

DETAILED ASSESSMENT OF POTENTIAL IMPACTS

The potential impacts described in this appendix have been identified by the EIA project team with input from specialists, regulatory authorities and I&APs. The sequence in which these issues are listed are in no order of priority or importance. The assessment and rating of potential impacts have been provided by specialists. These are attached as appendices to the EIA and EMPr.

The impacts are assessed cumulatively where the potential impacts assessed represent the cumulative impact of the proposed project in the context of the baseline environment, i.e. with existing impacts.

The potential impacts are firstly rated with the assumption that no mitigation measures are applied and then secondly with mitigation, unless otherwise stated.

The mitigated assessment assumes that technical design controls, as included in the project scope (see Section 3.2), would be included in the detailed design of the project and implemented when the project components are constructed and operated.

A) IMPACT ON BIOPHYSICAL ENVIRONMENT

ISSUE 1 LOSS OF SOIL RESOURCES AND LAND CAPABILITY THROUGH PHYSICAL DISTURBANCE

Information in this section was sourced from the soil and land capability impact assessment undertaken by Scientific Aquatic Services (SAS) (SAS, 2019) (refer to Appendix E).

Introduction

Soil is a valuable resource that supports a variety of ecological functions. Soil is the key to re-establishing post closure land capability. A number of activities/infrastructure and sources in all phases have the potential to disturb soil and related land capability through removal, compaction and/or erosion. In the construction and decommissioning phases these activities and sources are temporary in nature, usually existing from a few weeks to a few months. The operational phase will present more long-term activities. There will be no residual landforms after mine closure as ore will be taken off site for mineral processing and all waste rock material will be removed to backfill the open pits, or if necessary waste rock material will be disposed of offsite. The loss of soil resources has a direct impact on the potential loss of the natural capability of the land. This section therefore focuses directly on the potential for disturbance of the soil resources and the effect this has on land capability.

Mine phase and link to project specific activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks Civil works	Underground mining Opencast mining Transport system Power supply and use Water supply and use Mineralised waste Non-mineralised waste Support services Rehabilitation	Underground mining Opencast mining Transport system Power supply and use Water supply and use Mineralised waste Non-mineralised waste Support services Demolition Rehabilitation	Maintenance and aftercare of rehabilitated areas

Rating of impact

Severity/ nature

The establishment of surface infrastructure to support the underground mining operations, as well as the temporary waste rock dumps and opencast mining operations have the potential to affect the soils' ability to sustain natural vegetation and alter land capability. Potential impacts could include:

- Soil erosion resulting from cleared and disturbed areas, leading to the loss of soils;
- Soil compaction resulting from increased traffic of mining equipment;
- Loss of soil depth and volume due to excavation associated with mining activities;
- Loss of potential agricultural soils.

As described in Section 6.4.1.4, the project area is dominated by soils that have been heavily modified due to long-term human activity. In addition, most of soils in the project area are unsuitable for cultivation. The opencast operations will result in a loss of soil depth and volume, since the ore material will be transported off-site and sold as product. Taking these factors into account, the potential impact on soil through physical disturbance is rated as having a high severity in the unmitigated scenario. With mitigation measures aimed at minimising disturbance and rehabilitating disturbed areas, the severity can be reduced to low.

Duration

In the unmitigated scenario, the loss of soil and related land capability is long term and will continue after the life of the proposed project. In the mitigated scenario, the soil is conserved and replaced in disturbed areas during rehabilitation, which reduces the duration of the impact to the life of the proposed project.

Spatial scale/extent

In both the unmitigated and mitigated scenarios for all phases of the project prior to closure, the potential loss of soil and land capability through physical disturbance will be restricted to within the proposed project area.

Probability

Without any mitigation, the probability of losing soil and related land capability is definite. With mitigation, the probability will be reduced because emphasis will be placed on soil conservation and site rehabilitation, including soil re-establishment.

Significance

In the unmitigated scenario the impact is high. In the mitigated scenario the significance of this impact is reduced to low.

Summary of the loss of soil resources and land capability impact through physical disturbance per phase of the mine

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	M	H	L	M	H	H
Mitigated	L	M	L	M	L	L

Management objective

The objective is to minimise the loss of soil resources and related land capability from physical disturbance, erosion and compaction.

Management actions

The following management actions will be implemented:

- During construction, operation and decommissioning, the soil management principles in Table D 1 will be implemented with regard to soil management.
- Dust suppression and fire prevention plans will be compiled to guide the construction works and protect soils.
- Although the WRDs will be temporary, compaction could result in long-term impacts, therefore every effort will be made to avoid placement of the WRD on natural soils, but rather on disturbed soils.

TABLE D 1: SOIL MANAGEMENT PRINCIPLES

Steps	Factors to consider	Detail
Delineation of areas to be stripped		<p>The footprint of the proposed infrastructure area will be clearly demarcated to restrict vegetation clearing activities within the infrastructure footprint as far as practically possible.</p> <p>Stripping will only occur where soils are to be disturbed by activities and infrastructure that are described in the EIA and EMP report, and where a clearly defined end rehabilitation use for the stripped soil has been identified. Soil stripping should be conducted a suitable period ahead of mining.</p> <p>Bare soils will be regularly dampened with water to suppress dust during the construction phase, especially when strong wind conditions are predicted according to the local weather forecast.</p>
Adjacent areas		All disturbed areas adjacent to the infrastructure complexes and opencast mine pits will be re-vegetated with an indigenous grass mix, if necessary, to re-establish a protective cover, in order to minimise soil erosion and dust emission.
Stripping	Topsoil	<p>Excavation and long-term stockpiling of soil will be limited as far as practically possible. Stockpiled soils will therefore be stored for a maximum of 3-5 years. Concurrent rehabilitation will be conducted where practically possible to reduce the duration of stockpile storage in order to ensure that the quality of stored soil material does not deteriorate excessively, especially with regard to leaching and acidification.</p> <p>Topsoil horizons (A and B-horizons) are of higher quality and will be stored separately from lower quality underlying material to ensure sufficient volumes of high-quality soil is available for rehabilitation.</p> <p>Different soil type groups will be stockpiled separately to obtain the highest post-mining land capability possible.</p>
Delineation of stockpiling areas	Location	Stockpiling areas will be identified in close proximity to the source of the soil to limit handling and to promote reuse of soils in the correct areas.
	Designation of the areas	Soil stockpiles will be clearly identifiable in terms of soil type and the intended areas of rehabilitation. All topsoil will be stockpiled in areas clearly demarcated on the infrastructure layout and should be defined as no-go areas.
Stockpile management	Vegetation establishment and erosion control	Stockpiles will be revegetated to establish a vegetation cover as an erosion control measure. These stockpiles will also be kept free of alien vegetation at all times to prevent loss of soil quality.
	Storm water controls	Stockpiles will be established with storm water diversion berms to prevent run off erosion.

Steps	Factors to consider	Detail
	Height and slope	<p>Soil stockpile height will be controlled to avoid compaction and damage to the underlying soils. Stockpile height will additionally be restricted to that which can be stored without additional traversing by machinery. A maximum height of 2-3 m will be implemented where practically possible.</p> <p>Stockpiles will be treated with temporary soil stabilisation methods; such as the application of organic matter to promote soil aggregate formation, leading to increased infiltration rate, thereby reducing soil erosion.</p> <p>The stockpiles side slopes should be flat enough to promote vegetation growth and reduce run-off related erosion.</p>
	Waste	No waste material will be placed on the soil stockpiles.
	Vehicles	Equipment movement on top of the soil stockpiles will be limited to avoid topsoil compaction and subsequent damage to the soils and seedbank.
Rehabilitation of disturbed land: restoration of land capability	Placement of soil	<p>The recovered soils will re-used to rehabilitate the mine footprint following mine closure.</p> <p>During rehabilitation soil will be replaced to appropriate soil depths in the correct order, and areas will be covered to achieve an appropriate topographic aspect and attitude so as to achieve a free draining landscape that is as close as possible to the pre-mining land capability rating as possible. The slopes of the backfilled surfaces will therefore change gradually since abrupt changes in slope gradient increase the susceptibility for erosion initiation.</p> <p>Soil resources of similar characteristics will be imported back to the site to compensate for soil loss that will occur during mining activities.</p> <p>Infrastructure footprint areas will be ripped to alleviate compaction post closure before revegetation.</p> <p>The infrastructure footprints will be re-vegetated with a grass seed mixture as soon as possible, preferably in spring and early summer to stabilize the soil and prevent soil loss during the rainy season.</p>
	Fertilisation	<p>Soil fertility status will be determined by soil chemical analysis after levelling (before seeding/re-vegetation).</p> <p>Soil amelioration will be done according to soil analyses as recommended by a soil specialist, to correct the pH and nutrition status before revegetation.</p>
	Erosion control	Erosion control measures will be implemented to ensure that the topsoil is not washed away and that erosion gulleys do not develop prior to vegetation establishment. If erosion is evident on the topsoil stockpiles, the side slopes will be stabilised through re-vegetation with indigenous species.
	Restore land function and capability	Landscape function analysis and restoration interventions will be applied to areas where soil has been replaced as part of rehabilitation, but the land function and capability has not been effectively restored.

Emergency situations

None identified.

ISSUE 2 LOSS OF SOIL RESOURCES AND LAND CAPABILITY THROUGH CONTAMINATION

Information in this section was sourced from the soil and land capability impact assessment undertaken by Scientific Aquatic Services (SAS) (SAS, March 2019) (refer to Appendix E).

Introduction

Mining projects in general have the potential to result in the loss of or damage to soil resources through contamination. Contamination of soil resources would result in a decrease in the rehabilitation and post-closure land use potential. Contamination of soil resources resulting from accidental spillage of hydrocarbons and other hazardous material, leading to altered soil chemistry. In addition, proliferation of alien vegetation due to disturbances could cause alterations in the soil quality and chemistry.

Mine phase and link to project specific activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks Civil works	Underground mining Opencast mining Transport system Power supply and use Water supply and use Mineralised waste Non-mineralised waste Support services Rehabilitation	Underground mining Opencast mining Transport system Power supply and use Water supply and use Mineralised waste Non-mineralised waste Support services Demolition Rehabilitation	Maintenance and aftercare of rehabilitated areas

Rating of impacts

Severity/nature

In the unmitigated scenario, pollution of soils from numerous incidents can result in a loss of land capability as an ecological driver because it can create a toxic environment for vegetation and ecosystems that rely on the soil. It could also negatively impact on the chemistry of the soils such that current growth conditions are impaired. This is a medium severity in the unmitigated scenario.

In the mitigated scenario soil chemical pollution can be prevented or successfully mitigated when implementing the soil management plan diligently. Soil chemical pollution impacts should become negligible once the site has been successfully revegetated and vehicles and equipment are removed. The severity of this impact has been rated as low in the mitigated scenario.

Duration

In the unmitigated scenario, most pollution impacts and associated loss in land capability will remain long after closure. In the mitigated scenario most of these potential impacts should either be avoided or be remedied within the life of the project, which reduces the duration to low. This will be achieved by the effective reaction time of the clean-up team and the chosen remediation methods.

Spatial scale/extent

In both the unmitigated and mitigated scenarios for all phases, the potential loss of soil resources and associated land capability will be restricted to within the proposed project area.

Probability

Without any mitigation the probability of impacting on soils and land capability through pollution events is high. With mitigation, the probability will be reduced to low because emphasis will be placed on preventing pollution events and on quick and effective remediation if pollution events do occur.

Significance

In the unmitigated scenario, the significance of this potential impact is medium. In the mitigated scenario, the significance reduces to low.

Summary of the rated loss of soil resources and land capability through contamination impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	M	H	L	H	H	M
Mitigated	L	L	L	L	L	L

Management objective

The objective is to minimise the loss of soil resources and related land capability from contamination.

Management actions

Management measures that have been identified include the following:

- During the construction, operational and decommissioning phases, all hazardous chemicals (new and used), dirty water, mineralized wastes and non-mineralised wastes must be transported, handled and stored in such a manner that they do not pollute soils. This will be implemented through a procedure(s) covering the following:
 - Pollution prevention through basic infrastructure design.
 - Pollution prevention through maintenance of equipment. Maintenance of equipment should be done either on impermeable surfaces or drip trays should be used.
 - Pollution prevention through education and training of workers (temporary and permanent).
 - Pollution prevention through appropriate management of hazardous materials and waste.
 - The required steps to enable fast reaction to contain and remediate pollution incidents. In this regard the remediation options include containment and in situ treatment or disposal of contaminated soils as hazardous waste. In situ treatment is generally considered to be the preferred option because with successful in situ remediation the soil resourced will be retained in the correct place. The in-situ options include bioremediation at the point of pollution, or removal of soils for washing and/or bio remediation at a designated area after which the soils are returned
 - Specifications for post rehabilitation audit to ascertain whether the remediation of any polluted soils and re-establishment of soil functionality has been successful and if not, to recommend and implement further measures

Emergency situations

In case of major spillage incidents, the emergency response procedure in Section 30.2.2 will be followed.

ISSUE 3 PHYSICAL DESTRUCTION OF BIODIVERSITY

Information in this section was sourced from the biodiversity impact assessment undertaken STS (STS, 2019A) and the freshwater assessment undertaken by SAS (SAS, 2019B) (refer to Appendix F).

Introduction

There are a number of activities/infrastructure in all phases that have the potential to destroy biodiversity in the broadest sense. In this regard, the discussion relates to the physical destruction of specific biodiversity areas, of linkages between biodiversity areas and related species which are considered to be significant because of their status, and/or the role that they play in the ecosystem.

Mine phase and link to project specific activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks Civil works	Underground mining Opencast mining Transport system Power supply and use Water supply and use Mineralised waste Non-mineralised waste Support services Rehabilitation	Underground mining Opencast mining Transport system Power supply and use Water supply and use Mineralised waste Non-mineralised waste Support services Demolition Rehabilitation	Maintenance and aftercare of rehabilitated areas

Rating of impact

Severity/nature

Areas of high ecological sensitivity are functioning biodiversity areas with species diversity and associated intrinsic value. In addition, some of these areas host protected species. The linking areas have value because of the role they play in allowing the migration or movement of flora and fauna between the areas which is a key function for the broader ecosystem. The transformation of land for any purpose, including mining and associated activities, increases the destruction of the site-specific biodiversity, the fragmentation of habitats, reduces its intrinsic functionality and reduces the linkage role that undeveloped land fulfils between different areas of biodiversity importance.

The proposed infrastructure will not encroach on any watercourse or wetland in the project area. However, some activities will encroach on the legislated buffer zones for the wetlands (500 m buffer zone) and the Klip River (100 m or 1:100 year floodline, whichever is greatest). As described in the baseline section these watercourses have already been impacted upon to various degrees by historic activities, resulting in these systems being moderately to highly modified. Due to the small footprint area of the proposed Roodepoort Main Reef Pit within the 500 m the CVB 1 wetland and the Kimberley Reef East Pit within the 500 m of the CVB 3 wetland, limited direct impacts from the proposed mining activities is expected on the watercourses and associated aquatic ecosystems.

As described in the baseline section, the habitat within the project area has been significantly impacted upon by historic and current anthropogenic activities. Therefore habitats range in sensitivity from moderate for the Freshwater Feature habitat to low for the highly transformed habitat types. Biodiversity is generally low in all these areas and no faunal or floral species of concern were identified during fieldwork. It is however noted that the Freshwater Features habitat offers suitable habitat to the Southern African Hedgehog, which is protected by the Gauteng Province.

Taking the above into consideration, the severity has been rated as moderate in the unmitigated scenario, reducing to low with mitigation aimed at minimising impacts on the Freshwater Features habitat. Concurrent rehabilitation will be a key management measure especially in the opencast mining areas.

Duration

In the unmitigated scenario the loss of biodiversity and related functionality is long-term and will continue after the life of the mine. With mitigation, biodiversity and related functionality may be partially restored during the operational, decommissioning and closure phases. The duration is therefore high in the unmitigated scenario, reducing to medium in the mitigated scenario.

Spatial scale / extent

Given that biodiversity processes are not confined to the proposed project area, the spatial scale of impacts will extend beyond this boundary in both the mitigated and unmitigated scenarios. Key related issues are the migration of species and the flow of nutrients. The spatial scale is therefore medium in both the unmitigated and mitigated scenarios.

Probability

Without mitigation the probability is definite. With mitigation, the probability may be reduced to low with effective management measures and concurrent rehabilitation where practically possible.

Significance

The significance of this impact is medium without mitigation, reducing to low with the effective mitigation measures.

Summary of the loss of biodiversity through physical destruction impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	M	H	L	M	M	M
Mitigated	L	M	L	L	L	L

Management objective

Minimise habitat destruction and fragmentation.

Management measures

Mitigation measures to be implemented during all project phases include the following:

- The areas of disturbance will be limited to what is absolutely necessary as defined for infrastructure in this EIA, and monitored to ensure edge effects such as erosion and alien and invasive plant species proliferation do not affect the adjacent areas. In this regard, maintaining migratory corridors and connectivity in the Freshwater and Secondary Grassland habitat units is deemed essential. As much indigenous vegetation will be retained as is practically possible;
- During the surveying and site-pegging phase of surface infrastructure, a search and rescue for possible floral species of conservation concern that will be affected by surface infrastructure will be undertaken, marked and where possible, relocated to suitable habitat surrounding the disturbance footprint. The relevant permits (where necessary) will be applied for prior to removal of relocation of any species of conservation concern found. Such species will be handled with care and the relocation of these plant

species to nearby suitable similar habitat where deemed feasible will to be overseen by a suitably qualified botanist;

- Contractor laydown areas, material storage facilities and temporary stockpiles will be located outside of the watercourses and their regulated buffer zones;
- The watercourses, and their regulated buffer zones will be clearly demarcated and marked as a “no-go” areas unless authorised activities are allowed within this zone. Existing watercourse crossings will be used where possible to avoid driving through watercourses. Where is cannot be avoided, watercourse crossings should be made at right angles. Areas where bank failure is observed as a result of such watercourse crossings will be immediately repaired;
- The more sensitive faunal habitat (Freshwater features habitat) and associated buffer zones adjacent to footprint areas must be designated as No-Go areas, and no mining vehicles, personnel, or any other mining-related activities are to encroach upon these areas;
- All disturbed areas will be rehabilitated as soon as possible;
- Rehabilitation of natural vegetation will proceed in accordance with a rehabilitation plan compiled by a suitable specialist. This rehabilitation plan will consider ongoing rehabilitation during the operational phase of the project as well as rehabilitation actions to be undertaken during mine closure;
- Rehabilitation trials will be continuously undertaken from the commencement of construction in order to determine the efficiency of rehabilitation methods and the suitability of flora propagated in the nursery for rehabilitation;
- Rehabilitation efforts and monitoring thereof will be implemented for a period of at least five years after decommissioning and closure.

Emergency situations

None identified.

ISSUE 4 GENERAL DISTURBANCE OF BIODIVERSITY

Information in this section was sourced from the biodiversity impact assessment undertaken STS (STS, 2019) and the freshwater assessment undertaken by SAS (SAS, 2019B) (refer to Appendix F).

Introduction

A number of activities/infrastructure have the potential to directly disturb vegetation, vertebrates and invertebrates in all project phases, particularly in the unmitigated scenario. The open pit mining operations will be of short duration. In the construction and decommissioning phases these activities are temporary in nature, usually existing for a few weeks to a few months. The operational phase will present more long-term occurrences such as the mine infrastructure complexes, while closure will present rehabilitated land that may have the potential for some latent impacts.

Mine phase and link to project specific activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks Civil works	Underground mining Opencast mining Transport system Power supply and use Water supply and use Mineralised waste Non-mineralised waste Support services Rehabilitation	Underground and Opencast Transport system Power supply and use Water supply and use Mineralised waste Non-mineralised waste Support services Demolition Rehabilitation	Maintenance and aftercare of rehabilitated areas

Rating of impact

Severity / nature

In the unmitigated scenario, biodiversity may be disturbed in the following ways:

- Lighting can attract large numbers of invertebrates which become easy prey for predators. This can upset the invertebrate population balances;
- People may kill various types of species for food, for sport, for fire wood etc.;
- People may illegally collect and remove vegetation, vertebrate and invertebrate species;
- Excessive dust fallout from various dust sources (exposed areas, soil stockpiles etc.) may have adverse effects on the growth of some vegetation, and it may cause varying stress on the teeth of vertebrates that have to graze soiled vegetation;
- Noise and vibration pollution (from vehicle movement, materials handling etc.) may scare off vertebrates and invertebrates. In some instances, the animals may be deterred from passing close to noisy activities which can effectively block some of their migration paths. In other instances, vertebrates and invertebrates that rely on vibration and noise senses to locate for, and hunt, prey may be forced to leave the vicinity of noisy, vibrating activities;
- The increased presence of vehicles in the area can cause road kills especially if drivers speed;
- The presence of mine water impoundments may lead to drowning of fauna;
- Dewatering of the open pits (during the rainy season) may impact on surface water resources and the associated aquatic ecosystems if there is a hydraulic connection between surface and groundwater in these areas;
- Surface water contamination could affect organisms dependant on these resources for water and refuge; and
- An increase in pollution emissions and general litter may directly impact on the survival of individual plants, vertebrates and invertebrates.

Taken together, the remaining potential disturbances will have a medium severity in the unmitigated scenario. In the mitigated scenario, many of these disturbances can be prevented or mitigated to acceptable levels, which reduces the severity to low.

Duration

In the unmitigated scenario, the impact is long term because where biodiversity is compromised, killed or removed from the area this impact is likely to exist beyond the life of the project. With mitigation this reduces to medium.

Spatial scale / extent

Given that biodiversity processes are not confined to the proposed project area, the spatial scale of general disturbances will extend beyond the site boundary in the unmitigated and mitigated scenarios. Key related issues are the migration of species and linkages between biodiversity areas. This is a medium spatial scale.

Probability

Without any mitigation, the probability of negatively impacting on biodiversity through multiple disturbance events is possible. With mitigation, the probability can be reduced to low because most of the disturbances can be controlled through implementation and enforcement of practices, policies and procedures.

Significance

In the unmitigated scenario, the significance of this potential impact is medium reducing to low with mitigation.

Summary of the general disturbance of biodiversity impact rating per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	M	H	M	H	M	M
Mitigated	L	M	M	L	L	L

Management objective

To minimise disturbance of biodiversity.

Management measures

Mitigation measures to be implemented during all project phases include the following:

- The areas of disturbance will be limited to what is absolutely necessary as defined for infrastructure in this EIA, and monitored to ensure edge effects such as erosion and alien and invasive plant species proliferation do not affect the adjacent areas. In this regard, maintaining migratory corridors and connectivity in the Freshwater and Secondary Grassland habitat units is deemed essential. As much indigenous vegetation will be retained as is practically possible;
- During the surveying and site-pegging phase of surface infrastructure, a search and rescue for possible floral species of conservation concern that will be affected by surface infrastructure will be undertaken, marked and where possible, relocated to suitable habitat surrounding the disturbance footprint. The relevant permits (where necessary) will be applied for prior to removal of relocation of any species of conservation concern found. Such species will be handled with care and the relocation of these plant species to nearby suitable similar habitat where deemed feasible will to be overseen by a suitably qualified botanist;
- Contractor laydown areas, refuelling areas and material storage facilities will be located outside of the watercourses and their regulated buffer zones;
- Temporary soil stockpiles height will be limited between two and three metres where possible and will be protected to prevent contamination of runoff and sedimentation of the downgradient watercourses in the vicinity of the proposed activities;
- The watercourses, and their regulated buffer zones will be clearly demarcated and marked as a “no-go” areas unless authorised activities are allowed within these zones. Existing watercourse crossings will be used where possible to avoid driving through watercourses. Where is cannot be avoided, watercourse crossings should be made at right angles. Areas where bank failure is observed as a result of such watercourse crossings will be immediately repaired;
- The temporary waste rock dumps and topsoil stockpiles will be located out of the watercourse regulated buffer zones and managed to prevent infiltration of sediment and contaminants to downstream watercourses;
- Dewatering boreholes will be considered, if deemed necessary, in order to minimise the creation of dirty water within the ventilation shaft, and this clean water should be used to recharge the natural watercourses within close vicinity of the ventilation shafts. If clean water is released into the wetlands, stormwater management outlets will be installed, with erosion prevention structures (such as reno-mattresses) to limit the velocity of stormwater inflow from eroding the wetlands;

- Any mining activities within regulated buffer zones of the wetlands will be undertaken with care to ensure that downstream impacts on the ecology of these systems do not occur. In this regard:
 - The temporary waste rock dumps and topsoil stockpiles will be managed to minimise infiltration of contaminants to the downgradient wetlands. Mitigation methods that will be considered include development of a downgradient berm and trench system to collect seepage which can be re-used in the mining processes;
 - Pollution prevention through infrastructure design, to prevent, eliminate and/or control the potential for groundwater pollution, in accordance with any recommendations made by a suitably qualified geohydrologist and the stormwater management plan (these are detailed in the groundwater and surface water impact assessment and mitigation sections above);
 - A groundwater monitoring programme will be implemented to detect any changes in groundwater quality;
 - A monitoring programme will be implemented for the downgradient wetlands to detect possible contamination emanating from the site. In the case of contamination being detected, the mine will investigate and implement additional mitigation measures. This could include the installation of interception boreholes to remove and clean contaminated water; and
 - Clean and dirty water separation systems will be implemented and maintained to ensure that any contaminated water does not reach the wetlands downgradient of the mining activities.
- Trapping, collecting or hunting of fauna or flora species will be prohibited during all phases of the proposed project;
- Road margins close to telephone lines and powerlines will be burned and/or mowed regularly to prevent microhabitat for small mammals that could be hunted by raptors. By keeping the grass height low, it lowers the possibility of raptors colliding with vehicles;
- More sensitive faunal habitat (Freshwater features habitat) and associated buffer zones adjacent to footprint areas will be designated as “no-go” areas, and no mining vehicles, personnel, or any other mining-related activities are to encroach upon these areas;
- Road margins close to telephone lines and power lines will be burned and/or mowed regularly to prevent microhabitat for small mammals that could be hunted by raptors. By keeping the grass height low, it lowers the possibility of raptors colliding with vehicles;
- Awareness campaigns will be implemented to inform all construction and mine workers, especially vehicle operators/drivers, of the importance of plant and animal species within the project area;
- Informal fires will be prohibited during all project phases;
- Edge effects of all construction and operational activities, such as erosion and alien plant species proliferation, which may affect faunal habitat, will be strictly managed in all areas of increased ecological sensitivity (Freshwater Features habitat);
- An alien invasive species management and monitoring programme will be implemented. The programme will continue to be implemented for a period of five years after decommissioning and closure;
- Surface water management measures as outline in section Issue 6 will be implemented. The clean and dirty water separation systems will be developed in such a way, along with the rest of the proposed mining activities, to reduce the footprint of the dirty water area and thus minimise the impact on catchment yield;
- Should contamination be detected in watercourses (including wetlands) in the project area, the mine will implement additional management and mitigation measures to prevent further contamination and attempt to remedy the contamination. This may include the installation of interception boreholes to remove and treat contaminated water;

- Groundwater management measures as outline in Issue 8 will be implemented;
- Soil management measures as outline in Issue 1 and Issue 2 will be implemented;
- Dust management measures as outline in Issue 9 will be implemented;
- Lighting pollution and its effect on fauna will be effectively mitigated with the following guidelines in mind:
 - Downward facing lights will be installed and limited to essential areas; and
 - Covers/light diffusers will be installed to lessen the intensity of illumination if at all possible.
- Rehabilitation of natural vegetation will proceed in accordance with a rehabilitation plan compiled by a suitable specialist. This rehabilitation plan will consider ongoing rehabilitation during the operational phase of the project as well as rehabilitation actions to be undertaken during mine closure;
- Rehabilitation trials will be continuously undertaken from the commencement of construction to determine the efficiency of rehabilitation methods and the suitability of flora propagated in the nursery for rehabilitation;
- Rehabilitation efforts and monitoring thereof will be implemented for a period of at least five years after decommissioning and closure.

Emergency situation

In case of a major incident the emergency response procedure in Section 30.2.2 will be followed.

Monitoring

The areas of disturbance will be monitored to ensure edge effects such as erosion and alien and invasive plant species proliferation do not affect the adjacent areas.

An alien invasive species management and monitoring programme will be implemented throughout the mining areas.

The watercourses (including wetlands) within 500 m of proposed mine infrastructure will be monitored to determine whether contamination is leaching from the mine infrastructure. Should contamination be detected, the mine will implement additional management and mitigation measures to prevent further contamination and attempt to remedy the contamination. This may include the installation of interception boreholes to remove and treat contaminated water.

ISSUE 5 ALTERATION OF SURFACE DRAINAGE PATTERNS

Information in this section was sourced from the surface water study undertaken SLR (SLR, 2019) (refer to Appendix G).

Pre-mining natural drainage across the proposed project area is via preferential flow paths. With reference to the table below, there are a number of activities/infrastructure which will alter drainage patterns by reducing the volume of run-off into the downstream catchments. During the construction, operational and decommissioning phase, these activities will continue until such time as project infrastructure can be removed and/or the project areas are rehabilitated. During the closure phase rehabilitation will allow for the restoration of drainage patterns as far as practically possible. As part of the proposed project, rainfall and surface water run-off will be collected in all areas that have been designed with water containment infrastructure as required by legislation. The collected run-off will therefore be lost to the catchment and can

result in the alteration of drainage patterns. In addition, discharge of excess water also has the potential to alter drainage patterns.

Mine phase and link to project specific activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks Civil works	Underground mining Opencast mining Transport system Power supply and use Water supply and use Mineralised waste Non-mineralised waste Support services Rehabilitation Discharge of excess water	Underground mining Opencast mining Transport system Power supply and use Water supply and use Mineralised waste Non-mineralised waste Support services Demolition Rehabilitation	Maintenance and aftercare of rehabilitated areas

Rating of impacts

Severity/nature

During the construction, operation, decommissioning, and to a lesser extent, the closure phases, rainfall and surface water run-off will be collected in all areas that have been designed with water containment infrastructure. The collected run-off will therefore be lost to the catchment and can result in the alteration of drainage patterns. The collection of stormwater and physical alteration of drainage lines is estimated to reduce the catchment area for runoff to the streams by approximately 0.15 %. This is a very small area compared to the C22A Quaternary Catchment, therefore this impact is not considered to be significant.

The water balance shows that excess mine water will likely need to be treated (where required) and discharged into receiving watercourses during the wet season, and this also has the potential to change drainage patterns. The points of discharge for the excess water are yet to be determined, however, the volumes of water to be discharged are significant during the wet season. This impact is therefore rated as having a medium severity.

Duration

In the unmitigated scenario, the alteration of drainage patterns could extend beyond closure. In the mitigated scenario, the duration of the alterations will mostly be restricted to the phases before closure.

Spatial scale / extent

In the unmitigated and mitigated scenario, the physical alteration of drainage patterns will extend downstream beyond the site boundary.

Probability

The magnitude of the change in flows in receiving watercourses may well result in related flow impacts downstream, therefore the probability is medium in both the mitigated and unmitigated scenarios.

Significance

The significance is high in the unmitigated scenario reducing to medium with mitigation.

Summary of the rated alteration of natural drainage lines impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation and decommissioning						
Unmitigated	M	H	M	H	M	H
Mitigated	M	L	M	M	M	M

Management objective

The objective is to prevent unacceptable alteration of drainage patterns and related reduction of downstream surface water flow.

Management actions

The following management measures will be implemented during all mine phases:

- Mine infrastructure will be constructed, operated and maintained so as to comply with the provisions of the National Water Act (36 of 1998) and Regulation 704 (4 June 1999) of any future amendments thereto. These include:
 - Separation of clean and dirty water systems;
 - The size of dirty water areas will be minimized and clean run-off and rainfall water will be diverted around dirty areas and back into the normal flow in the environment;
- The location of all activities and infrastructure will be outside of the flood lines of watercourses. If this is unavoidable the necessary exemptions/approvals will be obtained;
- Discharges will be in line with a Water Use License and in a manner that mitigates potential risks on downstream environments;
- Regularly update and refine the site wide water balance with the input of actual flow and discharge volumes to enable the water balance to be used as a decision-making tool for water management and impact management actions;
- All discharge points will be checked regularly to determine if energy dissipaters or other management measures are required.

Emergency situations:

For any emergency discharge incident, the emergency response procedure in Section 30.2.2 will be followed.

ISSUE 6 CONTAMINATION OF SURFACE WATER

Information in this section was sourced from the surface water study undertaken SLR (SLR, 2019) (refer to Appendix G).

Introduction

There are a number of pollution sources in all project phases of the proposed project 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 in nature. Although these sources may be temporary, the potential pollution may be long term. The operational phase will present more long-term potential sources and the closure phase will present rehabilitated areas that have the potential to contaminate surface water through long term seepage and/or run-off.

Mine phase and link to project specific activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation	Underground and Opencast	Underground and Opencast	Maintenance and aftercare of

Construction	Operational	Decommissioning	Closure
Earthworks Civil works	Transport system Power supply and use Water supply and use Mineralised waste Non-mineralised waste Support services Rehabilitation Discharge of excess water	Transport system Power supply and use Water supply and use Mineralised waste Non-mineralised waste Support services Demolition Rehabilitation	rehabilitated areas

Rating of impacts

Severity/nature

Surface water may collect contaminants (hydrocarbons, salts, and metals) from numerous sources.

In the unmitigated scenario, potential construction and decommissioning phase pollution sources include:

- Sedimentation from erosion;
- Spillage from portable toilets, spillage of construction fuel, lubricants, cement or leaks from vehicles and equipment.

Potential operational phase pollution sources include:

- Spills from sewage treatment plant, spillage of operational fuel, lubricants, cement or leaks from vehicles and equipment;
- Contaminated discharges from the dirty water control systems;
- Contaminated runoff from the temporary waste rock dumps and exposed rock in the opencast pits;
- Discharge of excess water that cannot be used on site;
- Sedimentation from erosion.

At elevated concentrations contaminants can exceed the relevant surface water quality limits imposed by DWS and can be harmful to humans and livestock if ingested directly and possibly even indirectly through contaminated vegetation, vertebrates and invertebrates (refer to the biodiversity section in this Appendix for the potential biodiversity impacts. This impact will not be assessed in this section. The quality of water to be discharged into receiving water bodies is not currently known, however the water may have a low pH and contain contaminants if not treated sufficiently. This impact has therefore been rated as having a high severity.

In the mitigated scenario, clean water will be diverted away from the project areas and contaminated run-off will be contained in the normal course. The quality of discharge water will be treated to a standard to be determined by DWS during the water use licencing process, although it is noted that the water quality in the project area is already not fit for human use. The discharges could potentially even improve the water quality in these receiving watercourses. The severity should therefore be reduced to medium.

Duration

In the unmitigated scenario, the contamination of surface water resources will occur for periods longer than the life of proposed project. With mitigation, pollution can be prevented and/or managed and as such the impacts can be reversed or mitigated within the life of proposed project.

Spatial scale / extent

In both the mitigated and unmitigated scenarios, the spatial scale is likely to extend beyond the project area because contamination is mobile once it reaches flowing watercourses.

Probability

The probability of the impact occurring relies on a causal chain that comprises three main elements:

- Does contamination reach surface water resources?
- Will people and livestock utilise this contaminated water?
- Is the contamination level harmful?

The first element is that contamination reaches the surface water resources within the proposed project area. Excess water will be discharged directly into watercourses within the project area, although the exact discharge points are yet to be determined.

The second element is that third parties and/or livestock use this contaminated water for drinking purposes. Although surface water is already unfit for use, third parties were noted to be using surface water for subsistence irrigation and washing of clothes.

The third element is that it is likely that some contaminants will be at a level which is harmful to humans and livestock. This is influenced both by the quality of any discharged water and by the diluting effect of any rainwater particularly in the rainy season.

As a combination, when considering the nature and location of the proposed infrastructure in proximity to surface water resources, the unmitigated probability is medium. This can be reduced where water is discharged at suitable standards.

Significance

In the unmitigated scenario, the significance of this potential impact is high. In the mitigated scenario, the significance is reduced to medium-low because of the reduction in severity and duration.

Summary of the rated contamination of surface water resources impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	M	H
Mitigated	M	M	M	M	M-L	M-L

Management objectives

Prevent and minimise further water quality impacts in the catchment from the proposed project.

Management measures

The following management measures will be implemented during all project phases:

- Mine infrastructure will be constructed and operated so as to comply with the National Water Act (36 of 1998) and Regulation 704 (4 June 1999).
- Silt will be managed by minimising the disturbance of soils, implementing sediment source and erosion controls, phasing of earthworks activities, diverting upslope runoff from entering the earthworks areas and containment of sediment runoff i.e. use of silt traps;
- Discharges of surface water will only occur in accordance with authorisations that are issued in terms of the relevant legislation specifications and must not result in negative health impacts for downstream surface water users. The relevant legislation specifications comprise any applicable authorisation/exemption, the National Water Act (36 of 1998) and Regulation 704;

- The design of all onsite access roads, plant areas, stockpiles, pump station etc. will include stormwater management and erosion control during both the construction and operational phases;
- Good housekeeping practices will be implemented and maintained by clean-up of accidental spillages, as well as ensuring all dislodged material such as from run-of-mine stockpiles are kept within the confined storage footprints;
- Clean-up material and materials safety data sheets for chemical and hazardous substances will be kept on site for immediate clean-up of accidental spillages of pollutants;
- Regular inspections and maintenance will be conducted of water management facilities, to inspect drainage structures and liners for any in-channel erosion or cracks, de-silting of silt traps/sumps and pollution control dams, and any pumps and pipelines will be maintained according to manufacturer's specifications;
- Vehicles and plant equipment servicing will be undertaken within suitably equipped facilities, either within workshops, or within bunded areas, from which any stormwater will be conveyed to a pollution control dam, after passing through an oil and silt interceptor;
- Water conservation and water demand management measures will be implemented to ensure that as much water as is possible, is collected and reused;
- Concurrent rehabilitation of disturbed areas will be conducted where practical;
- All hazardous chemicals (new and used), mineralized waste and non-mineralised waste will be handled in a manner that they do not pollute surface water. This will be implemented by means of the following:
 - Pollution prevention through basic infrastructure design;
 - Pollution prevention through maintenance of equipment;
 - Pollution prevention through education and training of workers (permanent and temporary);
 - Pollution prevention through appropriate management of hazardous, materials; and
 - The required steps to enable containment and remediation of pollution incidents.

Emergency situations

In case of a potentially polluting discharge incident that may result in the pollution of surface water resources, the emergency response procedure in Section 30.2.2 will be followed.

ISSUE 7 REDUCTION OF WATER AVAILABILITY TO THIRD PARTIES

Information in this section was sourced from the groundwater study undertaken by Noa Agencies (Noa, 2019) (refer to Appendix H).

Introduction

Dewatering activities are required to allow for safe mining operations. Dewatering activities have the potential to cause a lowering of groundwater levels which may cause a loss in water supply to surrounding borehole users if they are in the impact zone. Dewatering activities can also affect baseflow contributions to surface watercourses if there is a hydraulic link between the surface and groundwater. According to Noa, the Klip River groundwater compartments appear to be in connection with the Klip River. No other hydraulic connections have been identified (Noa, 2019).

Mine phase and link to project specific activities/infrastructure

Construction	Operation	Decommissioning	Closure
N/A		N/A	N/A
-	Open pit and Underground mining - dewatering	-	-

Rating of impact

Severity / nature

A three-dimensional groundwater model was developed to simulate the potential impact on the receiving environment associated with the various open pits and the underground mining operations. Dewatering at the five opencast pits and the underground mine areas were simulated.

Little to no mine dewatering is predicted to occur at the open pits due to the shallowness of the proposed open pits (i.e. <30m deep). During the wet season minor dewatering could be required due to seepage and runoff from the Waste Rock Dump (WRD) and local catchment. At the Mona Lisa open pit a relatively higher (although still considered by the specialist to be small) dewatering volume has been predicted. This is due to the proximity of the open pit to the Klipspruit River. At 11 Shaft open pit, dewatering could influence the flow of water along the adjacent drainage line. The assumption is made that the dewatered volume simulated in the numerical flow model is derived from shallow groundwater flow that contributes to baseflow of the watercourses. It is however noted by the specialist that water may not accumulate in the Mona Lisa open pit, especially during the dry seasons (Noa, 2019). This is rated as a medium severity for the Mona Lisa and 11 Shaft pits and low severity for all other open pits. Open pit dewatering cannot be mitigated as this is a potential result of excavation and intersecting the groundwater table.

The groundwater report provides mapping showing the predicted zones of dewatering for each open pit (refer to Appendix H). No third-party groundwater users were recorded within the zones of dewatering. The groundwater specialist has also indicated that there will be very little to no influence on the surface and shallow groundwater regime and third-party users (Noa, 2019).

The simulated dewatering volumes range between 500 and just over 2 000 m³/day for Bird Reef Central and 800 and 3 600 m³/day for Kimberley Reef East underground mine areas. Depending on whether structures are intersected underground, this volume could increase or decrease. Therefore these volumes should be used as a guide for planning and management purposes. Where dirty water is collected in the underground workings it will be pumped into historical underground workings/voids. A water pillar will remain between the project and the historical underground workings to prevent continuous dirty water from flowing. According to Noa, the simulated zones of influence should however not be measurable or notable, on or close to surface. Shallow groundwater levels would remain, mostly due to the low vertical hydraulic permeability of the shallower formations (Noa, 2019).

Dewatering activities in the underground mine are predicted to pose little to no impact on the surface and shallow groundwater regime and users. The severity has therefore been rated as low in both the unmitigated and mitigated scenarios.

Duration

The duration of the impact is linked to the duration of the dewatering and the recharge time thereafter. Noa notes that shallow groundwater levels remain even with the historical mining in the basins, mostly due to the low vertical hydraulic permeability of the shallower formations. Therefore, the duration is limited to less than the life of the project.

Spatial scale / extent

The spatial scale of the predicted dewatering cone will extend beyond the mining area but remain localised, which is a low spatial scale in both the unmitigated and mitigated scenarios.

Probability

No third-party groundwater users have been recorded in the zones of influence, furthermore dewatering is expected to have very little to no influence on the surface and shallow groundwater regime. However dewatering at the Mona Lisa has the potential to reduce the baseflow contribution to the Klipspruit River. The probability of impacts on third-party water users is therefore low in both the unmitigated and mitigated scenarios.

Significance

The significance is low in both the unmitigated and mitigated scenarios.

Summary of the rated dewatering impact for the open pit mining per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Operation – all pits except Mona Lisa						
Unmitigated	L	L	L	L	L	L
Mitigated	L	L	L	L	L	L
Operation –Mona Lisa						
Unmitigated	M	L	L	L	L	L
Mitigated	M	L	L	L	L	L

Summary of the rated dewatering impact for the underground mining per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Operation						
Unmitigated	L	L	L	L	L	L
Mitigated	L	L	L	L	L	L

Management objective

To prevent third-party groundwater user loss of water supply.

Management measures

The following management measures will be implemented:

- Prior to mining, an updated hydrocensus will be conducted in a 500 m radius around each opencast pit and the underground mining areas. The data recorded will be used to finalise the monitoring protocol and the groundwater flow model and associated management scenarios;
- All potentially affected third-party groundwater users identified in the updated hydrocensus will be included in the mine's groundwater monitoring program to ensure that changes in water depths can be identified;
- Additional drilling will be conducted at the Mona Lisa open pit to further investigate how dewatering may impact on the baseflow contribution to the Klipspruit River. Once drilling is completed, an aquifer test will be performed and the water sampled will be compared to the Klipspruit River water to establish a link, or absence there-of, between the potential dewatering at Mona Lisa and the Klipspruit River;
- Additional boreholes will be drilled at key locations to serve as monitoring boreholes (see monitoring programme). These boreholes will be subjected to aquifer testing;
- The underground mining areas will be further assessed by drilling boreholes to the proposed depth of mining, intersecting known geological units, fractures and mining sequence. These boreholes will also be subjected to aquifer testing;

- The groundwater model will be updated once the hydrocensus, monitoring and testing data is updated. The simulations will be re-run to determine if the predictions were accurate or if any changes to the management measures are required; and
- Although this is not expected, should the West Wits dewatering activities cause a loss of water supply to third parties, alternative water supply of equivalent or better quantity and quality will be provided to the affected user, or appropriate compensation will be provided by West Wits, until such time as the dewatering impacts cease.

Emergency situations

None identified.

ISSUE 8 GROUNDWATER CONTAMINATION

Information in this section was sourced from the groundwater study undertaken by Noa Agencies (Noa, 2019) (refer to Appendix H).

Introduction

There are a number of sources in all mine phases that have the potential to pollute groundwater. In the construction and decommissioning phases some of these potential pollution sources are temporary and diffuse in nature. Even though the sources are temporary in nature, related potential pollution can be long term. The operational phase will present more long-term potential sources (temporary waste rock dumps) and the closure phase will present backfilled pits, underground mining voids and rehabilitated land that may have the potential to pollute water resources through long term seepage and/or run-off. Pollution sources can also affect baseflow contributions to surface watercourses if there is a hydraulic link between the surface and groundwater. According to Noa, the Klip River groundwater compartments appear to be in connection with the Klip River (Noa, 2019).

There will be no residual landforms after mine closure as ore will be taken off site for mineral processing and all waste rock material will either be used to backfill the open pits, or transported for disposal off site.

Mine phase and link to project specific activities/infrastructure

Construction	Operational	Decommissioning	Closure
Earthworks Civil works	Opencast mining Transportation Power supply and use Water supply and use Mineralised waste Non-mineralised waste Support services General site management Rehabilitation	Opencast mining Transportation Power supply and use Water supply and use Mineralised waste Non-mineralised waste Support services Demolition Rehabilitation	Maintenance and aftercare of rehabilitated land

Rating of impacts

Severity / nature

Two types of contamination sources are broadly considered. The one type is diffused contamination which includes ad hoc spills and discharges of contaminant substances. The other type is point source contamination which includes more long-term sources such as the temporary waste rock dumps. A three-dimensional model was developed to simulate the potential contamination from the temporary WRDs (during operations) and backfilled opencast pits (post-closure). It is possible that the potential plume could

migrate to the Klipspruit River at the Mona Lisa opencast pit due to the possible connection between the groundwater and river baseflow.

The geochemical nature of the waste rock was assessed and is discussed in Section 6.4.1.1 of this report. The acid base accounting and geochemical modelling have indicated that due to the absence of iron sulphide minerals the risk of the development of acid mine drainage conditions in the waste rock environment is negligible. In addition the leach tests and geochemical model, which was developed to evaluate the leach tests, shows that the risk of leaching of contaminants from the waste rock is negligible (Noa, 2019).

GeoDyn Systems recommended that the waste rock be treated as a Type 4 waste, which is generally inert and does not require complex engineered barrier systems. The temporary WRDs will therefore have a Class D barrier, which entails topsoil stripping and 150 mm base preparation. No significant or poor-quality leachate is expected from the temporary WRDs.

The groundwater report provides mapping showing the predicted movement of groundwater based on the physical characteristics of the waste rock material for each temporary WRD and open pit which will be concurrently backfilled and rehabilitated (refer to Appendix H). The simulations showed that a potential plume would migrate a maximum of 150 m from the temporary WRDs, at a concentration of less than 20 % of the source concentration. No third-party groundwater users were identified within the predicted zone. No decanting is expected after mine closure (Noa, 2019).

The severity has therefore been rated as low in both the unmitigated and mitigated scenarios.

Duration

Groundwater contamination is long-term in nature, occurring for periods longer than the life of proposed project.

Spatial scale / extent

The potential contamination plume would extend beyond the project footprint but remain localised in both the unmitigated and mitigated scenarios.

Probability

The probability of the impact occurring relies on a causal chain that comprises three main elements:

- Does contamination reach groundwater resources?
- Will people and animals utilise this contaminated water?
- Is the contamination level harmful?

The first element is that contamination reaches the groundwater resources underneath or adjacent to the proposed project area. Due to the proximity of the sources to groundwater in the shallow aquifer, contaminants could reach groundwater resources. It should be noted that the open pits and underground mine voids are not expected to decant.

The second element is that third parties and/or livestock use this contaminated water for drinking purposes. No known third-party groundwater users are located within the contamination plume zones, however it is possible that contamination could reach the baseflow of the Klipspruit as described above.

The third element is whether contamination is at concentrations which are harmful to users. Based on the geochemical assessment, no significant or poor quality leachate is expected to be associated with the temporary WRDs or backfilled open pits. As a combination, the unmitigated and mitigated probability is low.

Significance

The significance is low in both the unmitigated and mitigated scenarios.

Summary of the rated contamination of groundwater impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	L	H	L	M	L	L
Mitigated	L	H	L	M	L	L

Management objectives

Prevent and minimise further water quality impacts in the catchment from the proposed project.

Management measures

The following management measures will be implemented during all phases of the project:

- Prior to mining, an updated hydrocensus will be conducted in a 500 m radius around each opencast pit and the underground mining areas. The data recorded will be used to finalise the monitoring protocol and the groundwater flow model and associated management scenarios;
- All potentially affected third-party groundwater users identified in the updated hydrocensus will be included in the mines' groundwater monitoring program to ensure that changes in water quality can be identified;
- Although this is not expected, should the West Wits mining activities cause a loss of water supply through decreased water quality to third parties, alternative water supply of equivalent or better quantity and quality will be provided to the affected user, or appropriate compensation will be provided by West Wits, until such time as the pollution impacts cease;
- Mine infrastructure will be constructed and operated so as to comply with the National Water Act (36 of 1998) and Regulation 704 (4 June 1999);
- Concurrent rehabilitation of disturbed areas will be conducted where practical;
- Additional boreholes will be drilled at key locations to serve as monitoring boreholes. This is discussed in more detail below. These boreholes will also be subjected to aquifer testing;
- The underground mining areas will be further assessed by drilling boreholes to proposed depth of mining, intersecting known geological units, fractures and mining sequence. These boreholes will also be subjected to aquifer testing;
- The groundwater flow model will be updated once the hydrocensus, monitoring and testing data is updated. The simulations will be re-run to determine if the predictions were accurate or if any changes to the management measures are required;
- All hazardous chemicals (new and used), mineralized waste and non-mineralised waste will be handled in a manner that they do not pollute water. This will be implemented by means of the following:
 - Pollution prevention through basic infrastructure design;
 - Pollution prevention through maintenance of equipment;
 - Pollution prevention through education and training of workers (permanent and temporary);
 - Pollution prevention through appropriate management of hazardous, materials; and
 - The required steps to enable containment and remediation of pollution incidents.

Emergency situations

In case of a major discharge incident that may result in the contamination of groundwater resources the emergency response procedure in section 30.2.2 will be followed.

ISSUE 9 CHANGE IN AMBIENT AIR QUALITY

Information in this section was sourced from the air quality impact assessment undertaken by Airshed Planning Professionals (Airshed, 2019A) (refer to Appendix J).

Introduction

There are a number of activities in all phases that have the potential to contribute to the pollution of air. In the construction and decommissioning phases these activities are usually temporary in nature, usually existing for a few weeks to a few months. The operational phase will present more long-term activities and the closure phase will present final rehabilitated areas.

Air pollution related impacts on biodiversity are discussed in the biodiversity section and therefore this section focuses on the potential for human health impacts.

Mine phase and link to project specific activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks Civil works	Underground mining Opencast mining Transport system Power supply and use Water supply and use Mineralised waste Support services Rehabilitation	Underground mining Opencast mining Transport system Power supply and use Water supply and use Mineralised waste Support services Demolition Rehabilitation	Maintenance and aftercare of rehabilitated areas

Impact assessment

Severity / nature

The main air contaminants associated with the proposed project include: inhalable particulate matter less than 10 microns in size (PM₁₀), larger total suspended particulates (TSP) that relate to dust fallout, sulphur dioxide (SO₂), nitrite (NO₂) and carbon monoxide (CO) emissions mainly from vehicles and generators, in addition to diesel particulates from generators. The main sources of dust emissions from the opencast mining operations are likely to be materials handling of ROM and waste rock in the pit, as well as of waste rock at the WRD; and vehicle entrainment emissions from haul trucks and other mobile equipment. The main sources of dust emissions from the underground mining operations are the ventilation shafts and the aboveground handling of ROM (Airshed, 2019A). There will be no residual landforms after mine closure as ore will be taken off site for mineral processing and all waste rock material will be removed to backfill the open pits, or if necessary waste rock material will be disposed of offsite.

Airshed conducted dispersion modelling simulations using the US EPA AERMOD atmospheric dispersion modelling suite to determine the highest hourly, highest daily and annual average ground level concentrations for each of the pollutants considered for the operational phase. A set of isopleth plots are provided in the air report (refer to Appendix J). Averaging periods were selected to facilitate the comparison of simulated pollutant concentrations to the National Ambient Air Quality Standards (NAAQS). Dustfall results were compared to the National Dust Control Regulations (NDCR) standards.

Simulated maximum concentrations for all opencast operations at receptor locations are shown in Table D 2. The simulations show:

- **Inhalable dust:** In the unmitigated scenario, the simulated highest daily PM₁₀ concentrations exceed the NAAQS (75 µg/m³ for the 24-hour and 40 µg/m³ annual averaging period) at the closest receptor locations to the east, north and south of each of the pits, except the Mona Lisa Pit. Simulated PM_{2.5} concentrations are in compliance with the SA NAAQS for all averaging periods at all receptor locations. With simple mitigation measures such as wet suppression of dust at material handling points and regular water sprays on haul roads, the simulated incremental PM₁₀ concentrations due to the open pit mining operations fall within compliance with the NAAQS at all receptor locations, with the exception of daily PM₁₀ concentrations at the buildings to the south of Rugby Club and to the east of 11-Shaft where the annual average is still exceeded.
- **Dust fallout:** In the unmitigated scenario, simulated highest monthly dust fallout rates comply with the NDCR residential limit at all receptor locations and comply with the NDCR non-residential limit at all off-site areas.
- **Gases:** Simulated NO₂, SO₂, and CO concentrations comply with the NAAQS for all averaging periods at all receptor locations.

With respect to underground operations, the highest daily and annual average PM₁₀ concentrations as a result of aboveground ROM handling and ventilation shaft emissions were simulated to exceed the NAAQS in the immediate vicinity of the underground infrastructure complexes. However, the simulation shows compliance with the SA NAAQS at all receptor locations (Airshed, 2019A).

The severity rating is based on the simulated annual PM₁₀ concentrations, at the receptors close to open pit operations, which exceed the NAAQS, which represents the highest potential impact area. The severity has been rated as medium in the unmitigated scenario. With mitigation, although the annual NAAQS levels will no longer be exceeded, and although the daily PM₁₀ concentrations at the buildings to the south of Rugby Club and to the east of 11-Shaft will be significantly reduced, the concentrations cannot be reduced sufficiently to comply with the daily NAAQS at these receptors. The severity has therefore been rated as medium in the mitigated scenario.

TABLE D 2: DISPERSION MODELLING RESULTS – OPEN PIT OPERATIONS (AIRSHED, 2019A)

Pollutant	Scenario	Averaging Period	Limit Value (µg/m ³)	Simulated Maximum Concentration at Sensitive Receptor Locations (µg/m ³)				
				Roodepoort	Mona Lisa	Rugby Club	11 Shaft	Kimberley East
PM ₁₀	Unmitigated	24-hour	75	99	54	115	260	40
		1-year	40	33	14	63	82	7
	Mitigated	24-hour	75	51	29	91	150	23
		1-year	40	14	6	27	35	3
PM _{2.5}	Mitigated	24-hour	40	5	3	10	20	1
		1-year	20	1.3	0.6	3.2	5	0.3
NO ₂	Unmitigated	1-hour	200	37	21	67	110	17
		1-year	40	7.5	3.2	14.4	18.7	1.6
SO ₂	Unmitigated	1-hour	350	0.1	0.1	0.2	0.4	0.1
		24-hour	125	0.1	0.0	0.1	0.2	0.0
		1-year	50	0.03	0.01	0.05	0.07	0.01
CO	Unmitigated	1-hour	30 000	19	8	36	47	4
Diesel Particulates	Unmitigated	1-hour		2.7	1.5	4.9	8.0	1.2
		24-hour		2.0	1.2	3.6	6.0	0.9
		1-year		0.6	0.2	1.1	1.4	0.1
Dust Fallout	Mitigated	1-month	600	90	50	200	250	20

Bold and *italics* text indicates exceedance of the NAAQS.

Duration

The elevated PM₁₀ concentrations would be short-term due to the limited duration of opencast mining activities. With mitigation, the duration of impacts will be reduced.

Spatial scale / extent

The spatial scale of the potential impact could be beyond the immediate mining area in both the unmitigated and mitigated scenarios.

Probability

The health impact probability is linked to the probability of ambient concentrations exceeding the evaluation criteria in relation to potential receptors. In the unmitigated scenario this is high due to the elevated PM₁₀ concentrations at receptors close to the opencast pits. With mitigation, the probability therefore reduces to seldom.

Significance

The significance of this impact is high in the unmitigated scenario. With mitigation, the significance of reduces to medium.

Summary of the air pollution impact rating per phase of the mine

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operations and closure						
Unmitigated	M	L	M	M	H	H
Mitigated	M	L	M	M	L	M

Management objective

The objective is to prevent air pollution health impacts.

Management action

Management actions that have been identified in all phases prior to closure are provided below.

Dust emissions

- Best practice mitigation measures (wind breaks, wet suppression etc.) will be implemented for both the mining and rehabilitation phases of the opencast operations. Mitigation measures will be in-line with the requirements of the City of Johannesburg Metropolitan Municipality By-Laws which requires mitigation of any air pollution, as far as reasonably possible.
- In addition, best practice mitigation measures (wind breaks, wet suppression, minimised drop heights) will be implemented on ROM handling operations during the underground phase of the West Wits Mining Project.
- Specific measures include:
 - Wet suppression techniques will be used to control dust emissions, especially in areas where dry material is handled or stockpiled;
 - Exposed soils and other erodible materials will be re-vegetated or covered promptly;
 - New areas will be cleared and opened-up only when absolutely necessary;
 - Surfaces will be re-vegetated or otherwise rendered non-dust forming when inactive;
 - Storage for dusty materials will be enclosed or operated with efficient dust suppressing measures;

- Loading, transfer, and discharge of materials will take place with a minimum height of fall, and be shielded against the wind, and the use of dust suppression spray systems should be considered;
- Strict speed limits will be imposed to reduce entrained emissions and fuel consumption rates; and
- Should PM10 concentrations exceed the NAAQS at the closest receptor locations, additional dust suppression measures will be investigated.

Gaseous emissions

- Vehicles will be fitted with catalytic converters and low sulphur fuel will be used to minimise NO₂ and SO₂ impacts;
- Vehicle idle times will be kept to a minimum to minimise CO, NO₂, SO₂, diesel particulate and greenhouse gas emissions; and
- Strict speed limits (as low as practically feasible, a maximum of 40 km/hr, but preferably 20 km/hr) will be imposed on mine vehicles to reduce fuel consumption rates.
- The vehicle fleet should be regularly serviced and maintained to minimise CO, NO₂, SO₂, diesel particulate and greenhouse gas emissions.
- Older vehicles in the current fleet should be replaced with newer, more fuel-efficient alternatives where feasible.

Air quality complaint register

- The mine will keep an air quality complaint register and respond immediately to complaints about air quality related problems. All such complaints will be documented and recorded as incidents and addressed as deemed appropriate. These records will be kept for the life of mine.
- Regular community liaison meetings will be held with the neighbouring communities to address air quality related concerns.

Emergency situations

None identified.

ISSUE 10 INCREASE IN GREENHOUSE GAS EMISSIONS

Information in this section was sourced from the climate change assessment undertaken by Promethium Carbon (Promethium, 2019) (refer to Appendix I).

Introduction

Anthropogenic climate change as a global phenomenon is caused by the accumulated greenhouse gas emissions from global emitting sources. The impact thereof on society is increasingly of concern. The proposed project's contribution to global climate change is determined by the greenhouse gas emissions produced by the mine and its value chain. This assessment focuses on calculating the greenhouse gas emissions and investigating the consequent climate change impacts.

The global nature of climate change impacts is such that the greenhouse gas emissions from any individual project or source cannot be connected directly to any specific environmental impacts as a consequence of climate change. The analysis presented in this report is presented in the context that, even though the individual GHG emission contribution of a project cannot be directly linked to specific localised climate change impacts, global climate change is nevertheless significant and can be quantified as such.

Mine phase and link to project specific activities/infrastructure

Construction	Operational	Decommissioning	Closure
			N/A
Site preparation Earthworks Civil works	Underground mining Opencast mining Transport system Power supply and use Water supply and use Mineralised waste Support services Rehabilitation	Underground mining Opencast mining Transport system Power supply and use Water supply and use Mineralised waste Support services Demolition Rehabilitation	-

Impact assessmentSeverity / nature

South Africa's Nationally Determined Contribution (NDC) submitted in Paris in 2015 sets out a national emissions trajectory up to 2050. South Africa, as a developing nation, requires some allowances to increase its emissions in the short-term to foster economic growth and steadily transition towards a low carbon economy. The amount of greenhouse gas that South Africa can emit in terms of the NDC is the country's "carbon budget". This carbon budget forms one of the planetary boundaries that should not be exceeded in terms of sustainability principles.

The greenhouse gas emission impacts of the proposed project were analysed in terms of both South Africa's national greenhouse gas inventory and climate change, as well as the global inventory and climate change.

The proposed project is expected to generate approximately 802 tonnes of carbon dioxide equivalent (tCO₂e) of direct emissions over the mine's lifetime. The direct emissions are from the combustion of diesel and are considered to be within the direct control of the mine. A large percentage (99.7 %) of the mine's lifetime emissions are however categorised as indirect emissions. These emissions are as a result of electricity consumption (Scope 2 emissions) and other indirect sources specifically purchased goods and services, other fuel and energy related activities and diesel consumption for transport of goods.

The total project lifetime inventory is expected to consume approximately 0.0031 % of South Africa's carbon budget. This value is above the low-materiality threshold (0.00013 %) but below the medium-materiality threshold (0.013 %) of South Africa's carbon budget. The impact of the project's total greenhouse gas inventory within a domestic context is therefore considered to be medium-low severity (Promethium, 2019).

The specific greenhouse gas emissions from the construction and operation of the proposed West Wits mining project cannot be attributed directly to any particular climate change effects. In addition, greenhouse gas emissions from the proposed mine, when considered in isolation, will have a minimal impact on global climate change. However, the global atmosphere, as the receiving environment should be considered.

Duration

The impacts of anthropogenic climate change are permanent and cannot be reversed. The duration is high in both the unmitigated and mitigated scenarios.

Spatial scale / extent

The spatial scale of the potential impact will extend beyond the project area in both the unmitigated and mitigated scenarios. The spatial scale is high in both the unmitigated and mitigated scenarios.

Probability

The probability that GHG emissions will impact on global climate change is definite, regardless of the mitigation.

Significance

The significance of this impact is high in the unmitigated. With mitigation the significance can reduce to medium. It must be noted however that the duration that the project-related GHG are assumed to remain in the atmosphere renders the impacts (limited as they may be) effectively irreversible with the impacts of anthropogenic climate change, in many cases resulting in the irreversible loss of resources. There are options to mitigate the GHG emissions from the operation phases of the mining project. However, these options are not able to alter the impact that the GHG emissions will have on climate change in terms of their extent, duration or probability. It is only the magnitude of the GHG emissions impact that can be reduced by reducing the quantity of emissions (Promethium, 2019).

Summary of the increase in greenhouse gas emission impact rating per phase of the mine

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operations and decommissioning						
Unmitigated	M-L	H	H	H-M	H	H
Mitigated	L	H	H	M	H	M

Management objective

To limit greenhouse gas emissions from the project.

Management action

A greenhouse reduction strategy will be implemented during all mine phases as described below.

Plan	<ul style="list-style-type: none"> Quantify greenhouse gas emissions through a documented inventory Identify activities associated with greenhouse gas emissions Set short, medium and life of mine emission reduction targets.
Do	<ul style="list-style-type: none"> Identify continuous greenhouse gas emission reduction initiatives Manage risks associated with greenhouse gas emissions Ensure compliance with relevant policy and legislation, including greenhouse gas reporting requirements.
Check	<ul style="list-style-type: none"> Measure and track performance towards achievement of emission reduction targets Measure and track energy use to continuously consider energy efficiency options Report on greenhouse gas emissions to stakeholders.
Act	<ul style="list-style-type: none"> Continuously improve energy performance and the carbon management system Re-assess the impacts of existing and future policies and regulations Ensure that the mine's overall strategic goals are in line with the mine's climate change policy Adjust the mine's policies and indicators if the objectives are not being met.

Emergency situations

None identified.

ISSUE 11 RADIATION IMPACT

Information in this section was sourced from the radiological safety assessment undertaken by SciRAD (SciRAD, 2019) (refer to Appendix K).

Introduction

In the context of a mine, radiation typically originates from mineralised substances (ore, product and tailings dam), through inhalation (of radon gas and particulate matter), ingestion (of water or contaminated foodstuffs) and exposure to gamma radiation pathways. The operational and decommissioning phase will present long term activities and the closure phase will present backfilled opencast pits and rehabilitated areas that may have the potential to impact surrounding third parties.

It should be noted that potential occupational radiation exposure is not included in this EIA and is instead addressed as an occupational health and safety issue elsewhere.

Mine phase and link to project specific activities/infrastructure

Construction	Operational	Decommissioning	Closure
N/A			
-	Underground mining Opencast mining Mineralised waste	Mineralised waste	Maintenance and aftercare of rehabilitated areas

Rating of impact

Severity

As discussed in the baseline section (Section 6.4.1.9), the radionuclide activity concentrations for all the rock and soil samples are well below the regulatory limit of 500 Bg/kg (or 0.5 Bq/g). Based on this fact, a radiological assessment was in fact not deemed necessary by the radiation specialist but was conducted in order to address offer stakeholders concerns.

SciRAD determined the external exposure doses from dust deposition, dust and radon gas inhalation, as well as the total dose (the sum of external exposure and inhalation doses) from the potential radiation sources i.e. opencast pits, temporary waste rock dumps, dust etc. The doses were then compared to relevant regulatory limits as described below.

The NNR specifies an individual dose limit from all controllable radiation sources to which an individual may be exposed, and this is an additional dose over and above the background dose a person is normally exposed to. For a member of the public this dose limit is set at 1 000 $\mu\text{Sv/a}$ (or 1 mSv/a). To ensure that the dose limit is not exceeded, a dose constraint (a value lower than the limit) is introduced on individual sources of radiation. For South Africa a dose constraint of 250 $\mu\text{Sv/a}$ (i.e. 0.25 mSv/a) is specified in the regulations, which also serves as a public dose limit for a single radiation source or operation (SciRAD, 2019). The individual doses have been determined to be trivial (less than 10 $\mu\text{Sv/a}$) or insignificant (less than 1 $\mu\text{Sv/a}$) for the project. The maximum total incremental dose, with the uncertainty considered, is not expected to exceed 11 $\mu\text{Sv/a}$ (that is $7 \pm 4 \mu\text{Sv/a}$). These doses are therefore well below the dose constraint of 250 $\mu\text{Sv/a}$.

Radon doses are normally not added to the total dose as the NNR Act Regulations do not particularly address Radon exposure to members of the public. However, the calculated Radon concentration is compared to the latest International Commission on Radiation Protection (ICRP) recommendation of 300 Bq/m³ (ICRP, 2010). This criterion requires action to be taken when the level is exceeded. According to SciRAD, the Radon

concentrations at public areas are likely to be well below the action level of 300 Bq/m³ with values determined to be less than 0.2 Bq/m³ for the project.

According to SciRAD, based on the radionuclide activity concentrations for all the rock and soil samples falling well below the regulatory limit of 500 Bq/kg (or 0.5 Bq/g), and the calculated doses falling well below all relevant regulatory limits or levels where health impacts could occur, the proposed project does not warrant any concern regarding the radiological impacts to the public and no mitigation measures are deemed necessary. The severity is therefore rated as low.

Duration

Any health-related impacts can extend beyond closure; therefore, the duration is high.

Spatial scale

The potential impact zone is close to the source but potentially extending off site.

Probability

The probability of any health-related impacts occurring is low.

Significance

The impact significance is low.

Summary of the rated radiation impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Operation, decommissioning and closure						
Unmitigated	L	H	M	M	L	L

As indicated above, the proposed project does not warrant any concern regarding the radiological impacts to the public and no mitigation measures are deemed necessary.

ISSUE 12 INCREASE IN AMBIENT NOISE LEVELS

Information in this section was sourced from the noise impact assessment undertaken by Airshed Planning Professionals (Airshed, 2019B) (refer to Appendix L).

Introduction

Two types of noise are distinguished: noise disturbance and noise nuisance. The former is noise that can be registered as a discernible reading on a sound level meter and the latter, although it may not register as a discernible reading on a sound level meter, may cause nuisance because of its tonal character (egg. distant humming noises).

Mine activities have the potential to generate both noise disturbances and noise nuisance in all phases, prior to closure. Refer to the biodiversity section in this appendix for the potential noise impacts on biodiversity. This section will only focus on the potential human related noise impacts.

Mine phase and link to project specific activities/infrastructure

Construction	Operational	Decommissioning	Closure
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Construction	Operational	Decommissioning	Closure
Site preparation Earthworks Civil works	Underground mining Opencast mining Transport system Power supply and use Water supply and use Mineralised waste Non-mineralised waste Support services Rehabilitation	Underground mining Opencast mining Transport system Power supply and use Water supply and use Mineralised waste Non-mineralised waste Support services Demolition Rehabilitation	N/A -

Rating of impact

Severity / nature

Noise pollution can create nuisance that will have different impacts on different receptors because some are very sensitive to noise and others are not. The closest potential receptors are located in various surrounding communities as described in Section 6.4.1.10 and shown in Figure 6-14. Baseline noise levels are generally typical for suburban and urban districts, although one noise measurement location experienced higher noise levels due to heavy traffic on the R41 road.

The predicted change in ambient noise levels was modelled using CadnaA software and the set of isopleth figures are provided in the noise report (refer to Appendix L). Table D 3 indicates the predicted increase in noise levels at potential receptors. The noise modelling predicted that an increase of between 5 dB and 15 dB extends over potential receptors situated close to the 11 Shaft Main Reef Pit, Rugby Club Main Reef Pit, Mona Lisa Bird Reef Pit, Roodepoort Main Reef Pit and at the Vent Shafts. A more detailed table is provided in the noise report (refer to Appendix L) and provides the increase in noise levels outside of potential receptor areas as well.

The community reaction due to day-time noise levels from the project operations are expected to result in varying reactions and complaints based on distance from the project activities. The expected community reaction according to the South African National Standard (SANS) 1013 is also provided in is provided in Table D 3. Airshed has noted that the expected community reaction will overlap as not all individuals are equally sensitive to noise. An increase in noise of 10 dB is subjectively perceived as a doubling in the loudness of the noise according to Airshed (Airshed, 2019b).

The severity of the noise impacts was based on the Gauteng Noise Control Regulation level of 60 dBA at potential receptors for continuous day/night time noise levels, as advised by the noise specialists. For the open pit mining operations the severity is rated as medium, except for the Kimberly Reef East Pit where levels remain below 60 dBA and therefore the severity of the noise impact from this pit is rated as low. For underground mining operations, the severity rating is low. With mitigation focussed on controlling noise at source and establishing noise barriers, the severity can be reduced for all operations.

Duration

In both the unmitigated and mitigated scenarios, for the open mining operations, the noise pollution impacts will generally occur for the life of the specific pit which is a low duration. Some pits will be mined out in as little as three months. For the underground mining, in both the unmitigated and mitigated scenarios, the noise pollution impacts will generally occur until the closure phase of the mine when the noise generating activities are stopped. The ventilation shafts will be operated for 20 years to support underground mining. This is a medium duration.

Spatial scale / extent

The noise impacts are predicted to extend beyond the project area to potential receptors. This is a medium spatial scale for the open pit mining operations. With mitigation measures, the spatial scale should be reduced to low.

TABLE D 3: INCREASE IN NOISE LEVELS AT POTENTIAL RECEPTORS DUE TO MINING OPERATIONS AND EXPECTED COMMUNITY REACTION (SUMMARISED FROM AIRSHED, 2019B)

Mining area	Distance to closest potential receptor	Increase in noise level above the baseline (for the duration of the relevant operation)			
		0 - 10 dB	5 dB - 15 dB	10 dB - 20 dB	> 15 dB
		Expected community reaction according to SANS 10103			
		Little reaction with sporadic complaints	Medium reaction with widespread complaints	Strong reaction with threats of community action	Very strong reaction with vigorous community action
Day/night time					
Kimberly Reef East Pit	~590m	Up to ~80m	From ~30m to ~250m	Up to ~80m	Up to ~30m
11 Shaft Main Reef Pit	~100m	Up to ~60m	Up to ~180m	Up to ~60m	0 m
Rugby Club Main Reef Pit	~120m	Up to ~180m	From ~100m to ~350m	From ~40m to ~180m	Up to ~100m
Mona Lisa Bird Reef Pit	~60m	Up to ~200m	From ~60m to ~450m	From ~20m to ~200m	Up to ~60m
Roodepoort Main Reef Pit	~20m	Up to ~210m	From ~110m to ~400m	From ~50m to ~210m	Up to ~110m
Vent Shafts	~550m	Up to ~440m	From ~260m to ~700m	From ~120m to ~440m	Up to ~260m

Values have been **bolded** where potential noise sensitive receptors within the study area are affected.

Probability

The probability of the predicted noise increases causing a noise related disturbance at the potential receptors surrounding the open pit mining operations is medium. The probability associated with the vent shafts is considered to be low due to the absence of receptors within the predicted impact zone. With mitigation the probability can be reduced to low.

Significance

The unmitigated significance is medium for the open pit mining operations and low for the ventilation shafts. This can be reduced / maintained at low with mitigation.

Summary of the rated increase in disturbing noise levels due to open pit mining per phase of the mine

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation and decommissioning						
Unmitigated	M	L	M	M	M	M
Mitigated	L	L	L	L	L	L

Summary of the rated increase in disturbing noise levels due to underground mining per phase of the mine

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation and decommissioning						
Unmitigated	L	M	L	L	L	L
Mitigated	L	L	L	L	L	L

Management objective

To prevent public exposure to disturbing noise.

Management actions

Management actions that have been identified in all phases prior to closure are outlined below:

Engineering and operational practices

- All diesel-powered equipment and plant vehicles will be properly maintained so as not to produce unnecessary noise. This will particularly include the regular inspection and, if necessary, replacement of intake and exhaust silencers.
- Any change in the noise emission characteristics of equipment will serve as trigger for withdrawing it for maintenance.
- When new equipment is required, equipment with specifications with lower sound power levels must be selected. Vendors will be required to guarantee optimised equipment design noise levels.
- Ventilation shaft outlet face away from any residential area.
- Noise will be managed when using equipment as follows:
 - Machines used intermittently will be shut down between work periods or throttled down to a minimum and not left running unnecessarily. This will reduce noise and conserve energy.
 - Plants or equipment from which noise generated is known to be particularly directional (i.e. the vent shaft), will be orientated so that the noise is directed away from potential receptors where feasible;
 - Construction materials such as beams will be lowered and not dropped.
- In managing noise specifically related to truck and vehicle traffic, efforts will be directed at:
 - Minimising individual vehicle engine, transmission, and body noise/vibration. This is achieved through the implementation of an equipment maintenance program.

- Maintaining road surfaces regularly to avoid corrugations, potholes etc.
- Avoiding unnecessary idling times.
- Use of alternatives to the traditional reverse ‘beeper’ alarm such as a ‘self-adjusting’ or ‘smart’ alarm. Such alarms include a mechanism to detect the local noise level and automatically adjust the output of the alarm so that it is 5 to 10 dB above the noise level near the moving equipment.
- Limiting traffic to between 06:00 and 18:00.
- Where possible, other non-routine noisy activities such as construction, decommissioning, start-up and maintenance, will be limited to day-time hours.

Enclosure of noise sources

- Sources of significant noise will be enclosed where feasible. The extent of enclosure will depend on the nature of the machine and their ventilation requirements.

Noise barriers

- Earth berms can be built to provide screening for large scale earth moving operations a. Care should be taken when constructing earth berms since it may become a significant source of dust.
- The waste rock dumps would be developed in such a manner as to limit noise from the dumping of waste rock on top of the berm.

Speed control

- Limit vehicle speeds on mine access and internal roads to limit noise.

Noise complaints register

- The mine will provide an effective method of communication whereby community members can lodge any noise complaints. This may take the form of a help line.
- The mine will keep a noise complaints register and respond immediately to complaints about disturbing noise. All such complaints will be documented and recorded as incidents. The measures taken to address these complaints will be included in the documentation. This may include ad hoc noise monitoring at the location of the complainant. Where necessary additional management actions will be implemented to avoid repeat occurrences. These records will be kept for the life of mine.

Communication with potential receptor

- Surrounding noise receptors will be informed about the sound generated by proposed project operations on a factual basis through a stakeholder engagement process to be implemented for the mine.

Emergency situations

None identified.

ISSUE 13 CHANGE IN LANDSCAPE AND RELATED VISUAL IMPACTS

Information in this section was sourced from visual assessment undertaken by Scientific Terrestrial Services (STS, 2019B) (refer to Appendix N).

Introduction

Visual impacts on this receiving environment may be caused by activities and infrastructure in all mine phases. The more significant visual impacts relate to the larger infrastructure components (such as the shafts, opencast pits and mineralised waste). The opencast pits will be fully backfilled and all surface infrastructure will be removed upon closure, therefore there should be no visual impacts after post closure.

Mine phase and link to project specific activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks Civil works	Underground mining Opencast mining Transport system Power supply and use Water supply and use Mineralised waste Non-mineralised waste Support services Rehabilitation	Underground mining Opencast mining Transport system Power supply and use Water supply and use Mineralised waste Non-mineralised waste Support services Demolition Rehabilitation	Maintenance and aftercare of rehabilitated areas

Rating of impactSeverity / nature

The severity of visual impacts is determined by assessing the change to the visual landscape as a result of mine related infrastructure and activities. As indicated in the baseline section, the project area has already been impacted upon by historic and current mining and agricultural activities, as well as urban development. Sensitive visual receptors have been determined to primarily consist residential areas, motorists on the roads within and around the MRA, scholars at schools in the residential areas, users of outdoor recreational facilities such as the Durban Deep Golf Course, parks, sportsgrounds, Orlando Soccer Stadium, and people at their place of work in the industrial and commercial areas.

In the unmitigated scenario, the proposed project may impact on the existing landscape character and sense of place associated with the project area and its immediate surroundings as described below (STS, 2019B):

- Roodepoort Main Reef Pit and Rugby Club Main Reef Pit: Current mining activities take place in the greater area; however, the opencast pits are situated directly north of the main road (Randfontein Road) and directly south of businesses and houses. The landscape character and sense of place for road users, people at their place of work and residents, although already influenced by existing land uses, would be altered further;
- Mona Lisa Bird Reef Pit: The area currently provides a source of relative calmness and tranquillity, irrespective of the mining activities taking place to the northwest of the pit area, since it comprises grassland with limited anthropogenic structures in the footprint area. The proposed mining activities in this area will therefore have a negative visual impact on the landscape character and sense of place, especially for people residing in Solplaatje situated south of the pit.
- 11 Shaft Main Reef Pit, Kimberley Reef East Pit and Kimberley Reef Infrastructure Complex: The landscape character and sense of place associated with these areas have already been negatively impacted by the surrounding historic and ongoing mining activities, thus the negative visual impact of the proposed mining activities in these areas is low to negligible.
- Bird Reef Central Infrastructure Complex: The historic shaft lies within this area, which will be refurbished, therefore the visual impact on the landscape character and sense of place is already present and receptors in the area are accustomed to the presence of the shaft.

Direct visual exposure and intrusion will take place as a result of the loss of vegetation and excavation activities at the opencast pits and infrastructure complexes being visible to residents, people at their place of work and motorists traveling on the roads in the immediate vicinity thereof. Indirect visual exposure includes fugitive dust and lighting (at the infrastructure complexes only) which will alter the visual environment.

The visual intrusion impacts are described below (STS, 2019B):

- Roodepoort Main Reef Pit, Rugby Club Main Reef Pit and Mona Lisa Bird Reef Pit: The altered visual environment will lead to undesirable levels of visual intrusion, with moderate levels of incompatibility with surrounding land uses as well as visual contrast and discord between the opencast pit areas and their surroundings;
- 11 Shaft Main Reef Pit, Kimberley Reef East Pit and Kimberley Reef Infrastructure Complex: Given that these areas have a high visual adsorption capacity due to vegetation and remnant mine dumps screening these areas, the visual impact of the proposed mining activities have a low to negligible visual intrusion on surrounding receptors; and
- Bird Reef Central Infrastructure Complex: The visual impacts are considered to be moderately intrusive to the receiving environment, especially to people playing golf at the Durban Deep Golf Course northeast of the proposed infrastructure area. The surrounding environment has a moderate visual adsorption capacity due to the dense vegetation, therefore the proposed mining infrastructure will not be significantly visually intrusive to the surrounding environment.

Lighting associated with the proposed project may be visible during both day and night, but lighting is obviously more likely to have a visual impact during the night time. No lighting will be used for the open pit mining operations as no activities will take place at night in these areas. The areas surrounding the proposed operations are already heavily impacted by night-time lighting, therefore the addition of lighting at the proposed infrastructure areas will not be significant.

Taking the above discussions into consideration, the severity has been rated as high depending on the operations activities relative to the baseline environment and surrounding receptors. With mitigation, the severity prior to closure could reduce to medium. After decommissioning the severity would reduce to low with the removal of surface infrastructure, complete backfill of the opencast pits and general site rehabilitation.

Duration

In the unmitigated scenario the duration is high because the impacts could extend beyond closure. With mitigation, the duration of impacts would be medium reducing to low at closure.

Spatial scale / extent

In all phases visual impacts are likely to extend beyond the proposed project area. This is a medium spatial scale.

Probability

In the unmitigated scenario the probability of visual impacts occurring as a result of the proposed project is definite. In the mitigated scenario the probability would reduce to medium prior to closure and low at closure.

Significance

The unmitigated significance is high and reduces to medium with mitigation prior to closure. The mitigated significance reduces to low at closure.

Summary of the rated negative visual views impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All Phases						
Unmitigated	H	H	M	H	H	H
Construction, operation and decommissioning						
Mitigated	M	M	M	M	M	M
Closure						
Mitigated	L	L	M	L	L	L

Management objectives

To minimise any further visual impacts on receptors.

Management measures

Mitigation measures to be implemented during all project phases include the following:

- The areas of disturbance will be limited to what is absolutely necessary as defined for infrastructure in this EIA;
- As little vegetation as possible will be removed to act as visual screens from surrounding receptor sites, and wherever possible, all existing natural vegetation will be retained and incorporated into the project site rehabilitation. In particular natural vegetation will be retained in the vicinity of the Bird Reef Central Infrastructure Complex due to the presence of sensitive receptors;
- As far as possible, natural contours will be followed during infrastructure placement;
- The height of structures will be as low as possible, where this can be achieved without increasing the infrastructure footprint;
- Consideration will be given to placing stockpiles where they could screen mining activities from the potential viewers;
- Visually cluttered material storage yards and laydown areas will be screened with the use of material fencing;
- Natural colours will be used and the use of highly reflective material should be avoided. Any metal surfaces will be painted to fit in with the natural environment in a colour that blends in effectively with the background. The identification of appropriate colours and textures for facility materials will take into account both summer and winter appearance;
- The use of permanent signs and project construction signs will be minimised;
- Construction activities will be restricted to daylight hours as far as possible, in order to limit the need to bright floodlighting and the potential for skyglow;
- Open pit mining activities will take place during the daylight hours, in order to limit the use of bright floodlighting at night;
- Outdoor lighting will be strictly controlled:
 - All lights used for illumination (except for lighting associated with security) will be faced inwards and shielded to avoid light escaping above the horizon;
 - The use of high light masts and high pole top security lighting will be avoided along the periphery of the operations. Any high lighting masts will be covered to reduce sky glow;
 - Up-lighting of structures will be avoided, with lighting installed at downward angles that provide precisely directed illumination beyond the immediate surrounding of the mining infrastructure, thereby minimising the light spill and trespass;

- Care will be taken when selecting luminaries to ensure that appropriate units are chosen and that their location will reduce spill light and glare to a minimum. Only “full cut-off” light fixtures that direct light only below the horizontal will be used on the buildings;
- Censored and motion lighting will be installed at office areas, workshops and other buildings to prevent use of lights when not needed;
- Minimum wattage light fixtures will be used, with the minimum intensity necessary to accomplish the light's purpose;
- Vehicle-mounted lights or portable light towers are preferred over permanently mounted lighting for night-time maintenance activities. If possible, such lighting will be equipped with hoods or louvers and be aimed toward the ground to avoid causing glare and skyglow;
- The use of low-pressure sodium lamps, yellow LED lighting, or an equivalent will reduce skyglow and wildlife impacts.
- Erosion, which may lead to high levels of visual contrast and further detract from the visual environment, will be managed with the use of soil stabilisation measures and concurrent rehabilitation;
- Topsoil stockpiles will be properly managed in terms of slope angles and will be vegetated to minimise visual contrast and prevent soil losses;
- Dust will be managed to minimise visual impacts;
- Rubble will be removed from site on a regular basis;
- Litter and dust management measures will be implemented;
- The opencast will be backfilled, surface infrastructure removed and the overall project area rehabilitated as per the decommissioning and rehabilitation plan described in section 3.2.16.

Emergency situations

None identified.

B) IMPACT ON SOCIO-ECONOMIC ENVIRONMENT

ISSUE 14 ECONOMIC IMPACT (POSITIVE AND NEGATIVE)

Information provided in this section was sourced from the socio-economic assessment (Mercury, 2019) (refer to Appendix Q).

The development of a mine of this nature has the potential to impact on the economy both positively through potential growth in the mining sector and negatively through the potential loss of existing economic activities. This section focuses on the potential positive and negative economic impacts associated with the project and assesses these collectively.

Mine phase and link to project specific activities/infrastructure

Construction	Operational	Decommissioning	Closure
			N/A
Overall development of the mine	Operation of the mine Rehabilitation of the open pit areas	Overall decommissioning of the mine and rehabilitation	-

Rating of impact

Severity / nature

There is predicted to be a positive economic impact on the local, regional and national economies in both the construction and operational phases. Direct benefits would be derived from wages, taxes and profits. Indirect benefits would be derived through the procurement of goods and services, and the increased spending power of employees.

Positive economic impacts would include (Mercury, 2019):

- Direct employment: The opencast mining operations would require approximately 40 to 50 employees. During the construction phase for the underground mining operations it is expected that a contractor would require up to a maximum of 50 staff. The operational phase would require approximately 1 105 full-time employees (at peak production). The total value of the employment potential for the first 10 years life of mine, which includes the two years of construction work associated with the refurbishment of the underground operations, equates to R772.3 million in present value. This value could potentially increase to R1.48 billion in present value should the underground operational employment opportunities be maintained for the anticipated life of mine. In addition, the proposed mining development could stimulate current industries, manufacturing and distribution facilities, which could create additional employment opportunities. At closure, employment opportunities would be limited. With mitigation, the mine could create opportunities beyond the life of its operations.
- Direct contribution to the economy: The economic contribution as a result of the proposed mining development will have a positive impact through money spent to pay for salaries, supplies, raw materials, operating expenses and taxes, on the local, regional and national economy. The short-term nature of the open pit project will have less significant impacts on direct economic impacts than the potential long-term mining project, which may have a duration of 25 years. In this regard the project will provide a capital injection over the first 10 years of R613 million in present value and a potential revenue generation of R3.3 billion in present value for the life of mine. The revenue potential for the first 10 years is R2.5 billion in present value.
Without mitigation, the local and regional economy may not fully benefit from the proposed project. With mitigation through local economic development plans, it will be possible to enhance the contribution the mine will have on a local and regional economic scale, and some initiatives will be able to be sustained post closure.
- Indirect and induced benefits to the economy: Current industries, manufacturing and distribution facilities surrounding the proposed mining rights area is not expected to be influenced by the establishment of an active mining operation in the area. Instead, depending on the nature of the services and products provided, the proposed mining development could potentially stimulate the growth of these businesses. The proposed project will furthermore potentially create additional revenue and employment opportunities.

Induced effects are the results of increased personal income as a result of the proposed project, including indirect effects. Businesses experiencing increased revenue from the direct and indirect effects will subsequently increase payroll expenditures (by hiring more employees, increasing payroll hours, raising salaries, etc.). Households will in turn, increase spending at local businesses. The induced effect is therefore a measure of this increase in household-to-business activity.

In the unmitigated scenario, some of these positive impacts may not take place or may happen to a lesser extent. In the mitigated scenario the economic impacts could reach the maximum potential.

- Contribution towards socio-economic development: The proposed project will contribute towards the local economic development in the area through the company's corporate social investments and Social and Labour Plan projects and initiatives. This includes the following positive socio-economic benefits to its employees and surrounding communities:
 - Development of skills through the company's skills development plan;
 - Learnership programs to provide learners with an occupational qualification; and
 - Investment in infrastructure development through local economic development and integrated development programmes.

Although illegal mining does generate a certain degree of income for individuals involved in the illegal activities and the downstream value chain, the health, safety and environmental risks associated with this type of mining also contribute negatively to the local economy. The proposed development will assist towards the eradication of illegal mining in the area. Mined and rehabilitated land holds opportunity for spatial integration by improving fragmentation and unlocking development potential in large areas, which should contribute more positively to the economy (Mercury, 2019).

In the unmitigated scenario it is possible that land surrounding the project will experience some degree of additional negative social and environmental impacts, which could impact on current businesses and land values. The proposed open cast activities however span a relatively short life (months) and will involve the rehabilitation of areas mined by West Wits. With mitigation, this will have a positive impact on land value. Degraded land will be restored and illegal mining activities in the immediate area should come to a halt.

Underground mining activities may influence the desirability of planned housing developments, which could potentially affect the value of these properties. Impacts such as vibration, air, noise, traffic and water quality arising from the proposed mining activities could have a negative impact on housing developments and property values. In the scenario where the project successfully implements the stipulated environmental and social management measures, these impacts can be managed to acceptable levels which should not reduce surrounding land value. The area will however be rehabilitated in the decommissioning and closure phase in the mitigated scenario, which will enable alternative land uses to continue.

When considering alternative feasible land uses for the project site, housing and mix-use housing and commercial development are regarded as the only feasible alternative. These are however already approved and/or in progress. The fact that mineral resources are still present may make it difficult to obtain permission to establish the housing development in the area as it could result in sterilisation of these minerals. Where property developers are required to first remove mineral reserves and rehabilitate this will come at a cost to the developer and will require the necessary authorisations from the DMR. Where the project aligns its timeline to support post-closure development within an agreed timeline with the developer, the economic benefits of both the mining and alternative land use can be realised. The open cast activities will have a minimal impact on the programme of these projects. Should the proposed mining development not proceed, the potential opportunity to develop and grow existing industries, manufacturing and distribution facilities surrounding the proposed mining rights area may not take place (Mercury, 2019). Potential impacts on land uses and land values are assessed under Issue 23.

When considering the above, the overall severity is rated positive low in the unmitigated scenario. With mitigation, it is possible to enhance the positive economic contribution of the mine on a local and regional economic scale as well as support the post-closure land use objectives as agreed with relevant landowners.

Duration

In the normal course, the direct positive and negative economic impacts associated with the proposed mine will occur for the life of mine. Post closure, in the unmitigated scenario, the scale of the impacts will be reduced. However, the proposed mine would have contributed to income creation, and a better skilled workforce is expected to continue beyond the life of mine in the mitigated scenario.

Spatial scale / extent

In both the unmitigated scenario, the spatial scale of the impact is medium. With mitigation the benefits of the project can extend beyond the proposed project area on a regional and national scale.

Probability

The probability of local and regional economies and communities benefiting from the mine is medium. With mitigation the probability of enhancing positive economic impacts is definite.

Significance

In the unmitigated scenario, the significance of this potential impact is medium. In the mitigated scenario, the significance is further increased.

Unmitigated – summary of the rated economic impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	L+	M	M	L+	M	M+
Mitigated	H+	H	H	H+	H	H+

Management objectives

To enhance the positive economic impacts of the project and support post-closure land development.

Management measures

The following management measures will be implemented:

- Develop recruitment and procurement policies and procedures that:
 - prioritise local employment, with a focus on semi-skilled and skilled positions being made available to local people as far as possible;
 - source contractors and service providers from within the local community, where possible;
 - provide training and skills development to the youth, prospective employees and local businesses;
 - establish a procurement mentorship programme for local and black owned businesses including youth and women owned businesses.
- Facilitate local involvement in indirect business and service opportunities.
- Implement the Social and Labour Plan and relevant initiatives in line with legislation requirements.
- Develop and implement local corporate social investment strategies in consultation with the relevant authorities.
- Develop and implement a policy and plan for influx management that allows for collaboration with government authorities and landowners.
- Develop and implement a formal bursary and skills development programme in the closest communities to increase the number of local skilled people and thereby increase the potential local employee base.

- Identify and develop sustainable business opportunities and skills, independent from the project for members of the local communities to ensure continued economic prosperity beyond the life of the project.
- Develop and rehabilitate the open pit operations in line with the rehabilitation and closure plan and in consultation with relevant landowners.
- In consultation with landowners, ensure rehabilitation is such that the post-closure land use can be achieved.

Emergency situations:

None identified.

ISSUE 15 LOSS AND STERILISATION OF MINERAL RESOURCES

Introduction

Mineral resources can be sterilised and/or lost through the placement of infrastructure and activities in close proximity to mineral resources, by preventing access to potential mining areas, and through the disposal of mineral resources onto mineralised waste facilities (temporary waste rock dumps).

Mine phase and link to project specific activities/infrastructure

Construction	Operational	Decommissioning	Closure
N/A		N/A	N/A
-	Underground mining Opencast mining Mineralised waste	-	-

Discussion

No geological impacts such as sterilization of mineral resources are expected as the proposed project is being planned in a manner that allows for the maximum extraction of the targeted commodities within the project area. This impact is therefore considered to be insignificant and has not been assessed further. As part of normal operations West Wits will prevent mineral sterilization through:

- Incorporating cross discipline planning structures for all mining and infrastructure to avoid mineral sterilization. The mine resource manager will play a key role;
- Mine workings will be developed and designed so as not to limit the potential to exploit deeper or adjacent minerals deposits.

ISSUE 16 INWARD MIGRATION AND SOCIAL ILLS

Information provided in this section was sourced from the socio-economic assessment (Mercury, 2019) (refer to Appendix Q).

Introduction

Mining projects tend to bring with them an expectation of employment in all project phases prior to closure. This expectation can lead to the influx of job seekers to an area which in turn increases pressure on existing communities, housing, basic service delivery and raises concerns around safety and security. This section focuses on the potential for the inward migration and associated social issues.

Mine phase and link to project specific activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks Civil works	Underground mining Opencast mining Transport system Power supply and use Water supply and use Mineralised waste Non-mineralised waste Support services Rehabilitation	Underground mining Opencast mining Transport system Power supply and use Water supply and use Mineralised waste Non-mineralised waste Support services Demolition Rehabilitation	Maintenance and aftercare of rehabilitated areas

Rating of impactSeverity / nature

The effects of inward migration can be significant. These effects could include, but not be limited to:

- Potential establishment or expansion of informal settlements;
- Increased pressure on housing, water supply infrastructure, sanitation and waste management systems and infrastructure, health care and community services and infrastructure;
- Potential for increased pressure on natural resources such as water, fauna, flora and soils;
- Increase in trespassing and crime;
- Spread of disease, most notably HIV/Aids and tuberculosis.

It is not possible to predict how significant the inward migration may be; however, this impact severity has been rated as high using the precautionary approach. It may be possible to mitigate this impact by managing expectations with regard to employment.

Duration

Negative social issues associated with inward migration can continue beyond the closure of the mine, particularly in the unmitigated scenario.

Spatial scale / extent

In both the unmitigated and mitigated scenarios, the impacts of inward migration could extend beyond the proposed project area and into surrounding communities.

Probability

In the unmitigated scenario the impact is considered to be possible. With mitigation, the probability can be reduced to low.

Significance

In the unmitigated scenario, the significance of this potential impact is high. With mitigation this may reduce to low.

Summary of the rated inward migration impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation, decommissioning						
Unmitigated	H	H	M	H	M	H
Mitigated	L	L	M	L	L	L

Management objectives

To minimise negative socio-economic impacts associated with the mine.

Management measures

Key mitigation aspects include the implementation of good recruitment, procurement and training procedures during all mine phases as follows:

- Good communication with all job and procurement opportunity seekers will be maintained throughout the recruitment process. The process must be seen and understood to be fair and impartial by all involved. The personnel in charge of resolving recruitment and procurement concerns must be clearly identified and accessible to potential applicants;
- The precise number of new job opportunities (permanent and temporary) and procurement opportunities will be made public together with the required skills and qualifications. The duration of temporary work will be clearly indicated and the relevant employees/contractors provided with regular reminders and revisions throughout the temporary period;
- People will be hired from the closest communities as far as is practically possible;
- A vendor database will be developed and maintained including an assessment of business aptitude and skill;
- Procurement opportunities will be identified that can be ring-fenced for local businesses;
- Goods and services will be procured from the closest communities as far as is practically possible;
- A formal bursary and skills development programme will be developed and implemented in the closest communities to increase the number of local skilled people and thereby increase the potential local employee base;
- There will be no recruitment or procurement at the gates of the mine. All recruitment will take place off site at designated locations. All procurement will be through existing, established procurement and tendering processes that will include mechanisms for empowering service providers from the closest communities.

In addition to the above aspects, the following management measures will be implemented:

- The mine will develop and implement an Influx and Land use Management Plan in collaboration with CoJ;
- A social monitoring and evaluation strategy will be developed and implemented to monitor, review and adapt social implementation strategies if and when required;
- A grievance mechanism will be developed and implemented and communicated to surrounding communities;
- The mine will work with neighbouring mines and industries, local authorities and law enforcement officials to monitor and prevent the development of informal settlements near the mine and to assist where possible with crime prevention within the proposed project area;
- Local communities will be permitted to gather natural resources from specific areas that is earmarked for vegetation clearance (such as firewood);
- A Code of Conduct will form part of induction of new workers with a clear statement and procedure regarding access, conduct and identification;
- Workers will be urged to recognize and report suspicious activity and signs of burglary and be informed of crime prevention measures that they themselves can take;
- The mine will liaise with existing community policing forums to properly secure the project area and surrounding area;

- A health policy on HIV/AIDS and tuberculosis will be implemented. This policy will promote education, awareness and disease management both in the workplace and in the home so that the initiatives of the workplace have a positive impact on the communities from which employees are recruited. Partnerships will be formed with local and provincial authorities to maximize the off-site benefits of the policy;
- The mine will develop and implement a community health and welfare strategy to ensure that community health and welfare issues are addressed in an integrated and coordinated manner with existing health and welfare facilities and infrastructure;
- The mine will work closely with the local and regional authorities and other mines and industries in the areas to be part of the problem-solving process that needs to address social service constraints;
- The mine will develop agreements with developers to schedule implementation of mining and availability of land for development;
- The EMP commitments with regard to managing pollution, traffic and noise will be implemented; and
- Regular stakeholder engagement will be conducted to report on EMP compliance performance and give stakeholders an opportunity to raise issues or concerns regarding the operations.

Emergency situations:

In case of development of informal settlements the emergency response procedure in Section 30.2.2 will be followed.

ISSUE 17 LOSS OF LIVELIHOOD FOR ILLEGAL MINERS

Introduction

The illegal miners currently operating within the project area and accessing the relevant ore bodies will lose their livelihood once the project activities commence.

Mine phase and link to project specific activities/infrastructure

Construction	Operational	Decommissioning	Closure
N/A			
-	Underground mining Opencast mining Transport system Power supply and use Water supply and use Mineralised waste Non-mineralised waste Support services Rehabilitation	Underground mining Opencast mining Transport system Power supply and use Water supply and use Mineralised waste Non-mineralised waste Support services Demolition Rehabilitation	Maintenance and aftercare of rehabilitated areas

Rating of impact

Severity / nature

The loss of livelihood will directly affect the illegal miners and the families they support. In addition, the illegal mining value chain will no longer benefit from the illegal mining activities.

It is not possible to predict how significant the loss of livelihood will be to the illegal miners and the associated value chain; however, this impact severity has been rated as high in line with the precautionary approach. It may be possible to mitigate this impact by collaborating with the DMR, City of Joburg and Civil Rights Organisations to find solutions.

Duration

Where solutions are possible, loss of livelihood would be temporary and for less than the life of the project.

Spatial scale / extent

In both the unmitigated and mitigated scenarios, the impact is likely to extend beyond the proposed project area and into surrounding communities.

Probability

In the unmitigated scenario the impact is definite. With mitigation, the probability can be reduced.

Significance

In the unmitigated scenario, the significance of this potential impact is high. With mitigation the significance reduces to medium.

Summary of the rated Loss of livelihood for illegal miners impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation, decommissioning						
Unmitigated	H	H	M	H	H	H
Mitigated	M	M	M	M	M	M

Management objectives

To mitigate the loss of livelihood by illegal miners and the associated value chain.

Management measures

The following management measures will be implemented:

- The mine will collaborate with the DMR, City of Joburg and Civil Rights Organisations to find solutions to the illegal miner dilemma.
- Where possible, and where candidates are suitable, the mine will consider further development and employment of the illegal miners.

ISSUE 18 SOCIAL BENEFITS ASSOCIATED WITH EMPLOYMENT AND ECONOMIC DEVELOPMENT

Information provided in this section was sourced from the socio-economic assessment (Mercury, 2019) (refer to Appendix Q).

Introduction

Employment and economic development has the potential to improve livelihoods of individuals living in the local area through increased disposable income for individuals and households and the flow of revenue into local services and support sectors.

Mine phase and link to project specific activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks Civil works	Underground mining Opencast mining Transport system Power supply and use	Underground and Opencast Transport system Power supply and use Water supply and use	Maintenance and aftercare of rehabilitated areas

Construction	Operational	Decommissioning	Closure
	Water supply and use Mineralised waste Non-mineralised waste Support services Rehabilitation	Mineralised waste Non-mineralised waste Support services Demolition Rehabilitation	

Rating of impact

Severity/nature

Unemployment is a key issue for the area. There are a high number of job seekers and discouraged workers, in part due to due to general economic downturn in South Africa. New employment opportunities are likely to be of direct economic benefit at the local and regional level. Contractors may make use of existing staff during construction, which could limit the real number of new skilled, semi-skilled and unskilled opportunities. Despite this, there is likely to be an increase in employment locally, as the high number of opportunities during the underground mining operations (1100 at peak production) is likely to have a notable impact on the employment sector.

The direct impact of employment opportunities and indirect local economic improvement as well as local economic investment and development could contribute towards improving the quality of life for local communities. This may include increased disposable income for individuals and households. A potential positive local social impact could occur in the construction and operational phases.

The investment of capital into a new mining project and the operation of the mine, would likely have a trickle-down effect in terms of supporting local industries and the flow of revenue into local services and sectors. This in turn supports the development of the local economy through enabling businesses to grow or maintain their economic contribution. Where economic benefits are spread out over municipal or regional economies, the economic impact on local communities would likely be diluted.

The degree to which this impact would benefit local people and communities depends on a number of factors. This includes, the number of new opportunities realised locally (i.e. not through existing contractors who have staff or people brought in from outside the local area), and the manner in which income is used to benefit households and individuals (that is, spending on positive aspects such as education and food versus on negative social behaviour such as drug and alcohol abuse). The latter aspects are outside of the control of this project, but the former can be improved through specific internal policy development and implementation.

Social benefits during the open pit mining operations would be temporary and would likely be diluted due to the very large local urban population. Greater benefits, however, could be secured where local labour and procurement are prioritised. The promotion of employment in South Africa is always supported and is seen as a direct positive benefit of the project. Permanent employment of local people would help in improving the livelihoods of individuals living in the local area.

Duration

Positive social benefits would be for the life of the project, particularly in the unmitigated scenario. With mitigation these benefits could extend beyond closure.

Spatial scale / extent

In both the unmitigated and mitigated scenarios, social benefits would extend beyond the proposed project area and into surrounding communities.

Probability

In the unmitigated scenario the impact is considered to be possible. With mitigation, the probability can be increased to definite.

Significance

In the unmitigated scenario, the significance of this potential impact is medium positive. With mitigation this increases to high positive.

Summary of road disturbance and traffic safety impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation and decommissioning						
Unmitigated	L+	M	M	L+	M	M+
Mitigated	M+	H	M	H+	H	H+

Management objectives

To enhance social benefits.

Management measures

Apply the management measures outlined under Issue 16 above.

ISSUE 19 ROAD DISTURBANCE AND TRAFFIC SAFETY

Information provided in this section was sourced from the traffic impact assessment (Siyazi, 2019) (refer to Appendix O).

Introduction

Traffic impacts are expected from construction through to the end of the decommissioning phases when trucks, buses, and private vehicles make use of the private and public transport network in and adjacent to the proposed project area. The key potential traffic related impacts are on road capacity and public safety.

Mine phase and link to project specific activities/infrastructure

Construction	Operational	Decommissioning	Closure
			N/A
Transport system	Transport system	Transport system	-

Rating of impact

Severity / nature

The R41 is a provincial road and is already heavily congested during peak traffic times. The proposed project will generate additional volumes of traffic along the R41 and various smaller roads which intersect the R41 as a result of the transportation of ore, people and materials. The calculated trips to be generated by the project, which includes worker transport, transport of ore off-site for processing using heavy vehicles and the delivery of consumables using heavy vehicles, is provided in Section 3.2.13.

Due to the current congestion on the R41, Siyazi has indicated that upgrades are required at intersections D to K (refer to Figure 6-15) to increase the capacity and improve road safety for pedestrians and road users by

the relevant roads department, prior to the development of the proposed project. Once these upgrades are completed, the proposed project and the anticipated traffic should not impact significantly on the road network or require further upgrades.

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

- Pedestrian accidents
- Vehicle accidents.

In the unmitigated scenario the severity is high. In the mitigated scenario the severity reduces to medium because the frequency of potential accidents is expected to reduce.

Duration

Any serious injury or death is a long-term impact in both the unmitigated and mitigated scenarios.

Spatial scale / extent

Possible accident sites could be located within or outside the proposed project area given that both private and public roads are and will continue to be used for the transport of ore, materials and personnel. Any indirect impacts associated with any injuries or fatalities will extend to the communities to which the injured people/animals belong. This is a medium spatial scale both with and without mitigation.

Probability

In the unmitigated scenario, the probability of accidents occurring as a result of the proposed project is medium because although there is a possibility that traffic accidents could occur these are not expected to occur on a continuous basis or in the normal course of operations. With mitigation this reduces to low.

Significance

Without mitigation, the significance is high. With mitigation, this reduces to medium.

Summary of road disturbance and traffic safety impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation and decommissioning						
Unmitigated	H	H	M	H	M	H
Mitigated	M	H	M	H	L	M

Management objectives

To minimise the risk of increased traffic on public roads due to the proposed project.

Management measures

Due to the current congestion on the R41, Siyazi has indicated that upgrades are required by the relevant roads department at intersections D to K (refer to Figure 6-15) to increase the capacity, prior to the development of the proposed project. Siyazi has also noted that the following upgrades are required by the relevant roads department to ensure road safety, prior to the development of the proposed project (Siyazi, 2019):

- Pedestrian walkways and crossings should be provided at all intersections where not currently provided to ensure a split between vehicle traffic and pedestrians moving around the intersections; and
- Road markings, reflective road studs (LED), road signs and overhead lights should be provided and maintained at all the relevant intersections to ensure visibility during night time, proper visibility of intersection lane geometry and sufficient information to road users.

Once these upgrades are completed, the proposed project and the anticipated traffic should not require any further upgrades from a road capacity or safety perspective.

The following management measures will be implemented by the mine:

- Further investigations and collaboration with the relevant road authority will be conducted to finalise the access routes during the detailed design phase for the project;
- The Mona Lisa Pit new access road will be designed and constructed with the required approvals;
- The Roodepoort Pit access intersection on Gustaf Street will be designed and constructed according to the specialist recommendations (Siyazi, 2019) and with the required approvals. This will include dedicated turning lanes as shown in the specialist report;
- The mine will avoid peak traffic periods when transporting ore in heavy vehicles off-site for mineral processing;
- A transport safety programme will be implemented to achieve the mitigation objectives during the construction, operational and decommissioning phases. Key components of the programme include:
 - Education and awareness training;
 - Speed limit enforcement;
 - Maintenance of the transport system where appropriate; and
 - Use of dedicated loading and off-loading areas on site.
- Detailed investigations will be conducted in conjunction with the relevant road authority in terms of the existing quality and potential life span of the existing road surface layers of the roads where consumables, ROM ore and workers will be transported; and
- A road maintenance plan will be prepared in conjunction with the relevant road authority on public roads where trucks will operate as soon as the project has been approved in order to ensure that the consumables, ROM ore and workers can be transported at all times.
- A road safety awareness campaign and traffic monitoring strategy will be developed and implemented.

Due to the close proximity of Westlake Road that intersects with Main Reef Road (Point J), the traffic specialist is recommending that Point I be closed off permanently in the long-term by the Department of Roads. In the short-term the mine will limit the use of Point I by mining related vehicle trips in the following manner:

- By only making left-turns from the west into Reid Road to the proposed mine site (Inbound vehicle trips);
- Inbound mine vehicle trips from the east will travel via Point J and Westlake Road; and
- Outbound mine vehicle trips should gain access to Main Reef Road at Point J.

The proposed Roodepoort Main Reef Pit Access is expected to experience delays for mine related vehicles exiting the proposed mine site during the morning peak traffic period. Due to the short duration of the proposed mining at this site, outbound mine related vehicle trips during the morning peak traffic period will be limited to left-out movements only.

Emergency situations

In case of a person or animal being injured by transport activities the emergency response procedure in Section 30.2.2 will be followed.

ISSUE 20 SAFETY RISKS TO THIRD PARTIES

Introduction

The development and operation of a mine includes a number of activities and facilities that could present safety risks to third parties. Safety risks as a result of project-related traffic are assessed under Issue 19 above.

Mine phase and link to project specific activities/infrastructure

Construction	Operational	Decommissioning	Closure
			N/A
Site preparation Earthworks Civil works	Underground mining Opencast mining Transport system Non-mineralised waste Rehabilitation	Underground mining Opencast mining Transport system Demolition Rehabilitation	-

Rating of impact

Severity / nature

There will be a change in nature of the site during mining, although the sites have already been disturbed by historical anthropogenic activities.

The introduction of large machinery and vehicles, open pit mining activities and the presence of workers could negatively affect public safety. Berms would be established at the open pits to prevent access to the mining area. Once mining is complete, the open pit would be completely backfilled and rehabilitated in line with the post closure land use for the respective pit.

At the infrastructure complexes, the introduction of construction activities, large machinery and vehicles, and the presence of construction workers could negatively affect public safety. The infrastructure complexes however would be fenced to prevent accidental or deliberate access to the site. The fencing would remain for the life of the project. Thereafter decommissioning and closure of the complexes would be done taking into account post closure safety requirements.

Also present in the area are illegal mining activities where existing underground shafts are accessed. This is often done in an unsafe manner. Blasting, used as a mining method by the illegal miners, currently presents the potential for damage to infrastructure and fuel/gas pipelines located in the area. Where open pits are planned, these holings will be removed and the area made safe resulting in a positive impact.

An influx of people to the site or area in search of employment opportunities could pose safety risks to local businesses, land users and residents if unrest occurs.

In the absence of mitigation, any potential injury to third parties, infrastructure or animals could be severe. With mitigation that prevents access to mining areas, takes into account the safety of third parties and removes existing risks due to illegal mining, the severity reduces to low. At closure, the risk associated with illegal mining activities would be removed. This is considered a positive impact.

Duration

In the context of this assessment, death or permanent injury to humans and animals is considered a long term, permanent impact, regardless of the project phase or the mitigation measures implemented.

Spatial scale / extent

For the most part, direct impacts (injury and/or death) will be limited to within the mining or infrastructure boundary, but indirect impacts will extend to the communities to which the people / animals belong. This is applicable to all project phases.

Probability

In the case of third parties, in the unmitigated scenario, there is a high possibility that mining activities and facilities will present a risk to third parties and free-roaming animals during all project phases. With mitigation that prevents access to mining areas, takes into account the safety of third parties and removes existing risks due to illegal mining, the probability reduces to low. At closure, with mitigation, the probability of positive impacts occurring increases.

Significance

In the unmitigated scenario, the significance of this potential impact is high. In this regard, the significance of the mitigated impact will reduce to low for all phases prior to closure due to a reduced severity and likelihood of the impact occurring.

Summary of safety risks to third parties per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation, decommissioning						
Unmitigated	H	H	M	H	H	H
Mitigated	L	H	M	M	L	L
Closure						
Unmitigated	H	H	M	H	H	H
Mitigated	L+	H	M	M+	H	M+

Management objectives

To prevent physical harm to third parties and animals.

Management measures

The following measures are recommended:

- Use security control measures in the form of manned access points, fencing, barriers and/or warning signs (in appropriate languages or illustrations) to keep people and animals away from mining and infrastructure areas.
- Undertake regular patrols of the mining area to ensure no breach of security measures has taken place. Where required, maintenance of facilities will be done to re-instate the integrity of the security measures.
- Rehabilitate the site in line with the closure and rehabilitation plan included in this report.
- Educate and train all workers (temporary and permanent) on the risks associated with hazardous excavations.

- Undertake community awareness programmes to educate the community on project-related safety risks.

Emergency situations

In case of injury or death due to hazardous excavations, the mine will implement its emergency response procedure, Section 30.2.2.

ISSUE 21 INCREASE IN HEALTH RISKS TO RECEPTORS

Information provided in this section was sourced from the human health risk assessment conducted by EnviroSim Consulting (EnviroSim) (EnviroSim, 2019) (see Appendix R).

Introduction

Mining activities generally cause environmental disturbance, which has the potential to release hazardous substances into the environment. By moving hazardous substances from inaccessible locations underground to locations in the surface environment, the potential for human exposure to these substances is enhanced.

According to SciRAD, based on the radionuclide activity concentrations for all the rock and soil samples tested falling well below the regulatory limit of 500 Bg/kg (or 0.5 Bq/g), and the calculated doses falling well below all relevant regulatory limits or levels where health impacts could occur, the proposed project does not warrant any concern regarding the radiological impacts to the public (SciRAD, 2019) (see Issue 11). This human health risk is therefore regarded as insignificant and will not be assessed further.

The geochemistry and groundwater specialist studies indicate that the development of acid mine drainage conditions or the leaching of contaminants from the waste rock is unlikely; concentrations of constituents that may leach from the waste rock are all within accepted drinking water criteria (see Issue 8). A human health risk is therefore not predicted to occur and will not be assessed further.

This section therefore focusses on potential health risks from the atmospheric pathway, as a result of the proposed open pit mining operations. The assessment relies on the findings of the air quality study to identify pathways of exposure and assess the potential human health risks.

Mine phase and link to project specific activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks Civil works	Opencast mining Transport system Mineralised waste Support services Rehabilitation	Opencast mining Transport system Mineralised waste Support services Rehabilitation	Maintenance and aftercare of rehabilitated areas

Rating of impact

Severity / nature

Inhalable particulates, sulphur dioxide (SO₂), oxides of nitrogen (NO_x), and carbon dioxide (CO) are considered to be criteria pollutants that is, air pollutants that are regulated and used as indicators of air quality. Inhalable particulates exert a range of adverse health effects such as elevated total, cardiovascular, and infant mortality; respiratory symptoms and effects on lung growth and immune system function. SO₂, NO_x, and CO are also known to cause respiratory effects and cardiovascular effects. Using the predicted

results of the air quality study (see Issue 9), short-term (daily) and long-term (annual) risks were determined for exposure to inhalable particulates. Diesel particulate matter (DPM) from exhaust emissions can be carcinogenic and result in inflammatory changes in the airways. Using the elemental analysis of waste rock samples provided by Geodyn (see Appendix H) and the air quality assessment results, it is estimated that airborne concentrations of arsenic may exceed health screening criteria (EnviroSim, 2019).

Based on the source-pathway-receptor analysis, the human health specialist has considered inhalation health risks, systemic (non-cancer) health effects and increased cancer risk. Potential human health impacts for each of these are discussed below (EnviroSim, 2019).

- ***Human health impact from inhalation exposure to criteria pollutants***

Within the context of the estimated health risks, although severe health effects were shown to be low compared to baseline values, even under unmitigated conditions, less severe health effects such as sore throat, common cold, cough, wheeze and shortness of breath could still occur where persons are exposed to airborne pollutants.

The health risks calculated as part of the specialist's assessment show (for exposure to the criteria pollutants) a measurable increase in the short-term and long-term health effects, especially when unmitigated concentrations of airborne particulates are considered. This is based on the maximum predicted concentration of air pollutants at receptor points. With mitigation potential receptors would be exposed to lower concentrations however the calculated risks still show a measurable increase from baseline values. The severity of exposure to criteria pollutants is therefore rated medium for both mitigated and unmitigated conditions.

- ***Non-cancer (systemic) health effects from inhalation exposure to DPM and particle associated arsenic***

Exposure to DPM and particle associated arsenic was evaluated using a set of conservative assumptions with regard to the quantities that can enter the atmosphere. The estimated airborne concentrations were evaluated assuming long-term chronic exposure and hazard quotients.

Although the levels of exposure to DPM and particle associated arsenic will be similar to that of criteria pollutants the risk of health effects developing is low as all hazard quotients calculated are below 1. No measurable change in the health of persons exposed to the DPM or particulates from the project is therefore expected. The rated severity is low as the affected environment (human health) will not be altered.

- ***Increased cancer incidence from inhalation exposure to particle associated arsenic***

The risk of cancer developing in individuals exposed to arsenic present in the airborne particulates is low. However, given the seriousness of a health effect such as cancer and potential presence of sensitive individuals, the severity is rated medium for unmitigated conditions.

However, as the waste rock is the only source of dust that includes arsenic, dust mitigation measures directed specifically at the waste rock stockpiles would significantly reduce the concentration of airborne particulates from this source. Cancer risks will therefore be reduced far below one in a million rendering it a change that cannot be measured. The related mitigated severity is low.

Duration

Although exposure to airborne particulates would occur for the duration of the mining and rehabilitation of each pit, health effects caused by the exposure to emissions may extend beyond this period depending on

the seriousness of the illness. The related duration is rated as medium-term for both unmitigated and mitigated conditions for inhalation and systemic health risks. Although the cancer risk is predicted to be negligible, the duration is rated as long-term for both unmitigated and mitigated conditions, as should it occur (however unlikely the occurrence may be) the effects will last beyond the life of the project.

Spatial scale / extent

The dispersion modelling results presented indicate that air pollutants, specifically particulates, are predicted to disperse beyond the boundary of the mining pits. With mitigation, the spatial scale of predicted impacts would reduce, however due to the proximity of residential areas to the open pit operations exposure to airborne particulates is still expected. This is rated as a medium spatial scale for both mitigated and unmitigated conditions.

Probability

The inhalation human health risks calculated for the various receptors are small but show an increase when compared to baseline incidence estimates, at all the receptors. This result implies that the probability is expected to be low given the number of people exposed. However, given the uncertainty in the health status (baseline conditions) of the receptors and the possibility that airborne concentrations may reach high concentrations on some days, the probability is medium, in the unmitigated scenario. With mitigation the concentrations of particulates would be reduced at all the proposed mining operations, reducing the probability of health impacts to low.

The specialist has indicated that the probability of non-cancer or cancer health impacts occurring is unlikely given the low health risks.

Significance

In the unmitigated scenario the significance of human health impacts is rated medium as the potential for exposure exists, although it would be for a short period of time (between five and nine months per pit). With mitigation, the significance reduces to low as the severity and probability of impacts occurring is reduced.

Summary of inhalation health impacts rating per phase of the mine

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	M	M	M	M	M	M
Mitigated	M	M	M	M	L	L

Summary of the systemic (non-cancer) health impacts rating per phase of the mine

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	L	M	M	L	L	L
Mitigated	L	M	M	L	L	L

Summary of the cancer health risk impacts rating per phase of the mine

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	M	H	M	H	L	M
Mitigated	L	H	M	M	L	L

Management objective

To prevent human health effects due to the proposed project.

Management action

The dust mitigation measures identified above will be implemented at all open pit mining operations associated with the proposed project to prevent possible health effects associated with particulates.

Airborne particulates concentrations will be monitored at potential receptors for the duration of the mining and rehabilitation phases of all open pit mining areas.

The surface and groundwater quality management and mitigation measures will be implemented to manage any contaminated runoff from the site, detect any changes in water quality and identify any third-party water users who could be negatively affected by the project.

The mine will develop and implement a Community Health and Welfare Strategy and Community health awareness workshops.

Emergency situations:

None identified.

ISSUE 22 BLASTING AND VIBRATION IMPACTS

Information provided in this section was sourced from the blasting assessment (Cambrian CC, 2019) (refer to Appendix M).

Introduction

Blasting activities have the potential to impact on people, animals and structures located in the vicinity of the blasting operations.

Mine phase and link to project specific activities/infrastructure

Construction	Operational	Decommissioning	Closure
N/A		N/A	N/A
-	Underground mining Opencast mining	-	-

Discussion

No blasting will take place for the open pit operations and therefore no blasting impacts will occur.

For the underground mining operations, blasting will take place at depths greater than 50 m. Airblast will therefore have no effect on surface infrastructure as it will be confined to the underground workings. In addition, the predicted airblast levels will be well below the threshold for human irritation.

The highest predicted vibration levels occur at points closest to the blast site but remain well below the USBM threshold at around 2 mm/s or less. The specialist predictions are considered to be conservative and actual vibration levels may well be lower than predicted. The disturbance levels attenuate or reduce rapidly with an increase in distance. Given the increasing depth of the mining activity and the small charge masses being fired at one time, it is highly unlikely that any disturbances will be felt on the surface of the ground. If any vibrations are felt on surface, the levels will be far too low to cause damage to structures. Vibrations may be perceptible to people, but should remain below the disturbing levels of 2.54 mm/s to 7.62 mm/s.

Vibration will also be generated from the Xcentric ripper. As explained in Table 3-4, an Xcentric ripper will be used to break the ground in the opencast pits. This equipment replaces the need to conduct blasting on surface. This is both for safety reasons and to minimise impacts on the surrounding environment. The ground vibration and noise disturbance levels associated with the use of the rippers were measured in May 2018 at various distances from an operating ripper. The measurements showed that the disturbance levels were highest close to the Xcentric ripper's area of operation and that these levels attenuated (decreased) rapidly with increase in distance. At distances greater than 100 m the disturbance levels will be of no consequence and insignificant.

ISSUE 23 LAND USE IMPACT

Information provided in this section was sourced from the socio-economic assessment (Mercury, 2019) (refer to Appendix Q).

Introduction

Mining activities have the potential to affect land uses both within the mine area and in the surrounding areas. This can be caused by physical land transformation and through direct or secondary impacts.

Mine phase and link to project specific activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks Civil works	Underground mining Opencast mining Transport system Power supply and use Water supply and use Mineralised waste Non-mineralised waste Support services Rehabilitation	Underground mining Opencast mining Transport system Power supply and use Water supply and use Mineralised waste Non-mineralised waste Support services Demolition Rehabilitation	Maintenance and aftercare of rehabilitated areas

Rating of impact

Severity / nature

The area has been impacted by historic and current mining activities, with various mining remnant such as mine dumps in the project area. One of the opportunities identified in the Gauteng Spatial Development Framework 2030 is the rehabilitation of the mining belt. Mined and rehabilitated land being freed up for

housing developments will improve fragmentation, thereby unlocking development potential in large areas that can be used for future urban development and infill. This is considered a positive impact.

The current illegal mining in the project area is a risk to the safety, security and environment of surrounding communities.

The proposed project will allow formal mining within the legal framework of the country and rehabilitation of affected project areas. Degraded land within the open pit mining areas will be restored and illegal mining activities in the immediate area should cease once the open cast areas have been completely rehabilitated. The opencast pits will be mined for a short duration and the land will then be made available for housing and industrial developments earmarked for the area.

Although the project area is primarily utilised for residential and associated development, there are, however, open areas with limited vegetation that may be utilised for firewood collection; hunting small animals; gathering plants; and subsistence gardening or grazing. The use is likely very limited but due to the poverty in the area could have an impact on land users.

In the unmanaged scenario it is possible that land surrounding the project will experience some degree of additional negative social and environmental impacts, which could impact on current land use values. In the scenario where the project successfully implements the stipulated environmental and social management measures, these impacts can be managed to acceptable levels which should not reduce surrounding land value. In the mitigated scenario the duration of the open cast mining activities will be kept to a minimum and rehabilitation objectives will be achieved and post rehabilitation land value will be enhanced.

The proposed project does, however, have the potential to impact on planned housing developments as described in section 6.4.1.14. Settlement deadlines have been agreed to with the various housing developers. The open cast activities will therefore have a minimal impact on the programme of these projects.

Underground mining activities may influence the desirability of planned housing developments, which could potentially affect the value of these properties. Impacts such as vibration, air, noise, health, traffic, social and water arising from the proposed mining activities could have a negative impact on housing developments and property values. It is possible that some buyers may disinvest from these developments due to the mine being in close proximity. In the mitigated scenario, the environmental impacts could be mitigated to a more acceptable level.

The change in land use would therefore be both positive and negative as described above. Taking these factors into consideration, the overall impact severity is rated as having a moderate overall negative impact. This can be reduced to low with mitigation that is focussed on prevention and/or controls for each environmental and social impact type. Effective rehabilitation of the open pits could result in a positive land use impact post-closure.

Duration

In the unmitigated scenario the impact on land use will extend beyond mine closure. With mitigation the majority of the land use impacts are expected to be limited to the phases prior to mine closure.

Spatial scale / extent

The spatial scale extends beyond the immediate proposed project area in both the mitigated and unmitigated scenario.

Probability

In the unmitigated scenario, where environmental and social impacts are uncontrolled, the probability that surrounding land uses will be impacted by mining is definite. With mitigation, the probability reduces to medium prior to closure. Effective rehabilitation of the open pits could possibly result in a positive land use impact post-closure.

Significance

In the unmitigated scenario, the significance of the potential negative impact is high. With mitigation the significance of the mitigated negative impact will reduce to medium for all phases prior to closure. Effective rehabilitation of the open pits is rated to have a medium positive impact at closure.

Summary of the rated land use impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation and decommissioning						
Unmitigated	M	H	M	H	H	H
Mitigated	L	L	M	L	M	M
Closure						
Mitigated	L+	H	M	M+	M	M+

Management objectives

To prevent unacceptable negative impacts on surrounding land uses.

Management measures

The following management measures will be implemented:

- The EMP commitments will be implemented during construction, operation and decommissioning with a view not only to prevent and/or mitigate the various environmental and social impacts, but also to prevent negative impacts on surrounding land uses;
- Regular stakeholder engagement will be conducted to report on EMP compliance performance and give stakeholders an opportunity to raise issues or concerns regarding the operations. This will include the housing development stakeholders;
- Where relevant and in discussion with the applicable regulatory body, rezoning will be completed;
- The overall site will be rehabilitated to provide for the post closure land use in accordance with the mine Closure Plan.

Emergency situations

In case of veldt fires, the mine will implement its emergency response procedure, Section 30.2.2.

C) IMPACT ON HERITAGE RESOURCES (INCLUDING PALAEOLOGICAL RESOURCES)

ISSUE 24 DAMAGE TO OR DISTURBANCE OF HERITAGE (INCLUDING CULTURAL) AND PALAEOLOGICAL RESOURCES RESULTING IN A LOSS OF THE RESOURCE

Information in this section was sourced from the heritage study undertaken by Professional Graves Solutions (PGS, 2019) (refer to Appendix P).

Introduction

The development of infrastructure for the West Wits Project has the potential to damage heritage/cultural and palaeontological resources (if present), either directly or indirectly, and result in the loss of the resource for future generations.

Mine phase and link to project specific activities/infrastructure

Construction	Operational	Decommissioning	Closure
			N/A
Site preparation Earthworks Civil works	Underground mining Opencast mining Transport system Power supply and use Water supply and use Mineralised waste Non-mineralised waste Support services Rehabilitation	Underground mining Opencast mining Transport system Power supply and use Water supply and use Mineralised waste Non-mineralised waste Support services Demolition Rehabilitation	-

Impact assessment

Severity/nature

The development of the project has the potential to impact on various heritage resources as follows:

- 18 heritage resources are located within the proposed infrastructure footprint areas and will be directly impacted, including 16 historical structures ranging from low to medium heritage significance and two living heritage cultural sites (open air religious sites) with medium significance;
- No archaeological sites were found in the project area, although there is the possibility of occasional finds as have been found in the surrounding areas;
- No paleontological resources are expected to occur in the project area, and therefore no paleontological impacts are expected;
- Two burial grounds of high heritage and cultural significance and four historical sites of medium to high heritage significance are located within the project area, but outside of proposed infrastructure footprints. These sites could be disturbed through indirect impacts if proper management measures are not put in place.

The severity rating is based on the heritage resources that have a high significance. The severity is rated as high in the unmitigated scenario due to the value of these resources that could be lost for future generations. With mitigation focussed on avoidance of all heritage resources where feasible, particularly those with a high or medium heritage significance, the severity can be reduced to low. Where avoidance is not feasible, other mitigation measures must be implemented such as documentation of the sites and obtaining relevant authorisations or permissions.

Duration

The duration is high in the unmitigated scenario during all project phases because the loss of heritage resources would be permanent. In the mitigated scenario, heritage resources will be avoided where feasible, or these resources would be documented to preserve the heritage knowledge, thereby reducing the duration of the impact.

Spatial extent/ scale

Loss of heritage (including cultural) resources will impact on communities beyond the project area, therefore the spatial scale is medium in both the unmitigated and mitigated scenarios in all project phases.

Probability

The probability is high in the unmitigated scenario but can be reduced to low with mitigation.

Significance

The unmitigated significance is high. The mitigated significance reduces to low at closure.

Summary of the rated heritage resource impacts per phase of the mine

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	H	H
Mitigated	L	L	M	L	L	L

Management objectives:

- To minimize the disturbance of heritage resources; and
- Comply with relevant legislation and recommendations from SAHRA under Section 34 and 38 of NHRA.

Management action

A heritage management plan will be implemented during construction, operations and decommissioning of the project. The basis for this management plan is provided in n Table D 4 below. Mitigation will consider avoidance of resources where feasible. In cases where resources cannot be avoided, additional management measures will need to be implemented including applying for the necessary permits.

Emergency situations

In the event of any chance finds, a chance find procedure will be implemented as described in the heritage management plan provided in Table D 4.

TABLE D 4: HERITAGE MANAGEMENT PLAN

Type	Resource No.	Heritage grading	Location	Mitigation measures	Project phase
Cultural sites within proposed infrastructure footprints.	WW002	Medium	Roodepoort Main Reef pit	Avoid these sites where feasible and apply a buffer zone of least 30m. If the sites cannot feasibly be avoided, conduct stakeholder engagement and obtain consent to relocate the sites to a suitable alternative location, to be provided by the mine.	Construction Operation Decommissioning
	WW010	Medium	Roodepoort Main Reef pit		
Historical structures within proposed infrastructure footprints.	WW001	Low	Roodepoort Main Reef pit	Avoid these sites where feasible and apply a buffer zone of least 30m. The ore trucking road alignment will be adjusted to avoid heritage resources. If the sites cannot feasibly be avoided, document the site and obtain a destruction permit from the provincial heritage resource authority (Gauteng). In this regard, structures older than 60 years will require permits for destruction. Implement a chance find procedure in cases where possible additional heritage finds are made. Contact SAHRA and appoint a qualified heritage specialist to evaluate the finds and make appropriate recommendation on mitigation.	Construction Operation Decommissioning
	WW003 and WW003-1	Low	11 Shaft Main Reef pit		
	WW004	Low	Kimberley Reef East infrastructure		
	WW005	Low			
	WW006	Low			
	WW007	Low	11 Shaft Main Reef pit		
	WW008	Low			
	WW009 and WW009-1	Low	Ore trucking road		
	WW011	Medium			
	WW012	Low			
	WW013	Medium			
	WW014	Medium			
	WW015	Medium			
	WW016	Medium/High			
WW017	Very Low	Mona Lisa Bird Reef pit			
WW018	Medium/High	Bird Reef/ Central Circular Shaft			
Historical structures within project area, but outside infrastructure footprints.	WW019	Medium		South of Mona Lisa Bird Reef pit	Demarcate sites with a 30-meter buffer and avoid them. Implement a chance find procedure in cases where possible additional heritage finds are made. Contact SAHRA and appoint a qualified heritage specialist to evaluate the finds and make appropriate recommendation on mitigation.
	WW020	High	North-east of Bird Reef/ Central Circular Shaft		
	WW021 and WW021-1	Low	Close to Roodepoort Main Reef Pit		
	WW023	Low/ medium	Between Bird Reef Central Circular Shaft and Mona Lisa Bird Reef		

Type	Resource No.	Heritage grading	Location	Mitigation measures	Project phase
Burial Grounds located within project area, but outside infrastructure footprints.	WW022-1 to WW022-3	High	Between Bird Reef/ Central Circular Shaft and Mona Lisa Bird Reef Pit	Demarcate sites with a 100-meter buffer and avoid them. Implement stakeholder engagement as required by the NHRA in developing practical management measures to avoid further damage to these burial grounds and allow community access. Implement a chance find procedure in cases where possible additional heritage finds are made. Contact SAHRA and appoint a qualified heritage specialist to evaluate the finds and make appropriate recommendation on mitigation.	Construction Operation Decommissioning
	WW024	High	North of Bird Reef/ Central Circular Shaft, close to Ore transport road		
Archaeological and paleontological material	None found on site			Implement a chance find procedure in cases where possible heritage finds are made. Contact SAHRA and appoint a qualified heritage specialist to evaluate the finds and make appropriate recommendation on mitigation.	Construction Operation Decommissioning