 and Maranqapawlu 15351.

The dewatering of the aquifers around the pit area would result in a reduction of groundwater that would have ultimately discharged to the rivers in the catchment as baseflow. The assessment of reduction in baseflow indicated that a 9 % reduction in baseflow is expected over the operational period of the mine. Relative to stream flow, a 0.5 % reduction in stream flow is expected in the catchment at life of mine i.e. a river flow rate of 2.13 m^3/s to 2.09 m^3/s. This is expected to be insignificant on downstream water users.

A post mining a pit lake is expected to develop in the remnant open pit. In the first 16 years following completion of mining, the recovery in water level is anticipated to be rapid (rise to ± 300 mamsl). Beyond 16 years to 160 years the pit level gradually rises by approximately 74 m. The pit lake is expected to stabilise at this elevation between 160 and 300 years. The lowest elevation on the pit perimeter is 405 mamsl (Figure 1-1). Consequently, the pit lake is expected to remain below the edge of the pit and no decant/ spillage would occur.

Two features are of particular importance regarding groundwater with regard to this project, the waste rock dump (WRD) and tailings storage facility (TSF). The WRD is located on the granites north of the open pit within the proposed Mining Right (MR) area. A large fault zone runs through the central portion of the WRD. The terrain proposed for the WRD undulates with hilltops exceeding 600 mamsl and valleys at 370 mamsl. Several small drainages flow in the valley areas proposed for the waste rock deposition.

The TSF and return water dam (RWD) are situated on shales of Pietermaritzburg formation. The groundwater quantity impacts are cumulatively assessed as part of this process due to the integral nature of these facilities and their potential impact on groundwater levels over time.

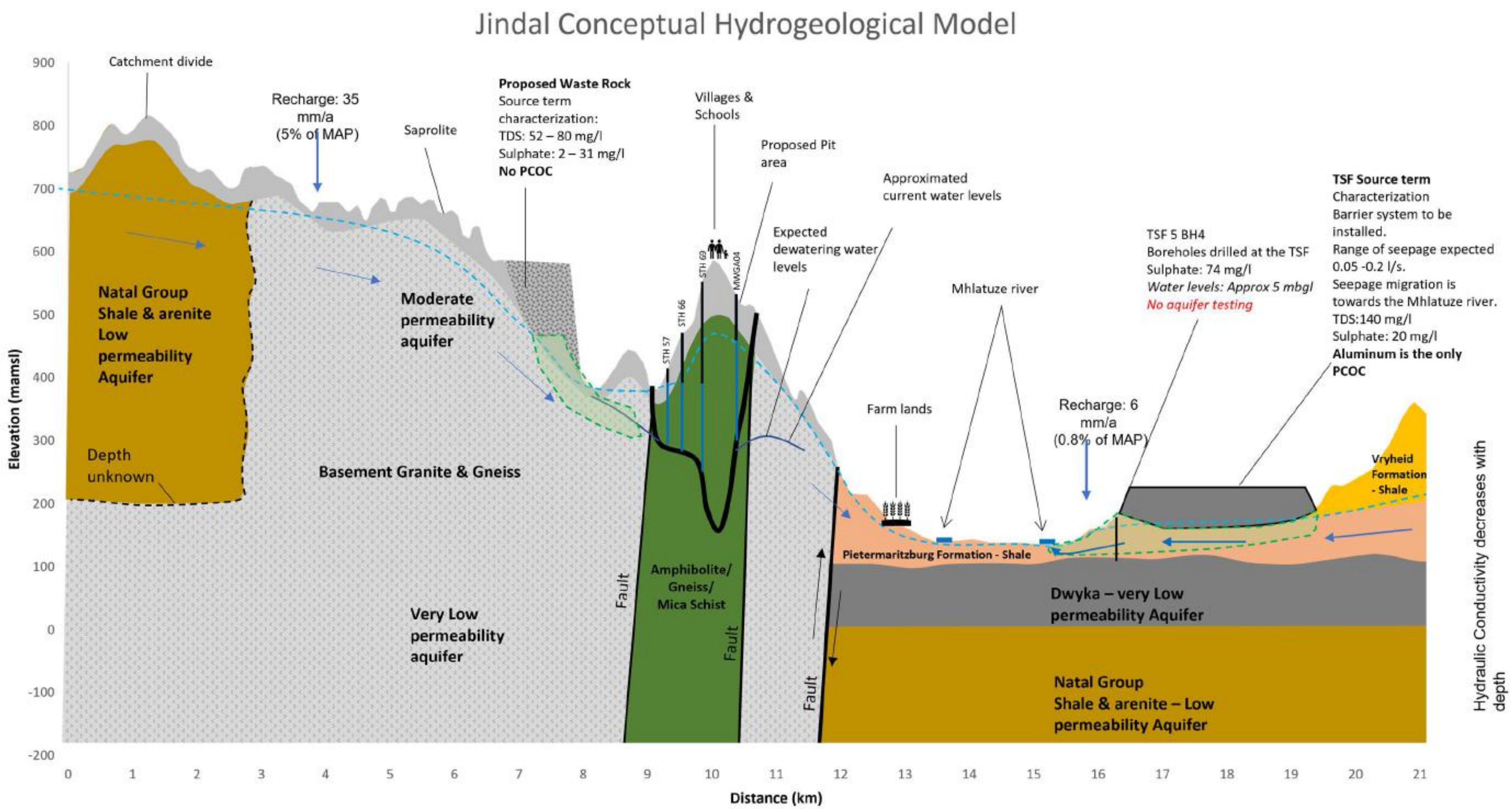

Figure 1-1 Jindal conceptual hydrogeological model

1.1.2 Source of impact

The project activities/infrastructure likely to result in reduced water quantity:

Project phase	Activity/infrastructure
Construction	• Groundwater use for construction activities
Operational	• Mining of the South East Pit • Deposition of waste rock onto the WRD • Deposition of tailings onto the TSF
Decommissioning/ Closure	• Pit lake

1.1.3 Impact Assessment

During the construction phase of the project a small amount of groundwater is expected to be required for construction purposes and dust suppression. This could potentially result in a localized cone of depression at the abstraction borehole.

However, the impact on groundwater quantity during the construction phase is predicted to be **VERY LOW** with no mitigation implemented and **INSIGNIFICANT** with mitigation due to the short-term of the construction phase as well as the minor potential impact and limited extent over which the impact may be felt (Table 1-1).

During the operational phase the mining of the open pit results in ingress of groundwater to the open pit and the consequent dewatering of adjacent aquifers. Where drawdown exceeds 5 m, water supply may be influenced. The extent of drawdown, where drawdown exceeds 5 m relative to the steady state water level, is up to 2.5 km in a westerly direction from the pit, 1.6 km in a southerly direction form the pit, 1.2 km in a northerly direction and 1 km in an easterly direction from the pit (Figure 1-1).

Groundwater users that fall within this area are expected to have a notable drawdown in water level in supply boreholes. The farm areas on which drawdown, exceeding 5 m, is expected to occur includes: Ntembeni 16921, Kromdraai 6110, Lot No 5 1038, Lot No 5 10383 GU, Lot 7 Umhlatuzi 10870, Lot 9 Umhlatuzi 10872, Hillcrest 15900, Loudwaters 11258, Lot 8 Umhlatuzi 10871, Maranqapawlu 15351 (Figure 1-3). From the hydrocensus results, it is known that groundwater is mainly used by the farms for irrigation and drinking water (post-treatment).

Further, the reduction in baseflow for the Mhlatuze River over the operational period is a 9 % reduction. The river flow reduction because of mining is predicted to be a 0.5 % reduction in river flow (Section 1.1.1).

In terms of the TSF the liner would reduce the seepage contribution to current groundwater levels in the vicinity to less than 0.05 % of the total volume of the TSF. Recharge in the area of the WRD would be comparable to natural recharge.

The impact on groundwater quantity during the operational phase is therefore largely due to the open pit operations. Due to the predicted very high intensity the overall impact is assessed to be **VERY HIGH** prior to any mitigation measures being put in place. Mitigation of the impact itself is not really feasible, however, the 'symptoms' of the impact can be mitigated and can therefore be marginally reduced to a **HIGH** significance (Table 1-1).

Post mining, a pit lake would develop at the Jindal MIOP. The pit lake levels are expected to rapidly rise within the first 15 years (100 m) following cessation of mining. Thereafter, water levels would gradually increase to an estimated elevation of 375 mamsl (164 years post operations – 300 years post operations). The lowest elevation on the pit perimeter would be 405 mamsl and consequently it is unlikely that the pit would decant (Figure 1-2). Instead, evaporation effects result in a persistent sink and the pit lake level would eventually reach an equilibrium at around 375 mamsl. A terminal pit lake will develop, and water levels will remain depressed around the pit area indefinitely.

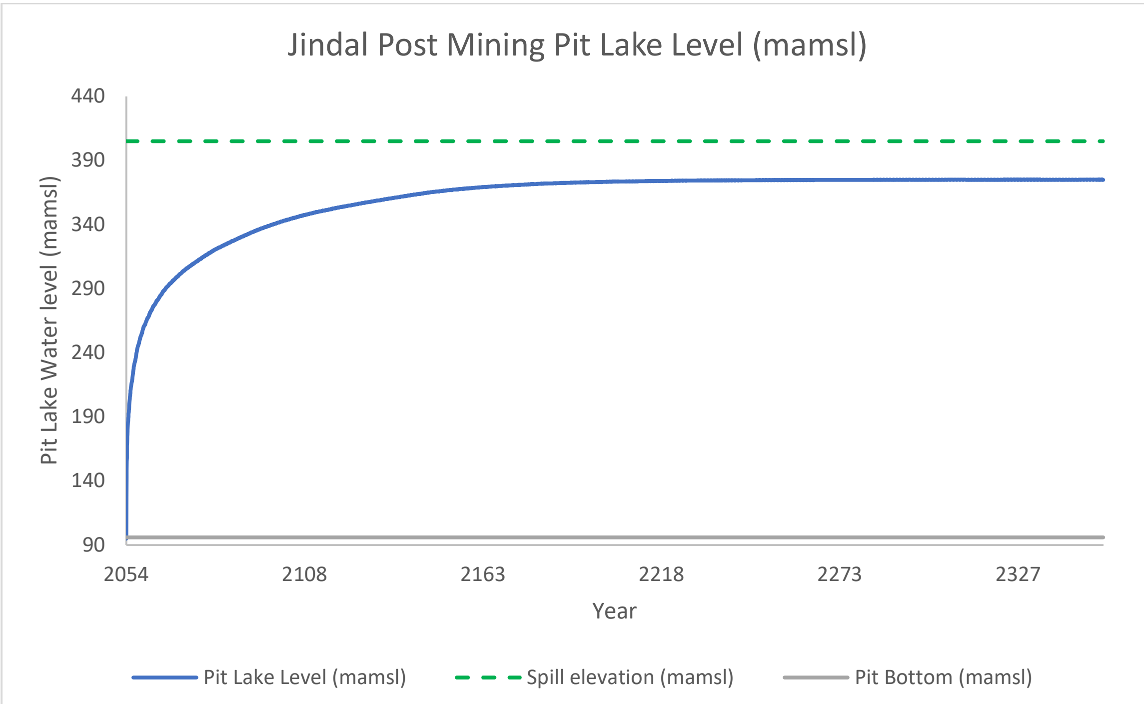

Figure 1-2 Post mining Jindal pit lake water level

In terms of the TSF, this would be lined and therefore negligible change in water level is expected over time.

The impact on groundwater levels post closure is predicted to be **VERY LOW** as the levels would largely recover within the first 15 years. Over time the impact would become **INSIGNIFICANT** (Table 1-1).

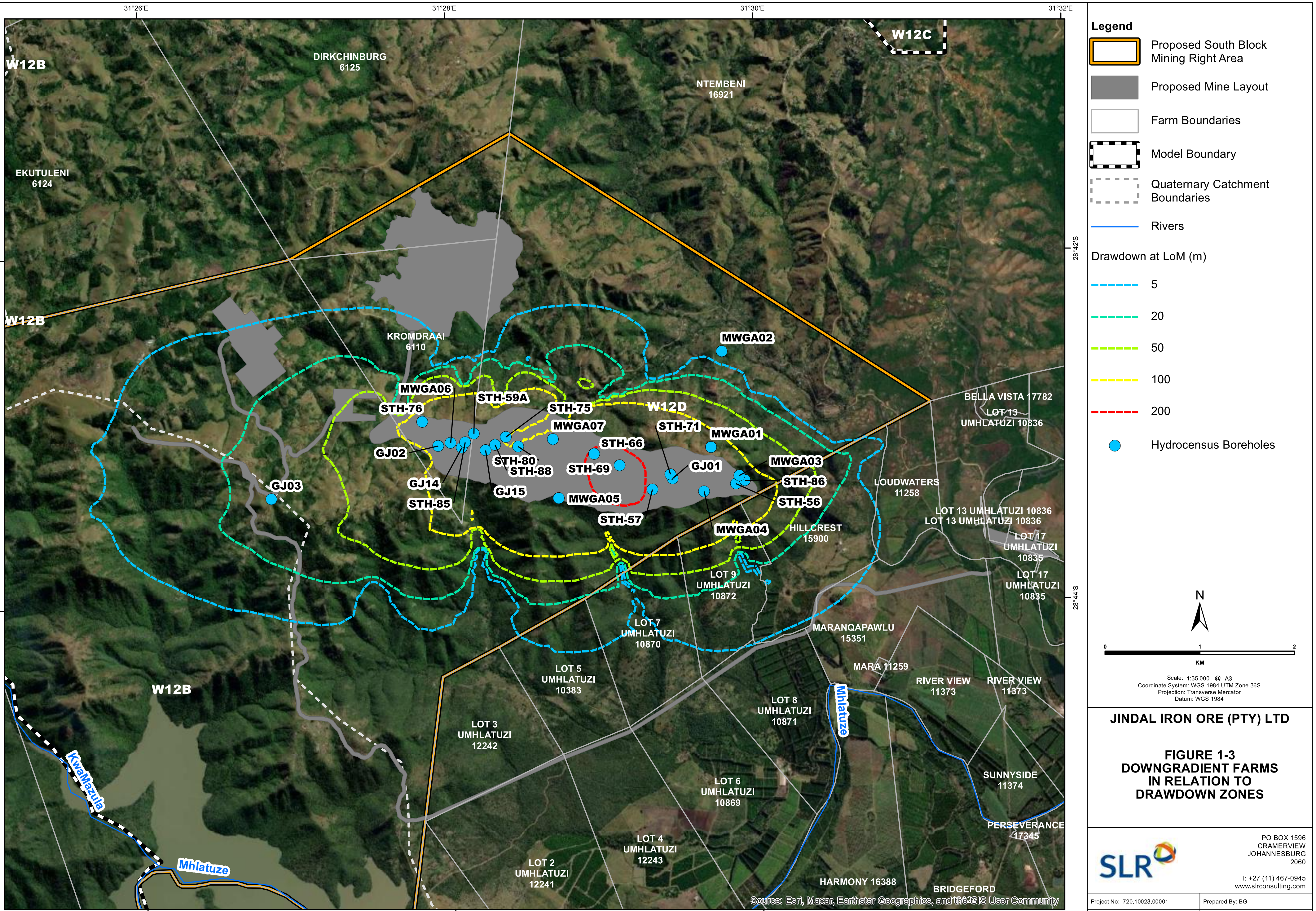

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FIGURE 1-3
DOWNGRADIENT FARMS IN RELATION TO DRAWDOWN ZONES

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720.10023.00001 EIA 1-3 Drawdown Zones

Table 1-1 Impact on groundwater levels

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phase	**Construction**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Minor change (Low)	Negligible change (Very low)
Duration	Short-term (1 to 5 years)	Short-term (1 to 5 years)
Extent	Whole site and nearby surroundings	Part of site/property
Consequence	Low	Very low
Probability	Conceivable (Low)	Unlikely / improbable (Very low)
Significance	**Very low -**	**Insignificant -**
Description of Impact		
Phases	**Operational**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Severe change (Very high)	Moderate change (Medium)
Duration	Very long term/ Permanent (> 20 years)	Very long term/ Permanent (> 20 years)
Extent	Local area, far beyond site	Local area, far beyond site
Consequence	Very high	High
Probability	Definite / Continuous (Very high)	Possible / frequent (Medium)
Significance	**Very high -**	**High -**
Phases	**Decommissioning and Closure Phases**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium)	Minor change (Low)
Duration	Very long term/ Permanent (> 20 years)	Very long term/ Permanent (> 20 years)
Extent	Beyond the site	Part of site/property
Consequence	Medium	Low
Probability	Conceivable (Low)	Unlikely / improbable (Very low)
Significance	**Low -**	**Insignificant -**
Degree to which impact can be reversed	**Partially reversable** - Post-mining the pit would be rehabilitated to a degree and groundwater ingress would reduce, thereby lowering the dewatering impact.	
Degree to which impact may cause irreplaceable loss of resources	**Medium** - Lowering of the local water table could occur.	
Degree to which impact can be avoided	**None** - The pit is necessary in order to operate an open pit mine. However, with appropriate resource management measures, impacts can be reduced.	

Degree to which impact can be mitigated	**Low** - Some mitigation is possible but minimal in effect. Mitigation is not able to minimise the source of the impact but can reduce the 'symptoms' of the impact.	
Cumulative impact		
Nature of cumulative impacts	Cumulative impacts in terms of groundwater quantity within the catchment have been qualitatively assessed. There are no other mining operations within the catchment which could result in additional drawdown issues. Further expansion of the mine in the neighbouring concession areas could result in a larger drawdown and result in a larger number of farms becoming impacted. Should mining operations be expanded in the future these would need to be cumulatively assessed. Commercial crop farming occurs in the lower areas of the catchment. Abstraction for water supply on these farms may result in additional water level drawdowns.	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Very low	**Insignificant**
Residual impact		
Residual impact discussion	**Insignificant** - The residual impact once mining is complete and rehabilitation of the WRD and TSF has taken place, is predicted to be insignificant as groundwater levels would largely rebound within the first 15 years post closure.	

Table 1-2 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	To minimise the impacts to groundwater levels through all phases of the Jindal MIOP.
Mitigation actions/measures	
Construction Phase	

- Water level data in the pit area is outdated as access was not possible during the assessment process and water level measurements were last taken in 2014. Access needs to be arranged to revisit the boreholes in the pit area and collect current water level data.
- An aquifer testing programme must be undertaken within the pit area. Suitable boreholes must be drilled, and aquifer testing must be completed prior to construction starting.
- Following drilling and testing the model should be re-simulated. This is particularly important if additional drilling data alters the current conceptual understanding.
- The water level data should be evaluated against the model predictions annually and if significant variation is observed, the model should be re-calibrated. Once operational the model should be re-looked at on a 3 year basis.
- There are currently no water level or aquifer parameters for the granites north of the pit where the WRD facility is proposed. Borehole drilling and aquifer testing is required in this area to characterise the lithology, geochemistry and hydrogeology and serve as long term monitoring locations up and downgradient of the WRD facility.
- Packer testing should be completed in existing boreholes within the pit area to characterise the hydraulic conductivity at various depths throughout the formations.
- Additional boreholes must be sited on the periphery of the pit to serve as long term monitoring boreholes.

Management Outcome, Mitigation Actions/Measures and Monitoring	
• The boreholes recently drilled at the TSF must be pump tested to SANS10299 testing standards to confirm the hydraulic conductivity values assumed within the modelling. • Prior to groundwater abstraction for water supply, supply boreholes should be aquifer tested and licenced to ensure that nearby water users are not impacted by drawdown due to pumping.	
Operational Phase	
• Ongoing monitoring at all boreholes, new and existing. The water level data should be evaluated against the model predictions annually and if significant variation is observed, the model should be re-calibrated. Once operational the model should be re-looked at on a 3 year basis. • An expanded hydrocensus on the farms Ntembeni 16921, Kromdraai 6110, Lot No 5 1038, Lot No 5 10383 GU, Lot 7 Umhlatuzi 10870, Lot 9 Umhlatuzi 10872, Hillcrest 15900, Loudwaters 11258, Lot 8 Umhlatuzi 10871, Maranqapawlu 15351 and accessible boreholes identified through this survey need to be incorporated into the groundwater monitoring program for the site. • The boreholes on the above listed farms may potentially become impacted by mine dewatering. The depths of the boreholes and the required yields should be evaluated as part of the hydrocensus study. Alternative water supply sources may be required for water users identified to be affected by mine dewatering. • Monitoring of boreholes at the TSF, near to the pit and on surrounding farms should be monitored monthly for a water level. Quarterly samples should be collected at these boreholes and sent for water quality analysis. • The monitoring data should be collated quarterly and analysed in detail annually to validate the findings of the modelling.	
Closure Phase	
• Post mining monitoring should be carried out for a period of 5 years in order to validate the findings of the modelling. • Depressed water levels should be mitigated by drilling deeper supply boreholes for water users located near to the pit/ mining area.	
Monitoring	• An expanded hydrocensus on the farms Ntembeni 16921, Kromdraai 6110, Lot No 5 1038, Lot No 5 10383 GU, Lot 7 Umhlatuzi 10870, Lot 9 Umhlatuzi 10872, Hillcrest 15900, Loudwaters 11258, Lot 8 Umhlatuzi 10871, Maranqapawlu 15351 and accessible boreholes identified through this survey need to be incorporated into the groundwater monitoring program for the site. • Monitoring of boreholes at the TSF, near to the pit and on surrounding farms should be monitored monthly for a water level. • Post mining monitoring should be carried out for a period of no less than 5 years in order to validate the findings of the modelling.

1.2 IMPACT ON GROUNDWATER QUALITY

1.2.1 Description of impact

Large scale mining operations have the potential to contaminate groundwater resources through a number of activities across the various phases of mining. Seepage from the WRD, temporary ore stockpiles, the TSF and via potentially hazardous leaks or spills. The potential receptors are:

- The groundwater resource; and
- Neighbouring groundwater users.

Access to the project area to undertake the proposed geohydrological drilling programme was not possible due to restrictions to site access and as such no current water quality data was able to be obtained for the proposed Jindal MIOP.

Groundwater sampling was, however, undertaken for the TSF site in 2022 and five holes were drilled and tested. Further drilling programmes are still required for the mine area.

1.2.2 Source of impact

The project activities/infrastructure likely to result in reduced water quality:

Project phase	Activity/infrastructure
Construction	• Leaks and spills of hazardous substances
Operational	• Mining of the South East Pit • Deposition of waste rock onto the WRD • Deposition of tailings onto the TSF
Decommissioning/ Closure	• Pit lake • Pit, WRD and TSF long term seepage

1.2.3 Impact assessment

During the construction phase of the Jindal MIOP a small amount of groundwater is expected to be required for construction purposes and dust suppression. From a groundwater quality perspective, during the construction phase potential water quality impacts could arise from the following sources:

- oil leakages from construction vehicles – localised impacts on aquifers in the study area;
- fuel storage – potential leakages causing localised impacts on aquifers in the study area; and
- sewage and effluent leakages from on-site toilets causing localised impacts on aquifers.

The groundwater quality impact during the construction phase prior to mitigation is predicted to be of moderate intensity, short term and could extend beyond the project area, as such the overall significance is rated as **LOW**. With the implementation of mitigation measures the overall rating can be reduced to **INSIGNIFICANT** (Table 1-3).

During operations, the geochemical source term characterisation of the WRD indicated that seepage emanating from the WRD does not have any potential contaminants of concern and concentrations of macro and micro elements are not expected to exceed drinking water quality guidelines. In addition, at this stage due to marginal total concentration exceedances according to the National Environmental Management: Waste Act (NEM:WA)

GNR. 635 which classified both the waste rock and tailings materials as Type 3, the WRD is proposed to be lined with a Class C liner. As such no water quality issues are expected in the proximity of the WRD due to seepage from the facility. The need for the liner will at a later stage be determined via humidity cell tests, however, for this process a liner has been assumed to be required.

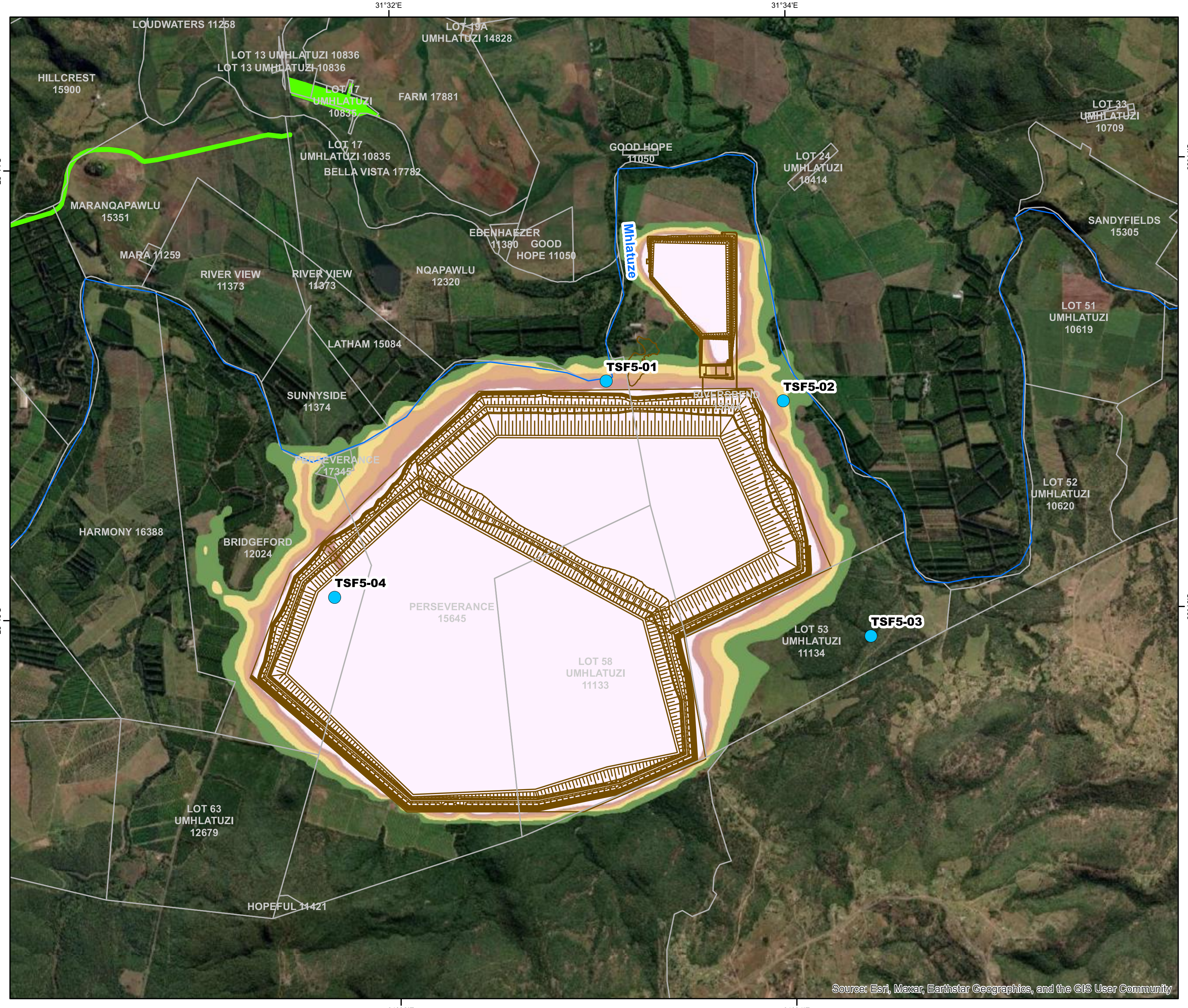
As the WRD is proposed to be lined the intensity of the potential impact is low and would likely only affect a part of the site, the overall significance prior to mitigation is considered to be **INSIGNIFICANT**. Little additional mitigation is required in addition to the liner and as such the impact remains **INSIGNIFICANT** (Table 1-3).

The source characterisation of the TSF found that only aluminium is expected to exceed drinking water quality guidelines. All other elements considered were within the guidelines for drinking water quality. The TSF is proposed to be lined by either a high density polyethylene (HDPE) liner or a geosynthetic clay liner (GCL) and consequently seepage from the facility is expected to be negligible. The main receptor for seepage, should it occur, is the Mhlatuze River. Without a liner the contribution of seepage from the TSF to the total river flow is approximately 3 %. Where a liner is considered the contribution from the TSF to the river flow is less than 0.05 %. Under these conditions, it is unlikely that any receptors downgradient of the TSF would be impacted due to water quality issues. Sulphate plumes were modelled for the TSF with and without the liner to ascertain potential seepage, from Figure 1-4 and Figure 1-5 it can be seen that with the liner installed seepage is minimal.

Therefore, considering that the use of a liner is a requirement it is assumed that mitigation measures will be implemented and the overall significance of seepage from the TSF is assumed to be **INSIGNIFICANT** (Table 1-3).

Post closure, the quality of the pit lake has not been assessed as part of this study and needs to be addressed as part of the closure study for the project. A groundwater plume is not expected to occur around the pit lake due to evaporation resulting in the pit lake becoming a persistent sink.

Post-mining, the WRD would be rehabilitated which should further reduce seepage from the facility. The source term characterisation of this facility indicated that there are no potential contaminants of concern and consequently any seepage which does arise post operations is not expected to impact upon nearby groundwater and surface water users. In the same way, the TSF is proposed to be lined with a HDPE liner or GCL and potential seepage in the long term is also deemed negligible from this facility. Following completion of mining the TSF would be appropriately rehabilitated further reducing any possible impacts to water quality. Therefore, the long term impacts from seepage from the WRD or TSF post closure are considered **INSIGNIFICANT (**Table 1-3).



Legend

- Proposed Mine Layout
- Farm Boundaries
- Rivers
- Proposed TSF and RWD

Sulphate (LoM) (mg/L) (Unlined)

- 0.6 - 5
- 5.1 - 10
- 10.1 - 15
- 15.1 - 19.9
- 20

N

0 0,5 1
KM

Scale: 1:30 000 @ A3
Coordinate System: WGS 1984 UTM Zone 36S
Projection: Transverse Mercator
Datum: WGS 1984

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FIGURE 1-4
SULPHATE PLUME AT LOM AT TSF (UNLINED SCENARIO)

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Project No: 720.10023.00001	Prepared By: BG
Map Ref No: EIA 1-4	Date: 17/05/2023

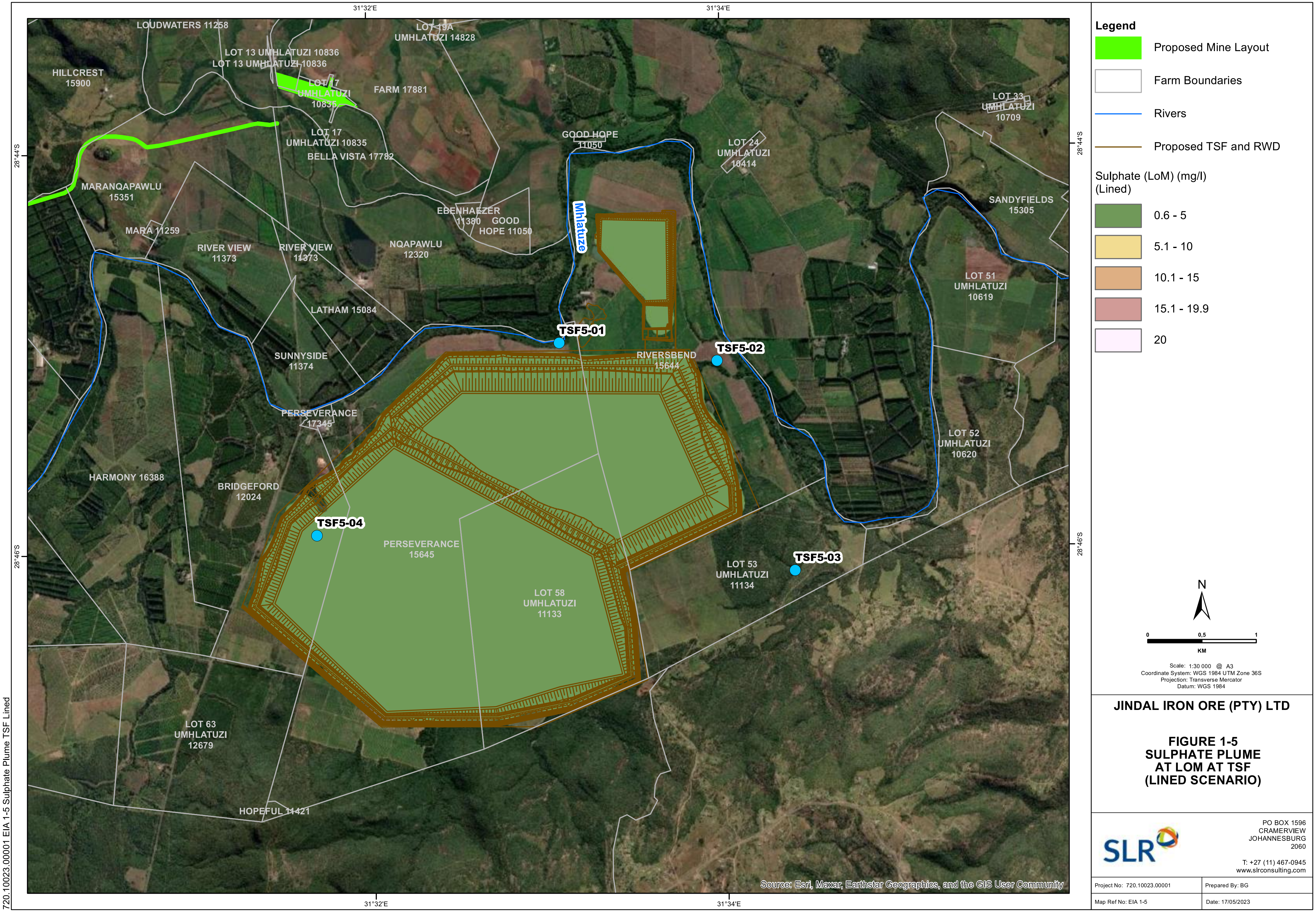
Legend
Proposed Mine Layout
Farm Boundaries
Rivers
Proposed TSF and RWD
Sulphate (LoM) (mg/l) (Lined)
0.6 - 5
5.1 - 10
10.1 - 15
15.1 - 19.9
20
31°32'E
31°34'E
28°44'S
28°46'S
LOUDWATERS 11258
HILLCREST 15900
LOT 13 UMHLATUZI 10836
LOT 19A UMHLATUZI 14828
LOT 17 UMHLATUZI 10835
FARM 17881
BELLA VISTA 17782
MARANQAPAWLU 15351
MARA 11259
RIVER VIEW 11373
EBENHAEZER 11380
GOOD HOPE 11050
NQAPAWLU 12320
LATHAM 15084
SUNNYSIDE 11374
PERSEVERANCE 17345
HARMONY 16388
BRIDGEFORD 12024
PERSEVERANCE 15645
LOT 58 UMHLATUZI 11133
LOT 63 UMHLATUZI 12679
HOPEFUL 11421
Mhlatuze
RIVERSBEND 15644
LOT 24 UMHLATUZI 10414
LOT 33 UMHLATUZI 10709
SANDYFIELDS 15305
LOT 51 UMHLATUZI 10619
LOT 52 UMHLATUZI 10620
LOT 53 UMHLATUZI 11134
TSF5-01
TSF5-02
TSF5-03
TSF5-04
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
N
0 0,5 1
KM
Scale: 1:30 000 @ A3
Coordinate System: WGS 1984 UTM Zone 36S
Projection: Transverse Mercator
Datum: WGS 1984
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FIGURE 1-5
SULPHATE PLUME
AT LOM AT TSF
(LINED SCENARIO)
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Project No: 720.10023.00001
Prepared By: BG
Map Ref No: EIA 1-5
Date: 17/05/2023
720.10023.00001 EIA 1-5 Sulphate Plume TSF Lined

Table 1-3 Impact on groundwater quality

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phase	**Construction**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium)	Minor change (Low)
Duration	Short-term (1 to 5 years)	Very Short-term (< 1 year)
Extent	Beyond site (Medium)	Part of site/property (Low)
Consequence	Medium	Very low
Probability	Possible / frequent (Medium)	Conceivable (Low)
Significance	**Low -**	**Insignificant**
Description of Impact		
Phases	**Operational – WRD Seepage**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Minor change (Low)	Negligible change (Very low)
Duration	Very long term/permanent (+20 years)	Very long term/permanent (+20 years)
Extent	Part of site/property (Low)	Part of site/property (Low)
Consequence	Very low	Very low
Probability	Unlikely / improbable (Very low)	Unlikely / improbable (Very low)
Significance	**Insignificant**	**Insignificant**
Phases	**Operational – TSF Seepage**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Minor change (Low)	Negligible change (Very low)
Duration	Very long term/permanent (+20 years)	Very long term/permanent (+20 years)
Extent	Part of site/property (Low)	Part of site/property (Low)
Consequence	Very low	Very low
Probability	Unlikely / improbable (Very low)	Unlikely / improbable (Very low)
Significance	**Insignificant**	**Insignificant**
Phases	**Closure Phases - WRD and TSF Seepage**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Minor change (Low)	Negligible change (Very low)
Duration	Very long term/permanent (+20 years)	Very long term/permanent (+20 years)
Extent	Part of site/property (Low)	Part of site/property (Low)
Consequence	Very low	Very low
Probability	Unlikely / improbable (Very low)	Unlikely / improbable (Very low)
Significance	**Insignificant**	**Insignificant**

Degree to which impact can be reversed	**Partially reversable** - The liner reduces seepage potential from the WRD. Recharge in the area of the WRD is comparable to natural recharge. The liner reduces the contribution from the TSF to < 0.05 %.	
Degree to which impact may cause irreplaceable loss of resources	**None** - No irreplaceable loss is expected. Minimal contribution from the WRD and TSF and is likely to undergo mixing with groundwater and not cause any irreplaceable loss.	
Degree to which impact can be avoided	**High** – Installation of a liner at both the WRD and TSF can significantly reduce seepage.	
Degree to which impact can be mitigated	**High** - Mitigation is possible and deemed effective.	
Cumulative impact		
Nature of cumulative impacts	The catchment is extensively used for crop farming. Groundwater and river water quality may be impacted by the application of fertilizers on the crop lands but deemed to be of very low cumulative impact.	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Very low	**Insignificant**
Residual impact		
Residual impact discussion	**Insignificant** – The residual impact on water quality from the Jindal MIOP is predicted to be insignificant.	

Table 1-4 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	Minimise the impact on water quality during all phases of the Jindal MIOP.

Mitigation actions/measures

Construction Phase

- Good housekeeping, and adherence to good health and safety practices on site during construction.
- Establish good waste management practices on site, to include recycling, separation, and storage of hazardous waste at suitable lined/bunded areas.
- Supply chemical toilets, which should be regularly, maintained at sites where worker/ contractor numbers are high.
- Oil spill kits should be available on site in case of spills of hydrocarbon chemicals and the relevant training on the use of spill kits must be provided.

Operational Phase

- Should monitoring show that there are impacts to the water quality in the vicinity of either the Jindal MIOP or the TSF the cause would need to be investigated and additional mitigation measures be implemented.
- Should the boreholes being monitored become impacted by mine activities, alternative water supply sources may be required for water users identified to be affected.

Closure/ Post Closure Phase

- Pit lake modelling to be undertaken prior to the closure of the Jindal MIOP.
- Post mining monitoring should be carried out for a period of 5 years in order to validate the findings of the modelling.

<table>
<tr><th colspan="2">Management Outcome, Mitigation Actions/Measures and Monitoring</th></tr>
<tr><td>Monitoring</td><td>Operational
• The current boreholes are limited to the pit area and the TSF. An expanded hydrocensus on the farms Ntembeni 16921, Kromdraai 6110, Lot No 5 1038, Lot No 5 10383 GU, Lot 7 Umhlatuzi 10870, Lot 9 Umhlatuzi 10872, Hillcrest 15900, Loudwaters 11258, Lot 8 Umhlatuzi 10871, Maranqapawlu 15351 and accessible boreholes identified through this survey need to be incorporated into the groundwater monitoring program for the site.
• Monitoring of boreholes at the TSF, near to the pit and on surrounding farms should be monitored monthly for a water level. Quarterly samples should be collected at these boreholes and sent for water quality analysis.
• Water quality sampling up and downgradient of the TSF should be completed per the surface water monitoring plan.
• The monitoring data should be collated quarterly and analysed in detail annually to validate the findings of the modelling.
• Once the mine is operational and the waste rock is reporting to the WRD, regular testing of the exposed WR material should be undertaken to document changes in its geochemical characterisation, most especially when operations transition into different stratigraphies. If the geochemistry is found to be evolving significantly, the groundwater model should be updated with the new source terms.
• To regularly document the performance of the WRD and its liner, an exceptive network of monitoring boreholes be put in place to monitor change in the groundwater chemistry in the vicinity of the facility.

Closure
• Post mining monitoring should be carried out for a period of 5 years in order to validate the findings of the modelling.
• The pit lake is not expected to decant, and a plume associated with the pit lake is not expected to occur post closure. Monitoring of the pit lake in terms of water level and water quality should be carried out five years post operations to validate the findings of this study.
• A pit lake study will need to be undertaken prior to closure of the pit.</td></tr>
</table>

2. SURFACE WATER

2.1 REDUCED SURFACE WATER QUALITY

2.1.1 Description of Impact

There are several sources in all project phases that have the potential to pollute surface water, particularly in the unmitigated scenario. In the construction, decommissioning and closure phases these potential pollution sources are temporary and diffuse in nature. Although these sources may be temporary, the potential pollution may be long-term. The operational phase would present the longer-term potential pollution sources.

2.1.2 Source of Impact

The project activities/infrastructure likely to result in reduced water quality:

Project phase	Activity/infrastructure
Construction	• Earthworks and site clearance • Use of and maintenance of vehicles and machinery on site • Temporary storage of waste
Operational	• Mining of the South East Pit and associated activities • Dumping of waste rock onto the WRD • Operation of the processing plant and all ancillary activities • Use of and maintenance of vehicles and machinery on site • Storage and handling of waste
Decommissioning/ Closure	• Demolition (removal of infrastructure from site) • Rehabilitation

2.1.3 Impact Assessment

Deterioration of water quality during the construction phase can be attributed to the following activities:

- Clearance of the surface area and site preparation for the new infrastructure would result in exposure of soil surfaces to potential erosion. When a large area of vegetation is cleared and topsoil disturbed, it exposes loose material which is susceptible to erosion.
- Water contamination could result from poor management of waste during the construction phase. Typically, the following pollution sources exist: fuel and lubricants, sewage etc.
- Water quality deterioration as a result of discharge of dirty water into the catchment around the Jindal MIOP when unplanned events occur, some of the dirty water containment structures may overtop and overflow, causing dirty material to wash into nearby streams.

Long term contamination of surface areas could result in contamination of the water courses. Potential operational phase contamination sources could, therefore, include:

- Contaminated stormwater runoff from operational areas containing potential pollutants such as oils, solvents, paints, fuels and waste materials.
- Some of the structures may have the potential for seepage such as the WRD, pollution control dams (PCDs) and plant infrastructure areas.

- Potential pollution of water resources through sediment transport.
- Contamination of the water courses during heavy downpours or in the case of unplanned events e.g. spills or leaks.
- Discharge of excess water from the PCDs after excessive rainfall could also present risks to water quality, although this is expected to occur during the extreme events.

Compacted surfaces from moving vehicles and machinery over the site during the decommissioning and closure phase could potentially lead to an increase in runoff into the nearby streams. In addition, compacted surfaces would be expected where infrastructure is demolished and removed from the site. Surface water resources are receptors of fine materials and contaminants arising from the demolition of infrastructure and earthworks and transported by rainwater and surface runoff. This may be deposited in watercourses resulting in siltation and contamination of surface water. The contaminants could include oil, fuel and domestic and/ or other industrial chemicals.

At elevated concentrations contaminants can exceed the relevant surface water quality limits imposed by local guidelines and therefore the implementation of relevant mitigation measures is important to manage these potential impacts.

The unmitigated significance is **MEDIUM** and can be reduced to **LOW** in both the construction and decommissioning phases with implementation of mitigation measures (Table 2-1). In the operational phase the unmitigated significance is **HIGH** and can be reduced to **MEDIUM** with mitigation. **This is taking a conservative approach. With the implementation of the management actions, the mitigated incremental impact could be lower.**

Table 2-1 Reduced surface water quality due to Jindal MIOP

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phase	**Construction**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Severe change (Very high)	Minor change (Low)
Duration	Short-term (1 and 5 years)	Short-term (1 and 5 years)
Extent	Beyond site (Medium)	Beyond site (Medium)
Consequence	Medium	Low
Probability	Probable	Probable
Significance	**Medium -**	**Low -**
Description of Impact		
Phases	**Operational**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Severe change (Very high)	Moderate change (Medium)
Duration	Long-term (10 and 20 years	Long-term (10 and 20 years
Extent	Beyond site (Medium)	Beyond site (Medium)
Consequence	High	Medium
Probability	Probable	Probable

Significance	**High -**	**Medium -**
Phases	**Decommissioning and Closure Phases**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Prominent change (High)	Moderate change (Medium)
Duration	Medium-term (5 to 10 years)	Medium-term (5 to 10 years)
Extent	Beyond site (Medium)	Beyond site (Medium)
Consequence	Medium	Medium
Probability	Probable	Possible / frequent
Significance	**Medium -**	**Low -**
Degree to which impact can be reversed	**Partially reversable** - There is the potential for impact to the surface water quality post closure, even if this is considered to be a LOW significance.	
Degree to which impact may cause irreplaceable loss of resources	**Low** - Some infrastructure such as waste rock dumps may contain low levels of polluting substances, which may find their way to natural rivers or drainage channels but are not expected to cause irreplaceable losses. In addition, the implementation of the mitigation measures will promote the containment of potential polluting substances.	
Degree to which impact can be avoided	**High** - The SWMP and other recommended mitigation measures are expected to significantly reduce the risk of potential impacts. The stormwater management designs aim to contain all dirty water as per the regulations.	
Degree to which impact can be mitigated	**Medium** -Mitigation measures are expected to reduce the impact from High to Medium during operations. **High** -Mitigation measures are expected to reduce the impact from Medium to Low during construction and post decommissioning as the source of contaminants would be lower than during operations.	
Cumulative impact		
Nature of cumulative impacts	There are no major industries or other mining projects in the immediate vicinity of the proposed Jindal MIOP, except for the agriculture and livestock production activities in surrounding areas. The Mhlatuze catchment is currently predominantly used for irrigated commercial crops, largely sugarcane and citrus, which are found along the Mhlathuze River downstream of the Goedertrouw Dam. Other key activities in the catchment are cattle and subsistence farming. Return flows from the substantial irrigation activities in the middle reaches of the catchment are likely to contribute to the reduced water quality in this area. Construction phase activities of the proposed mine could have an additional impact on existing water quality challenges if not mitigated. The contribution is, however, likely to be LOW with the implementation of mitigation measures.	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Medium -	**Low -**
Residual impact		
Residual impact discussion	**Low** - Post closure of the Jindal MIOP there is the potential for long term impact on the surface water quality, however, provided that sufficient rehabilitation of the site is undertaken and post closure monitoring in place, the residual impact is considered to be low.	

Table 2-2 Management outcome, mitigation actions/measures and monitoring

Management outcome, mitigation actions/measures and monitoring	
Management objective	Minimise surface water quality impacts throughout all phases of the Jindal MIOP.
Mitigation actions/measures	
All Phases	
• In case of an occurrence of a discharge incident that could result in the pollution of surface water resources, the emergency response procedure should be implemented. • Good housekeeping practices should be implemented and maintained by timeous cleaning-up of accidental spillages. Waste should be disposed to a licensed waste site. In addition, spill cleaning kits and material safety data sheets for chemical and hazardous substances should be accessible and available to be used for immediate clean-up of accidental spillages of pollutants.	
Construction Phase	
• Minimise the disturbance of vegetation and soils as far as possible by restricting construction activities to within demarcated areas. • Clear areas as and when needed for construction related purposes. • Phasing / scheduling of earthworks should be implemented in order to minimise the footprint that is at risk of erosion at any given time, or schedule works according to the season, where possible. • Progressive rehabilitation of disturbed land should be carried out to minimize the amount of time that bare soils are exposed to the erosive effects of rain and subsequent runoff. • Traffic and movement over stabilised areas should be controlled (minimised and kept to certain paths), and damage to stabilised areas should be repaired timeously and maintained. • In case of an occurrence of a discharge incident that could result in the contamination of surface water resources, the emergency response procedure should be implemented. • Any on-site maintenance of vehicles must be undertaken within a lined bunded area or off-site. • Emergency spill kits must be kept on-site and be easily accessible and all staff must be trained on the correct procedure to follow in case of a spill.	
Operational Phase	

• Stormwater management has been designed in accordance with the regulations of GN704 and the following has been recommended:
    • Dirty water must be separated from clean water.
    • The dirty water and clean water drainage systems have been specified around the processing plant, the WRD and the South East Pit.
    • Containment of dirty water from dirty water catchments (WRD, South East Pit and process plant area) will be within PCDs.
• All hazardous chemicals (new and used), mineralized waste and non-mineralised waste must be handled in such a manner that they do not contaminate surface water. This will be implemented by means of the following:
    • Pollution prevention through basic infrastructure design such as waste storage containment, hardstanding and containment bunds.
    • Maintenance of vehicles to be done within a lined bunded workshop area or off-site.
    • Pollution prevention through regular maintenance of vehicles and equipment.
    • Pollution prevention through regular education and training of workers (permanent and temporary).
    • A spill clean-up plan must be in place and all employees be trained in the use thereof to enable containment and remediation of pollution incidents.
    • Emergency spill kits must be kept on-site and be easily accessible and all employees must be trained on the correct procedure to follow in case of a spill.	

Management outcome, mitigation actions/measures and monitoring	
Decommissioning/ Closure Phase	
• Rehabilitation of the site must be undertaken in accordance with the Rehabilitation Plan. • Emergency spill kits must be kept on-site and be easily accessible and all staff must be trained on the correct procedure to follow in case of a spill. • Any on-site maintenance of vehicles must be undertaken within a lined bunded area or off-site. • Phasing/ scheduling of decommissioning/ rehabilitation activities should be implemented in order to minimise the footprint that is at risk of erosion at any given time, or schedule works according to the season.	

Monitoring	• The following monitoring is required:
	  ◦ Monthly monitoring of specified surface water locations should be undertaken until a longer-term baseline has been established and should be ongoing throughout all phases of the project. Additional monitoring should be done after storm events.
	  ◦ The monitoring plan should be reviewed regularly, no more than every three years to ensure appropriateness of sites and sampling frequency during operations.
	  ◦ A post rehabilitation audit should be undertaken to ascertain whether the remediation has been successful and if not, further measures should be recommended and implemented.
	
	• The following reporting is required:
	  ◦ Internal Reporting – Monthly for:
	    ▪ Water Levels in holding dams; and
	    ▪ Drainage Inspections.
	  ◦ External Reporting to Department of Water and Sanitation (DWS)– Annual for:
	    ▪ Water Quality; and
	    ▪ Spillages / Emissions.
	  ◦ Accidental spillages and overflows should be reported as and when they occur to the DWS.

2.2 ALTERATION OF NATURAL DRAINAGE PATTERNS AND FLOW

2.2.1 Description of Impact

Natural drainage across the project area is via preferential flow paths (natural drainage line). Development of the mine infrastructure and associated SWMP measures and the proposed diversion of rivers can alter the hydrologic response of an area and, potentially, an entire watershed within which the project is proposed.

The development of the Jindal MIOP would require the removal of vegetation which would likely be replaced with turf grass lawns and impervious roofs, driveways, parking lots, and roads, thereby reducing the natural evapotranspiration and infiltration rates. Construction of the mine and its supporting infrastructure could reduce the runoff reporting downstream due to stormwater management measures and alter instream flow regimes. During the low flow season, flows in rivers downstream may receive less water than during the pre-development period as water that would have infiltrated, or runoff downstream may be intercepted and contained onsite (dirty water containment). In the wet season, rivers may experience high volumes of surface runoff because of the increased impervious areas introducing unnatural flows into receiving rivers. Intense storms may also induce soil erosion causing sedimentation in downstream reaches of nearby rivers.

2.2.2 Source of impact

The project activities/infrastructure likely to result in an alteration to drainage patterns:

Project phase	Activity/infrastructure
Construction	• Earthworks and site clearance • Construction of stormwater management infrastructure
Operational	• Ongoing use of stormwater management infrastructure e.g. culverts for river crossings, clean and dirty water separation etc. • Diversion of streams for the WRD • Artificial surfaces resulting in increased runoff and reduced infiltration
Decommissioning/ Closure	• Demolition (removal of infrastructure from site) • Rehabilitation

2.2.3 Impact assessment

Surface water run-off would be managed utilising engineered infrastructure, which is to be designed and constructed as required by legislation and specified in the Surface Water Management Plan (SWMP) (Appendix F). When the stormwater management measures that attenuate surface runoff are constructed on site, clean stormwater will be diverted around the infrastructure, and it will alter the drainage flow. The runoff amount reporting downstream consequently would also be altered. A portion of rainfall during the wet season will fall within the WRD and the pit footprints, this impact would occur beyond the life of the mine.

Informed by the baseline hydrology of the site and the surroundings, a review of the proposed surface infrastructure has been undertaken, and a series of design guidelines for storm water management have been developed to ensure compliance with the requirements of Government Notice 704 (GN704).

A SWMP has been developed for the site where ‘dirty’ and ‘clean’ contributing catchments are discretised based on topography. Based on the discretised catchments, the required stormwater management drainage elements (including channels, pipes, berms, and PCDs) have been sized to ensure appropriate stormwater management according to the management principles outlined in the GN704 and Best Practise Guidelines (BPGs).

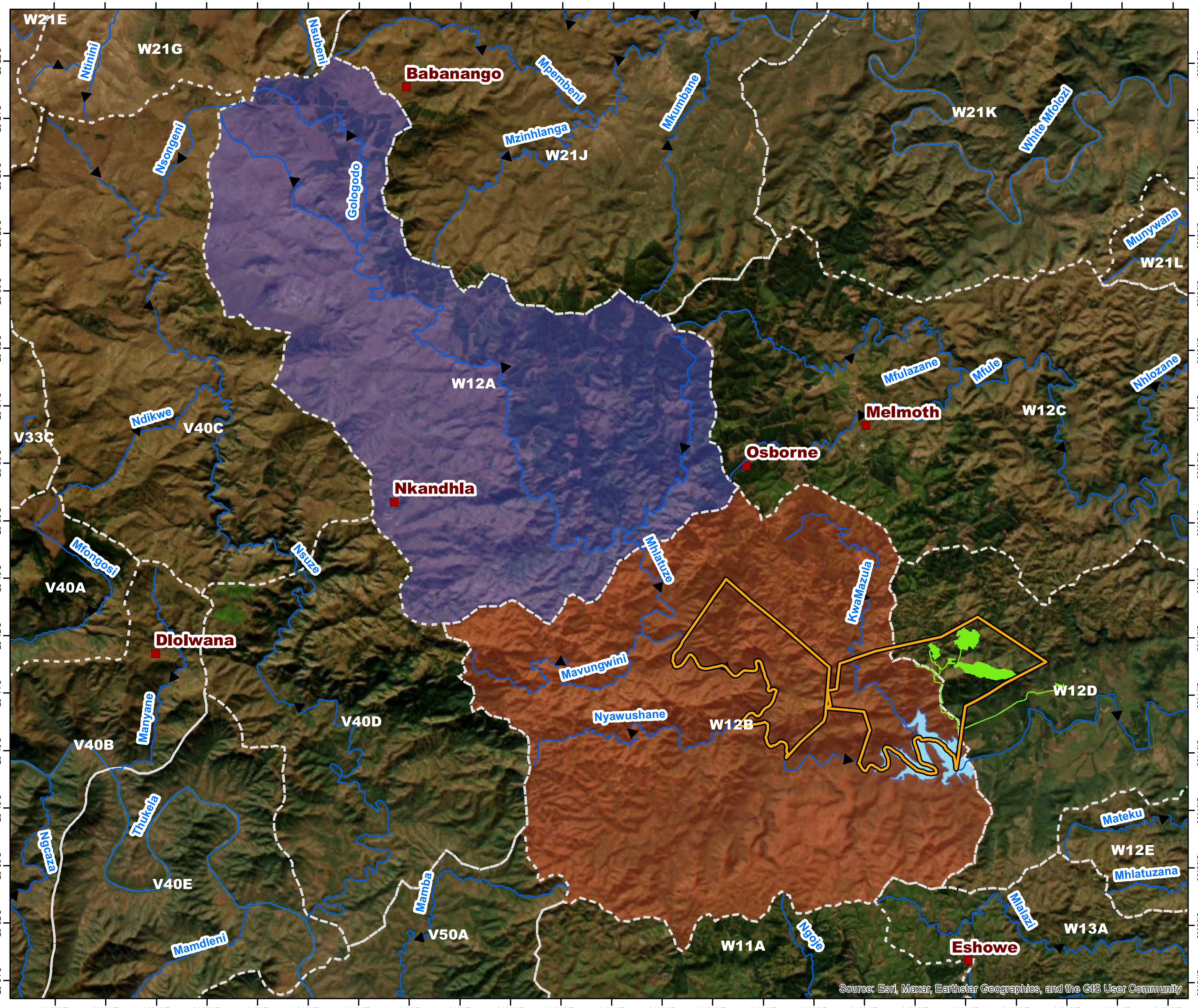
The concept of the proposed SWMP for the Jindal South Block is to divert and allow clean water within the mine area to flow across the site as free surface flow. Dirty water runoff would be directed and discharged into lined conveyance and storage facilities.

Based on the proposed infrastructure design, the plant and processing areas (dirty water producing areas) are self-contained and have stormwater infrastructure (channels, berms and PCDs) built-in to these areas. Cut-off channels and culverts are proposed to divert clean water around proposed infrastructure and access routes. Further, earthen cut off/diversion channels and berms are proposed for construction around the project site and WRD. The cut-off channels will intercept and divert clean runoff from upstream catchments and contain dirty runoff within certain areas.

In terms of the catchment areas, Figure 2-1 indicates the catchment area of the Goedertrouw Dam, which encompasses W12A and W12B. The infrastructure proposed within the Mining Right Area (the WRD, South East Pit and processing plant) all fall within quaternary catchment W12D, which is to the east and falls outside of the catchment area of the Goedertrouw Dam. The proposed development would therefore not impact on the runoff entering Goedertrouw Dam. In order to show the impact of the proposed development on downstream catchments, a point immediately downstream of the development was chosen and is referred to as "Point A" Figure 2-2).

The catchment area of Point A is shown in Figure 2-2. The catchment area at Point A is 175 km², and the total area of the dirty water catchments resulting from the proposed development is 5.72 km². This translates to a loss in catchment area, due to the proposed Jindal MIOP (only within the catchment area of Point A) of 3.3%. The impact of the proposed development decreases for points in downstream catchments i.e. the ratio of the dirty water catchments (from the proposed development) to total catchment area would be less than 3.3%, further downstream from the development. The proposed development is therefore expected to have minimal impact (if any) on the runoff to the catchments downstream of the proposed development.

The unmitigated significance has been assessed to be **MEDIUM** and can be reduced to **LOW** for all phases of the project provided that mitigation measures are implemented (Table 2-3). **This is taking a conservative approach. With the implementation of the management actions, the mitigated incremental impact could be lower.**



Legend

- Towns / Villages
- River Flow Direction
- Goedetrouw Dam
- Quaternary Catchment Boundaries

Quaternarys of Concern

- W12A
- W12B

Proposed Project Components

- South Block Mining Right Area
- Mine Layout

N

0 1 2 KM

Scale: 1:236 455 @ A3
Coordinate System: TM WG31
Projection: Transverse Mercator
Datum: Hartebeesthoek 1994

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FIGURE 2-1
CATCHMENT AREA OF GOEDETROUW DAM

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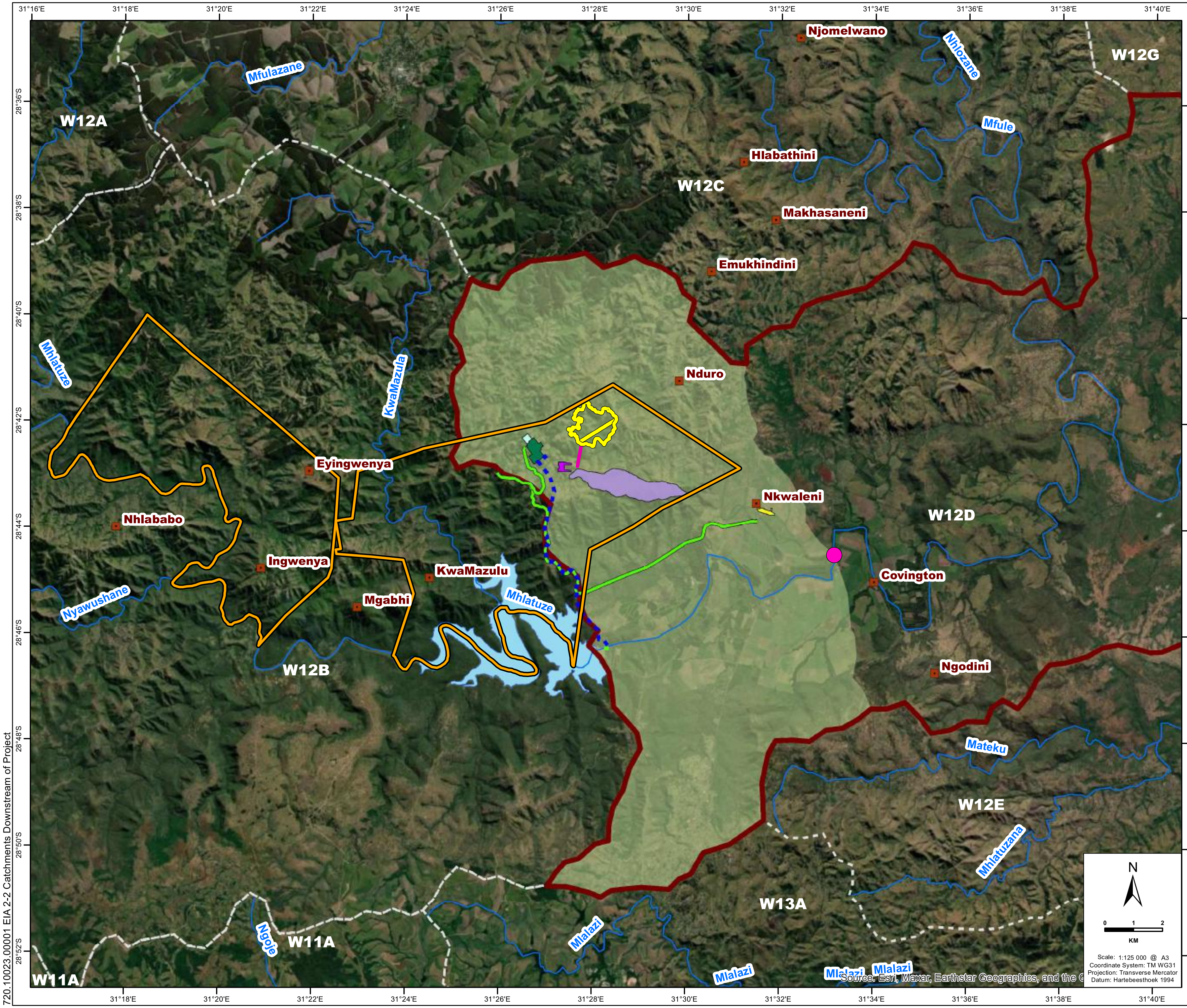
Project No: 720.10023.00001	Prepared By: BG
Map Ref No: EIA 2-1	Date: 17/05/2023



Legend

- Towns / Villages
- Rivers
- Goedetrouw Dam
- Quaternary Catchment Boundaries
- Quaternary W12D Area
- Catchment for Point A Outlet
- Point A Outlet

Proposed Project Components

- South Block Mining Right Area
- South East Pit
- Raw Water Pump
- Processing Plant
- Primary Crusher
- Incoming Power Yard
- Rail Siding
- Waste Rock Dump
- Haul Road
- Access Road Option 1 - Preferred
- Overland Piping

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FIGURE 2-2
CATCHMENTS DOWNSTREAM OF PROPOSED DEVELOPMENT

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Map Ref No: EIA 2-2	Date: 17/05/2023

Table 2-3 Alteration of natural drainage patterns and flow

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	All Phases	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Severe change (Very high)	Moderate change (Medium)
Duration	Long-term (10 and 20 years	Long-term (10 and 20 years
Extent	Site (Very low)	Site (Very low)
Consequence	Medium	Low
Probability	Probable	Probable
Significance	**Medium -**	**Low -**
Degree to which impact can be reversed	**Partially reversible** - Some of the drainage lines and catchments will be permanently altered but these are relatively small areas (occupied by the WRD and pit) compared to the greater catchment areas that will be contributing to flow in rivers and streams. These areas will also be rehabilitated during closure and thus impacts may be partially reversed.	
Degree to which impact may cause irreplaceable loss of resources	**Low** - there may be an increase in runoff from the area of development due to an increase in area of clean hard surfaces and watercourses downstream may be susceptible to erosion and sedimentation as result. The increase in runoff is, however, small compared to the catchment area of the rivers and streams that have been identified.	
Degree to which impact can be avoided	**Low** - As mine infrastructure cannot be relocated. However, the potential impacts are expected to be low after mitigation.	
Degree to which impact can be mitigated	**High** – The implementation of the SWMP as well as other mitigation measures can significantly reduce the long term impacts on streams and stream flow.	
Cumulative impact		
Nature of cumulative impacts	Unlikely as there are no other activities in the vicinity which would have a significant impact on the natural drainage patterns and/ or stream flows.	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Low -	**Very low -**
Residual impact		
Residual impact discussion	**Low** - The residual impact is likely to remain low as other than at the processing plant which would likely be decommissioned and demolished, the other stormwater management infrastructure would remain in place on a permanent basis.	

Table 2-4 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	Minimise alteration to natural drainage and flow patterns throughout all phases of the Jindal MIOP.

<table>
<tr><th colspan="2">Management Outcome, Mitigation Actions/Measures and Monitoring</th></tr>
<tr><th colspan="2">Mitigation actions/measures</th></tr>
<tr><td colspan="2">All Phases</td></tr>
<tr><td colspan="2">A SWMP has been conceptualized for the proposed South Block of Jindal MIOP to meet the applicable legislation. It is proposed that the recommendations made for the proposed stormwater infrastructure be taken to preliminary and detailed design prior to implementation. The following considerations should be noted:
• The proposed stormwater infrastructure is at a conceptual level and would require refinement which may require alterations to the dimensions and details presented.
• Additional studies such as geochemical waste assessments, geotechnical investigations and structural detailing may be required to further these designs at a later stage.
• Terraces, platforms and road designs which alter the existing terrain have been considered here with information provided by external design teams (Wood PLC and Geotheta Consulting Engineers and Scientists).</td></tr>
<tr><td>Monitoring</td><td>• Flow measuring devices such as weirs or flow meters may be installed across rivers/streams and outlet works to measure flows. The data from the devices may then be used to determine any changes in flows or flow patterns.</td></tr>
</table>

2.3 IMPACT OF FLOODING

2.3.1 Description of impact

The natural drainage patterns in a pre-developed environment is via natural drainage flow paths. Development can alter the hydrologic response of an area and, ultimately, an entire watershed.

Floodlines on river sections are analysed to evaluate risks associated with potential flooding of infrastructure and protection of natural water resources. Legislation provides guidelines with regards to minimum requirements of placement of infrastructure in relation to a natural watercourse.

Floodline assessments on the proposed mine infrastructure were conducted in accordance with Condition 4 of GN704. The main purpose of floodlines determination is to identify areas around natural watercourses that need to be protected. Infrastructure such as the processing plant, WRD, primary crusher, South East Pit and the incoming power yard are located within the 1:100-year floodlines. In addition, the proposed overland pipelines traverse two streams and the maximum flood depths[1] around the pipeline river crossing are 0.6 m and 2.65 m for Crossing 1 and Crossing 2, respectively (Figure 2-3). Maximum flood depths around the processing plant range between 0.86 m and 1.96 m. Floodlines for the main rivers draining the South East Pit can also be seen in Figure 2-3.

2.3.2 Source of Impact

The project activities/infrastructure likely to cause flood or cause increased flood impacts:

Project phase	Activity/infrastructure
Construction	• Earthworks
Operational	• Mining of the South East Pit and associated activities • Dumping of waste rock onto the WRD
Decommissioning/ Closure	• Demolition (removal of infrastructure from site) • Rehabilitation

[1] The maximum flood depth represents the maximum vertical height from the lowest ground level point in the middle of the river to the surface water level.

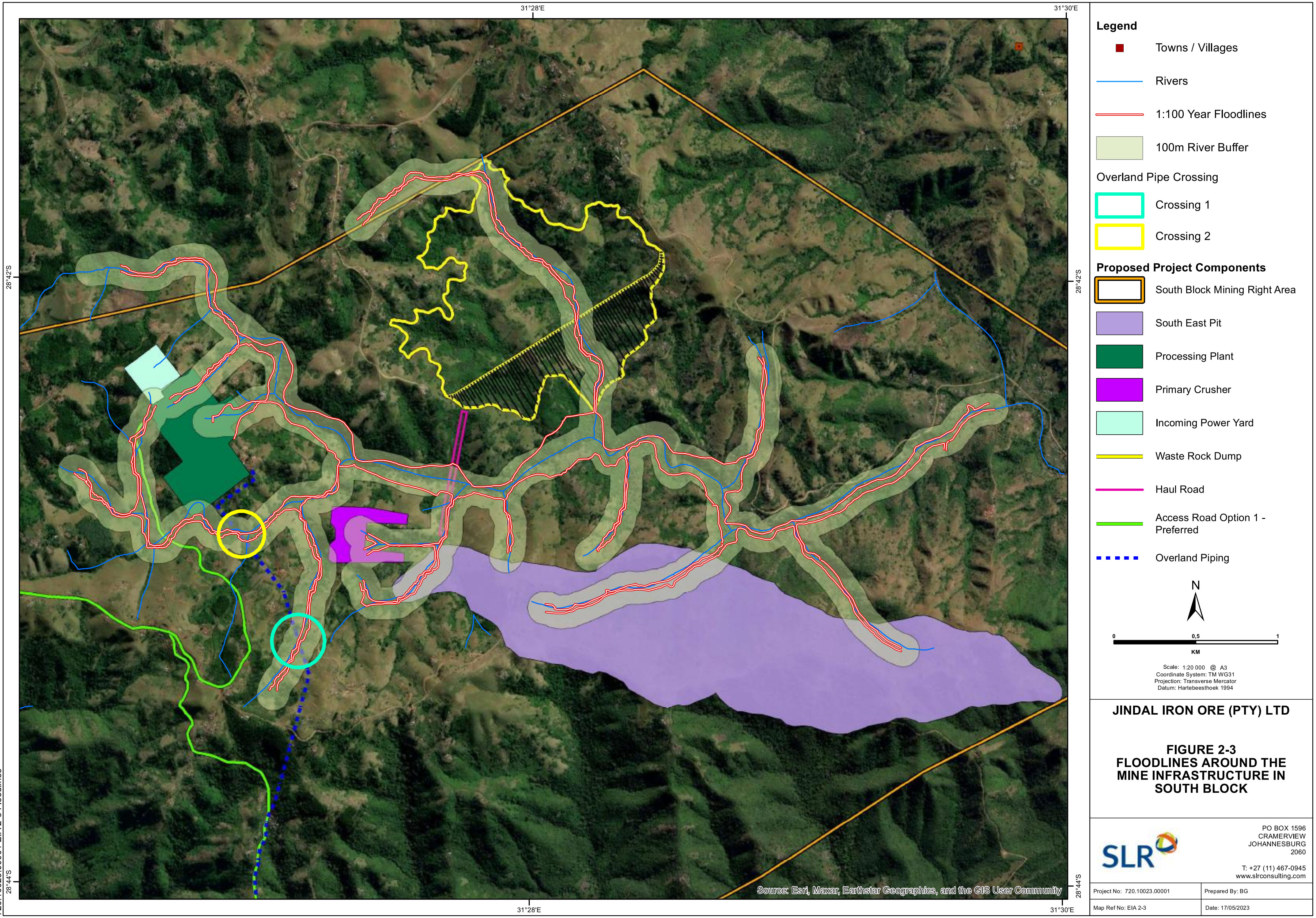
31°28'E
31°30'E
28°42'S
28°44'S
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
Legend
Towns / Villages
Rivers
1:100 Year Floodlines
100m River Buffer
Overland Pipe Crossing
Crossing 1
Crossing 2
Proposed Project Components
South Block Mining Right Area
South East Pit
Processing Plant
Primary Crusher
Incoming Power Yard
Waste Rock Dump
Haul Road
Access Road Option 1 - Preferred
Overland Piping
N
0 0.5 1
KM
Scale: 1:20 000 @ A3
Coordinate System: TM WG31
Projection: Transverse Mercator
Datum: Hartebeesthoek 1994
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FIGURE 2-3
FLOODLINES AROUND THE MINE INFRASTRUCTURE IN SOUTH BLOCK
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Prepared By: BG
Map Ref No: EIA 2-3
Date: 17/05/2023
720.10023.00001 EIA 2-3 Floodlines

2.3.3 Impact Assessment

Floodlines have been determined for the entire South Block area. It has been deduced that the processing plant, South East Pit and the WRD traverse the 1:100-year floodlines in a number of areas as per Figure 2-3.

This infrastructure is therefore susceptible to flooding. This potential impact would continue throughout all phases of the Jindal MIOP: construction, operational and closure. In the event of heavy rainfall or rainfall of longer duration the watercourses traversing the buildings and other mine support infrastructure could overflow inundating the exposed infrastructure.

Flooding is normally accompanied with high losses because of the damage and losses it causes. Flood damages may be direct and tangible i.e. in contact with flood water and can be expressed in monetary value (eg. overtopping and subsequent failure of PCD, overlapping and collapse of road crossings). Flood damages may also be indirect and intangible i.e. not in contact with flood water and cannot be expressed in monetary value (eg. environmental losses, reduced performance of infrastructure in the long term).

The unmitigated significance has been assessed to be **MEDIUM** and can be reduced to **LOW** for all phases of the project provided that mitigation measures are implemented (Table 2-5). **The rating provided in Table 2-5 is reliant on the flood protection berm, river diversions and stormwater management measures being implemented as mitigation measures.**

Table 2-5 Flooding of infrastructure

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	All	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Prominent change (High)	Minor change (Low)
Duration	Long-term (10 and 20 years	Long-term (10 and 20 years
Extent	Site (Very low)	Site (Very low)
Consequence	Medium	Low
Probability	Probable	Probable
Significance	**Medium -**	**Low -**
Degree to which impact can be reversed	**Partially reversible** - Mitigation measures are designed to accommodate flood events as per the regulations. Without mitigation measures, increased dirty and clean runoff may be expected and result in possible contamination of water resources and failure of mining infrastructure.	
Degree to which impact may cause irreplaceable loss of resources	**Low** - The development will not increase the degree to which flooding would normally occur as the development occupies a relatively small area and increased runoff will be contained as per the SWMP.	
Degree to which impact can be avoided	**Low** - As the infrastructure that impedes the watercourses is unlikely to be relocated, the infrastructure will impact the 1:100yr floodline. However, impacts are expected to be relatively low as the SWMP incorporates storage or diversion of design floods as per the regulations. Mining infrastructure is also expected to be designed to mitigate against flood damage.	

Degree to which impact can be mitigated	**Low** - Provided the flood protection measures are implemented (berms, diversion and stormwater management measures) to protect infrastructure as recommended.	
Cumulative impact		
Nature of cumulative impacts	The cumulative impact with the installation of the berms, river diversion and implementation of stormwater management measures is considered to be very low as there are currently no other impacts in the catchment that would be impacted by flooding.	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Low -	**Very low -**
Residual impact		
Residual impact discussion	**Low** - The residual impact is low with the implementation of flood protection measures.	

Table 2-6 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	Minimise flooding of mine related infrastructure throughout all phases of the Jindal MIOP.
Mitigation actions/measures	
All Phases	
• It is recommended in accordance with GN704 that the mine infrastructure be relocated outside the floodlines and where necessary rivers be diverted outside of the infrastructure footprint. • In the event that the mine infrastructure cannot be relocated, it is recommended that suitable flood protection measures be designed to ensure the safety of the infrastructure and surrounding environment during flood events. • Suitable remedial measures should also be investigated for the rivers passing through the South East Pit area. Maximum flood depths specified throughout the various streams must be considered during the development of flood protection berms including relevant engineering freeboard. The flood protection berms need to be sufficiently high along their full alignment in order to withstand the flood level and flood velocities. The design specification of the flood/ stormwater management measures is presented in Section 7.4 of Appendix F .	
Monitoring	• Regular monitoring and inspection of channels, containment berms, silt traps, culverts, pipelines and PCDs for signs of erosion, cracking, silting and blockages of inflows, to ensure the performance of the storm water infrastructure is recommended. • Monitoring should be undertaken monthly during wet season and after storm events or as per the site management schedule.

3. TERRESTRIAL ECOLOGY

3.1.1 Description of Impact

The Project Area of Influence (PAOI) was defined in terms of primary (direct footprint), and secondary and tertiary (indirect) influences (Figure 3-1). Mining and related activities can often lead to irreversible damage or longer term, gradual and cumulative changes to terrestrial ecosystems.

The impacts of mining on terrestrial ecosystems can be varied and depend on a range of factors, including:

- the scale and extent of mining;
- the type of material being mined and waste products involved;
- the potential for Acid Mine Drainage (AMD);
- the type of terrain and associated climatic features (including the scarcity of water);
- the functioning, importance and sensitivity of the receiving environment; and
- the efficiency and effectiveness of any environmental management systems that are employed by the mine and the practicalities of implementation.

For the purposes of this assessment, the potential impacts to the terrestrial flora and local terrestrial biodiversity resulting from the proposed activities are grouped into the following impact categories:

- Direct ecosystem destruction and modification impacts – This refers to the direct physical destruction and/or modification of terrestrial vegetation communities and habitat during the construction, operational and decommissioning phases of the project and incudes habitat loss impacts, biota fatalities and population reductions, habitat fragmentation, habitat patch size reduction, and the occurrence of barriers to propagule and animal movement.
- Indirect ecosystem disturbance impacts – This impact refers to the indirect impacts to the biota and vegetation communities as a result of activities within close proximity that result in the following impacts: (i) alteration of abiotic soil and moisture conditions, (ii) increased rates of erosion and sedimentation, (iii) alteration of the chemical and biological characteristics of soil and water, (iv) increased alien invasive plant invasion, (v) noise pollution, (v) vibrations and (vi) light pollution, and (vii) expanded edge effects.

Each of the above-listed impacts were assessed in terms of impacts to:

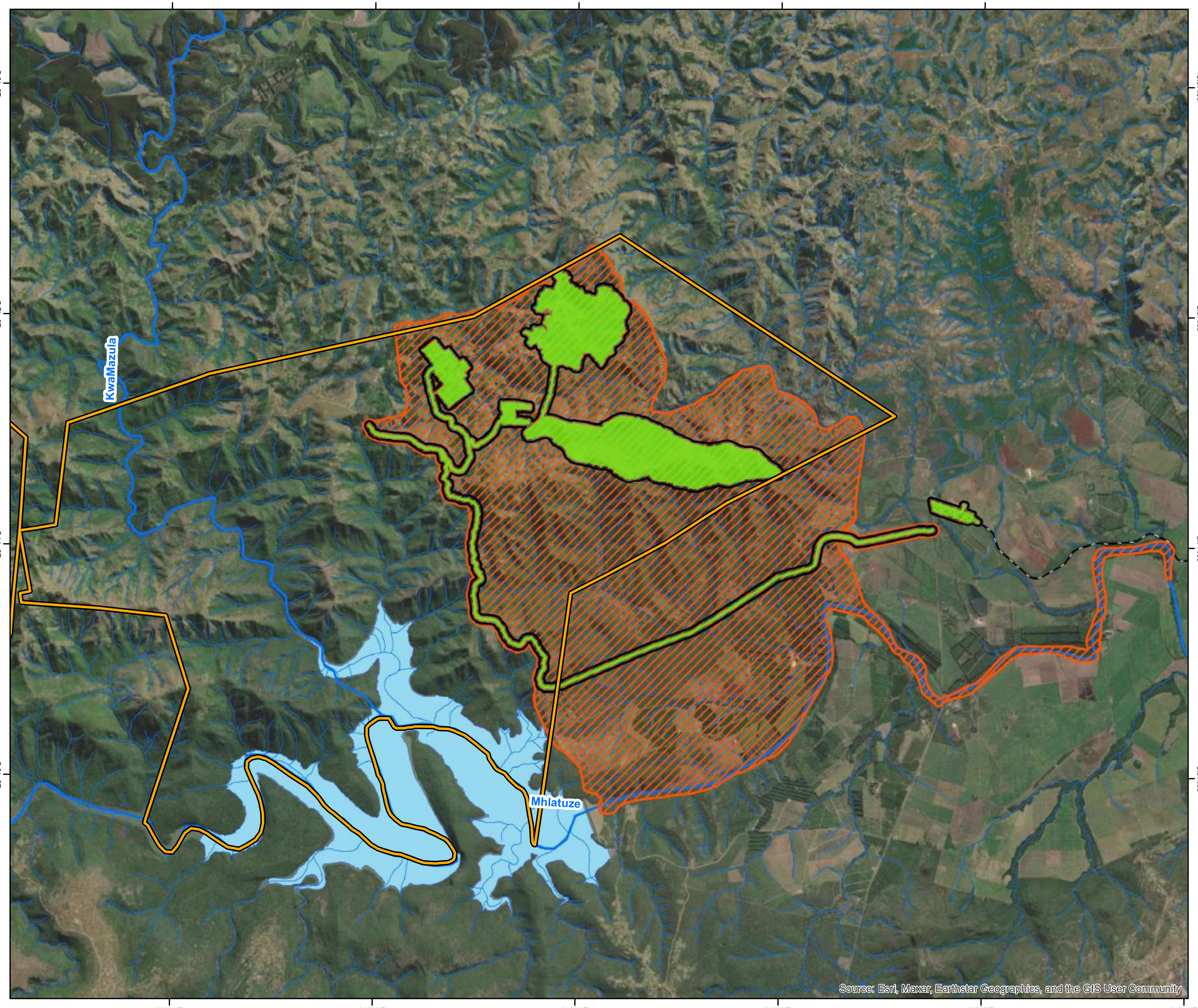
- Terrestrial ecosystems and habitats;
- Terrestrial biota / species (flora and fauna); and
- Local and regional landscape ecological processes.

3.1.2 Source of impact

The project activities/infrastructure likely to result in impacts to terrestrial biodiversity include:

Project phase	Activity/infrastructure
Construction	• Earthworks and site clearance • Uncontrolled runoff, erosion and sedimentation • Activities within no-go areas
Operational	• Uncontrolled release of water, clean or dirty • Uncontrolled runoff, erosion and sedimentation

Project phase	Activity/infrastructure
	• Non compliance with no-go area demarcation • Poor housekeeping
Decommissioning/ Closure	• Uncontrolled runoff, erosion and sedimentation • Non compliance with no-go area demarcation • Rehabilitation success



Legend

- Towns / Villages
- Railway
- Major Rivers
- Minor Rivers
- Goedetrouw Dam
- Proposed South Block Mining Right Area
- Primary PAOI (Footprint)
- Secondary PAOI (50m Buffer)
- Tertiary PAOI

N

0 1 2 KM

Scale: 1:59 000 @ A3
Coordinate System: TM WG31
Projection: Transverse Mercator
Datum: Hartebeesthoek 1994

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FIGURE 3-1
THE PROJECT AREA OF INFLUENCE ACROSS THE SOUTH CENTRAL BLOCK AND JUST BEYOND

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Project No: 720.10023.00001	Prepared By: BG
Map Ref No: EIA 3-1	Date: 17/05/2023

720.10023.00001 EIA 3-1 PAOI Across the South Central Block

3.2 IMPACTS TO VEGETATION COMMUNITIES AND IMPLICATIONS FOR THREATENED ECOSYSTEMS AND BIODIVERSITY CONSERVATION

3.2.1 Impact Assessment – Direct Impacts

The proposed phase 1 mine plan would involve the construction of various infrastructure that would run through a mixture of Very High to Very Low Site Ecological Importance (SEI) vegetation communities which would result in a loss of habitat within the development footprint itself, and modification of habitat through anticipated edge effects in areas immediately adjacent to the proposed infrastructure. Direct loss of habitat (526.02 ha of habitat loss in total), based on the footprint provided and included in the Primary Project Area of influence would include:

1. Ngongoni Veld/Eastern Valley Bushveld Open Savannah (very high SEI) – 123.59 ha.
2. Eastern Valley Bushveld Thicket/Ngongoni Veld Closed Woodland (very high SEI) – 71.02 ha.
3. Degraded Ngongoni Veld/Eastern Valley Bushveld Open Savannah (low SEI) – 37.09 ha.
4. Degraded Eastern Valley Bushveld Thicket/Ngongoni Veld Closed Woodland (medium SEI) – 208.47 ha.
5. Secondary Open Savannah/Thicket/Closed Woodland (very low SEI) – 85.85 ha.

The degree to which each vegetation community mapped has been disturbed/ degraded, including grazing impacts (amongst others), has been accounted for in the Present Ecological State (PES) and SEI rating, and the description of each community.

In addition, large portions of the mine footprint have been flagged as part of the National Protected Area Expansion Strategy and as a Critical Biodiversity Area (CBA): Optimal at the provincial level.

For these reasons, the significance of the impact is rated as **VERY HIGH** for the construction phase (Table 3-1), which means that the proposed mining development would have measurable negative impacts on biodiversity conservation and on the ability to meet provincial and national conservation targets. Very High significance impacts are potentially fatally flawed impacts according to national guidelines, especially as the feasibility and acceptability of offsets as a form of compensation has not been formally investigated at this stage. Such impacts can only be compensated for through the finalisation of a biodiversity offset, assuming that an offset is viable.

Outside of compensation for ecosystem loss in the form of a biodiversity offset, there are limited options to reduce direct impacts onsite for this project unless a reduction in the footprint occurs.

There are minimal options to mitigate the loss of Very High SEI, except for on-site rehabilitation which would result in a marginal reduction in significance (from Very High to High) under a good mitigation scenario. This means that a highly significant residual impact would remain that could likely only be addressed through a formal biodiversity offset (as previously discussed).

It is important to state upfront that the direct operational impacts only consider accidental impacts to ecosystems and habitat near the mining footprint that are likely to be modified and transformed by operational activities. The direct impacts of all ecosystem and habitat loss under the development footprint has been assessed as part of the construction phase.

During the mine operational phase terrestrial habitat could be impacted by workers and machinery during repair and maintenance of onsite infrastructure, and through the potential injudicious movement of vehicles and people across the site that may cause unnecessary habitat disturbance. Natural habitat outside the mine footprint, must therefore be appropriately safeguarded as no-go areas. The unmitigated significance for the operational phase is assessed to be **HIGH** and can be reduced to **MEDIUM** with implementation of mitigation measures (Table 3-1).

Direct impacts in the decommissioning phase are limited to accidental incursion into sensitive no-go areas by heavy vehicles/machinery during the removal of infrastructure and decommissioning of access roads. Additional intact areas may be impacted by accidental incursion if they are not clearly demarcated as no-go areas and an Environmental Control Officer (ECO) is not on site to enforce the relevant mitigation measures. This could result in additional loss in extent of Very High, Medium, Low and Very Low SEI vegetation communities on the margins of the mining footprint.

The unmitigated significance for the decommissioning phase is assessed to be **MEDIUM** and can be reduced to **LOW** with implementation of mitigation measures (Table 3-1).

Table 3-1 Direct impacts to vegetation communities and implications for threatened ecosystems and biodiversity conservation

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phase	**Construction**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Severe change (Very high)	Severe change (Very high)
Duration	Very long term/ Permanent (> 20 years)	Very long term/ Permanent (> 20 years)
Extent	Beyond site	Whole site
Consequence	Very high	High
Probability	Definite / Continuous	Definite / Continuous
Significance	**Very high -**	**High -**
Description of Impact		
Phases	**Operational**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Prominent change (High)	Moderate change (Medium)
Duration	Very long term/ Permanent (> 20 years)	Very long term/ Permanent (> 20 years)
Extent	Beyond site	Whole site
Consequence	High	Medium
Probability	Definite / Continuous	Probable
Significance	**High -**	**Medium -**
Phases	**Decommissioning and Closure Phases**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Prominent change (High)	Moderate change (Medium)
Duration	Very long term/ Permanent (> 20 years)	Very long term/ Permanent (> 20 years)
Extent	Beyond site	Whole site
Consequence	High	Medium

Probability	Possible / frequent	Conceivable
Significance	**Medium -**	**Low -**
Degree to which impact can be reversed	**Irreversible**- The impact is irreversible. Once intact grassland ecosystems within the study area are lost through clearing of vegetation and earthworks associated with the construction phase of the proposed development it is highly unlikely that the natural ecosystem structure and levels / patterns of diversity encountered within these ecosystems will ever be recovered even with rehabilitation following mine closure.	
Degree to which impact may cause irreplaceable loss of resources	**Moderately High** - Given that the vegetation survey was conducted outside the correct seasonal window, the moderately high rating above is based largely on the precautionary principle and the assumption that a large number of the Endangered plant species flagged as part of the desktop potential occurrence assessment will occur within the study area and that good condition grassland that supports these threatened plant species populations will be lost during the construction phase.	
Degree to which impact can be avoided	**Low to Moderate**– Due to the extent of the very high SEI in the South East Block avoidance of the sensitive areas would be very difficult to achieve.	
Degree to which impact can be mitigated	**Low** - Mitigation potential is low. Loss in extent of intact habitat will be very difficult to mitigate completely as some of the floral species lost may only occupy specific ecological niches unique to the study area that are unlikely to be replicated under a rehabilitation scenario. Therefore, such species are unlikely to be successfully translocated to adjacent areas. An offset scenario would require like-for-like areas of similar size with these rare floral species confirmed to occur identified for protection. This in reality would be difficult to achieve given the level of degradation and anthropogenic pressure existing in the remaining intact natural areas and the fact that the feasibility of an offset still needs to be investigated. Hence the original recommendation that avoidance is achieved first and foremost.	
Cumulative impact		
Nature of cumulative impacts	The direct loss impacts outlined above in combination with direct loss impacts associated with forestry, agriculture and human settlement in the area, will result in moderate levels of cumulative direct loss impacts to vegetation communities in the area. Cumulative impacts will be more significant for remaining intact open savannah/grassland areas as these areas have a smaller remaining extent (~1000 hectares or more within the larger southern section of the mining right area) in comparison to more closed woodland thicket areas (currently in the region of ~3000 hectares or more within the larger southern section of the mining right area). Additionally future impacts associated with other land-uses in the area are more likely to occur in vegetation communities that have a more open structure (i.e. the open savannah and grassland vegetation communities) and are more accessible in comparison to closed woodland and thicket areas.	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Medium -	**Medium -**
Residual impact		
Residual impact discussion	**Low** - Residual impacts to vegetation communities would be low under a good mitigation scenario, which assumes that enforcement of	

	sensitive no-go areas by an ECO is achieved and accidental incursion into intact vegetation communities is avoided.

Table 3-2 Management outcome, mitigation actions/measures and monitoring

Management outcome, mitigation actions/measures and monitoring	
Management objective	Minimise direct impacts to vegetation communities and implications for threatened ecosystems and biodiversity conservation during all phases of the Jindal MIOP.
Mitigation actions/measures	
All Phases	

- Access control and Site Camps:
  - All staff involved in work within the mining area must receive basic environmental awareness training.
  - All relevant staff on the property are to be informed of the sensitivity of the natural ecosystems and the need to avoid damaging/polluting these sensitive natural environments.
  - Site supervisors must ensure that impacts are confined to designated mining areas as far as possible.
  - All areas outside of the formal demarcated working area must be considered no-go areas for all phases (construction, operation, decommissioning, and closure).
  - As far as possible, all mining-related activities and infrastructure should remain outside of the recommended no-go areas.
  - All no-go areas in the vicinity of any mining operations should be clearly demarcated. These demarcated areas should be considered as "out of bounds" for all vehicles and personnel.
  - When locating temporary construction camps and equipment yards, areas susceptible to soil erosion and/or water contamination must be avoided.
  - Attempts must be made to situate the camp on flat ground that is at least 50m away from the edge of the nearest no-go area.
  - Access to and from the development area should be either via existing roads or within the construction servitude.
  - Any contractors found working inside the 'No-Go' areas (areas outside the construction/ working servitude) should be fined as per a fining schedule/system setup for the project.

- Storm water management and erosion/sediment control:
  - Wherever possible, existing vegetation cover at the site should be maintained during the construction phase. The unnecessary removal of groundcover from slopes must be prevented, especially on steep slopes.
  - Where possible construction roads should be aligned along contours rather than downslopes to avoid these features generating excessive sediment laden runoff.
  - All bare slopes and surfaces to be exposed to the elements during clearing and earthworks must be protected against erosion using rows of hay-bales, sandbags and/or silt fences aligned along the contours and spaced at regular intervals to break the energy of surface flows.
  - The use of hay-bale berms, sandbags and/or silt fences is particularly important in areas where surface runoff is concentrated (e.g.: rills, road stormwater discharge points etc.).
  - Once shaped, all exposed/bare surfaces and embankments must be re-vegetated immediately.
  - If re-vegetation of exposed surfaces cannot be established immediately due to construction phasing issues, temporary erosion and sediment control measures must be maintained until such a time that re-vegetation can commence.
  - All temporary erosion and sediment control measures must be monitored for the duration of the construction phase and repaired immediately when damaged. All temporary erosion and sediment control structures must only be removed once vegetation cover has successfully recolonised the affected areas.

- After heavy rainfall events, site checks must be conducted for erosion damage and rehabilitate this damage immediately. Erosion rills and gullies must be filled-in with appropriate material and / or silt fences until vegetation has re-colonised the rehabilitated area.
- Undertake any crossing construction or maintenance during low flows (winter season).
- Storm water infrastructure is likely to require regular on-going maintenance to ensure optimal functioning. At a minimum this should include silt and debris/litter removal from catch pits, filtration devices and attenuation ponds, and maintenance and repair of stormwater outlets to ensure the optimal functioning of such systems.
- All new planned dirty water containment facilities must remain outside of no-go areas.
- Stormwater that may be contaminated with industrial-type wastes should drain to sump collection points where this water will need to be filtered and/or treated for fuel/oil/chemical contaminants before being released into the environment. Any release must then comply with the relevant standards stipulated by the DWS.
- During the construction and operational phases of the proposed mining project, erosion berms should be installed on all unpaved surfaces and roadways and around stockpile areas to prevent gully formation and siltation of adjacent or downstream areas as follows:
  - Where the track has a slope <2%, berms every 50m should be installed.
  - Where the track slopes between 2% - 10%, berms should be installed every 25m.
  - Where the track slopes between 10% - 15%, berms should be installed every 20m.
  - Where the track has a slope > 15%, berms should be installed every 10m.
- Undertake the construction of any road or pipeline crossings of watercourses during low flows (winter season
- Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible and in accordance with the Rehabilitation Plan.
- Dewatering of any areas within the mining site needs to be done in a manner that does not cause erosion and does not result in heavily silt-laden water flowing downslope of the mining footprint. Water must be pumped out into a well vegetated and already disturbed area 100 m from any watercourse to facilitate sediment trapping and reduce the chance of sediment entering rivers/streams.
- After every major rainfall event, all erosion and sediment control structures or interventions will need to be inspected for damage immediately after the rains and repaired accordingly.
- Excavated or imported material/sediments/spoil should not be placed or stockpiled within any no-go areas.
- Soil/sand required for construction purposes must not be derived from nearby rivers/streams or other no-go areas.
- Any concentrated flow path within and around mine operating areas must be backfilled/shaped and ideally revegetated to promote more diffuse flows/sheet-wash runoff rather than concentrated flows.
- Any breached stormwater structures (e.g. eroded berms, collapsed stormwater channels, etc.) must be repaired timeously.
- Sediment barriers such as silt fences, berms, cut-off drains and sand bags must be implemented at sources of sediment. Berms, sandbags and/or silt fences employed must be maintained and monitored throughout the operational phase of mining areas.
- After every significant rainfall event, staff must check the site for erosion damage and rehabilitate this damage immediately. Erosion rills and gullies must be stabilised and where possible with appropriate material with appropriate sediment barriers for additional protection until grass has re-colonised the rehabilitated area.
- Stockpiles must not be placed in areas vulnerable to excessive erosion.
- Any and all soil stockpile areas are to be located outside of no-go areas.
- Erosion/sediment control measures such as silt fences; bricks or low soil berms must be placed around soil stockpiles to limit sediment runoff from stockpiles.
- Subsoil and topsoil must be stockpiled separately.
- Stockpiles of construction materials must be clearly separated from soil stockpiles in order to limit any contamination of soils.

    - The stockpiles may only be placed within demarcated stockpile areas, which must be established on flat ground and away from slopes.
    - Stockpiled soils are to be kept free of weeds and are not to be compacted. The stockpiled soil must be kept moist using some form of spray irrigation on a regular basis as appropriate and according to weather conditions.
    - The slope and height of stockpiles must be limited to 2m to avoid collapse and compaction.

- Pollution control:
    - No dirty water runoff from mining or processing areas must be discharged into the environment during the entire life-span of mining operations.
    - Clean and dirty water management systems must be put in place to prevent contaminated runoff (containing sediments, salts, pollutants/toxicants such as hydrocarbons/oils and water with low pH) from entering the receiving natural environment outside of the mine footprint.
    - Contaminated stormwater must be conveyed to PCDs and not discharged into the natural environment.
    - Road runoff carrying iron ore residue must be conveyed to PCDs. There must be no direct discharge of contaminated road runoff into the natural environment that forms part of the no-go area.
    - All dirty water containment facilities must remain outside of the no-go areas.
    - The location of RoM and tailings stockpiles, and retention dams should be carefully evaluated around the likelihood of pollution of water resources because of drainage and/or seepage into downstream areas. Site-specific mitigation measures must then be put in place to reduce risks.
    - Care should be taken to reduce the risks of aquifer penetration when drilling/blasting, wherever this occurs.
    - All run-off from stockpiles should be captured in a suitable PCD. The base of the stockpile should be sealed to prevent infiltration of polluted water into the ground.
    - No dumping of waste (liquid & solid waste) is permitted to take place within no-go areas.
    - The proper storage and handling of hazardous substances (hydrocarbons and chemicals) needs to be administered for all mining activities.
    - Drip trays should be utilised at all fuel/oil dispensing areas.
    - Potentially hazardous materials (chemicals, fuel, oils) liable to spillage need to be stored in appropriate containment structures (e.g using suitable industry-standard drip-trays or within concrete bunded areas).
    - Washing and cleaning of any construction and/or mining equipment should be undertaken only in clearly designated areas which are located far from no-go areas.
    - Drip-trays should be used beneath any standing machinery/plant if such equipment is to be left standing for an extended period.
    - Vehicles are not to be refuelled or serviced within no-go areas.
    - Spillages of fuels, oils and other potentially harmful chemicals should be cleaned up immediately and contaminants properly drained and disposed of using proper solid/hazardous waste facilities (not to be disposed of within the natural environment). Any contaminated soil from the site must be removed and rehabilitated timeously and appropriately.
    - Clear and completely remove from the site, all general waste, construction related plant, equipment, surplus rock and other foreign materials.
    - All solid waste recorded within no-go areas must be collected and placed in bins prior to being disposed of appropriately.
    - Adequate scavenger-proof rubbish bins and waste disposal facilities are to be provided on-site at strategic points at work areas and educate/encourage workers not to litter or dispose of solid waste in the natural environment but to use available facilities for waste disposal. The bins must be emptied on a regular basis and taken to a registered landfill for disposal only.
    - A culture of “conserve, reduce, reuse & recycle” should be promoted with regards to the use and disposal of products to minimise resource consumption and reduce the amount of potential waste.

- No stockpiling of any materials should take place within any no-go areas.
- Sanitation – portable toilets (1 toilet per 30 users is the norm) must be provided where mining is occurring. Workers need to be encouraged to use these facilities and not the natural environment. Toilets should be located outside of the 1:100 year flood line of all watercourses and outside of the recommended no-go areas. Waste from chemical toilets should be disposed of regularly and in a responsible manner by a registered waste contractor.
- Signage should be provided at a visible location at the wastewater treatment works (WWTW) to inform workers and locals in the area of the purpose of the treatment works. Emergency telephone contact details should also be provided on the signs so that pump station failure, leakage or electrical power outages affecting the system can be easily reported.
- A monitoring and maintenance programme should be prepared for the WWTW to ensure the on-going performance of infrastructure and prevention of foreseeable faults/problems that could result in leakage/failure. An annual report should be compiled, highlighting monitoring undertaken and main findings in terms of faults, problems, breakdowns, etc. Monitoring should consider the use of telemetry systems at pump stations and include regular inspections of the WWTW operation.
- Noise pollution should be minimized where possible by ensuring the proper maintenance of equipment and vehicles, including the tuning of engines and mufflers as well as employing low noise equipment where possible.
- Haul trucks must operate within the recommended 30 km/h speed limit when driving on all dirt roads (low speeds generally generate less dust when compared to high speeds).
- Adequate water carts and or adequate spray frequencies must be implemented particularly on dry and hot days to suppress dust pollution. Water retained in PCDs, provided the water quality is acceptable should be used for this purpose for example.
- Water trucks will be required to suppress dust by spraying water on affected areas producing dust. This may be required daily and may be subject to a water use license from the DWS.

- Topsoil management:
  - Subsoil and topsoil must be stockpiled separately.
  - Stockpiles of construction materials must be clearly separated from soil stockpiles in order to limit any contamination of soils.
  - The stockpiles may only be placed within demarcated stockpile areas, which must be established on flat ground and away from slopes.
  - Stockpiled soils are to be kept free of weeds and are not to be compacted. The stockpiled soil must be kept moist using some form of spray irrigation on a regular basis as appropriate and according to weather conditions.
  - Topsoil from different vegetation communities should be stripped and stockpiled separately.
  - Handling of the stripped topsoil should be minimized.
  - If possible, topsoil should not be stockpiled but used directly.
  - Where topsoil is stocked, the piles should be lower than 2m.
  - Stockpiling should be minimized to periods of 6-12 months to limit deterioration of seed, nutrients and soil biota.
  - Stockpiles should be seeded with grass or legume mixtures to minimize erosion and loss of beneficial micro-organisms.

- Managing flora and fauna:
  - Construction should take place in the winter months where possible in order to minimise the impacts on the breeding activities of the terrestrial faunal species.
  - Vegetation removal/stripping must be limited to the approved mining footprint.

- No clearing of indigenous vegetation outside of the defined working servitudes is permitted for any reason (i.e. for firewood or medicinal use).
- Grubbing is not permitted as a method of clearing vegetation. Any trees needing clearing must be cut down using chain saws and hauled from the site using appropriate machinery where practically possible.
- Vegetation clearing/stripping must only be done as construction/mining progresses to minimise areas of bare soil left standing for prolonged periods.
- Species diversity and the health of biotic communities supported by natural ecosystems should be maintained. This includes the feeding, breeding and movement of fauna and flora. This means that the loss of habitat availability and/or condition that leads to deterioration in the current condition of terrestrial ecosystems is not acceptable.
- If any Red Data plant species are identified that may be disturbed, effective relocation of such species to suitable natural habitat outside of the mining impact zone must be arranged in consultation with Ezemvelo Kwazulu Natal Wildlife (EKZNW).
- Prior to mining activities taking place in natural areas, it is advised that the 'flushing out' of local wildlife be undertaken to allow species to relocate naturally before mining commences.
- No animals are to be killed on the site or surrounding areas, including species considered as dangerous/ vermin such as snakes and rats. Where these are encountered on the site, they should be removed and transferred to the nearest suitable natural habitat by a qualified handler.
- Any fauna that are found within the mining area should be moved to the closest point of natural or semi-natural vegetation outside the construction servitude. Where these are encountered on the site, they should be removed and transferred to the nearest suitable natural habitat by a qualified handler.
- Plants that are removed during construction should be maintained on site and used to re-vegetate the disturbed soil.
- Only indigenous plant species naturally occurring in the area should be used during the rehabilitation of the affected areas.
- All vehicles accessing the site should adhere to a low speed limit (30km/h is recommended) to avoid collisions with susceptible species such as reptiles (snakes and lizards).
- No trapping of any animal must be allowed on the site and nearby/adjacent areas.
- No fishing is to take place.
- No firewood or medicinal plants may be harvested from natural areas.
- It is recommended that landscaping during the operational phase promote the use of indigenous species common to the region and that as much natural ground cover is established (naturally) on the site to help with binding soils and encouraging water infiltration, thus reducing overland flows and the pressure on stormwater management infrastructure.
- Any damage to the terrestrial ecosystems that takes place during the life of the mine outside of the designated mining footprint must be rehabilitated immediately. A site-specific rehabilitation plan would need to be developed by a qualified botanist.
- It is recommended that the developer compile and implement a long-term plan to promote the conservation of remaining primary grassland vegetation communities and habitat on the property and surrounds, in consultation with local stakeholders and local and provincial conservation authorities EKZNW in this instance and a terrestrial ecologist consulted in this regard should such disturbance occur.
- NOTE: An update to the baseline biodiversity information should ideally be undertaken for the project to further inform mitigation and management requirements as the original vegetation survey was undertaken outside of the recommended summer seasonal window and a number of conservation important plant species are likely to have been overlooked, in addition no faunal specialist was involved in the baseline survey which was only undertaken at a desktop level.

- Fire management:

- Adequate firebreaks around the mining areas must be maintained at all times.
- Illicit or informal fires must be prohibited on site and within natural areas.
- No open fires to be permitted on the site.
- Smoking must not be permitted in areas considered to be a fire hazard (i.e. in close proximity to grasslands, etc.).
- Ensure adequate fire-fighting equipment is available at the site and train workers on how to use equipment.
- Ensure that all workers on site know the proper procedure in case of a fire occurring.
- Ensure that no refuse wastes are burnt on the site or surrounding areas.

Pre-Construction Phase

- The following supplementary actions will need to be completed, in addition to the Environmental Management Programme (EMPr), if the development is approved to inform the monitoring and mitigation of biodiversity impacts related to the project:
  - Protected flora rescue and translocation plan to be prepared by a terrestrial ecologist or botanist, which will need to include a monitoring programme and follow-up action plan to ensure successful rescue/translocation is achieved.
  - Permits for the destruction or relocation of protected plants will need to be acquired subject to the submission of the relevant applications to EKZNW. This will be required prior to the implementation of the flora rescue and relocation plan.
  - Undertake flora rescue and relocation in line with the approved rescue and relocation plans. The flora rescue and relocation should be undertaken by a qualified botanist in consultation with EKZNW.
  - A comprehensive monitoring programme for the mining right areas which includes detailed information collected from multiple surveys (covering seasonal variation i.e. dry and wet season) of the mining right area and its 500m buffer which includes the following minimum baseline data which should be monitored and updated on a quarterly basis:
    - Soil monitoring which focuses on picking up on any soil pollution and contamination of soils in the area with various pollutants associated with iron ore mining tested for. Crucial to the success of this monitoring programme will be a comprehensive initial baseline survey across the proposed mining area and downslope areas that stand to be affected and the incorporation of multiple control sites located above the mining area as well.
    - Fixed Vegetation plots with fixed point photography providing a representative picture of vegetation and plant species diversity within the larger study area and which will enable monitoring of any changes in vegetation condition and species diversity over time, multiple control sites which will be unaffected by planned mining should be included within each vegetation type occurring within the study area, areas immediately downslope as well as progressively further away from the mine should also be included to gauge the area affected by indirect impacts associated with mining.
    - Faunal surveys (birds, amphibians, reptiles, mammals, insects) which provide a representative picture of faunal species diversity within the larger study area and which will enable monitoring of any changes in species diversity overtime, likewise multiple control survey sites which will be unaffected by planned mining should be included within each habitat type occurring with the study area.
  - A management plan for areas within the mining right area and managed by the applicant. Such a plan should be informed by:
    - A comprehensive invasive alien plant eradication programme compiled by an appropriately qualified person which accounts for alien plant clearing during the construction, operational and de-commissioning phase of the mine and covers the entire mining right area.
    - An alien plant monitoring programme or schedule must also be included and incorporated into the mines standard operating procedure from inception.
    - A comprehensive grassland management programme, which accounts for an appropriate fire management regime.

	• An overarching rehabilitation strategy for terrestrial ecosystems that will be affected by mining and a detailed rehabilitation plan for each phase of mine development (i.e. the construction, operational, de-commissioning and closure phases) once detailed information on site infrastructure and mining footprints becomes available. • A rehabilitation audit programme which reviews rehabilitation success periodically and allows for amelioration and follow-up to be accounted for. An independent auditor should be appointed for rehabilitation audits conducted. • A handover document and programme if the mine intends to pass the land holdings onto a successor in title/new land owner. • Financial surety for the implementation of the above programmes and plans will need to be incorporated into the financial provision report and a certified bank guarantee as part of the application for environmental authorisation.

Monitoring – All Phases	• Compliance monitoring:
	  • Compliance monitoring will be the responsibility of a suitably qualified/trained ECO (Environmental Control Officer) with any additional supporting Environmental Officers (EO's) (Environmental Officers) having the required competency skills and experience to ensure that monitoring is undertaken effectively and appropriately.
	  • A photographic record of the state of the terrestrial ecosystems prior to the commencement of clearing/ construction must be kept for reference and rehabilitation monitoring purposes.
	  • The ECO must undertake weekly compliance monitoring audits. Terrestrial ecosystem aspects that must be monitored related to monitoring terrestrial ecosystem impacts include:
	    • The condition of the demarcations / fence.
	    • Evidence of any no-go area incursions.
	    • The condition of temporary runoff, erosion and sediment control measures and evidence of any failures or sediment deposits.
	    • Evidence of erosion.
	    • Visual assessment of stormwater quality.
	    • The condition of waste bins and the presence of litter within the working area.
	    • Evidence of solid waste dumping within the no-go areas.
	    • Evidence of hazardous materials spills and soil contamination.
	    • Presence of alien invasive and weedy vegetation within the working area.
	    • Rehabilitation and re-vegetation methods and success.
	  • At the end of the construction phase a construction phase EMPr audit report will need to be compiled and submitted to the competent authorities for review, as well as a specific rehabilitation audit report for the construction phase.
	  • Bi-annual operational and decommissioning phase audits will need to be conducted and reports submitted to the relevant competent authorities as well as specific rehabilitation focused audit reports and should continue until closure of the mine is approved.

3.2.2 Impact Assessment – Indirect Impacts

During the construction phase, large exposed bare areas associated with vegetation clearing and bulk earthworks are likely to result in altered landforms, drainage and runoff flow patterns leading to major erosion and/or sedimentation downslope. This will either result in the smothering of large patches of vegetation (in the case of sediment plumes) or loss of vegetation cover (in the case of major erosion) within the vegetation communities' downslope of the mine footprint. Storm water management is required to mitigate these impacts.

Potential pollution impacts associated with the proposed iron ore mine during the construction phase can include the mishandling of hazardous substances and/or improper maintenance of machinery during construction e.g. oil and diesel leaks and spills, contamination of local ground water by drilling muds and exposed ore, contamination of surface and ground water by seepage and effluent discharges or discharge of contaminants via mine de-watering activities. These pollution impacts may result in the die-back of vegetation and some mortalities for fauna, the extent of which will depend on the severity of the spill or the amount of contaminated water discharged into the environment. It is likely that following on from the die-back of vegetation, areas affected by soil and water pollution or point source spills would be colonised by more common indigenous weedy/pioneer species as well as alien species. However, the likelihood of spills and pollution can be reduced through various best practice mitigation measures which include measures listed in Table 3-2 under 'Pollution Control'.

Altered drainage and increased runoff, as well as de-watering activities and water use by the mine during the construction phase will result in an increase in the demand on local water resources. This could result in a lowering of the groundwater table and reduce the amount of surface water available and alter soil moisture conditions. Thereby resulting in drier more water stressed conditions for vegetation communities in the study area. Decreasing their resilience to withstand future stressors such as droughts, extremely high temperatures, increased grazing pressure etc.

Exposure of large bare areas could result in large amounts of dust coating vegetation within and surrounding the mine footprint. This would negatively affect the ability of plants to photosynthesise effectively and may result in increased mortalities of more sensitive plant species, reducing the level of diversity within vegetation communities located on the edge of the mine footprint. These conditions again would likely favour recruitment of more weedy, pioneer and alien invasive plant species in these areas, that are more adaptable to a spectrum of environmental conditions and habitat types. It is recommended that various dust suppression measures are implemented during the construction phase of the mine to ensure this potential stressor/risk is minimised as much as possible.

The unmitigated significance for the construction phase is therefore assessed to be **HIGH** and could be reduced to **MEDIUM** (Table 3-3) with implementation of mitigation measures.

During the operational phase, hardened surfaces associated with the power yard, processing plant, primary crusher, WRD, South East Pit and other infrastructure are likely to reduce infiltration rates which could lead to increased runoff downslope and loss of soil and vegetation. Storm water management design must be considered by the project management team to mitigate these impacts. The dewatering of the mine may also increase flows on certain slopes if this water is discharged into the environment.

Additionally, as with the construction phase, during the operational phase of the mine large bare areas of earth and bedrock would be exposed to surface weather elements. As exposed bedrock has very little infiltration capacity it is expected that runoff volumes from the mine pit would increase as mining advances. If this storm water is not effectively managed it could cause erosion, which has implications for the ecological condition of terrestrial ecosystems downslope of the planned mine pit area. Bare and exposed soil associated with the mine pit may also wash onto downslope areas during rainfall events. The WRD area would also likely hold or distribute runoff in an altered fashion, with this likely having knock on effects downslope.

In addition to sedimentation and erosion risks highlighted, impacts to vegetation of Medium to Very High SEI adjacent to and outside of the development footprint during the operational phase may occur as a result of increased human activity and associated disturbance (e.g., increased alien plant invasion and grazing pressure, as well as light and noise pollution – with respect to faunal species). This is likely to continue to impact on terrestrial ecosystems, reducing overall biodiversity.

Dust generation from operational activities which could also impact vegetation within and on the margins of the operational footprint, associated with haul roads, the expanding mine pit, WRD and other infrastructure as discussed for the construction phase consequently favouring recruitment of more weedy, pioneer and alien invasive plant species. Dust suppression measures should be implemented during the operational phase to minimised this impact.

Accumulation of unnatural concentrations of heavy metals in the soil may also have a long term cumulative negative effect on certain plant species, thereby reducing their resilience, increasing mortality rates in affected species and potentially resulting in less diverse plant species assemblages and ultimately impacting upon terrestrial biodiversity levels in areas downstream of the mine.

Correct storm water management will be critical in minimising sediment runoff and heavy metal accumulation downstream. Although this impact cannot be eliminated with mitigation it could be reduced in extent and intensity.

At a smaller point source scale, accidental fuel spills and wastewater infrastructure failure (e.g. sewer pipeline leaks or waste water treatment work malfunction) may result in spills to adjacent intact ecosystems during the operational phase of the mine which could result in die-back of vegetation and some mortalities for fauna. However, the likelihood of spills can be reduced through various best practice mitigation measures which include measures as per Table 3-2 under 'Pollution Control'.

The unmitigated significance is therefore assessed to be **HIGH** and can be reduced to **MEDIUM** in the operational phase (Table 3-3) with implementation of mitigation measures.

During the decommissioning phase the most significant indirect impacts on species of conservation concern (SCC) would be associated with an increase in alien plant cover and an accumulation of pollutants in the soil. Both would result in invasive alien plants potentially outcompeting indigenous species, thereby decreasing the number of individuals remaining in populations of plant SCC. Consequently, reducing the resilience of the remaining populations of the affected plant SCC to persist.

Impacts on populations of animal SCC would likely be a reduction in suitable habitat, movement corridors, as well as potentially increased mortalities associated with a bioaccumulation of heavy metals and toxicants.

The unmitigated significance is assessed to be **MEDIUM** and can be reduced to **LOW** in the operational phase with implementation of mitigation measures (Table 3-3).

Table 3-3 Indirect impacts to vegetation communities and implications for threatened ecosystems and biodiversity conservation

Description of Impact		
Type of Impact	Indirect	
Nature of Impact	Negative	
Phase	**Construction**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Severe change (Very high)	Moderate change (Medium)

Duration	Medium-term (5 to 10 years)	Medium-term (5 to 10 years)
Extent	Local	Local
Consequence	High	Medium
Probability	Definite / Continuous	Definite / Continuous
Significance	**High -**	**Medium -**
Description of Impact		
Phases	**Operational**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Prominent change (High)	Moderate change (Medium)
Duration	Long-term (10 and 20 years	Long-term (10 and 20 years
Extent	Local	Whole site
Consequence	High	Medium
Probability	Definite / Continuous	Definite / Continuous
Significance	**High -**	**Medium -**
Phases	**Decommissioning and Closure Phases**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium)	Moderate change (Medium)
Duration	Long-term (10 and 20 years	Long-term (10 and 20 years
Extent	Beyond site	Whole site
Consequence	Medium	Medium
Probability	Definite / Continuous	Possible / frequent
Significance	**Medium -**	**Low -**
Degree to which impact can be reversed	**Partially Reversible** - In terms of indirect impacts such as sedimentation, point source pollution and alien plant invasion which would take place during the construction phase, these impacts can be addressed to some degree through mitigation such as alien plant clearing, spill clean-up, silt fencing etc., however, if these impacts take place in areas that are largely intact, even with the mitigation measures above implemented, pollution, erosion and alien plant invasion could result in a reduction in the condition of the affected vegetation communities.	
Degree to which impact may cause irreplaceable loss of resources	**Moderate** - Erosion and pollution impacts as well as alien plant invasion could reduce the ecological condition of vegetation communities surrounding the mine footprint. However, with strict and comprehensive mitigation applied, the impact can be reduced.	
Degree to which impact can be avoided	**Moderate** – The very high SEI in the South East Block but outside of the proposed Jindal MIOP active mining areas can be avoided provided the no-go areas are clearly demarcated and controlled.	
Degree to which impact can be mitigated	**Moderate** - Mitigation such as strict enforcement of no-go areas, erosion and sediment control measures, pollution control and alien plant eradication can contribute to ensuring additional indirect impacts to vegetation communities beyond the mine's development footprint are minimised as far as practicably possible.	

Cumulative impact		
Nature of cumulative impacts	**Medium** - The indirect impacts outlined above in combination with indirect impacts associated with forestry, agriculture and human settlement in the area, would result in moderate levels of cumulative indirect impacts to vegetation communities in the area.	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Medium -	Medium -
Residual impact		
Residual impact discussion	**Low** - Under a good mitigation scenario, additional edge effects and associated alien plant invasion in remaining intact areas of grassland, savannah and valley bushveld/thicket vegetation were rated as low.	

Table 3-4 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	Minimise indirect impacts to vegetation communities and implications for threatened ecosystems and biodiversity conservation during all phases of the Jindal MIOP.
Mitigation actions/measures	
All Phases	
• See Table 3-2	
Monitoring	• See Table 3-2

3.3 IMPACTS TO SPECIES AND THREATENED SPECIES CONSERVATION

3.3.1 Impact Assessment – Direct Impact

Vegetation communities rated as being of Low or Very Low SEI are unlikely to host conservation important species, however, based on the current layout, the location of certain mine infrastructure as well as the WRD and the South East Pit coincide with areas of Medium to Very High SEI and could therefore eliminate or reduce the size of threatened plant populations on-site. Therefore, impacts to populations of threatened plant species are anticipated (two threatened plant species are confirmed to occur within the larger mining right area, namely, *Moraea graminicola* subsp graminicola – Near threatened and *Stangeria eriopus* – Vulnerable; in addition, what appeared to be *Helichrysum pannosum* – Endangered was noted on site (however no available flowering specimens were present to confirm this). A plant rescue, relocation and protection plan, which would include a detailed search of the footprint for any threatened and/or protected plant species would need to be compiled and actioned.

Faunal impacts associated with the construction phase may also be high. Although, large portions of the study area have already been transformed or degraded, with any fauna persisting in these areas likely habituated to the existing disturbance regime (subsistence cultivation, livestock grazing, domestic animals and working dirt roads), there are certain invertebrate species flagged as potentially occurring. These invertebrate species have specific habitat requirements and occur in areas of Medium to Very High SEI that stand to be lost. Moreover, at the local scale the potential loss of important ecological corridors for faunal species movement as well as the loss of seed sources for certain plant species is also a concern and anticipated impact. Loss of existing ecological corridors for faunal species such as leopard etc., are anticipated as well as loss of the exchange of genetic material between threatened plant populations.

The unmitigated significance is assessed to be **HIGH** for both the construction and operational phases. However, the significance in the construction phase remains **HIGH** due to the high sensitivity of the floral species that exist within the proposed mine footprint as well as that these species would likely be lost in the area on a permanent basis (Table 3-5). Mitigation measures are still required to be implemented to minimise the extent of the impact to the areas directly within the mine footprint. In the operational phase with mitigation measures implemented the significance can be reduced to **MEDIUM** (Table 3-5).

Direct impacts in the decommissioning phase are limited to accidental incursion into sensitive no-go areas by heavy vehicles/ machinery during the removal of infrastructure and decommissioning of access roads. Additional intact areas may be impacted by accidental incursion if they are not clearly demarcated as no-go areas and an ECO is not on site to enforce the relevant mitigation measures.

The unmitigated significance is assessed to be **MEDIUM** and can be reduced to **LOW** in the decommissioning phase with implementation of mitigation measures (Table 3-5).

Table 3-5 Direct impacts to species and threatened species conservation

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phase	**Construction**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Prominent change (High)	Prominent change (High)

Duration	Permanent (>20 years)	Permanent (>20 years)
Extent	Beyond site	Whole site
Consequence	High	High
Probability	Definite / Continuous	Definite / Continuous
Significance	**High -**	**High -**
Description of Impact		
Phases	**Operational**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Prominent change (High)	Moderate change (Medium)
Duration	Very long term/ Permanent (> 20 years)	Very long term/ Permanent (> 20 years)
Extent	Beyond site	Whole site
Consequence	High	Medium
Probability	Definite / Continuous	Probable
Significance	**High -**	**Medium -**
Phases	**Decommissioning and Closure Phases**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Prominent change (High)	Moderate change (Medium)
Duration	Very long term/ Permanent (> 20 years)	Very long term/ Permanent (> 20 years)
Extent	Beyond site	Whole site
Consequence	High	Medium
Probability	Possible / frequent	Conceivable
Significance	**Medium -**	**Low -**
Degree to which impact can be reversed	**Irreversible** - This depends on the floral species affected and whether they survive rescue and translocation prior to construction. Some SCC may be translocated successfully. However, even if successfully translocated, the loss in extent of viable habitat is nevertheless still likely to reduce resilience of remaining populations to future risks and stressors.	
Degree to which impact may cause irreplaceable loss of resources	**Moderately-High** - If a population of a range restricted rare floral species is not successfully translocated into suitable habitat this could negatively affect the continued persistence of the species and result in a significant reduction in their known range and available habitat.	
Degree to which impact can be avoided	**Low** – Due to the extent of the very high SEI in the South East Block avoidance of the sensitive areas would be very difficult to achieve.	
Degree to which impact can be mitigated	**Moderate** - Impact can be mitigated through rescue and translocation where possible, however, this is not always guaranteed to be successful with certain sensitive species.	
Cumulative impact		
Nature of cumulative impacts	The direct loss impacts outlined above in combination with direct loss impacts associated with forestry, agriculture and human settlement in the area, will result in moderate levels of cumulative direct loss impacts to SCC in the area.	

Rating of cumulative impacts	Without Mitigation	With Mitigation
	Medium	Medium
Residual impact		
Residual impact discussion	**Low** - Residual impacts to SCC would be low under a good mitigation scenario, which assumes that enforcement of sensitive no-go areas by an ECO is achieved and accidental incursion into intact vegetation communities during the decommissioning phase is avoided/highly unlikely to occur. Successful site rehabilitation should also improve the quality of the site.	

Table 3-6 Management outcome, mitigation actions/measures and monitoring

Management outcome, mitigation actions/measures and monitoring	
Management objective	Minimise direct impacts to species and threatened species conservation during all phases of the Jindal MIOP.
Mitigation actions/measures	
All Phases	
• See Table 3-2	
Monitoring	• See Table 3-2

3.3.2 Impact Assessment – Indirect Impact

During both construction and operations, increased rates of sedimentation and erosion associated with bulk earthworks could result in vegetation being smothered downslope. Windborne dust can smother plants compromising their ability to photosynthesise as effectively. Disturbed areas can also quickly become colonised with weeds, pioneer and alien plant species. Any spills or pollution associated with construction can contaminate natural areas downslope or downstream. These indirect impacts can result in increased mortalities of threatened flora and fauna.

The unmitigated and mitigated significance is assessed to be **MEDIUM** in both the construction and operational phases largely due to the regional extent that the impact of the loss could affect (Table 3-7). The intensity of the impact can, however, be reduced with the implementation of the relevant mitigation measures.

During decommissioning the most significant indirect impacts on SCC would be associated with an increase in alien plant cover and an accumulation of pollutants in the soil. Both would result in invasive alien plants potentially outcompeting indigenous species, thereby decreasing the number of individuals remaining in populations of plant SCC and consequently, reducing the resilience of the remaining populations of the affected plant SCC to persist.

Impacts on populations of animal SCC would likely be a reduction in suitable habitat, movement corridors, as well as potentially increased mortalities associated with a bioaccumulation of heavy metals and toxicants.

The unmitigated significance is assessed to be **MEDIUM** and can be reduced to **LOW** in the decommissioning phase with implementation of mitigation measures (Table 3-7).

Table 3-7 Indirect impacts to species and threatened species conservation

Description of Impact	
Type of Impact	Indirect
Nature of Impact	Negative

Phase	Construction	
Criteria	Without Mitigation	With Mitigation
Intensity	Prominent change (High)	Moderate change (Medium)
Duration	Medium-term (5 to 10 years)	Medium-term (5 to 10 years)
Extent	Beyond site	Whole site
Consequence	Medium	Medium
Probability	Definite / Continuous	Definite / Continuous
Significance	Medium -	Medium -
Description of Impact		
Phases	Operational	
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate change (Medium)	Moderate change (Medium)
Duration	Long-term (10 and 20 years	Long-term (10 and 20 years
Extent	Beyond site	Beyond site
Consequence	Medium	Medium
Probability	Definite / Continuous	Probable
Significance	Medium -	Medium -
Phases	Decommissioning and Closure Phases	
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate change (Medium)	Moderate change (Medium)
Duration	Long-term (10 and 20 years	Long-term (10 and 20 years
Extent	Beyond site	Whole site
Consequence	Medium	Medium
Probability	Definite / Continuous	Possible / frequent
Significance	Medium -	Low -
Degree to which impact can be reversed	**Partially Reversible** - In terms of indirect impacts such as sedimentation, point source pollution and alien plant invasion which would take place during the construction phase, these impacts can be addressed to some degree through strict adherence to mitigation such as alien plant clearing, storm water management, pollution control, etc., however, even with the mitigation measures above implemented, loss of certain individuals of threatened plant species may occur along with the loss of some level of genetic diversity.	
Degree to which impact may cause irreplaceable loss of resources	**Moderate** - Erosion and pollution impacts could, lead to higher levels of mortality within threatened plant species populations. In addition, alien plant invasion could result in indigenous plant species being outcompeted. However, with strict and comprehensive mitigation applied, the impact can be marginally reduced.	
Degree to which impact can be avoided	**Moderate** – The very high SEI in the South East Block but outside of the proposed Jindal MIOP active mining areas can be avoided provided the no-go areas are clearly demarcated and controlled.	

Degree to which impact can be mitigated	**Moderate** - Mitigation such as strict erosion and sediment control measures, well designed and maintained storm water management systems, pollution control and alien plant eradication can contribute to ensuring additional indirect impacts to vegetation communities beyond the mine's development footprint are minimised as far as practicably possible.	
Cumulative impact		
Nature of cumulative impacts	The indirect impacts outlined above in combination with indirect impacts associated with forestry, agriculture and human settlement in the area, will result in moderate levels of cumulative indirect impacts to SCC in the area.	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Medium	**Medium**
Residual impact		
Residual impact discussion	**Low** - Residual impacts associated with increased edge effects and associated alien plant invasion in remaining intact areas of grassland, savannah and valley bushveld/thicket vegetation which would reduce the extent of viable habitat available for threatened and/or sensitive flora and fauna were assessed as being of low significance due to the application of mitigation measures decreasing the likelihood of this impact occurring as well as the intensity of the impact. Successful site rehabilitation should also improve the quality of the site.	

Table 3-8 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	Minimise indirect impacts to species and threatened species conservation during all phases of the Jindal MIOP.
Mitigation actions/measures	
All Phase	
• See Table 3-2	
Monitoring	• See Table 3-2

3.4 IMPACTS TO LOCAL AND REGIONAL ECOLOGICAL PROCESSES

3.4.1 Impact Assessment – Direct Impact

As previously discussed large portions of the study area are considered CBA: Optimal at the provincial scale, and at the national scale, portions of the study area have been flagged as part of the National Protected Area Expansion Strategy (this includes the entire WRD, incoming power yard, processing plant and primary crusher) and, in addition, portions of the footprint also form part of a Surface Water Strategic Water Source Area at the national scale. Therefore, the project area is considered an important intact ecological corridor at the national and provincial scale that plays a critical role for biodiversity maintenance and for ecosystem services related to water supply.

Direct loss of more than 500 ha of vegetation would result in significant habitat fragmentation, a reduction in the extent of available ecological corridors and remaining intact areas that are capable of contributing meaningfully to biodiversity maintenance and various ecosystem services.

Fragmentation of large contiguous areas of intact grassland habitat would also occur should the Jindal MIOP proceed. Large contiguous areas of intact grassland are becoming increasingly rare, with the result being that fires that would have historically spread across larger areas and been more intense, will become more localised and less intense in nature. This would likely result in shifts in landscape scale ecosystem processes over time, thereby irreversibly altering these grassland ecosystems.

The construction phase unmitigated significance is assessed to be **HIGH** and even with the implementation of mitigation measures, remains **HIGH** (Table 3-9). Again, this is largely due to the permanent loss of these significant ecological processes, that they are of regional importance and the very high probability of them occurring.

In the operational and decommissioning phases, additional direct loss of vegetation beyond the mine footprint due to accidental incursion would result in additional habitat fragmentation impacts, a reduction in the extent of available ecological corridors and remaining intact areas that are capable of contributing meaningfully to biodiversity maintenance and various ecosystem services.

Further fragmentation of areas of intact grassland habitat will likely take place under a poor mitigation scenario, further reducing the extent of remaining contiguous areas of grassland.

The unmitigated significance is assessed to be **MEDIUM** and remains **MEDIUM** in the operational and decommissioning phases (Table 3-9).

Table 3-9 Direct impacts to local and regional ecological processes

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phase	**Construction**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Prominent change (High)	Prominent change (High)
Duration	Very long term/ Permanent (> 20 years)	Very long term/ Permanent (> 20 years)
Extent	Beyond site	Beyond site
Consequence	High	High

Probability	Definite / Continuous	Definite / Continuous
Significance	**High -**	**High -**
Description of Impact		
Phases	**Operational**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium)	Moderate change (Medium)
Duration	Very long term/ Permanent (> 20 years)	Very long term/ Permanent (> 20 years)
Extent	Whole site	Whole site
Consequence	Medium	Medium
Probability	Definite / Continuous	Probable
Significance	**Medium -**	**Medium -**
Phases	**Decommissioning and Closure Phases**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Prominent change (High)	Moderate change (Medium)
Duration	Very long term/ Permanent (> 20 years)	Very long term/ Permanent (> 20 years)
Extent	Beyond site	Whole site
Consequence	High	Medium
Probability	Possible / frequent	Conceivable
Significance	**Medium -**	**Low -**
Degree to which impact can be reversed	**Irreversible** - Rehabilitation post closure may restore some ecological corridors for some more common faunal species that are habituated to disturbed/degraded environments, however, sensitive threatened floral species are unlikely to re-colonise these degraded areas in the medium to long term, moreover the hydrological and geomorphological processes and ecosystem services provided by intact areas vs. the degraded areas post closure and rehabilitation are unlikely to ever be comparative.	
Degree to which impact may cause irreplaceable loss of resources	**Moderately High** - Other ecological corridors will still exist for faunal species frequenting or passing through the area along major rivers and valley drainage lines adjoining the project area, however, connectivity between intact primary grassland areas will be greatly reduced and may represent a loss in terms of seed dispersal across contiguous intact areas for certain plant species that are wind dispersed.	
Degree to which impact can be avoided	**Low** – Due to the extent of the very high SEI in the South East Block avoidance of the sensitive areas would be very difficult to achieve.	
Degree to which impact can be mitigated	**Low** - Mitigation potential is low. Loss in extent of intact habitat will be impossible to mitigate completely.	
Cumulative impact		
Nature of cumulative impacts	The direct loss impacts in combination with indirect loss impacts associated with forestry, agriculture and human settlement in the area, would result in moderate levels of cumulative impacts to ecological processes in the area.	

Rating of cumulative impacts	Without Mitigation	With Mitigation
	Medium	Medium
Residual impact		
Residual impact discussion	**Medium** - Residual impacts to ecological processes will be moderate due to increased habitat fragmentation, reduced biodiversity and therefore reduced resilience for threatened ecosystems and species to withstand additional/future stressors and risks.	

Table 3-10 Management outcome, mitigation actions/measures and monitoring

Management outcome, mitigation actions/measures and monitoring	
Management objective	Minimise direct impacts to local and regional ecological processes during the decommissioning phase of the Jindal MIOP.
Mitigation actions/measures	
Decommissioning Phase	
• See Table 3-2	
Monitoring	• See Table 3-2

3.4.2 Impact Assessment – Indirect Impact

During both the construction and operational phases, increased rates of sedimentation and erosion associated with the bulk earthworks impact vegetation downslope. These disturbed areas can quickly become colonised with weedy, pioneer and alien plant species. In addition, any spills or pollution associated with construction activities could contaminate natural areas downslope/ downstream thereby compromising the integrity and functioning of these ecosystems and indirectly affecting the ecosystem goods and services they provide.

The construction phase unmitigated and mitigated significance is assessed to be **MEDIUM** (Table 3-11). This is largely due to the regional extent and the very high probability of occurrence of the impact, however, the intensity could be reduced from high to medium with the implementation of mitigation measures.

During active mining, groundwater entering the open pits will be continually pumped to the surface to create a suitable mining environment. Should pumping of groundwater cease after the mining has stopped, this groundwater could potentially rise to the surface and may discharge onto adjacent downslope areas which This could alter long-term hydrological and geomorphological processes in the area.

In addition, should roads, buildings, parking lots, and other infrastructure associated with hardened surfaces not be removed at decommissioning, these areas would continue to be associated with reduced infiltration rates and increased storm water runoff and potentially additional erosion and siltation. Bare and exposed soil associated with the mine pit and potentially from the WRD may also wash down sloped areas during rainfall events.

Any areas that are not successfully re-vegetated post mine closure could also generate dust thereby having long term impacts to surrounding vegetation and favouring recruitment of pioneer and alien invasive plant species.

There is also the risk that water and soil contamination could increase over time through long-term mine drainage associated with rising groundwater and runoff from the WRD area, where not closed and rehabilitated appropriately. Mine drainage would likely contain metal rich water which can be toxic to fauna and flora. Ongoing mine drainage associated with decommissioned mines is a common concern associated with the mining industry, and is often unavoidable and can decrease ecological integrity of an area if it is not adequately managed.

As such, the unmitigated significance in the decommissioning and closure phase is assessed to be **MEDIUM** but could be reduced to **LOW** if properly managed (Table 3-11).

Table 3-11 Indirect impacts to local and regional ecological processes

Description of Impact		
Type of Impact	Indirect	
Nature of Impact	Negative	
Phase	**Construction**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium)	Moderate change (Medium)
Duration	Medium-term (5 to 10 years)	Medium-term (5 to 10 years)
Extent	Local	Local
Consequence	Medium	Medium
Probability	Definite / Continuous	Definite / Continuous
Significance	**Medium -**	**Medium -**
Description of Impact		
Phases	**Operational**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Prominent change (High)	Prominent change (High)
Duration	Long-term (10 and 20 years	Long-term (10 and 20 years
Extent	Whole site	Whole site
Consequence	Medium	Medium
Probability	Definite / Continuous	Probable
Significance	**Medium -**	**Medium -**
Phases	**Decommissioning and Closure Phases**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium)	Moderate change (Medium)
Duration	Long-term (10 and 20 years	Long-term (10 and 20 years
Extent	Beyond site	Whole site
Consequence	Medium	Medium
Probability	Definite / Continuous	Possible / frequent
Significance	**Medium -**	**Low -**
Degree to which impact can be reversed	**Partially Reversible** - In terms of indirect impacts such as sedimentation, point source pollution and alien plant invasion which would take place during the construction phase, these impacts can be addressed to some degree through mitigation such as alien plant clearing, spill clean-up, silt fencing etc. However, if these impacts take place in areas that are largely intact, even with the mitigation measures implemented, pollution, erosion and alien plant invasion could result in a reduction in the condition of the affected vegetation communities.	
Degree to which impact may cause irreplaceable loss of resources	**Moderate** - Erosion and pollution impacts as well as alien plant invasion could reduce the ecological condition of vegetation communities surrounding the mine footprint. However, with strict and	

	comprehensive mitigation applied, the impact can be reduced to moderate.	
Degree to which impact can be avoided	**Moderate** – The very high SEI in the South East Block but outside of the proposed Jindal MIOP active mining areas can be avoided provided the no-go areas are clearly demarcated and controlled.	
Degree to which impact can be mitigated	**Moderate** - Mitigation such as strict enforcement of no-go areas, erosion and sediment control measures, pollution control and alien plant eradication can contribute to ensuring additional indirect impacts to vegetation communities beyond the mine's development footprint are minimised as far as practicably possible.	
Cumulative impact		
Nature of cumulative impacts	Reduced connectivity and ecological corridors as well as reduced capacity to deal with additional stressors could result in a higher level of sensitivity to any additional impacts and pressures such as the impacts associated with forestry as well as commercial and subsistence agriculture, grazing and human settlement. Cumulative impacts associated with the decommissioning phase include water, air, and soil pollution, increased runoff, erosion and siltation which could all be compounded by other anthropogenic activities All these disturbances would lead to higher levels of invasive alien plant cover and a reduction in floral and potentially faunal diversity.	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Medium	**Medium to Low**
Residual impact		
Residual impact discussion	**Low** - Residual impacts associated with the decommissioning phase could include water, air, and soil pollution, increased runoff, erosion and siltation which could all be compounded by other anthropogenic activities in the area (i.e. forestry, agriculture, residential and infrastructure development). All these disturbances would lead to higher levels of invasive alien plant cover and a reduction in floral and potentially faunal diversity. Under a good mitigation scenario alien plant control and monitoring of rehabilitation and potential impacts and addressing issues through adaptive management during the decommissioning phase can reduce the intensity of these impacts and the likelihood of these impacts occurring.	

Table 3-12 Management outcome, mitigation actions/measures and monitoring

Management outcome, mitigation actions/measures and monitoring	
Management objective	Minimise indirect impacts to local and regional ecological processes during all phases of the Jindal MIOP.
Mitigation actions/measures	
All Phases	
• See Table 3-2	
Monitoring	• See Table 3-2

4. FRESHWATER ECOLOGY

4.1 PHYSICAL LOSS OR MODIFICATION OF FRESHWATER HABITAT

4.1.1 Description of Impact

In order to develop the proposed Jindal MIOP there would be some encroachment into the freshwater systems which could result in either the physical loss of these systems or the modification which could change the way these systems' function. The most significant construction (mine development) phase impacts are likely to be the direct physical loss or modification of freshwater habitat at road crossing locations and in instances were infrastructure advances into delineated watercourses.

4.1.2 Source of Impact

The project activities/infrastructure likely to result in physical loss or modification of freshwater habitat:

Project phase	Activity/infrastructure
Construction	• Earthworks • Construction of road crossings
Operational	• Mining of the South East Pit and associated activities • Dumping of waste rock onto the WRD

4.1.3 Impact assessment

The construction/ establishment phase is assumed to consist of the following activities:

- Upgrading of existing road alignment;
- Construction of new road alignment;
- Construction of the primary crusher;
- Construction of incoming power yard;
- Construction of a single sewerage treatment plant (assumed to be located beyond any watercourses and associated buffers); and
- Construction of a single workshop facility (assumed to be located beyond any watercourses and associated buffers).

The most likely impact associated with the construction phase is associated with the infilling of watercourses and accidental direct physical modification to freshwater habitat during construction.

In order for the proposed Jindal MIOP to be constructed a new access road would be required. Under the proposed alignment there is an approximately 1.5km length of road leading to the processing plant that runs through 'virgin' land, and which would involve crossing two mountain streams (new road crossings) (SE-PU06-12 and SE-PU06-487). There is an additional approximately 250m length of proposed access road near the primary crusher that does not following an existing alignment, and which crosses a mountain stream (SE-PU6-11). Each of these watercourses is considered to be in fair ecological condition (C PES Category) and were rated as being of low overall Ecological Importance and Sensitivity (EIS). An approximately 800m length of road linking the mine pit and the WRD is also proposed. This access road will require new road crossings of two additional watercourses

(SE-Upper Foothill River-466 and SE-PU06-486). Depending on the road crossing design and level of mitigation during construction, it is possible that a loss of freshwater habitat could occur due to infilling at these locations.

The proposed power yard footprint coincides with the headwaters of a valley bottom wetland (SE-WET-PU04-6). This wetland is moderately modified (C PES Category) and was rated as being of moderate overall EIS. The process plant area intersects a seep wetland (SE-WET-PU01-23), two mountain headwater streams (SE-PU03-103 and SE-PU03-447), and a Mountain Stream (SE-PU06-487). Each of these watercourses are in fair ecological condition (C PES Category) and were rated as being of low overall EIS. Under the current mine infrastructure layout, the construction phase of the project would result in the permanent destruction or alteration of approximately 0.65ha of freshwater habitat. This includes 0.27ha of critically endangered wetland habitat (Figure 4-1).

Given that there are no plans to re-site infrastructure at this stage, the impact is direct and negative with the level of intensity expected to be high and of permanent duration both with and without the implementation of mitigation. As such there is limited additional mitigation that can be implemented to minimise the impacts, the impact is assessed to be **MEDIUM** and would remain **MEDIUM** (Table 4-1).

The operational phase is assumed to consist of the following activities:

- Extraction of material from the mine pit.
- Although the advancement and growth of the mine pit will be an ongoing operational process, the full extent of the proposed mine pit has been assessed.
- Accumulation of waste rock at the designated dump site.
- Although the accumulation of material in the waste rock dump will be an ongoing operational process, the full extent of the dump site has been assessed.
- Crushing, processing and storage of material extracted from the mine pit.

The direct and permanent loss of large areas of freshwater habitat would be unavoidable due to the operation and expansion of the open pit and WRD, which are necessary for the project to be commercially viable. The most likely cause of impacts during the operational phase would be due to accidental direct physical modification to river or stream habitat during maintenance and repair.

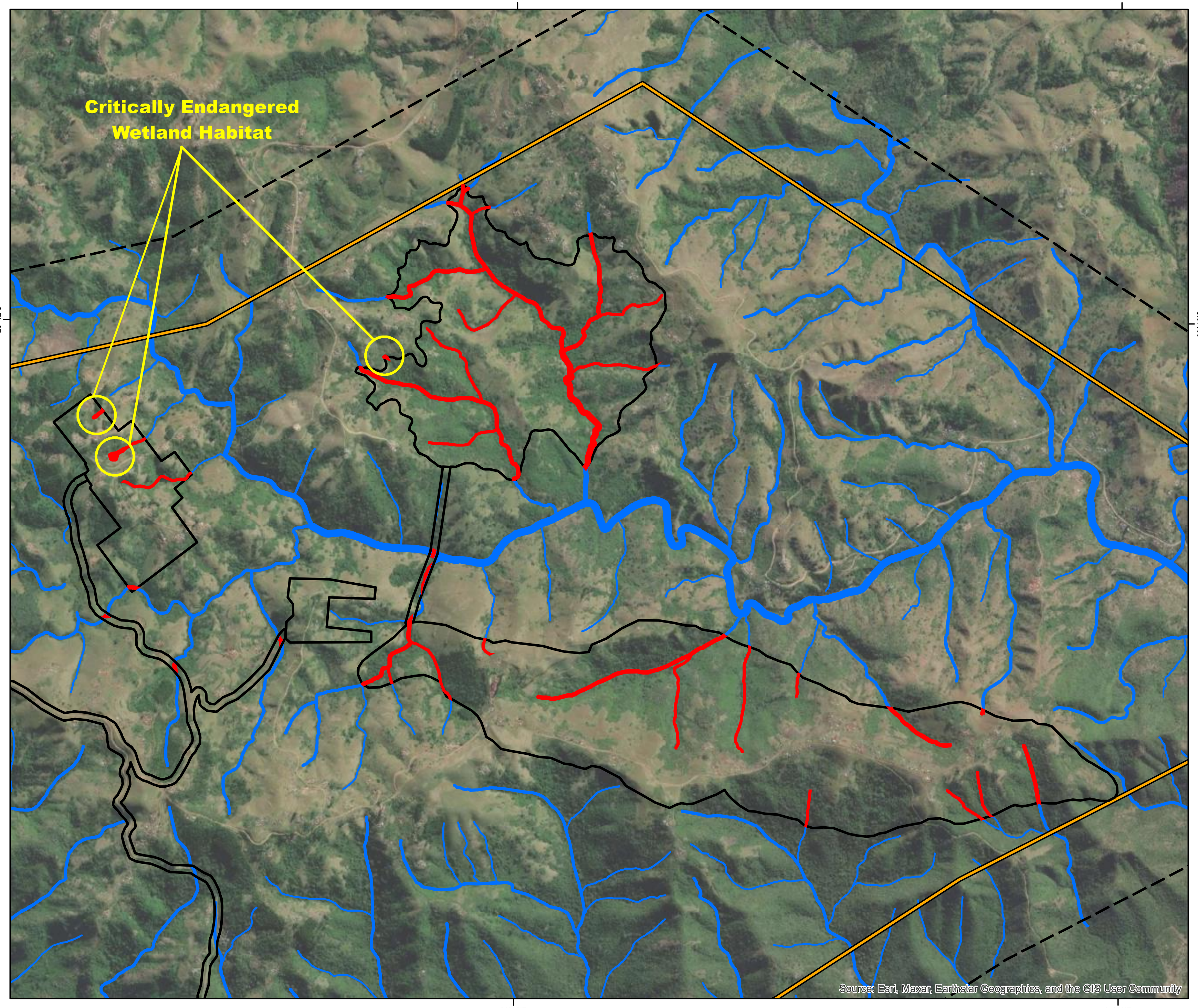
A total of 14 watercourses exist within the proposed footprint of the open pit. This includes nine mountain headwater streams and five mountain streams. These watercourses stand to be partially or completely modified as the pit advances. It is possible that additional watercourses in the vicinity of the mine pit would also be directly impacted as part of pit establishment and ongoing mining processes.

When at capacity, the WRD footprint intersects with a total of 14 watercourses. This includes six mountain headwater streams, six mountain streams, one transitional river, and one seep wetland. Each of these watercourses is at risk of incurring direct physical habitat loss or modifications of habitat as the WRD is established as mining progresses. Therefore, based on the mine plan, when the proposed mine pit and WRD have reached maximum capacity, the operational phase of the mine project would have resulted in the direct and permanent physical loss of 9.80ha of freshwater habitat by the time the full extent of the pit has been utilised. This includes 0.02ha of critically endangered wetland habitat.

During the mine operation phase additional areas of freshwater habitat could also be impacted by workers and machinery during watercourse crossing repair and maintenance, and through the potential movement of vehicles and people across the site that may cause habitat disturbance unless water resources are appropriately safeguarded.

In addition to the direct physical loss of wetland and riparian habitat, additional habitat losses of watercourse areas could occur due to the infilling or altering of recharge zones and catchment areas.

As the avoidance of direct impacts at the location of the proposed WRD and open pit are unavoidable for this project to be feasible, operational phase direct physical loss / modification of freshwater habitat impact significance has been assessed as being **HIGH** with and without the implementation of mitigation measures (Table 4-1). It is, however, essential that these measures be implemented to reduce additional impacts occurring.



Legend

- Proposed South Block Mining Right Area
- Proposed Mine Layout
- DWS 500m Regulated Area
- Delineated Watercourses
- Areas of Watercourse Habitat Loss

N

0 0.5 1
KM

Scale: 1:19 830 @ A3
Coordinate System: TM WG31
Projection: Transverse Mercator
Datum: Hartebeesthoek 1994

JINDAL IRON ORE (PTY) LTD

FIGURE 4-1
AREAS WHERE LOSS OF WATERCOURSE HABITAT AS SET TO TAKE PLACE

SLR

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Project No: 720.10023.00001	Prepared By: BG
Map Ref No: EIA 4-1	Date: 17/05/2023

720.10023.00001 EIA 4-1 Loss of Watercourse Habitat

Table 4-1 Physical loss or modification of freshwater habitat

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phase	**Construction and Decommissioning**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Prominent change (High)	Moderate change (Medium)
Duration	Permanent (> 20 years)	Permanent (> 20 years)
Extent	Site	Site
Consequence	Medium	Medium
Probability	Definite / Continuous	Definite / Continuous
Significance	**Medium -**	**Medium -**
Description of Impact		
Phases	**Operational**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Prominent change (High)	Prominent change (High)
Duration	Permanent (> 20 years)	Permanent (> 20 years)
Extent	Local	Local
Consequence	High	High
Probability	Definite / Continuous	Definite / Continuous
Significance	**High -**	**High -**

Degree to which impact can be reversed	**Irreversible/ partially reversable** – Once these systems have been altered the ability to reverse the impact is low.
Degree to which impact may cause irreplaceable loss of resources	**High** – The potential for irreplaceable loss is high.
Degree to which impact can be avoided	**Low** – Due to the extent of the proposed project the potential for avoiding the impact is very low.
Degree to which impact can be mitigated	**Low** – The mitigation options are limited.
Cumulative impact	
Nature of cumulative impacts	Given the largely rural and isolated nature of the study area existing direct physical impacts to watercourses caused by people who live in the area are largely limited to the use of most wetlands for subsistence agriculture, the removal of indigenous tree species from river and stream riparian zones, and road crossings. As the area becomes more populated over time it is likely that the extent of these impacts would increase, but to a negligible degree. Additionally, the Goedertrouw Dam, built in the early 1980s, has inundated an approximately 11km long reach of the Mhlatuze River system and the lower reaches of several mountain and mountain headwater streams. The currently proposed mining project would result in a further permanent loss of 10.43ha of freshwater habitat, including a total of 0.3ha of critically endangered wetland.

Rating of cumulative impacts	Without Mitigation	With Mitigation
	High -	High -
Residual impact		
Residual impact discussion	**High** – The residual impact is considered to be high.	

Table 4-2 Management outcome, mitigation actions/measures and monitoring

Management outcome, mitigation actions/measures and monitoring	
Management objective	To minimise the physical loss or modification of freshwater habitat during all phases of the Jindal MIOP.
Mitigation actions/measures	
Construction and Decommissioning Phases	

- General Mitigation:
  - Avoid delineated wetlands and riparian areas during layout planning for mine infrastructure and stockpile areas. This should be done through the consideration of the watercourse delineations provided as part of this assessment. It would, however, be ideal for a wetland and aquatic ecologist to do more detailed watercourse delineation sampling at locations of proposed encroachment to increase delineation accuracy at those locations.
  - Limit the number of required road crossings as far as practically possible.
  - Utilise best practice design principles at all road crossing locations where crossings of watercourses are unavoidable.
  - Undertake the construction of any road or pipeline crossings of perennial rivers/wetland during low flows (winter season).
  - Limit instream habitat disturbance during crossing construction phase. This can be achieved through the implementation of the No-go area demarcation recommendations provided in Section 7.6.1 of this report.
  - Implement post-construction wetland and river rehabilitation strategy as and where necessary.
  - Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible.

- 'No-Go' Areas During Construction.
  - All watercourses must be considered no-go areas for the duration of the construction process.
  - Construction staff and machine operators must be informed of the location of all watercourses in the vicinity of the construction site.
  - No areas outside the construction footprint may be cleared and stripped of vegetation. To this end the outer edges of construction sites must be demarcated using a high visibility barrier / fencing. The demarcation must be signed off by the project ECO.
  - Access to and from construction areas should, as far as practically possible, be via existing roads.
  - All disturbed areas beyond the demarcated construction area that are intentionally or accidentally disturbed must be immediately rehabilitated to the satisfaction of the ECO.

- Runoff, Erosion, and Sediment Control
  - Wherever possible, existing vegetation cover at the site should be maintained during the construction phase. The unnecessary removal of groundcover from slopes must be prevented, especially on steep slopes.
  - Where possible construction roads should be aligned along contours rather than downslopes to avoid these features generating excessive sediment laden runoff.

Management outcome, mitigation actions/measures and monitoring

• All bare slopes and surfaces to be exposed to the elements during clearing and earthworks must be protected against erosion using rows of hay-bales, sandbags and/or silt fences aligned along the contours and spaced at regular intervals to break the energy of surface flows.
• The use of hay-bale berms, sandbags and/or silt fences is particularly important in areas where surface runoff is concentrated (e.g.: rills, road stormwater discharge points etc.).
• Once shaped, all exposed/bare surfaces and embankments must be re-vegetated immediately.
• If re-vegetation of exposed surfaces cannot be established immediately due to construction phasing issues, temporary erosion and sediment control measures must be maintained until such a time that re-vegetation can commence.
• All temporary erosion and sediment control measures must be monitored for the duration of the construction phase and repaired immediately when damaged. All temporary erosion and sediment control structures must only be removed once vegetation cover has successfully recolonised and covered the affected areas.
• After heavy rainfall events, site checks must be conducted for erosion damage and rehabilitate this damage immediately. Erosion rills and gullies must be filled-in with appropriate material and / or silt fences until vegetation has re-colonised the rehabilitated area.
 	
• Hazardous Substances / Materials Management
  • The proper storage and handling of hazardous substances (e.g., fuel, oil, cement, etc.) needs to be administered.
  • Mixing and / or decanting of all chemicals and hazardous substances must take place on an impermeable surface and must be protected from the ingress and egress of stormwater.
  • Drip trays should be utilised at all fuel dispensing areas and whenever refuelling is carried out, including when portable re-fuelling systems are used.
  • No refuelling, servicing or chemical storage should occur near any watercourse. In this regard watercourse buffer zones should be adhered to.
  • Hazardous substance storage and refuelling areas must be bunded prior to their use on site during the construction period. Bund walls should be high enough to contain at least 110% of any stored volume. The surface of the bunded area should be graded downwards to the centre so that spillage may be collected and satisfactorily disposed of.
  • An emergency spill response procedure must be formulated for the site, and staff are to be trained in spill response.
  • All necessary equipment for dealing with spills of fuels / chemicals must be available at the site.
  • Spills must be cleaned up immediately and contaminated soil / material disposed of appropriately at a registered site.
  • Drums must be kept on site to collect contaminated soil. These should be disposed of at a registered waste site.
  • Contaminated water containing fuel, oil or other hazardous substances must never be released into the environment. It must be disposed of at an appropriately registered site.
  • Vehicle maintenance should not take place on site unless a specific bunded area with a roof covering is constructed for such a purpose.
 	
• Noise & Dust Pollution Minimisation
  • Temporary noise pollution due to construction works should be minimized where possible.
  • Water trucks will be required to suppress dust.
 	
• Landscaping Recommendations

Management outcome, mitigation actions/measures and monitoring
- It is recommended that landscaping promote the use of indigenous species common to the region and that as much natural ground cover as possible is established on the site to help with binding soils and encouraging rainfall and stormwater runoff infiltration. • Alien Plant Monitoring and Control - In line with the requirements of Section 2(2) and Section 3 (2) the National Environmental Management: Biodiversity Act (NEM:BA), which obligates the landowner/developer to control invasive alien plants (IAPs) on his property, all IAPs within the development property must be controlled on an on-going basis. In terms of section 75 of NEMBA, the following applies to the control & eradication of invasive species: - The control and eradication of a listed invasive species must be carried out by means of methods that are appropriate for the species concerned and the environment in which it occurs. - Any action taken to control a listed invasive species must be executed with caution and in a manner that may cause the least possible harm to biodiversity and damage to the environment. - The methods employed to control and eradicate a listed invasive species must also be directed at the offspring, propagating material, and re-growth of such invasive species in order to prevent such species from producing offspring, forming seed, regenerating or re-establishing itself in any manner. - It is recommended that bi-annual alien plant clearing be undertaken by the mine operator throughout construction. Thereafter, alien plant clearing should be undertaken annually.
Operational Phase
• Storm Water Management - Storm water infrastructure will require regular on-going maintenance to ensure optimal functioning. At a minimum this should include silt and debris/litter removal from catch pits, filtration devices and attenuation ponds, and maintenance and repair of stormwater outlets to ensure the optimal functioning of such systems. • Alien Plant Monitoring and Control - In line with the requirements of Section 2(2) and Section 3 (2) the NEM:BA, which obligates the landowner/developer to control invasive alien plants (IAPs) on his property, all IAPs within the development property must be controlled on an on-going basis. In terms of section 75 of NEMBA, the following applies to the control & eradication of invasive species: - The control and eradication of a listed invasive species must be carried out by means of methods that are appropriate for the species concerned and the environment in which it occurs. - Any action taken to control a listed invasive species must be executed with caution and in a manner that may cause the least possible harm to biodiversity and damage to the environment. - The methods employed to control and eradicate a listed invasive species must also be directed at the offspring, propagating material, and re-growth of such invasive species in order to prevent such species from producing offspring, forming seed, regenerating or re-establishing itself in any manner. - It is recommended that bi-annual alien plant clearing be undertaken by the mine operator throughout construction. Thereafter, alien plant clearing should be undertaken annually. • Contingency Plan for Freshwater Ecosystems - An environmental contingency plan for freshwater ecosystems should be included in the Operational EMPr for the development. This plan should assist in the identification of abnormal/unforeseen environmental incidents and provide guidance for action in the event of an environmental emergency. The contingency plan should provide a framework of organisational responsibility and actions to be taken in the event of an incident. The plan should identify key personnel and their responsibilities in terms of preparing for abnormal incidents/events and identifying and responding to incidents including reporting on emergencies, and implementing measures to contain and mitigate impacts to aquatic ecosystems.

Management outcome, mitigation actions/measures and monitoring	
Monitoring	• Develop a detailed freshwater ecosystem monitoring plan. This should involve at least monthly water quality monitoring and bi-annual aquatic biomonitoring of water resource units (rivers/streams) in the vicinity of the development. This should also include regular (daily or weekly) basic visual inspections by the ECO and support staff, documenting issues such as: • Invasive Alien Plant infestation. • Scouring and deposition associated with storm water runoff. • Development of erosion head cuts. • Channel incision downstream of development. • Blockage/siltation of culverts/pipes/side drains. • Scouring at the location of stormwater outlets. • Erosion or instability of road embankments. • The results of the surface water quality and aquatic biomonitoring assessments must be used to inform further management actions, remedial measures and/or the revision of mitigation strategies aimed at protecting watercourses in the study area and downstream from water quality impacts associated with the development.

4.2 ALTERATION OF HYDROLOGICAL AND GEOMORPHOLOGICAL PROCESSES

4.2.1 Description of Impact

The alteration of hydrological and geomorphological processes means that a physical change could occur within the freshwater systems thereby altering their natural functionality, this is largely due to an increase in sediment supply to watercourses associated with earthworks taking place within and near watercourses. This can result in a temporary alteration of natural water distribution patterns.

4.2.2 Source of Impact

The project activities/infrastructure likely to result in alteration of hydrological and geomorphological processes:

Project phase	Activity/infrastructure
Construction	• Earthworks • Construction of road crossings
Operational	• Mining of the South East Pit and associated activities • Dumping of waste rock onto the WRD

4.2.3 Impact Assessment

Where mining related infrastructure traverses' watercourses (i.e. road crossings: damming; obstruction; redirection and / or canalisation of a watercourse) could lead to the alteration of flows and natural channel processes. Potential impacts may include altered flow seasonality, bed and bank erosion, and the inundation of habitat. Vegetation removal and earthworks associated with the establishment of onsite infrastructure would also reduce basal vegetation cover at the site which could result in the reduction of rainfall infiltration rates, thus increasing the volume of surface stormwater runoff being delivered to onsite watercourses. The removal of soil from the site would also limit the 'soil water store' potential of the area, contributing to increased runoff volumes. The additional flows within wetlands and rivers could trigger erosional processes. Bulk earthworks would also disturb and expose notable areas of bare soil that are likely to then be mobilised by wind and water during storm events. This could result in sediment frequently being delivered to watercourses in higher than natural volumes. Although the above-mentioned impacts would be temporary due to the short-term nature of the construction period, the size of the site and expected scale of bulk earthworks means that runoff and sediment related impacts to onsite watercourses is a likely outcome during the construction phase.

Where high runoff volumes incite isolated erosion along watercourses near construction sites, and large volumes of sediment are regularly deposited into nearby watercourses following storms, the construction phase hydrological and geomorphological impact is assessed as **MEDIUM**. However, with the implementation of mitigation measures the probability of occurrence can be reduced to 'probable' and the extent reduced to being site specific, as such the significance of the impact could be reduced to **LOW** (Table 4-3).

Hardened surfaces associated with the power yard, processing plant, and other infrastructure will reduce infiltration rates in the catchments of watercourses, which could lead to increased runoff reaching downslope watercourses. Additionally, the operation of the open pit would likely expose notable areas of bare earth and bedrock to surface weather elements. As the exposed bedrock has minimal rainfall infiltration potential, it is expected that runoff volumes from the open pit and WRD will increase as mining advances (increase in impermeable surface area as the mine grows). If this stormwater is not effectively managed it can cause both dryland and watercourse erosion, which has implications for the ecological condition of watercourses downslope of planned infrastructure. Reduced infiltration across the site could result in erosion along nearby watercourses within the study area. Erosion and associated sedimentation of watercourses poses a great risk to the geomorphological / functional integrity of wetlands, rivers and streams and can also affect system hydrology. For example, the excessive deposition of sediment within wetlands and riparian areas can result in the alteration of flow paths and channel gradients. Regular excessive sedimentation along water courses can also lead to the siltation of in-stream habitats. The discharge of treated effluent from the required sewage treatment plant would alter flow along the receiving watercourse, assumed to be a mountain headwater stream. This would alter the natural flow regime of the watercourse and could instigate erosion without proper design and planning. The open pit and WRD also have the potential to interrupt the recharge areas of wetlands located lower than these features in the hydrological profile, effectively de-watering them. This would result in the complete or partial loss of the functional processes of such wetlands. The same could be true of rivers, where catchments are removed by mining, leading to the complete loss of downstream riverine habitat.

Most notable, however, is that the WRD would fill in several watercourses, permanently altering the natural hydrological and geomorphological characteristics of these units. The WRD would likely impede and alter flow entering the dump area from the upstream watercourse network. This would alter the flow and sediment input characteristics of the reach of SE-Upper Foothill River-466 located downstream of the proposed WRD. This could permanently alter the seasonality and habitat characteristics of the full length of this watercourse.

Where high flow volumes incite erosion along watercourses, and large volumes of sediment are regularly deposited into nearby watercourses, the 32 watercourses in the proposed WRD footprint would have their hydrological and geomorphological characteristics permanently altered. In addition, where the seasonality and habitat characteristics of SE-Upper Foothill River-466 are notably altered. As such, the impact significance has been assessed as being **HIGH** prior to mitigation. However, with the implementation of mitigation measures the extent and the consequence can be reduced and as such the overall significance can be reduced to **MEDIUM** (Table 4-3).

Table 4-3 Alteration of hydrological and geomorphological processes

Description of Impact		
Type of Impact	Indirect	
Nature of Impact	Negative	
Phase	**Construction and Decommissioning**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium)	Moderate change (Medium)
Duration	Medium-term (5 to 10 years)	Short-term (1 to 5 years)
Extent	Local	Site
Consequence	Medium	Low
Probability	Definite / Continuous	Probable
Significance	**Medium -**	**Low**
Description of Impact		
Phases	**Operational**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium)	Moderate change (Medium)

Duration	Permanent (> 20 years)	Permanent (> 20 years)
Extent	Regional	Local
Consequence	High	Medium
Probability	Definite / Continuous	Definite / Continuous
Significance	**High -**	**Medium -**
Degree to which impact can be reversed	**Irreversible** - Should significant impacts be experienced the impacts would be largely irreversible.	
Degree to which impact may cause irreplaceable loss of resources	**High** - 32 watercourses in the footprint of the WRD would be lost.	
Degree to which impact can be avoided	**Low** - 32 watercourses in the footprint of the WRD would be lost, this would not easily be avoided.	
Degree to which impact can be mitigated	**Low** – the potential for mitigation is low.	
Cumulative impact		
Nature of cumulative impacts	The generally low settlement density associated with the study area means that there are limited major alterations to catchment runoff patterns and processes. There would, however, be at least a minor increase in sediment delivery volumes to watercourses, and slight alteration to flood peaks, especially in the more densely settled areas of the South Block. These impacts are, however, expected to have a minimal overall impact of the hydrological and geomorphological functioning of most onsite watercourses. local populations in the study area are likely to utilize water from seasonally and perennially flowing watercourses for domestic use. Overall abstraction volumes are, however, not expected to have a notable affect on these systems or those downstream. Future impacts to geomorphological and hydrological functioning of onsite watercourses due to the rural habitation of the area are not expected to be significant. The Goedertrouw Dam has altered natural flow and sediment distribution regimes for the inundated reach of the Mhlatuze system, as well as river reaches downstream of the dam (DWS, 2022). In addition to the above mentioned existing impacts, the mining project would be a major activity potentially affecting hydrological and geomorphological integrity of local water resources. Therefore, cumulatively, impact significance was assessed as being 'High'. It would, however, be possible to limit the extent of hydrological and geomorphological impacts to the region through appropriate layout planning and operational mitigation measures. The impact significance has therefore been reduced to 'Medium) in a 'good' mitigation scenario (all mitigation measures provided below are implemented).	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	High -	**Medium -**
Residual impact		
Residual impact discussion	**Medium** – The residual impact is assessed to be medium.	

Table 4-4 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	To minimise the alteration of hydrological and geomorphological processes during all phases of the Jindal MIOP.
Mitigation actions/measures	
All Phases	
• See Table 4-2	
Monitoring	• See Table 4-2

4.3 IMPACTS TO WETLANDS AND AQUATIC ECOSYSTEMS DUE TO REDUCED WATER QUALITY

4.3.1 Description of Impact

There are several sources in all project phases that have the potential to pollute surface water, particularly in the unmitigated scenario. In the construction and decommissioning phases these potential pollution sources are temporary and diffuse in nature. Although these sources may be temporary, the potential pollution may be long-term. The operational phase would present the longer-term potential pollution sources.

4.3.2 Source of Impact

The project activities/infrastructure likely to result in impacts to wetlands and aquatic ecosystems due to reduced water quality:

Project phase	Activity/infrastructure
Construction	• Earthworks • Accidental leaks and spills of pollutants • Construction of road crossings
Operational	• Mining of the South East Pit and associated activities • Dumping of waste rock onto the WRD

4.3.3 Impact Assessment

It is anticipated that water quality impacts during construction would be limited to potential elevated sediment delivery (and associated turbidity) to watercourses and potential pollution related to accidental spillages/ leakages of fuels and chemicals during construction activities. If poorly managed, construction phase impacts to water quality could be of **MEDIUM** significance where large sediment plumes and / or hazardous substance spills are not effectively mitigated. Mitigation measures relating to the runoff, erosion, sediment and hazardous substance control during the construction and decommissioning phases would likely reduce the extent and probability of water quality impacts to a **LOW** significance (Table 4-5).

Most mining operations share similar sets of activities, processes, or products that generate contaminants which can potentially enter freshwater environments as surface runoff or via subsurface water movement. Notable potential operational phase sources of pollutants associated with the mining project which could alter surface water quality include:

- Exposure of bare soils;
- Spillage of hydrocarbon fuels and other chemicals;
- Surface runoff from overburden stockpiles and WRDs;
- Iron ore dust reaching watercourses;
- PCD overflow/ failure during extreme events;
- Solid waste pollution (including litter);
- Discharge of effluent from the sewage treatment infrastructure;
- Leakages from sewage treatment and reticulation infrastructure;

- Runoff of partially treated sewage water being re-used for mine operation purposes; and
- Altered watercourse flow regimes and associated turbidity / sedimentation.

Contaminated runoff and the discharge of polluted water has the potential to negatively impact aquatic faunal and floral species that are sensitive to changes in water quality (especially from toxicant inputs). The impact on the receiving freshwater environment will depend on the volume of water being discharged, the severity of water contamination and the degree to which dilution takes place in the receiving water resource.

AMD is the most widely recognised water pollution problem resulting from mining activities. Iron ore mines are known to be associated with the AMD phenomenon due to the presence of iron-sulphide chemical compounds. However, according to the geochemical waste assessment (Appendix V) undertaken on the waste rock the potential for AMD is considered to be low for the Jindal MIOP.

Where impacts and risks are poorly managed the impact due to reduced water quality is assessed to be of **HIGH** significance. However, where best practical mitigation is implemented this can potentially be reduced to a **MEDIUM** significance (Table 4-5).

Table 4-5 Impacts to wetland and aquatic ecosystems due to reduced water quality

Description of Impact		
Type of Impact	Indirect	
Nature of Impact	Negative	
Phase	**Construction**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Prominent change (High)	Prominent change (High)
Duration	Short term (1 and 5 years)	Short term (1 and 5 years)
Extent	Local	Site
Consequence	Medium	Low
Probability	Definite / Continuous	Probable
Significance	**Medium -**	**Low -**
Description of Impact		
Phases	**Operational**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Prominent change (High)	Prominent change (High)
Duration	Long term (10 and 20 years)	Long term (10 and 20 years)
Extent	Regional	Local
Consequence	High	Medium
Probability	Definite / Continuous	Probable
Significance	**High -**	**Medium -**
Phases	**Decommissioning and Closure Phases**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Prominent change (High)	Prominent change (High)
Duration	Short term (1 and 5 years)	Short term (1 and 5 years)
Extent	Local	Site

Consequence	Medium	Low
Probability	Definite / Continuous	Probable
Significance	**Medium -**	**Low -**
Degree to which impact can be reversed	**Partially reversible** – Overtime some of the wetland areas are likely to recover.	
Degree to which impact may cause irreplaceable loss of resources	**Medium** – Irreplaceable loss could occur, particularly if long term pollutants are impacting on the critical biodiversity areas.	
Degree to which impact can be avoided	**Low** – Due to the placement of infrastructure avoidance is unlikely.	
Degree to which impact can be mitigated	**Medium** – The chance of contaminants entering the freshwater systems can be mitigated to some extent.	
Cumulative impact		
Nature of cumulative impacts	Existing impacts to the water quality of watercourses in the South Block study area are generally limited as indicated by the outcomes of the water quality analysis, the aquatic macroinvertebrate assessment, and the fish survey. As the population of the area expands into the future additional sources of water quality pollutants could emerge. The overall significance of these impacts is, however, expected to remain low given the rural nature of the area. The proposed mine operation will, however, represent the most significant threat to local and regional water quality along watercourses. Therefore, where impacts and risks are poorly managed, this impact could be of 'High' significance. Where best practical mitigation is implemented, this can be potentially reduced to a 'Medium' level.	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	High -	**Medium -**
Residual impact		
Residual impact discussion	**Medium** – The residual impact is assessed to be medium.	

Table 4-6 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	To minimise the impacts to wetland and aquatic ecosystems due to reduced water quality during all phases of the Jindal MIOP.
Mitigation actions/measures	
All Phases	
• See Table 4-2	
Operational Phase	
• The potential for this mine to generate AMD must be additionally assessed once operations start and more waste rock becomes available. • As a general principle, clean and dirty/polluted water must be kept separate. This can be achieved through designing a closed stormwater management system for dirty/polluted catchments. • Sewer treatment plant design and operation to meet relevant discharge standards with compliance monitoring.	

Management Outcome, Mitigation Actions/Measures and Monitoring	
• The design of the sewage treatment plant must allow for any large variations in flow and organic loading, both on a diurnal and seasonal basis, that are typically experienced by small treatment plants serving small groups of people (Gaydon et al., 2007). Some form of flow balancing may be necessary to deal with these variations (often accomplished by incorporating an enlarged septic tank ahead of the biological treatment stage). • The location of run-of-mine (ROM) and tailings stockpiles, and retention dams should be carefully evaluated regarding the likelihood of pollution of water resources because of drainage and/or seepage into downstream areas. Site-specific mitigation measures must then be put in place to reduce risks. • PCDs must be designed to capture all dirty water runoff from the mine, including the discard dumps and stockpile areas and must be designed to contain at least a 1: 100-year rainfall event. • Monthly inspections and maintenance of PCDs, stockpiles and mine discard dumps will be required to reduce the risk of failure and contamination. • Address potential erosion and sedimentation risks on site through the implementation of Best Management Practices (BMPs) in erosion and sediment control. • Address potential spill and pollution risks on site through the implementation of BMPs in spill and pollution control and hazardous substances management. • Wherever possible, treated water should be reused in the mining process.	
Monitoring	• See Table 4-2 • A suitably qualified aquatic specialist should be appointed to develop and initiate a water quality and aquatic bio-monitoring programme for the site to include wetlands and rivers/streams immediately adjacent to and/or downstream of mining operations. Water quality samples should ideally be collected at strategic locations monthly with aquatic biomonitoring taking place at least bi-annually.

4.4 IMPACTS TO ECOLOGICAL CONNECTIVITY AND/OR ECOLOGICAL DISTURBANCE IMPACTS

4.4.1 Description of Impact

The presence of workers and heavy machinery in the general vicinity of onsite watercourses is likely to create noise, vibrations and dust which has the potential to temporarily disturb and displace fauna that make use of these watercourse corridors for movement and refuge. Such faunal species are likely to include amphibians, reptiles, birds, and small mammals.

4.4.2 Source of Impact

The project activities/infrastructure likely to result in impacts to ecological connectivity and/or ecological disturbance impacts:

Project phase	Activity/infrastructure
Construction	• Earthworks • Construction of road crossings
Operational	• Mining of the South East Pit and associated activities • Dumping of waste rock onto the WRD

4.4.3 Impact Assessment

During construction the presence of workers and heavy machinery onsite is likely to create noise, vibrations and dust which have the potential to disturb and displace fauna associated with the watercourses in the vicinity. Where construction activities within watercourses require a dry working area, rivers may be temporarily impounded, or flow diverted (such as during road crossing construction and upgrades). This will have a temporary impact on the movement of aquatic biota and would affect the connectivity between river reaches.

Where impacts and risks are poorly managed, this impact could be of a **MODERATE-LOW** significance. Guidance around 'no-go' areas during construction should be followed to avoid unnecessary ecological disturbance as well as the implementation of other mitigation measures aimed at minimising the impact of noise and dust. Implementing these measures will reduce the extent to site and probability of ecological disturbance impacts to probable and thus the overall significance can be reduced to **LOW** (Table 4-7). Similar impacts are expected during the decommissioning phase.

Road crossings and infilled or heavily modified watercourse reaches (i.e., mined out reaches or reaches filled with waste rock deposits) will present a barrier to invertebrate and fish movement. This is likely to have the most significant impact on perennial watercourses such as the SE-Transitional River-470, SE-Transitional River-469, and SE-Upper Foothill River-466, which all fall within the current WRD footprint. The South African Scoring System (SASS5) and fish surveys conducted along SE-Transitional River-470 and SE-Upper Foothill River-466 indicate that these systems host diverse aquatic fauna, many of which are known to be sensitive to water quality and flow alterations. Notable impacts to fish species may include the fragmentation of breeding/spawning areas with a potential long-term detrimental effect on fish feeding, spawning and reproduction cycles and the isolation of fish populations, potentially reducing genetic variability and the resilience of populations to environmental change. Notably the vulnerable *Enteromius gurneyi* was noted along SE-Transitional River-470, while the endangered *Marcusenius caudisquamatus* was noted along SE-Upper Foothill River-466.

The presence of workers and machinery, and the need for blasting during mining will create long-term ecological noise and vibration disturbances that could impact on amphibians, reptiles, birds, and small mammals that use watercourse corridors for refuge. The temporary diversion and/or impoundment of flows to create a 'dry' working area during road crossing repairs could temporarily impact habitat connectivity. The disturbance of natural areas by mining-related activities can lead to optimal conditions for alien invasive plants to invade these areas. The establishment of alien and invasive plant species in natural areas may be caused by the following mining-related activities: vegetation clearing and disturbance, establishment of access/haul roads, tipper trucks are implicated in the dispersal of propagules to newly mined areas, incorrect rehabilitation and remediation methods, soil erosion linked with mining disturbance, and dumping/litter. Invasive alien plants can rapidly transform natural areas, displacing indigenous flora and fauna. In addition, certain alien plants exacerbate soil erosion whilst others contribute to a reduction in stream flows.

Without mitigation operational phase ecological disturbances are rated as being of **MEDIUM** significance. This rating is based on the potential impacts on fish and other aquatic faunal assemblages through habitat fragmentation along SE-Transitional River-470, SE-Transitional River-469, and SE-Upper Foothill River-466 by the WRD. It is also based on the potential for water quality impacts emanating from the operation of the mine to advance downstream, affecting faunal assemblages for a long distance (>10km) downstream of the study area. Whilst habitat fragmentation by the WRD, and noise disturbance during mining are unavoidable under the current layout, where best practical mitigation is implemented regarding water pollution control and minimizing other ecological disturbances, the extent can be reduced to be site specific and the consequence reduced to low, therefore the overall significance with mitigation measures implemented would be assumed to be **LOW** (Table 4-7).

Table 4-7 Impacts to ecological connectivity and/ or ecological disturbance impacts

Description of Impact		
Type of Impact	Indirect	
Nature of Impact	Negative	
Phase	**Construction**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium)	Moderate change (Medium)
Duration	Short-term (1 and 5 years)	Short-term (1 and 5 years)
Extent	Local	Site
Consequence	Low	Low
Probability	Definite / Continuous	Probable
Significance	**Moderate-Low -**	**Low -**
Description of Impact		
Phases	**Operational**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium)	Moderate change (Medium)
Duration	Long-term (10 and 20 years)	Long-term (10 and 20 years)
Extent	Regional	Site
Consequence	Medium	Low
Probability	Definite / Continuous	Definite / Continuous

Significance	Medium -	Low -
Phases	**Decommissioning and Closure Phases**	
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate change (Medium)	Moderate change (Medium)
Duration	Short-term (1 and 5 years)	Short-term (1 and 5 years)
Extent	Local	Site
Consequence	Low	Low
Probability	Definite / Continuous	Probable
Significance	Moderate-Low -	Low -
Degree to which impact can be reversed	**Fully reversable** - Once impacts no longer occur the watercourses would likely recover to pre mining levels.	
Degree to which impact may cause irreplaceable loss of resources	**Low** - The fauna are mobile and should the impact cease or diminish in time the fauna would likely reinhabit the area.	
Degree to which impact can be avoided	**Low** - Limiting impacts by implementing mitigation measures can significantly reduce the impacts but would be unlikely to eliminate it completely.	
Degree to which impact can be mitigated	**Medium** - Even with mitigation measures implemented there would likely still be some level of impact on the local fauna.	
Cumulative impact		
Nature of cumulative impacts	The settlement of the area by humans, with the rural settlements expanding over time, exists as an ecological disturbance for fauna that make use of watercourses and riparian corridors for movement and refuge. The connectively of semi – to largely intact watercourses and riparian zones across the study area is currently, however, good, meaning that aquatic and terrestrial fauna should be able to freely move and reside within the area under current and future settlement conditions. The proposed mine would be the most notable activity in the area responsible for creating ecological noise and vibration disturbances that could impact on amphibians, reptiles, birds, and small mammals that use watercourse corridors for refuge. Where best practical mitigation is implemented regarding water pollution control and minimizing other ecological disturbances this can be managed to a 'Low' significance level.	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Medium -	Low -
Residual impact		
Residual impact discussion	**Low** – The residual impact is assessed to be low.	

Table 4-8 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	To minimise the impacts to ecological connectivity and/or ecological disturbance during all phases of the Jindal MIOP.

Management Outcome, Mitigation Actions/Measures and Monitoring	
Mitigation actions/measures	
All Phases	
• See Table 4-2	
All Phases	
• See Table 4-2 • Avoid delineated wetlands and riparian areas during layout planning for mine infrastructure and stockpile areas. • Avoid delineated wetlands and riparian areas during mining, including the dumping of overburden and placement of stockpiles. • Restrict worker and machinery access to areas outside of sensitive environments. • Prohibit poaching or collection of plants and biota. • Remove temporary diversions and impoundments once repair/maintenance work is complete. • Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible.	
Monitoring	• See Table 4-2

5. AIR QUALITY

5.1 IMPACT ON AMBIENT AIR QUALITY

5.1.1 Description of Impact

There are a number of sources and activities in the area that contribute to the existing baseline air quality, these include:

- Agricultural activities: the majority of the commercial farms in the region produce sugarcane, timber and citrus. Land clearing and ploughing in preparation of fields for sowing can generate a significant amount of dust, in addition to agricultural vehicle movements. Seasonal sugarcane burning results in products of combustion, with pollutants of concern including particulate matter (PM) as well as carbon monoxide (CO) and nitrogen dioxide (NO_2) emissions.
- Biomass burning: biomass burning is considered as the incomplete combustion of natural plant matter with PM, CO, and NO_2 being emitted during the process. Crop residue burning and wildfires represent significant sources of combustion-related emissions associated with agricultural areas.
- Domestic fuel burning: the rural households within the vicinity of the site are anticipated to rely on wood burning for space heating and cooking purposes. Emissions from these activities are expected to have an impact on air quality. More so during the winter months due to the increased demand for space heating.
- Unpaved roads and exposed areas: the quantity of dust emissions from unpaved roads vary based on the volume of traffic. Dust is generated by the loosened material lifted from the road surface by turbulent air currents created when the vehicle is moving. Given the rural nature of the Project site, dust generated by vehicles on unpaved roads is likely to be a source of PM, however, it is expected to be limited due to low traffic volumes. The greatest impacts are expected to be limited to the areas immediately adjacent to the roads (within 200m).
- Vehicle emissions: Given the low population density residing in the region it is anticipated that vehicle exhaust emissions will be limited and therefore relatively insignificant. The nearest major road is the R34 which is located to the north and east of the Project site. The R34 is a long provincial route that connects Vryburg with Richards Bay via Kroonstad and Newcastle.

The Jindal MIOP site is located in an area that is currently inhabited and nearby sensitive receptors (SRs) have been identified and are presented inFigure 5-1. A 500 m buffer was placed around each of the key working areas of the proposed Jindal MIOP, it is, however, assumed that sensitive receptors within this boundary would likely need to be moved for safety reasons and therefore no one would be located within this zone during the operations phase.

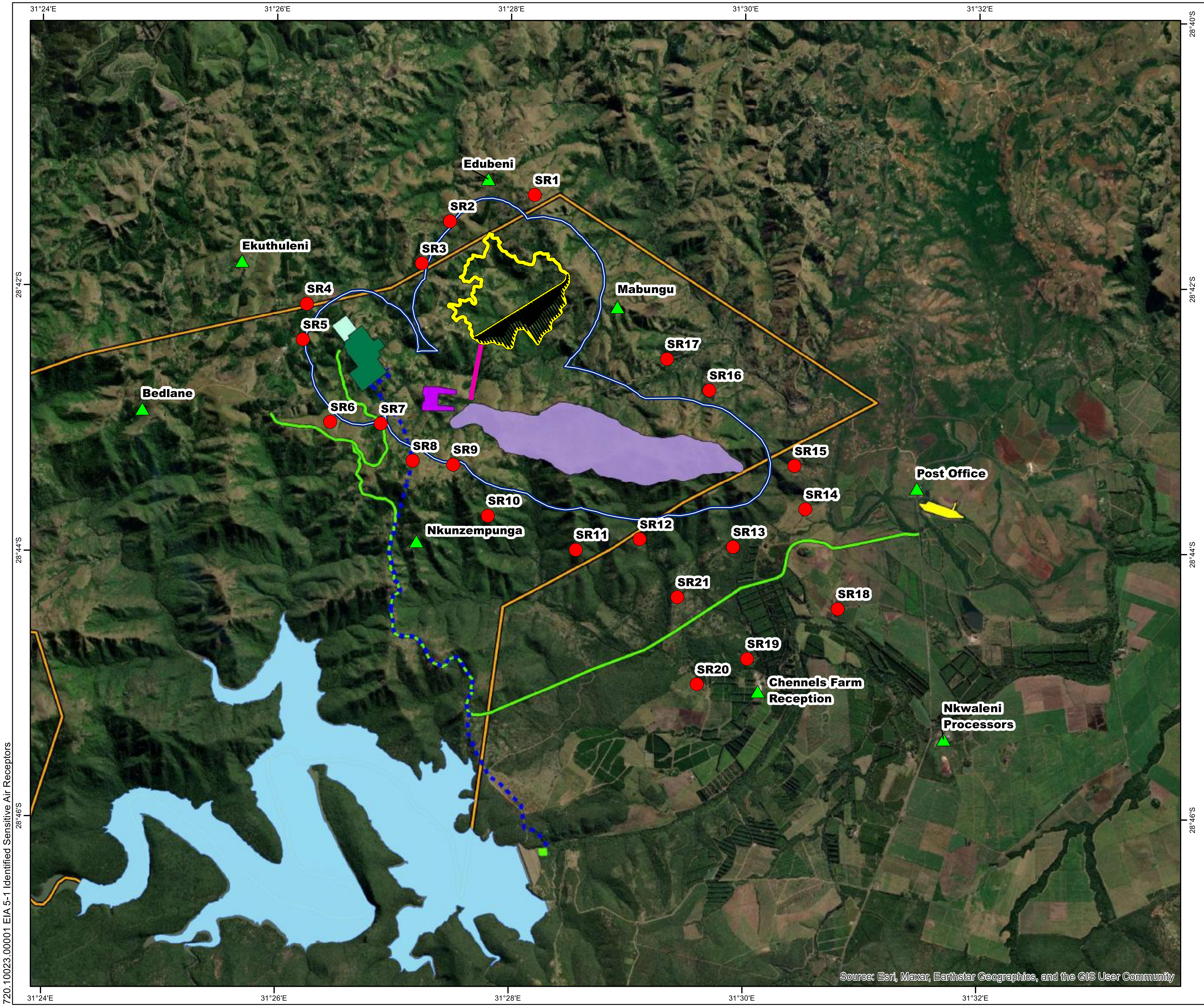
There are a number of activities in all phases of the Jindal MIOP that have the potential to contribute to changes in the ambient air quality. During the construction and decommissioning phases these activities are usually more temporary in nature, from a few months to a few years. The operational phase consists of longer term activities and the closure phase would present the final rehabilitated areas.

5.1.2 Source of Impact

The project activities/infrastructure likely to result in impacts to ambient air quality include:

Project phase	Activity/infrastructure
Construction	• Dust from earthworks and onsite vehicle movement activities

Project phase	Activity/infrastructure
	• Emissions associated with construction vehicles transporting materials and personnel to and from the site • Emissions associated with construction activities onsite
Operational	• Blasting • Earthworks and haul vehicle movement • Transport of workers to site on unpaved roads • Dumping onto the WRD • Stockpiling of ore, stripped soils etc.
Decommissioning/ Closure	• Demolition activities • Vehicle movement



Legend

- Goedetrouw Dam
- 500m Buffer
- Sensitive Receptors
- Places of Interest

Proposed Project Components

- South Block Mining Right Area
- South East Pit
- Raw Water Pump
- Processing Plant
- Primary Crusher
- Incoming Power Yard
- Rail Siding
- Haul Road
- Access Road Option 1 - Preferred
- Overland Piping
- Waste Rock Dump

N

0 1 2
KM

Scale: 1:50 000 @ A3
Coordinate System: TM WG31
Projection: Transverse Mercator
Datum: Hartebeesthoek 1994

JINDAL IRON ORE (PTY) LTD

FIGURE 5-1
IDENTIFIED SENSITIVE AIR RECEPTORS

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Project No: 720.10023.00001	Prepared By: BG
Map Ref No: EIA 5-1	Date: 17/05/2023

5.1.3 Impact Assessment

5.1.3.1 Construction and Decommissioning Phases

The total Project construction area footprint is classified as "large" according to the Institute of Air Quality Management (IAQM) criteria as the total site area is >10 000 m^2 and because it is considered likely that there will be more than 10 heavy earthmoving vehicles to operate on-site at any given time. The soil type has been assumed to be dusty. Overall, it has been estimated that the unmitigated magnitude of dust and PM_{10} emissions is also considered to be "Large" for earthworks activities.

The total volume of buildings to be constructed on the site is expected to be more than 25 000 m^3, therefore, the magnitude of dust and PM_{10} emissions is considered large for construction activities.

There is potential for there to be >50 heavy duty vehicle (HDV) outward movements in any one day during the construction period. In addition, the unpaved road surface material is likely to have a high potential for dust release and the majority of the roads to be traversed by construction vehicles will be unpaved and greater than 100 m in length. Therefore, it is conservatively considered that the unmitigated magnitude of dust and PM_{10} emissions is "Large".

The construction site will be located a minimum of 500 m away from the community members, given the buffer between the mine boundary and nearest receptors, and therefore receptor sensitivity is expected to be "Low". However, construction vehicles are likely to use the access roads in the vicinity of the mine , where more than 100 receptors are likely located within 50 m of the construction and access roads. Taking into account the IAQM guidance, the area surrounding the Project site is considered to be of low sensitivity, and people living adjacent to the access roads are considered to be of "High" sensitivity to changes in dust and PM_{10} as a result of construction activities.

Dust deposition due to demolition, earthworks, construction and trackout has the potential to affect sensitive habitats and plant communities. Dust can have two types of effect on vegetation: physical and chemical. Direct physical effects include reduced photosynthesis, respiration and transpiration through smothering. Chemical changes to soils or watercourses may lead to a loss of plants or animals, for example via changes in acidity. Indirect effects can include increased susceptibility to stresses such as air pollution in the form of PM from construction activities. These changes are likely to occur only as a result of long-term construction works adjacent to ecological and agricultural sensitivities such as the nearby farmlands. Often impacts will be reversible once the works are complete, and dust emissions cease.

In accordance with the IAQM methodology, and the minimum distance of the nearest commercial farms (approximately 1 km) the ecological and agricultural sensitivity for the area is considered to be of "Medium" sensitivity, as the nearby agricultural farms are locations where there is a particularly important plant species from an economic perspective such as citrus fruit and sugar cane, and where the dust sensitivity of the species is uncertain or not well documented.

A risk assessment was undertaken to determine the risk associated with each of the construction activity categories; the results of which are summarised in Table 5-1.

The risk category identified for each activity is established to determine the risk of impacts with no mitigation applied for each relevant construction component. The risk categories are presented in Table 5-1.

Table 5-1 Construction and decommissioning impact assessment risk categories

Potential Impact	Risk			
	Demolition	Earthworks	Construction	Track-out
Dust Fallout / Soiling	N/A	Low Risk	Low Risk	High Risk
Human Health	N/A	Low Risk	Low Risk	High Risk
Ecological and Agricultural	N/A	Low Risk	Low Risk	Medium Risk

Taking into account all of the above and given the 500 m buffer between the mine site and receptors, the key dust related issues for the construction and decommissioning phases are expected to relate to vehicle track-out and unpaved roads.

As such, the unmitigated significance in both the construction and decommissioning phases is assessed to be **MEDIUM** but could be reduced to **LOW** if properly managed (Table 5-2).

Table 5-2 Impact on ambient air quality

Impacts to ecological connectivity and/or ecological disturbance Impacts		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Construction & Decommissioning	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium)	Minor change (Low)
Duration	Short-term (1 and 5 years)	Short-term (1 and 5 years)
Extent	Beyond site	Whole site
Consequence	Medium	Low
Probability	Definite / Continuous	Probable
Significance	**Medium -**	**Low -**
Degree to which impact can be reversed	**High** – once all earthworks cease the likelihood of dust being generated will significantly reduce.	
Degree to which impact may cause irreplaceable loss of resources	**Low** – The impact of dust on agriculture and ecological resources is not very well understood but the extent of dust fallout is likely to remain quite near to the source.	
Degree to which impact can be avoided	**Low** – dust generation cannot be avoided completely but it can be managed to acceptable levels.	
Degree to which impact can be mitigated	**Medium** – Mitigation measures can be implemented that can significantly reduce the impacts of dust.	
Cumulative impact		
Nature of cumulative impacts	The cumulative impact could be medium, especially at certain times of year should harvesting or burning of sugar can be taking place. The overall cumulative impact can be reduced to low with the	

Impacts to ecological connectivity and/or ecological disturbance Impacts		
	implementation of mitigation measures, in particular the tarring of the main access road.	
Rating of cumulative impacts	**Medium -**	**Low -**
Residual impact		
Residual impact discussion	**Low** – The residual impact for the construction and decommissioning phases is assessed to be low.	

Table 5-3 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	To minimise the impacts to ambient air quality during the construction and decommissioning phases of the Jindal MIOP.
Mitigation actions/measures	
Construction Phase	
• Focused staff training on air quality management. • Hard surfacing of the main mine access road. • Wet suppression of stockpiles when necessary (including wind shielding, storage away from site boundaries, and restricted height of stockpiles). • Water and/ or chemical sprays will be used for dust suppression on haul roads. • Restricting vehicle speeds on haul routes and other unsurfaced areas of the site. • Minimised idling of vehicles. • Ensuring that vehicles carrying dry soil and other materials are covered during travel. • Best practices adopted to control emissions from loading and dumping material include water application and minimisation of drop heights during adverse weather conditions. • Increase frequency of site inspections by the responsible person for air quality and dust issues on site when activities with a high potential to produce dust are being carried out. • Restrict vehicle access to no-go areas to avoid unnecessary off-road vehicle movements outside of the active work sites. • Detailed equipment maintenance and preventative maintenance schedules in place focused on dust minimisation. • Implement methods of reducing wind speed around potentially dusty activities / areas. Early planting of site perimeter areas with native tree species, and / or the strategic use of ‘snow fencing’ will potentially reduce wind speed across the site. • Display details of responsible person for air quality and dust issues at the site boundary.	
Monitoring	The following monitoring is recommended: • Daily inspection to ascertain the need for wet suppression and its subsequent implementation; • Grading activities should be monitored on a daily basis; and • Weekly inspection of unsurfaced haulage routes. Daily inspection should be undertaken during particularly dry periods to determine the need for wet suppression.

5.1.3.2 Operational Phase

In order to understand the potential impacts on air quality due to the Jindal MIOP, air dispersion modelling was undertaken. The Project contribution has been assessed against the ambient air quality standards (AAQS) in isolation.

PM_{10} and $PM_{2.5}$ Model

The modelled concentration contours for PM_{10} and $PM_{2.5}$ are presented in Figure 5-2 and Figure 5-3. The contour maps depict the model predicted pollutant concentrations by means of concentration contours with reference to the Project components, SRs and areas of particular interest/sensitivity. The model predicted concentrations at the SRs have been included within the contour maps with the following key:

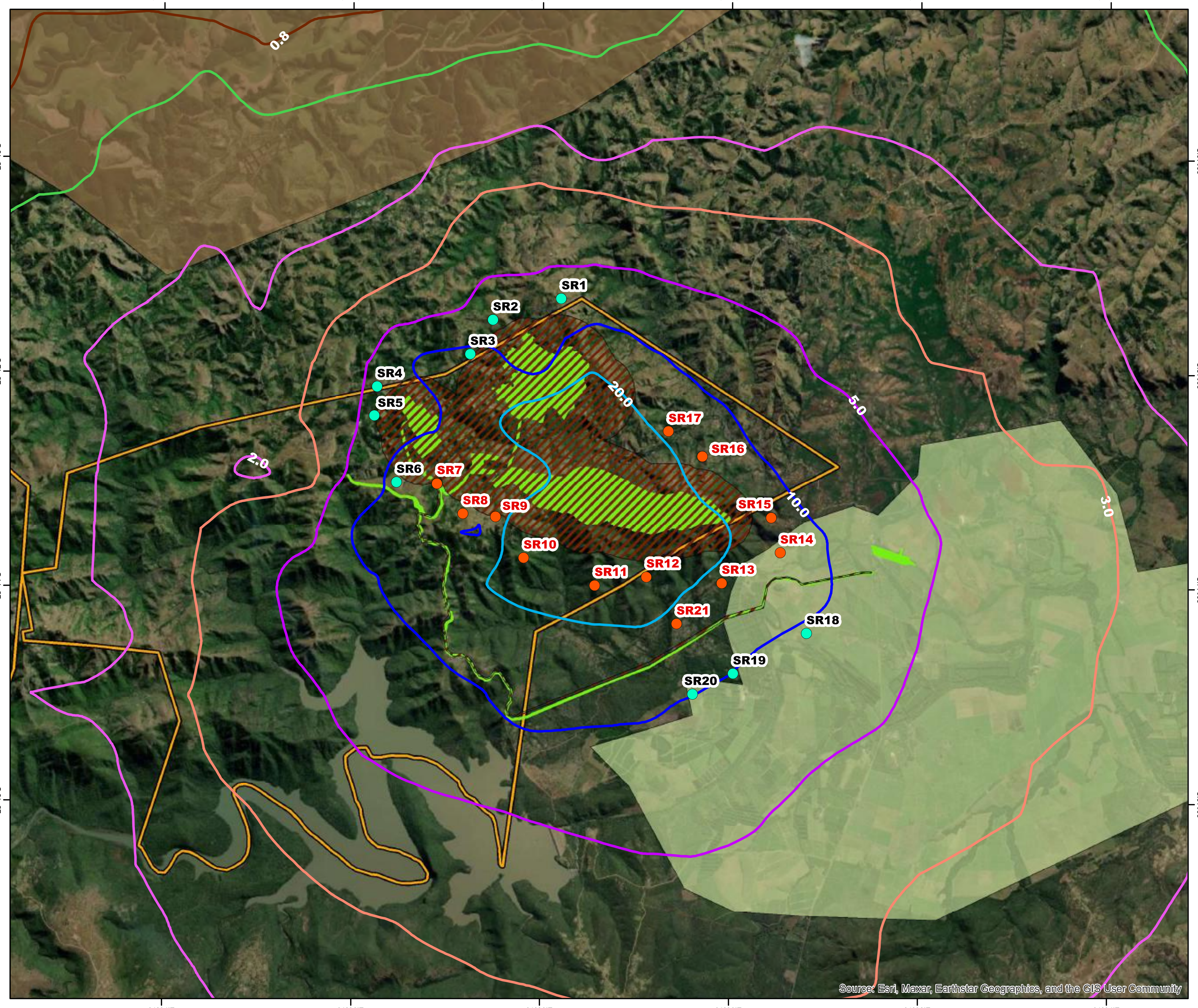
- Red: concentration at the SR exceedance of the relevant National Ambient Air Quality Standards (NAAQS);
- Orange: concentration at the SR is less than 100% but greater than 25% of the relevant NAAQS; and
- Green: concentration at the SR is less than 25% of the relevant NAAQS.

The primary aim of the AAQS is to provide a uniform basis for the protection of public health and ecosystems from the adverse effects of air pollution, and to eliminate or reduce to a minimum, exposure to those pollutants that are known or likely to be hazardous. In terms of interpreting the contour plots, the Green and Orange contours are indicators of the areas that are likely to fall below the AAQS during the operational phase.

Dust Fallout Model Results

Although AERMOD is equipped with algorithms for modelling dry deposition (dust fallout), inherent inaccuracies are associated with the modelling of this pollutant, given the relatively simplistic methods that are used to simulate fallout rates. This is due to many limitations and uncertainties associated with the number of assumptions required to facilitate the model run. As such, a range of values, representing the upper and lower range, has been provided as opposed to a single value. The range was obtained by considering results for both the unmitigated and mitigated emission rates for mining activities. The model predicted dust fallout rates for the upper and lower predicted ranges are presented in Figure 5-4. These maps indicate the model predicted concentrations with reference to the Project components, SRs and areas of interest/sensitivity.

It should be noted that the dust fallout AAQS are set primarily for prevention of nuisance and soiling and are not associated with impacts to community health.



Legend

- Proposed South Block Mining Right Area
- Proposed Mine Layout
- Project Area
- Commercial Cane and Timber
- Commercial Fruit Crops
- SRs - Less than 25% of the Relevant AAQS
- SRs - Between 25% and 100% of the AAQS

PM_{10} Annual Contours (ug/m^3)

- 20.0
- 10.0
- 5.0
- 3.0
- 2.0
- 1.0
- 0.8

N

0 1 2 KM

Scale: 1:63 360 @ A3
Coordinate System: TM WG31
Projection: Transverse Mercator
Datum: Hartebeesthoek 1994

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FIGURE 5-2
PM10 ANNUAL AVERAGING PERIOD MODELLED CONCENTRATIONS

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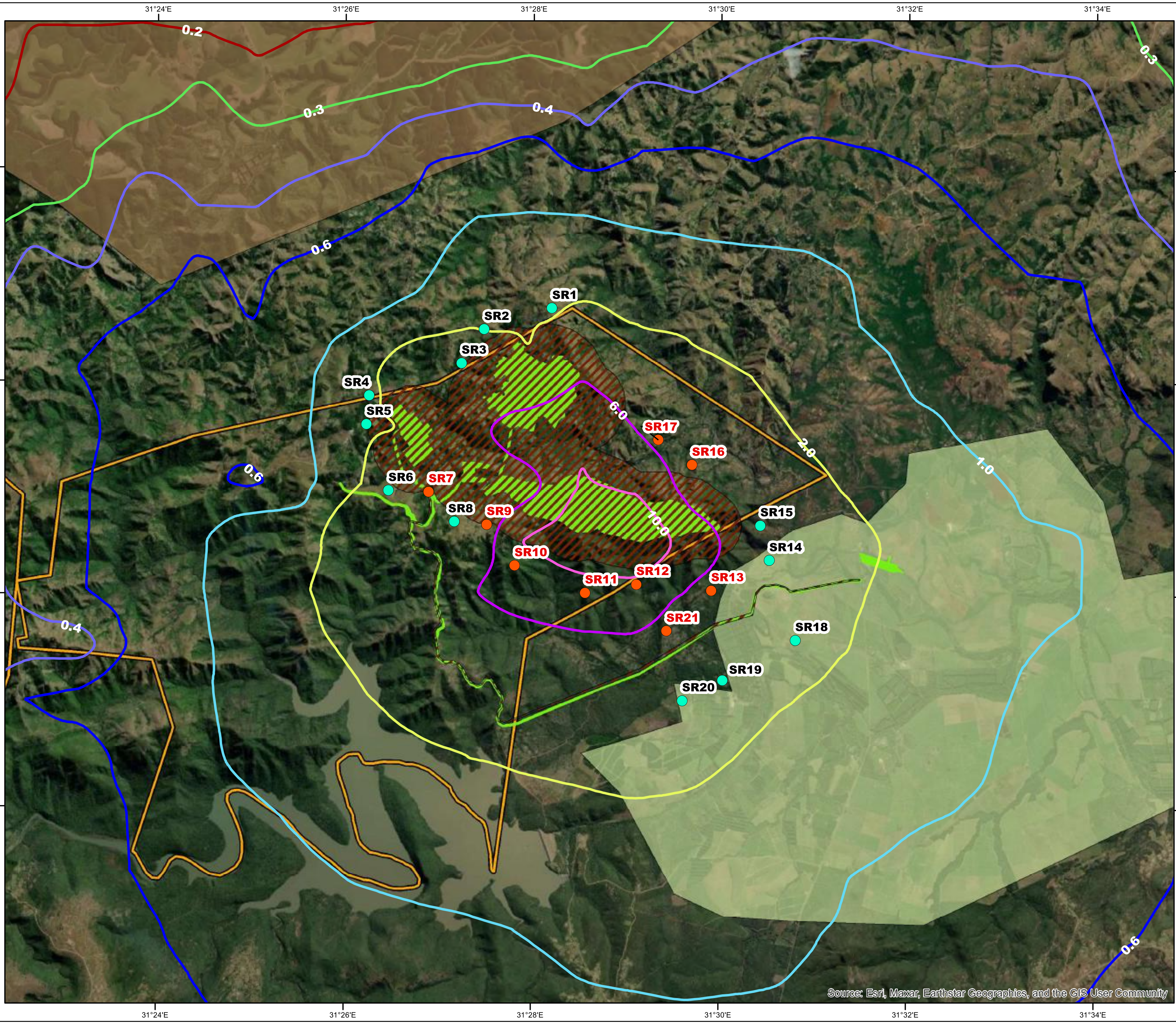
Map Ref No: EIA 5-2 | Date: 17/05/2023

720.10023.00001 EIA 5-2 PM10 Modelled Concentrations



Legend

- Proposed South Block Mining Right Area
- Proposed Mine Layout
- Project Area
- Commercial Cane and Timber
- Commercial Fruit Crops
- SRs - Less than 25% of the Relevant AAQS
- SRs - Between 25% and 100% of the AAQS

$PM_{2.5}$ Annual Contours (ug/m³)

- 10.0
- 6.0
- 2.0
- 1.0
- 0.6
- 0.4
- 0.3
- 0.2

N

0 1 2
KM

Scale: 1:63 360 @ A3
Coordinate System: TM WG31
Projection: Transverse Mercator
Datum: Hartebeesthoek 1994

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FIGURE 5-3
PM2.5 ANNUAL AVERAGING PERIOD MODELLED CONCENTRATIONS

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Map Ref No: EIA 5-3	Date: 17/05/2023

720.10023.00001 EIA 5-3 PM2.5 Modelled Concentrations

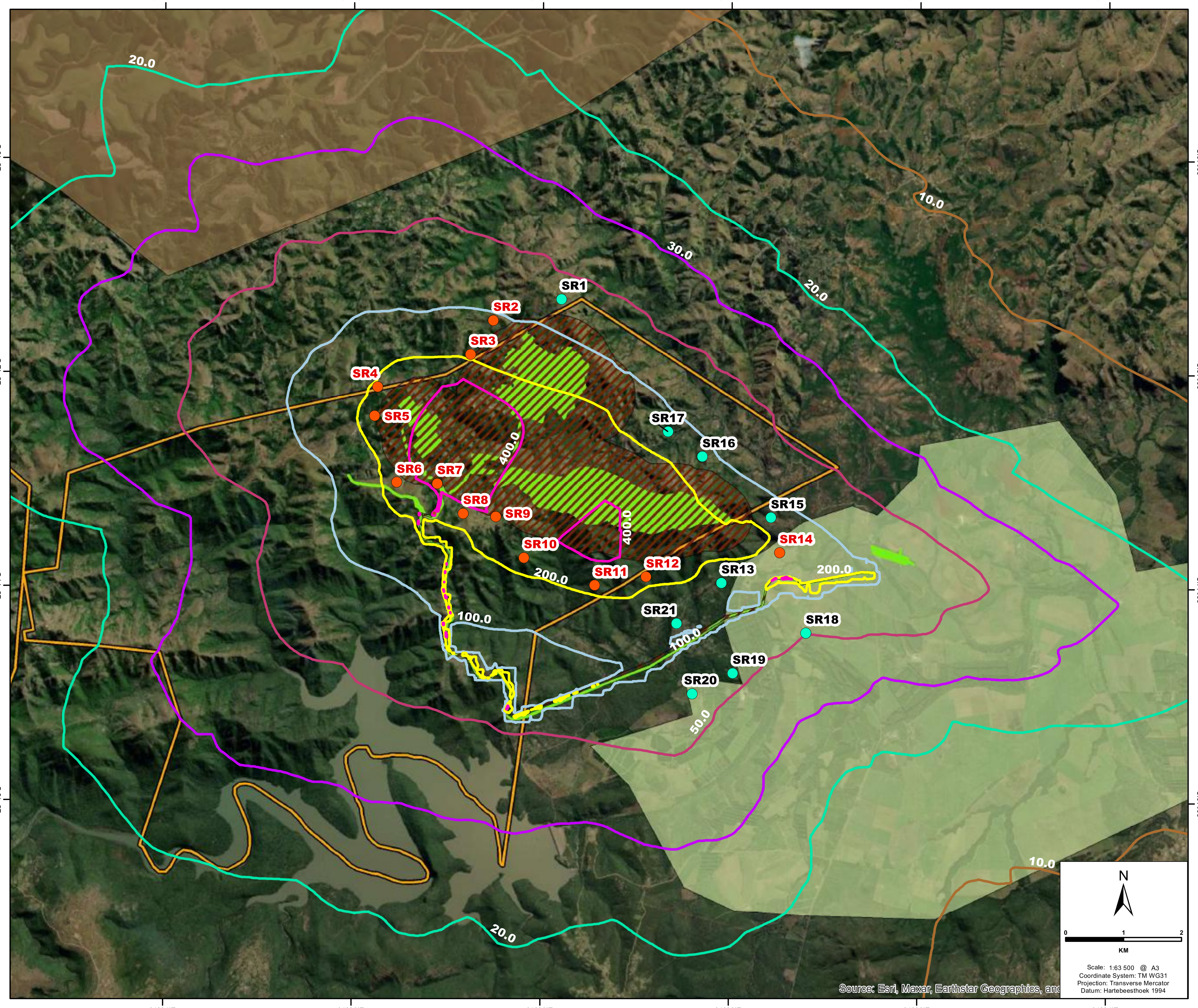

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FIGURE 5-4
DUST FALLOUT MODEL DEPOSITION RATES FOR UPPER PREDICTED RANGE

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Project No: 720.10023.00001 | Prepared By: BG
Map Ref No: EIA 5-4 | Date: 17/05/2023

720.10023.00001 EIA 5-4 Dust Fallout Model_Upper Predicted Range

Assessment of Impacts

In terms of effects, mines can give rise to annoyance factors due to the soiling of surfaces by dust from mining activities including ore handling and processing, blasting and from unpaved roads and exposed surfaces. Very high levels of soiling can also damage plants and affect the diversity of ecosystems. Additionally, exposure to PM_{10} and $PM_{2.5}$ has long been associated with a range of health effects. The following sections provide a summary of the impact assessment tables as per the SLR methodology. The assessment is informed though both quantitative means (i.e., dispersion modelling) and qualitative means (literature review).

Impacts to Community Health:

An analysis of emissions impact on human health and the environment is achieved using the air dispersion modelling results, and the NAAQS which have been set for the protection of both human health and the environment. These standards serve to indicate what levels of exposure to pollution, as a result of dust emissions from project activities, are generally safe for most people, including vulnerable groups, over their entire lifetimes. The closest SRs are located less than 100 m from the Project area to the southeast, south and southwest of the project boundary (SR7,SR10-17, SR19 and SR21). At SR locations where the NAAQS is predicted to be exceeded, the impact to community health is considered **HIGH** prior to the implementation of mitigation but can be mitigated to **MEDIUM**. Those receptors that fall outside of the standard (more than 25% of the standard), the impact assessment shows a **MEDIUM** impact prior to the implementation of additional mitigation and **LOW** subsequent to its implementation (Table 5-2).

Impacts to Agricultural Crops:

Dust from mining operations deposited on crops could create ecological stress on commercial agricultural activities. During long dry periods dust can coat plant foliage adversely affecting photosynthesis and other biological functions. Large scale mining activities may give rise to dust deposition over an extended period of time, creating the potential to adversely affect commercial crops. The air dispersion modelling study indicates that dust fallout (in excess of the national standards) from the Jindal MIOP is unlikely to travel the distances required to impact the nearest commercial crops (at a distance of approximately 1 km), as the larger particles associated with soiling will settle out within this distance. In addition, the nearest forestry plantations are more than 3km away and beyond the likely zone of influence (Figure 5-4).

Given the distance between the source (mine) and receptor (crops), and the larger size of the dust particles associated with dust deposition nuisance, the impact of dust fallout on agricultural crops is predicted to be **LOW** prior to the implementation of mitigation measures and **VERY LOW** after mitigation (Table 5-5). It should, however, be noted that the mine access road (linking the R66 with the eastern corner of Goedertrouw Dam, to the mine site) passes through both citrus and cane fields and is likely to be used by the community as well as for mine vehicle access. At present this road is not paved and could therefore lead to localised dust deposition impacts in close proximity to the road, given the increase in traffic flows and heavy vehicles. A comparison of the various control options for the main access road is provided in Table 5-4. Paving the main access road (which passes through agricultural areas) would reduce Total Suspended Particulate (TSP) emissions by approximately 200 tonnes per annum, as dust emissions from paved roads would be negligible in comparison to unpaved roads. Therefore, it is recommended that the main access road be paved as part of the design basis.

Table 5-4 Access road dust control mitigation comparison

	Design Mitigation Control Efficiency	Total Emissions (TPA)
Access Road TSP Emissions	50% for level 1 watering (2 litre/m^2/hour)	208
	75% for level 2 watering (< 2 litre/m^2/hour)	103
	100% for sealed roads	Negligible

Impacts from Blasting Activities:

Blasting activities have the potential to generate gaseous pollutants NO_x and CO from the blast emulsion (explosive type), as well as TSP and PM_{10} from the blasting of the ore body.

The extent and duration of the blasting events is relatively short lived, with a sequence of near instantaneous blasts within the block (up to 200 holes with charges), and in most cases with visible plume that dissipates after a few minutes.

Research suggests that almost all dust with a particle size of about 250 µm and greater will fall to the ground within 30 seconds under low wind speed conditions, whilst dust with a particle size of 60 – 100 µm settles more slowly. Dust with a particle size of below 40 µm stays airborne for the longest due to the strong disturbance by air flow and size fraction.

Regarding impacts to agricultural activities, the nearest fields (citrus, cane and other edible crops) are located at the closest approximately 1 km to the east and south east of the pit. The nearest commercial forestry is located approximately 3 km to the north west of the pit. As blasting would only take place during the day time, a day time annual wind rose has been superimposed on the image below. The most frequent winds during the day blow from the direction of the commercial fruit and cane plantations towards the pit (away from the crops). The key wind vectors likely to blow in the direction of the commercial farms are from the west and north west. If the larger diameter particles (> 250 µm) are likely to settle within 30 seconds of the blast, with a 5m/s wind speed, larger particles are likely to deposit within 150 m from the blast (300 m for a 10 m/s wind speed). Smaller particles are likely to travel further, however, smaller particles are less of a concern in terms of deposition and soiling. It is reasonable to assume that with the implementation of specific blast control measures (modern, electronic, sequential blast techniques with adequate stemming), particles that are likely to cause dust deposition concerns for agriculture would have limited potential for impact given the distance to the nearest fields / crops. In addition, once the blasting reaches sub ground levels (i.e., in the pit) there will be additional control provided by the pit walls.

In terms of long-term health impacts from finer particles, the blasting is likely to take place twice a week (same day), and the actual event will be short lived (less than 5 minutes visible plume per blast). Health impacts from PM arise from long term exposure, and as a result the NAAQS for PM are set for the 24 hour and annual averaging period. Therefore, given the short duration of the blast event, and infrequent nature of blasting (one day per week) blasting activities are unlikely to pose an impact to community health from finer particles. In addition, the mine blast impact report concluded that no receptors should be present within 500 m of the pit (Blast Management and Consulting, 2022), which will allow sufficient diffusion and dispersion to occur.

The impact on ambient air quality due to blasting is predicted to be **MEDIUM** prior to the implementation of mitigation but can be mitigated to **LOW** (Table 5-5).

Table 5-5 Impact on ambient air quality

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phase	**Operational – Community Health**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	High - Medium	Medium - Low
Duration	Long-term	Long-term
Extent	Local	Local
Consequence	High - Medium	Medium - Low
Probability	Definite / Continuous	Definite / Continuous
Significance	**High - to Medium -**	**Medium - to Low -**
Description of Impact		
Phases	**Operational – Commercial Crops**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Medium	Low
Duration	Long-term	Long-term
Extent	Regional	Regional
Consequence	Medium	Low
Probability	Possible	Possible
Significance	**Low -**	**Very Low -**
Phases	**Operational - Blasting**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Medium	Low
Duration	Very Short Term	Very Short Term
Extent	Local	Local
Consequence	Medium	Low
Probability	Probable	Probable
Significance	**Medium -**	**Low -**
Degree to which impact can be reversed	**Reversible** - The impacts are reversable with the implementation of mitigation measures, or ceasing of activities	
Degree to which impact may cause irreplaceable loss of resources	**Unlikely** – Irreplaceable losses are unlikely, with the implementation of management actions.	
Degree to which impact can be avoided	**Medium** – With the implementation of mitigations the impact can be reduced, however, dust and other emissions cannot be completely avoided.	
Degree to which impact can be mitigated	**High** – Implementation of mitigation measures can significantly reduce the impact of reduced air quality.	
Cumulative impact		

Nature of cumulative impacts	The cumulative impact could be medium, especially at certain times of year should harvesting or burning of sugar can be taking place in addition to operational dust. The overall cumulative can be reduced to low though with the implementation of mitigation measures.	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Medium -	**Low -**
Residual impact		
Residual impact discussion	**Medium** – The residual impact during the operational phase is predicted to be medium.	

Table 5-6 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	To minimise the impacts on ambient air quality during the operational phase of the Jindal MIOP.
Mitigation actions/measures	
Operational Phase	

Community Health:

- Establish exact boundaries for any proposed resettlement activities, as this may overlap with receptors associated with high impact significance.
- Preparation of a dust management plan as part of the Project EMPr.
- Addition of surfactants and dust suppressants when watering, specifically in working areas takes place close to the project boundaries.
- Large trees and thick indigenous vegetation (in consultation with the project ecologist) to be established along the Project boundary to reduce wind speeds and provide visual buffer between mining activities and community.
- Reduce vehicle speeds to 30 km/hr or below on all internal haul routes and roads.
- Utilise chutes at material handling transfer points.
- While the processing plant will be enclosed, all bag filters on extraction points should be designed for 30 mg/Nm3.
- Ensure that vehicles carrying dry soil and other materials are covered during travel.
- Cover the surface of haul routes with less erodible aggregate material such as compacted and treated crusher run / aggregate.

Commercial Crops:

- Paving the main access road.
- Preparation of a dust management plan as part of the Project EMPr.
- Addition of surfactants and dust suppressants when watering.
- Large trees and thick indigenous vegetation to be established along the Project boundary to reduce wind speeds and provide visual buffer between mining activities and community. Planting should commence well in advance of construction activities and should be informed by a dedicated Plan.
- Reduce vehicle speeds to 30 km/hr or below on all internal haul routes and roads.
- Utilise chutes at material handling transfer points.
- Ensure vehicles carrying dry soil and other materials are covered during travel.
- Cover the surface of haul routes with less erodible aggregate material such as compacted and treated crusher run / aggregate.

Blasting:

- Evacuate people and animals out of the danger zone prior to any blasting taking place (blast safety recommendation is 500m).

<table>
<tr><th colspan="2">Management Outcome, Mitigation Actions/Measures and Monitoring</th></tr>
<tr><td colspan="2">

It is recommended that a standard blasting time is fixed and blasting notice boards setup at various routes around the project area that will inform the community of blasting dates and times, in addition to social media postings.
Undertake initial test blast and monitoring downwind to define blasting operations going forward. This test blast can be based on the existing design and after this blast it may be necessary to define if design changes are required or not.
Monitoring during the test phase should include a continuous ambient air quality analyser capable of measurement of PM_{10}, $PM_{2.5}$, NO_2 and CO. The analyser should be located downwind of the blast, at the boundary of the danger zone. Once the test blasting is complete and the proponent has demonstrated that concentrations of these pollutants are below the corresponding standard, this requirement can be removed and replaced by the long term monitoring campaign (see monitoring section).
Recommended stemming length should range between 25 and 30 times the blast hole diameter. In cases for strict fly rock control this should range between 30 and 34 times the blast holes diameter.
Video footage, on a monthly basis, will help to define if excessive fly rock and dust plumes occurred and the origin. Immediate mitigation measures can then be applied if necessary. The video will also be a record of blast conditions in case of complaints.
Meteorological conditions:

Blasting should only be undertaken during low winds speeds (< 5 m/s). No blasting should be undertaken where wind speeds are greater than 20m/s from a design safety perspective, however for dust dispersion purposes, 10m/s should be the maximum threshold.
Avoidance of blasting during winds from the West and South West will minimise potential impacts on agricultural receptors.
Avoid early morning blasting and late in the afternoon in winter when there is a possibility of atmospheric inversion.
Do not blast in fog, or low overcast clouds.
Do not blast in the dark (day time hours only).
Refrain from blasting when wind is blowing strongly in the direction of the closest nearby receptors
Watering or application of palliatives on the blast area following the charging of the blast holes with explosives is recommended where feasible.

</td></tr>
<tr><td>Monitoring</td><td>

Install at least two continuous analyzers (for PM_{10} and $PM_{2.5}$) at the Project boundary (or at other suitable locations such as homesteads), one upwind and one downwind. Dates and times of blast activities should be recorded and monitoring data analysed to determine if an increase in PM_{10} and $PM_{2.5}$ levels occur during blasting.
Install dust fallout gauges at a minimum of 8 locations (principal wind directions), with monitoring commencing at least one year before the construction begins. The gauges need to cover both community and agricultural areas.
Implement a community complaints / grievance mechanism.
Implement a monthly/ quarterly feedback meeting with the nearby farming communities.

</td></tr>
</table>

6. NOISE

6.1 IMPACT ON AMBIENT NOISE LEVELS

6.1.1 Description of Impact

For a person with average hearing acuity an increase of less than 3 dBA in the general ambient noise level is not detectable. With the approach adopted for the assessment, the predicted increase in noise levels of 3 dBA above baseline (i.e. notable increase in noise) due to the Jindal MIOP and related activities are expected up to a distance of approximately 2 km from the plant.

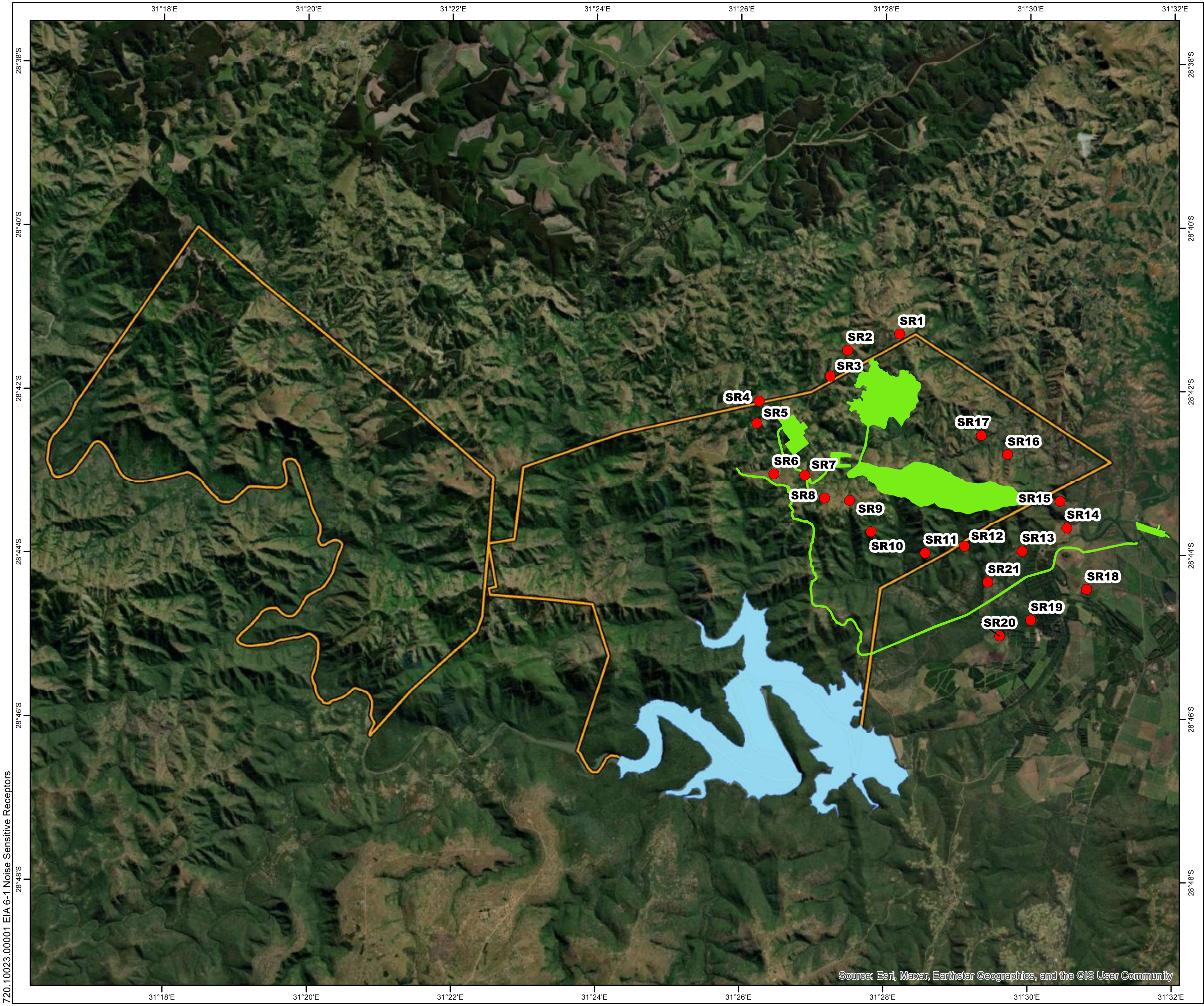
According to the Noise Control Regulations (NCR) "No person shall make, produce or cause a disturbing noise, or allow it to be made, produced or caused by any person, machine, device or apparatus or any combination thereof". A disturbing noise being a noise level greater than the zone sound level which in the case of this project is the South African National Standards (SANS) 10103 noise limit for rural residential areas, being 45 dB(A) for daytime and 35 dB(A) for night-time. Therefore, according to the NCR the noise from the project should not exceed noise levels of 45 dB(A) and 35 dB(A) for daytime and night-time respectively.

Sensitive receptors have been identified within and around the mining area and are presented in Figure 6-1.

6.1.2 Source of Impact

The project activities/infrastructure likely to result in impacts to ambient noise include:

Project phase	Activity/infrastructure
Construction	• Earth-moving operations • Construction and delivery vehicles
Operational	• Blasting • Haul vehicle movement • Processing plant equipment and primary crusher • Dumping of waste rock
Decommissioning/ Closure	• Demolition activities • Vehicle movement



Legend

- Proposed South Block Mining Right Area
- Proposed Mine Layout
- Goedetrouw Dam
- Sensitive Receptors

N

0 1 2
KM

Scale: 1:81 000 @ A3
Coordinate System: TM WG31
Projection: Transverse Mercator
Datum: Hartebeesthoek 1994

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FIGURE 6-1
NOISE SENSITIVE RECEPTORS FOR THE JINDAL MIOP

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Project No: 720.10023.00001	Prepared By: BG
Map Ref No: EIA 6-1	Date: 17/05/2023

720.10023.00001 EIA 6-1 Noise Sensitive Receptors

6.1.3 Impact Assessment

Construction noise was assessed by assuming construction occurs at the plant boundary nearest to the closest receptor. The construction site boundary adopted for the assessment is limited to the perimeter of the plant boundary. A worst-case, conservative scenario was by assuming that all identified equipment would be operating concurrently at a single location.

The construction noise assessment has been carried out in accordance with the SANS noise limits in conjunction with the internationally recognised construction noise guidelines of the Department of Environment and Climate Change New South Wales (NSW), as the SANS do not explicitly prescribe construction noise limits. The NSW construction noise guidelines define a construction noise threshold margin of 10 dB(A) above the background noise levels with a 75 dB(A) upper limit for construction operations during recommended standard hours. The NSW guidelines are preferred because they account for the fact that construction operations are inherently and inevitable noisy, but transient and temporary, allowing for reasonable margins above the normal noise limits or background noise levels based on the expected construction times (normal vs abnormal).

The impact of the noise from the Jindal MIOP construction activities is assessed at the closest sensitive receptor (SR5) as this would represent the worst-case impact. Based on the noise measurement closest to SR5 a representative baseline noise level of 51.8 dB(A) has been used, therefore the noise limit at this location based on the NSW criteria would be 61.8dB(A).

The predicted noise levels in the area surrounding the Project site are detailed in Table 6-1 and have been evaluated against the standards.

Table 6-1 Predicted construction noise emissions surrounding the project site

Distance from boundary	Construction Noise	Noise Limit at SR5 dB(A), L_{10}	Exceedance of Noise Limit?
m	**dB(A)**	**dB(A)**	
50	83.3	61.8	Yes
100	77.2		Yes
150	73.7		Yes
200	71.2		Yes
250	69.3		Yes
500	63.3		Yes
600	61.7		No
1000	57.2		No

The predicted noise levels generated by the construction activities are expected to be below the noise limit of 61.8 dB(A) at distances greater than 600 m from the Project boundary.

Construction would take place at the processing plant and primary crusher with the closest sensitive receptor to these areas being approximately 533 m away. The noise level at this location is calculated to be 62.7 dB(A), exceeding the noise limit by 1.1dB(A). Based on the construction noise assessment, the construction noise level contributions at the nearest sensitive receptors are expected to be 0.9dB(A) above 61.8 dB(A) and therefore the impact prior to mitigation is assessed to have a **LOW** significance. With mitigation the impact can be reduced to **VERY LOW** (Table 6-2).

In terms of understanding operational noise the internationally recognised noise modelling software SoundPLAN© 8.1 was used for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of sources. The most influential environmental condition on noise propagation is distance, the greater the distance between the noise source and the receiver the greater the noise reduction achieved. Typically for stationary sources, a reduction of 6 dB(A) per doubling of distance is considered the norm.

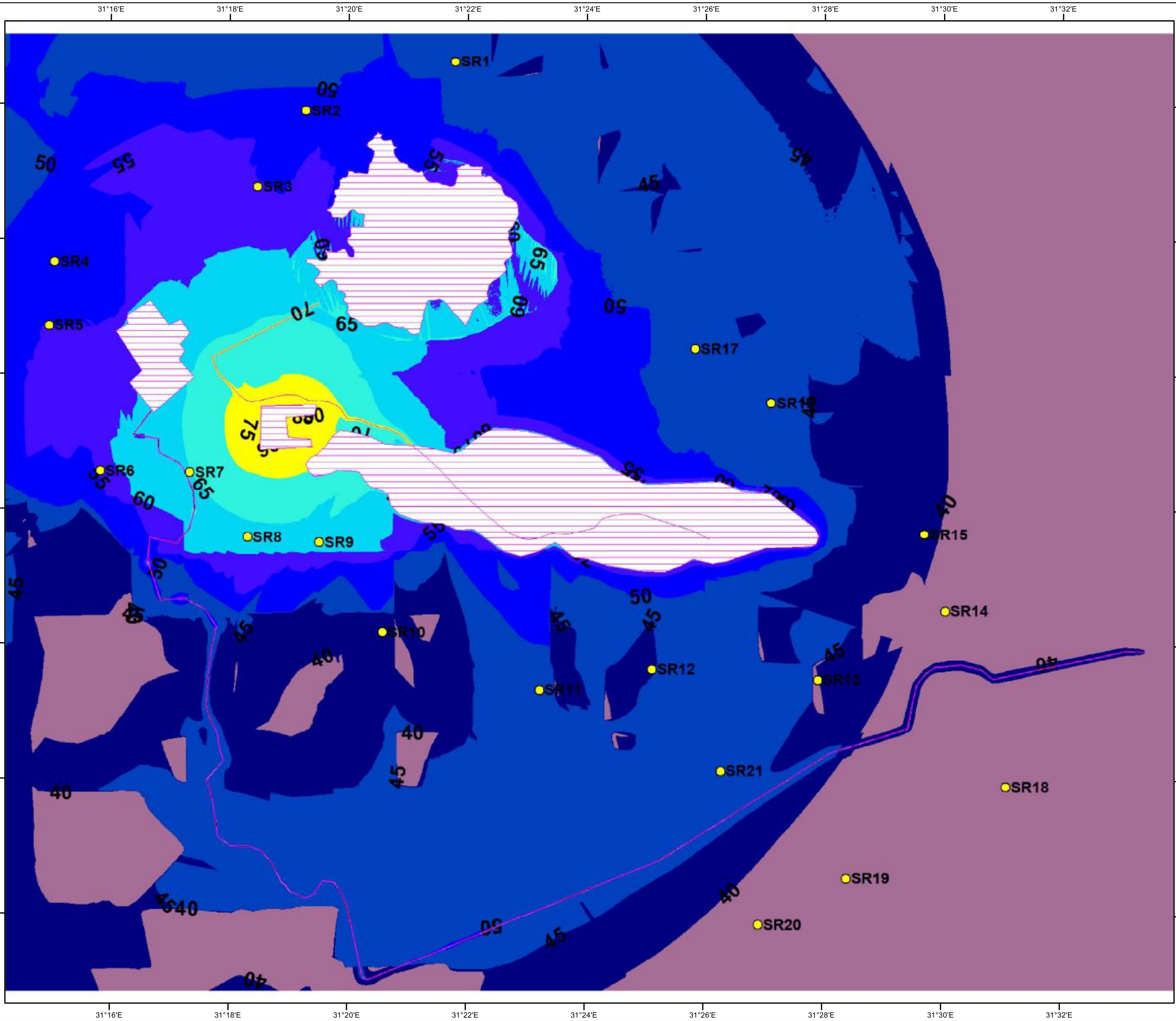
A series of noise contour maps have been produced to depict predicted noise levels within and around the Project study area. Calculations have been carried out under normal operating conditions to determine the level of compliance with environmental standards. These calculations are depicted in Figure 6-2 (day-time calculations) and Figure 6-3 (night time calculations).

It must be noted that the terrain in the area has influenced the propagation of noise levels around the project site, this is evident when looking at the area to the south where elevated terrain has had a screening effect on the noise propagation.

The noise modelling results indicate that the Jindal MIOP noise contributions at sensitive receptors are likely to exceed the relevant SANS noise limits when assessed in isolation at a number of locations. This is expected due to the proximity of the new mining operations to certain assessed sensitive receptors (the closest being approximately 530 m away), as well as the relatively low SANS noise limit for zones or areas classified as “rural”.

Based on the predicted changes in ambient noise level, the mining activities are anticipated to result in increases in ambient noise levels that are greater than 7 dB(A) at SR7, SR8 and SR9 during the daytime and night-time periods and SR5 and SR6 during the night-time periods only.

As such, the impact prior to mitigation is assessed to have a **HIGH** significance. With mitigation the impact can be reduced to **MEDIUM** (Table 6-2).



Noise levels dB(A)

	<= 40.0
40.0 <	<= 45.0
45.0 <	<= 50.0
50.0 <	<= 55.0
55.0 <	<= 60.0
60.0 <	<= 65.0
65.0 <	<= 70.0
70.0 <	<= 75.0
75.0 <	<= 80.0
80.0 <	<= 85.0
85.0 <	<= 90.0
90.0 <	<= 95.0
95.0 <	

Signs and symbols

- Area source
- Line source
- Road

WKC

J21066

JINDAL IRON ORE (PTY) LTD

FIGURE 6-2
OVERALL PROJECT AREA
DAYTIME

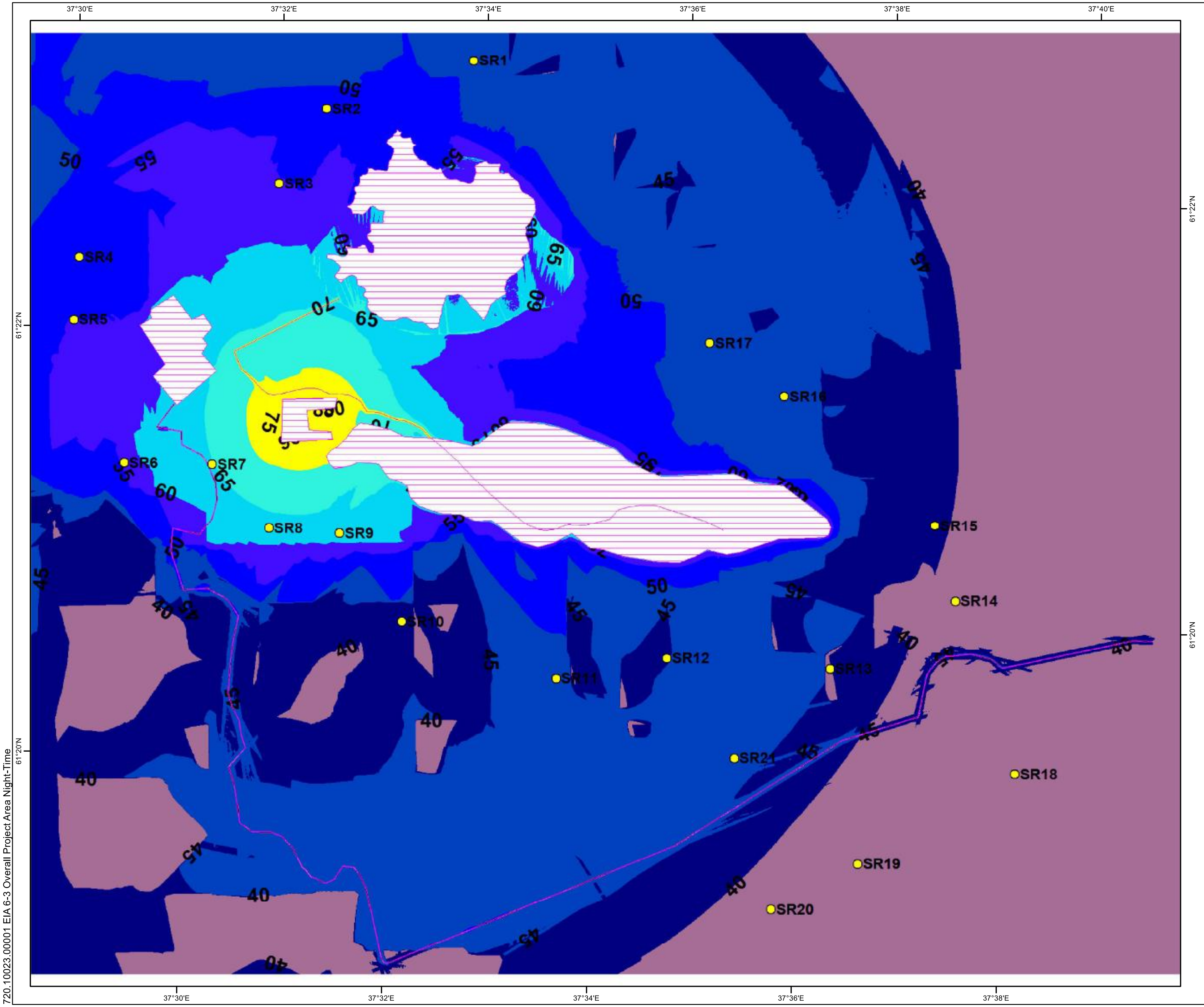
SLR

PO BOX 1596
CRAMERVIEW
JOHANNESBURG
2060

T: +27 (11) 467-0945
www.slrconsulting.com

Project No: 720.10023.00001	Prepared By: BG
Map Ref No: EIA 6-2	Date: 17/05/2023

720.10023.00001 EIA 6-2 Overall Project Area Daytime



JINDAL IRON ORE (PTY) LTD

FIGURE 6-3
OVERALL PROJECT AREA
NIGHT TIME

SLR
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www.slrconsulting.com

Project No: 720.10023.00001	Prepared By: BG
Map Ref No: EIA 6-3	Date: 17/05/2023

720.10023.00001 EIA 6-3 Overall Project Area Night-Time

The cumulative noise assessment in terms of the Institute of Environmental Management and Assessment (IEMA) and Institute of Acoustics (IoA) criteria indicate that the cumulative noise levels are currently in the range of 65.0 dB(A) to 49.0 dB(A) during the daytime and between 64.9 dB(A) and 46.1 dB(A) during the night. From the assessment done the Project noise contribution is anticipated to result in impacts ranging from Negligible to Severe impacts, which is similar for both daytime and night-time periods due to the 24-hour operation of the mining activities.

Severe impacts are anticipated for SR7, SR8 and SR9 with changes in ambient noise levels of up to 13.2dB(A) during the day and 19.0 dB(A) during the night. These SRs are located within the project concession boundary and within close proximity to the crushing area which is a major source of noise for the project.

During the daytime period there are also Moderate and Prominent impacts at SR3, SR4, SR5 and SR6 with SR3 and SR4 having an increase of 3 dB(A) and SR5 and SR6 having an increase of 5 dB(A). During the night-time period Prominent impacts are expected at SR3, SR4, SR5 and SR6, additionally there are Moderate impacts at SR11, SR16 and SR17.

Table 6-2 Impacts on ambient noise levels

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phase	**Construction and Decommissioning**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Minor change (Low)	Negligible change (Very low)
Duration	Very Short-term (< 1 year)	Very Short-term (< 1 year)
Extent	Beyond site	Beyond site
Consequence	Low	Very low
Probability	Probable	Probable
Significance	**Low -**	**Very low -**
Description of Impact		
Phases	**Operational**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Severe change (Very high)	Prominent change (High)
Duration	Long-term (10 and 20 years	Long-term (10 and 20 years
Extent	Beyond site	Beyond site
Consequence	High	High
Probability	Definite / Continuous	Conceivable
Significance	**High -**	**Medium -**
Degree to which impact can be reversed	**Fully reversable** - Once the mining activities end the impact will be gone	
Degree to which impact may cause irreplaceable loss of resources	**None**	

Degree to which impact can be avoided	**Medium** - Exceedances of the limits may be able to be avoided should good site practice be followed and mitigations implemented.	
Degree to which impact can be mitigated	**High** - Mitigation measures can reduce the impacts significantly	
Cumulative impact		
Nature of cumulative impacts	Cumulative noise levels are currently in the range of 65.0 dB(A) to 49.0 dB(A) during the daytime and between 64.9 dB(A) and 46.1 dB(A) during the night. From the assessment done the Project noise contribution is anticipated to result in impacts ranging from Negligible to Severe impacts, which is similar for both daytime and night-time periods due to the 24-hour operation of the mining activities.	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	High -	**Medium -**
Residual impact		
Residual impact discussion	**Insignificant** – Once mining is completed and the site decommissioned the noise impact will be reduced to insignificant.	

Table 6-3 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	To minimise the impacts of noise during all phases of the Jindal MIOP.
Mitigation actions/measures	
Construction and Decommissioning Phases	
• Site inductions to cover the importance of noise control and available noise reduction measures. • Construction contractors should be required to use equipment that is in good working order, is properly maintained according to the equipment's manufacturer requirements and that meets current best practice noise emission levels. This should be achieved by making it a component of contractual agreements with the construction contractors. • As far as reasonably practicable, sources of significant noise should be enclosed. The extent to which this can be done depends on the nature of the machines to be enclosed and their ventilation requirements. • Construction site speed limits should be established and enforced during the construction period, typical speed limits are 40km/hr on paved site roads and 20km/hr on unpaved haul routes. • A gradual start to noisy activities and as far as it is feasible, establish a schedule for noisy activities to reduce overlapping of works. • The on-site construction supervisor should have the responsibility and authority to receive and resolve noise complaints (this can be part of the grievance mechanism). A clear appeal process to the owner should be established prior to construction commencement that will allow for resolution of noise problems that cannot be immediately solved by the site supervisor. • The Engineering, Procurement and Construction (EPC) contractor should develop a Project Construction Noise Control Plan, which should implemented prior to commencement of any construction activity. • Implement a community complaints and grievance procedure. • Contract incentives may be offered to the construction contractor to minimise or eliminate noise complaints resulting from Project activities where Project construction would result in significant noise impacts.	
Operational Phase	
• Develop overburden dumps in such a way that the dumps act as a noise berm for closest receptors. • Use of noise barrier walls or berms, especially around crushing area location.	

<table>
<tr><th colspan="2">Management Outcome, Mitigation Actions/Measures and Monitoring</th></tr>
<tr><td colspan="2">
Site inductions for all employees that operate machinery with the potential to generate significant noise should cover the importance of noise control and available noise reduction measures.
Plant operations should always be carried out using equipment that is in good working order and that meets current best practice noise emission levels.
The designation of a community liaison officer who is able to deal with the concerns of residents and the establishment of a complaint response programme (this can form part of the grievance mechanism) would enable the identification and resolution of any noise related concerns at an early stage of the plant operation, as well as throughout the different phases of project development.
As far as reasonably practicable, sources of significant noise should be enclosed. The extent to which this can be done depends on the nature of the machines to be enclosed and their ventilation requirements. Enclosures are specifically recommended for pumps and compressors.
Minimise reversing of equipment to prevent nuisance caused by reversing alarms.
Driver practice when approaching and leaving the site should minimise noise emissions created through activities such as unnecessary acceleration and breaking noise.
Material stockpiles and mobile equipment staging, parking, and maintenance areas shall be located as far as practicable from SRs.
Permanent haul-road speed limits shall be established and enforced, especially where SRs are located close to the roads, typical speed limits are 40km/hr on paved site roads and 20km/hr on unpaved haul routes.
The use of noise-producing signals, including horns, whistles, alarms, and bells shall be for safety warning purposes only.
Ensure that all haul roads are maintained and kept free of potholes, ruts and bumps in order to reduce vehicle noise.
Relocation of residences that are within close proximity to the mining areas or within the project boundary, primarily as a function of the minimum blast safety distance recommendation.
</td></tr>
<tr><td>Monitoring</td><td>Noise monitoring should be undertaken in order to determine the operational noise emission levels and to aid the selection of additional noise controls where necessary. These locations should be determined based on the closest SRs to the site once plans have been finalised and should be chosen to determine the noise levels in all directions around the site (eg locations to the North, South, East and West of the site). Additional noise controls such as portable screening can be employed if monitoring indicates the need or in response to concerns.</td></tr>
</table>

7. SOILS, LAND USE AND LAND CAPABILITY

7.1 IMPACT OF CHANGE OF LAND USE FROM SUBSISTENCE FARMING TO MINING

7.1.1 Description of impact

Wherever the infrastructure footprint of the proposed Jindal Melmoth Iron Ore mine is located within the South Block, the current homesteads will have to be moved to another area, guided by an approved Resettlement Action Plan (RAP). The subsistence farmers that resided in the area will no longer practice agriculture here and the land use within the development footprint will change to mining. This impact will only occur once and once mining is the main land use in the area, it is not foreseen that subsistence agriculture will return to the footprint area, even after decommissioning and closure.

7.1.2 Source of Impact

The project activities/infrastructure likely to result in a change of land use from subsistence farming to mining include:

Project phase	Activity/infrastructure
Construction	• Earth-moving operations • Construction and delivery vehicles
Operational	• Blasting • Haul vehicle movement • Processing plant equipment and primary crusher • Dumping of waste rock
Decommissioning/ Closure	• Demolition activities • Vehicle movement

7.1.3 Impact Assessment

Prior to the construction of the mine infrastructure, the homesteads that will be affected by the development footprint, will need to be relocated somewhere else. No subsistence fields will be cultivated in the footprint area and no further livestock grazing will be possible where mine infrastructure will be constructed. This will change the current land use from subsistence agriculture with small crop fields and livestock herding, to mining. This impact will be permanent as the land use change will remain mining during the operational phase as well as the decommissioning and closure phases. It is not expected that subsistence agriculture will return to the area in the post-closure phase of the mine.

The change in land use will be permanent and be a severe change with very high intensity that is limited to the mining site area. The probability of this impact occurring is definite and the resulting significance of the impact prior to mitigation, is **HIGH**. However, implementing the mitigation measure of limiting the footprint to its current layout, reduces the intensity of the impact to a minor change and the resulting significance, is **LOW** (Table 7-1).

Table 7-1 Land use change from subsistence agriculture to mining

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	All	
Criteria	Without Mitigation	With Mitigation
Intensity	Sever change (Very high)	Minor change (Low)
Duration	Very long term/ Permanent (> 20 years)	Very long term/ Permanent (> 20 years)
Extent	Whole Site	Site
Consequence	High	Low
Probability	Definite / Continuous	Definite / Continuous
Significance	**High -**	**Low -**
Degree to which impact can be reversed	Irreversible: Once the land use of the footprint changes from subsistence farming to mining, it will only be returned if all infrastructure is removed.	
Degree to which impact may cause irreplaceable loss of resources	High: It is unlikely that subsistence farming will return to the area	
Degree to which impact can be avoided	None: Land use change is unavoidable	
Degree to which impact can be mitigated	Medium: Limited mitigation measures available but limiting the footprint can avoid increasing the extent of the impact.	
Cumulative Impact		
Nature of cumulative impacts	The cumulative impact is predicted to be low as there has not been much change to land use in the area in recent times.	
Rating of cumulative impacts	**Low -**	**Low -**
Residual Impact		
Residual impact discussion	**Low** – the residual impact is assessed to be low.	

Table 7-2 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	To minimise the impacts of land use change from subsistence agriculture to mining during the construction phase.
Mitigation actions/measures	
Construction Phase	
• Limit the land use change to the infrastructure footprint of the mine. • Keep the infrastructure footprint as small as possible. • Ensure that RAP considers the resettlement of livestock to the areas where the current homestead owners will be resettled. • The RAP must ensure that the areas where homestead owners will be resettled, have soil that is suitable for subsistence-level crop production near the houses.	
Monitoring	• No monitoring or reporting on monitoring is required.

7.2 IMPACT OF LOSS AND/OR REDUCTION OF CURRENT LAND CAPABILITY

7.2.1 Description of Impact

The infrastructure footprint of the proposed project includes five different land capability classes with Class 09 and Class 08 land capability, suitable for rainfed crop production. The activities of the different project phases will negatively impact soil quality through soil compaction, disturbance of soil horizon organization, soil pollution and increased risk of soil erosion. The degradation of soil quality would reduce the soil suitability in areas of impact, and this would lower the current land capability or destroy it so that it becomes unsuitable for any agricultural production. The loss and/or reduction of the current land capability is considered a permanent impact that remains the same during all project phases. It is not expected that the pre-mining land capability will be restored after mine closure.

7.2.2 Source of Impact

The project activities/infrastructure likely to result in a loss and/or reduction of current land capability include:

Project phase	Activity/infrastructure
Construction	• Earth-moving operations • Construction and delivery vehicles
Operational	• Blasting • Haul vehicle movement • Processing plant equipment and primary crusher • Dumping of waste rock
Decommissioning/ Closure	• Demolition activities • Vehicle movement

7.2.3 Impact Assessment

During the construction phase, topsoil will be stripped and stockpiled from areas where infrastructure such as the South East pit area, waste rock dumps, office complex, workshops and processing plant will be constructed. The access road will be constructed and the surface of the road graded and compacted. These activities result in soil quality degradation, thereby reducing and possibly destroying the suitability of these soils for rainfed crop production. It is anticipated that the current land capability in some areas such as the access road, pit area and waste rock dump areas, will be completely lost as these areas will also have no suitability for livestock farming.

The reduction in land capability is considered a prominent change in the ability of the natural resources (soil, terrain and climate) to support agricultural production. The impact will be permanent or very long term. However, the extent of the impact is limited to the site. The probability of this impact occurring is definite and the resulting significance of the impact prior to mitigation, is **MEDIUM**. The implementation of mitigation measures would reduce the significance to **LOW** (Table 7-3).

Table 7-3 Loss and/or reduction of current land capability

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	All	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium)	Minor change (Low)
Duration	Very long term/ Permanent (> 20 years)	Very long term/ Permanent (> 20 years)
Extent	Site	Site
Consequence	Medium	Low
Probability	Definite / Continuous	Conceivable
Significance	**Medium -**	**Low -**
Degree to which impact can be reversed	Irreversible: Once the land capability of the site has been reduced or destroyed, it will be difficult to restore the original land capability.	
Degree to which impact may cause irreplaceable loss of resources	High: It is unlikely that the pre-mining land capability will be restored.	
Degree to which impact can be avoided	None: Reduction in soil capability and therefore land capability, is unavoidable during surface mining.	
Degree to which impact can be mitigated	Medium: Limited mitigation measures available but limiting the footprint can avoid increasing the extent of the impact.	
Cumulative Impact		
Nature of cumulative impacts	The cumulative impact is predicted to be low as there has not been much change to land use in the area in recent times.	
Rating of cumulative impacts	**Low -**	**Low -**
Residual Impact		
Residual impact discussion	**Low** – the residual impact is assessed to be low.	

Table 7-4 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	To minimise the loss and/or reduction of current land capability during all phase of the Jindal MIOP.
Mitigation actions/measures	
Construction Phase	
• Keep the infrastructure footprint as small as possible. • In areas where infrastructure will be decommissioned and materials removed, topsoil must be put back at depths similar to the pre-mining topsoil depths during the land rehabilitation.	

<table>
<tr><th colspan="2">Management Outcome, Mitigation Actions/Measures and Monitoring</th></tr>
<tr><td colspan="2">Once rehabilitation of a section is completed after mining and decommissioning, a land capability audit must be conducted by a suitably qualified person to record the post-mining land capability classification of the mining footprint.</td></tr>
<tr><td>Monitoring</td><td>The following monitoring is required:
Once the rehabilitation of a specific area is completed, a South African Council for Natural Scientific Professions (SACNASP) registered soil or agricultural scientist must conduct a land capability audit of the rehabilitated area.
A land capability audit is also required after the final land rehabilitation of the mined area following the decommissioning phase.
The following reporting is required:
The land capability audit report submitted after the assessment, must include as a minimum the following information:
Effective soil depths of the rehabilitated area(s).
Bulk density of the soil.
Soil texture of the rehabilitated area(s).
Slope and slope length of the rehabilitated area(s).
Land capability classification.
Recommendations for soil quality improvement and post-rehabilitation land use.</td></tr>
</table>

7.3 IMPACT OF INCREASED SOIL EROSION

7.3.1 Description of Impact

Activities associated with the proposed mining project such as vegetation removal, topsoil stripping, haul road construction, blasting and drilling and topsoil stockpiling, will leave soil surfaces exposed to wind and rain. The uncovered soil particles are easily transported away from their origin by water and wind movement and deposited in other areas. In the case of rain and surface water movement, the soil particles usually end up in toe-slopes and valley bottoms and result in sedimentation of waterways. In the case of soil particle transport by wind, soil particles create dust and the dust deposits settle in other areas, including crop fields. Once the soil particles are lost from the mining area, it result in a material loss from the soil balance available for land rehabilitation. This again increases the cost of land rehabilitation as soil has to be sourced from somewhere else or otherwise, the rehabilitation objectives for soil depth cannot be met. The area where the Jindal MIOP will be located, is at high risk of soil erosion because of the steep slopes of the landscape.

7.3.2 Source of Impact

The project activities/infrastructure likely to result in soil erosion include:

Project phase	Activity/infrastructure
Construction	• Earth-moving operations • Construction and delivery vehicles
Operational	• Blasting • Haul vehicle movement • Processing plant equipment and primary crusher • Dumping of waste rock
Decommissioning/ Closure	• Demolition activities • Vehicle movement

7.3.3 Impact Assessment

During the construction phase, soil will be stripped from areas where infrastructure will be constructed. These areas include the waste rock dumps, access road, workshops and offices, and the processing plant. Prior to the soil stripping, the vegetation currently growing in these areas will be removed. The bare soil surfaces will be at risk of soil erosion, especially during the rainy season. In the area of the Jindal MIOP, the onset of soil erosion has the potential to spread quickly into areas outside of the mining footprint because of the high rainfall of the area and steep slopes of the terrain.

The formation of eroded areas and the resulting soil loss is an impact with very high intensity that is permanent. When left unmanaged and unrehabilitated, the erosion can affect the whole site and nearby areas. It is probable that soil erosion can occur as the terrain and high rainfall combined with the sudden nature of the soil impacts associated with surface mining, pose a high risk for soil erosion. The significance of the impact without any mitigation measures is **HIGH**. The implementation of mitigation measures can reduce the impact to **MEDIUM** (Table 7-5).

During the operational phase, topsoil will be removed from the pit area and stockpiled in designated areas. The topsoil stockpiles will be exposed to wind and rain and will be prone to erosion. Stormwater runoff from the access road surface will increase the risk of soil erosion in the areas directly next to the access road.

Erosion during the operational phase will be a moderate change that will be permanent. When left unmanaged and unrehabilitated, the erosion can affect the whole site. It is probable that soil erosion can occur especially during periods of intense rainfall or wind. The significance of the impact without any mitigation measures is **MEDIUM**. The implementation of mitigation measures can reduce the impact to **VERY LOW** (Table 7-5).

During the decommissioning and closure phases, most of the infrastructure will be removed such as the workshops and offices as well as the processing plant. Once the material is removed from the surface, the soil underneath will be exposed to erosion. The areas where topsoil was stockpiled will also be exposed to soil erosion as well as the newly rehabilitated surfaces of the pit area. It is expected that the haul road surface will remain bare and surface runoff from the road, will increase the risk of erosion in areas directly next to the road.

The formation of eroded areas after mining has ceased, is an impact with high intensity that is permanent. When left unmanaged and unrehabilitated, the erosion can affect the whole site. It is probable that soil erosion can occur, especially with newly exposed bare soil surfaces. The significance of the impact without any mitigation measures is **HIGH**. The implementation of mitigation measures can reduce the impact to **MEDIUM** (Table 7-5).

Table 7-5 Impact of increased soil erosion

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phase	**Construction**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Severe change (Very high)	Severe change (Very high)
Duration	Permanent (> 20 years)	Permanent (> 20 years)
Extent	Whole site	Site
Consequence	High	Medium
Probability	Probable (High)	Possible / frequent (Medium)
Significance	**High -**	**Medium -**
Description of Impact		
Phases	**Operational**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium)	Minor change (Low)
Duration	Very long term/ Permanent (> 20 years)	Very long term/ Permanent (> 20 years)
Extent	Whole site	Site
Consequence	Medium	Low
Probability	Probable	Possible / frequent
Significance	**Medium -**	**Very Low -**
Phases	**Decommissioning and Closure Phases**	
Criteria	**Without Mitigation**	**With Mitigation**

Intensity	Prominent change (High)	Severe change (Very high)
Duration	Permanent (> 20 years)	Permanent (> 20 years)
Extent	Whole site	Site
Consequence	High	Medium
Probability	Probable (High)	Possible / frequent (Medium)
Significance	**High -**	**Medium -**
Degree to which impact can be reversed	**Irreversible** - Soil erosion is irreversible and should be prevented. Once soil particles are transported away by wind or water, it cannot be returned.	
Degree to which impact may cause irreplaceable loss of resources	**High** - Once soil particles are lost from an area, it cannot be replaced.	
Degree to which impact can be avoided	**Medium** - Prevention of erosion is possible but the terrain of the JMIOP will pose difficulties because of steep slope	
Degree to which impact can be mitigated	**Medium** - Erosion can be mitigated by effective stormwater control and geotextiles, however, bare soil surfaces during the rainy season will limit mitigation success	
Cumulative impact		
Nature of cumulative impacts	There is currently little to no development in the project area, however, local subsistence farming and possible overgrazing in areas will likely have resulted in some soil erosion. Therefore the impact is predicted to be medium with no mitigation and low with mitigation measures implemented.	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Medium -	**Low -**
Residual impact		
Residual impact discussion	**Medium** – Post mining the residual impact is predicted to be medium.	

Table 7-6 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	To minimise the impact of increased soil erosion during all phases of the Jindal MIOP.
Mitigation actions/measures	
Construction Phase	
• Land clearance must only be undertaken immediately prior to construction activities and only within the development footprint. • Restrict land clearance to demarcated areas as agreed in the final infrastructure layout of the project. • Revegetation of soils which will be exposed for long periods, such as the topsoil stockpiles. • The Stormwater Management Plan must be designed to minimise soil erosion at topsoil stockpile areas resulting from surface water runoff.	
Operational Phase	
• The following measures should be implemented: • Regularly maintain the Stormwater Management Plan, especially around areas with bare soil surfaces such as the access road and topsoil stockpiles.	

<table>
<tr><th colspan="2">Management Outcome, Mitigation Actions/Measures and Monitoring</th></tr>
<tr><td colspan="2">• Revegetate any areas where soil surfaces remained bare around buildings after the construction phase such as around workshops and offices.</td></tr>
<tr><td colspan="2">Decommissioning Phase</td></tr>
<tr><td colspan="2">• Revegetation of all bare surfaces should be done as soon as infrastructure is removed.
• No additional areas outside of the demarcated footprint must be affected by vegetation removal during decommissioning of infrastructure.
• Final landform of sloped areas such as waste rock dumps must have concave areas and longer footslopes, to limit sedimentation of nearby areas.</td></tr>
<tr><td>Monitoring</td><td>Construction Phase
• The following monitoring is required:
  • Monthly inspections around the constructed infrastructure to detect early signs of soil erosion developing.
  • When signs of erosion are detected, the areas must be rehabilitated, using a combination of geo-textiles and re-vegetation to prevent the eroded area(s) from expanding.
• The following reporting is required:
  • No additional reporting required

Operational Phase
• The following monitoring is required:
  • Monthly inspections around surfaced areas and topsoil stockpiles to detect early signs of soil erosion developing.
  • When signs of erosion are detected, the areas must be rehabilitated, using a combination of geo-textiles and re-vegetation to prevent the eroded area(s) from expanding.
• The following reporting is required:
  • No additional reporting is required.

Decommissioning Phase
• The following monitoring is required:
  • Soil audit after decommissioning and prior to closure to detect any eroded areas and bare surfaces that has the potential risk of soil erosion.
  • When signs of erosion are detected, the areas must be rehabilitated, using a combination of geo-textiles and re-vegetation to prevent the eroded area(s) from expanding.
• The following reporting will be required once the soil audit is completed:
  • One soil audit report after decommissioning the records all areas that are eroded and all bare surfaces that are at risk of soil erosion. The soil audit must include recommendations for restoration of eroded areas and a revegetation plan.</td></tr>
</table>

7.4 IMPACT OF SOIL COMPACTION

7.4.1 Description of Impact

Soil compaction is the increased density of soil resulting from applied pressure. In some areas, such as where buildings and haul roads are constructed, soils are deliberately compacted for surface stability. All activities on the mine that require the movement of vehicles and equipment over the soil surface, contribute to soil compaction. The applied pressure resulting from the weight of the waste rock dumps and topsoil stockpiles, also contribute to soil compaction. Compacted soils limit root growth and are at higher erosion risk as it lacks a continuous macropore network that allow plant root growth, water movement and aeration. The absence of soil structure from the compacted soils also have reduced hydraulic conductivity. Compacted soils are difficult to alleviate and soil compaction remains throughout all project phases.

7.4.2 Source of Impact

The project activities/infrastructure likely to result in soil compaction include:

Project phase	Activity/infrastructure
Construction	• Earth-moving operations • Construction and delivery vehicles
Operational	• Haul vehicle movement • Processing plant and primary crusher • Dumping of waste rock
Decommissioning/ Closure	• Demolition activities • Vehicle movement

7.4.3 Impact Assessment

During the construction phase, the areas where the workshops and offices will be constructed will be resurfaced and compacted to ensure the stability of the road surface and the buildings that are constructed. During this phase topsoil will also be stripped from the waste rock dump areas as well as a part of the pit area. These soils will be stockpiled in demarcated areas for topsoil stockpiles. Vehicles and equipment will traverse over the soil surface and the applied pressure will cause soil compaction. During the operational phase, soil will be stripped from the sections of the pit area where the ore are mined, and the topsoil are transported to the stockpile areas where it increases the weight of the topsoil stockpiles. The movement of ore trucks and vehicles over the haul roads continue to add pressure to the already compacted soils of the haul roads. During the decommissioning and closure phases, the removal of materials and infrastructure from site and the levelling of topsoil in areas that are rehabilitated, adds pressure to the soil surface.

The significance of the impact without any mitigation measures is **HIGH** and with the implementation of mitigation measures can be reduced to **MEDIUM** (Table 7-7).

Table 7-7 Soil compaction

Impacts to ecological connectivity and/or ecological disturbance Impacts		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	All	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Severe change (Very high)	Prominent change (High)
Duration	Permanent (> 20 years)	Long-term (10 to 20 years)
Extent	Whole site and nearby surroundings	Part of site/property
Consequence	High	Medium
Probability	Definite / Continuous (Very high)	Probable (High)
Significance	**High -**	**Medium -**
Degree to which impact can be reversed	**Partially reversible** - Soil compaction can be alleviated through deep ripping but the negative impact on water infiltration and root development remains for years	
Degree to which impact may cause irreplaceable loss of resources	**Low** - Soil is not lost, but the functionality is compromised.	
Degree to which impact can be avoided	**None** - Soil compaction is unavoidable, especially in areas of haul roads and laydown areas	
Degree to which impact can be mitigated	**Low** - Some areas will have to be compacted for surface stability	
Cumulative impact		
Nature of cumulative impacts	There is currently little to no development in the project area and the cumulative impact is therefore predicted to be low.	
Rating of cumulative impacts	**Low -**	**Low -**
Residual impact		
Residual impact discussion	**Low** – The residual impact is assessed to be low.	

Table 7-8 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	To minimise the impacts of soil compaction during all phases of the Jindal MIOP.
Mitigation actions/measures	
All Phases	

- Do not allow vehicle and equipment movement or parking outside of demarcated areas.
- Materials must be off-loaded and stored in designated laydown areas.
- Use specific tracks for tipping trucks.
- Rip all compacted areas such as roads and stockpiles areas, during the last phases of site rehabilitation.

Management Outcome, Mitigation Actions/Measures and Monitoring	

Monitoring	• The following monitoring is required:
	  • The bulk density of rehabilitated areas must be measured once the rehabilitation of a specific area is completed as well as before the final closure of the mine.
	  • The bulk density measurement must be included as a parameter in the land capability audit.
	  • The audit must be completed by a SACNASP registered soil or agricultural scientist.
	  • A land capability audit is also required after the final land rehabilitation of the mined area following the decommissioning phase.
	  • If the bulk density exceeds 1.5 $kg.m^{-3}$, deep ripping must be applied to the compacted surface after the audit.
	  • In areas where bulk density exceeded 1.5 $kg.m^{-3}$, a follow-up assessment must be conducted six months after deep ripping to determine whether the action was successful in alleviating the compaction.
	
	• The following reporting is required:
	  • The results of the bulk density measurements must be submitted as part of the land capability audit report.
	  • The report must indicate all areas where deep ripping is required.
	  • Any areas where deep ripping was done, must be re-audited within six months after deep ripping and the report submitted to the environmental management team of the mine.

7.5 IMPACT OF SOIL POLLUTION

7.5.1 Description of Impact

Activities associated with the proposed mining project such as vehicles and equipment traversing the area during topsoil stripping and infrastructure construction, dust suppression on haul roads, ore crushing and processing and storage of chemicals, lubricants and fuel on site, can all be sources of soil pollution. During the decommissioning phase, the materials that are in contact with the soil surface when infrastructure is demolished, can contaminate the soil surface. The potential contaminants include trace elements that are part of the iron ore complex, petroleum hydrocarbons and volatile organic compounds.

7.5.2 Source of Impact

The project activities/infrastructure likely to result in soil erosion include:

Project phase	Activity/infrastructure
Construction	• Earth-moving operations • Construction and delivery vehicles • Generation of waste during construction
Operational	• Dust suppression on haul roads • Haul vehicle movement • Crushing and processing of ore • Dumping of waste rock
Decommissioning/ Closure	• Demolition activities • Vehicle movement

7.5.3 Impact Assessment

During the construction phase, vehicles and equipment will traverse the mine site when soil will be stripped from areas where infrastructure will be constructed. The emissions from the vehicles and equipment are a source of soil contamination, including any fuel and/or oil spillage from the vehicles. Materials and products such as concrete, paints and solvents will be used during construction, and these are all potential sources of soil contamination. Once the haul roads have been constructed, dust will be suppressed on these roads. The chemicals used for dust suppression, as well as the water itself, can be a source of contamination. During the decommissioning phase, the demolition of infrastructure can result in soil contamination through the emissions from vehicle movement as well as the demolished materials itself. Contamination of the soil surface can also affect groundwater and surface water resources as the pollutant particles can enter water resources when rainwater seeps through the soils.

The risk of potential soil pollution is an impact with high intensity that will result in a prominent change. When left unmanaged and unrehabilitated, the soil pollution can negatively affect areas beyond the site, especially if contaminants enter water resources on site. Without any mitigation measures, soil pollution can definitely occur and the significance of the impact without any mitigation measures is **HIGH**. The implementation of mitigation measures can reduce the impact to **LOW** (Table 7-9).

Table 7-9 Soil pollution

Impacts to ecological connectivity and/or ecological disturbance Impacts		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	All	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Prominent change (High)	Minor change (Low)
Duration	Very long term/ Permanent (> 20 years)	Short-term (1 and 5 years)
Extent	Beyond site	Regional/National
Consequence	High	Medium
Probability	Definite / Continuous	Conceivable
Significance	**High -**	**Low -**
Degree to which impact can be reversed	**Fully reversible** - Soil pollution can be reversed when detected early enough while the polluted area is still small and can be contained. There are specialised service providers that can assist with pollution clean up and remediation once it is detected.	
Degree to which impact may cause irreplaceable loss of resources	**Low** - Soil is not lost, but the functionality is compromised.	
Degree to which impact can be avoided	**Medium** - Soil pollution can be avoided, especially in areas of haul roads and laydown areas	
Degree to which impact can be mitigated	**High** – With regular monitoring and regular maintenance of vehicles and equipment, the significance of soil pollution can successfully be reduced.	
Cumulative impact		

Impacts to ecological connectivity and/or ecological disturbance Impacts		
Nature of cumulative impacts	There is currently little to no development in the project area and the cumulative impact is therefore predicted to be low.	
Rating of cumulative impacts	**Low -**	**Low -**
Residual impact		
Residual impact discussion	**Low** – The residual impact is assessed to be low.	

Table 7-10 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	To prevent and minimise the impacts of soil pollution during all phases of the Jindal MIOP.
Mitigation actions/measures	
All Phases	
• Regular monitoring of all vehicles and equipment to ensure vehicle emissions are within acceptable limits and to prevent oil and fuel spills. • Materials must be off-loaded and stored in designated laydown areas. • No solvents, chemicals and paints must be stored outside designated store rooms and workshops. • Fuel must be stored in a bunded area.	

Monitoring	The following monitoring is required:
	• Appoint a SACNASP registered soil scientist to conduct an annual soil pollution audit.
	• The audit must include a site visit to the mine during which soils will be sampled using a soil auger. The site visit must include a site walkover in the areas of existing mining activities as well as around the fringes, to determine if there are soil impacts not anticipated in the Environmental Authorization process.
	• Topsoil must be sampled in areas of likely impact on soil quality as well as at two reference points that can be used for calculation of the Contamination Factor.
	• It is recommended that no fewer than eight soil samples be analysed for each monitoring cycle. The samples must be submitted to a soil laboratory and be analysed for the following parameters:
	  o pH
	  o EC
	  o Water-soluble anions (sulphate, phosphate, nitrate, chloride, fluoride)
	  o Total Petroleum Hydrocarbons
	  o BTEX (benzene, toluene, ethylbenzene and xylene)
	• Once the analysis results are received, a report must be compiled to describe the current soil physical and chemical conditions of soils within and around the mining footprint.
	• The report must include recommendations for future sampling and considerations for remediation (if any issues have been detected).

8. VISUAL

8.1 IMPACT ON LANDSCAPE AND VISUAL ASPECTS

8.1.1 Description of Impact

The proposed mining activities occur in moderate to high rated landscape character types, i.e. grassland hills, open bush and villages and homesteads on grassland hills. In addition, sizeable portions of the study area's landscape have a low visual absorption capacity (VAC) meaning that the existing landscape's ability to absorb physical changes caused by the project without transforming its visual character and quality is limited.

The Project is proposed in a 'greenfields' area, surrounded by rural residential development and a few tourism facilities. Viewing areas, typically from residences and tourist facilities/routes are the most sensitive since views from within these areas are potentially frequent and of long duration. Sensitive receptor locations are identified in Figure 8-1. Given the anticipated sensitivity of receptors as described above, the primary areas of concern are:

- Residential properties associated with rural development on the hills in and around the Project site north and east of the ridgeline.
- Residential/homestead, farming and tourist facilities south of the ridgeline and associated with the Goedertrouw Dam and environs, including Shakaland.
- Travellers along the R66 main road.

Sensitive viewing locations occur throughout the study area and across the proposed mining area, making the development susceptible to visual and aesthetic impacts (Figure 8-1). A high visual impact is expected for sections of the study area immediately surrounding the site up to distances of 3 km to 5 km in an arc from the southwest through to the northeast of the mine.

In addition, the impact of lights at night is a sensitive issue associated with mines. Interested and affected parties (I&APs) consistently raise the impact of night lighting, specifically if they can be seen from tourist and residential sites.

The intensity of visual impacts considers four main factors:

- Visual Intrusion: The nature of intrusion or contrast (physical characteristics) of a Project component on the visual quality of the surrounding environment and its compatibility/discord with the landscape and surrounding land use within the context of the landscape's VAC;
- Visibility: The area/points from which Project components will be visible;
- Visual exposure: Visibility and visual intrusion qualified with a distance rating to indicate the degree of intrusion; and
- Sensitivity: Sensitivity of visual receptors to the proposed development.

Given these factors, the intensity of the visual impact is summarised in Table 8-1.

Table 8-1 Intensity of Visual Impact

High For residential properties north, south and west of the mine during the construction and operational phases	**Moderate** From sections of the R66 and homesteads east of the mine.	**Low** *For* residences, farming activities and tourist facilities south of the mine beyond the ridgeline, and areas associated with the Goedertrouw Dam and environs.	**Negligible** The remainder of the study area
Major loss of or alteration to key elements / features / characteristics of the baseline in the immediate vicinity of the site. i.e. Pre-development landscape or view and / or introduction of elements considered to be uncharacteristic when set within the attributes of the receiving landscape. **High visual impacts would result.**	Partial loss of or alteration to key elements / features / characteristics of the baseline. i.e. Pre-development landscape or view and / or introduction of elements that may be prominent but may not necessarily be problematic when set within the attributes of the receiving landscape. **Moderate visual impacts would result**	Minor loss of or alteration to key elements / features / characteristics of the baseline. i.e. Pre-development landscape or view and / or introduction of elements that may not be problematic when set within the attributes of the receiving landscape. **Low visual impacts would result.**	Very minor loss or alteration to key elements/features/characteristics of the baseline. i.e. Pre-development landscape or view and / or introduction of elements that is not problematic with the surrounding landscape – approximating the 'no change' situation. **Negligible scenic quality impacts would result.**

8.1.2 Source of Impact

The project activities/infrastructure likely to result in impacts to landscape and visual aspects include:

Project phase	Activity/infrastructure
Construction	• Land clearance and earthworks • Building of access and haul roads • Construction of the processing plant, crusher and power yard and associated infrastructure • Night lighting
Operational	• Blasting • Mining activities and pit creation • Waste Rock Dump • Movement of vehicles • Night lighting
Decommissioning/ Closure	• Demolition and dismantling activities • Rehabilitation activities

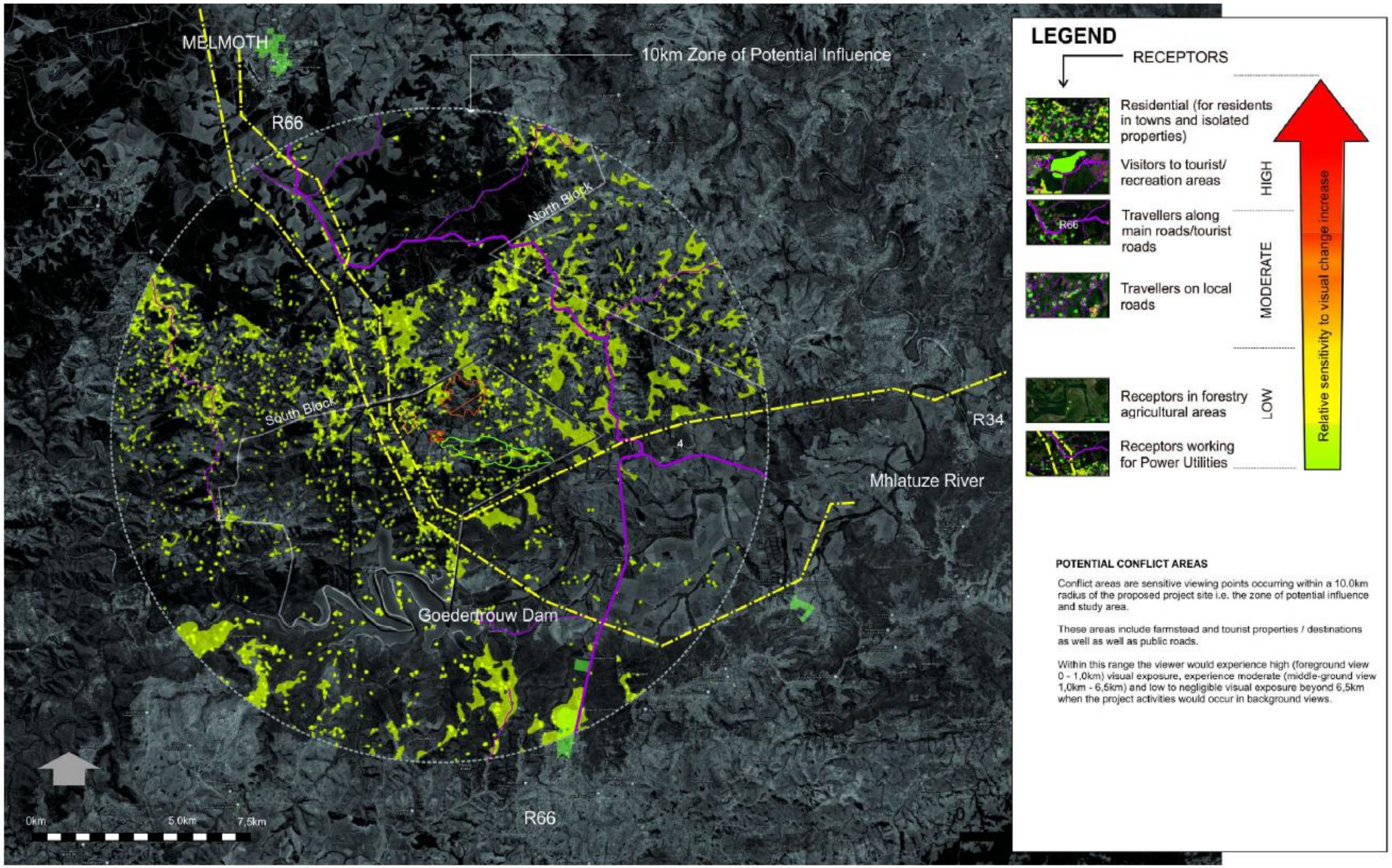

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FIGURE 8-1
RECEPTOR SENSITIVITIES

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8.1.3 Impact Assessment

Construction activities include the removal of vegetation, extensive earthworks required to create haul roads and access roads as well as terraces for offices, the processing plant, the primary crusher and the power yard and would continue with the erection of these infrastructural activities. Construction activities would negatively affect the landscape's visual quality and sense of place relative to its baseline. They would contrast with the patterns that define the structure of the landscape and cause an intense change over a localized area, resulting in a significant change to key views.

The impact on the visual environment during the construction phase is assessed to have a very high intensity and would occur over the short term (less than five years). The unmitigated impact is thus predicted to be **HIGH**. The implementation of mitigation measures would not significantly reduce the anticipated impact, which would remain **HIGH** (Table 8-2).

Operational activities include the removal of vegetation, topsoil and soft overburden from the pit area as the mine advances, excavation of the mine areas, trucks moving overburden to the WRD and material being transferred to the processing plant, graders maintaining the haul roads and water tankers wetting the roads, expansion of the WRD and product stockpiles as the mining progresses and light from the plant and crusher areas, including security and other lighting associated with the movement of vehicles at night.

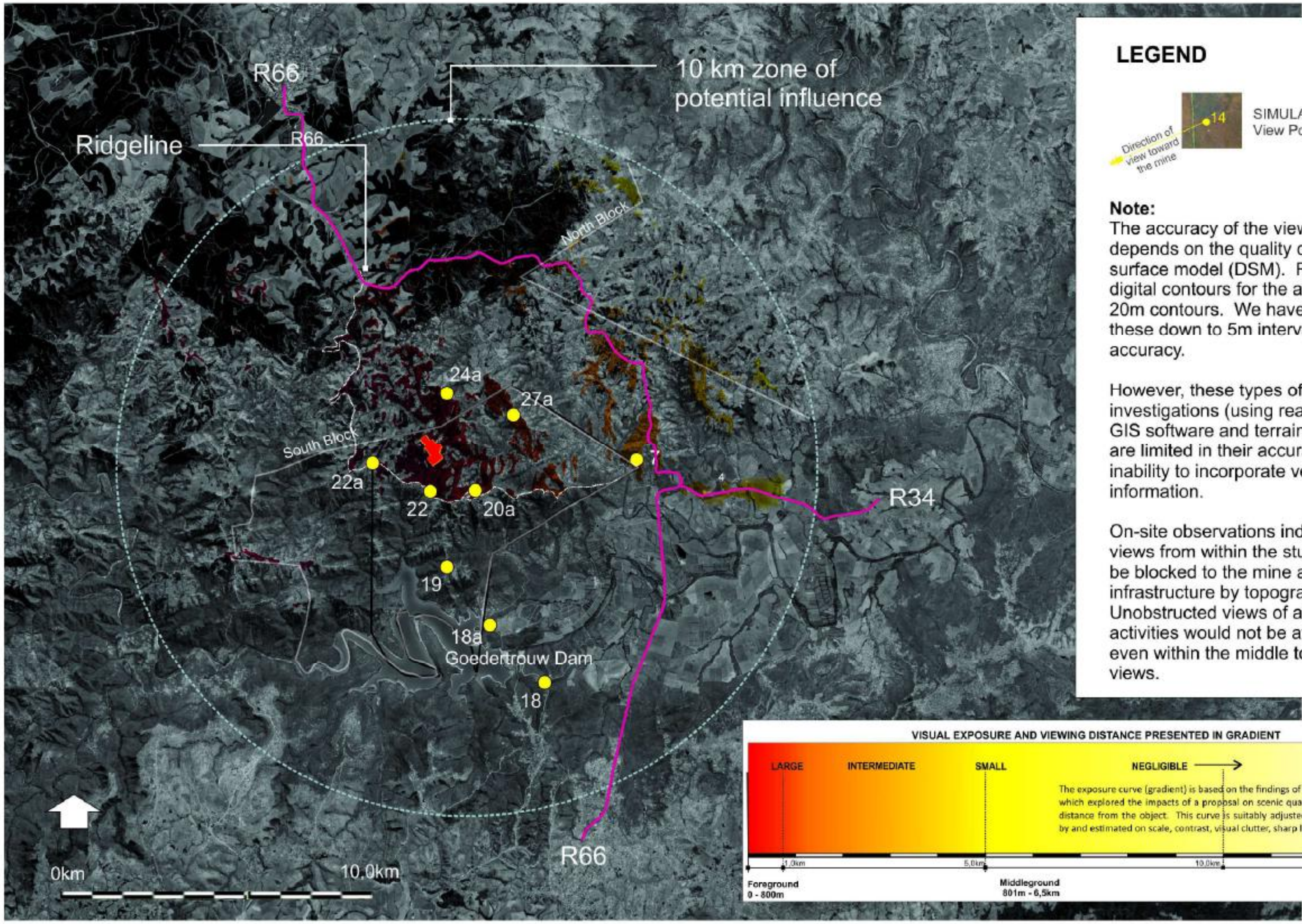
Project components are planned within a moderate to highly rated landscape and would potentially be highly visible to people living within a 5 km radius and along the R66 and other local roads. However, the ridgeline south of the mine acts as a visual divide between views from the far south and west. The screening effect of the ridgeline is evident in the viewsheds presented in Figure 8-2 to Figure 8-4. The most visible aspect of the mine is the open pit which would be visible from both north and south of the ridgeline (Figure 8-5). Viewers from the south towards the mine would, however, only observe a receding ridgeline as it's mined away. Views from east of the mine are mostly screened by topography (Figure 8-6). The WRD would, however, be visible from areas associated with the citrus farms in the Mhlatuze valley and on the hills east and north east of the pit (Figure 8-4). Photomontages of the proposed Jindal MIOP and the associated infrastructure can be seen in Figure 8-7 to Figure 8-12.

A high visual impact is expected for sections of the study area immediately surrounding the site up to distances of 3 km to 5 km in an arc from the southwest through to the northeast of the mine.

The impact on the visual environment during the operational phase is assessed to have a very high intensity and would occur over the long term (25 years). The unmitigated impact would be localized but would extend beyond the site boundary (at least 3 km) and is assessed to be **VERY HIGH**. Mitigation measures are possible and could reduce the visual impact of the mine and its infrastructure to **HIGH** (Table 8-2).

Decommissioning and closure activities include the dismantling and removal of infrastructure and the rehabilitation and shaping of the WRD, building terraces and the pit.

The impact on the visual environment during the decommissioning and closure phases is assessed to have a moderate intensity and would occur over the long term. The unmitigated impact would be localized but extend beyond the site boundary (at least 3 km) and is assessed to be **HIGH**. However, after decommissioning and closure, when the rehabilitation of disturbed areas takes hold, the impact could reduce significantly to **MEDIUM** (Table 8-2). As the landscape recovers, there would be a loss of the original key elements and features of the baseline.



LEGEND

SIMULATION View Point

Note:
The accuracy of the viewshed analysis depends on the quality of the input digital surface model (DSM). Readily available digital contours for the area are limited to 20m contours. We have interpolated these down to 5m intervals to get better accuracy.

However, these types of viewshed investigations (using readily available GIS software and terrain contours only) are limited in their accuracy due to their inability to incorporate vegetation information.

On-site observations indicated that many views from within the study area would be blocked to the mine and its infrastructure by topography and tall trees. Unobstructed views of all the mine's activities would not be available, even within the middle to foreground of views.

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FIGURE 8-2
VIEWSHED ANALYSIS
PROCESSING PLANT
AND POWER PLANT

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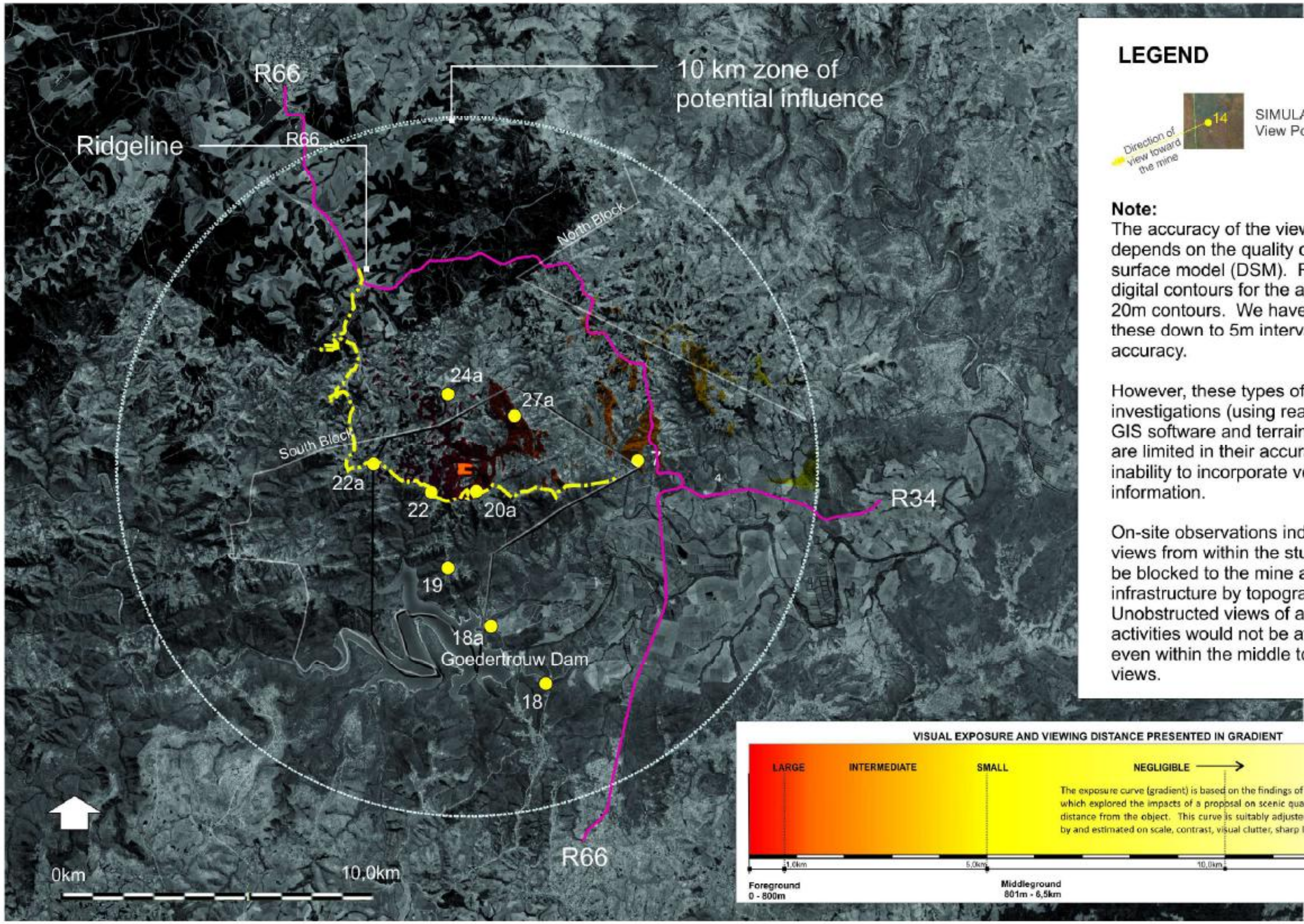

Note:
The accuracy of the viewshed analysis depends on the quality of the input digital surface model (DSM). Readily available digital contours for the area are limited to 20m contours. We have interpolated these down to 5m intervals to get better accuracy.

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On-site observations indicated that many views from within the study area would be blocked to the mine and its infrastructure by topography and tall trees. Unobstructed views of all the mine's activities would not be available, even within the middle to foreground of views.

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FIGURE 8-3
VIEWSHED ANALYSIS
PRIMARY CRUSHER

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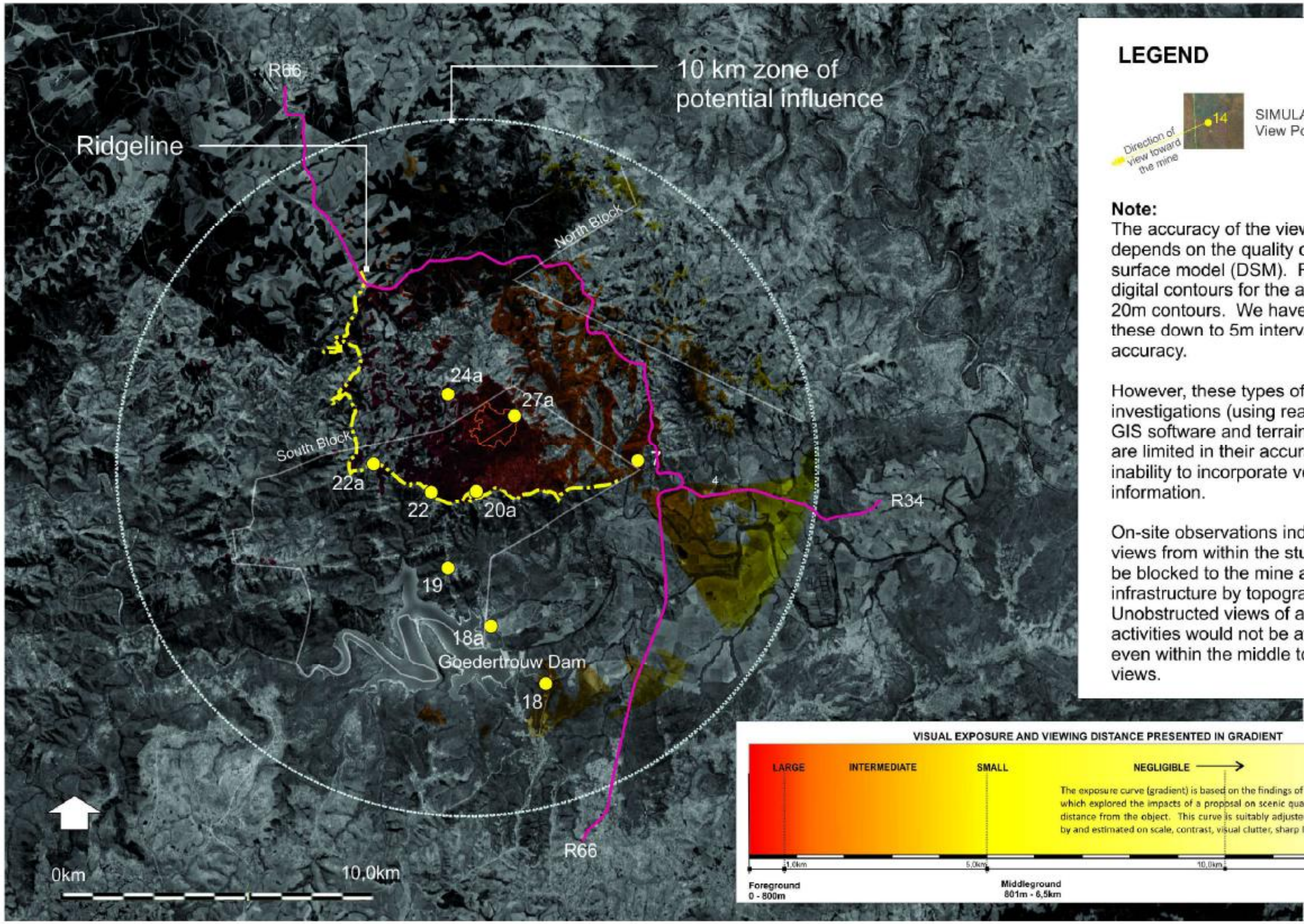

Note:
The accuracy of the viewshed analysis depends on the quality of the input digital surface model (DSM). Readily available digital contours for the area are limited to 20m contours. We have interpolated these down to 5m intervals to get better accuracy.

However, these types of viewshed investigations (using readily available GIS software and terrain contours only) are limited in their accuracy due to their inability to incorporate vegetation information.

On-site observations indicated that many views from within the study area would be blocked to the mine and its infrastructure by topography and tall trees. Unobstructed views of all the mine's activities would not be available, even within the middle to foreground of views.

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FIGURE 8-4
VIEWSHED ANALYSIS
WASTE ROCK DUMP

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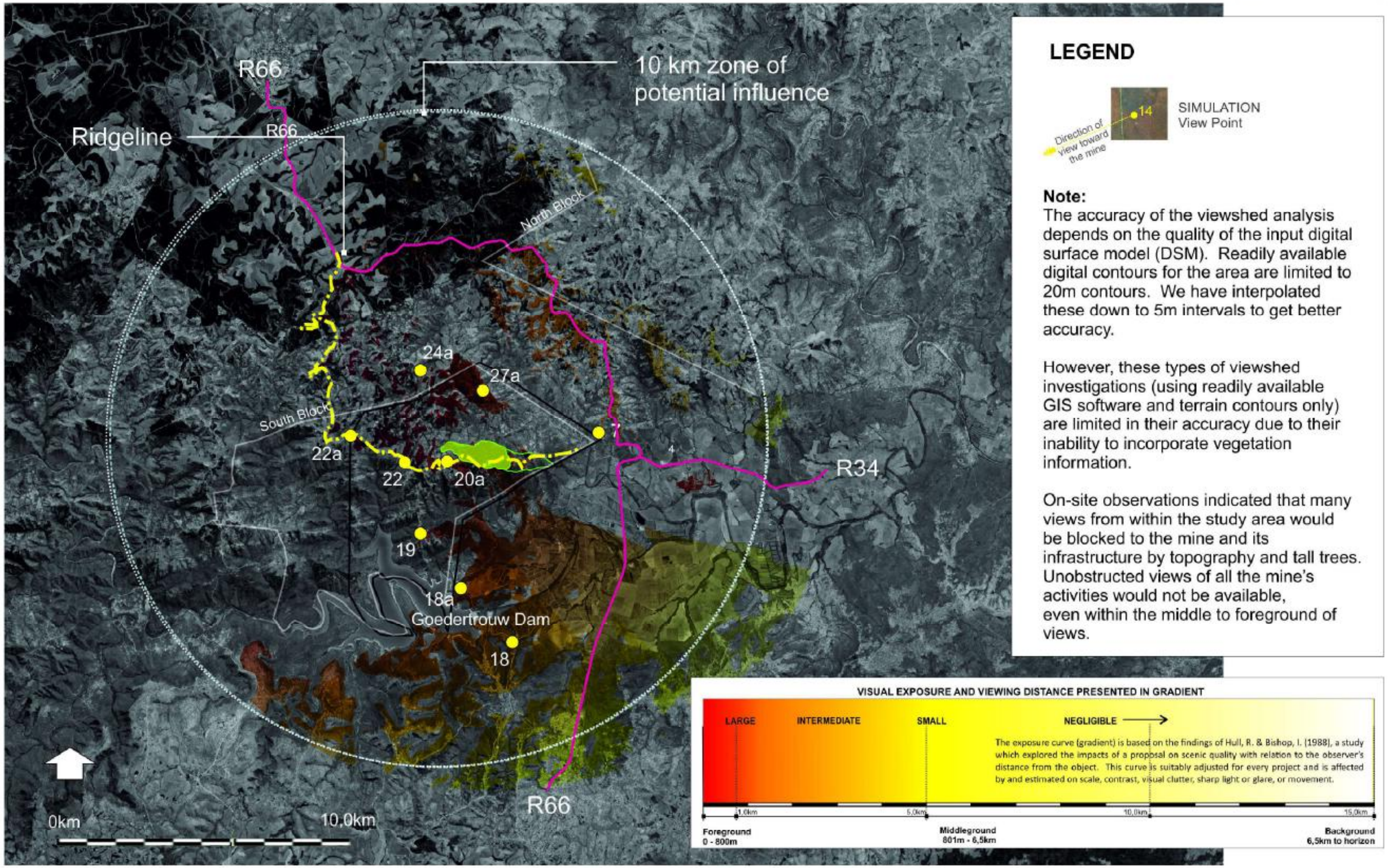

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FIGURE 8-5
VIEWSHED ANALYSIS
WESTERN SECTION
OF PIT

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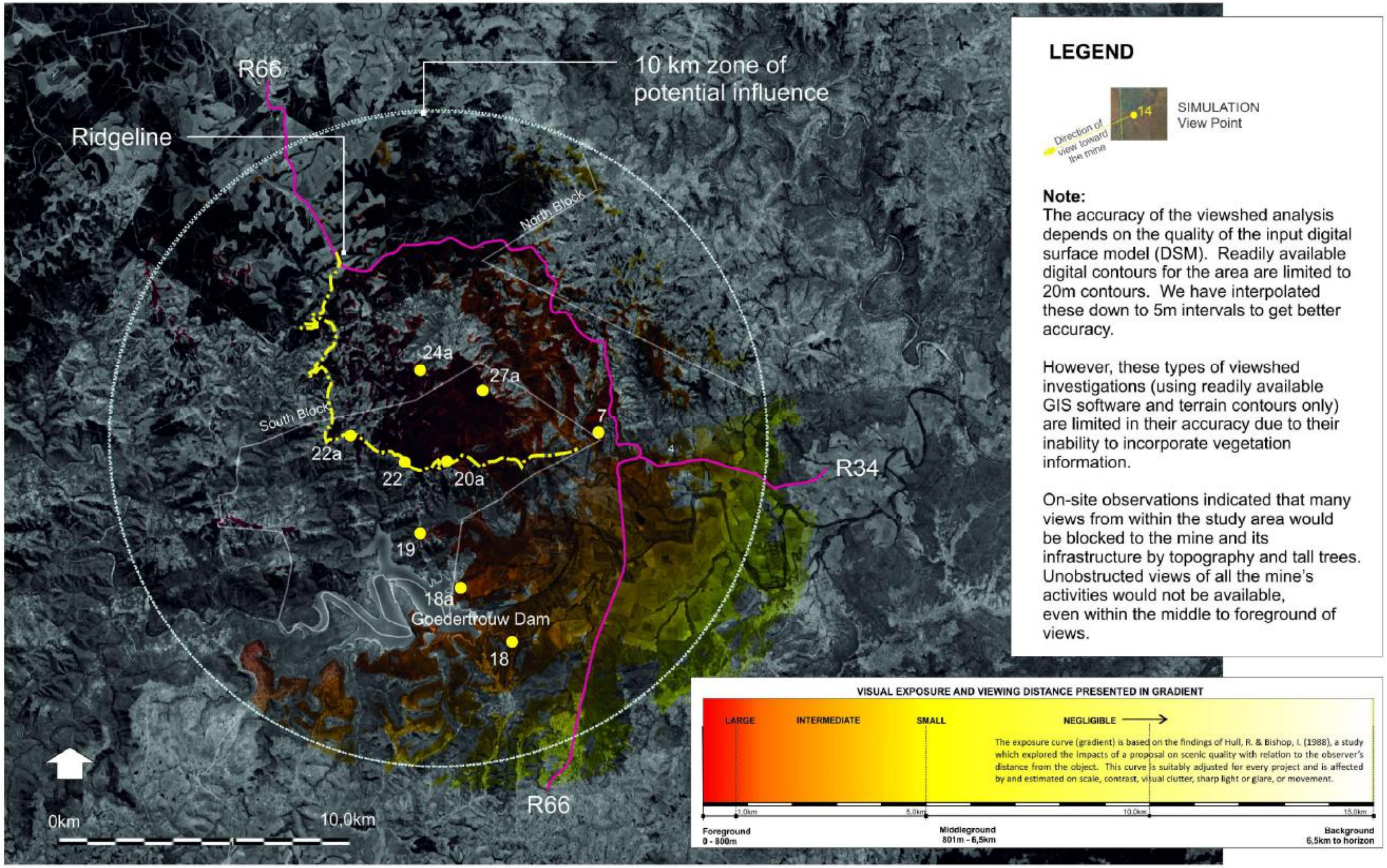

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FIGURE 8-6
VIEWSHED ANALYSIS
ALL PROPOSED
INFRASTRUCTURE

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Figure 8-7 Viewshed analysis – Simulation 7

Figure 8-8 Viewshed analysis – Simulation 14

Figure 8-9 Viewshed analysis – Simulation 19

Figure 8-10 Viewshed analysis – Simulation 20a

Figure 8-11 Viewshed analysis – Simulation 22

Figure 8-12 Viewshed analysis – Simulation 24a

Table 8-2 Visual impact on receptors

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phase	**Construction**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Severe change (Very high)	Severe change (Very high)
Duration	Short-term (Low)	Short-term (Low)
Extent	Far beyond site (High)	Far beyond site (High)
Consequence	High	High
Probability	Definite / Continuous	Definite / Continuous
Significance	**High -**	**High -**
Description of Impact		
Phases	**Operational**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Severe change (Very high)	Prominent change (High)
Duration	Permanent (Very Long)	Long-term (High)
Extent	Far beyond site (High)	Far beyond site (High)
Consequence	Very high	High
Probability	Definite / Continuous	Probable
Significance	**Very high -**	**High -**
Phases	**Decommissioning and Closure Phases**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium)	Minor change (Low)
Duration	Long-term (High)	Long-term (High)
Extent	Far beyond site (High)	Beyond site (Medium)
Consequence	High	Medium
Probability	Probable	Probable
Significance	**High -**	**Medium -**
Degree to which impact can be reversed	**Irreversible** - The reversal of the change to key elements/features/ characteristics of the baseline landscape and key views is not realistically feasible.	
Degree to which impact may cause irreplaceable loss of resources	**High** - There would be a major loss of or alteration to key elements/ features/ characteristics of the baseline causing an intensive change over a localized area resulting in a major change in key views.	
Degree to which impact can be avoided	**Low** – Due to the size of the project avoidance is not an option.	
Degree to which impact can be mitigated	**Low** – Although mitigation can to some extent minimise the impact, due to the size of the development mitigation would only marginally minimise the impact.	
Cumulative impact		

Nature of cumulative impacts	The proposed Jindal MIOP would be a new land-use introduced to the sub-region, and as such, there is no cumulative effect with respect to other mining projects. However, the cumulative effect of individual components of the mine, including the proposed tailings storage facility (TSF) which occur in distinct locations in the study area, has been discussed and rated in terms of the anticipated effect of the project on the landscape and key views of the area.	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Very high -	**High -**
Residual impact		
Residual impact discussion	**Medium** – The residual impact, post decommissioning and closure of the mine and rehabilitation of the WRD and terraces would result in a medium residual impact.	

Table 8-3 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	To minimise the impacts of noise during all phases of the Jindal MIOP.
Mitigation actions/measures	
Construction Phase	

- Apply dust suppression methods to limit the dust generated on haul roads and at the primary crusher and processing plant areas.
- With the preparation of the portions of land on which activities will take place, the minimum amount of existing vegetation and topsoil should be removed and should be scheduled for just before they are required for construction.
- Progressive rehabilitation, where feasible, of disturbed areas should be carried out to minimise the amount of time bare soils are exposed, creating a sharp contrast with the existing landscape.
- All topsoil that occurs within the proposed footprint of an activity must be removed and stockpiled for later use in accordance with a Topsoil Management Plan. The construction contract must include the stripping and stockpiling of topsoil. Topsoil would be used later during the rehabilitation phase and / or ongoing rehabilitation. The presence of degraded areas and disused construction roads, which are not rehabilitated, will increase the overall visual impact.
- Construction activities should be limited to between 08:00 and 17:00, where possible. It is recommended that discussions are undertaken with local landowners who would be affected by the project during the construction phase to determine what would be a reasonable time to carry out construction activities, given the relative location of households to the proposed project activities.
- During construction, temporary fences surrounding the material storage yards and laydown areas should be draped with 'shack' cloth (khaki coloured).
- All construction/establishment activities must remain within specifically demarcated areas.
- Building or waste material should be discarded at an authorised/ licensed location, which should not be within any sensitive areas.
- Earthworks should be executed so that only the footprint and a small 'construction buffer zone' around the proposed activities are exposed. In all other areas, the naturally occurring vegetation should be retained, especially along the periphery of the project sites.
- Paint all structures with colours that reflect and compliment the colours of the surrounding landscape. This can be achieved by painting rooftops and walls of buildings in the hues and tones of the surrounding grasslands. To further

Management Outcome, Mitigation Actions/Measures and Monitoring	
reduce glare potential, the external surfaces of structures should be painted with matt paints and pure whites and blacks should be avoided.	
Operational Phase	
• Apply dust suppression methods to limit the dust generated on haul roads and at the crushing and processing plant areas • Where new vegetation is proposed to be introduced to the site, an ecological approach to rehabilitation, as opposed to a horticultural approach, should be adopted as per the approved Rehabilitation Plan. For example, communities of indigenous plants will enhance biodiversity, a desirable outcome for the area. This approach can significantly reduce long-term costs as less maintenance would be required over conventional landscaping methods as well as the introduced landscape is more sustainable. • Progressive rehabilitation, where feasible, of disturbed areas should be carried out to minimise the amount of time bare soils are exposed, creating a sharp contrast with the existing landscape. • Install light fixtures that provide precisely directed illumination to reduce light "spillage" beyond the immediate surrounds of the site, i.e. lights (spotlights) are to be aimed away from sensitive viewing areas. • Avoid high pole top security lighting along the periphery of the site and use only lights that are activated on illegal entry to the site. • Minimise the number of light fixtures to the bare minimum, including security lighting.	
Decommissioning Phase	
• Progressive rehabilitation, where feasible, of disturbed areas should be carried out to minimise the amount of time bare soils are exposed, creating a sharp contrast with the existing landscape. • At closure, all remaining exposed terraced areas should be formed, contoured, and revegetated to appear natural and blend with the surrounding topographic features in conformance with the Rehabilitation Plan. • Where areas are required to be rehabilitated and vegetation is proposed to be introduced to the site, an ecological approach, as opposed to a horticultural approach should be adopted. Communities of indigenous plants will enhance biodiversity which is a desirable outcome for the area. This approach can significantly reduce long-term costs as less maintenance would be required over conventional landscaping methods as well as the introduced landscape being more sustainable.	
Monitoring	**Construction Phase** • Monitoring or reporting of adherence to the proposed management measures should be conducted by the Environmental Control Officer (ECO) on a weekly basis during the construction phase. **Operational Phase** • Monitoring or reporting of adherence to the proposed management measures should be conducted by the Mine's Environmental Officer on a monthly basis. **Decommissioning Phase** • Monitoring or reporting of adherence to the proposed management measures should be carried out by the Environmental Control Officer (ECO) on a monthly basis.

9. CLIMATE CHANGE

9.1 IMPACT OF THE PROJECT ON CLIMATE CHANGE

9.1.1 Description of Impact

The greenhouse gas (GHG) inventory for the Jindal Project was developed in accordance with the SANS 14064-1:2021 standard, as well as the GHG Protocol (ISO 14064-1 (2006)). This analysis took into consideration the relevant emissions from core operations, as well as upstream and downstream emissions.

Table 9-1 summarises the calculated emissions for the Jindal Project for the direct emissions and significant indirect emissions. The key GHG emission sources are the consumption of electricity during operation and the processing of the sold concentrate during the steel production process.

The emissions from processing the iron ore[2] contributes 91% of the overall emissions. These emissions are calculated making use of the emission intensity published by Jindal's operations in India. This intensity is significantly higher than the global average for steel production. As such, the downstream emissions from the project could change significantly, should the steel be produced elsewhere. The higher emission factor has been selected to be conservative in the estimate of the downstream emissions. Should the iron ore be processed in a plant indicative of the global average which includes new build plants in developed countries such as Europe, the emissions from downstream processing could decrease by approximately 40%.

Table 9-1 Construction and operational emissions for the Jindal MIOP

Emission category	Emission source	Construction phase	Operation phase	Total over life of project (25 years)
Category 1: Direct GHG emissions and removals)	Diesel Combustion	1 530 tCO_2e	103 029 tCO_2e	2 575 722 tCO_2e
Category 2: Indirect GHG emissions from imported energy	Electricity		1 213 978 tCO_2e	30 349 453 tCO_2e
	Fuel & energy related emissions not included in category 1 and 2	340 tCO_2e	159 855 tCO_2e	3 996 375 tCO_2e
Category 3: Indirect GHG emissions from transportation	Waste generated in operations	444 tCO_2e		
	Employee commuting		546 tCO_2e	13 659 tCO_2e
	Downstream transportation and distribution		220 804 tCO_2e	5 520 102 tCO_2e
Category 4: Indirect GHG emissions from products used by organization	Purchased goods and services	323 568 tCO_2e		

2 Emission Source: Category 5: Indirect GHG emissions from use of products sold by organization

Emission category	Emission source	Construction phase	Operation phase	Total over life of project (25 years)
Category 5: Indirect GHG emissions from use of products sold by organization	Processing of sold product		18 144 000 tCO_2e	453 600 000 tCO_2e
Total indirect emissions		**324 531 tCO_2e**	**19 739 184 tCO_2e**	**493 479 589 tCO_2e**
Total emissions		**325 881 tCO_2e**	**19 842 212 tCO_2e**	**496 055 311 tCO_2e**

9.1.2 Source of Impact

The project activities/infrastructure likely to result in impacts to climate change include:

Project phase	Activity/infrastructure
Operational	• Contribution to renewable energy sources through steel production
Operational	• Blasting • Mining activities and pit creation • Waste Rock Dump • Movement of vehicles • Night lighting
Decommissioning/ Closure	• Demolition and dismantling activities • Rehabilitation activities

9.1.3 Impact Assessment

During the construction phase the proposed Jindal MIOP will consume diesel for various activities. The combustion of this diesel results in direct GHG emissions from the project. The manufacturing and transport of purchased fuels and materials also leads to GHG emissions. These emissions are indirect emissions for the project.

The emissions considered for this impact assessment are those that occur within the boundary of South Africa. This includes all direct and indirect GHG emissions associated with the project construction phase. The direct and indirect emissions occurring within South Africa from the Jindal MIOP construction phase amounts to approximately 325 000 tCO_2e/year.

The emissions considered for this impact assessment are those that occur within the boundary of South Africa. This includes all direct and indirect GHG emissions associated with the project. As a result, the emissions from the transport and processing of the concentrate are excluded from the assessment despite these emissions forming a significant portion of the overall GHG inventory. These emissions are excluded as the transport occurs in international waters and the processing is most likely to occur in India. The direct and indirect emissions occurring within South Africa from the Jindal Project amounts to approximately 1.5 million tCO_2e/year.

However, iron and steel will play a vital role in the global transition to a low-carbon economy. According to the World Bank, global cumulative demand for steel under a 4-degree scenario[3] is approximately 1.5 billion tonnes. This means that an additional 1.5 billion tonnes of steel up to 2050 is required. Under a 2-degree scenario, this demand increases to 2.5 billion tonnes, an additional 1 billion tonnes of steel[4], approximately 67% increase from the 4-degree scenario. The global increase in demand for iron and steel will be partially driven by the growth in demand for components used in renewable energy technologies.

A second World Bank report further investigates this global increase in demand for minerals and metals specifically in the energy sector[5]. Iron, a key component in steel production, is projected to have an increase in demand of up to 219% in the energy sector, depending on the scenario.

The iron ore, and subsequent steel, from Jindal is an enabler for moving the global economy to a 2-degree scenario. The global economy will not be able to move to a lower GHG emissions scenario without a substantial increase in renewable energy infrastructure development, which will require steel.

The Project would, therefore, have an overall positive net climate change impact, as the project could result in 2 743 tCO_2e abated by the economy for every tonne of iron produced. The mine itself will only emit 0.18 tCO_2e/tonne ore, which is immaterial when compared to the potential abatement. The lifetime emissions of the project forms 0.01% of the emissions that could be abated through its potential contribution to the transition to a low-carbon economy.

Provided the iron ore ends up in the renewable energy sector the unmitigated impact is predicted to be **HIGH POSITIVE**. The implementation of mitigation measures would not significantly reduce/ enhance the anticipated impact, which would remain **HIGH POSITIVE** (Table 9-2).

Detailed information is not available for the decommissioning phase. Compared to the operational emissions, it is expected that the decommissioning phase emissions of the proposed Jindal MIOP would be insignificant. Nevertheless, it is important that the impacts of climate change are considered in the decommissioning and rehabilitation plans.

Table 9-2 Impact of the project on climate change

Impacts to Water Quality		
Type of Impact	Direct/ Indirect	
Nature of Impact	Positive	
Phases	All	
Criteria	**Without Mitigation**	**With Mitigation**
Phases	**Construction**	
Intensity	Minor change (Low)	Minor change (Low)
Duration	Short-term (1 and 5 years)	Short-term (1 and 5 years)
Extent	Local	Local
Consequence	Medium	Medium
Probability	Possible / frequent	Possible / frequent

[3] The idea of a four degree world refers to what climate models predict the world could look like by 2100 when, averaged over all of earth's surfaces, temperatures rise by four degrees Celsius compared to pre-industrial levels - **https://www.carbonbrief.org/what-is-a-4c-world** - accessed 25 April 2023
[4] World Bank. 2017. *The Growing Role of Minerals and Metals for a Low Carbon Future.*
[5] World Bank. 2020. *Minerals for Climate Action: The Mineral Intensity of the Clean Energy Transition*

Significance	**Low -**	**Low -**
Phases	**Operational**	
Intensity	Minor change (Low positive)	Minor change (Low positive)
Duration	Long-term (10 and 20 years)	Long-term (10 and 20 years)
Extent	Regional/ National	Regional/ National
Consequence	High positive	High positive
Probability	Definite	Definite
Significance	**High +**	**High +**
Degree to which impact can be reversed	N/A	
Degree to which impact may cause irreplaceable loss of resources	N/A	
Degree to which impact can be avoided	N/A	
Degree to which impact can be mitigated/ enhanced	**Low**	
Cumulative impact		
Nature of cumulative impacts	The cumulative impacts are assessed to be very low on a global and local scale in terms of emissions.	
Rating of cumulative impacts	**Very low -**	**Very low -**
Residual impact		
Residual impact discussion	**High +** - The residual impact is assessed to be a high +.	

Table 9-3 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	To minimise the impact on climate change due to project activities.
Mitigation actions/measures	
Construction Phase	
• There are several non binding proposals for mitigation of these emissions, such as fuel additives in diesel vehicles or regular service intervals to ensure optimal vehicle efficiency. • The impact of these mitigation measures could marginally reduce the energy emissions of the construction phase.	
Operational Phase	

• Some potential options for energy use reduction to be considered include:
  • Decarbonisation of the electricity supply: This could come in several forms, such as the decarbonisation of the grid emission factor as new renewable energy comes online in the national grid system. Alternatively, some decarbonisation could be achieved through the installation of on-site renewable energy for own use.
  • Electrification of the fleet: This option could mitigate emissions by electrifying the mine vehicle fleet and reducing the fuel consumption in mobile machinery. The electrification could be combined with renewable energy for further mitigation.	

Monitoring	• N/A

9.2 PROJECT VULNERABILITY TO CLIMATE CHANGE

9.2.1 Description of Impact

Vulnerability is defined as the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes[6]. The physical risks of climate change, such as water stress, precipitation, and heat, must be evaluated at a localised level. The map presented below indicates the fire risk, flood risk, increased extreme rainfall and extreme hot days[7] for the Mthonjaneni Local Municipality, within which the Jindal MIOP is located. The trends displayed in the map indicate that the Mthonjaneni Local Municipality is exposed to numerous climate change risks such as fire and floods, specifically in the central region of the municipality, as well as an increase in extreme rainfall events and hot days.

The King Cetshwayo District Municipality's Climate Change Response Plan (2018)[8], further reported that the district is prone to climate-related hazards, prioritized hazards include severe storms (wind, hail, snow, lightning, fog), fire hazards, floods and drought. Rainfall variations within the Mthonjaneni Local Municipality are also likely to cause an increase in the number of rainfall days[9]. The increase in the rainfall intensity may likely result in flooding events across the district. The risks mentioned above must therefore be considered within the context of the project and within the context of the vulnerability of the local municipality.

According to the information provided, the map presented in Figure 9-1 summarises the risks associated with Mthonjaneni Local Municipality within which the Jindal Project is located. It is anticipated that the Mthonjaneni Local Municipality region of KwaZulu-Natal will experience increased temperatures and decreased rainfall volumes, with increased rainfall variability[10]. Such events will inevitably increase the municipalities risk to floods and fires. Such implications will inevitably have impacts on the Project's core operations, value chain and broader network.

The Jindal MIOPs core operations could be impacted by climate change in two main ways, namely, (i) the physical impacts on the mining infrastructure and (ii) the impact on labourers.

9.2.1.1 Physical Risks

Physical risks relate to the direct impacts climate change conditions may have on several sectors of society and the environment. With relevance to the Jindal MIOP, the physical risks considered include the impacts temperature and rainfall will have on the project, the work force, and the surrounding local community. Agricultural crops are considered in so far as they impact on community vulnerability. If the climate change impacts affect the agriculture in an area, it will increase the vulnerability. The Jindal MIOP will be an open pit

[6] IPCC, 2022: Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. In Press.

[7] Extreme hot days are defined as summertime temperatures that are much hotter and/or humid than average (**https://www.cdc.gov/disasters/extremeheat/heat_guide.html**).

[8] Available at: **https://letsrespondtoolkit.org/municipalities/kwazulu-natal/king-cetshwayo/**.

[9] **https://letsrespondtoolkit.org/municipalities/kwazulu-natal/king-cetshwayo/**.

[10] Green Book Tool, *Mthonjaneni Local Municipality: Current status*, [Website] Available at: **https://riskprofiles.greenbook.co.za/** [accessed on 31/03/2022].

mine, and as a result the risk of dust needs to be considered in respect to climate change. Such implications would likely impact not only the mine operations, but the surrounding environments and communities as well.

Temperature

It is expected that the Mthonjaneni Local Municipality will experience an increase in average temperature, as well as an increase in the frequency of hot days. The average temperature is said to increase by between 1.7°C to 2.0°C by the middle of the century under the Shared Socio-economic Pathway (SSP 2 – previously RCP 4.5) scenario and between 2.10°C to 2.3°C under an SSP 5 (RCP 8.5) scenario. The number of very hot days (days when the temperature is above 35°C) is also predicted to increase by up to 9 days under SSP2. Typical risks associated with the relationship between increased temperatures and mining, include the following:

- The increased annual temperatures and an increased frequency in the number of hot days/ heatwaves, will result in equipment thresholds being exceeded more frequently.
- Temperature rise will affect physical plant machinery as well as equipment efficiencies. With increased temperatures, overheating of equipment is more likely, and equipment thresholds can be reached at a faster rate.
- In addition, the onsite offices will have increased energy demands for cooling and associated energy costs.

Rainfall

It is seen that there will be an increase in rainfall variability and high flood risks in specific regions of the Mthonjaneni Local Municipality. As a result of the location of the Jindal MIOP, the operations would most likely also be water sensitive. For example, the mining transportation, infrastructure, buildings, and facilities are likely to be negatively impacted by increased rainfall and flood risks, i.e., unregulated discharge of the mine water. Therefore, change in rainfall patterns and availability has the potential to impact the operations and production at the Jindal MIOP.

Labour and Working Conditions

In terms of the project's workforce, the existing hot and dry environment, coupled with the expected increase in the number of extreme hot days, could have a negative impact on the health of employees, particularly for individuals working outside who are exposed to extreme heat. Heat stress is a major occupational health risk and can directly impact labour productivity and consequently, operations at the Jindal MIOP.

Since the Jindal Project is planned to be an open pit mine, workers will be impacted by increasing ambient temperatures. Rising ambient temperatures increases exposure to heat and in turn heat stress, especially for outdoor workers. Heat stress at work resulting from (climate change-related) rising temperatures impacts workers' health, safety, productivity, and social well-being. Heat stress and discomfort felt by truck drivers and machine operators could lead to unforeseen incidents that could cause damage to equipment/or human injury. This could lead to high mortality rates, heat-related illnesses, increased injuries, more absenteeism, slow work pace, loss of productive capacity, and poor social well-being.

Furthermore, increased rainfall events and flood risks could create numerous safety hazards at the project area. Such events could have extreme repercussions on the workforce's safety and health, which would inevitably impact the productions and core operations at the Jindal project.

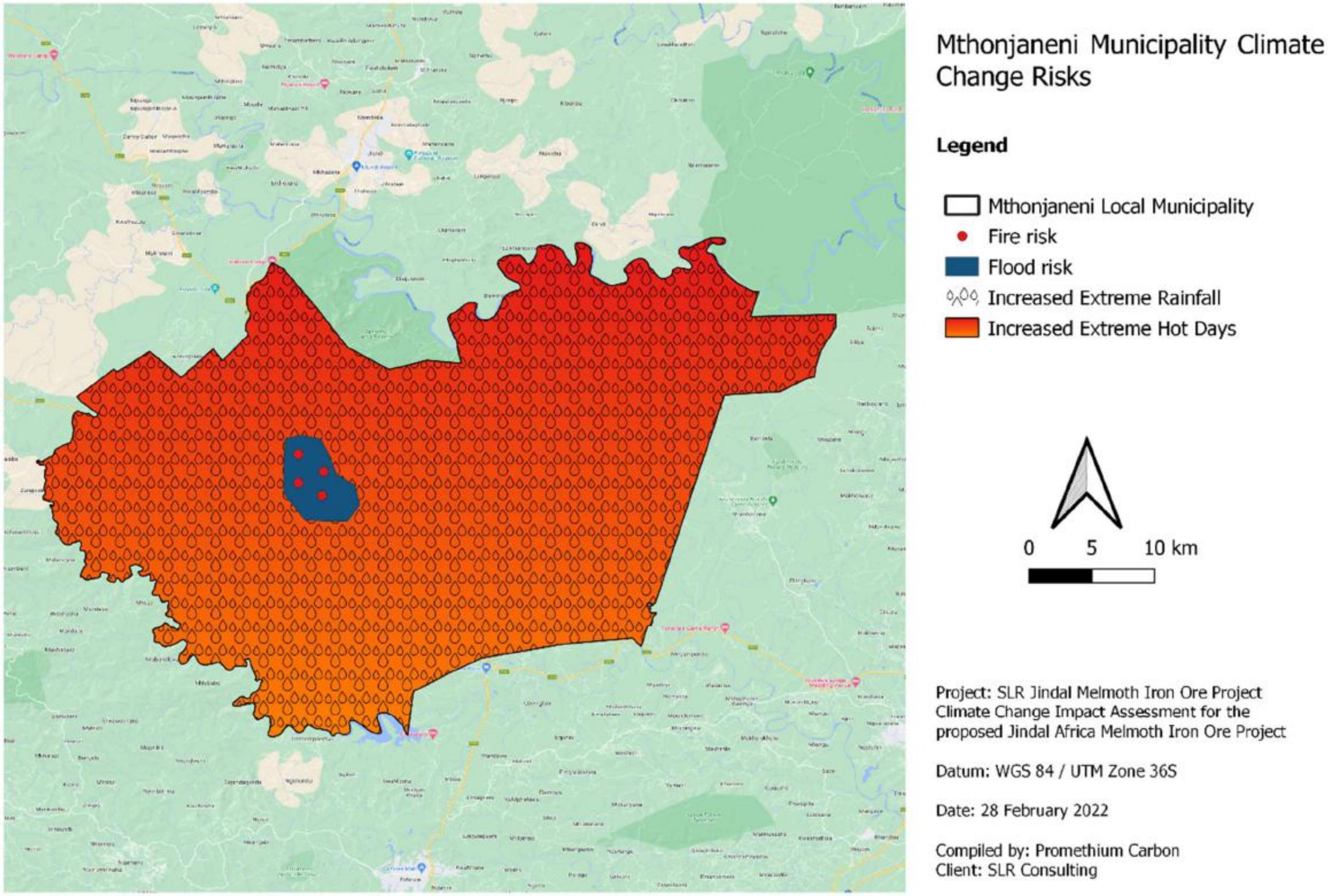

Figure 9-1: Mthonjaneni local municipality fire, drought, extreme hot days, and flood risks

9.2.1.2 Value Chain

Analysing the impact climate change will have on the Jindal Project's value chain allows for an understanding of how materials, equipment, and resources (upstream), and manufacturing, production, and distribution (downstream) process, would be affected.

The upstream value chain for the project will be impacted by climate change, as indicated for the main items used in the Project (Table 9-4).

Table 9-4 Climate change impacts on the upstream value chain of the Jindal MIOP

Item	Aspects affected by the impacts of climate change
Transport and storage of all goods	It is anticipated that diesel will also be used onsite for machinery and generators. Similarly, all equipment and other such goods will be transported to the project site. These items will make use of the established road networks in and around the Mthonjaneni Local municipality. In addition, water obtained from the municipality will be transported via existing municipal water distribution systems. *Extreme weather events* With increased seasonal variability, the Jindal MIOP may be exposed to periods of intense rainfall and flood risks. This could lead to limited road access to the project and cause delays in product deliveries to the Project site.
Concrete supply	Concrete will be mainly used for the construction and maintenance of the Jindal Project. The main risk associated with concrete production is the possible damaging of the concrete. Flood events could impact the foundation of the concrete and in extreme cases cause collapses. This is of concern since this region is currently, and anticipated, to experience increased rainfall. If a concrete producer is affected by increased water, this could disrupt the supply of concrete to the Project, which could delay construction and further operations.

9.2.1.3 Downstream Value Chain

Table 9-5 Climate change impacts on the downstream value chain of the Jindal Project.

Item	Aspects affected by the impacts of climate change
Distribution lines and substations	Various infrastructure is in place to support the mine, this could include road access, transmission lines and sub-stations, raw water abstraction and pipelines, and so forth. *Increasing daily temperatures* Hotter ambient temperatures often decreases the efficiency of electric components like substations, and will impact the performance of kV distribution lines, causing increases in transmission and distribution losses. *Increased rainfall/flood risks* Heavy rainfall and extreme events would likely cause the pylons and poles to be increasingly susceptible to uprooting and toppling, resulting in a disruption of electricity supply to consumers.

Item	Aspects affected by the impacts of climate change
Road access for maintenance and services	*Extreme weather events* There are several roads and gravel roads available to access the site. However, with increased rainfall events and flood risks, road access to the location could get disrupted and could affect the transportation of ore to the Richards Bay port, as well as impact the maintenance workers health and work productivity.

9.2.1.4 Broader Social Context

The following key points that should be considered with respect to climate change and the broader local community:

- With respect to the demographic profile, women are generally considered to be more vulnerable to climate change than their male counterparts, as women generally head up the household whilst males leave to urban centres, as a result, firewood and water collection is often a women's primary responsibility.
- A high unemployment rate points to existing socio-economic vulnerabilities. High levels of poverty, low-income distribution and low education levels all contribute to vulnerability. Social vulnerability from climate change would result in further inequalities and reduced capacity to cope with climate shocks.
- A local community that is largely younger than 15 or older than 65 indicates a higher dependency ratio. Increased economic strain on households can lead to increased vulnerability to climate change impacts.

9.2.1.5 Broader Environmental Context

- Climate change will affect natural ecosystems, reducing their ability to withstand impacts. The continued loss of biodiversity and degradation of ecosystems, and impacts to water resources weakens their ability to provide essential services.
- According to the South African National Biodiversity Institute's summary, it is identified that there are approximately 312 wetlands present within Mthonjaneni Local Municipality, with 3 of these wetlands being found within the South Block site[11]. Wetlands have important regulatory functions in that they moderate floods. They allow for attenuation of flood peaks thus reducing the risks to people and infrastructure. In addition, wetlands improve water quality though filtration and detoxification. Climate change will negatively impact wetlands and their ability to provide essential services.

9.2.1.6 Mitigations

- To improve resiliency, reduce the water intensity of the Jindal MIOPs mining processes. Jindal can also consider recycling used water and reduce water loss from evaporation, leaks, and waste. Mining companies can prevent evaporation by putting covers on small and medium dams. Jindal could also consider natural capital, like wetland areas, to improve groundwater drainage.
- To address high-water concerns, companies can adopt flood-proof mine designs that improve drainage and pumping techniques. They can adapt roads (such as by using hard metal or crusted rock for speed drying) or build sheeted haul roads. They can also use conveying methods that don't rely on trucking (such as by creating a full in-pit crushing and conveying system).

[11] Golder Associates, 2015. Iron Ore Mine near Melmoth. KZN operated by Jindal Mining KZN (Pty) Ltd.

10.BLASTING & VIBRATION

10.1 IMPACT OF GROUND VIBRATION, AIR BLAST AND FLY ROCK DUE TO BLASTING ACTIVITIES

10.1.1 Description of Impact

Blasting operations using explosives are required to break up rock which is then excavated to access the targeted ore material beneath. Ground vibration, air blast and fly rock can occur as a result of this blasting process.

Sensitivity mapping is undertaken at the start of the process to understand areas that would potentially be affected (Figure 10-1). Three different areas were identified in this regard:

- A highly sensitive area of 500 m around the mining area. Normally, this 500 m area is considered an area that should be cleared of all people and animals prior to blasting. Levels of ground vibration and air blast are also expected to be higher closer to the pit where the blasting is taking place.
- An area 500 m to 1 500 m around the pit area can be considered as being a medium sensitivity area. In this area, the possibility of impact is still expected, but it is lower.
- An area greater than 1 500 m is considered a low sensitivity area.

In the case of the Jindal MIOP, ground vibration levels when using a maximum charge have the possibility to be perceptible. Ground vibration can have a physical impact on buildings and other structures in the vicinity and could result in cracking of these structures. Ground vibration limits are dependent on the frequency of the ground vibration with lower frequencies being less acceptable than higher frequencies because structures have a low natural frequency. Significant ground vibration at low frequencies could cause increased structure vibrations due to the natural low frequency of the structure and this may lead to crack formation or damages.

Air blast or air-overpressure is a pressure wave generated by the blasting process. Air blast is normally associated with frequency levels less than 20 Hz, which is at the threshold for hearing. Air blast should not be confused with sound that is within the audible range (detected by the human ear).

Blasting practices require some movement of rock to facilitate the excavation process. Material or elements travelling outside of this expected range would be considered to be fly rock which is categorised as follows:

- Throw - the planned forward movement of rock fragments that form the muck pile within the blast zone.
- Fly rock - the undesired propulsion of rock fragments through the air or along the ground beyond the blast zone by the force of the explosion that is contained within the blast clearance (exclusion) zone. When using this definition, fly rock, while undesirable, is only a safety hazard if a breach of the blast clearance (exclusion) zone occurs.
- Wild fly rock - the unexpected propulsion of rock fragments that travels beyond the blast clearance (exclusion) zone when there is some abnormality in a blast or a rock mass.

The concept of fly rock is shown in Figure 10-2.

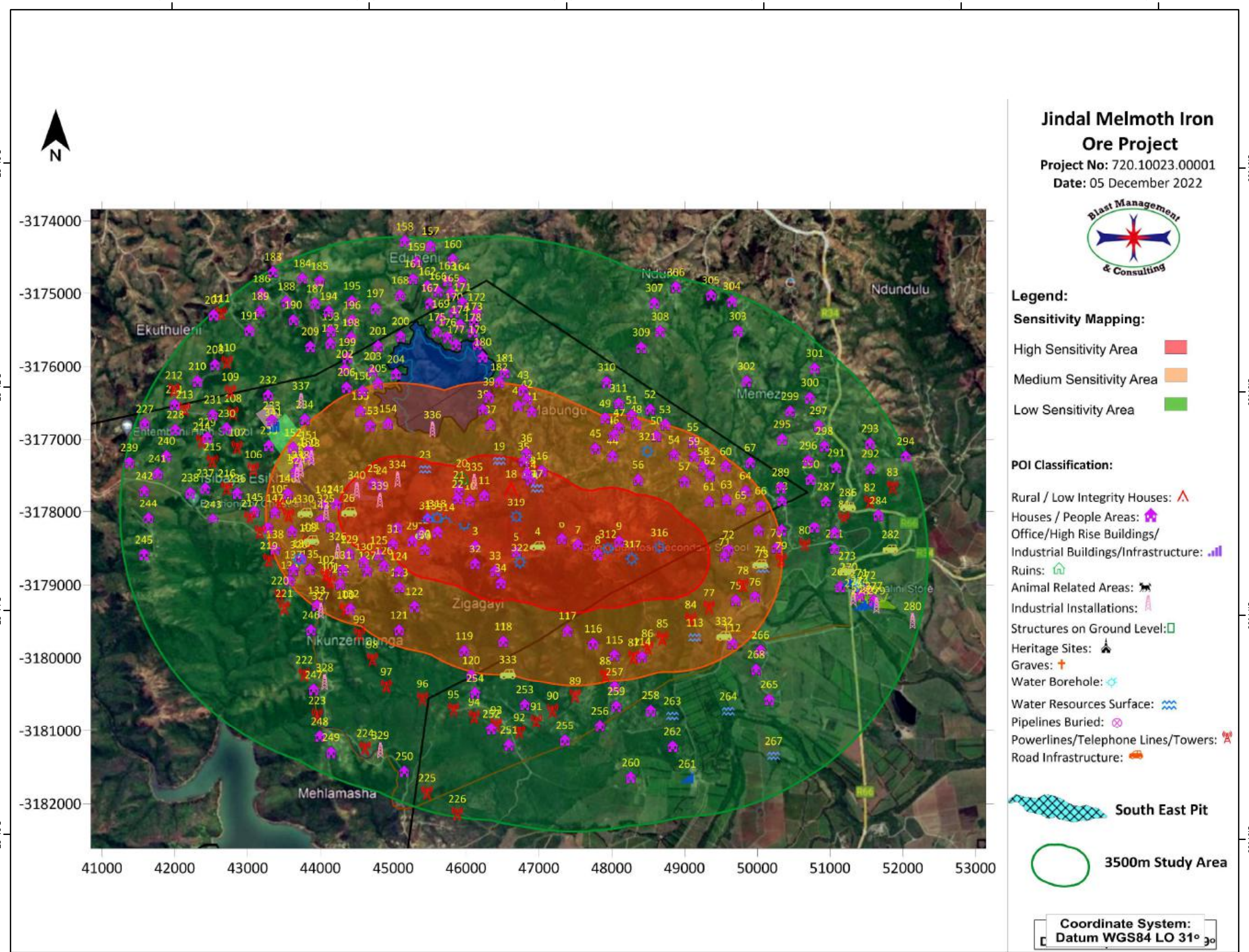

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FIGURE 10-1
SENSITIVE RECEPTORS
FOR BLASTING

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Project No: 720.10023.00001 | Prepared By: BG
Map Ref No: EIA 10-1 | Date: 17/05/2023

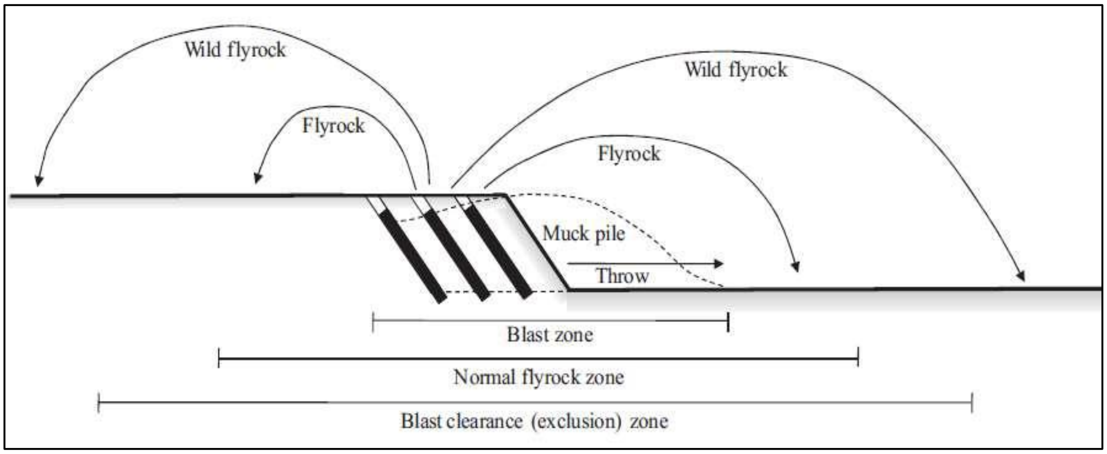

Figure 10-2 Schematic of fly rock

There is also the potential for the release of noxious gases from the explosives used for blasting. Noxious fumes could be as a result of poor quality control on explosive manufacture, damage to the explosive, lack of confinement, insufficient charge diameter, excessive sleep time, water in blast holes, incorrect product used, or product not loaded properly, and/ or specific types of rock/geology which can also contribute to fumes.

10.1.2 Source of Impact

The project activities/infrastructure likely to result in impacts due to blasting:

Project phase	Activity/infrastructure
Construction	• N/A
Operational	• Blasting for the open pit
Decommissioning/ Closure	• N/A

10.1.3 Impact assessment

During the construction and decommissioning phases no mining, drilling or blasting operations are expected. Therefore, no impacts have been identified as a result of blasting during these phases and the impact is considered to be **INSIGNIFICANT**.

During operations blasting will be undertaken for the advancement of open pit mining. As described above there are three main impacts due to blasting: ground vibration, air blast and fly rock. These are looked at in more detail for the Jindal MIOP in the following sections.

10.1.3.1Ground Vibration:

The location of structures around the pit area means that there could be impacts due to ground vibration. The closest structures observed are community houses, other buildings/ structures and hydrocensus boreholes. Ground vibrations predicted for the pit area ranged between low and very high and would therefore require specific mitigations.

The open pit operations were evaluated for expected levels of ground vibration from future blasting operations. Review of the site and the surrounding installations/ houses / buildings showed that structures vary in distance from the pit area. The impacts would also vary with distance from the pit area.

In addition to distance from the blast different charge masses evaluated would result in different levels of ground vibration. Modelling of the minimum charge used indicated twenty-seven points of interest (POI) and the maximum charge indicated forty POI's of concern in relation to possible structural damage.

On a human perception scale forty-three POI's were identified where vibration levels may be perceptible and lower for the minimum charge and hundred and twenty-six POI's for the maximum charge. Eight POI's were identified where vibration levels may be unpleasant for the minimum charge and fifteen for the maximum charge. Perceptible levels of vibration may be experienced up to 2 431 m with intolerable levels up to 356 m. Problematic levels of ground vibration (levels greater than the proposed limit) are expected up to 373 m from the pit edge for the maximum charge. Any blast operations further away from the boundary would have less influence.

The evaluation mainly considered a distance up to 3500 m from the pit area. The closest structures observed are the D395 Road, community houses, hydrocencus boreholes, building/structures and informal housing.

10.1.3.2Air Blast

Air blast predicted showed the same concerns for open pit blasting. High levels may contribute to effects such as rattling of roofs, doors and/ or windows. The current accepted limit on air blast is 134 dBL. Damages are only expected to occur at levels greater than 134dB.

With the charges being considered it is expected that air blast will be greater than 134 dB at a distance of 393 m and closer to the pit boundary (Figure 10-3). The structures inside the pit area are expected to be relocated and are thus not considered further in terms of blasting impacts. Infrastructure at the pit area such as roads and power lines/ pylons are present, but air blast does not have any influence on these installations.

Air blast predicted for the maximum charge ranges between 120.5 and 152.4 dB for all the POI's considered.

10.1.3.3Fly Rock

Fly rock remains a concern for blasting operations. Based on the drilling and blasting parameters the fly rock range (with a safety factor of 2) was calculated to be 412 m. The absolute minimum unsafe zone is then the 412 m. This calculation is a guideline and any distance cleared should not be less than this. The occurrence of fly rock can, however, never be 100% excluded.

The D395 road runs through the pit area. This road is specifically of concern when blasting is done more with regards to fly rock concerns than ground vibration. The D255 road is at a closest distance of 350 m to the pit area. The R66 is at 2 398 m and the R34 road at 2 992 m. There are other roads and gravel roads in the vicinity of the MIOP area but all are expected to be within the recommended limits. There may, however, be people and animals on these routes and careful planning would be required to maintain a safe blasting radius.

The occurrence of fly rock in any form would have a negative impact if found to travel outside the unsafe zone. This unsafe zone may be anything between 10 m or 1 000 m. A general unsafe zone applied by most mines is normally considered to be within a radius of 500 m from the blast; but needs to be qualified and determined as best possible.

The unmitigated impact of ground vibration, air blast and fly rock is predicted to be **HIGH** but with the implementation of mitigation measures could be reduced to **LOW** (Table 10-1).

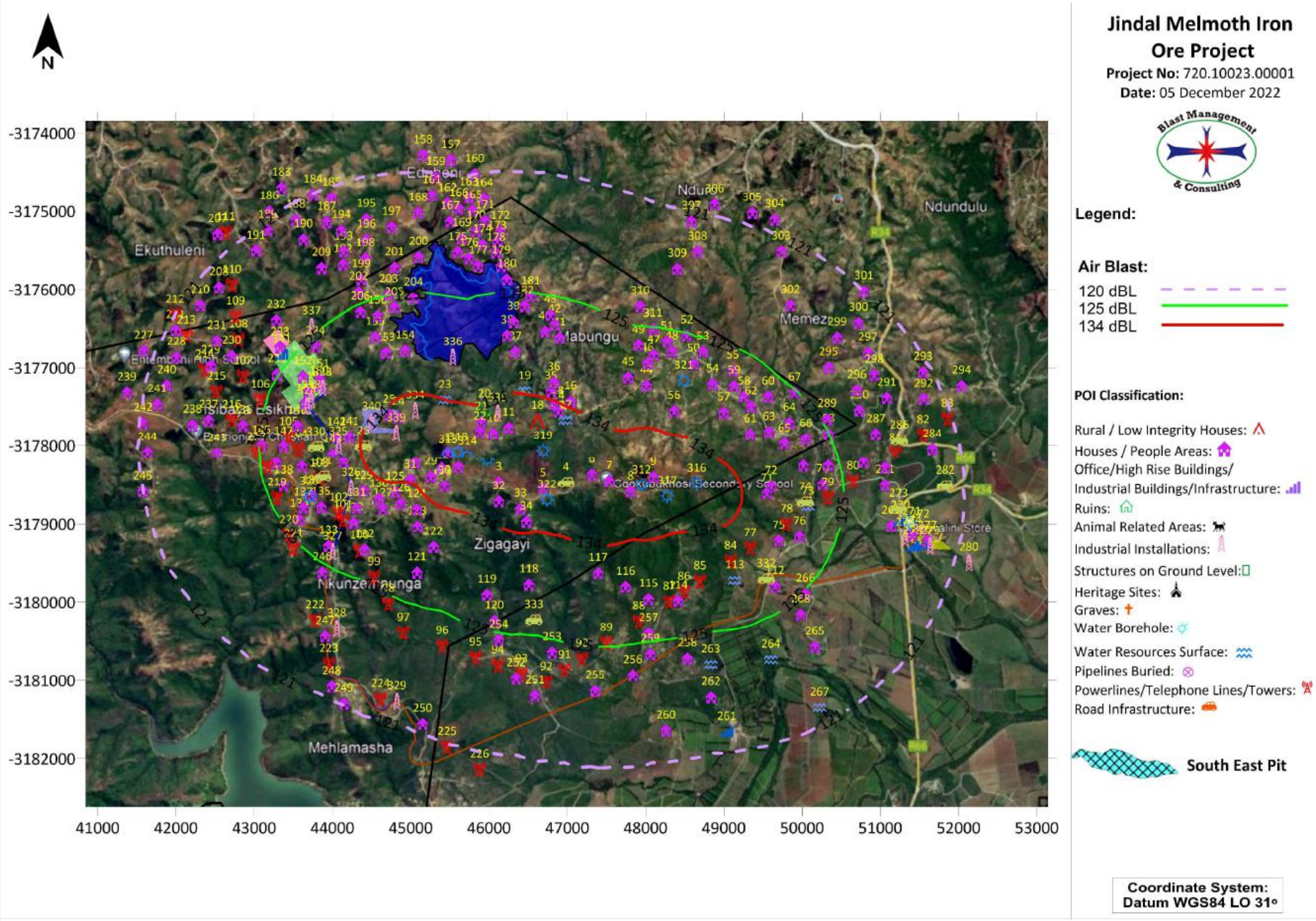

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FIGURE 10-3
AIR BLAST INFLUENCE
FROM MAXIMUM CHARGE

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Project No: 720.10023.00001 | Prepared By: BG
Map Ref No: EIA 10-3 | Date: 17/05/2023

Table 10-1 Impact of ground vibration, air blast and fly rock due to blasting activities during operational phase

Impacts to Water Quality		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Operational	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Prominent change (High)	Moderate change (Medium)
Duration	Long-term (Long-term (10 and 20 years)	Long-term (Long-term (10 and 20 years)
Extent	Beyond the site boundary	Beyond the site boundary
Consequence	High	Medium
Probability	Probable	Possible/ frequent
Significance	**High -**	**Low -**
Degree to which impact can be reversed	**Partially reversible** - Provided mitigation measures are implemented the impact can be managed and reduced significantly.	
Degree to which impact may cause irreplaceable loss of resources	**Medium** - The impact may cause damage to structures if not controlled properly.	
Degree to which impact can be avoided	**Low** – Avoidance of the impact will not be possible if blasting is taking place.	
Degree to which impact can be mitigated	**Medium** – There are a number of factors that can reduce the impact to some extent.	
Cumulative impact		
Nature of cumulative impacts	There is not currently any other blasting taking place in the area and therefore the cumulative impact is insignificant.	
Rating of cumulative impacts	**Insignificant**	**Insignificant**
Residual impact		
Residual impact discussion	**Low** – the residual impact, provided all mitigation measures are implemented is determined to be low.	

Table 10-2 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	Minimise the impact of blasting during the operational phase of the Jindal MIOP.
Mitigation actions/measures	
Operational Phase	

Generic Mitigation:

- Conduct a test blast to assist with defining expected air blast levels for future blast designs.
- Do blast design that considers the actual blasting and the air blast levels to be adhered too.
- Do design for smaller diameter blast holes that will use fewer explosives per blast hole. Smaller diameter blastholes will also have better stemming vs explosive column ratio.

Management Outcome, Mitigation Actions/Measures and Monitoring	
Mitigation of ground vibration for this can be done applying the following methods: • Only apply electronic initiation systems to facilitate single hole firing. • Consider relocation of households closest to the pit areas – preferably within 500 m from pit edge. • Good housekeeping practices should be implemented and maintained with monitoring of each blast. • Evacuating of people and animals out of the danger zone. • Undertake independent structural surveys on a regular basis. Mitigation of air blast can be done applying the following methods: • Blast design to consider proper stemming management. • Use of crushed aggregate with size of 10% the drill diameter. • Consider increase of stemming lengths to ratio of 25 to 30 times the blast diameter. • Consider relocation of households closest to the pit areas – preferably within 500 m from pit edge. • Good housekeeping practices should be implemented and maintained with monitoring of each blast. • Structural surveys will need to be done as indicated in the report. Mitigation of fly rock can be done applying the following methods: • Do blast design that considers the actual blasting and the ground vibration levels to be adhered too. • Only apply electronic initiation systems to facilitate single hole firing. • Consider relocation of households closest to the pit areas – preferably within 500 m from pit edge. • Good housekeeping practices should be implemented and maintained with monitoring of each blast. • Evacuating of people and animals out of the danger zone. • Structural surveys will need to be done as indicated in the report.	

Monitoring	**Operational**
	• A monitoring programme for recording blasting operations to include:
	  ◦ Ground vibration and air blast results;
	  ◦ Blast Information summary;
	  ◦ Meteorological information at time of the blast;
	  ◦ Video Recording of the blast; and
	  ◦ Fly rock observations.
	• Ground vibration and air blast monitoring requires identified locations for monitoring. Monitoring of ground vibration and air blast is done to ensure that the generated levels of ground vibration and air blast comply with recommendations.

11.PALAEONTOLOGY

11.1 LOSS OF PALAEONTOLOGICAL RESOURCES

11.1.1 Description of Impact

The Jindal MIOP lies in the southeastern part of the main Karoo Basin where the Karoo Sequence unconformably overlies the ancient intrusive igneous rocks of the Tugela Group, Natal sector of the Namaqua-Natal Province that have been metamorphosed. They in turn lie on some of the oldest basement rocks in the world, the Nondweni Group. This is the Ilangwe remnant of southern exposures of the Barberton Greenstone Belt.

The Karoo Supergroup rocks cover a very large proportion of South Africa and extend from the northeast (east of Pretoria) to the southwest and across to almost the KwaZulu Natal south coast. It is bounded along the southern margin by the Cape Fold Belt and along the northern margin by the much older Transvaal Supergroup rocks. Representing some 120 million years (300 – 183 Ma), the Karoo Supergroup rocks have preserved a diversity of fossil plants, insects, vertebrates and invertebrates.

The site for development falls within the unnamed granitic gneiss and the Mhlatuze Formation of the Nondweni Group. These rocks are ancient volcanic rocks but single-celled algae or bacteria have been found in other exposures of this group, to the north.

There are two strata in the Barberton Greenstone Belt that have strong evidence of the earliest microbial life forms, namely the deposits of the 3.416 Ga Buck Reef Chert (in the Onverwacht Anticline and Kromberg Syncline, central part) and the sandstones of the 3.22 Ga Moodies Group. These strata have a wealth of remarkably preserved microbial mats and microfossils, consistent lateral exposure for several tens of kilometres and with a fairly thick stratum. Based on its universal and outstanding geological and palaeobiological value the Barberton-Makhonjwa Mountains were inscribed in the UNESCO World Heritage Site register in 2018. Research on the earliest evidence of early life from the Barberton Greenstone Belt has allowed many researchers to reconstruct its habitat, metabolism, biogeochemical cycling and mode of preservation.

11.1.2 Source of Impact

The project activities/infrastructure likely to result in impacts on palaeontological resources:

Project phase	Activity/infrastructure
Construction	• Earthworks and excavations
Operational	• Blasting and open pit mining

11.1.3 Impact Assessment

Only the construction and operational phases are relevant to the Palaeontology. The surface rocks and volcanic rocks overlying the iron ore deposits should be assessed.

Fossils have not been recorded from the area but might be present although they would be difficult to recognise due to their microscopic size. If fossils were found during excavations this would be considered a positive impact.

Summary: Based on the nature of the project, surface activities and excavations may impact upon the fossil heritage if within the open pit footprint. The geological structures suggest that the rocks might preserve very old microbial fossils.

The unmitigated and mitigated impact is, however, predicted to be **INSIGNIFICANT** (Table 11-1).

Table 11-1 Loss of palaeontological resources

Impacts to Water Quality		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Construction and Operational	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Minor change (Low)	Minor change (Low)
Duration	Very long term/ Permanent (> 20 years)	Very long term/ Permanent (> 20 years)
Extent	Site	Site
Consequence	Low	Low
Probability	Unlikely / improbable	Unlikely / improbable
Significance	Insignificant -	Insignificant -
Degree to which impact can be reversed	**Irreversible** – Should palaeontological resources be impacted upon the impact would not be reversible.	
Degree to which impact may cause irreplaceable loss of resources	**Low** – The likelihood of impact is low.	
Degree to which impact can be avoided	**High** – Should palaeontological resources be discovered and operations halted the impact can be avoided.	
Degree to which impact can be mitigated	**Medium** – Provided mitigation measures are in place and adhered to the impact can be mitigated.	
Cumulative impact		
Nature of cumulative impacts	No cumulative impacts are expected.	
Rating of cumulative impacts	**Insignificant**	**Insignificant**
Residual impact		
Residual impact discussion	**Insignificant** – the residual impact, provided the Chance Find Procedure is adhered to is determined to be very low.	

Table 11-2 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	Minimise the impact on palaeontological resources during the construction and operational phases of the Jindal MIOP.
Mitigation actions/measures	
Construction and Operational Phases	

- Implement the Fossil Chance Find Protocol. If fossils occur on site they need to be photographed, removed and stored in a safe place for a palaeontologist to assess. Since the fossils are too small to see it is recommended that

Management Outcome, Mitigation Actions/Measures and Monitoring	
samples of the black, finely laminated rocks of the Nondweni Group that overlie the iron ore deposits are put aside for future research.	
Monitoring	• N/A

B) IMPACT ON SOCIO-ECONOMIC ENVIRONMENT

12. COMMUNITY HEALTH

The Jindal MIOP has the potential to positively and/ or negatively influence the health status of surrounding communities by impacting on the spread of communicable diseases such as HIV and TB, the incidence of non-communicable diseases such as cardiovascular disease and asthma, the nutritional status of local communities, and access to health care facilities and institutional capacities. These impacts need to be systematically evaluated so that a Community Health Monitoring and Management Plan (CHMMP) can be developed to avoid or mitigate potential negative impacts while enhancing positive opportunities.

There are many aspects to community health, however, only three are assessed under this section. The remainder of the community health impacts have been assessed under the various other sections in this report. These include:

- Displacement and resettlement (Section 15.2);
- Increased employment (Section 16.1);
- Population influx (Section 15.1);
- Change in ambient air quality (Section 5);
- Reduced groundwater quality (Section 1.2);
- Reduced groundwater quantity (Section 1.1); and
- Flooding of mining infrastructure (Section 2.3).

12.1 IMPACT OF CHANGING FARMING PRACTICES, MARKET OPTIONS AND SOURCES OF NUTRITION

12.1.1 Description of Impact

The loss of farmland and the increased opportunity for employment on the mine is likely to cause a shift in the local community away from subsistence agriculture towards a greater reliance on purchased food products. This can have various implications on diet and economic security.

12.1.2 Source of Impact

The project activities/infrastructure likely to result in impacts due changing farming practices, market options and sources of nutrition include:

Project phase	Activity/infrastructure
All phases	• Employment at/ for the mine • Land take

12.1.3 Impact Assessment

The following impacts could occur as a result of the Jindal MIOP:

- An influx of people during the construction and operational phases of the proposed Project may result in inflation in food costs in the local area, increasing food deprivation for the poorest, and nutrition-related diseases. If long-term food inflation occurs, food deprivation would disproportionally impact susceptible sub-populations such as the children and marginalised groups.
- Poor food hygiene practices associated with mass handling of food may also increase food-related illnesses (as opposed to in household food preparation practices on a small scale).
- Potential increase in non-communicable (lifestyle) diseases such as obesity and diabetes.
- Some positives associated with the shift away from subsistence diets includes decreased vulnerability to weather-related crop production variabilities, the potential for a greater diversity in the diet through food purchases, and greater efficiencies in access to food in general and semi-prepared and even prepared meals increases the time available in the household for other practices.
- However, a shift towards purchased diets may mean that homesteads cease to maintain vegetable gardens or keep animals, which means that when there are shocks to household income, these resources are not available to fall back on for food supply. Of the 90 households surveyed, 75% experienced hunger in the past year. On average households experienced hunger for three months of the year.
- Another positive is that there may be increased opportunity for some farmers to sell their produce to construction workers and mine workers during the operational phase, and potentially increased access to markets through improved road infrastructure. While economic benefits are obvious, there is an extensive literature base that highlights that increased market access for subsistence farmers does not automatically have positive socio-economic impacts.

The intensity of these impacts is considered **VERY HIGH** because there are significant health implications of changing diets and greater reliance on shop-bought goods but with the implementation of mitigation measures could be reduced to **MEDIUM** (Table 12-1). Changes in diet and lifestyle can be permanent if communities shift away from traditional lifestyles and subsistence agricultural practices. Health impacts of poor nutrition are considered only partially reversible through long-term improvements in diet. Children, for example, can experience developmental problems with poor diet with implications for the rest of their lives.

Table 12-1 Health implications of changing farming practices, market options and sources of nutrition

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative (the mitigated impact may be positive for some but the potential for negative impacts remains)	
Phases of Project	All	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Prominent change (High)	Moderate change (Medium)
Duration	Permanent (> 20 years)	Permanent (> 20 years)
Extent	Local	Local
Consequence	Very High -	High -
Probability	Probable	Possible
Significance	**Very high -**	**Medium -**
Degree to which impact can be reversed	**Partially reversible** - Health impacts of poor nutrition are considered only partially reversible through long-term improvements in diet.	
Degree to which impact may cause irreplaceable loss of resources	**Low –** It is unlikely to result in an irreplaceable loss.	
Degree to which impact can be avoided	**Medium –** Should the Jindal MIOP go ahead it would not be possible to avoid the impact completely.	
Degree to which impact can be mitigated	**Medium** – The impact can be mitigated to some extent.	
Cumulative impact		
Nature of cumulative impacts	Other factors may contribute negatively to local diets (e.g. weakening traditions and cultural practices, increased exposure to mass media, changing preferences in the youth) so results are considered potentially cumulative.	
Rating of cumulative impacts	**Low -**	**Very Low -**
Residual impact		
Residual impact discussion	**Medium** – the residual impact, provided all mitigation measures are implemented can be reduced to medium.	

Table 12-2 Management outcome, mitigation actions/measures and monitoring

<table>
<tr><th colspan="2">Management Outcome, Mitigation Actions/Measures and Monitoring</th></tr>
<tr><td>Management objective</td><td>Minimise impacts on health implications due to changing farming practices, market options and sources of nutrition during all phases of the Jindal MIOP.</td></tr>
<tr><td colspan="2">Mitigation actions/measures</td></tr>
<tr><td colspan="2">All Phases</td></tr>
<tr><td colspan="2">Compensation for loss of agricultural land through provision of alternative fields or financial compensation.
Liaison with local supermarkets to curb food inflation during the construction phase,
Provision of sanitation awareness materials to local district environmental health officers for educational sessions with slaughterhouse, food handlers and vendors.
Education on lifestyle behaviours including eating habits, exercise, etc. Supply of educational materials for use in local clinics, with cognizance of the low levels of education in the community (see Section 6.2).
Food security and childhood nutritional status can be improved through school feeding programmes, and education on food gardens, nutrition, and good nutritional habits.
Engagement with charity organisations such as Gift of the Givers to establish a plan of action should there be critical food shortages in the region.</td></tr>
<tr><td>Monitoring</td><td>Implement a process of measuring, recording and analysing data for the programme.
Must be communicated to programme managers so that any deviation from the planned operations are detected and diagnosis for causes of deviation carried out and suitable corrective actions be taken.</td></tr>
</table>

12.2 EXPOSURE TO VECTOR-BORNE AND ZOONOTIC DISEASE

12.2.1 Description of Impact

While vector borne diseases (other than bilharzia perhaps) are not prevalent in the proposed Project area, the influx of people coupled with poor onsite mine management (e.g. stagnant water bodies) may lead to the establishment of vector breeding sites, a situation that may lead to emergence and increase in prevalence of vector-borne diseases.

In addition, an increase in domestic waste can attract disease-carrying vermin to the region in the absence of regular waste collection and management services. Flies and cockroaches are attracted to putrefying domestic waste, and flies can be attracted to long-drop toilets in the absence of flushable services. It is possible that these services would become more viable in the region with increased population and provide existing residents with sewage and waste collection services, limiting the need to bury or burn waste. The latter could also improve local air quality.

12.2.2 Source of Impact

The project activities/infrastructure likely to result in exposure to vector-borne and zoonotic disease include:

Project phase	Activity/infrastructure
All phases	• Poor site management

12.2.3 Impact Assessment

The impact is considered **MEDIUM** in the unmitigated scenario but can be reduced to **LOW** with effective mitigation measures being implemented. Some vector-borne and zoonotic diseases are fatal (e.g. rabies) and this the impact is potentially irreversible (Table 12-3). However, the presence of vectors and vermin can be avoided effectively. Cumulative impacts are unlikely as there are no other large developments planned for this locality.

Table 12-3 Significance assessment of health implications of exposure to vector-borne and zoonotic diseases

Description of Impact		
Type of Impact	Indirect	
Nature of Impact	Negative (the mitigated impact may be positive for some but the potential for negative impacts remains)	
Phases of Project	Construction and Operational	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium)	Minor change (Low)
Duration	Permanent (>20 years)	Permanent (>20 years)
Extent	Local	Local
Consequence	High -	High -
Probability	Conceivable	Unlikely

Significance	Medium -	Low -
Degree to which impact can be reversed	**Potentially irreversible** - Some vector-borne and zoonotic diseases are fatal (e.g. rabies) and this the impact is potentially irreversible.	
Degree to which impact may cause irreplaceable loss of resources	**Low** –Loss of life could occur but the likelihood is generally low.	
Degree to which impact can be avoided	**High –** With effective management in place this impact can be avoided.	
Degree to which impact can be mitigated	**High** – There are a number of measures that can be put in place to manage this impact.	
Cumulative impact		
Nature of cumulative impacts	Cumulative impacts are considered unlikely.	
Rating of cumulative impacts	**Insignificant**	**Insignificant**
Residual impact		
Residual impact discussion	**Low** – with good management in place the residual impact is considered to be low.	

Table 12-4 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	Minimise exposure to vector-borne and zoonotic diseases during all phases of the Jindal MIOP.
Mitigation actions/measures	
All Phases	
• Control of vector breeding sites through efficient removal of organic/ domestic wastes, draining of stagnant water (e.g. in ditches or hollows), and sealing off of building roofs and basements. • Replacement of pit latrines with flushable or dry diversion options. • Vector control in the local communities using indoor residual spraying is possible, however, sustainability is important and best practice guidelines should be implemented. • Effective domestic waste management will be required with the influx of people to prevent disease-carrying vermin from being attracted to the region. • Coordination with the relevant government departments (i.e. health and social development) to establish vector awareness programs. • Education on household and food hygiene and waste management for the control of vectors and vermin, keeping household surfaces clean, sealing off food storage must be undertaken.	
Monitoring	• Implement a process of measuring, recording and analysing data for the programme. • Must be communicated to programme managers so that any deviation from the planned operations are detected and diagnosis for causes of deviation carried out and suitable corrective actions be taken.

12.3 CHANGES IN ACCESS TO HEALTHCARE

12.3.1 Description of Impact

The expected influx of construction workers and then mine workers (and potentially their families) during the operational phase has the potential to place pressure on already burdened healthcare services in the vicinity of the proposed Jindal MIOP unless an influx management plan is implemented. Emergency services are limited in the area and the potential for increased trauma and accidents (e.g. occupational injuries or vehicular accidents) would place additional burdens thereon. However, should the Project see an increased investment in healthcare facilities through direct (e.g. mine clinics for workers and their families) and indirect (investment in local emergency services, local healthy living campaigns, attracting doctors to the area) interventions, the impact could be positive. These positive impacts would extend for the life of mine (LoM), albeit some of these services may become self-sustaining beyond the LoM.

12.3.2 Source of Impact

The project activities/ infrastructure likely to result in changes in access to healthcare include:

Project phase	Activity/infrastructure
Construction & Operational	• Mine clinic/ investment in local emergency services

12.3.3 Impact Assessment

The significance impact of the lack of (or provision of) healthcare facilities is considered **VERY HIGH NEGATIVE** without mitigation. However, this can become a **VERY HIGH POSITIVE** should the proposed enhancement measures be implemented (Table 12-5). Since the incoming population is likely to remain in the region beyond the LoM, the demand for healthcare services is considered permanent. The impact is regional since individuals generally are willing to travel outside of their immediate locality for healthcare services. An increased population in the Project area is likely to result in an increased demand on regional healthcare services if these are not available locally. Similarly, the provision of healthcare services locally would likely attract patients regionally if there are shortages in outside areas.

Table 12-5 Significance assessment of health implications of changes in access to healthcare

Description of Impact		
Type of Impact	Direct/ indirect	
Nature of Impact	Negative (without mitigation) / Positive (with mitigation)	
Phases of Project	Construction and Operational	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Prominent change (High)	Prominent change (High) +
Duration	Permanent (>20 years)	Long term (10 and 20 years)
Extent	Regional	Regional

Consequence	Very high -	Very high +
Probability	Definite	Definite
Significance	**Very high -**	**Very high +**
Degree to which impact can be reversed	**Potentially irreversible** - The impacts of a lack of access to healthcare is considered potentially irreversible, particularly in the context of emergencies that may be fatal without critical care.	
Degree to which impact may cause irreplaceable loss of resources	**Low** – Irreplaceable loss due to the mine is unlikely and can be decreased further with mitigation measures in place.	
Degree to which impact can be avoided	**High** - The degree to which impacts can be avoided and mitigated is considered high through provision of effective healthcare.	
Degree to which impact can be mitigated	**High** - The degree to which impacts can be avoided and mitigated is considered high through provision of effective healthcare.	
Cumulative impact		
Nature of cumulative impacts	Impacts are considered cumulative should the mine attract other industries and services that increase the population size and demand for healthcare further. The positive impact can also be cumulative should the growing population attract medical service providers to the area or result in state investment in the development of healthcare facilities.	
Rating of cumulative impacts	**Low -**	**Very Low -**
Residual impact		
Residual impact discussion	**Very High +** – The residual impact could be a very high positive if enhancement measures are properly implemented.	

Table 12-6 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	Maximise access to healthcare during all phases of the Jindal MIOP.
Mitigation actions/measures	
All Phases	

To shift impacts from potentially negative to positive, and to maximise these positive impacts, the following should be considered:

- Provision/support of basic clinic services. This could be through investment projects with existing clinics and/or the development of private clinics, for example onsite clinics for workers and their families, and potentially opening these up to the local community.
- Provision/support of private ambulance services.
- Support of local hospitals, particularly for emergency/casualty care.

Management Outcome, Mitigation Actions/Measures and Monitoring	
• Health and healthy living (e.g. diet and exercise, dental care, clean water and food hygiene), and vaccination information campaigns to raise the baseline health level of the local community and limit the need for urgent healthcare. • Engagement with the Department of Health to ensure that any investment in local healthcare projects is aligned with state healthcare plans for the region. • Engagement with flight emergency services to ensure availability for critical cases that local hospitals are not equipped to care for and identification of (and engagement with) nearest equipped hospitals to receive these cases.	
Monitoring	• Implement a process of measuring, recording and analysing data for the programme. • Must be communicated to programme managers so that any deviation from the planned operations are detected and diagnosis for causes of deviation carried out and suitable corrective actions be taken.

13. CULTURAL HERITAGE

13.1 LOSS OF CULTURAL HERITAGE RESOURCES

13.1.1 Description of Impact

Archaeological artefacts are considered, in each instance, a unique and non-renewable resource. Unfortunately, due to the inability to gain access to the area to undertake a survey to identify cultural heritage resources within the Jindal MIOP footprint, the potential resources that exist in the area are not known. However, should any artefacts be discovered during the construction and operational phases the impacts can be seen as permanent and irreversible.

Construction phase activities would include land clearance and excavation of different parts of the site in preparation for the development of the processing plant, primary crusher and associated infrastructure. In addition, pre-stripping of the WRD and South East Pit area would be undertaken as mining progresses. Each of these areas has the potential to have heritage resources.

13.1.2 Source of Impact

The project activities/ infrastructure likely to result in a loss of heritage resources include:

Project phase	Activity/infrastructure
Construction and operational	• Earthworks and land clearance

13.1.3 Impact Assessment

Archaeological resources are considered a unique and non-renewable resource. Should any such resources be discovered during the construction and operational phases the impacts can be seen as permanent and irreversible. The impact would be **VERY HIGH** without mitigation but can be reduced to **MEDIUM** should mitigation measures be implemented (Table 13-1). **The worst case scenario has been assessed here due to no surveys having been undertaken at this stage.**

Table 13-1 Loss of cultural heritage resources

Impacts to Water Quality		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Construction and Operational	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Severe change (Very high)	Prominent change (High)
Duration	Very long term/ Permanent (> 20 years)	Very long term/ Permanent (> 20 years)
Extent	Local	Beyond site
Consequence	Very high	High
Probability	Definite / Continuous	Possible / frequent

Impacts to Water Quality		
Significance	**Very high -**	**Medium -**
Degree to which impact can be reversed	**Irreversible** - Archaeological resources have a low scientific significance if altered or damaged by construction and operational activities.	
Degree to which impact may cause irreplaceable loss of resources	**High** - Archaeological resources have a low scientific significance if altered or damaged by construction and operational activities.	
Degree to which impact can be avoided	**Medium** - Predevelopment mitigation (survey, site identification, mapping, and description of archaeological finds).	
Degree to which impact can be mitigated	**Medium** - Predevelopment mitigation (survey, site identification, mapping, and description of archaeological finds).	
Cumulative impact		
Nature of cumulative impacts	Development activities in and around the project area have been limited to domestic homestead expansion and local infrastructure, e.g. access roads, water pipelines and electricity provision. Cumulative impacts are thus not expected.	
Rating of cumulative impacts	**Medium -**	**Low -**
Residual impact		
Residual impact discussion	**Medium** – the residual impact, provided the Chance Find Procedure is adhered to is determined to be medium.	

Table 13-2 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	Minimise the impact on cultural heritage resources during the construction and operational phases of the Jindal MIOP.
Mitigation actions/measures	
Construction and Operational Phases	

- Complete survey of the proposed Jindal MIOP footprint for possible site identification, mapping and description will allow for further mitigatory measures.
- Low significance sites can be recorded for addition to the provincial archaeological data base. Medium and high significance sites may require further recording and excavation to retrieve data for future research and addition to the data base.
- Induction and training of the appointed ECO/s must be undertaken in order that the application of the Chance Finds Protocol for the life-of-mine through such ECOs can be implemented.
- Chance Finds Protocol must be in place for construction and operational phases.
  - Protocols for the identification, protection and recovery of heritage resources during construction and operation. This must include:
    - It is possible that sub-surface heritage resources could be encountered during the construction phase of this project. The ECO and all other persons responsible for site management and excavation should be aware that indicators of sub-surface sites could include:
      - Ash deposits (unnaturally grey appearance of soil compared to the surrounding substrate).
      - Bone concentrations, either animal or human.
      - Ceramic fragments, including potsherds.

Management Outcome, Mitigation Actions/Measures and Monitoring	
	- Stone concentrations that appear to be formally arranged (may indicate the presence of an underlying burial, or represent building/structural remains); and - Fossilised remains of fauna and flora, including trees. • In the event that such indicator(s) of heritage resources are identified, the following actions should be taken immediately: - All construction within a radius of at least 20m of the indicator should cease. This distance should be increased at the discretion of supervisory staff if heavy machinery or explosives could cause further disturbance to the suspected heritage resource. - This area must be marked using clearly visible means, such as barrier tape, and all personnel should be informed that it is a no-go area. - A guard should be appointed to enforce this no-go area if there is any possibility that it could be violated, whether intentionally or inadvertently, by construction staff or members of the public. - No measures should be taken to cover up the suspected heritage resource with soil, or to collect any remains such as bone or stone. - If a heritage practitioner has been appointed to monitor the project, s/he should be contacted, and a site inspection arranged as soon as possible. - If no heritage practitioner has been appointed to monitor the project, the head of archaeology at Amafa's Pietermaritzburg office should be contacted; telephone 033 3946 543). - The South African Police Services should be notified by an Amafa Heritage staff member or an independent heritage practitioner if human remains are identified. No SAPS official may disturb or exhume such remains, whether of recent origin or not. - All parties concerned should respect the potentially sensitive and confidential nature of the heritage resources, particularly human remains, and refrain from making public statements until a mutually agreed time. - Any extension of the project beyond its current footprint involving vegetation and/or earth clearance should be subject to prior assessment by a qualified heritage practitioner, considering all information gathered during this initial heritage impact assessment.
Monitoring	• During the construction phase all mine infrastructure and excavation areas must be monitored by an accredited Heritage Practitioner.

13.2 RELOCATION OF GRAVES

13.2.1 Description of Impact

Graves and Burial Grounds are accorded the highest level of significance in the National Heritage Resources Act, Act 25 of 1999 (NHRA). The procedure for consultation regarding burial grounds and graves (Section 36 of the NHRA) is applicable to all graves older than 60 years located outside a formal cemetery administrated by a local authority.

13.2.2 Source of Impact

The project activities/ infrastructure likely to require relocation of graves include:

Project phase	Activity/infrastructure
Construction and operational	• Earthworks and land clearance

13.2.3 Impact Assessment

Should any graves be discovered during the construction and operational phases the impacts can be seen as permanent and irreversible. The impact would be **VERY HIGH** without mitigation but can be slightly reduced to **HIGH** should the correct procedures be followed for grave relocation (Table 13-3). **The worst case scenario has been assessed here due to no surveys have been undertaken at this stage.**

Table 13-3 Relocation of graves

Impacts to Water Quality		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Construction and Operational	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Severe change (Very high)	Prominent change (High)
Duration	Very long term/ Permanent (> 20 years)	Very long term/ Permanent (> 20 years)
Extent	Local	Beyond site
Consequence	Very high	High
Probability	Definite / Continuous	Definite / Continuous
Significance	**Very high -**	**High -**
Degree to which impact can be reversed	**Irreversible** - Substantial intervention will be required. Unmitigated graves will incur vigorous/ widespread community mobilization against project. May result in legal action if altered or damaged by construction and operational activities.	
Degree to which impact may cause irreplaceable loss of resources	**High** - Unmitigated graves will incur vigorous/widespread community mobilization against project. May result in legal action if altered or damaged by construction and operational activities.	
Degree to which impact can be avoided	**Medium** - Predevelopment mitigation (graves audit and engagement with affected families to negotiate exhumation and reinterment with fair compensation) is an essential requirement.	
Degree to which impact can be mitigated	**Medium** - Predevelopment mitigation (graves audit and engagement with affected families to negotiate exhumation and reinterment with fair compensation) is an essential requirement.	
Cumulative impact		
Nature of cumulative impacts	Development activities in and around the project area have been limited to domestic homestead expansion and local infrastructure development, e.g. access roads, water pipelines and electricity provision. Resident communities, cognoscente of grave locations, would have advised infrastructure contractors where to deviate in order to avoid such grave locations. Cumulative impacts are thus not expected.	
Rating of cumulative impacts	**Medium -**	**Low -**
Residual impact		
Residual impact discussion	**Insignificant** – the residual impact, provided the Chance Find Procedure is adhered to is determined to be very low.	

Table 13-4 Management outcome, mitigation actions/measures and monitoring

<table>
<tr><th colspan="2">Management Outcome, Mitigation Actions/Measures and Monitoring</th></tr>
<tr><td>Management objective</td><td>Minimise the impact on cultural heritage resources during the construction and operational phases of the Jindal MIOP.</td></tr>
<tr><td colspan="2">Mitigation actions/measures</td></tr>
<tr><td colspan="2">Construction and Operational Phases</td></tr>
<tr><td colspan="2">• Complete survey of the Jindal MIOP footprint for possible graves identification, auditing, and engagement with affected families will allow for further mitigatory measures to be pursued and within the scope of the envisaged RAP.
• Amafa will not issue a permit for any alteration to or disinterment or reburial of a grave unless it is satisfied that the developer has, in accordance with regulations made by the responsible heritage resources authority –
  ◦ (a) made a concerted effort to contact and consult communities and individuals who by tradition have an interest in such grave or burial ground; and,
  ◦ (b) reached agreements with such communities and individuals regarding the future of such grave or burial ground.
• The Chance Finds Protocol for unidentified graves must be in place for Construction and Operational Phases.</td></tr>
<tr><td>Monitoring</td><td>• During the construction phase all mine infrastructure and excavation areas must be monitored by an accredited Heritage Practitioner.</td></tr>
</table>

14. TRAFFIC

14.1 IMPACT ON ROAD USERS AND TRAFFIC SAFETY

14.1.1 Description of Impact

Traffic impacts are expected from the construction phase through to the end of the decommissioning phase when trucks, buses, and private vehicles make use of the private and public transport network in and adjacent to the proposed Jindal MIOP. The key potential traffic related impacts are on road capacity and public safety. The road network most likely to be affected by the increased traffic volumes are the R66, R34 and the D395 with various intersections along the route.

The following safety risks apply when additional traffic associated with the proposed project is added to the transport network:

- Pedestrian accidents; and
- Vehicle accidents.

Access to and from the Jindal MIOP would be gained directly from Road D395 which is classified as a U4b road. Road D395 currently traverses the site of the Jindal MIOP where mining infrastructure is proposed and would require further investigation as part of the detailed design phase in terms of re-routing or diverting the relevant section of the D395.

Broader access to the Jindal MIOP is currently gained via a series of local gravel roads which include Road L742, Road L2765, Road PROW15, and Road P258. All of the last mentioned road's lead to the main road, Road P47-7 (R66), a tarred road which provides access to the broader area.

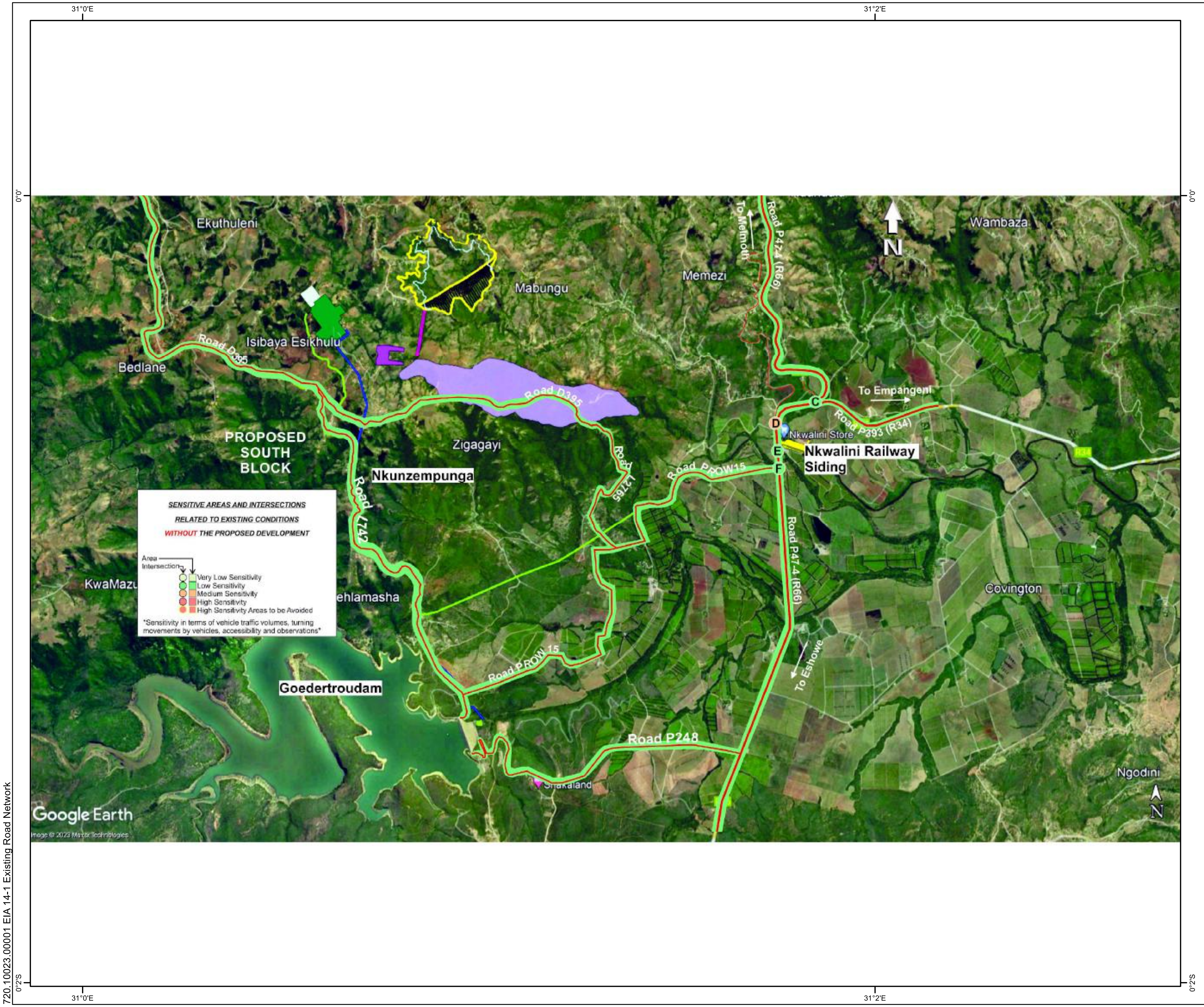
As part of access to and from the Jindal MIOP, a more direct access route is proposed which would ultimately link up with the existing intersection of the R66 and Road PROW15 (Point F) (Figure 14-1). The proposed access route would need more detailed investigation as part of the detailed design phase which should include consultation with roads authorities and the local community. The proposed access route would also be utilised by heavy vehicles transporting concentrate from the Jindal MIOP to the Nkwalini railway siding for loading onto trains. Access to the Nkwalini railway siding is currently at Point E.

The proposed access route is regarded as acceptable from a traffic engineering point of view.

14.1.2 Source of Impact

The project activities/infrastructure likely to result in impacts on road users and traffic safety:

Project phase	Activity/infrastructure
Construction	• Construction related traffic
Operational	• Transport of staff • Transport of concentrate • Maintenance related traffic
Decommissioning/ Closure	• Decommissioning related traffic



JINDAL IRON ORE (PTY) LTD

FIGURE 14-1
EXISTING ROAD NETWORK AND INTERSECTIONS

SLR

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Project No: 720.10023.00001	Prepared By: BG
Map Ref No: EIA 14-1	Date: 17/05/2023

14.1.3 Impact Assessment

During the construction and operational phases additional traffic would be generated due to the transportation of equipment, materials and workers to the site. The additional traffic can impact on the safety of other road users, vehicular and pedestrian, as well as potentially causing disruption of daily local movement patterns.

The following number of vehicular trips are anticipated for the construction phase.

- AM Peak: 52 trips in, 27 trips out.
- PM Peak: 27 trips in, 52 trips out.

The following number of vehicular trips are anticipated for the operational phase.

- Anticipated Vehicle Trips: Operational Phase – 5 years from Base year:
  - AM Peak: 84 trips in, 75 trips out.
  - PM Peak: 75 trips in, 84 trips out.
- Anticipated Vehicle Trips: Operational Phase 10 Years from Base year:
  - AM Peak: 124 trips in, 81 trips out.
  - PM Peak: 81 trips in, 124 trips out.

The following is relevant to the construction and operational phases of the Jindal MIOP:

- That vehicle capacity on the road network is available and would be able to accommodate the additional vehicle trips anticipated to be generated by the Jindal MIOP during the construction phase, and therefore from a road capacity perspective has a **LOW** significance and no mitigation measures would be required (Table 14-1).
- It could be expected that workers of the Jindal MIOP would make use of the public transport loading and off-loading facilities as well as the retail facilities at Point D. From a road safety perspective, pedestrian movement at Point D because of retail activities and public transport loading and off-loading at the intersection is regarded to have a **MEDIUM** significance due to a lack of pedestrian crossings and walkways, and therefore mitigation measures would be required. With the implementation of mitigation measures, the significance would improve to a **MEDIUM POSITIVE** (Table 14-1).
- From a road safety perspective, the anticipated vehicle trips to be generated by the Jindal MIOP during the construction phase would have a low significance at Points C, D, and E and no mitigation measures would be required.
- From a road safety perspective, the anticipated vehicle trips to be generated by the Jindal MIOP during the construction and operational phases would have a **HIGH** significance at Point F, and mitigation mitigating would be required. With the implementation of mitigation measures the significance could improve to a **HIGH POSITIVE** (Table 14-1).

During decommissioning the number of vehicles that would be coming and going from the Jindal MIOP is likely to be very similar to that for the construction phase, as such the impact significance is predicted to be **LOW** (Table 14-1).

The concerns at Point D with regards to pedestrian movements, should no mitigating measures have been implemented, would persist as long as the public transport loading and off-loading takes place, and the retail facilities are active.

In summary, the existing road network has vehicle capacity available to accommodate the anticipated number of vehicle trips proposed to be generated by the Jindal MIOP but mitigation needs to be implemented in some instances to minimise safety impacts to pedestrians and other vehicles. As such various road upgrades are recommended should the mine go ahead to minimise these impacts (Figure 14-2).

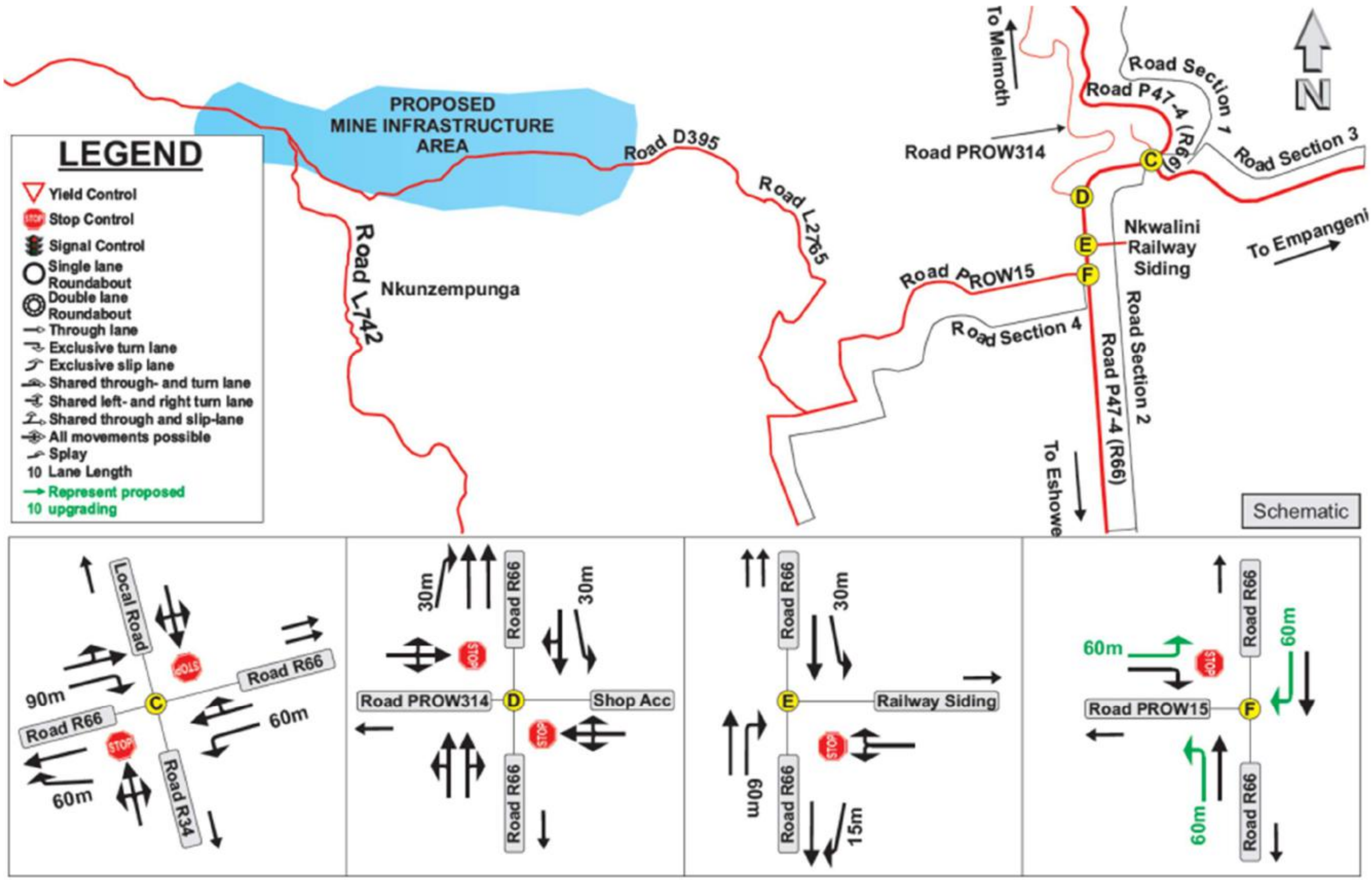

Figure 14-2 Recommended intersection and road network improvements with the Jindal MIOP

Table 14-1 Impact on road users and traffic safety

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phase	**Construction and Decommissioning**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Minor change (Low)	Minor change (Low)
Duration	Short-term (1 and 5 years)	Short-term (1 and 5 years)
Extent	Beyond site	Beyond site
Consequence	Low	Low
Probability	Probable	Probable
Significance	**Low -**	**Low -**
Description of Impact		
Phases	**Operational**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Prominent change (High)	Prominent change (High)
Duration	Long-term (10 and 20 years	Long-term (10 and 20 years
Extent	Beyond site	Beyond site
Consequence	High	High
Probability	Probable	Probable
Significance	**High to Medium -**	**Medium to High +**
Degree to which impact can be reversed	**Irreversible** – Should an impact result in a loss of life due to mine related transport the impact would be irreversible.	
Degree to which impact may cause irreplaceable loss of resources	**Low** – The likelihood is low that an irreversible impact would occur, particularly if the road upgrades are implemented.	
Degree to which impact can be avoided	**Medium** – Provided mitigation measures are implemented and adhered to.	
Degree to which impact can be mitigated	**Medium** – Well implemented mitigation measures can minimise the associated impacts and even result in a positive change for the local commuters.	
Cumulative impact		
Nature of cumulative impacts	There are likely to be cumulative impacts, particularly during harvesting season when there may be additional vehicles on the road. However, due to the seasonal nature of this and due to the improved road network as part of mitigation requirements the cumulative impact can be reduced from medium to low.	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Medium -	**Low -**
Residual impact		
Residual impact discussion	**Medium – High Positive** - The residual impact is expected to be positive.	

Table 14-2 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	Minimise impacts on road users and traffic safety during all phases of the Jindal MIOP.
Mitigation actions/measures	
All Phases	
• Implement all road upgrades as per Figure 14-2. • Road safety mitigation measures at Point D which includes pedestrian crossings/walkways should be implemented. • A dedicated right-turn lane on the northern approach of Road R66 should be implemented. • Provision of a dedicated right-turn lane would require relocating the existing intersection to the south in order to accommodate the right-turn lane, due to an existing bridge to the north. • Provision of a dedicated left-turn lane on the southern approach of Road R66 and western approach of Road PROW15.	
Monitoring	• Ensure that required upgrades are implemented.

15.SOCIAL – COMMUNITY IMPACTS

15.1 LABOUR INFLUX / IN-MIGRATION OF JOBSEEKERS

15.1.1 Impact Description

The scale of the proposed Jindal MIOP means that it is likely to attract people from outside the area looking for employment opportunities. An increase in the population will increase the demand for basic services in an environment that is already suffering from low levels of service delivery, thus placing an increasing service delivery burden on the local government authorities.

Further to this, with high levels of poverty in the receiving environment, employment opportunities being offered to outsiders has a high propensity to create social tension and conflict between the resident population and outsiders.

15.1.2 Source of Impact

The project activities/infrastructure likely to result in labour influx / in-migration of jobseekers include:

Project phase	Activity/infrastructure
Construction	• Short-term employment opportunities
Operational	• Long-term employment opportunities
Decommissioning/ Closure	• Short-term employment opportunities

15.1.3 Impact Assessment

The 5-year construction phase is anticipated to require in the order of 26 437 Full Time Employment (FTE) personnel, or around 8 800 persons per year. It is unlikely that the labour pool is large enough to provide all these persons and therefore there is bound to be an influx of people into the area.

Social conditions outside the mines have historically been major drivers of epidemics, starting in the past with the “circular transmission” of sexually transmitted diseases (STDs) between rural areas and the mines, and now driving HIV/AIDS and tuberculosis (TB). The labour migration system creates a mechanism to spread miners’ HIV and TB risks to their families and home communities, in turn placing an increased burden on healthcare facilities, both in the mine communities and in their home communities.

Growth in the resident population in Mthonjaneni and Umlalazi Local Municipalities (LMs) is also likely to place an increased burden on bulk public service infrastructure such as water, electricity, and housing.

There is a potential risk of an escalation in crime within the surrounding communities. Such crime could be petty in nature, such as pick-pocketing and theft, or more serious contact crimes, such as mugging, carjackings and home invasions. This is likely to place an increased burden on the community police services and create dangers for the surrounding communities.

This negative impact is assessed to have a medium intensity and is likely to extend beyond the site boundaries into the surrounding communities in both Mthonjaneni and Umlalazi LM. The significance of the impact is assessed as **LOW**, with mitigation measures this could be reduced to **VERY LOW** (Table 15-1).

The operational phase of the Jindal MIOP is projected to create and sustain around 800 FTE employment opportunities per year. The technical skill and education requirements of the MIOP mean that the absorption of the local labour force to fulfil all functions is unlikely and some skills would need to be brought into the local economy.

This negative impact is assessed to have a low intensity but is likely to extend beyond the site boundaries into the surrounding communities in the Mthonjaneni LM. The significance of the impact is assessed as **MEDIUM** prior to mitigation, with mitigation measures implemented this could be reduced to **LOW** (Table 15-1).

At decommissioning the likelihood of influx will cease and with mitigation the impact can be reduced from **LOW** to **VERY LOW** (Table 15-1).

Table 15-1 Labour influx / in-migration of jobseekers

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phase	**Construction**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium)	Moderate change (Medium)
Duration	Short-term (1 and 5 years)	Short-term (1 and 5 years)
Extent	Local	Local
Consequence	Low	Low
Probability	Probable	Possible / frequent
Significance	**Low -**	**Very Low -**
Description of Impact		
Phases	**Operational**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Low	Very low
Duration	Long-term (10 and 20 years)	Long-term (10 and 20 years)
Extent	Local	Local
Consequence	Medium	Low
Probability	Probable	Probable
Significance	**Medium -**	**Low -**
Phases	**Decommissioning and Closure Phases**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium)	Moderate change (Medium)
Duration	Short-term (1 and 5 years)	Short-term (1 and 5 years)
Extent	Local	Local
Consequence	Low	Low
Probability	Probable	Possible / frequent
Significance	**Low -**	**Very Low -**

Degree to which impact can be reversed	**Partially Reversible** - Given the long-term nature of the mine's operations, the negative impact of labour influx associated with the operational phase would be challenging to reverse.	
Degree to which impact may cause irreplaceable loss of resources	**Low** - Unlikely to cause irreplaceable loss of resources, however, some level of destabilisation of the community is likely as a result of outsiders taking up residence in the community.	
Degree to which impact can be avoided	**Medium** – Provided mitigation measures are implemented the influx of jobseekers and the associated impacts to the local communities can be controlled to some extent.	
Degree to which impact can be mitigated	**Medium** – Well implemented mitigation measures can minimise the associated impacts.	
Cumulative impact		
Nature of cumulative impacts	The cumulative impact is likely to be low to very low.	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Low -	**Very low -**
Residual impact		
Residual impact discussion	**Low** - The residual impact is expected to be low.	

Table 15-2 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	To minimise the impacts of labour influx / in-migration of jobseekers during all phases of the Jindal MIOP.
Mitigation actions/measures	
Construction Phase	
• Effective implementation of the Social and Labour Plan (SLP), including the ring-fencing of a portion of procurement to locally empowered suppliers and a stipulation for them to employ local residents. • Providing opportunities for local residents to take up construction jobs is likely to mitigate potential conflict arising from the influx of outsiders. • Increased security and proactive policing to prevent and combat escalation in crime within the surrounding communities. • Continuous engagement with local community and labour representatives, including traditional leadership and ward committees.	
Operational Phase	
• Effective implementation of the SLP, including the ring-fencing of a portion of procurement to locally empowered suppliers and a stipulation for them to employ local residents. • Providing opportunities for local residents to take up operational jobs is likely to mitigate potential conflict arising from the influx of outsiders. • Implementation of the SLP Skills Development Plan (SDP), including undertaking a skills audit in the local population to identify skill deficits which need to be addressed based on operational requirements.	
Decommissioning Phase	
• As for construction phase.	
Monitoring	**Construction & Decommissioning Phases** • The following monitoring is required:

Management Outcome, Mitigation Actions/Measures and Monitoring	
	- Procurement of goods and services for the establishment of the MIOP should be monitored to ensure ring-fenced procurement is implemented and that local empowered suppliers fulfil their contractual obligations of hiring local residents. - A database of all labourers in the construction companies should be compiled and submitted to Jindal, including proof of residence. - This should be done on a continual basis throughout the construction phase to ensure compliance. • The following reporting is required: - Internal reporting – monthly for: • Procurement appointments. • Tracking of Historically Disadvantaged South Africans (HDSA) as part of the construction labour force with an emphasis on local resident population. - External reporting – quarterly for: • Apprising local authorities, including municipal government, traditional leadership, and ward councillors, of composition of construction labour force. **Operational Phase** • The following monitoring is required: - Procurement of goods and services for the establishment of the MIOP should be monitored to ensure ring-fenced procurement is implemented and that local empowered suppliers fulfil their contractual obligations of hiring local residents. - A database of all labourers should be compiled, including proof of residence. - This should be done on a continual basis throughout the operational phase to ensure compliance. • The following reporting is required: - Internal reporting – monthly for: • Procurement appointments. • Tracking of Historically Disadvantaged South Africans (HDSA) as part of the operational labour force with an emphasis on local resident population. - External reporting – quarterly for: • Apprising local authorities, including municipal government, traditional leadership, and ward councillors, of composition of labour force. - External reporting – annual for: • Department of Mineral Resources and Energy (DMRE) on SLP compliance

15.2 RESETTLEMENT AND RELOCATION

15.2.1 Description of Impact

The establishment of the proposed Jindal MIOP will require resettlement of households and community facilities, such as schools, clinics and places of worship. Forced resettlement can be particularly disastrous for indigenous communities who have strong cultural and spiritual ties to the lands of their ancestors and who may find it difficult to survive when these are broken. In traditional or rural areas, communities bury their loved ones in their yards. Therefore, losing their land or being forced to resettle elsewhere will mean that the graveyards/ burial sites would need to be relocated as well.

The displacement of settled communities is likely to cause resentment towards and conflict with the mine. The removal of communities to elsewhere, often into purpose-built settlements not necessarily of their own choosing, may cause a significant disruption to their lives. Besides losing their homes, communities lose their land, and thus their livelihoods. Community institutions and power relations may also be disrupted. Displaced communities are often settled in areas without adequate resources or are left near the mine, where they may bear the brunt of pollution and contamination.

15.2.2 Source of Impact

The project activities/ infrastructure likely to result in resettlement and relocation include:

Project phase	Activity/infrastructure
Construction	• Development of the processing plant and primary crusher • Planning for the South East Pit and WRD

15.2.3 Impact Assessment

During the construction phase, there is a likelihood that family and community bonds will be stretched and broken as those family members that fall outside of the demarcated resettlement zone are relocated, while others are left behind. Physical and emotional isolation from relatives, friends, and social support networks can have an enormous psychological toll on families and communities.

Being predominantly Zulu tribal land under the authority of the Ingonyama Trust Board and other traditional authorities, the relocation and exhumation of graves is likely to be a source of contention for the local community in the receiving environment. Conflicts and disagreements are likely to arise as this type of activity affronts most people's beliefs and cultural practices.

Religious, customary, and spiritual practices could be interrupted because of household and community resettlement. Resettlement is likely to strain or possibly sever people's customary and religious networks by moving them away from their places of worship and practice, with ancestral connections to the land being lost.

The relocation and resettlement of community households, schools and other facilities will only occur in the construction phase although the impacts are likely to be on a long-term to permanent basis.

This impact is considered to have a high intensity which would persist over the medium-term but is localised, extending to those directly affected by the mine's establishment, viz, those communities currently living in the

South East Block, where mining activities would be concentrated. The significance prior to mitigation is assessed as **HIGH** and could be reduced to **MEDIUM** with good mitigation (Table 15-3).

Table 15-3 Resettlement and relocation during construction phase

Impacts to Water Quality		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Construction	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Prominent change (High)	Moderate change (Medium)
Duration	Long-term (10 and 20 years	Long-term (10 and 20 years
Extent	Local	Local
Consequence	Medium	Medium
Probability	Probable	Probable
Significance	**High -**	**Medium -**
Degree to which impact can be reversed	**Irreversible** - From a physical location perspective, this impact cannot be reversed. However, in time, a new dynamic will emerge as residents get used to the new normal. There is a potential for medium-term psychological distress and trauma	
Degree to which impact may cause irreplaceable loss of resources	N/A	
Degree to which impact can be avoided	**None** – Should the Jindal MIOP go ahead resettlement would be definitely be required.	
Degree to which impact can be mitigated	**Medium** – The implementation of a well planned Resettlement Action Plan could minimise the long-term impact on those that need to be resettled.	
Cumulative impact		
Nature of cumulative impacts	There is no other instance of resettlement in the area and the cumulative impact is therefore insignificant.	
Rating of cumulative impacts	**Insignificant**	**Insignificant**
Residual impact		
Residual impact discussion	Medium – The residual impact of resettlement is medium as the long term impacts of resettlement are hard to predict.	

Table 15-4 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	To minimise the impacts of resettlement and relocation during the construction phase of the Jindal MIOP.
Mitigation actions/measures	
Construction Phase	
• The resettlement mitigation measures should be developed by qualified resettlement specialists and should be included as part of a RAP. This may include the following suggested mitigations:	

<table>
<tr><th colspan="2">Management Outcome, Mitigation Actions/Measures and Monitoring</th></tr>
<tr><td colspan="2">

Jindal must engage in open and transparent discussions with community members, through the mandated channels, to effectively manage community expectations.
Fair and just compensation must be provided to any relocated community members and all lost infrastructure must be replaced to a similar or better standard.
Continual engagement with local community and labour representatives, including traditional leadership and ward committees.

</td></tr>
<tr><td>Monitoring</td><td>

The following monitoring is required:

The monitoring of the resettlement mitigation measures should be developed by qualified social monitoring specialists and should be included as part of a RAP. This may include following monitoring indicators:
Restoration of livelihoods and assets including type of assistance and compensation paid such as :

Condition and quality of livestock owned
Condition and quantity of grazing land accessible
Access to water, sanitation and electricity

Grievance management including number of grievances received and promptly resolved
The monitoring and evaluation should be done before the relocation, during compensation and post relocation using specific indicators.
More specific monitoring to understand the success of the RAP would need to be developed by qualified social monitoring specialists.

The following reporting is required:

The reporting of the resettlement mitigation measures should be developed by qualified social monitoring specialists and should be included as part of a RAP. This may include following reporting indicators:

Internal reporting – monthly for:

Restoration of livelihoods
Grievance management

External reporting – quarterly for:

Apprising local authorities, including municipal government, traditional leadership, and ward councillors, of progress on the RAP.

External reporting – annual for:

DMRE on SLP compliance

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15.3 COMMUNITY DEVELOPMENT AND LIFESTYLE

15.3.1 Description of Impact

The establishment of the proposed Jindal MIOP could have both positive and negative impacts on the lifestyle of communities in the receiving environment. Large scale construction projects and, later, the presence of a mine in the area is likely to result in negative changes to the sense of place and aesthetic qualities of what is a tranquil, rural landscape set amongst rolling green hills. Uncertainty over the future can result in fear and anxiety within the community, with negative consequences for community development. Additionally, as is common with large-scale mining projects, misrepresentation of the community by their traditional leadership has the potential to negatively influence community development, while fraud, corruption and political interference in employment and procurement can negatively impact public service delivery for residents.

15.3.2 Source of Impact

The project activities/infrastructure likely to result in impacts to community development and lifestyle include:

Project phase	Activity/infrastructure
Construction	• Mine development • Community development initiatives
Operational	• Ongoing mining activities • Community development initiatives

15.3.3 Impact Assessment

During the construction phase, a range of potential negative impacts affecting community development are anticipated. Misrepresentation of community members by traditional leadership and the use of violence, fear and intimidation to secure support for the Jindal MIOP amongst the community are possible, with numerous instances of this having occurred in other mining projects in South Africa, often with fatal consequences, such as the Xolobeni Sands Mineral Project in the Eastern Cape and the Somkhele Mine in Northern KZN.

There are three Traditional Authority areas within the Mthonjaneni LM:

- Biyela KwaYanguye Traditional Authority is located to the north-east of the municipality and incorporating the KwaYanguye area and surrounding settlements.
- Zulu-Entembeni Traditional Authority is located to the south east of the municipality and incorporates Makasaneni and Ndundulu and surrounding settlements.
- Biyela-Obuka Traditional Authority is located towards the East of the municipality and incorporates areas like Sqhomaneni, Upper Nseleni and other surrounding rural settlements.

All these Traditional Authority areas are solely owned by Ingonyama Trust. Failure to secure the support and buy-in of these Traditional Authorities regarding the planned developments could potentially frustrate the process and create discord within the resident communities.

South Africa is also well-versed in the way projects of this magnitude are capitalised on by nefarious interests in both the private and public sector to secure political influence through patronage. The impacts of such activities can be potentially disastrous for surrounding communities and the economic development and growth of the country. Vote-buying through promises of employment and removal of bureaucratic red-tape to secure favourable decisions is a risk that must be mitigated.

The intensity of this impact is assessed to be high due to the risk of serious injury or fatalities. However, it is a short-term impact that is likely to subside post- construction activities and is considered localised, affecting those in relative proximity to the site. The pre-mitigation significance is thus assessed as **MEDIUM** and following mitigation can be reduced to **LOW** (Table 15-5).

Through the SLP, the proposed MIOP can potentially positively support the general upskilling of the community and especially of community members that are employed by the mine. Inclusion of skills and capacity building programmes that focus on Adult Basic Education and Training (ABET), learnerships/ apprenticeships, driver's licensing, and bursaries for higher education degrees that are related to the skills requirements of the mine's operations. Such programmes can empower the community, reduce poverty by equipping community members with skills that will improve their economic development prospects, and support the strengthening of social inclusion.

The positive impact is considered to be of **MEDIUM** intensity and would occur over the long-term life of mine. It is likely to extend beyond the site boundaries and into the LM and is therefore assessed to have a **MEDIUM** positive significance prior to enhancement measures being implemented. With enhancement the impact could extend beyond the Mthonjaneni and uMlalazi LM as the skills developed could be transferrable to other sectors and geographic locations and could be improved to **HIGH POSITIVE** significance (Table 15-5).

The major social implication associated with the decommissioning phase is linked to the loss of jobs and associated income. This has implications for the households who are directly affected, the communities within which they live, and the relevant local authorities. The downscaling and retrenchment will be required in full consultation with recognised organised labour. The Company will follow the procedures for downscaling and retrenchment as set out by the Department of Labour (DoL) and the Labour Relations Act. The impact is likely to be similar to that for the construction phase.

Table 15-5 Community development and lifestyle

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative/ Positive	
Phase	**Construction and Decommissioning**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Prominent change (High)	Prominent change (High)
Duration	Short-term (1 and 5 years)	Short-term (1 and 5 years)
Extent	Local	Local
Consequence	Medium	Medium
Probability	Probable	Conceivable
Significance	**Medium -**	**Low -**
Description of Impact		
Phases	**Operational**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium) +	Prominent change (High) +

Duration	Long-term (10 and 20 years)	Long-term (10 and 20 years)
Extent	Local	Regional
Consequence	Medium	High
Probability	Probable	Probable
Significance	**Medium +**	**High +**
Degree to which impact can be reversed	N/A as a positive impact	
Degree to which impact may cause irreplaceable loss of resources	**Very Low** -Skills development and training will increase the knowledge and skills resource base of the local communities.	
Degree to which impact can be avoided	N/A as a positive impact	
Degree to which impact can be mitigated	**Medium** – Enhancement measures can increase the positive impact.	
Cumulative impact		
Nature of cumulative impacts	Should local communities gain skills through the 25 years of operations these skills should be transferable and the impacts minimised cumulatively.	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Low -	**Low -**
Residual impact		
Residual impact discussion	**High +** - With enhancement of community skills development the residual impact could be a high positive impact.	

Table 15-6 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	To maximise the community development and lifestyle impacts during all phases of the Jindal MIOP.
Mitigation actions/measures	
Construction Phase	

- The following mitigation measures are recommended to reduce the significance of this:
  - Jindal must engage in early and ongoing open and transparent discussions with community members, through the mandated channels to effectively manage community expectations.
  - Continual engagement with local community and labour representatives, including traditional leadership and ward committees.
  - At the pre-construction phase, Jindal should undertake a skills audit in the labour-sending communities with the objective of identifying skills development interventions necessary for community members to take up the employment opportunities on offer.
  - Effective implementation of the SLP, especially in relation to the skills development plan.
  - Establishment and implementation of effective governance controls to reduce or avoid opportunities for political influence.

Operational Phase

- The following enhancement measures are recommended to ensure this impact becomes of HIGH significance:

<table>
<tr><th colspan="2">Management Outcome, Mitigation Actions/Measures and Monitoring</th></tr>
<tr><td colspan="2">

Effective implementation of the SLP, especially in relation to the skills development plan.
Jindal should continually undertake skills audits in the labour-sending communities with the objective of identifying skills development intervention necessary for community members to take up the employment opportunities on offer.
Jindal must engage in open and transparent discussions with community members, through the mandated channels to effectively manage community expectations.
Continual engagement with local community and labour representatives throughout the operational phase, including traditional leadership and ward committees.

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<tr><td>Monitoring</td><td>
Construction Phase

The following monitoring is recommended:

Ongoing engagements with community and labour representatives should be monitored.
An annual skills audit should be undertaken in the community and in the labour force to identify skills deficits against the mine’s operational requirements.
Implementation of all skills development interventions must be monitored against Jindal’s commitments as articulated in the SLP.

Reporting on the above monitoring should be as follows:

Internal reporting – quarterly for:

Skills development interventions
Tracking of Historically Disadvantaged South Africans (HDSA) as part of the construction labour force with an emphasis on local resident population

External reporting – quarterly for:

Apprising local authorities, including municipal government, traditional leadership, and ward councillors, of composition of labour force and skills requirements and opportunities for community development.

Operational Phase

The following monitoring is recommended:

Monitoring of annual skills audit should be undertaken in the community and in the labour force to identify skills deficits against the mine’s future operational requirements.
Monitoring of implementation of all skills development interventions must be monitored against Jindal’s commitments as articulated in the SLP.

Reporting on the above monitoring should be as follows:

Internal reporting – quarterly for:

Skills development interventions
Tracking of Historically Disadvantaged South Africans (HDSA) as part of the construction labour force with an emphasis on local resident population

External reporting – quarterly for:

Apprising local authorities, including municipal government, traditional leadership, and ward councillors, of composition of labour force.
DMRE regarding SLP skills development plan interventions.

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15.4 BUSINESS AND ENTERPRISE - IMPACTS ON THE AGRICULTURAL SECTOR

15.4.1 Description of Impact

The Nkwalini Valley is a highly productive bio-resource zone, with high-value export commodities such as citrus and avocado being commercially produced in the area. As of 2021 the agriculture, forestry and fishing sector was contributing about 30.5% (R 6 628.90 million) of the total uMlalazi Gross Value Added (GVA) and about 10% (R 2 180.20 million) of total Mthonjaneni GVA. The nature of the mine's construction and operations could impact commercial and subsistence agricultural operations through the introduction of contaminated windblown dust. Depending on the contaminants, the possibility exists of soil contamination over a potentially significant area which extends far beyond the mine's borders. Impeding the citrus growing areas would have dire consequences for their operations, which in turn may result in job losses along the value chain, and loss of valuable export earnings.

Additionally, changes in both the quantity and quality of water available for agricultural operations could place these operations in jeopardy. It is understood that water-users downstream of the Goudertrouw Dam have, in recent years, been unable to use their full water allocations due to drought-induced water shortages. There is a risk that actual allocations would be further reduced should the Jindal MIOP be granted a Water Use License for abstraction from the Mhlatuze Catchment (although this currently seems unlikely).

It is estimated, through correspondence with the Nkwalini Farmers Association (NFA), that the agricultural operations in the Nkwalini Valley provide direct employment for approximately 2 000 people. Employment multipliers within the agricultural sector average around 1.13, meaning that for every 10 direct on-farm FTE jobs, another 11.33 FTE jobs are created throughout the value chain. The agricultural operations in Nkwalini therefore potentially support 4 266 FTE jobs and sustain them on an ongoing basis. It is reasonably safe to suggest that these jobs will be supported on a long-term or even permanent basis.

Mining activity in some cases comes into direct competition with another predominant means of economic development in rural areas: agriculture (both small scale and large commercial farms). As shown in the economic profile of the area of influence (AOI), agriculture is one of the driver economic sectors in the region. Farming is the traditional source of livelihood in the AOI, but mining has emerged as a lucrative activity. This is due to its high income-generating potential. Although mining and agriculture can co-exist, generating economic and social benefits, there are some inherent tensions between the two as they compete for resources.

People in the AOI depend on agriculture to sustain their livelihoods; however, the mines have also become important because they are perceived to create better employment opportunities. The agricultural sector may lose labour to the mine, as the mine is assumed to pay more for labour than the farming areas. Research shows that tensions over control of land and labour have led to community protests and violent conflict in some cases. However, mining and agriculture are not necessarily incompatible economic activities. Mining can generate money that supplements the income of farmers which allows them to improve their farms' productivity through buying inputs such as fertiliser and hiring of labour. Finding ways to reconcile these two important development drivers is a critical governance issue for the MIOP to reduce conflicts and ensure that mining's benefits contribute to long-term sustainable development in the economy of the AOI. Improved planning, dialogue and social compacts are required to optimise the relationship and ensure a balanced coexistence that would produce social and economic development without disrupting the livelihoods of rural people whose lives are tied to farming.

15.4.2 Source of Impact

The project activities/infrastructure likely to result in business and enterprise impacts related to the agricultural sector include:

Project phase	Activity/infrastructure
All Phases	• Jindal MIOP employment opportunities

15.4.3 Impact Assessment

Construction activities will require the loosening and removal of significant volumes of overburden and the clearing of swathes of land to create platforms required for construction of the mine. Construction activities typically also require a significant amount of water and have the potential to contaminate ground water sources through the run-off of contaminated liquids into the water system, which would have negative consequences for agricultural activities downstream of the MIOP.

The possible loss of agricultural potential is assessed to have a very high intensity and could persist over the long-term depending on the extent of the change in environmental quality. Given the importance of the agricultural sector for the region, the impacts could extend well beyond the site boundary. Unmitigated, the impact is considered to have a **HIGH** significance but effective mitigation measures aimed at reducing the probability of occurrence could reduce it to **MEDIUM** (Table 15-7).

Mining activity may compete for resources with agricultural activity in the area (both small scale and large commercial farms). People in the AOI depend on agriculture to sustain their livelihoods. The agricultural sector may lose labour to the mine, as the mine is assumed to pay more for labour than the farming areas. Thus, the impact is also assumed to be **HIGH** prior to mitigation but can be reduced to **MEDIUM** with mitigations implemented (Table 15-7).

Table 15-7 Agricultural sector impacts

Impacts to Water Quality		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Construction and Operational	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Severe change (Very high)	Severe change (Very high)
Duration	Long-term (10 and 20 years)	Short-term (1 and 5 years)
Extent	Regional	Regional
Consequence	High	High
Probability	Probable	Possible / frequent
Significance	**High -**	**Medium -**
Degree to which impact can be reversed	**Partially reversible** - Low reversibility once carrying capacity lost	
Degree to which impact may cause irreplaceable loss of resources	**Low** – Local subsistence farmers within the proposed mine footprint would likely have to be resettled. Should they have areas that are farmed, as part of the RAP they would be required to be provided with 'like for like' areas to farm.	

Impacts to Water Quality		
Degree to which impact can be avoided	**Low** – The resource defines the footprint of the pit and therefore avoidance is unlikely.	
Degree to which impact can be mitigated	**Medium** – This impact can be mitigated to some extent to minimise impacts on the agricultural sector.	
Cumulative impact		
Nature of cumulative impacts	The cumulative impacts to the agricultural sector are predicted to be of medium significance but could be managed to have a low impact significance.	
Rating of cumulative impacts	**Medium -**	**Low -**
Residual impact		
Residual impact discussion	**Medium** – The residual impact is expected to be medium significance.	

Table 15-8 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	To minimise impacts to the viability of the agricultural sector during all phases of the Jindal MIOP.
Mitigation actions/measures	
Construction Phase	
• Mitigation measures would be required to limit changes in air and water quality and also in water quantity. These specialists in the team will need to determine what measures are taken to reduce the significance of the associated impacts.	
Operational Phase	
• Improved planning, dialogue and social compacts are required to optimise the relationship and ensure a balanced coexistence that will produce social and economic development without disrupting the livelihoods of those whose lives are tied to farming.	
Monitoring	• Regular meetings with local farmers.

15.5 BUSINESS AND ENTERPRISE - IMPACTS ON TOURISM

15.5.1 Description of Impact

Tourism has been identified within the municipal strategic planning documents (both the Local Economic Development (LED) Plans and the Integrated Development Plans (IDP) as being a key economic sector within the AOI. It is noted that interest in northern KZN has been increasing particularly from overseas visitors. New identified markets include bird watching, cruise tourism, and educational tourism. The local municipalities in the King Cetshwayo District Municipality have all identified the need for greater tourism support and coordination from the District Municipality in aiding the development of tourism related small, medium and micro enterprises (SMME's) and new tourism opportunities.

Mthonjaneni is a member of Tourism Association Agency Route 66 which comprises of all municipalities that are linked by the R66 in their economic and tourism activities. Route 66 members include Gingindlovu, Eshowe, Mthonjaneni, Ulundi, Nongoma and Pongola. Mthonjaneni is the gateway to Mthonjaneni and major economically active provinces in RSA including Mpumalanga Province and Gauteng through the R66 route.

Tourism products within proximity to the site are most likely to be affected if the visual aesthetics of the area are altered, while increased noise and dust pollution can make the area undesirable for tourists which may lead to closure of tourism related products and activities, if not well managed and controlled. The tourism industry in South Africa was hard hit by the curtailment of economic activity due to the Covid-19 pandemic and any further disruptions to their activities could be detrimental to their survival and their ability to provide employment opportunities to the communities in which they are located. As an industry with a relatively high economic multiplier effect, through its indirect and induced effects, any loss of tourism products could have long-lasting social consequences for the Mthonjaneni LM population and economy. The impacts could extend beyond the Mthonjaneni LM and into uMlalazi LM where Eshowe is home to a number of tourism products and sites, as well as north on the R66 towards Ulundi as the road is home to the Route 66 Zululand Heritage Route. Changes in sense of place could negatively impact the perceptions of tourists along this route.

Tourism interest in northern KZN has been increasing, particularly from overseas visitors. New identified markets include bird watching, cruise tourism, and educational tourism. Mthonjaneni LM has, amongst others, the following key tourism areas:

- Phobane Lake (also known as Goudertrouw Dam) in Ward 6;
- The home to Queen Nandi family in Ward 5; and
- Mthonjaneni cultural museum in Ward 4.

For those tourism product owners targeting the business tourism sector, the establishment and operation of the mine could be beneficial to their operations due to the increased economic activity resulting from those enterprises that engage in business activities with the MIOP.

15.5.2 Source of Impact

The project activities/ infrastructure likely to result in business and enterprise impacts related to the agricultural sector include:

Project phase	Activity/infrastructure
Construction	• Vehicle movements

Project phase	Activity/infrastructure
	• Earthworks and site clearance • Construction of the processing plant and primary crusher
Operational	• Blasting and mining activities • Vehicle movements
Decommissioning/ Closure	• Demolition and earthworks • Vehicle movements

15.5.3 Impact Assessment

In the construction phase, increased traffic on the roads is likely as materials, equipment and construction crew are brought onto site. The R66 is a tourism route known as the R66 Zululand Tourism Heritage Route. It connects Amatikulu on the east coast, to Pongola in the north and passes through Eshowe, Melmoth, and Ulundi. Tourism KwaZulu-Natal (TKZN) and various tourism stakeholders consider this route a strategic route for international tourists who are attracted to the rich Zulu heritage and history contained in the region.

The impact is assessed as having medium intensity for those tourism establishments that are focused on culture, heritage, avi-tourism (mainly Eshowe), and adventure tourism, and would persist over the short-term. There is, however, a possibility that the construction phase activities could alter tourists perceptions of the region for the long-term. The impacts are likely to extend beyond the site boundary and into the whole region, with tourists potentially discouraged from travelling along the whole route, especially from the Amatikulu side. The unmitigated impact is assessed as having a **HIGH** significance which can be reduced to **MEDIUM** with mitigation (Table 15-9).

Mine and tourism activities are typically incompatible with each other and for those tourism establishments focused on Zulu culture and nature-based tourism such as avi-tourism and adventure tourism, as well as those venues catering for weddings and social functions, there is a possibility of disruptions to business activities. Most visitors are attracted by the undisturbed nature of an area and mining activities during the operational phase are not physically pleasing to tourists due to the associated noise, visual and potential air quality impacts.

The impact significance is assessed to be **MEDIUM** impact pre and post mitigation (Table 15-9).

Should mining cease at the end of the 25 years, the impact on tourism would likely be **HIGH** if it has become dependent on mine related tourism. With a good Closure Plan in place this could probably be reduced to **MEDIUM** (Table 15-9).

Table 15-9 Impacts on the tourism sector

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative/ Positive	
Phase	**Construction and Decommissioning**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium)	Minor change (Low)
Duration	Short-term (1 and 5 years)	Short-term (1 and 5 years)
Extent	Regional	Regional
Consequence	High	High

Probability	Probable	Possible / frequent
Significance	**High -**	**Medium -**
Description of Impact		
Phases	**Operational**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium)	Moderate change (Medium)
Duration	Long-term (10 and 20 years)	Long-term (10 and 20 years)
Extent	Regional	Regional
Consequence	High	High
Probability	Probable	Possible / frequent
Significance	**Medium -**	**Medium -**
Degree to which impact can be reversed	**Low** - Tourism activities and establishments not focused on business tourism could be forced to close.	
Degree to which impact may cause irreplaceable loss of resources	**High** - Tourism establishments that are forced to close will be difficult to replace.	
Degree to which impact can be avoided	**Low** – Should the Jindal MIOP go ahead this impact would be difficult to avoid due to the size of the operation.	
Degree to which impact can be mitigated	**Low** – Should the Jindal MIOP go ahead this impact would be difficult to avoid due to the size of the operation.	
Cumulative impact		
Nature of cumulative impacts	The cumulative impact is assessed to be low as, other than commercial farming in the area which does not have the same visual impact, there are no other significant industries that would add to the cumulative impact.	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Very Low	**Insignificant**
Residual impact		
Residual impact discussion	**Medium** - The residual impact is predicted to be medium.	

Table 15-10 Management outcome, mitigation actions/measures and monitoring

Management Outcome, Mitigation Actions/Measures and Monitoring	
Management objective	To minimise impacts to the viability of the tourism sector during all phases of the Jindal MIOP.
Mitigation actions/measures	
Construction Phase	
• Apply mitigations aimed at limiting the visual impact, as recommended by the visual specialist (Section 8.1.3). • Apply mitigations aimed at reducing the impact of blasting, as recommended by the blasting specialist (Section 10.1.3). • Apply mitigations aimed at reducing traffic impacts, as recommended by the traffic specialist (Section 14.1.3).	

Management Outcome, Mitigation Actions/Measures and Monitoring	
Operational Phase	
• Tourism establishments focussed on business activities are likely to see a boost in business as people travel to the area to do business with the mine. Those tourism establishments that can shift their business model to capture a new market could see success. The mine should actively promote and encourage its visitors to utilise the tourism products that are present in the area, especially those offering board and lodging. • The mine must work with tourism product owners to understand if there are opportunities for collaborating around mine tourism, which is becoming a popular attraction in other parts of the world. • The mine should participate in the R66 Zululand Heritage Route as well as engage with the tourism and local economic development (LED) officers at the King Cetshwayo District Municipality to understand ways in which it can support the sector.	
Monitoring	• Regular monitoring of the impacts of the mine on tourism sector through engagement with tourism product owners, associations, and municipal tourism officers. • If impacts are discovered, then appropriate actions to address those impacts will need to be undertaken with I&APs involved in the process.

16. ECONOMIC IMPACTS

16.1 IMPACT ON THE LOCAL AND REGIONAL ECONOMY

16.1.1 Impact Description

The establishment and operational phase of the MIOP are likely to impart several macro-economic impacts that can be quantified and then assessed against the baseline to determine their likely significance on the receiving environment.

16.1.2 Source of Impact

The project activities/ infrastructure likely to have an impact on the local and regional economy include:

Project phase	Activity/infrastructure
All Phases	• Employment creation • Community investment

16.1.3 Impact Assessment

16.1.3.1 Construction Phase

Construction phase economic impacts are determined through modelling the stimulation of the economy through the injection of capital expenditure (CAPEX). Any imported content (machinery, materials, goods or service) is not considered as imported goods and services do not benefit the community / regional economy. They are temporary in nature and typically last for the duration of the construction phase, which in this case is estimated to be 5 years. The estimated CAPEX requirement for the project is indicated in Table 16-1.

Table 16-1 Project CAPEX profile[12]

Item	Capital Cost	Local Content ZAR	Local content %
Mining	R2 658 613 482	R797 584 045	30%
Services (plant)	R308 669 836	R246 935 868	80%
Services (Port)	R142 316 924	R113 853 540	80%
Ore crushing	R3 097 393 387	R929 218 016	30%
Ore Milling	R1 016 506 058	R304 951 818	30%
Magnetic Separation	R2 971 628 780	R1 485 814 390	50%
Concentrate handling phase 1	R283 363 718	R198 354 603	70%
Concentrate handling phase 2	R538 926 772	R161 678 031	30%
Tailings disposal	R612 916 542	R612 916 542	100%
Reagents	R37 005 923	R29 604 738	80%
Tailings Storage Facility	R1 607 439 834	R1 607 439 834	100%

[12] The TSF CAPEX is included in this calculation for the complete understanding.

Item	Capital Cost	Local Content ZAR	Local content %
Ship Loading	R764 406 166	R229 321 850	30%
Infrastructure 1	R2 427 084 400	R728 125 320	30%
Infrastructure 2	R12 657 532	R3 797 259	30%
Total Direct Fixed Costs	**R16 478 929 354**	**R7 449 595 854**	
Contractor P&Gs	R3 777 224 447	R3 399 502 002	90%
ÉPCM costs	R2 641 823 755	R2 377 641 380	90%
Other Costs	R271 272 355	R244 145 120	90%
Contingency (15%)	R3 491 899 967	R3 142 709 970	90%
Sub Total Project costs	**R26 661 149 878**	**R16 613 594 326**	90%
Eskom Connection	R1 830 207 028	R1 647 186 325	90%
Total Costs	**R28 491 356 905**	**R18 260 780 651**	

Source: Patrick Donlon (email: Jindal MIOP SLP Discussion). 21/01/2022, and (ABGM, 2021)

Using the CAPEX as an input variable, the macro-economic benefits in Table 16-2 are anticipated.

Table 16-2 Economic impacts of CAPEX injection (Rand Millions)

CAPEX IMPACTS	Direct	Indirect	Induced	Total
Production	R18 260.78	R8 608.96	R11 043.60	R37 913.33
GDP/ GVA	R11 830.99	R3 273.10	R4 227.63	R19 331.72
Income	R4 338.31	R1 394.51	R1 692.25	R7 425.07
Employment (FTE)	26 437	14 438	17 064	57 939
Taxes	R1 490.76	R447.40	R558.26	R2 496.42

Source Urban-Econ Modelling, 2022

Production/ New Business Sales

The impact of the CAPEX investment can be used to determine the economic value of additional business opportunities created upstream and downstream of the contractors who secure work in constructing the proposed development. The localisation of these opportunities will be dependent on the localisation of the supply chain for the construction of the proposed development.

Through forward and backward linkages into the regional economy, the CAPEX is anticipated to support new business sales opportunities worth **R37.91 billion**, a significant boost for the regional economy.

GDP/ GVA

The development's positive socio-economic impact on the regional economy can be measured via its contribution to GVA, which is a proxy for Gross Domestic Product (GDP) at a scale smaller than a whole country. GVA provides a Rand value for the amount of goods and services that have been produced, less the cost of all inputs and raw materials that are directly attributable to that production.

The development is expected to inject an additional total of **R19.33 billion** into the regional economy (GVA). The economic scale at which the GVA impact will be felt is, however, a function of the geographic location of the companies appointed as service providers to undertake the required construction and engineering services.

Income Contribution

Another positive socio-economic impact which is anticipated to result from the input CAPEX investment during the construction of the proposed development is the contribution to improving the income levels of businesses (and households) who benefit from the increased business sales stimulation.

The stimulation of business activity is anticipated to generate improvements in income levels for those businesses (and households) that are able to benefit from supply contracts, both to undertake the construction, as well as to supply the required goods and specialist services. This cumulative impact in their income levels is expected to be **R7.43 billion**. Again, the scale of the economic impact could extend beyond the regional economy as it is based on the geographic extent of the supply chain, which could reach all over South Africa.

Employment Creation

The nature and scale of the proposed development is likely to positively impact the socio-economic environment through the creation of employment opportunities.

It should be noted that these opportunities will be created only for the duration of construction (approximately 5 years) and, therefore, should be considered temporary in nature. Also, it should be noted that the geographic spread of these employment opportunities will be a function of the location of the companies appointed as service providers to undertake the required construction work. While a project of this nature is anticipated to create employment opportunities in the local area and surrounding communities, the supply chains of the service providers and the skill levels of the community members will determine the localisation of these opportunities. Finally, it should be understood that the employment opportunities created are considered FTE employment opportunities. This means, for example, one full-time job for one person for 10 years or 10 full-time jobs for 10 people for one year.

The construction phase would create an estimated **57 939 jobs**, **26 437 of which are expected to be direct jobs**. Direct jobs relate to the individuals employed by the construction companies, research specialists, and equipment suppliers commissioned to undertake the required work and supply the required services and equipment.

A further 14 438 jobs are expected to materialise through second round suppliers. This occurs when suppliers of new goods and services to the appointed contractors (first round suppliers) experience larger markets and potential to expand.

Lastly it is expected that the increased income in these households employed directly or indirectly through the construction of the proposed development will result in additional expenditure in the economy which stimulates growth and spurs additional employment. It is estimated that 17 064 jobs would be induced through the input CAPEX injection.

This positive impact is assessed to have a high intensity in terms of employment and would occur over the short-term. Local communities would be prioritized as far as possible for employment opportunities. This could impact the socio-economic environment in the Region (District Municipality/ Province) and is considered to be a definite/ continuous impact over the duration of the construction phase. The impact is therefore assessed to be of MEDIUM significance. Enhancement measures are unlikely to change the significance, however, some management measures is still required.

Taxes

It is well known that the mining sector contributes considerably to the national fiscus through tax receipts. The CAPEX injection is anticipated to generate a total of **R2.5 billion** in tax receipts, with R1.49 billion being a direct result of the CAPEX injection.

Assessment of Construction Phase Economic Impacts

The direct, indirect and cumulative economic impacts resulting from the capital expenditure in the construction phase are assessed in Table 16-6. The temporary economic impacts are assessed as having a high intensity that will persist only for the short-term and are likely to extend beyond the site boundaries and into the whole region which will experience an increase in economic activity. The significance is assessed as being **HIGH POSITIVE** and enhancement measures are suggested to ensure this is realised.

16.1.3.2 Operational phase

Operational phase impacts are determined through modelling the stimulation of the economy through the estimated annual OPEX of the Jindal MIOP, which has been provided for a period of 25 years. The project OPEX profile is indicated in Table 16-3.

Table 16-3 Project OPEX profile (25 years)

Item	Operating Cost
Total Operating Cost - Weathered Ore Mining	R3 181 632 572
Total Operating Cost - Fresh Ore Mining	R29 858 126 473
Total Operating Cost - Waste Mining	R3 613 650 605
Total Operating Cost - Mining	**R36 653 409 650**
Total Operating Cost - Melmoth Process Plant	R45 162 271 960
Total Operating Cost - TSF	R963 028 637
Total Operating Cost - Filtration at Plant (Rail)	R5 474 072 354
Total Operating Cost - Rail	R12 853 231 923
Total - Operating Costs	**R101 106 014 524**

Source: (ABGM, 2021)

Using the OPEX as an input variable, the following macro-economic benefits are anticipated (Table 16-4).

Table 16-4 Economic impacts of OPEX profile (Rand Millions) for 25 years (in present values)

OPEX IMPACTS (25 YEARS)	Direct	Indirect	Induced	Total
Production	R101 106.01	R70 616.07	R53 602.36	R225 324.45
GDP/ GVA	R45 144.68	R27 155.28	R20 458.82	R92 758.78
Income	R16 335.93	R11 506.08	R8 192.50	R36 034.51
Employment (FTE)[13]	20 073	24 262	16 777	61 111
Taxes	R5 649.15	R3 700.41	R2 702.18	R12 051.74

Source: Urban-Econ Modelling, 2022

Production/ New Business Sales

Over a 25-year operational period, the proposed development is anticipated to support **R225.32 billion** in new business sales, or just over **R15 billion a year**. Since some of the goods and services required for effective

[13] Operational phase FTE employment for mining activities and processing activities was provided to the specialist and has been utilised in place of the SAM IO model outputs. The estimates provided did not include administrative/ support staff, health and safety personnel etc. FTE employment will gradually increase from year 1 to year 4, by which time the mine will be fully operational. Average annual FTE employment is 803.

management and functioning of the proposed development are likely to be secured locally (in accordance with the SLP), this portion of the enhanced business activity should be secured within the regional economy.

Gross Value Added

Over a 25-year period, the operational phase of the proposed development is expected to inject an additional total of **R92.76 billion** into the regional economy, effectively **R6.18 billion a year** without escalations or financial charges, such as interest or taxes. As with the construction phase impacts, the economic scale of the GVA impact is determined by the location of companies appointed as services providers for the effective functioning of each component of the development.

Income Contribution

Enhanced business activity will generate income level improvements for the businesses (and households) that provide the necessary goods and services for the effective functioning of the proposed development. The cumulative impact on their income levels over a 25-year period is expected to be **R36.03 billion,** which equates to around **R2.4 billion a year**. With the requirements for local expenditure outlined in the SLP, this portion of the impact is anticipated to be felt by the regional economy.

Employment Creation

The operational nature and scale of Jindal MIOP would positively impact the socio-economic environment through creating employment opportunities, which would be sustained over the operational phase, if OPEX levels remain as projected in the financial modelling. Direct employment opportunities were identified in the financial modelling. Over a 25-year operational period, the proposed developed is expected to create **36 666 FTE jobs**, **12 044 of which are expected to be direct jobs**.

This equates to an average of **803 direct FTE job opportunities** sustained each year over the 25-year period. Direct jobs relate to the individuals working in mining and processing activities.

A further **14 557 FTE jobs** are expected to materialise through second round suppliers. This occurs when suppliers of new goods and services to the appointed companies (first round suppliers) experience larger markets and potential to expand.

Lastly it is expected that the increased income in these households employed directly or indirectly through the operations of the proposed development would result in additional expenditure in the economy which stimulates growth and spurs additional employment. It is estimated that **10 066 FTE jobs** would be induced through the OPEX of the proposed development.

Taxes

In addition to the above economic impacts, the operational phase of the project is also likely to generate tax benefits for the national fiscus in the form of Value Added Tax (VAT) (15%) and Company Income Tax (CIT), which would be lowered from 28% at present, to 27% for financial years ending on or after 31 March 2023.

Over a 25-year operational period, the Jindal MIOP is anticipated to contribute **R12.05 billion** in tax revenue for the national fiscus, with R5.65 billion of this being direct expenditure from the MIOP, equivalent to an annual tax bill of around R376.61 million.

Assessment of Operational Phase Economic Impacts

The direct, indirect and cumulative economic impacts resulting from the expenditure in the operational phase are assessed in Table 16-6. The economic impacts are assessed as having a high intensity that would persist for the long-term and would likely extend beyond the site boundaries and into the whole region which would experience an increase in economic activity. The significance is assessed as being **HIGH POSITIVE** and enhancement measures are suggested to ensure that these benefits are realised.

16.1.3.3Summary of Economic Impacts

To understand the full scale of the economic impacts of the proposed project, impacts from the CAPEX and operational expenditure (OPEX) injection are summed, with the results indicated in Table 16-5.

Table 16-5 Composite economic impacts (Rand millions) for 25 years, in present values

COMPOSITE IMPACTS (15 YEARS)	Direct	Indirect	Induced	Total
Production	R119 366.80	R79 225.03	R64 645.95	R263 237.78
GDP/ GVA	R56 975.67	R30 428.38	R24 686.45	R112 090.50
Income	R20 674.25	R12 900.58	R9 884.75	R43 459.58
Employment	38 480	28 995	27 130	94 606
Taxes	R7 139.90	R4 147.81	R3 260.44	R14 548.15

Source: Urban-Econ Modelling, 2022

In summary, the establishment and operations (for a 25-year period) of the proposed Jindal MIOP are anticipated to result in the following economic benefits:

- The generation or attraction of new business sales opportunities of R263.23 billion;
- An injection of R112.09 billion into the regional economy;
- An improvement in business incomes levels in the order of almost R43.46 billion;
- The creation of 94 606 FTE job opportunities, 38 480 of which will be direct opportunities; and
- A tax injection to the national fiscus in the order of R14.55 billion.

16.1.3.4 Decommissioning/ Closure Impacts

The major social implication associated with the decommissioning phase is linked to the loss of jobs and associated income. This has implications for the households who are directly affected, the communities within which they live, and the relevant local authorities. The downscaling and retrenchment would be required in full consultation with recognised organised labour. The Company must follow the procedures for downscaling and retrenchment as set out by the DoL and the Labour Relations Act.

The significance is assessed as being **MEDIUM** and with mitigation measures that are well planned and implemented can be reduced to **LOW**.

Table 16-6 Impact on the local and economy

Description of Impact		
Type of Impact	Direct (temporary increase in production and GDP in the local economy) and Indirect (improved household income and increased business sales in the local economy)	
Nature of Impact	Positive/ Negative	
Phase	**Construction**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Prominent change (High)	Prominent change (High)
Duration	Short-term (1 and 5 years)	Short-term (1 and 5 years)
Extent	Regional	Local
Consequence	High	High

Probability	Definite / Continuous	Definite / Continuous
Significance	**High +**	**High +**
Description of Impact		
Phases	**Operational**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Prominent change (High)	Prominent change (High)
Duration	Long-term (10 and 20 years)	Long-term (10 and 20 years)
Extent	Local	Regional
Consequence	High	High
Probability	Definite / Continuous	Definite / Continuous
Significance	**High +**	**High +**
Phases	**Decommissioning and Closure Phases**	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium)	Minor change (Low)
Duration	Medium-term (5 to 10 years)	Medium-term (5 to 10 years)
Extent	Beyond site	Beyond site
Consequence	Medium	Medium
Probability	Definite / Continuous	Possible / frequent
Significance	**Medium -**	**Low -**
Degree to which impact can be reversed	N/A	
Degree to which impact may cause irreplaceable loss of resources	N/A	
Degree to which impact can be avoided	N/A	
Degree to which impact can be mitigated	**Medium** – It is important to ensure that measures are taken to ensure that the full benefit is realised.	
Cumulative impact		
Nature of cumulative impacts	Increase in production, GDP, and tax contributions in the regional economy	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Medium +	**Medium +**
Residual impact		
Residual impact discussion	**High +** - The residual impact on the economy provided the process is properly managed is expected to be high. The residual impact post operations is, however, predicted to be a low negative.	

Table 16-7 Management outcome, mitigation actions/measures and monitoring

<table>
<tr><th colspan="2">Management Outcome, Mitigation Actions/Measures and Monitoring</th></tr>
<tr><td>Management objective</td><td>To maximise economic benefits during all phases of the Jindal MIOP.</td></tr>
<tr><td colspan="2">Mitigation actions/measures</td></tr>
<tr><td colspan="2">Construction Phase</td></tr>
<tr><td colspan="2">• Effective implementation of the SLP, including the ring-fencing of a portion of procurement to locally empowered suppliers and a stipulation to employ local residents.</td></tr>
<tr><td colspan="2">Operational Phase</td></tr>
<tr><td colspan="2">• Provision of relevant and effective training and skills development initiatives to residents of the local community to provide them with the skills to take up employment opportunities in the MIOP.
• Effective implementation of the SLP, including the ring-fencing of a portion of procurement to locally empowered suppliers and a stipulation for them to employ local residents.</td></tr>
<tr><td colspan="2">Decommissioning/ Closure Phase</td></tr>
<tr><td colspan="2">• Develop a Closure Plan (which includes socio-economic measures) at the start of the Jindal MIOP to include the following:
  • Predict the likely socio-economic impact of closure on employee households, local communities and the region, and recommended measures to address these impacts;
  • Identify critical issues which could affect the on-going sustainability of employees and communities during closure, by means of a detailed consultation process;
  • Identify alternative livelihood and socio-economic development opportunities for employees, as well as community-based projects which may become sustainable over the long-term; and
  • Provide financial and/ or technical support for the establishment of sustainable community projects.
  • It is recommended that the Closure Plan provide more detail on how the Jindal MIOP would assess and mitigate/manage the social and economic impacts on individuals, communities and the local economy when retrenchments and closure is certain. When downscaling and/or retrenchment take place, the Jindal MIOP should assist affected employees in finding alternative employment or livelihood opportunities. This should be done if workers cannot be integrated or redeployed to other operations or if they are not of a retirement age.</td></tr>
<tr><td>Monitoring</td><td>Construction Phase
• The following monitoring is recommended:
  • Procurement of goods and services for the establishment of the MIOP should be monitored to ensure ring-fenced procurement is implemented and that local empowered suppliers fulfil their contractual obligations of hiring local residents.
  • A database of all labourers in the construction companies should be compiled and submitted to Jindal, including proof of residence.
  • This should be done on a continual basis throughout the construction phase to ensure compliance.
• The following reporting is required:
  • Internal reporting – monthly for:
    • Procurement appointments.
    • Tracking of Historically Disadvantaged South Africans (HDSA) as part of the construction labour force with an emphasis on local resident population.
  • External reporting – quarterly for:</td></tr>
</table>

Management Outcome, Mitigation Actions/Measures and Monitoring	
	- Apprising local authorities, including municipal government, traditional leadership, and ward councillors, of composition of construction labour force. **Operational Phase** - The following monitoring is recommended: - Procurement of goods and services for the establishment of the MIOP should be monitored to ensure ring-fenced procurement is implemented and that local empowered suppliers fulfil their contractual obligations of hiring local residents. - Jindal to report annually to the DMRE. - This should be done on a continual basis throughout the operational phase to ensure compliance. - The following reporting is required: - Internal reporting – monthly for: - Procurement appointments. - Tracking of Historically Disadvantaged South Africans (HDSA) as part of the construction labour force with an emphasis on local resident population. - External reporting – quarterly for: - Apprising local authorities, including municipal government, traditional leadership, and ward councillors, of composition of construction labour force. - Annual reporting to the DMRE.

17.CUMULATIVE IMPACTS

The IFC (2013) defines cumulative impacts as 'those that result from the successive, incremental, and/or combined effects of an action, project, or activity (collectively referred to as "developments") when added to other existing, planned, and/or reasonably anticipated future ones' and further states that 'For practical reasons, the identification and management of cumulative impacts are limited to those effects generally recognised as important on the basis of scientific concerns and/or concerns of affected communities.'

In this section the potential cumulative impacts on various environmental aspects are considered taking into account other projects in the area as well as potential known new projects which could be developed in the area.

17.1 GROUNDWATER

Cumulative impacts in terms of groundwater quantity within the catchment have been qualitatively assessed. There are no other mining operations within the catchment which could result in additional drawdown issues. Further expansion of the mine in the neighbouring concession areas could result in a larger drawdown and effects a wider number of farms becoming impacted. Should mining operations be expanded in the future these would need to be cumulatively assessed.

Commercial crop farming occurs in the lower areas of the catchment which is extensively used for crop farming. Abstraction for water supply on these farms may result in additional water level drawdowns. Groundwater and river water quality may be impacted by the application of fertilizers on the crop lands but is deemed to be of low cumulative impact.

17.2 SURFACE WATER

17.2.1 Water Quality

A large area of the Mhlatuze catchment is under irrigated crops, predominantly sugarcane and citrus, which is found along the Mhlathuze River downstream of the Goedertrouw Dam. The other key activities in the catchment are cattle and subsistence farming. These are major users of water in the catchment. The water quality issues which do arise are from irrigation in the middle reaches of the catchment (Mhlathuze Water, 2004) are likely due to irrigation return flows from the substantial irrigation activities in the middle reaches of the catchment (where the proposed mine would be located).

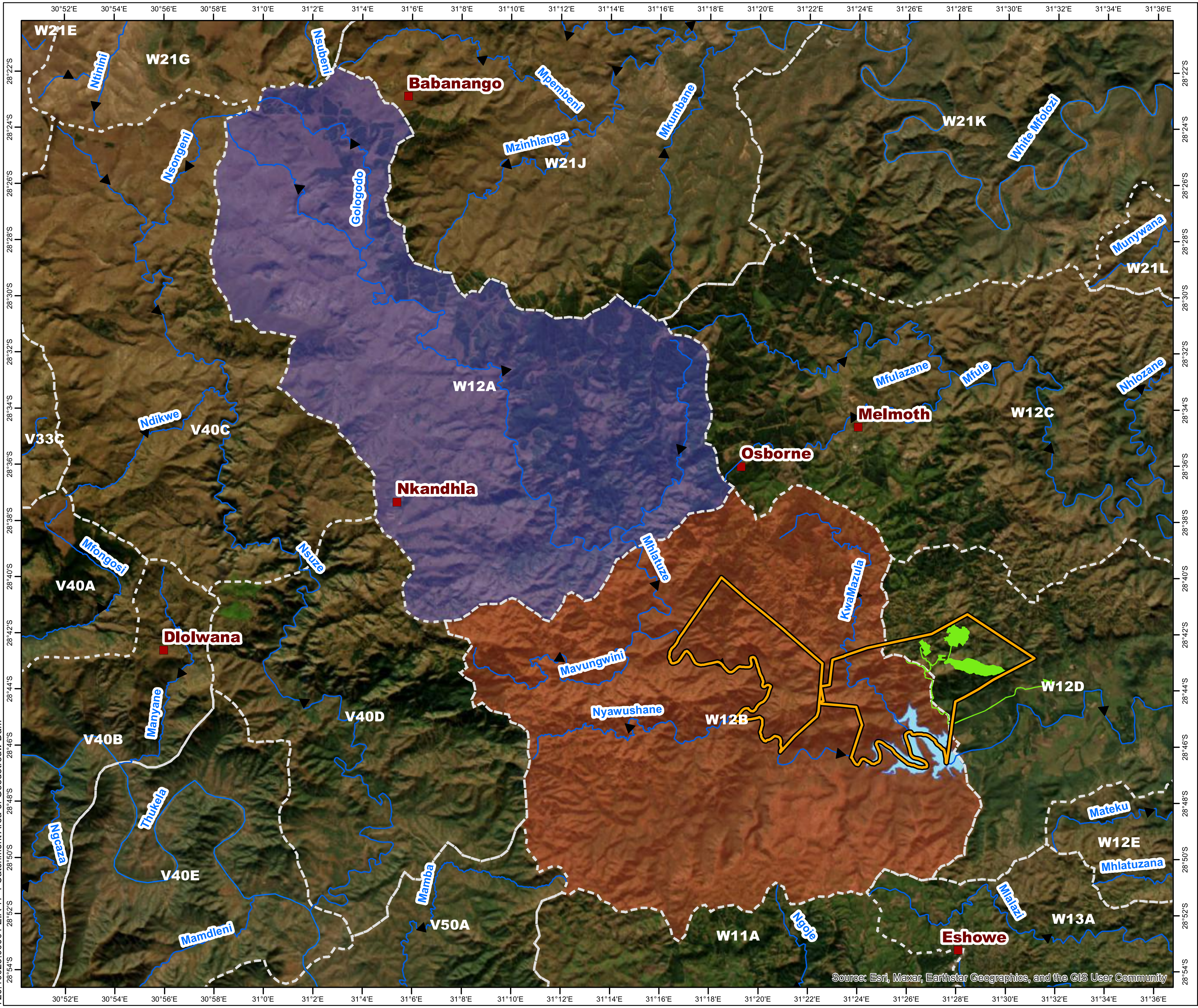
The cumulative impact on water quality due to the proposed mine project is assessed to be low as clean and dirty water catchments would be separated thereby minimizing contamination of surface water and any potential runoff.

The cumulative impact due to the proposed TSF will be investigated and reported separately.

17.2.2 Water Quantity

As mentioned, the Mhlatuze catchment is under irrigated crops predominantly sugarcane and citrus. These water users mostly receive water from the Goedertouw Dam. The cumulative impact on the quantity of water available from Goedertrouw Dam and the downstream catchments due to the proposed mine is of importance.

The infrastructure proposed within the Mining Right Area (the WRD, South East Pit and power yard) all fall within quaternary catchment W12D which is lying to the east outside of the catchment area of the Goedertrouw Dam. The proposed development would therefore not impact on the inflow into the Goedertrouw Dam.



Legend

- Towns / Villages
- River Flow Direction
- Goedetrouw Dam
- Quaternary Catchment Boundaries

Quaternarys of Concern

- W12A
- W12B

Proposed Project Components

- South Block Mining Right Area
- Mine Layout

N

0 1 2 KM

Scale: 1:236 455 @ A3
Coordinate System: TM WG31
Projection: Transverse Mercator
Datum: Hartebeesthoek 1994

JINDAL IRON ORE (PTY) LTD

FIGURE 17-1
CATCHMENT AREA OF GOEDETROUW DAM

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Project No: 720.10023.00001	Prepared By: BG
Map Ref No: EIA 17-1	Date: 17/05/2023

In order to show the impact of the proposed development on downstream catchments, a point immediately downstream of the development was chosen and is referred to in this Section as “Point A”.

The catchment area of Point A is shown in Figure 17-1. The catchment area at Point A is 175 km², and the total area of the dirty water catchments resulting from the proposed development is 5.72 km². This translates to a loss in catchment area, due to the proposed development, and only within the catchment area of Point A shown in Figure 17-1, of 3.3%. The impact of the proposed development decreases for points in downstream catchments i.e. the ratio of the dirty water catchments (from the proposed development) to total catchment area would be less than 3.3%, further downstream from the development. The proposed development is therefore expected to have minimal (low) impact (if any) on the runoff to the catchments downstream of the proposed development.

17.3 TERRESTRIAL BIODIVERSITY

The terrestrial biodiversity study that was undertaken for the Jindal MIOP illustrates the importance of the site for supporting a range of plant and animal species and associated ecological processes. Development would have a detrimental impact on biodiversity which has been rated as being of high significance.

The direct loss impacts outlined in Section 3, in combination with direct loss impacts associated with forestry, agriculture and human settlement in the area, would result in moderate levels of cumulative direct impacts to vegetation communities in the area. Cumulative impacts would be more significant for remaining intact open savannah/grassland areas as these areas have a smaller remaining extent (approximately 1 000 ha within the larger South Block of the proposed mining right area) in comparison to more closed woodland thicket areas (currently in the region of 3 000 ha or more within the South Block). Additionally future impacts associated with other land-uses in the area are more likely to occur in vegetation communities that have a more open structure (i.e. the open savannah and grassland vegetation communities) and are more accessible in comparison to closed woodland and thicket areas.

Should the Jindal MIOP be granted a Mining Right and/ or Environmental Authorisation, compensation would be required to offset the residual impacts both on species of conservation concern and on terrestrial habitats. Such a plan would need to be informed by further supplementary assessments to ensure that impacts could be quantified more accurately and to inform the offset design process.

17.4 FRESHWATER ECOLOGY

Given the largely rural and isolated nature of the study area existing direct physical impacts to watercourses caused by people who live in the area are largely limited to the use of most wetlands for subsistence agriculture, the removal of indigenous tree species from river and stream riparian zone, and road crossings across watercourses. As the area becomes more populated over time it is likely that the extent of these impacts will increase, but to a negligible degree. Additionally, the Goedertrouw Dam, built in the early 1980s, has inundated an approximately 11 km long reach of the Mhlatuze River system and the lower reaches of several mountain and mountain headwater streams. The currently proposed mining project would result in a further permanent loss of 11.17 ha of freshwater habitat, including a total of 0.62 ha of critically endangered wetland. With mitigation assumed, the cumulative direct physical loss/ modification of freshwater habitat impact significance was assessed to be high.

Given that the conservation/ threat status of all wetlands in the study area is considered critically endangered with little to no protection of this wetland vegetation group, any loss of wetland habitat, no matter how large or small, is likely to require some form of an offset as compensation for the loss.

17.5 AIR QUALITY

The cumulative impact could be medium, especially at certain times of year should harvesting or burning of sugar cane be taking place. The overall cumulative impact could be reduced to low with the implementation of mitigation measures, in particular the tarring of the main access road.

17.6 NOISE

Cumulative noise levels are currently in the range of 65.0 dB(A) to 49.0 dB(A) during the daytime and between 64.9 dB(A) and 46.1 dB(A) during the night. From the assessment in Section 6 done the Project noise contribution is anticipated to result in impacts ranging from negligible to severe, which is similar for both daytime and night-time periods due to the 24-hour operation of the mining activities. Noise impacts reduce the further from the source the receptor is.

17.7 VISUAL

The proposed Jindal MIOP would be a new land-use introduced to the sub-region, and as such, there is no cumulative effect with respect to other mining projects or large developments. However, the cumulative effect of individual components of the mine, including the proposed TSF which would occur in distinct separate locations in the study area. The cumulative impact is assessed to be high with mitigation measures implemented.

17.8 COMMUNITY HEALTH – ACCESS TO HEALTHCARE

The impact of the lack of (or provision of) healthcare facilities is considered high. Since the incoming population is likely to remain in the region beyond the LoM, the demand for healthcare services is likely to result in increased demand on regional healthcare services if these are not available locally. Similarly, the provision of healthcare services locally would likely attract patients regionally if there are shortages in outside areas. Impacts are considered cumulative (medium to low negative) should the mine attract other industries and services that increase the population size and demand for healthcare further. The cumulative impact could, however, also be positive should the growing population attract medical service providers to the area or result in state investment in the development of healthcare facilities.

17.9 TRAFFIC

There are likely to be cumulative impacts, particularly during harvesting season when there may be additional vehicles on the road. However, due to the seasonal nature of this and due to the improved road network as part of mitigation requirements the cumulative impact is expected to be low.

17.10 SOCIO-ECONOMIC

The socio-economic benefits of the Jindal MIOP are expected to have a high positive impact on the local community and local towns in terms of economic investment. This is primarily as a result of the spend of the project during both the construction and operational phases, together with the job and skills development opportunities that would be created for local communities. These opportunities would, however, only be realised if appropriate mechanisms are put in place to enhance the opportunities for local businesses to participate and to allocate a maximum number of jobs possible for local community members.

Special effort would need to focus on upskilling the local communities to allow them to be able to take advantage of the job opportunities that would become available. Furthermore, contracting and tendering strategies would need to be structured in a way that allows for smaller local companies to take advantage of the opportunities. If managed appropriately, the positive cumulative impact on the local economy could be significant.

Conversely, the most significant cumulative impact at the decommissioning and closure phase would be the negative impact on the local area as a result of the loss of employment and the associated benefits linked to the spend of the Jindal MIOP in the local economy. If not managed properly and planned for well in advance, through a well-structured and implemented mine closure plan, the negative impacts on the local communities and surrounding towns would be of high significance. Careful consideration needs to be given to creating alternative economic activities throughout the life of mine and upskilling staff to allow them to source alternative work post closure. Closure planning must adopt an approach to reviewing the mine closure plan on a regular basis in consultation with local communities, local authorities and relevant government departments.

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