APPENDIX C: DETAILED ASSESSMENT OF POTENTIAL IMPACTS

DRAFT ENVIRONMENTAL MANAGEMENT PROGRAMME FOR THE PROPOSED CHANGES TO SURFACE INFRASTRUCTURE AT THE MOKALA MINE: APPENDIX C - IMPACT ASSESSMENT

Mokala Mine

Prepared for: Mokala Manganese Mine (Pty) Ltd

Authority References: NC 30/5/1/1/3/2/ (00197/10090) MR

SLR Project No.: 720.09012.00010
Report No.: 01
Revision No.: 01
February 2022

DOCUMENT INFORMATION

Title	Mokala Manganese EIA and EMPr Amendment –Impact Assessment
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Keywords	EIA, EMPr, impact assessment, impact, significance, cumulative impacts
Status	Final draft for client review
Report No.	01
SLR Company	SLR Consulting (South Africa) (Pty) Ltd.

DOCUMENT REVISION RECORD

Rev No.	Issue Date	Description	Issued By
A	February 2022	Draft for Public Review	MN

REPORT SIGN OFF AND APPROVALS

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ACRONYMS AND ABBREVIATIONS

Acronym / Abbreviation	Definition
AQSR	Air Quality Sensitive Receptors
BPG	Best Practice Guidelines
CBA	Critical Biodiversity Area
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
EMS	Ecological Management Services
ESA	Ecological Support Area
I&APs	Interested and Affected Parties
IBA	Important Bird Area
mamsl	Metres Above Mean Sea Level
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
mbgl	Metres Below Ground Level
Mokala	Mokala Manganese (Pty) Ltd
NAAQS	National Ambient Air Quality Standards
NCNCA	Northern Cape Nature Conservation Act (No. 9 of 2009)
NDCR	National Dust Control Regulations
NSR	Noise Sensitive Receptor
SACAD	South Africa Conservation Areas Database
SAHRA	South African Heritage Resources Agency
SANS	South African National Standards
SCC	Species of Conservation Concern
SLR	SLR Consulting (South Africa) (Pty) Ltd
SLP	Social and Labour Plan
VOC	Volatile Organic Compound
WRD	Waste Rock Dump
WUL	Water Use Licence

MOKALA MANGANESE MINE
APPENDIX C

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 Interested and Affected Parties (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 Environmental Management Programme (EMPr).

The potential impacts are rated with the assumption that no management actions are applied and then again with management actions. The mitigated assessment assumes that technical design controls, as included in the project scope (see Section 4.2 of the main EIA document), would be included in the detailed design of the project, and implemented when the project components are constructed and operated.

An indication of the phases in which the impact will occur including the project specific activity associated with each impact is provided below. A summary of the impact assessment findings is provided in Section 11.5 of the main EIA document. Management actions identified to prevent, reduce, control, or remedy the assessed impacts are provided under the relevant impact discussions sections below.

It is important to note that management actions will include any measures outlined in the approved EMPr and any additional management actions identified as part of the project, where relevant. The section below also includes management actions outlined in the approved EMPr (SLR, December 2015). Any additional management actions are indicated in *italics*. **It is important to note that the management actions outlined in this document are specific to the proposed project components only.**

IMPACTS ON THE BIOPHYSICAL ENVIRONMENT

1 TOPOGRAPHY

The information contained in this section was informed of the proposed project components as detailed in Section 4.2 of the main EIA and EMPr document, approved EIA and EMPr (SLR, December 2015) as well as findings from site visits undertaken by the EIA project team.

1.1 ISSUE: HAZARDOUS EXCAVATIONS AND INFRASTRUCTURE RESULTING IN SAFETY RISKS TO THIRD PARTIES AND ANIMALS

1.1.1 DESCRIPTION OF IMPACT

Hazardous excavations and infrastructure include all structures into, or off which third parties and animals can fall and be harmed. Hazardous excavations and infrastructure can occur in all mine phases from construction through operation to decommissioning and closure. In the construction and decommissioning phases these hazardous excavations and infrastructure are usually temporary in nature, usually existing for a few weeks to a few years. The operational phase will present more long-term hazardous excavations and the closure phase will present final landforms that are considered hazardous.

1.1.2 IMPACT ASSESSMENT

1.1.2.1 ALL PHASES

In all project phases the potential for injury and/or death to both people and animals due to the proposed project has a high intensity. With mitigation measures the intensity is rated as low in the mitigated scenario the intensity reduces to low with the implementation of management measures focused on access control and the design of the open pit con-current rehabilitation components to prevent and/or mitigate impacts. Death or permanent injury is considered a permanent impact in both the mitigated and unmitigated scenarios. Direct impacts associated with hazardous infrastructure and excavations will extend beyond the site boundary to the areas to which the injured people and/or animals belong. The consequence is high in both the unmitigated and mitigated scenarios. The probability of occurrence is possible in the unmitigated scenario and reduced to conceivable in the mitigated scenario. The significance is **HIGH** in the unmitigated scenario and **LOW** in the mitigated scenario.

Table 1-1: Impact Summary – Hazardous excavations and infrastructure

Issue: Hazardous excavations and infrastructure		
Phases: Construction, Operational, Decommissioning and Closure		
Criteria	Without Mitigation	With Mitigation
Intensity	High	Low
Duration	Very High	Very High
Extent	Medium	Medium
Consequence	High	Medium
Probability	Medium	Low
Significance	**High**	**Low**

MANAGEMENT OBJECTIVES

The objective is to prevent physical harm to third parties and animals from potentially hazardous excavations and infrastructure.

EMERGENCY SITUATIONS

If people or animals fall off or into hazardous excavations or infrastructure causing injury, or if any mineralised waste or water facilities fail causing injury to people or animals, the emergency response procedure in Section 34 of the main EIA document will be initiated.

1.1.3 MANAGEMENT ACTIONS

The mitigation measures as per the approved EIA and EMPr (SLR, December 2015) remain valid for the proposed project.

1.1.3.1 ON-GOING / ALL PHASES

- *Ensure access control of the mining right area is maintained.*
- All mineralised waste facilities and water dams will be designed, constructed, operated, and closed in a manner to ensure stability and related safety risks to third parties and animals are addressed. It will furthermore be monitored according to a schedule that is deemed relevant to the type of facility by a professional engineer. As part of closure, Mokala should ensure that provision is made to address long term and safety risks in the decommissioning and rehabilitation planning.
- Mokala will survey its mining area and update its mine plan map on a routine basis to ensure that the position and extent of all potential hazardous excavations, hazardous infrastructure and subsidence is known as part of construction, Operational, and decommissioning. It will furthermore ensure that appropriate management measures are taken to address the related safety risks to third parties and animals.

1.1.3.2 CONSTRUCTION PHASE

- *During construction each hazardous excavation will have a barrier around it to prevent access by people and animals. The barrier may be in the form of fences, walls, or berms. In addition, the barriers must have warning signs at appropriate intervals. These warning signs must be in picture format and/or written in English, Afrikaans, and Sepedi.*

1.1.3.3 DECOMMISSIONING AND CLOSURE

- During decommissioning planning of any part of the mine, provision will be made to address long term safety risks in the decommissioning and rehabilitation phases.
- At closure of any part of the mine, the hazardous infrastructure will either have been removed or decommissioned and rehabilitated in a manner that it does not present a long-term safety and/or stability risk.
- At closure the hazardous excavations and subsidence will have been dealt with as follows:
  - All pits will have been backfilled and rehabilitated
  - The potential for surface subsidence will have been addressed by providing a bulking factor for the backfilled pit
  - Monitoring and maintenance will take place to observe whether the relevant long term safety objective have been achieved and to identify the need for additional intervention where the objectives have not been met.

- In case of injury or death due to hazardous excavations, the emergency response procedure in Section 34 will be followed.

1.1.3.4 MONITORING

- All mineralized waste facilities and *water containment facilities (dirty and clean)* will be monitored to ensure stability, safety, and prevention of environmental impacts. The findings will be documented for record-keeping and auditing purposes and addressed where relevant to achieve the stated objectives.

2 SOILS AND LAND CAPABILITY

The assessment of impacts to soil and land capability presented in this section, was sourced from the Soil and Land Capability specialist study prepared by Zimpande Research Collaborative (August 2021). The scope of the specialist study included an assessment of the layout changes which have already taken place. Proposed project activities (excluding the proposed potable water pipeline) as described in Section 4.2 of the main EIA report were assessed as part of the specialist investigation.

2.1 DESCRIPTION OF IMPACTS

Soil is a valuable resource that supports a variety of ecological functions and is the key to re-establishing post closure land capability. Soil resources can be disturbed through removal, erosion, and compaction, as well as pollution during accidental spills and leaks which can result in a loss of soil functionality as an ecological driver. Existing mining activities have already disturbed soils and related land capability through the establishment of related surface infrastructure and mining activities. The soils towards the eastern portion of the project area are Enrosa and Witbank/Grabouw formations. The majority of the soils occurring within the western portion of the project area can be broadly classified as soils that are ideal for agricultural cultivation practices (with minor limitations) were climate permits as well as grazing activities as well as wildlife/wilderness. These ideal soil forms include Ermelo/Clovelly, which are considered ideal for agricultural cultivation due to:

- Deep well drained soil characteristics;
- Texture and structure allowing for effective rooting depth; and
- Good water holding/storage capacity.

The proposed project activities will require the physical disturbance of soils at varying degrees through the mining life cycle. This physical disturbance has the potential to result in soil erosion, soil compaction and loss of agricultural land capability.

ASSESSMENT OF IMPACTS TO SOILS AND LAND CAPABILITY DUE TO LAYOUT CHANGES ALREADY TAKEN PLACE

The changes to the approved infrastructure layout that have already taken place include:

- The reconfiguration of the plant area, ROM stockpile and product stockpile;
- The relocation of the ROM low grade product stockpile;
- The relocation of support infrastructure;
- The relocation of transportation related facilities/infrastructure;
- The relocation of the approved WRD; and
- The relocation of the approved topsoil stockpiles.

The impacts of the above-mentioned activities were taken into consideration with regards to their impacts on soil and land capability of the project area (within the MRA). In this regard, a specialist study conducted by (TerraAfrica Consulting, 2015) was consulted in order to gain an understanding of the nature of the impacts on soil and land capability prior to the relocation and reconfiguration activities.

Activities considered were the relocated WRD, relocated topsoil and relocated low-grade stockpile. The relocation of the above-mentioned activities is not anticipated to cause any cumulative significant impact on the land capability, because of the active mining operations taking place. The impacts can thus be regarded as low.

The soil forms identified within the approved project include Clovelly, Molopo, Witbank, Brandvlei and Kinkelbos. The soils forms identified, although they would be moderately to highly suited for crop production, the rainfall in the area is consistent with long periods of drought from time to time which has the potential to restrict the profitability of large-scale crop production (TerraAfrica Consulting, 2015). The significance of impact on land capability was rated **MEDIUM** because the Mokala Mine development falls within a larger area for mining projects intermixed with cattle and game farming. Thus, the proposed mining right area will not impact on any current crop production and will therefore not affect primary grain production provided that soil management measures are followed, and the land is rehabilitated to the highest standard possible (TerraAfrica Consulting, 2015).

ASSESSMENT OF IMPACTS TO SOILS AND LAND CAPABILITY DUE TO PROPOSED ACTIVITIES

2.2 ISSUE: LOSS OF SOIL AND LAND CAPABILITY THROUGH PHYSICAL DISTURBANCE RESULTING IN SOIL EROSION

2.2.1 IMPACT ASSESSMENT

2.2.1.1 CONSTRUCTION PHASE

Typical construction activities undertaken during the construction phase include:

- Earthworks
  - Removal of existing minor structures (such as fencing if present).
  - Clearing of vegetation (trees, bushes, and grasses) in the footprint area associated for the proposed developments.
  - Soil stripping and stockpiling.
- Construction activities
  - Excavations and trenching.
  - Frequent operation and movement of earth moving and digging machinery.

The establishment of new surface infrastructure has the potential to negatively influence 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; and
- Soil compaction resulting from increased traffic and the presence of infrastructure.

Soil erosion is largely dependent on land use and soil management and is generally accelerated by anthropogenic activities. In the absence of detailed South African guidelines on erosion classification, the erosion potential and interpretation were based on field observations as well as observed soil profile characteristics. In general, soils with high clay content have a high-water retention capacity, thus less prone to erosion in comparison to sandy textured soils, which in contrast are more susceptible to erosion. The proposed project area is located on relatively flat terrain. The soils of Ermelo/Clovelly and

Witbank/Grabouw formation occurring within the project area are susceptible to soil erosion due to their sandy nature. Soils which were vegetated prior to the proposed activities, will be more susceptible to erosion during the construction phase if left bare or if not vegetated when in stockpile areas before the rainy season; thus, exposed to wind and storm water. The severity of this impact is anticipated to be moderate for most of the soils and with the appropriate mitigation measures the significance of this impact may be low. In the unmitigated scenario, soil erosion is likely to have negative impacts which will most likely lead to the following:

- Removal of organic matter and important soil nutrients essential for vegetation growth and thus reduced yield potential.
- Pollution and sedimentation of nearby water sources consequently affecting the water quality for livestock.
- Limited water availability essential for vegetation growth.

Table 2-1: Impact Summary - Loss of soil and land capability through physical disturbance resulting in soil erosion during the construction phase

Issue: Loss of soil and land capability through physical disturbance resulting in soil erosion		
Phases: Construction Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Medium	Low
Duration	Medium	Low
Extent	Low	Low
Consequence	Medium	Low
Probability	Very High	High
Significance	**Medium**	Low

2.2.1.2 OPERATIONALPHASE

The physical disturbance of soils causing soil erosion and compaction is possible during the operational phase due to the following activities:

- Earthworks and civil works
  - Stripping and stockpiling of topsoil resources in line with soil management programme.
  - Levelling and excavating activities by dozer, grader, excavator, loader, and haul-trucks.
  - Establishing temporary access and construction roads.
  - Excavation, preparation, and compaction of WRD extension foundations and trenches.
  - Construction of expansion cells for the approved WRD expansion areas in a phased manner over the life of the mine.
  - Construction of expansion cells for the new WRD areas in a phased manner over the life of the mine.
  - Establishing and maintaining storm water controls (berms, cut-off drains/trenches and channels) as per storm water management plan.
- Mineralised waste
  - Hauling, tipping and dozing of waste rock and product material.

- Waste rock stored in cells on the WRD extension and new WRD area.
- Concurrent backfilling of the pit (in-pit dumping).

- Non-mineralised waste
  - Collection of general and hazardous waste on mine site.
  - Disposal and/or treatment of contaminated soils.
- Concurrent rehabilitation
  - Hauling, tipping of topsoil material.
  - Slope stabilisation, erosion control and landscaping.
  - Re-vegetation of landscaped areas.
  - Removal of alien invasive species from rehabilitated sites.
- Open pit mining.

In the unmitigated scenario the impact of soil erosion due to the above activities was rated as **MEDIUM** and was reduced to **VERY LOW** with the implementation of mitigation and management measures.

Table 2-2: Impact Summary – Loss of Soil and Land Capability through Physical Disturbance resulting in Soil Erosion during the Operational Phase

Issue: Loss of soil and land capability through physical disturbance resulting in soil erosion		
Phases: Operational Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Low	Low
Duration	High	Medium
Extent	Low	Low
Consequence	Medium	Low
Probability	High	Medium
Significance	Medium	Very Low

2.3 ISSUE: LOSS OF SOIL AND LAND CAPABILITY THROUGH PHYSICAL DISTURBANCE RESULTING IN SOIL COMPACTION

2.3.1 IMPACT ASSESSMENT

2.3.1.1 CONSTRUCTION PHASE

Heavy equipment traffic during construction activities is anticipated to cause soil compaction. The Project Area is more prone to compaction as there will be a significant increase in the use of vehicle and heavy machinery during the construction phase and if work is done when the soil is wet this may increase the soils susceptibility to compaction. Soil compaction may potentially lead to:

- Increased bulk density and soil strength, reduced aeration and lower infiltration rate;
- Consequently, it lowers crop performance via stunted aboveground growth coupled with reduced root growth;

- Destroyed soil structure, causing it to become more massive with fewer natural voids with a high possibility of soil crusting. This situation can lead to stunted, drought-stressed plants as a result of restricted water and nutrient uptake, which results in reduced crop yields;
- Soil biodiversity is also influenced by reduced soil aeration. Severe soil compaction may cause reduced microbial biomass. Soil compaction may not influence the quantity, but the distribution of macro fauna that is vital for soil structure including earthworms due to reduction in large pores.

In the unmitigated scenario the impact of soil compaction is **MEDIUM**. In the mitigated scenario, the impact significance is reduced to **LOW** because compaction will be localized and restricted to access roads, vehicle hardstand areas and equipment and machinery laydown areas.

Table 2-3: Impact Summary – Loss of soil and land capability through physical disturbance resulting in soil compaction during Construction Phase

Issue: Loss of soil and land capability through physical disturbance resulting in soil compaction		
Phases: Construction Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Medium	Low
Duration	Medium	Medium
Extent	Low	Low
Consequence	Medium	Low
Probability	Very High	High
Significance	**Medium**	**Low**

2.3.1.2 OPERATIONAL PHASE

Frequent disturbance of soils due to the aforementioned operational phase activities will result in soil compaction if left unmanaged or mitigated. In the unmitigated scenario the impact of soil compaction is rated **MEDIUM** but is reduced to **VERY LOW** post mitigation.

Table 2-4: Impact Summary – Loss of soil and land capability through physical disturbance resulting in soil compaction

Issue: Loss of soil and land capability through physical disturbance resulting in soil compaction		
Phases: Operational Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Low	Low
Duration	High	Low
Extent	Low	Low
Consequence	Medium	Low
Probability	High	Medium

Issue: Loss of soil and land capability through physical disturbance resulting in soil compaction		
Significance	Medium	Very Low

MANAGEMENT OBJECTIVE

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

EMERGENCY SITUATIONS

Soil eroding incidents will be handled in accordance with the Mokala's emergency response procedure in Section 34 of the main EIA document.

2.3.2 MANAGEMENT ACTIONS

2.3.2.1 CONSTRUCTION PHASE

Soil Erosion and Dust Emission Management

- *Bare soils within the access roads can 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;*
- *Temporary erosion control measures should be used to protect the disturbed soils during the construction phase until adequate vegetation has established.*

2.3.2.2 ON-GOING / ALL PHASES

- *It is important that the total available soil resource is fully utilised and is made available for rehabilitation. Closure objectives must be outlined so that the planning is done with the end use in mind considering that the Mokala mine is currently operational and concluding most of their construction activities. In this way final closure costs may be minimised and design constraints that will prevent full compliance with the legal commitments made in the mine EMPR may be avoided (Chamber of Mines of South Africa, 2007). The key planning phase activities are as follows:*
    - *Rehabilitation specialist must evaluate the mine plan to assess the extent to which the current plan will debase land use capability, ecological status, or result in long-term (i.e., post-closure) maintenance liabilities;*
    - *Rehabilitation specialist must propose mine plan modifications to mitigate environmental impacts;*
    - *Mine planner must re-assess the mine plan to determine the extent to which the rehabilitation specialist's requirements can be accommodated;*
    - *The residual impacts of the current activities, and the likely end product must be agreed upon by the mine planner and rehabilitation specialist; and*
    - *An estimate of the cost of rehabilitation should be developed based on the current mining plan.*
- Limit the disturbance of soils to what is absolutely necessary for earthworks on-going activities, infrastructure footprints and use of vehicles during all phases.
- All employees (permanent and temporary) should be aware of demarcated areas for proposed infrastructure/activities. *In this regard, no activities or infrastructure should be placed on areas not approved for disturbance.*

- Where soils have to be disturbed, the soils will be stripped, stored, maintained, and replaced in accordance with the specifications of the soil management principles included below.
- *Consideration and implementation of the Soil Management Plan (SMP) (as detailed below) is recommended as far as practical.*
- All disturbed areas adjacent to the proposed development areas should be re-vegetated with an indigenous grass mix, if necessary, to re-establish a protective cover, to minimise soil erosion and dust emission.

SOIL MANAGEMENT PLAN (SMP)

The effective and appropriate re-use of topsoil is essential in achieving successful rehabilitation outcome for the proposed activities at the Mokala Mine. This soil management plan (SMP) is intended as a guide only and should be reviewed and updated periodically throughout the life of the mine in response to technology changes, research and to address changes to management strategies. Proposed activity/infrastructure changes to the approved surface layout include:

- *The proposed expansion of the open pit;*
- *The proposed increase in the capacity of the approved WRD and the establishment of an additional WRD;*
- *The proposed establishment of additional topsoil stockpiles;*
- *The proposed relocation of stormwater management infrastructure;*
- *The proposed increase in the capacity of product stockpiles (ROM and Low Grade, High Grade); and*
- *The proposed mining of the barrier pillar between the Kalagadi Mine and Mokala Mine.*

1. *Existing Soil Resources*

The dominant soil forms occurring within the Project Area are Ermelo/Clovelly, Mispah/Glenrosa and Witbank/Grabouw forms. The Ermelo/Clovelly soil forms are very sandy in nature with little to no organic matter content on the topsoil and are more susceptible to wind erosion. Based on the site observations these soils are not covered by thick and dense vegetation and thus increase the risk of wind erosion. On the other hand, these soils are not highly susceptible to water erosion as these soils are well drained. Soils of the Grabouw and Witbank are also more susceptible to wind and water erosion as these soils have undergone some level of disturbance due to the mining related activities already taking place in the approved footprint areas. The Mispah/Glenrosa soils are more susceptible to water erosion, and they are located mainly on sloping areas. This is due to their limited water holding capacities which thus result in overland flow and thereby promoting incised erosion gullies.

2. *Topsoil Management*

Soil investigations were carried out and the soils were characterized according to their morphology and thus ascertain the suitability of the topsoil for rehabilitation. The current EMPR commitment states that stripping of topsoil requires a minimum of 400 mm topsoil unless a soils expert advises otherwise (Department of Environmental Affairs and Tourism, 2004). However, based on the assessment of the Project Area by the specialist it is recommended that this commitment be amended to suit the local conditions where the majority of soils are shallow (less than 0.2 m in average depth). In these areas topsoil stripping should be based on that is achievable in the shallow soils (defined as Mispah/Glenrosa soils in the soil type map). Where deeper soils such as the Ermelo/Clovelly soil forms are present the minimum depth of topsoil stripping should be at least 1 m. The aim is to maximise recovery of topsoil and plant growth media from each cleared area. This top-soil material should be used directly in the rehabilitation of the disturbed areas as the mine *activities progresses. Stockpile height should be restricted to that which can deposited without additional traversing by machinery. Topsoil utilisation should be scheduled and planned as part of the detailed rehabilitation programme. Rehabilitation areas must be subject to restricted access. Topsoil should be stored such that it is protected from internal rainfall and runoff using temporary vegetation or mulching and protected from external runoff using diversion banks/drains.*

3. *Soil Stripping*

Maximizing topsoil recovery during development and construction is important to ensure that there is sufficient topsoil available for rehabilitation. These considerations are applicable to future developmental/ surface layout changes on the Mokala mine. Potential impacts from inadequate stripping management procedures include dust emissions, altered soil structure, and the dispersal and spread of weed species. Wherever possible, stripping and replacing of soils should be done in a single action. This is both to reduce compaction and also to increase the viability of the seed bank contained in the stripped surface soil horizons. It is preferable to strip a little too much ahead of the proposed activities rather than too little, particularly where stripping is concentrated in the dry months so as to minimise the potential for compaction. Close supervision of the stripping process is thus also imperative to ensure that all soils are stripped correctly and not mixed. Monitoring requires assessment of the depth stripped, the degree of mixing of soil materials and the volumes of material replaced directly or placed on stockpiles. A topsoil stockpile quantification analysis was conducted to determine the best estimate for the topsoil and total soil material for closure and rehabilitation processes. The average depth for the Ermelo/Clovelly and Witbank soil forms was estimated at 1.5 m. To maximise the recovery of topsoil and plant growth media from each cleared area the topsoil stripping should be 1 m. The Mispah/Glenrosa soil forms which are the shallow rocky soil types the average depth was estimated at 0.2 m and due to the shallow nature of the soils the stripping of topsoil can be based on the achievable soil recovery. Based on the available topsoil material in stockpile areas, an approximate area that can be covered per stockpile has been calculated based on the recommended minimum topsoil depth of 0.4m to serve as a seedbed. The 0.4m depth can also be adjusted based on the local conditions.

Table 2-5: Estimation of area that can be covered based on the available topsoil material (Zimpande Research Collaborative, August 2021)

Types of Material	*Area in m^2*	*Volume of available soil material (m^3)*	*Area that can be covered (in ha) if the minimum depth is 0.4 m*
Ermelo/Clovelly	*1209000*	*1 813 500*	*453.4*
Mispah/Glenrosa	*28000*	*5600*	*1.4*
Witbank	*3345000*	*5017500*	*1 254.4*
Total	*4 582 000*	*5 023 100*	*1709.2*

4. *Soil Storage and Stockpiling*

Prior to the commencement of the proposed activities, topsoil should be removed, and stockpiled for future use. Surface and subsoil material should be stockpiled separately. This is to prevent the mixing of the fertile topsoil with the nutrient limited subsoils. Stockpiles will be constructed to minimise deterioration of seed, nutrients, and soil biota, by avoiding topsoil collection when saturated following rainfall (this will promote composting), and by creating stockpiles of lower height (one to three metres) where possible. The duration of stockpiling must be minimised where possible. Vegetation debris, logs and leaf litter will be retained where possible for reuse during rehabilitation. A Maximum height of 2-3 m is therefore proposed, and the *stockpile should 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. Also, the use of lime to stabilise soil pH levels. Thereafter a short-term topsoil amelioration program should be based on the soil chemical status after levelling and should consists of a pre-seeding lime and fertilizer application, an application with the seeding process as well as a maintenance application for 2 to 3 years after rehabilitation or until the area can be declared as self-sustaining by an appropriately qualified soil scientist. Once established, stockpiles should be managed to ensure that losses from the piles are minimised and that additional damage to the physical, chemical, or biotic content is minimised.*

5. *Limited Topsoil Medium for Adequate Rehabilitation*

The soil material identified on the Project Area can be considered very sandy and subject to wind erosion. This is due to the lack of cohesion between the sandy materials of the soils. Therefore, this has led to limited topsoil material being available for use in the rehabilitation programme of the Mokala manganese mine.

The following measures are proposed in order counteract the problems associated with limited topsoil stockpile:

- *Ideally, removal of infrastructure once mining activities are completed is usually considered. However, all the structures on site should be assessed in conjunction with the ultimate land users, and the authorities, to determine which infrastructure areas and/or components could be used in future. This will aid in the minimisation of the amount of topsoil stockpile required for rehabilitation.*
- *Where infrastructure is removed all the rubble and residual foundations need to be covered with at least one metre of cover material. Best practice is to cover with 1 metre of inert cover material (which may be “B” or “C” horizon material that can be penetrated by plant roots), which in turn is covered with topsoil material.*
- *Capping of the WRD and other residual waste sites is recommended as this will limit the amount of topsoil needed for rehabilitation and topsoil can thus be used to rehabilitate flatter areas that will better support grazing land use post closure.*
- *The topsoil stockpile is recommended in areas where there is a likelihood for post closure use such as grazing, where the slopes are not excessively steep.*

2.4 ISSUE: LOSS OF SOIL AND LAND CAPABILITY THROUGH CONTAMINATION

2.4.1 DESCRIPTION OF IMPACT

Mining related projects in general have the potential to result in the loss of or damage to soil resources through contamination. Contamination of soil resources could result from accidental spillage of hydrocarbons and other hazardous material (unplanned events), leading to an altered soil chemistry which could result in a decrease in the rehabilitation and post-closure land use potential. Proliferation of alien vegetation due to disturbances could also result in alterations in the soil quality and chemistry. Contamination sources are mostly unpredictable and often occur as incidental spills or leaks during both the construction and operational phase. Thus, all the identified soils are considered equally predisposed to potential contamination. Therefore, strict waste management protocols as well as product stockpile management and activity specific Environmental Management Programme (EMPR) and monitoring guidelines should be adhered to during the construction and operational activities. If the management protocols are not well managed this will more likely lead to:

- Contaminants leaching into the soil and thus potentially rendering the soil sterile. reducing the yield potential of soils.
- Potential reduction of water quality used for irrigation and for livestock use.

2.4.2 IMPACT ASSESSMENT

2.4.2.1 CONSTRUCTION PHASE

Possible occurrences contributing to soil contamination include accidental spillage of petroleum hydrocarbons during vehicle operations, construction of associated infrastructure and improper disposal of hazardous and non-hazardous waste (including waste material spills and refuse deposits into the soil). In the construction phase these activities and sources are temporary in nature, usually existing from a few weeks to a few months. In the unmitigated scenario the impact of soil contamination is rated as Medium but is reduced to Very Low after mitigation.

Table 2-6: Impact Summary – Loss of soil and land capability through contamination

Issue: Loss of soil and land capability through contamination		
Phases: Construction Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Medium	Low
Duration	Medium	Low
Extent	Low	Low
Consequence	Medium	Low
Probability	Definite	Possible
Significance	**Medium**	**Very Low**

2.4.2.2 OPERATIONAL PHASE

During the operational phase of the proposed project activities, contamination may likely occur as a result of leaching of hydrocarbons chemicals into the soils and improper disposal of hazardous and non-hazardous waste. In the unmitigated scenario the potential impact of soil contamination is rated as **MEDIUM** and reduced to **VERY LOW** post mitigation.

Table 2-7: Impact Summary – Loss of soil and land capability through contamination in Operational Phase

Issue: Loss of soil and land capability through contamination		
Phases: Operational Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Medium	Very Low
Duration	High	Low
Extent	Low	Low
Consequence	Medium	Low
Probability	Very High	Medium
Significance	**Medium**	**Very Low**

MANAGEMENT OBJECTIVE

The objective is to prevent soil pollution.

EMERGENCY SITUATIONS

Major spillage incidents will be handled in accordance with the mine's emergency response procedure in Section 34 of the main EIA document.

2.4.3 MANAGEMENT ACTIONS

Construction Phase

- *Contamination prevention measures addressed in the Environmental Management Programme (EMPr) for both the proposed and approved/existing developments should be implemented and made available and accessible at all times to the contractors and construction crew conducting the works on site for reference.*
- *A spill prevention plan and a dust suppression and fire prevention plan should also be compiled to guide the construction works.*

On-going (all phases)

- During the construction, operational and decommissioning phases, Mokala will ensure that all hazardous chemicals (new and used), dirty water, mineralized wastes and non-mineralised wastes are transported, handled and stored in 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 as outlined in Section 4.1.1.3 of the main EIA document*.
  - 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;
- *Adherence to the emergency response contingency plan (Section 34 of the main EIA document) should be put in place to address clean-up measures should a spill and/or a leak occur, as well as preventative measures to prevent contamination; and*
- *Burying of any waste including domestic waste, empty containers on the site should be strictly prohibited and all construction rubble waste must be removed to an approved disposal site.*

2.5 ISSUE: LOSS OF AGRICULTURAL LAND CAPABILITY

2.5.1 DESCRIPTION OF IMPACT

The eastern portion of the project area are characterised by soils not considered ideal for agricultural cultivation practices. These soils include the Mispah/Glenrosa and Witbank/Grabouw formations. The majority of the soils occurring within the western portion of the Project Area can be broadly classified as soils ideal for agricultural cultivation practices (with minor limitations) were climate permits as well as grazing activities as well as wildlife/wilderness. These ideal soil forms include Ermelo/Clovelly, which are considered ideal for agricultural cultivation due to:

- Deep well drained soil characteristics;
- Texture and structure allowing for effective rooting depth; and
- Good water holding/storage capacity.

A significant portion of soils (120.8 ha out of 466.8) considered suitable for cultivation will be lost, resulting in a loss of land capability. Large portions of arable soils will be stripped and stockpiled and thus potentially reducing the fertility status (sterilisation) of the soils and being prone to erosion. The proposed activities will lead to a permanent change of land use if not properly mitigated. Consequently, the loss of agricultural soils and the permanent change in land use will be localized to within the project area and also considering that mining related activities are already taking place on a large portion of the project area and surrounding areas which may potentially impact on these arable soils.

2.5.2 IMPACT ASSESSMENT

2.5.2.1 CONSTRUCTION PHASE

The activity of site clearance, the removal of vegetation, improper waste management and associated disturbances to soils may lead to increased nutrient leaching, runoff and erosion and consequent sedimentation. Typical activities in the construction phase include:

- Earthworks
  - Removal of existing minor structures (such as fencing if present).
  - Clearing of vegetation (trees, bushes and grasses) in the footprint area associated for the proposed developments.
  - Soil stripping and stockpiling.
- Construction activities
  - Excavations and trenching.
  - Frequent operation and movement of earth moving and digging machinery.

In the unmitigated scenario, the impact of construction activities on the agricultural potential of the soils was rated as Medium and reduces to Low post mitigation.

Table 2-8: Impact Summary - Loss of agricultural land capability in Construction Phase

Issue: Loss of agricultural land capability in Construction Phase		
Phases: Construction Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Medium	Low
Duration	Medium	Low
Extent	Low	Low
Consequence	Medium	Low
Probability	Very High	Medium
Significance	**Medium**	Low

2.5.2.2 OPERATIONAL PHASE

During the operational phase, there will be on-going disturbances to soil resources in areas marked for mining activities as well as maintenance activities and the continued use of existing services. These activities have the potential to impact the agricultural land capability by increased leaching of soil nutrients and risk of erosion, potential increase in concentrations of contaminant concentration and altered vegetation community structures, and consequently altering the quality and nutrient status of the soil. In an unmitigated scenario, the impacts are rated as **MEDIUM** and can be reduced to **LOW** post mitigation.

Table 2-9: Impact Summary - Loss of agricultural land capability in Operational Phase

Issue: Loss of agricultural land capability		
Phases: Operational Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Medium	Low
Duration	High	Low
Extent	Low	Low
Consequence	Medium	Low
Probability	Very High	Medium
Significance	**Medium**	Low

MANAGEMENT OBJECTIVE

The objective is to prevent a loss of agricultural land capability.

EMERGENCY SITUATIONS

None identified.

2.5.3 MANAGEMENT ACTIONS

2.5.3.1 CONSTRUCTION PHASE

- *Close supervision and monitoring of the stripping process is required to ensure that soils are stripped correctly and backfilled after the laying down of water pipelines.*
- *The footprint areas should be lightly ripped to alleviate compaction.*

2.5.3.2 ON-GOING (ALL PHASES)

- *Revegetate the disturbed soils with an indigenous grass mix, to re-establish a protective cover, in order to minimise soil erosion and dust emissions.*

2.6 CUMULATIVE IMPACTS ON SOIL AND LAND CAPABILITY

The loss of land capability is anticipated to be MEDIUM as the significant portion (164.05 ha out of 522.63) of the dominant soils are considered ideal for cultivation. Large portions of arable soils will be stripped and stockpiled and thus potentially reduce the fertility status of the soils and will be prone to erosion. The proposed activities will lead to a permanent change of land use if not appropriately mitigated. The cumulative loss from a soil and land capability perspective is anticipated to be Medium pre-mitigation and Low after mitigation. This is due to the significant portion of the Project Area having soils classified as suitable for agricultural cultivation. However, the suitability for successful dry land agriculture is low due to the climatic conditions of the area. This area experiences erratic and very low rainfall which is necessary for successful dryland agriculture. In addition, no large dams or irrigation schemes are available in the area thus limiting the soils in the area to grazing and wildlife uses. The high evaporation rate of the hot, dry climate will result in regular irrigation needed should crops be produced this way. Lastly, the loss of agricultural soils and the permanent change in land use will be localized to within the Project Area. The mitigation measures presented in this EMPR must be implemented accordingly, with the aim of minimizing the potential loss of these valuable soils considering the need for sustainable development.

3 BIODIVERSITY

The assessment of impacts to biodiversity (flora and fauna) presented herein was sourced from the Biodiversity Assessment Report for Mokala Manganese Mine as prepared by Ecological Management Services (EMS) in January 2022. The scope of the specialist study included all project components as described in Section 4.2 of the main EIA document.

3.1 ISSUE: LOSS OF NATURAL VEGETATION, INCREASE IN ALIEN INVASION AND FURTHER HABITAT FRAGMENTATION

3.1.1 DESCRIPTION AND ASSESSMENT OF IMPACT

The proposed project comprises of activities which have the potential to negatively impact on natural vegetation through all phases of the proposed project. The approval of the proposed project activities will result in unavoidable destruction of vegetation through developmental, operational, decommissioning and closure phases.

3.1.2 IMPACT ASSESSMENT

3.1.2.1 ALL PHASES

Vegetation clearing will occur as a result of mining and changes to the infrastructure. This will cause additional fragmentation and habitat disturbance in the landscape. This disturbance destroys primary vegetation. As primary vegetation is more functional in an ecosystem, this could irreversibly transform the vegetation characteristics and faunal populations in the area. Clearing of additional surface area has the effect of creating more unnatural open spaces through the vegetation and the matrix of the landscape.

Additional clearance of primary vegetation allows secondary pioneer species or invasive plants to enter and re-colonise disturbed areas, thus increasing the possibility of alien species invading. Invasive species affect our natural biodiversity in a number of ways. They may compete directly with natural species for food or space, may compete indirectly by changing the food web or physical environment or hybridize with indigenous species. Rare species with limited ranges and restricted habitat requirements are often particularly vulnerable to the influence of these alien invaders.

Table 3-1: Impact Summary - Loss of natural vegetation, alien invasion and further habitat fragmentation

Issue: Loss of natural vegetation, alien invasion and further habitat fragmentation		
Phases: Construction, Operational, Decommissioning & Closure		
Criteria	Without Mitigation	With Mitigation
Intensity	High	Medium
Duration	High	High
Extent	Very Low	Very Low
Consequence	Medium	Medium

Issue: Loss of natural vegetation, alien invasion and further habitat fragmentation		
Probability	High	Medium
Significance	**Medium**	**Medium**

MANAGEMENT OBJECTIVES

To prevent loss of natural vegetation, increase in alien invasion and further habitat fragmentation due to mining operations.

EMERGENCY SITUATIONS

None identified.

3.1.3 MANAGEMENT ACTIONS

3.1.3.1 OPERATION

- *Compile a comprehensive concurrent site wide rehabilitation plan to revegetate the area post mining to reflect a re-mining state. This should be reviewed* and/or amended as per the GNR 1147 or relevant legislation at the time)

3.1.3.2 ON-GOING / ALL PHASES

- Implementation of an alien invasive species programme.
- Implementation of a biodiversity action plan to ensure that the undeveloped/mined areas within the property are properly conserved and maintained.
- *Investigate and implement a biodiversity offset to offset against the current and future loss of natural vegetation.*
- *Limit disturbances to the actual development footprint.*
- *Demarcate the surrounding edges of the developmental footprint as no-go areas.*
- *Managed non - mined areas in line with the biodiversity action plan to ensure functioning ecological linking corridors of these sites with the surrounding undisturbed properties.*
- *Keep non-mined areas of the mining right site free of disturbance.*
- *Compile and implement a comprehensive Alien Invasive Plant Removal Programme for the mining right area.*
- *All cleared areas should be re-seeded once the topsoil has been replaced with a seed mixture reflecting the natural vegetation as is currently found (harvesting of seed from similar areas within the study area should be undertaken). This may be used in conjunction with a commercially available mix as this will ensure a good vegetation coverage and soil stability. Species such as Stipagrostis are good sand binders and aid in stabilising the substrate and are present within the study area*.

3.1.4 MONITORING

- *Monitoring of non-mined areas to ensure they are kept free from disturbance as part of the biodiversity action plan.*

3.2 ISSUE: ADDITIONAL LOSS OF SENSITIVE HABITATS, PROTECTED FLORA AND FAUNAL SPECIES OF CONSERVATION CONCERN

3.2.1 DESCRIPTION OF IMPACT

The proposed new mining and infrastructure layout will result in the additional loss of a significant number of protected trees, mainly through vegetation clearance. However indirect impacts of dust generation and ground water drawdown associated with the increased area of the pit may also cause a loss sensitive specifies and Species of Conservation Concern (SCC).

3.2.2 IMPACT ASSESSMENT

3.2.2.1 ALL PHASES

Vegetation clearance and removal

The preliminary tree removal permit for the currently approved mining right, caters for the removal of ≈20 000 trees. An additional ± 203 ha will be cleared for the proposed amendments this could result in more than 10 000 additional trees being lost. The infrastructure changes that have already occurred were undertaken for the most part within the area already covered by the permit which would not have influenced the clearance of the protected plants significantly, unless the area of clearance was significantly greater than what was proposed in the original layout plan. However protected plants may have been removed without the necessary permits in the areas not covered by the permit, this is also pertinent to the low grade stockpile and WRD.

The area of the proposed pit expansion and the area where the barrier pillar mining would take place falls within the *V. haematoxylon* Savannah and contains a large number of protected trees and can be classified as an area with medium sensitivity. The western portion of the mining right area (where the new WRD will be established) is indicative of a game area which is heavily overstocked, resulting in degraded vegetation. The grass biomass is very low and there are patches where there is very little grass cover, in other areas grass species such as *Schmidtia kalahariensis* dominates which is very indicative of over utilization. This heavy grazing pressure has resulted in a change in grass structure and composition and the condition ranges from poor to moderate. There are however still a substantial number of protected trees, mostly *Vachellia erioloba* in this area which will be lost as a result of the proposed mining activity. The area of the proposed pipeline that runs along the R380 contains some protected trees, the area is heavily disturbed and is populated by many weedy plants and invasive species, thus it is not considered a sensitive area. The portion from the R380 towards the extraction point, contains protected trees and a significant population of *Harpagophytum procumbens* (Devil's claw), thus this area has a higher sensitivity rating, owing to the presence of these protected species. Although a comprehensive rehabilitation program is planned, there is no guarantee that the protected trees will successfully re-populate the area, or over what time period successful re-growth will occur.

Indirect impacts - ground water drawdown

The increased area of the open pit (and barrier pillar mining) may cause indirect impacts. The impact could be temporary and reverse on mine closure (e.g., dust from roads) or could be permanent (e.g., ground-water dewatering, although ground water levels may recover over time after mining, important ecosystems, may have been lost) resulting in permanent changes in the ecosystem. While the activities causing the impacts happen on the site; they could result in offsite impacts and regional effects. Some mining impacts do not result in the immediate loss of natural habitat and important species but are cumulative on the structure and function of individual plants, vegetation communities and ecosystems. Negative impacts on Aquifer Dependent Ecosystems (ADEs) may occur due to the proposed pit expansion (including barrier pillar mining).

The ADEs depend on groundwater in, or discharging from an aquifer, structural and functional losses will occur to the ADEs if groundwater was no longer available. ADEs found on Kalahari sands are characterised by the abundance of *Vachellia erioloba*, a species which is sensitive to changes in depth to the water table as well as *Vachellia haematoxylon*, *Vachellia karroo*, *Rhus lancea*, *Tamarix usneoides*, and *Euclea pseudebenus.* These trees have been identified in academic literature as occurring in stands and as gallery forests - are keystone ecosystems. Keystone species are considered sensitive species because their roots are thought to act as nutrient pumps, It is equally likely that these species provide water to shallower-rooted plants via hydraulic lift. ADEs particularly in arid ecosystems provide habitats for an array of species and are considered important in ecological processes by making available resources for the biodiversity in an area that would otherwise not be available.
A high rainfall year is needed to stimulate seed germination and promote seedling recruitment in groundwater dependent phreatophytes such as *Vachellia erioloba*. Very little research in the Kalahari has focused on water consumption by the various types of vegetation and on the partitioning of transpired water between water that is extracted from different depths of the unsaturated zone and that which originates from the saturated zone. Thus, it is very difficult to predict the extent to which altering the water levels in the aquifers may impact on these ecosystems. A study on the Ga-Mogara River near Kathu to evaluate the effects of dewatering due to mining activities (Institute for Water Research, 2012) shows that along the main tributary, the largest hydrological output from the system is due to riparian evapotranspiration. Such evapotranspiration constitutes approximately 96% of water loss from the system in unaffected areas and 99% in mining-affected areas where water abstraction has taken place (Institute for Water Research, 2012). The difference is small but indicates that there is very little margin of change that can be tolerated before ecosystem stress will occur. Ecosystem change, i.e., increased mortality rates of trees, would be expected in areas of increased abstraction. Unfortunately, there is very limited research information on how the ADE plants access the water and at what depth they are accessing this water, what the effect of changing the ground water system would have on the plants and vegetation structure within the ADE and how this would affect ecosystem function on a landscape scale.

In terms of dewatering impacts, larger trees will be most at risk because they are less flexible in root growth. Small trees are more flexible because they can grow down to the depths necessary. However, for big trees, a sudden drop in the water table can effectively put them into a situation where they can't reach the water. Although camel thorns have very deep recorded root depths, however research suggests that they only extend their roots down as far as necessary. This would suggest that the dewatering as a result of mining would have the greatest negative impact on large trees within and around the study area and that these negative impacts would be exacerbated during periods of drought which could result in large scale mortalities of large trees in particular and the destruction of the aquifer dependent ecosystem.

The ground water study conducted for this project, has determined that the Radius of Influence (ROI) for this project has an elliptical shape with an extent of approximately 5 km to the north and south and approximately 1 to 1.5 km towards the east and west. The simulated drawdown below the proposed topsoil stockpiles and WRDs ranges between approximately 16 m and 60 m and it is likely that the water level will be drawn down below the sediments of the Kalahari Formation. The highest impact on boreholes is expected in the direct vicinity to the proposed mining infrastructure and only a minor negative impact on borehole yields is expected for boreholes further away from the project site. It is unlikely that an additional water level drawdown will be observed that far from the mine pit, and the impact on ground water is considered to be low (SLR, November 2021). However, there is still the potential that additional protected trees could be lost indirectly through the lowering of the water table.

Indirect impacts - dust generation

Dust may cause physical injury to tree leaves and bark, reduced fruit setting, and cause a general reduction in growth. Dusting of stigmatic surfaces can completely suppress fruit production and dust may also inhibit pollen germination. Dust can cause blockage and damage to stomata, shading, abrasion of leaf surface or cuticle, and cumulative effects e.g., drought stress on already stressed species as dust can cause a reduction in photosynthesis and diffusive resistance and an increase in leaf temperature, the latter two effects making the tree more likely to be susceptible to drought. These changes in the vegetation may also affect animal communities, from vertebrate grazers to soil invertebrates, which could result in the alteration of cycles of decomposition. There are also chemical effects of dust, either directly on the plant surface or on the soil. Dust deposited on the ground may produce changes in soil chemistry, which may in the longer-term result in changes in plant chemistry, species competition and community structure. However, the soil type surrounding a mineral site will probably reflect the mineral being worked, so this is unlikely to be a common problem. The effects of dust are not always permanent, and relief may occur after periods of rain. However, in an area where the rainfall is low and erratic the respite received from rainfall may not be significant. A dust dispersion model should be undertaken to assess the potential for additional protected trees to be lost indirectly because of the negative effects of dust on vegetation and ecology. These impacts affect the ecological functioning of ecosystems and may result in deterioration of habitats and loss of sensitive species.

Table 3-2: Impact Summary - Additional loss of Sensitive habitats, Protected Flora and Faunal Species of Conservation Concern

Issue: Loss of Sensitive habitats, Protected Flora and Faunal Species of Conservation Concern		
Phases: Construction, Operational, Decommissioning & Closure		
Criteria	Without Mitigation	With Mitigation
Intensity	High	Medium
Duration	High	High
Extent	Medium	Low
Consequence	High	Medium
Probability	High	Medium
Significance	**High**	**Medium**

MANAGEMENT OBJECTIVES

To prevent the additional loss of sensitive habitats, protected flora and faunal Species of Conservation Concern.

EMERGENCY SITUATIONS

The unauthorised removal of protected trees and/ or faunal species is considered an emergency. Mokala should obtain rectify the unauthorised activity by obtaining the necessary permits and consulting with an appropriately qualified specialist as well as the relevant officials to assess the extent of loss and / or damage.

3.2.3 MANAGEMENT ACTIONS

3.2.3.1 ON-GOING / ALL PHASES

- *Identify protected tree species which may require removal due to mining activity and discuss the implementation* of a biodiversity offset with the relevant authorities (DAFF) prior the removal of any protected trees.
- Prevent the disturbance of sensitive areas so that the species composition and ecosystem functionality remain intact as far as practically possible.
- As part of con-current rehabilitation during the operational and decommissioning phases, all cleared areas should be re-seeded once the topsoil has been replaced with a seed mixture reflecting the current natural vegetation. This may be used in conjunction with commercially available mix as this will ensure good vegetation coverage and soil stability.
- *Implement dust suppression measures to limit the amount of dust generated.*
- *Apply engineering measures to minimize the predicted groundwater impacts. The mitigation measures should be developed on a site-specific basis. Examples of engineering measures could include artificial recharge where groundwater from the pumped discharge can be re-injected back into the ground, either to prevent lowering of groundwater levels and corresponding ground settlement, or to prevent depletion of groundwater resources.*
- *Where protected trees occur within the planned infrastructure areas, losses can be lessened by re-designing the infrastructure which will minimize the impact to individual trees.*

3.2.3.2 PRE-CONSTRUCTION AND CONSTRUCTION PHASE

- Limiting infrastructure, activities, and related disturbance to those specifically identified and described in this report
- Preconstruction surveys of the development footprints for species suitable for search and rescue operations.
- *Collect pods of Vachellia erioloba, and Vachellia haematoxylon from the area prior to construction and clearance activities to aid in the re-establishment of these species. These seeds do however require artificial scarring/acid washing in order to aid in germination.*
- *Prior to the clearing of the protected floral species the relevant permits must be obtained from the relevant authorities.*
- Implement a search and rescue plan for protected trees such as Devli's Claw which can be removed prior to development. *The relocation site must be carefully selected to prevent disturbance at the relocation site and the process must be managed to ensure adequate survival rates of relocated plants.*

3.2.3.3 DECOMMISSIONING AND CLOSURE PHASE

- Closure objectives should aim to ensure effective rehabilitation to as close to pre-mining conditions as practically possible. In addition to this closure planning needs to take into consideration the requirements for the establishment of long term species diversity, ecosystem functionality, aftercare, and confirmatory monitoring

3.2.4 MONITORING

3.2.4.1 ON-GOING / ALL PHASES

- A comprehensive monitoring programme of the protected trees within the area must be undertaken. This monitoring should be conducted on an individual tree basis as well as monitoring on a community level.
- *Compile a comprehensive rehabilitation plan to revegetate the area post mining to reflect a re-mined state. The plan must include the establishment of protected trees within the rehabilitated areas. Progress of tree growth and recruitment must be monitored and actively managed to ensure that the rehabilitated areas reflect the surrounding vegetation in terms of structure and composition.*

3.2.4.2 CONSTRUCTION AND OPERATIONAL PHASE

- *During the construction and operational phases, Mokala should investigate the possibility and practicality of removing dust from protected trees as an experimental monitoring trial. Should the experimentation process prove successful the techniques developed could assist in minimizing the stresses of the trees, particularly within linking corridors inside the mining area.*

3.3 ISSUE : ANTHROPOGENIC DISTURBANCES, INTENTIONAL AND/OR ACCIDENTAL KILLING OF FAUNA

3.3.1 DESCRIPTION OF IMPACT

The proposed project activities will require the development, operation and decommissioning of infrastructure, as such anthropogenic disturbances (even controlled) are inevitable. This disturbance may be short lived during the construction and decommissioning phases and decrease in the operational phase. Anthropogenic disturbances include aspects such as, vibrations caused by machinery and vehicles.

3.3.2 IMPACT ASSESSMENT

3.3.2.1 ALL PHASES

These aspects will impact on invertebrate species more than any other faunal species. These **a**nthropogenic disturbances impact on the way invertebrates forage. For example; some invertebrates use vibrations caused by their prey to locate and catch them. Vibrations caused by construction equipment will make this impossible. Smaller fauna will inevitably be killed during land clearing activities as these activities will destroy their habitat some fauna may also be killed as a result of operational activities. Mining related infrastructure also pose a risk for faunal species in terms of contaminated water or rowning in retention dams. Increase vehicle traffic could result in an increase in road-kill incidences beyond the boundary of the mine. In addition to unintentional killing of fauna, some faunal species, particularly herpetofaunal species, are often intentionally killed as they are thought to be dangerous. Artificial lighting of the mine area has the potential to impact faunal species, particularly invertebrates. Studies have indicated that artificial light can affect trophic levels (altering the predator prey relationship) which then translates to an ecosystem imbalance. This impact will have a greater impact during the operational phase of the mine, as it is assumed that continuous lighting will occur throughout the night of the operational and infrastructure area.

Table 3-3: Impact Summary - Anthropogenic disturbances, intentional and/or accidental killing of fauna

Issue: Anthropogenic disturbances, intentional and/or accidental killing of fauna		
Phases: Construction, Operational& Decommissioning		
Criteria	Without Mitigation	With Mitigation
Intensity	Medium	Medium
Duration	High	High
Extent	Very Low	Very Low
Consequence	Medium	Medium
Probability	Medium	Low
Significance	**Medium**	**Low**

MANAGEMENT OBJECTIVES

To prevent avoid and or reduce anthropogenic disturbances which cause the intentional and/or accidental killing of fauna.

EMERGENCY SITUATIONS

The unauthorised removal of protected trees and/ or faunal species is considered an emergency. Mokala should obtain rectify the unauthorised activity by obtaining the necessary permits and consulting with an appropriately qualified specialist as well as the relevant officials to assess the extent of loss and / or damage.

3.3.3 MANAGEMENT ACTIONS

3.3.3.1 ON-GOING (ALL PHASES)

During construction, operation, decommissioning and closure the following needs to be adhered to:

- The use of light is kept to a minimum, and where it is required, yellow lighting is used where possible.
- Vertebrates should be kept away from the proposed project area with appropriate fencing.
- Implement training for workers on the value of biodiversity and the need to conserve the species and systems that occur within the surface use area. *The intentional killing of fauna can be mitigated through education and training and the enforcement of a strict policy against the killing of fauna.*
- There is zero tolerance of the killing or collecting of any biodiversity by anybody working for or on behalf of Mokala.
- Strict speed control measures are used for any vehicles driving within the surface use area.
- Noisy and/or vibrating equipment will be well maintained to control noise and vibration emission levels.
- Dust control measures must be implemented.
- Implement pollution and litter prevention measures.

- Prevention and combatting veld fires though establishment and maintaining of fire breaks and through the education of employees.
- Mokala will form part of existing forums within the area and work together with local farmers to combat, manage, and control veld fires.
- In case of a major incident the emergency response procedure in Section 34 of the main EIA document will be followed.
- *A Biodiversity Action Plan for the unmined areas of the mining right should be drawn up and monitoring of these sites undertaken.*
- *Minimising the number of lights on a development will lower the overall levels of light pollution and reduce the impact that lighting will have on wildlife.*
- *An area should not be over-illuminated, it is best to only use as many lights as necessary.*
- *Utilise lamps with longer wavelengths of the light spectrum (i.e., red, yellow, and orange light) to prevent visual disturbance of the majority of insects and other invertebrates.*
- *Lights that emit a broad spectrum of light with a high UV component should be avoided. If lighting is necessary, then low pressure sodium lamps or narrow spectrum LED lights that incorporate full cut-off shielding are preferable. Ultraviolet - absorbing filters or glass can also be used on lamps that emit UV light.*

3.3.3.2 DECOMMISSIONING AND CLOSURE PHASE

- As part of closure planning, the designs of any permanent and potentially polluting structures (mineralised waste facilities) will take consideration of the requirements for long term pollution prevention and confirmatory monitoring.

3.4 CUMULATIVE IMPACTS ON THE BIODIVERSITY

Cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity when added to other existing, planned, and/or reasonably anticipated future ones. Cumulative impacts are contextual and encompass a broad spectrum of impacts at different spatial and temporal scales. In some cases, cumulative impacts occur because a series of projects of the same type are being developed in close proximity, or from the combined effects over a given resource of a mix of different types of projects.

Figure 3-1 shows the current level of disturbance surrounding the Mokala MRA, there are numerous mines as well as the town of Hotazel within a 10 km radius of the MRA. One can assume that some of these mines will increase in size over the next 20 years, and that this area will be subject to mining disturbance for at least another 30 years. Two water courses namely the Ga-Morgara and Witleegte run through the area. These are classified as ecological support areas and, generally CBA land-use guidelines propose no mining within ESAs. However there has already been some mining within these two rivers courses, at other mines in the local area.

The Mokala mine has already undertaken a river diversion along the portion of the Ga-Moraga River, in order to accommodate the pit expansion into the river course. South of this area are two open pits (the Hotazel Pit and the York Pit which are part of Kudumane Mine) that encroach within the Ecological Support Area (ESA) of the Ga-Moraga River. An old pit is located within the Witleegte just before the confluence between the Ga-Morgara and the Witleegte to the south of the Mokala Mine. Between the Vlermuisleegte water course and the Witleegte are two additional large mining areas, UMK and Tshipi Borwa Mine as well as the old Mamatwan Mine. Thus, along a 40 km stretch there are already large amounts of disturbances along the water courses which fragments this ESA.

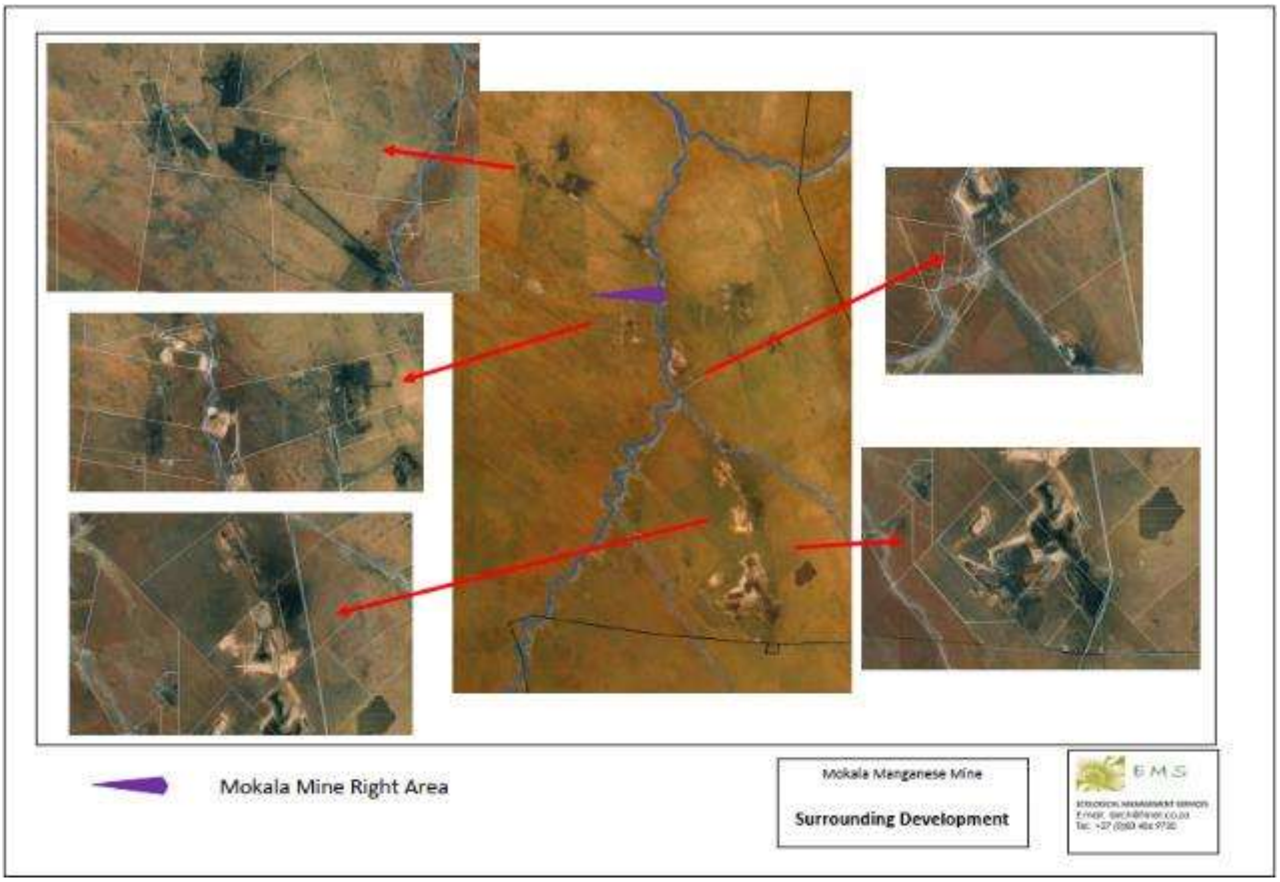


Figure 3-1: Current development surrounding the Mokala Mining Right Area (MRA) (EMS, January 2022)

Additional transformation of intact habitat contributes to the fragmentation of the landscape and could potentially disrupt the connectivity of the landscape for fauna and flora and impair their ability to respond to environmental fluctuations. This greater area contains Kathu Bushveld and Gordonia Duneveld, however most of the development surrounding the Mokala MRA falls within the Kathu Bushveld. Both of these vegetation types are listed as least concerned; however, the Kathu Bushveld is regarded as poorly protected. The loss of unprotected/poorly protected vegetation types on a cumulative basis from the broad area may impact the countries' ability to meet its conservation targets.

The area surrounding the Mokala MRA contains protected trees which have been impacted as a result of the various developments in the greater area. Resulting in an ever-increasing amount of these protected trees being lost from the area. The biodiversity is degraded by many small impacts that individually do not appear to threaten these species' persistence but could have a significant impact of this system's ability to function.

The ground water survey conducted for the current project, estimates that the Radius of Influence (ROI) from dewatering will be limited and that the impact to ground water will be low. However, one has to consider that there are other mines within a 10 km radius of the Mokala MRA mostly with pits that would also have an impact on the ground water. These small individual impacts however do add additional stress to the system as a whole which could significantly stress the project area ecosystem, and in turn, it could result in additional tree losses and ecosystem function.

The significance of the impact of dust, is also increased by the cumulative effect of the number of mines and mining activity surrounding the Mokala MRA. Additional clearing of vegetation and mining activity in the area will add to the significance of this already occurring impact.

Table 3-4: Impact Summary - Cumulative impacts on biodiversity

Issue: Cumulative impacts on biodiversity		
Phases: Construction, Operational, Decommissioning & Closure		
Criteria	Without Mitigation	With Mitigation
Intensity	High	Medium
Duration	High	High
Extent	Medium	Low
Consequence	High	Medium
Probability	High	Medium
Significance	**High**	**Medium**

3.4.1 MANAGEMENT ACTIONS

Mitigating cumulative impacts depends on the success of all the mitigation measures proposed to mitigate the various impacts to the biodiversity. As this will limit the incremental addition of a particular impact on the biodiversity. Project mitigation to minimize cumulative impacts, may include adaptive management approaches to project mitigation as well as participation in regional monitoring programs to assess the realized cumulative impacts and efficacy of management effort. The significance of the cumulative impact on the biodiversity will largely be influenced by the success of the rehabilitation of the area post mining.

4 FRESHWATER RESOURCES AND ECOLOGY

The assessment of impacts to freshwater resources presented in this section was sourced from the Freshwater Assessment as prepared by Scientific Aquatic Services (SAS) in July 2021. The scope of the specialist study included an assessment of the expansion of the open pit and barrier pillar mining between Mokala and Kalagadi mines, proposed berms situated between the extended pit and the river, the Plant Area, High Grade and ROM stockpiles and the internal haul road, all in the north-eastern portion of the project area. All other proposed activities are located to the west of the open cast pit which will intercept any potential impacts arising as a result of those activities of the layout changes which have already taken place. Impacts to freshwater resources due to the proposed establishment of the potable water pipeline is not included in the specialist assessment, however the pipeline is located to the west of the site and is not expected to impact on freshwater resources or ecology.

4.1 ISSUE: IMPACT ON FRESHWATER RESOURCES AND ECOLOGY

4.1.1 DESCRIPTION OF IMPACT

Four aspects of freshwater ecology were considered when assessing the impacts of the proposed mining related activities:

- Loss of habitat and ecological structure (including alien plant invasion);
- Changes to ecological and sociocultural service provision;
- Hydrological function and sediment balance; and
- Impacts on water quality (when surface water is present).

The assessed reach of the Ga-Mogara River is deemed of increased ecological integrity, and although capacity to provide specific ecological and socio-cultural services is restricted by the episodic nature of the system, it nevertheless forms part of the continuum of ecological processes within the focus area, immediate surrounds, and downstream areas. Although the Ga-Mogara River is a highly episodic system, flowing once every few decades, riverine systems and particularly ephemeral / episodic riverine systems or river systems that have very low flows as part of their annual hydrological cycles are particularly susceptible to changes in habitat condition, and changing climatic conditions and rainfall patterns may result in changes to the hydraulic regime of the system. Flooding of the Ga-Mogara River can have economically and ecologically devastating effects. Thus, potential impacts on habitat and ecological structure, hydrological function, sediment balance and water quality were considered to have a 'high' intensity but are mostly site specific and therefore limited in extent, although the duration during construction particularly may be short but occur daily.

4.1.2 IMPACT ASSESSMENT

4.1.2.1 CONSTRUCTION PHASE

This section presents the impact significance ratings per project activity in the construction phase as assessed by (SAS, July 2021).

Internal Haul Road (approximately 140 m west of the Ga-Mogara River)

Typical construction phase activities which are associated with the internal haul road (140 m west of the Ga-Mogara River) as detailed below:

- Vehicular transport and access to the site, site clearing;
- Removal of vegetation and associated disturbances to soil
- Miscellaneous activities by construction personnel.
- Potential indiscriminate encroachment of the watercourse by personnel and construction vehicles;
- Possible spills / leaks from construction vehicles;
- Removal of topsoil and creation of soil stockpiles upgradient of the river;
- Disturbances to soil leading to proliferation of alien vegetation which may spread to the river; and
- Possible discard of construction material within the river.

The potential impacts associated with the construction activities as listed above include:

- Exposure of soil, leading to increased runoff, erosion and transport of sediment in runoff or by wind, leading to increased sedimentation of the river;
- Increased sedimentation of already transformed riparian habitat, leading to smothering of flora and of egg banks of macroinvertebrate taxa and potentially further altering surface water quality when present;
- Decreased ecoservice provision; and
- Further proliferation of alien vegetation as a result of disturbances.
- Disturbances of soil leading to increased alien vegetation proliferation, and in turn to further altered riparian habitat;
- Possible contamination of freshwater soil and surface water, leading to reduced ability to support biodiversity;
- Altered runoff patterns, leading to increased erosion and sedimentation of the instream and/or riparian habitat.

Table 4-1: Impact summary – Freshwater ecology due to construction of internal haul road (approximately 140 m west of the Ga-Mogara River) during the construction

Issue: Freshwater ecology due to construction of internal haul road (approximately 140 m west of the Ga-Mogara River)		
Phases: Construction		
Criteria	Without Mitigation	With Mitigation
Intensity	Very Low	Very Low
Duration	Very Low	Very Low
Extent	Very Low	Very Low
Consequence	Very Low	Very Low
Probability	Very Low	Very Low
Significance	Insignificant	Insignificant

Plant Area, High Grade and Run of Mine (ROM) Stockpiles approximately 575 m from and upgradient of the Ga-Mogara River

Typical construction phase activities which are associated with the Plant Area, High Grade and Run of Mine (ROM) Stockpiles approximately 575 m from and upgradient of the Ga-Mogara River are detailed below:

- Site preparation prior to construction of Plant Area, and various High Grade and ROM stockpiles
- Removal of topsoil from Plant Area and stockpiles footprint and stockpiling thereof for rehabilitation.
- Clearing of vegetation upgradient of (but further than 500 m from the Ga-Mogara River) for construction of the Plant Area and establishment of the various ROM and High Grade stockpiles.

The potential impacts associated with the construction activities as listed above include:

- Exposure of soil, leading to increased runoff, erosion, and transport of sediment in runoff or by wind, and thus increased sedimentation of the watercourse;
- Increased sedimentation of already transformed riparian habitat, leading to smothering of flora and of egg banks of macroinvertebrate taxa and potentially further altering surface water quality when present;
- Decreased ecoservice provision; and
- Further proliferation of alien vegetation as a result of disturbances.
- Increased risk of transportation of sediment from exposed soil in stormwater runoff or by wing, leading to increased turbidity of surface water when present, sedimentation of watercourse and changing the characteristics of the stream bed, smothering of vegetation and/or altered vegetation composition, smothering of egg banks of macroinvertebrate taxa and/or destruction of suitable macro-invertebrate habitats;
- Indirect impacts on riparian areas due to the disturbance of the activity, such as increased dust generation leading to smothering of riparian vegetation;
- Exposure of soils, leading to increased runoff and erosion, and thus increased risk of sedimentation of the river;
- Increased sedimentation of the river, leading to smothering of flora and egg banks of macro-invertebrates, and potentially altering surface water quality when present;
- Increased hardened surfaces and compacted soils thus altering the pattern, timing and distribution of recharge of the river; and
- Increased proliferation of alien vegetation as a result of disturbances.

Table 4-2:Impact summary - Freshwater ecology due to construction of Plant Area, High Grade and Run of Mine (ROM) Stockpiles

Issue: Freshwater ecology due to construction of Plant Area, High Grade and Run of Mine (ROM) Stockpiles		
Phases: Construction		
Criteria	Without Mitigation	With Mitigation
Intensity	Low	Low
Duration	Very Low	Very Low

Issue: Freshwater ecology due to construction of Plant Area, High Grade and Run of Mine (ROM) Stockpiles		
Extent	Very Low	Very Low
Consequence	Very Low	Very Low
Probability	Low	Low
Significance	**Very Low**	**Very Low**

Expansion of open pit to within 55 m of diverted segment of Ga-Mogara River and mining of barrier pillar between Mokala and Kalagadi Mines within 25 m of Ga-Mogara River

Typical construction phase activities which are associated with the expansion of open pit to within 55 m of diverted segment of Ga-Mogara River and mining of barrier pillar between Mokala and Kalagadi Mines within 25 m of Ga-Mogara River are detailed below:

- Site clearing prior to commencement of construction activities related to the open pit expansion area, including placement of contractor laydown areas and storage facilities, if existing facilities cannot be utilised for practical reasons.
- Removal of topsoil from open pit footprint and stockpiling thereof for rehabilitation.
- Potential indiscriminate disposal of hazardous and non-hazardous material and waste in the Ga-Mogara River
- Surface impact during blasting and initial removal of overburden.

The potential impacts associated with the construction activities as listed above include:

- Damage to marginal and non-marginal vegetation, leading to exposure and compaction of soil, in turn leading to further increased runoff and erosion
- Exposure of soil, leading to increased runoff from cleared areas and further erosion of the river, and thus increased potential for further sedimentation of the river;
- Increased sedimentation of the river may lead to changes in instream habitat, potentially altered surface water quality when present and smothering of vegetation and/or altered vegetation composition;
- Decreased ecoservice provision;
- Further decreased ability to support biodiversity, specifically downstream of the MRA; and
- Increased proliferation of alien vegetation as a result of disturbances.

The identified activities above have the potential to impact on the freshwater ecology to varying degrees, where impact caused by site clearance and removal of topsoil from the pit and stockpiling were assessed to have the least significant impact on the Freshwater Ecology. The significance rating was Very Low in both the mitigated and unmitigated scenario. The impact of blasting and overburden removal was assessed as Medium significance both before and after mitigated measures. Taking the risk adverse approach to impact assessment, the issue with the highest impact significance in an unmitigated scenario is presented below for the expansion of the open pit and mining of barrier pillar activities in the construction phase. This activity was the improper waste management practises for both non-hazardous and hazardous wastes. In an unmitigated scenario the impact was assessed as High and was reduced to Negligible with mitigation.

Table 4-3: Impact summary – Impact on freshwater ecology due to expansion of open pit to within 55 m of diverted segment of Ga-Mogara River and mining of barrier pillar during the construction phase

Issue: Freshwater ecology due to expansion of open pit to within 55 m of diverted segment of Ga-Mogara River and mining of barrier pillar		
Phases: Construction		
Criteria	Without Mitigation	With Mitigation
Intensity	High	Very Low
Duration	Very High	Very Low
Extent	Medium	Very Low
Consequence	High	Very Low
Probability	High	Very Low
Significance	High	**Insignificant**

Construction of berms within 30 m of diverted segment of Ga-Mogara River

Construction of berms during site preparation and establishment of the berms between open pit and Ga-Mogara River will typically involve the clearing and levelling activities. Potential impacts to freshwater ecology include an increase in sediment-laden runoff entering riparian habitat from berms which can lead to altering of water quality and altered drainage/flow regimes. Altered drainage and flow can causes altered runoff patterns and formation of preferential flow paths which contributes to erosion. In an unmitigated scenario the significance of the impact is Medium and can be reduced to Low after mitigation.

Table 4-4: Impact summary – Impact on freshwater ecology due to Construction of berms within 30 m of diverted segment of Ga-Mogara River during the construction phase

Issue: Impact freshwater ecology due to expansion of open pit to within 55 m of diverted segment of Ga-Mogara River and mining of barrier pillar		
Phases: Construction		
Criteria	Without Mitigation	With Mitigation
Intensity	High	Low
Duration	Medium	Medium
Extent	Very Low	Very Low
Consequence	Medium	Low
Probability	Medium	Low
Significance	**Medium**	Low

4.1.2.2 OPERATIONAL PHASE

This section will present the impact significance ratings per project activity in the operational phase as assessed by SAS (July 2021).

Internal Haul Road (approximately 140 m west of the Ga-Mogara River)

Typical operational phase activities which are associated with the internal haul road (140 m west of the Ga-Mogara River) as detailed below:

- Discharge of water into the river when rainfall occurs
- Regular vehicular traffic on internal access and haul roads upgradient of and within 140 m of the Ga-Mogara River.

The potential impacts associated with the operational activities as listed above include:

- Exposure of soil, leading to increased runoff, erosion and transport of sediment in runoff or by wind, leading to increased sedimentation of the river;
- Increased sedimentation of already transformed riparian habitat, leading to smothering of flora and of egg banks of macroinvertebrate taxa and potentially further altering surface water quality when present;
- Decreased ecoservice provision; and
- Further proliferation of alien vegetation as a result of disturbances.
- Disturbances of soil leading to increased alien vegetation proliferation, and in turn to further altered riparian habitat;
- Possible contamination of freshwater soil and surface water, leading to reduced ability to support biodiversity;
- Altered runoff patterns, leading to increased erosion and sedimentation of the instream and/or riparian habitat.

Table 4-5: Impact summary – Impact on freshwater ecology due to construction of internal haul road (approximately 140 m west of the Ga-Mogara River)

Issue: Impact freshwater ecology due to construction of internal haul road (approximately 140 m west of the Ga-Mogara River)		
Phases: Operational		
Criteria	Without Mitigation	With Mitigation
Intensity	Very Low	Very Low
Duration	Very Low	Very Low
Extent	Very Low	Very Low
Consequence	Very Low	Very Low
Probability	Very Low	Very Low
Significance	Negligible	Negligible

Plant Area, High Grade and Run of Mine (ROM) Stockpiles approximately 575 m from and upgradient of the Ga-Mogara River

Typical construction phase activities which are associated with the Plant Area, High Grade and Run of Mine (ROM) Stockpiles approximately 575 m from and upgradient of the Ga-Mogara River are detailed below:

- Alteration of the local hydrological regime due to potentially poorly managed stormwater and increased extent of impermeable surfaces upgradient of but further than 500 m from the river.
- Presence of clean and dirty separation infrastructure between the Plant Area and the Ga-Mogara River.

The potential impacts associated with the construction activities as listed above include:

- Erosion of terrestrial areas as preferential flow paths are formed in the landscape, resulting in sedimentation of the river, leading to altered channel competency, altered vegetation community structures, and loss of riparian and terrestrial habitat.
- Potential for erosion of terrestrial areas as a result of the formation of preferential flow paths, leading to sedimentation of the river
- Reduction in volume of water entering the river, leading to further loss of recharge of downstream system.

Table 4-6: Impact summary – Impact on freshwater ecology due to construction of Plant Area, High Grade and Run of Mine (ROM) Stockpiles during the operational phase

Issue: Impact freshwater ecology due to construction of internal haul road (approximately 140 m west of the Ga-Mogara River)		
Phases: Construction		
Criteria	Without Mitigation	With Mitigation
Intensity	Low	Low
Duration	Very Low	Very Low
Extent	Very Low	Very Low
Consequence	Very Low	Very Low
Probability	Low	Low
Significance	Very Low	Very Low

Expansion of open pit to within 55 m of diverted segment of Ga-Mogara River and mining of barrier pillar between Mokala and Kalagadi Mines within 25 m of Ga-Mogara River

Typical operational phase activities which are associated with the expansion of open pit to within 55 m of diverted segment of Ga-Mogara River and mining of barrier pillar between Mokala and Kalagadi Mines within 25 m of Ga-Mogara River are detailed below:

- Operation of expanded open pit within 55 m of diverted segment of Ga-Mogara River:
- Removal of topsoil and overburden and stockpiling thereof;
- Transport of manganese to High Grade stockpile and Plant Area
- Blasting/mining activities in order to remove overburden and to extract the manganese;
- Removal of manganese and overburden from the open cast pits.

The potential impacts associated with the construction activities as listed above include:

- Increased risk of pollution of surface water when present, which may affect the downstream reaches of the river, leading to impaired water quality and salination of soil within the river;
- Increased risk of sediment transport via wind and/or surface runoff from the overburden stockpile into the river, potentially leading to altered water quality, further altered channel competency and further altered vegetation community composition; and
- Increased risk of erosion, leading to further altered topography/geomorphology, in turn resulting in altered runoff patterns and formation of preferential flow paths.

- Nitrates from blasting leading to potential eutrophication of the receiving environment and resulting in impairment of water quality within the catchment.

Table 4-7: Impact summary – Impact on freshwater ecology due to expansion of open pit to within 55 m of diverted segment of Ga-Mogara River and mining of the barrier pillar during the operational phase

Issue: Impact freshwater ecology due to expansion of open pit to within 55 m of diverted segment of Ga-Mogara River and mining of barrier pillar		
Phases: Construction		
Criteria	Without Mitigation	With Mitigation
Intensity	High	High
Duration	High	High
Extent	Medium	Low
Consequence	High	High
Probability	High	Medium
Significance	**High**	**Medium**

Construction of berms within 30 m of diverted segment of Ga-Mogara River
During the operational phase the berms will be present within 30 m of the diverted segment of the Ga-Mogara River. Potential impacts will include:

- Sediment-laden runoff entering riparian habitat from berms, leading to altered water quality when present;
- Altered drainage/flow regimes, leading to altered runoff patterns and formation of preferential flow paths, leading to erosion.

In an unmitigated scenario the significance of the impact is **MEDIUM** and can be reduced to **LOW** after mitigation.

Table 4-8: Impact summary – Impact on the freshwater ecology due to the construction of berms within 30 m of diverted segment of Ga-Mogara River during the operational phase

Issue: Impact on freshwater ecology due to the operation of berms within 30 m of diverted segment of Ga-Mogara River		
Phases: Operational		
Criteria	Without Mitigation	With Mitigation
Intensity	High	Low
Duration	Medium	Medium
Extent	Very Low	Very Low
Consequence	Medium	Low
Probability	Medium	Low
Significance	**Medium**	**Low**

4.1.3 CUMULATIVE IMPACT

Cumulative impacts are activities and their associated impacts on the past, present and foreseeable future, both spatially and temporally, considered together with the impacts identified above. The assessed reach of the Ga-Mogara River associated with the Mokala Mine has already been influenced by impacts which have occurred upstream of the mine, including the formation of swallets, upstream river diversion structures and encroachment of various mining activities on portions of the river. These impacts have most likely had an effect on the ecological functioning of downstream reaches, and the proposed and existing activities at Mokala Mine are likely to contribute to further impacts downstream of the mine.

MANAGEMENT OBJECTIVE

The objective is to prevent negative impacts on freshwater resources and freshwater ecology.

EMERGENCY SITUATIONS

Emergency situations should be handled in accordance with the Mokala emergency procedure as detailed in Section 34 of the main EIA document.

4.1.4 MANAGEMENT ACTIONS

4.1.4.1 ONGOING/ ALL PHASE

- 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):
  - Clean water systems are separated from dirty water systems
  - Clean run-off and rainfall water is diverted around dirty areas and back into its normal flow in the environment
  - The size of dirty water areas are minimized and dirty water is contained in systems that allow the reuse and/or recycling of this dirty water
  - Discharges of dirty water may only occur in accordance with authorisations that are issued in terms of the relevant legislation specifications, and they 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.
- All hazardous chemicals (new and used), mineralized waste and non-mineralised waste must 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
  - Specifications for post rehabilitation audit criteria to ascertain whether the remediation has been successful and if not, to recommend and implement further measures.
- The designs of potentially polluting structures will take account of the requirements for long term surface water pollution prevention.
- Mokala will monitor the water quality of the Ga-Mogara when in flow as per the monitoring programme outlined in the main EIA document.

- In case of a discharge incident that may result in the pollution of surface water resources, the emergency response procedure will be followed.
- 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:
    - Clean water systems are separated from dirty water systems
    - The size of dirty water areas are minimized and clean run-off and rainfall water is diverted around dirty areas and back into the normal flow in the environment
    - The site wide water balance is refined on an on-going basis with the input of actual flow volumes and used as a decision making tool for water management and impact mitigation.
    - The location of all activities and infrastructure should be outside of the specified zones and/or flood lines of watercourses. If this is unavoidable the necessary exemptions/approvals will be obtained.
    - Due to the uncertainties associated with the peak flood events, it is recommended that these uncertainties are managed by applying a 1 m freeboard to design levels for any infrastructure within close proximity to the Ga-Mogara drainage channel, including the proposed channel realignment and any flood protection berms.

4.1.4.2 CONSTRUCTION PHASE

Internal Haul Road (approximately 140 m west of the Ga-Mogara River)

- *There should be no need for any personnel or construction equipment to enter the delineated river or associated setback area, as the internal haul road is planned approximately 100 m from the river. Therefore, the river must be demarcated as a 'no go' area;*
- *No construction material or waste matter is to be discarded or disposed of within the river;*
- *Contractor laydown areas, vehicle re-fuelling areas and material storage facilities to remain outside of the delineated river and applicable setback area;*
- *Vehicle refuelling is to take place on sealed surfaces, and all spills are to be cleaned and treated in accordance with an approved emergency spills plan*
- *Construction of a temporary sediment trap downgradient of the haul road construction area is strongly recommended, to minimise the volume of sediment reaching the river;*
- *Construction footprint areas to remain as small as possible and vegetation clearing to be limited to what is absolutely essential;*
- *Vegetation removal to be kept to a minimum, and preferably only alien floral species to be removed; and*
- *Retain as much indigenous vegetation as possible.*

Plant Area, High Grade and Run of Mine (ROM) Stockpiles approximately 575 m from and upgradient of the Ga-Mogara River

- *The footprint area of the construction activity must be limited to what is absolutely essential in order to minimise the loss of clean water runoff areas and catchment yield, and concomitant recharge of the Ga-Mogara River;*
- *Prior to bulk earthworks either the existing clean and dirty water management system must be extended or, construction of new clean and dirty water management systems around the Plant must be prioritised for construction prior to commencing all other construction activities, to ensure that all "dirty water" areas can be managed as they are created;*

- *Design of the Plant, High Grade and ROM stockpiles must be environmentally and structurally sound and all possible precautions taken to prevent contamination of surface water.*
- *Limit the footprint of vegetation clearing to what is absolutely essential, retaining as much indigenous vegetation as possible;*
- *Rehabilitation and revegetation of disturbed areas (as a result of construction) must take place immediately after construction; and*
- *If an alien vegetation control plan has been developed for the mine, this must be implemented at this site. Alternatively, a suitable alien vegetation control plan must be developed by a suitably qualified specialist and implemented as soon as possible*

Expansion of open pit to within 55 m of diverted segment of Ga-Mogara River and mining of barrier pillar between Mokala and Kalagadi Mines within 25 m of Ga-Mogara River

- *Contractor laydown areas, and material storage facilities to remain outside of the delineated river and its 32m NEMA zone of regulation beyond the extent of the planned pit expansion;*
- *All vehicle re-fuelling is to take place outside of the river and its 32m NEMA zone of regulation;*
- *All clean and dirty water separation areas are to be developed first prior to any other major earthworks to reduce risk of erosion and sedimentation;*
- *All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is absolutely essential;*
- *Retain as much indigenous wetland and riparian vegetation as possible;*
- *It should be feasible to utilise existing roads to gain access to the site, and crossing the river in areas where no existing crossing is apparent should be unnecessary, but if it is essential crossings should be made at right angles;*
- *Areas where bank failure is observed as a result of such river crossings should be immediately repaired; and*
- *The watercourse areas beyond the proposed footprint of development and the NEMA zone of regulation (32m) should be clearly demarcated with danger tape and areas in which no activities are proposed should be marked as a no-go area.*
- *During construction, the topsoil should be removed up to a depth of 150mm and be carefully stockpiled, for use during rehabilitation, outside of the river and its 32m NEMA Zone of Regulation;*
- *Excavated materials should not be contaminated and it should be ensured that the minimum surface area is taken up. The stockpiles may not exceed 2m in height;*
- *All exposed soils must be protected for the duration of the construction phase in order to prevent erosion and further sedimentation of the reach of the river proximal to these stockpiles.*

Construction of berms within 30 m of diverted segment of Ga-Mogara River

- *Construction of sediment traps downgradient of the berms (i.e. between the berms and the river) are strongly recommended prior to construction of the berms, to minimise sediment volumes entering the river. These must be regularly inspected, and accumulated sediment removed by hand when required.*

4.1.4.3 OPERATIONAL PHASE

Internal Haul Road (approximately 140 m west of the Ga-Mogara River)

- *The design criteria of stormwater management structures are important to mitigate the operational impacts of the release of stormwater into the river when rainfall occurs. Regular inspection of the* *stormwater outlet structures should be undertaken in order to monitor the occurrence of erosion. If erosion has occurred, it should immediately be rehabilitated through stabilisation of the embankments and revegetation;*

- *Only indigenous vegetation species may be used as part of the rehabilitation process and invasive plant species should be eradicated.*
- *Regular dust suppression of the haul road (and other internal roads) must be undertaken, using recycled water (not dirty water) to minimise sedimentation.*

Plant Area, High Grade and Run of Mine (ROM) Stockpiles approximately 575 m from and upgradient of the Ga-Mogara River

- *Significant alterations to the local hydrological regime are not expected due to the semi-arid climate and intermittent rainfall patterns in the region. Nevertheless, all areas must be monitored for erosion, which must be managed and rectified according to existing soil management commitments should it occur.*

Expansion of open pit to within 55 m of diverted segment of Ga-Mogara River and mining of barrier pillar between Mokala and Kalagadi Mines within 25 m of Ga-Mogara River

- *Pollution prevention through appropriate management and monitoring of pollution prevention systems, with specific mention of the management of clean and dirty water separation systems, in order to prevent, eliminate and/or control potential pollution of soils, groundwater and surface water must be implemented;*
- *Implement a monitoring programme to detect and prevent the pollution of soils, surface water and groundwater; and*
- *Regular dust suppression of all internal transport routes must be undertaken, using recycled water (not dirty water) to minimise sedimentation.*
- *Reduce airborne dust during blasting activities through damping dust generation areas with water (although not in sufficient quantities to generate runoff).*

Construction of berms within 30 m of diverted segment of Ga-Mogara River

- *Retain sediment traps downgradient of the berms and continue with regular inspection and removal of accumulated sediment as necessary.*

5 GROUNDWATER

The assessment of impacts to groundwater presented herein was taken from Groundwater Assessment undertaken for the proposed project, as prepared by SLR in November 2021. The scope of the specialist study was limited to the following project components; expanded open pit mining area (including barrier pillar); proposed new waste rock dump (WRD); expansion of the approved WRD; approved product stockpiles.

5.1 ISSUE: CHANGE IN GROUNDWATER LEVELS AND GRADIENT

5.1.1 DESCRIPTION OF IMPACT IN THE OPERATIONAL PHASE

The mine floor elevation is below the general groundwater level thus causing groundwater inflows into the opencast mining areas from the surrounding aquifers during operations. The mining areas will have to be actively dewatered to ensure a safe working environment. Abstraction of groundwater that seeps into the mine areas will cause dewatering of the surrounding aquifers and an associated decrease in groundwater level within the zone of influence of the dewatering cone.

The zone of influence of the dewatering cone depends on several factors including the depth of mining below the regional groundwater level, recharge from rainfall to the aquifers, vertical infiltration of the recharging water, the size of the mining area, and the aquifer transmissivity amongst others. The 3-D numerical groundwater flow model was used to simulate the development of the drawdown cone over time in the study area. The latest mining schedules (at the time of investigation) was also taken in consideration when calculating the drawdown.

During the operational phase, it is expected that the main impact on the groundwater environment will be de-watering of the surrounding aquifer. Due to the aquifer characteristics in the focus area, a north-south elongated cone of depression occurs following the geological strike direction. Steep groundwater gradients are simulated east of the mine in lava of the Ongeluk Formation. The result suggests that mine pit dewatering will have a lower impact on water levels west and east of the pit. Drawdown at the end of LOM is illustrated in Figure 5-1. The Radius of Influence (ROI) has an elliptical shape with an extent of approximately 6 km to the north and south and approximately 1 to 1.5 km towards the east and west. The simulated drawdown below the proposed low-grade stockpile and WRDs ranges between approximately 16 m and 60 m, and it is likely that the water level will be drawn down below the sediments of the Kalahari Formation. The highest impact on boreholes is expected in the direct vicinity to the proposed mining infrastructure and only a minor negative impact on borehole yields is expected for boreholes further away from the project site. It is unlikely that an additional water level drawdown will be observed that far from the mine pit. Hydrocensus boreholes from the 2015 and current study that are located within the predicted ROI are all monitoring boreholes, and no private water supply (domestic or livestock) are predicted to be located within the ROI.

It must furthermore be kept in mind that the water table in the area is already affected by inflows into the neighbouring mines and impacts on water users in the area should therefore be considered as cumulative.

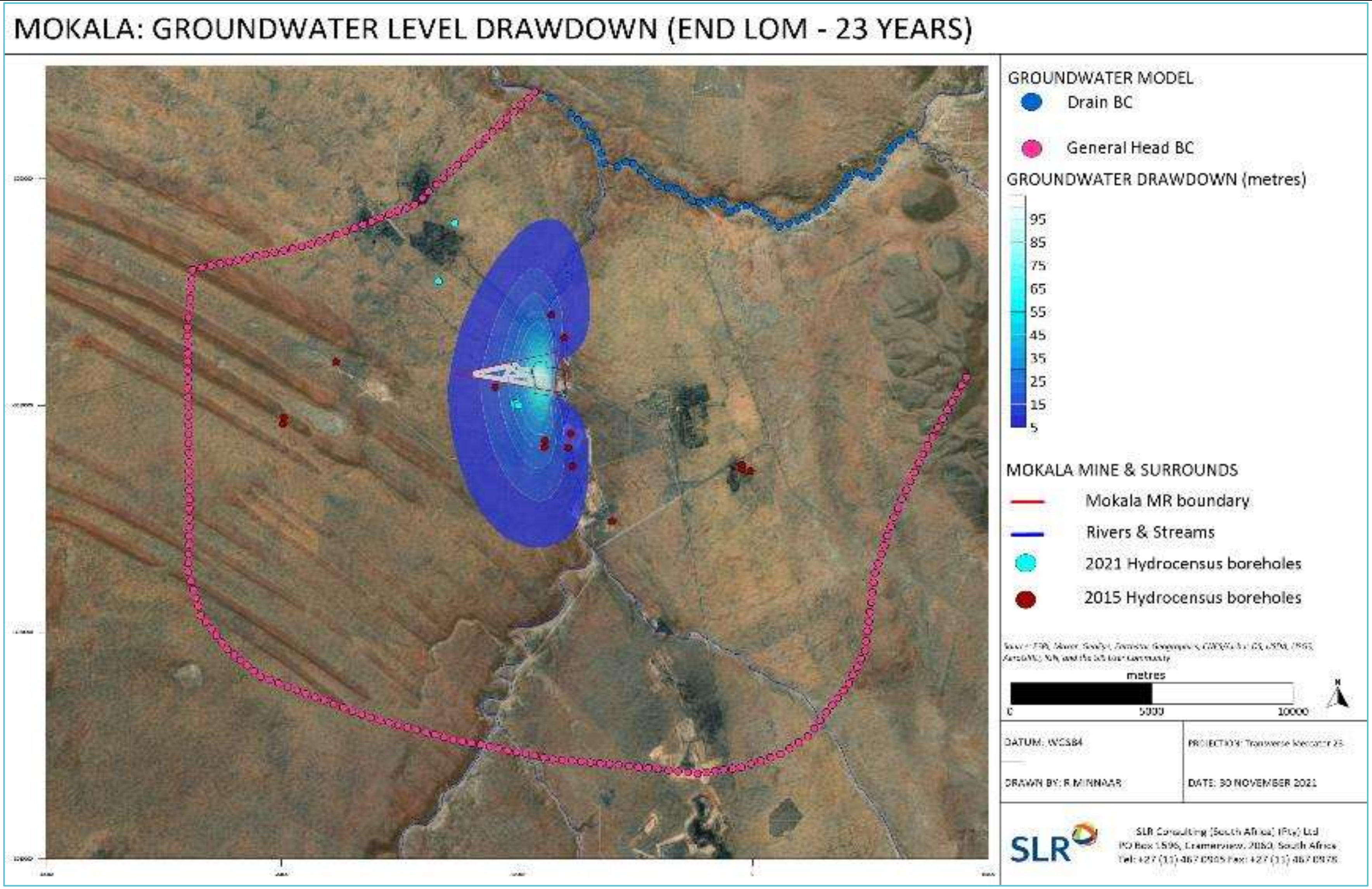


Figure 5-1: Simulated drawdown due to mine dewatering at end LOM (2042)

Mine groundwater inflow volumes: To account for the level of confidence in the calibration of the steady state numerical groundwater model and to provide an uncertainty range in calculated mine pit inflow rates the calibrated hydraulic conductivities were increased and lowered by 20% in additional scenarios. Estimates on mine pit inflow rates calculated using the base case model and the model scenarios assuming increased and decreased hydraulic conductivity values are presented in Figure 5-2**Error! Reference source not found.**. The inflow rates range between 297 m^3/d (3.4 L/s) and 399 m^3/d (4.6 L/s).

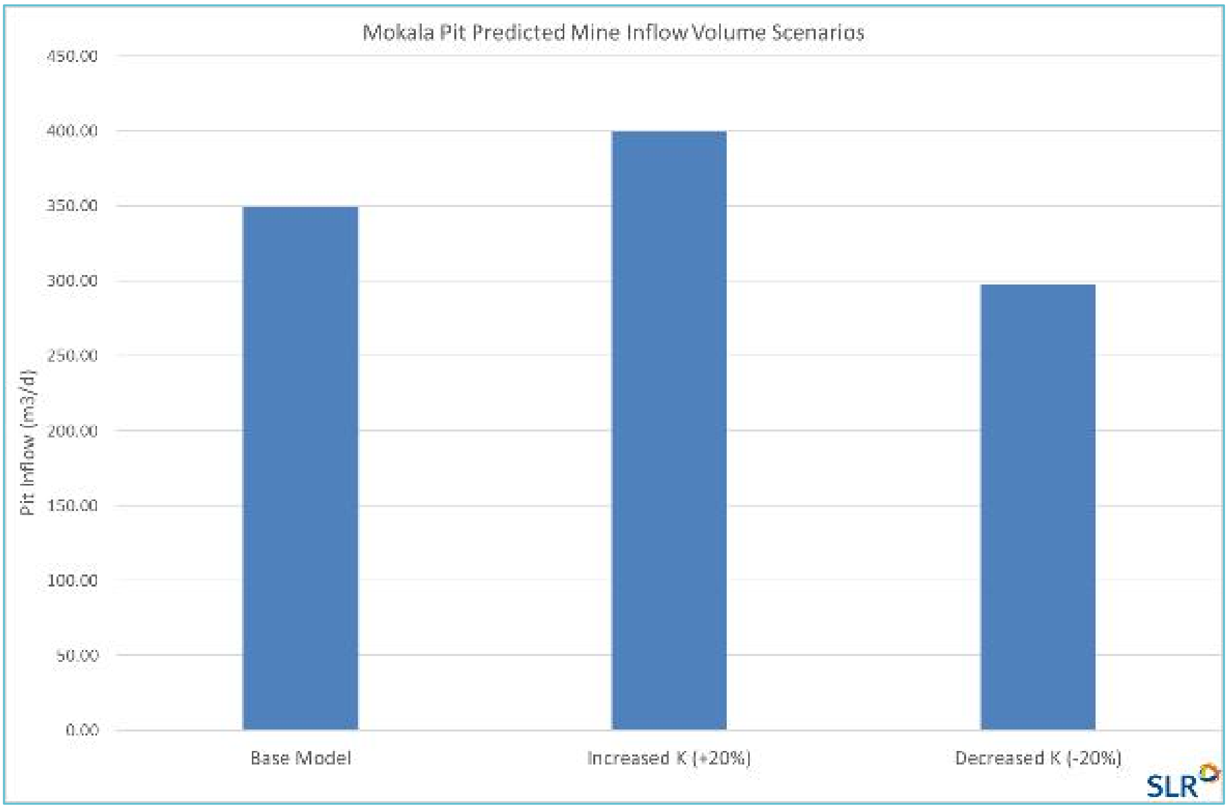


Figure 5-2: Mokala pit predicted inflow volume scenarios

5.1.1.1 IMPACT ASSESSMENT

The mine floor elevation is below the general groundwater level thus causing groundwater inflows into the opencast mining areas from the surrounding aquifers during operations. The mining areas will have to be actively dewatered to ensure a safe working environment. Abstraction of groundwater that seeps into the mine areas will cause dewatering of the surrounding aquifers and an associated decrease in groundwater level within the zone of influence of the dewatering cone. The Radius of Influence (ROI) has an elliptical shape with an extent of approximately 5 km to the north and south and approximately 1 to 1.5 km towards the east and west. The simulated drawdown below the proposed low-grade stockpile and WRDs ranges between approximately 16 m and 60 m and it is likely that the water level will be drawn down below the sediments of the Kalahari Formation. The highest impact on boreholes is expected in the direct vicinity to the proposed mining infrastructure and only a minor negative impact on borehole yields is expected for boreholes further away from the project site. It is unlikely that an additional water level drawdown will be observed that far from the mine pit. Hydrocensus boreholes from the 2015 and current study that are located within the predicted ROI are all monitoring boreholes, and no private water supply (domestic or livestock) are predicted to be located within the ROI. Therefore, the significance of this impact is ranked as low. The groundwater quantity impact during the operational phase is summarised in Table 5-1.

Table 5-1: Operational phase impact summary – Impact on groundwater quantity from open pit.

Issue: Change in groundwater levels and flow patterns due to dewatering of open pit		
Phases: Operational		
Criteria	Without Mitigation	With Mitigation
Intensity	Medium	Medium
Duration	Long term	Long term
Extent	Medium	Medium
Consequence	Medium	Medium
Probability	Possible	Possible
Significance	Low	Low

5.1.2 DESCRIPTION OF IMPACT IN THE CLOSURE PHASE

Feedback received from the client on the 25th of May 2021 indicated that a concurrent backfilling strategy over the LOM will be followed, but the scheduling thereof depends on commercial agreements between neighbouring parties for mining the boundary pillars.

Not all waste will be backfilled into the pit at the end of LOM due to swell. Remaining dumps will be rehabilitated. Since the backfilling scheduling has not been finalised, backfilling during LOM was not included in the numerical modelling. The estimated average pit water level simulated in the backfill scenario was used to calculate the time for pit water level recovery using a simple analytical approach. Pore volume has been calculated using the provided pit shell information and conservative porosity values of 10%, 15% and 20% for the backfilled material. Factors such as the shape and size, and the degree of sorting of the backfill material play a major role in porosity and may also vary significantly within the backfilled opencast pit areas. Inflow rates were taken from the simulated numerical groundwater model mine inflow volumes.

The calculations indicated that mine water level rebound will range between approximately 121 and 243 years. This implies that the backfilled mine pit will most likely continue to represent a local sink for many years after closure. It must be noted that the simulated timeframe of mine groundwater rebound is highly sensitive to assigned aquifer porosities, regional recharge rates, and seepage rates into the rehabilitated mining and waste areas, which are poorly defined model parameters. Once backfilling and closure plans are finalised the numerical groundwater model should be updated for closure predictive scenarios.

5.1.2.1 IMPACT ASSESSMENT

Analytical calculations indicated that mine water level rebound will range between approximately 121 and 243 years. This implies that the backfilled mine pit will most likely continue to represent a local sink for many years after closure. It must be noted that the simulated timeframe of mine groundwater rebound is highly sensitive to assigned aquifer porosities, regional recharge rates, and seepage rates into the rehabilitated mining and waste areas, which are poorly defined model parameters. Once backfilling and closure plans are finalised the numerical groundwater model should be updated for closure predictive scenarios. The groundwater quantity impact during the closure phase is summarised in Table 5-2.

Table 5-2: Closure phase impact summary – Impact on groundwater quantity from open pit.

Issue: Change in groundwater levels and flow patterns due to dewatered pit		
Phases: Closure		
Criteria	Without Mitigation	With Mitigation
Intensity	Medium	Medium
Duration	Very Long	Very Long
Extent	Medium	Medium
Consequence	High	High
Probability	Possible	Conceivable
Significance	**Medium**	**Medium**

MANAGEMENT OBJECTIVE

To ensure groundwater levels remains within acceptable limits.

EMERGENCY SITUATIONS

Soil eroding incidents will be handled in accordance with the Mokala's emergency response procedure in Section 34 of the main EIA document.

5.1.1 MANAGEMENT ACTIONS

5.1.1.1 ONGOING

The following management measures should be implemented to manage impacts to groundwater level:

- During the construction and operational and decommissioning phases, Mokala will implement the following:
  - All potentially affected third party boreholes will be included in the Mokala groundwater monitoring program to ensure that changes in water depths can be identified, where possible.
  - Where Mokala's dewatering causes a loss of water supply to third parties, appropriate compensation will be provided by Mokala until such time as the dewatering impacts cease.
  - Mokala will monitor groundwater quantity as per the monitoring programme as follows:
  - Boreholes located on Assmang's property (Gloria Mine) need to be incorporated into the groundwater monitoring programme, subject to Assmang granting Mokala access to their boreholes.

5.1.1.2 OPERATIONAL PHASE

The following management measures should be implemented to manage impacts to groundwater level:

- *Keeping the workings dry is necessary for mining and mitigation is not possible. No private water users are currently likely to be affected. Long term groundwater level monitoring is proposed, in order to compare measured groundwater levels to modelling results.*
- *Implement a pit dewatering strategy and prevent standing/ ponding of water within the open pit to minimize contamination. Water should be pumped on a continuous basis during the operational phase to ensure mine workings remain dry as well as to minimise chemical contact time with surrounding rock and build-up of salts due to evapotranspiration.*

5.1.1.3 CLOSURE PHASE

The following management measures should be implemented:

- *Change in post-closure groundwater levels is an unavoidable consequence of replacing the original aquifer material with backfill that has significantly different hydraulic properties. It is practically impossible to change the backfill properties. In this case, mitigation should address the uncertainty associated with the impact significance.*
  - *The drilling of boreholes into mining areas is recommended so that recovery of water can be monitored.*
  - *A hydrogeological closure assessment should evaluate the rebound of groundwater levels within the pit and site property boundary in more detail.*
- *The key source of uncertainty is the limited dataset on which the numerical model was based on, such as aquifer characterisation data and groundwater levels. Additional data can be obtained through a systematic groundwater monitoring programme. The data should be used to improve and update the numerical model and refine the model predictions of post-closure groundwater levels.*

5.2 ISSUE: DETERIORATION OF GROUNDWATER QUALITY

5.2.1 DESCRIPTION OF IMPACT IN THE OPERATIONAL PHASE

Potential plumes emanating from the most significant potential sources (low-grade stockpile, pit backfill, ROM, and WRDs) were simulated in a non-reactive solute transport groundwater model. No lining or base preparation of the stockpile footprint was assumed. Source concentrations modelled by SLR 2015b were used and the plumes are concentrations above background concentrations. Impacts associated with ad hoc sources such as spillages were not modelled. It is furthermore assumed that these ad hoc sources can be managed by Mokala using accepted management measures. The calibrated groundwater flow model served as the base for the non-reactive solute transport model. Potential impacts on groundwater levels due to progressive mine pit dewatering were accounted for during transport modelling. According to the dewatering scenario, the entire proposed mining infrastructure will be located within the cone of the depression of the dewatered mine pit. Therefore, it is assumed that the mine pit will eventually capture potential leachates and consequently a partial recycling of the seepage water with subsequent potential salt build-up within the water system of the mine.

Adsorption and potential degradation were not modelled, and the solute was treated as a conservative tracer by simulating only advection, longitudinal and transversal dispersion. Hence, processes that could reduce transport of contaminants were not simulated. Background sulphate and chloride concentrations from the site as analysed during the hydrocensus investigation were on average 551 mg/L (SO_4) and 970 mg/L (Cl).

The dyke underneath the low-grade pile and waste rock dump was inferred from drilling results of 1 exploration borehole (GL30), which intercepted an inferred dyke at 189 – 198.93 mbgl. Regionally and within the Mokala site, dykes and/or sill are present below the Olifantshoek Supergroup and Kalahari Formation. The inferred dyke underneath the low-grade pile and WRD is overlain by more than ~190 metres of Olifantshoek Supergroup and Kalahari Formation. Exploration borehole GL30 also intercepted at least ~85 metres of clay within the Kalahari Formation. The presence of the dykes had minimal influence on contaminant fate and transport from surface waste facilities. The numerical groundwater contaminant transport models at the end of the operational phase (23 years) resulted in a maximum plume migration of sulphate and chloride of ~165 m, with a sharp decrease of the source concentration within a short distance away from the mine site is predicted. Predicted sulphate and chloride plumes at the end of the operational phase are illustrated in Figure 5-3 and Figure 5-4, respectively. No private owned boreholes are predicted to be within the potential contaminant plumes.

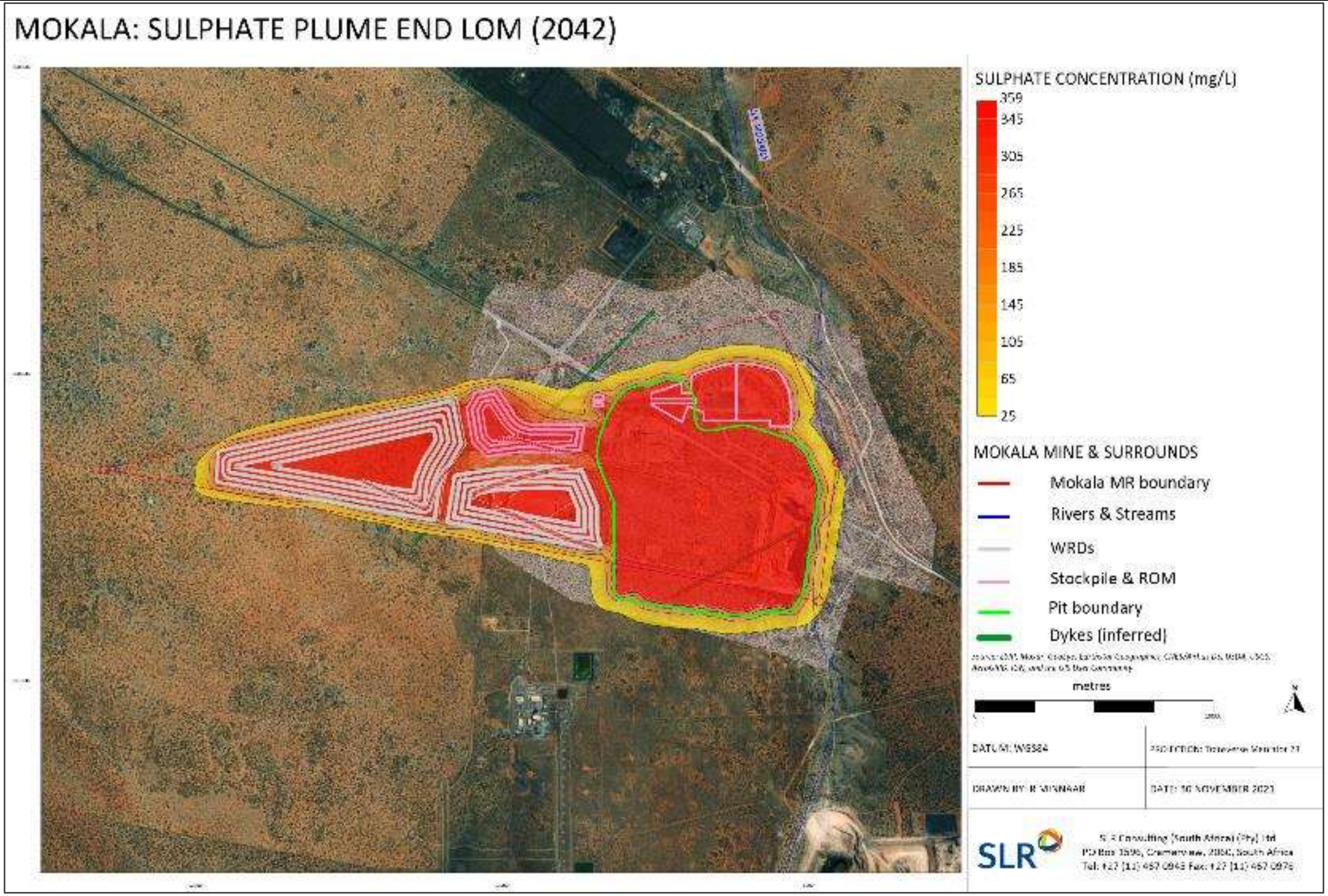


Figure 5-3: Simulated sulphate plume at end LOM from waste facilities and pit area.

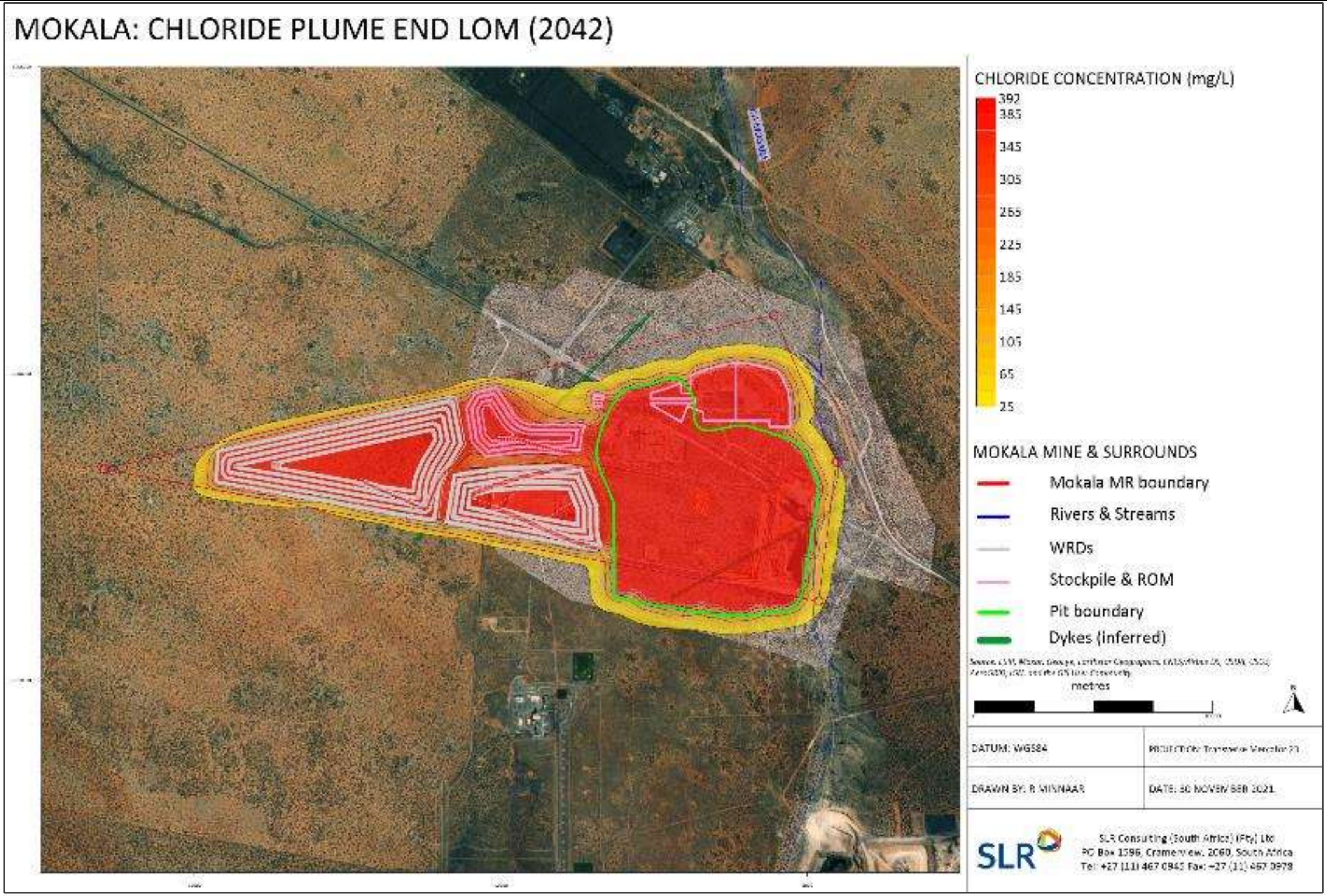


Figure 5-4: Simulated chloride plume at end LOM from waste facilities and pit area

5.2.1.1 IMPACT ASSESSMENT

Potential plumes emanating from the most significant potential sources (low-grade stockpile, pit backfill, and WRDs) were simulated and maximum plume migration of sulphate and chloride of ~165 m were predicted. A sharp decrease of the source concentration within short distance away from the mine site were predicted. No privately owned boreholes were predicted to be within the potential contaminant plumes. The groundwater quality impact during the operational phase is summarised in Table 5-3.

Table 5-3: Operational phase impact summary – Impact on groundwater quality from mine infrastructure.

Issue: Change in groundwater quality due to pit backfilling, low-grade stockpile, and waste rock dumps.		
Phases: Operational		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate	Low
Duration	Long term	Long term
Extent	Whole site	Whole site
Consequence	Medium	Medium
Probability	Possible	Conceivable
Significance	**Low**	**Low**

5.2.2 DESCRIPTION OF IMPACT IN THE CLOSURE PHASE

Potential plumes emanating from the most significant potential sources (low-grade stockpile, pit backfill, and WRDs) during the closure phase were simulated assuming a constant source term concentration. This is a worst-case assumption as in reality seepage concentration will decline over time due to leaching processes in the facility and rehabilitation. The stockpile and WRDs will also only exist as a source during the life of mine. Part of the WRDs will remain and will be rehabilitated after closure. Since there is no final closure plan and schedule, the WRDs and stockpile/ Run-of-Mine (ROM) areas are assumed to remain as a possible contaminant source term during closure, but with a reduced seepage rate to account for rehabilitation activities.

The groundwater model should be updated once final closure and backfilling plans and schedules are available to account for the backfilling and rehabilitation of pit, waste facilities, and stockpile/ ROM areas. Closure phase geochemical modelling should also be conducted to account for potential reduction in source terms due to rehabilitation, to provide a final closure phase input source term for the numerical groundwater model. The backfilled mine pit will most likely continue to represent a local sink for several years capturing potential residual pollutants in the unsaturated and saturated zones below the mining area, while also delaying the spreading of potential pollutants from the backfilled material.

The numerical groundwater contaminant transport models at 50 years after closure resulted in a maximum plume migration of sulphate and chloride of ~400 m. Potential contaminant plumes are predicted to remain within the mine area due to the pit acting as a local sink. Predicted sulphate and chloride plumes 50 years after closure are illustrated in Figure 5-5 and Figure 5-6, respectively. No privately owned boreholes are predicted to be within the potential contaminant plumes.

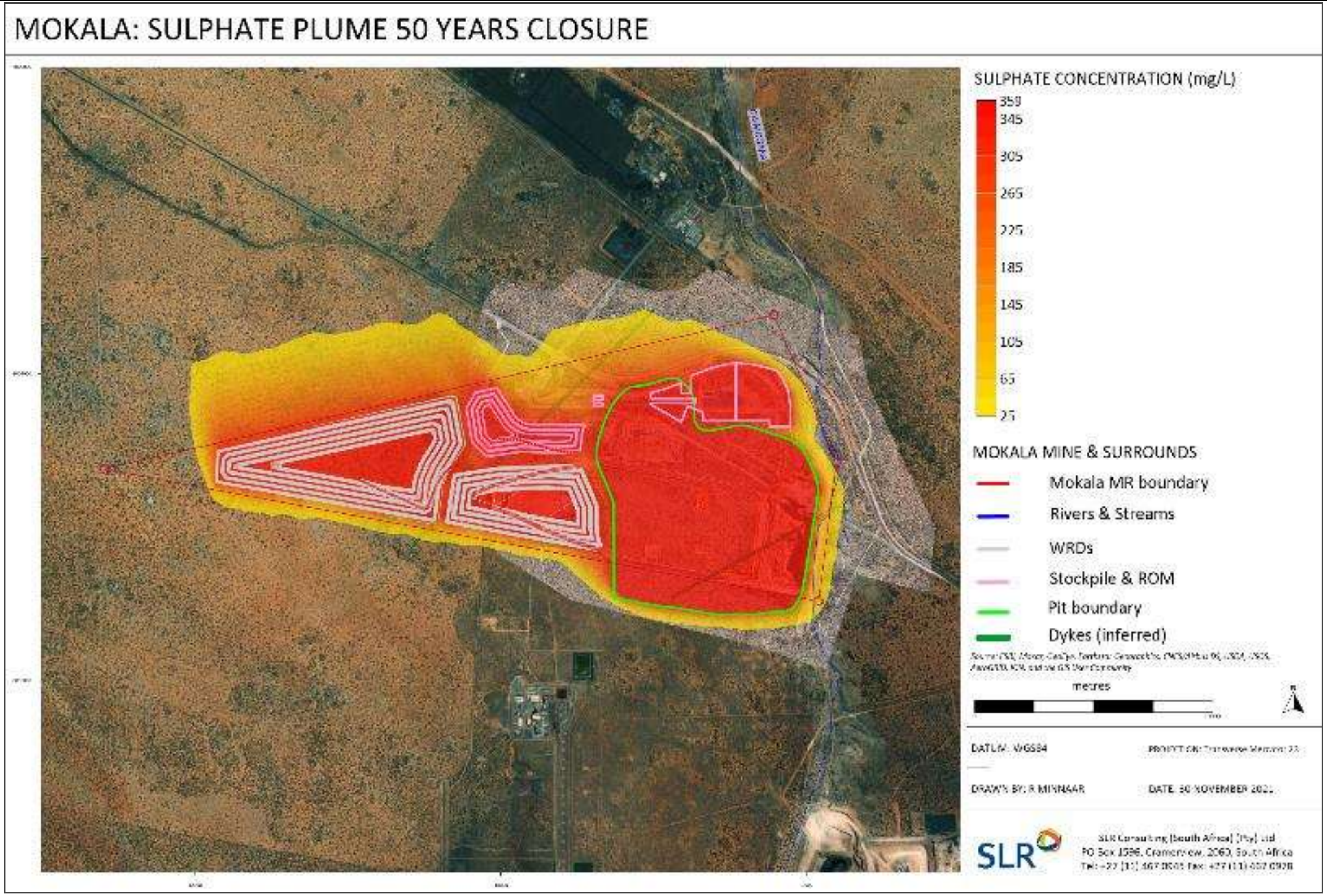


Figure 5-5: Simulated sulphate plume 50 years after closure from pit backfill and waste facilities.

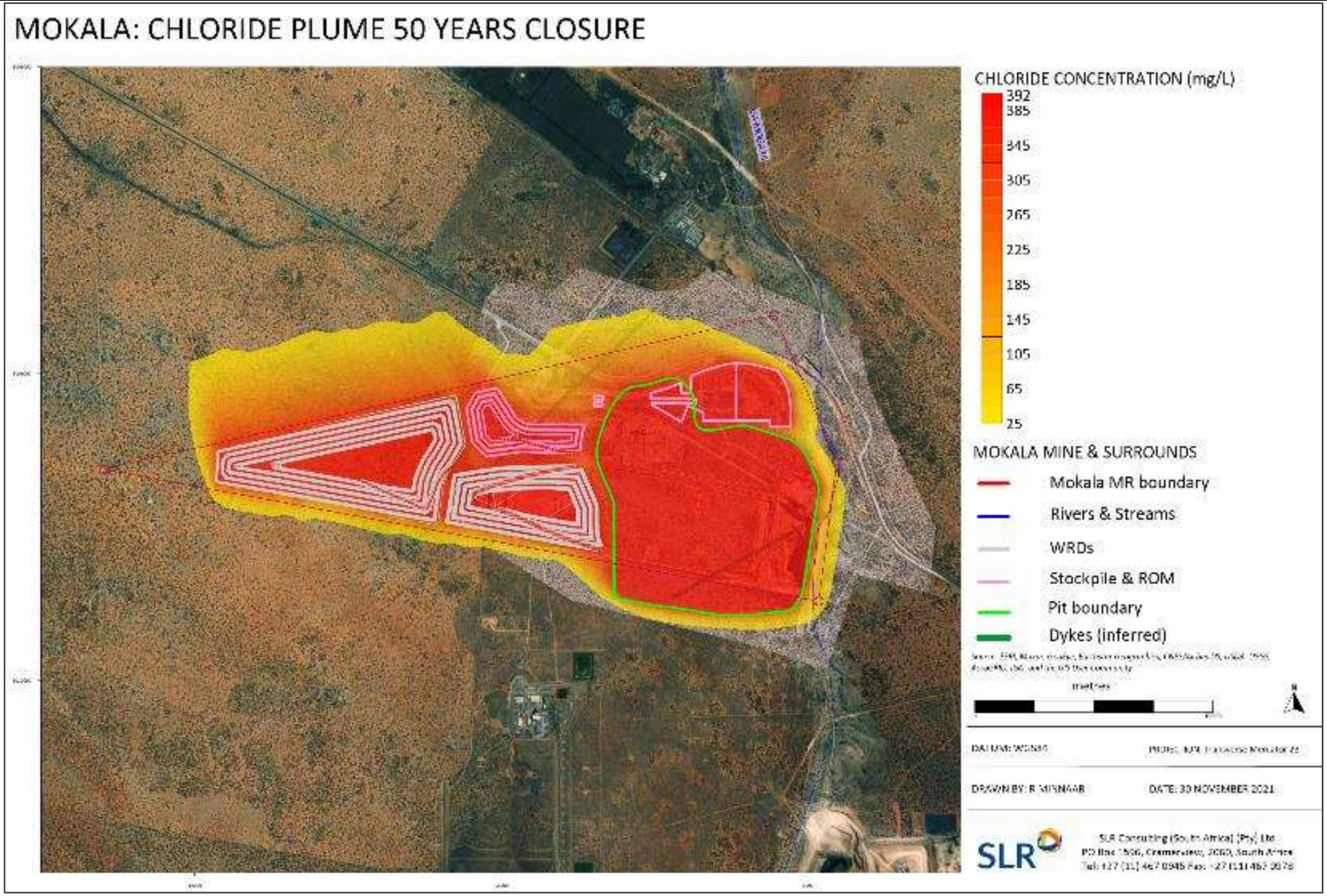


Figure 5-6: Simulated chloride plume 50 years after closure from pit backfill and waste facilities.

5.2.2.1 IMPACT ASSESSMENT

The numerical groundwater contaminant transport models at 50 years after closure resulted in a maximum plume migration of sulphate and chloride of ~400 m. Potential contaminant plumes are predicted to remain within the mining right area due to the pit acting as a local sink. No privately owned boreholes are predicted to be within the potential contaminant plumes. While the backfill material may pollute the groundwater resource, no third parties or animals are expected to make use of the polluted water. In the unlikely event that humans or animals make use of the polluted water, is it unlikely that short-duration exposure to contaminant concentrations will cause a health impact. The groundwater quality impact during the operational phase is summarised in the Table 5-4 below.

Table 5-4: Closure phase impact summary – Impact on groundwater quality from mine infrastructure.

Issue: Change in groundwater quality due to pit backfilling, low-grade stockpile, and waste rock dumps.		
Phases: Closure		
Criteria	Without Mitigation	With Mitigation
Intensity	Low	Low
Duration	Long term	Long term
Extent	Whole site	Whole site
Consequence	Medium	Medium
Probability	Possible	Conceivable
Significance	Low	Low

MANAGEMENT OBJECTIVE

To ensure groundwater quality remains within acceptable limits for both domestic and agricultural purposes to prevent harm to water users.

EMERGENCY SITUATIONS

Soil eroding incidents will be handled in accordance with the Mokala's emergency response procedure in Section 34 of the main EIA document.

5.2.1 MANAGEMENT ACTIONS

5.2.1.1 OPERATIONAL PHASE

The following management measures should be implemented to manage the deterioration of groundwater quality:

- In case of a major discharge incident that may result in the pollution of groundwater resources the emergency response procedure in will be followed.
- *Storm water control measures should be implemented to minimise infiltration into waste facilities, ensure diversion of clean and dirty water, and to minimise any potential ingress into the open pit.*
- *Low-grade stockpile and Waste Rock Dumps must be kept on a compacted area that will minimise infiltration of seepage.*

- *One of the most effective mitigation measures is the use and regular update of the existing numerical groundwater model as a management and predictive tool.*
    - *An updated hydrocensus investigation should be conducted with each model update to verify and establish potential groundwater impacts on neighbouring properties in terms of groundwater levels and quality.*
    - *The Mokala numerical model classified as Class 1 merely provides an initial assessment of the mine and associated impacts and can subsequently be refined and improved to higher confidence level classes as additional data is gathered.*
- *Improved confidence in the geochemical assessment results can be obtained by the continuation of geochemical sampling and analyses, and geochemical modelling during the operational phase.*
- *Rehabilitation should be an ongoing operational process for waste facilities (WRDs), where possible, to minimise the dirty footprint area and rainwater infiltration.*
- *Establish a groundwater monitoring network and implement a monitoring programme which includes:*
    - *Groundwater levels and quality – within the mine site and well as periodic regional monitoring.*
    - *Pit discharge quality and volumes.*
    - *Groundwater abstraction volumes from all water supply boreholes.*
    - *Daily rainfall.*
    - *All mine water data should be recorded and maintained within a dedicated central database that can be shared with relevant authorities and consultants.*

5.2.1.2 CLOSURE PHASE

The following management measures should be implemented:

- *The site should be rehabilitated according to an approved site closure and rehabilitation plan in the line with the contents of National Water Act (Act No 36 of 1998) and National Environmental Management Act (Act 107 of 1998), to avoid subsequent negative environmental impacts that may occur.*
- *It is recommended the site conduct a hydrogeological closure assessment.*
    - *The general closure objective would be to implement an environmental protection strategy to prevent any residual impacts on the environment, restore the land so that it may be suitable for the proposed end land use and obtain expedient closure.*
    - *All rehabilitation measures should be designed to facilitate a gradual reduction in the potential and identified hydrogeological environmental impacts caused by the entire mining operation.*
    - *A dedicated groundwater model should be used in the closure modelling and planning. This model should be updated regularly during closure phase.*
    - *Updates to the model will have to include mining plan, infrastructure data, and rehabilitation and closure options. Regular updates will increase the prediction accuracy as well as providing long term trends and allowing for intervention and timeous prevention measures.*
    - *The update of the numerical groundwater model for closure modelling and planning should include an updated geochemical assessment and model to characterise the closure source terms more accurately.*
- *Continuation of the site groundwater monitoring plan.*
    - *Frequency of monitoring and the groundwater closure monitoring network should be determined from a hydrogeological closure assessment.*
- *All old exploration boreholes must be sealed off during decommissioning/ closure.*

- *The monitoring network should be evaluated after closure and after any groundwater model updates.*

The following management measures should be implemented to manage the deterioration of groundwater quality:

- Mokala will comply with both the National Water Act (36 of 1998) and Regulation 704 (4 June 1999)
- Storage and handling of hazardous chemicals (new and used), mineralized wastes and non-mineralised waste must be handled in a manner that they do not pollute groundwater. This will be implemented by covering 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 chemicals, materials and non-mineralised waste
  - Required steps to enable containment and remediation of pollution incidents
  - Specification for post rehabilitation audit criteria to ascertain whether the remediation has been successful and if not, to recommend and implement further measures
- Planned infrastructure that has the potential to pollute groundwater (overburden stockpiles) will be identified and included into the groundwater pollution management plan which will be implemented and needs to comply with Section 7 of GN. 632. The plan includes:
  - Identify potential pollution sources
  - Determine the extent of the pollution plume
  - Design and implement intervention measures to prevent, eliminate and/or control the pollution plume.
  - Limit unauthorized access to overburden stockpile
  - Monitoring all potential impact zones to track pollution and mitigation impacts
  - Where monitoring results indicates that third party water supply has been polluted by Mokala, Mokala will ensure that appropriate compensation will be provided.
  - At closure no overburden will remain on surface as all overburdens will be backfilled into the open pit as part of rehabilitation
- Infrastructure that has the potential to pollute groundwater resources will be designed and implemented in a manner that pollution is addressed in all mine phases. In this regard design of overburden stockpiles need to comply with Section 7 of GN. 632 of NEM:WA where relevant.
- *Chemicals must be stored with the correct liner and spillage collection system to prevent water quality contamination.*
- *Development of a soil and water clean-up strategy must be developed in terms of unexpected spillage.*
- *Design and implement the correct spillage control such as fuel and oil traps at workshops, vehicle washing bays and oil/fuel depots*
- *Have oil spill kits available at areas where oil spills are likely and clean up oil spills immediately and dispose on prepared bunkered area or bioremediation site.*

GROUNDWATER MONITORING

5.2.1.3 GROUNDWATER MONITORING NETWORK

Mokala must implement the groundwater monitoring programme as per the approved 2015 EMPR, however the current assessment includes an update to the current groundwater monitoring network. It is therefore recommended that Mokala comply to the following:

- *The proposed location of the groundwater monitoring boreholes, exact location and number of monitoring boreholes should be defined as per the updated groundwater monitoring network recommended by the geohydrology assessment (SLR, November 2021).*
- The monitoring results should be assessed by a suitably-qualified professional registered with the South African Council for Natural Scientific Professional (SACNASP). All of the above may be amended to comply with the WUL conditions.
- Groundwater quality should be monitored bi-annually for the duration of the mine and for at least ten years after closure.
- Groundwater quantity should be monitored on a quarterly basis for the duration of the mine and for at least ten years after closure.
- The following parameters should be included as part of the groundwater quality monitoring:

pH	Potassium	Sulphate as SO_4
Electrical conductivity	Magnesium	Nitrate as N
Temperature	Manganese	Aluminium
Fluoride as F	Sodium	Boron
Total alkalinity as $CaCO_3$	Selenium	Total dissolved solids
Chloride as Cl	Zinc	Iron
Calcium		

- Groundwater monitoring reports need to be submitted to the DWS as per the conditions of the WUL.

The groundwater monitoring network design should comply with the risk-based source-pathway-receptor principle. A groundwater monitoring network should contain monitoring positions which can assess the groundwater status throughout the mine site. Both the impact on water quality and water quantity should be catered for in the monitoring system. The boreholes in the network should cover the following: contaminant sources, receptors, and potential contaminant plumes.

Furthermore, monitoring of the background water quality and levels is also required. Groundwater monitoring should be conducted to assess the following:

- *The impact of mine dewatering on the surrounding aquifers. This will be achieved through monitoring of groundwater levels in the monitoring boreholes.*
  - *Quarterly groundwater level monitoring is recommended with at least two boreholes equipped with automatic level sensors.*
- *Groundwater inflow into the open pit. This will be achieved through monitoring of groundwater levels in the monitoring boreholes as well as measuring water volumes pumped from mining areas.*
  - *Dewatering volumes should be metered and recorded in an appropriate water database.*
- *Groundwater quality trends. This will be achieved through sampling of the groundwater in the boreholes on a quarterly basis.*

- *Closure monitoring. A closure monitoring programme should be established when closure and rehabilitation plans are finalised.*
- *An updated hydrocensus investigation should be completed every 2 years during the operational phase to monitor background and regional groundwater level and quality parameters.*
    - *Post-closure regional monitoring should be conducted. However, post-closure monitoring requirements must be confirmed during a dedicated hydrogeological closure assessment.*

Preliminary suggestions for groundwater monitoring locations are indicated in Figure 5-7 and given in the Table 5-5 below.

Table 5-5: Proposed Mokala groundwater monitoring network details

BH ID	X	Y	Target	Parameters
BH01	-12335.87	-3008610	Background	Level and quality
BH02	-10866.62	-3008206	WRD	Level and quality
BH03	-10027.04	-3008592	WRD & stockpile	Level and quality
BH04	-9297.94	-3007874	Dyke	Level and quality
BH05	-8079.08	-3008143	Pit dewatering	Level and quality
BH06	-8664.57	-3009339	Pit & dyke	Level and quality
BH07	-10472.61	-3009041	WRD & dyke	Level and quality

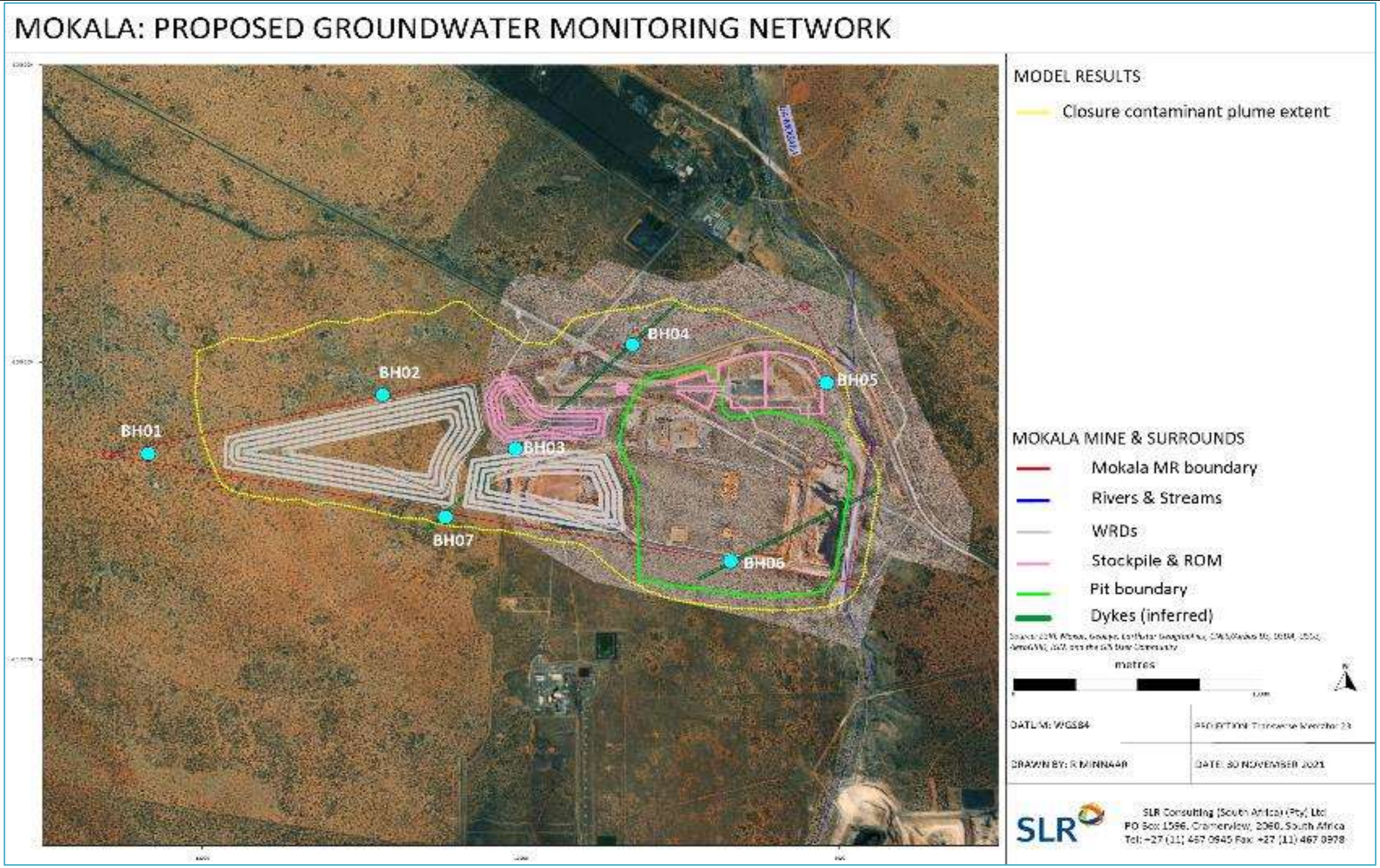


Figure 5-7: Proposed Mokala groundwater monitoring network.

6 AIR QUALITY

The assessment of air quality impacts due to the proposed project presented herein was sourced from the Air Quality Impact Assessment undertaken for the proposed project (Airshed, January 2022). It is important to note that this specialist study did not include an assessment of impacts due to the proposed establishment of the potable water pipeline.

6.1 ISSUE: AIR POLLUTION

Existing sources of emissions in the region and the characterisation of existing ambient pollution concentrations is fundamental to the assessment of cumulative air impacts. A change in ambient air quality can result in a range of impacts which in turn may cause a disturbance and/or health impacts to nearby receptors. There are a number of activities and or infrastructures in the operational and decommissioning and closure phases that have the potential to pollute the air. In the decommissioning and closure phase these activities are temporary in nature. The operational phase will present more long term activities. The closure phase will present final rehabilitated areas that may have the potential to pollute the air through long term wind erosion. This section focuses on the potential for human health impacts due to the proposed project activities.

6.1.1 DESCRIPTION OF IMPACTS

QUALITATIVE DESCRIPTION AND ASSESSMENT OF IMPACT OF ACTIVITIES WHICH HAVE ALREADY TAKEN PLACE

A qualitative assessment of air quality impacts due to project components that have already taken place is discussed in Table 6-1. Information gathered from historical reports for the authorisation of the original mine development (SLR, December 2015) was used to draw inferences to the qualitative assessment. Previous findings indicated that health impacts due to PM and gaseous pollutants were low, with a medium probability of occurrence. The human health impacts due to respirable Mn (elemental) were deemed to be medium with dispersion modelling results displaying exceedances to the various international guidelines up to 4 km south of the mine boundary.

Table 6-1 indicates that the overall emissions could have been high if no mitigation measures were implemented, likely resulting in medium impacts to human health through inhalation. There was no information available regarding the implementation schedule of the already undertaken activities. However, if they took place over a shorter period, the duration and severity of the impacts could have been low. Therefore, ranking these sources is not possible to determine the components that contribute significantly to the emissions. Similar to construction activities, the implementation of these project components likely happened over a short period and resulted in intermittent emissions. There is no evidence that any cumulative impacts on human health due to the proposed activity and or infrastructure changes can be attributed to the components that have already taken place.

Table 6-1: Qualitative Assessment of Air Quality Impacts (Airshed, January 2022)

Project Component	Impact on Human Health
The reconfiguration of the plant area, ROM, and high-grade product stockpiles to accommodate the expansion of the open pit.	It is likely that there were no dust impacts due to the reconfiguration of the plant area. However, movement of the ROM, and high-grade product stockpile to new locations could have resulted in additional dust, PM and elemental Mn emissions due to material handling. If mitigation measures such as water sprays were applied, then the impacts were significantly reduced.
The relocation of the low-grade product stockpile.	The movement of the low-grade product stockpile involved material handling processes such as tipping, loading, and dumping, which results in the emission of dust, PM and Mn. Mitigation through water sprays can reduce the impacts by up to 50%.
The relocation of support infrastructure (water storage facilities for potable and process water, workshops, and wash bay, change houses, sewage treatment plant, water treatment plant, fuel storage, administrative block including offices, kitchen, canteen, training centre, mustering centre, clinic, stores and waste storage).	The movement of the support infrastructure involved carrying it to their new location. Haulage trucks were likely used, and this resulted in dust and PM emissions due to vehicle entrainment, and gaseous emissions through the exhaust pipes. If the relocation did not result in the construction of new infrastructure, these emissions were short lived.
Relocation of the approved WRD to accommodate the expansion of the open pit;	Relocation of the WRD involved material handling processes such as tipping, loading, and dumping, which results in the emission of dust and PM. Mitigation through water sprays can reduce the impacts by up to 50%.
Relocation of the approved topsoil stockpiles	Same as above.

DESCRIPTION OF IMPACTS OF THE PROPOSED ACTIVITIES

The establishment of a comprehensive emission inventory formed the basis for the assessment of the air quality impacts from the project's operations on the receiving environment. The proposed project operations will consist of a construction phase, an operational phase, and a closure (decommissioning and post-closure) phase. A short discussion on the expected activities, typical of an open cast manganese mine is provided in the sections below with a summary on the typical sources and associated activities for construction, operational and closure phase of the project.

6.1.1.1 CONSTRUCTION AND CLOSURE

Construction activities are potentially significant sources of dust emissions that may have a substantial temporary impact on local air quality. Construction activities that contribute to air pollution typically include land clearing, excavation, material handling activities, wheel entrainment, operation of diesel or petrol engines etc. If not properly mitigated, construction sites could generate high levels of dust (typically from concrete, cement, wood, stone, silica) which has the potential to travel for large distances.

Construction dust, in the larger TSP fraction, will generally impact close to the construction activities and is more responsible for soiling than health issues. Health impacts are more associated with the finer PM_{10} and $PM_{2.5}$ fractions, both of which are invisible to the naked eye. Combustion engines also emit emissions of CO, hydrocarbons, NOx and SO_2. However, these gaseous emissions may often not be as significant when compared to particulate emissions, and the quantification of particulate matter emissions (and the atmospheric dispersion thereof) is generally considered a better key-indicator pollutant for construction phase impacts than gaseous emissions. Dust emissions can also vary substantially from day to day, depending on the level of activity, the specific operations, and the prevailing meteorological conditions. It is therefore often necessary to estimate area wide construction emissions, without regard to the actual plans of any individual construction process. Construction phase emissions were not quantified since the construction schedule is not known and the temporary nature of these operations is not easily captured in dispersion simulations.

All operational activities will have ceased by the closure (decommissioning and post-closure) phase of the project. This will obviously result in a positive impact on the surrounding environment and human health. The potential for impacts during the closure phase will therefore depend on the extent of rehabilitation efforts to be undertaken at the plant area and the waste dump site. Aspects and activities associated with the closure phase of the project are listed in Table 6-2.

Table 6-2: Activities and aspects identified for the closure phase

Aspects	Activities
Fugitive dust	Demolition and stripping away of buildings and facilities
Fugitive dust	Topsoil recovered from stockpiles for rehabilitation and re-vegetation of surroundings
Fugitive dust	Wind-blown dust from stockpile and exposed areas
Fugitive dust	Degradation of paved roads resulting in unpaved road surfaces. **Note:** the R380 diversion road will remain part of the provincial road. All other roads will be rehabilitated.

An assessment of the significance of construction and closure phase air quality impacts associated with PM emissions (design mitigation) is shown in **Error! Reference source not found.**. Due to the absence of any adverse impacts to human health due to inhalation of the gaseous pollutants, there may not be a need for additional mitigation to the impacts.

Table 6-3: Impact Summary – Air pollution due to PM emissions

Issue: Air pollution due to $PM_{2.5}$, PM_{10}, and Dust fallout		
Phases: Construction, Decommissioning & Closure		
Criteria	Without Mitigation	With Mitigation
Intensity	Low	Low
Duration	Low	Low
Extent	Low	Low
Consequence	Low	Low
Probability	Low	Low
Significance	**Low**	**Low**

6.1.1.2 OPERATIONAL PHASE

Sources of emission and associated pollutants considered in the emissions inventory for the operational phase include:

- Blasting – $PM_{2.5}$, PM_{10}, TSP and elemental Mn
- Crushing and screening – $PM_{2.5}$, PM_{10}, TSP and elemental Mn
- Drilling – $PM_{2.5}$, PM_{10}, TSP and elemental Mn
- Materials handling (ore and waste rock) – $PM_{2.5}$, PM_{10}, TSP and elemental Mn
- Vehicle exhaust emissions – CO, NO_x, $PM_{2.5}$, PM_{10}, SO_2 and VOC
- Windblown dust from material stockpile – $PM_{2.5}$, PM_{10}, TSP and elemental Mn
- Entrained dust from unpaved roads – $PM_{2.5}$, PM_{10}, and TSP

The following should be noted with regards to the emissions inventory:

- Crushing and screening contribute most notably to estimated PM and Mn emissions during the project's operational phase. About 35% to 87% of emissions are expected to be from crushing and screening when mine design mitigation is applied. Its contribution decreases to between 17% and 63% with further mitigation measures in place. Unpaved roads, as the second highest emission source, contribute between 17 % and 42 %.
- CO, VOCs, NOx and SO_2 emissions are only emitted by diesel engines.

Atmospheric Dispersion Modelling

The impact of operations on the atmospheric environment was determined through the simulation of dustfall rates and ambient pollutant concentrations. Dispersion models are used to simulate ambient pollutant concentrations and dustfall rates as a function of source configurations, emission strengths and meteorological characteristics, thus providing a useful tool to ascertain the spatial and temporal patterns in the ground level concentrations arising from the emissions of various sources.

Dispersion modelling was undertaken to determine highest hourly, highest daily and annual average ground level concentrations as well as dustfall rates for each of the pollutants considered in the study. Averaging periods were selected to facilitate the comparison of predicted pollutant concentrations to relevant ambient air quality and inhalation health criteria as well as dust fall regulations. Pollutants with the potential to result in human health impacts were assessed include CO, NO_2, $PM_{2.5}$, PM_{10}, SO_2, Mn and VOC. Dust fall was assessed for its nuisance potential.

$PM_{2.5}$ Impact

The simulated ground level concentrations (GLC) for daily $PM_{2.5}$ are shown in Figure 6-1 and Figure 6-2 for the design mitigated scenario and the additionally mitigated scenario respectively. Simulated GLCs for the annual $PM_{2.5}$ are shown in Figure 6-3 and

Figure 6-4 for the design and additionally mitigated scenarios respectively. Exceedances to the simulated daily $PM_{2.5}$ concentrations occur outside the boundary of the mining prospects for the daily SA NAAQS during the design mitigated scenario. However, the area of the simulated exceedance is not near any of the identified receptors. As illustrated in Figure 6-2, exceedances outside the mine boundary are significantly reduced by applying additional mitigation to some emission sources. GLCs for the annual $PM_{2.5}$ concentrations (Figure 6-3 and

Figure 6-4) show no exceedances to the SA NAAQS outside the boundary of the mining prospects

PM_{10} Impact

Simulated exceedances of the daily PM_{10} NAAQS occur for ~1.5 km away from the mine boundary in the northerly and south-south-westerly directions when design mitigation is utilised. Additional mitigation reduces the impacts such that exceedance to the daily PM_{10} NAAQS occurs for less than a kilometer outside the mine boundary. The simulated GLCs exceed the annual PM_{10} NAAQS for less than a kilometer outside the mine boundary when design mitigation is applied. Application of additional mitigation would further reduce in impacts, thus restricting exceedances of the annual PM_{10} NAAQS within the mine boundary.

The simulated GLCs for daily PM_{10} are shown in
Figure 6-5 and
Figure 6-6 for the design mitigated scenario and the additionally mitigated scenario respectively; while those for the annual PM_{10} are shown in
Figure 6-7 and
Figure 6-8 for the design and additionally mitigated scenarios respectively. An assessment operational phase air quality impacts associated with PM and inhalable Mn emissions is presented in Table 6-4.

Mn Impact

From literature, background Mn concentrations range from very low concentrations of 0.05 – 5.4 ng/m³ over the oceans to 20 – 800 ng/m³ over land with 24- hour concentrations between 2-3 µg/m³ over land having been recorded. The highest concentrations of manganese in the working environment have been reported from manganese mines, ore-processing plants, dry-cell battery plants and ferro-manganese plants. In mining operations, manganese concentrations of up to 250 mg/m³ or even higher have sometimes been found. The areas over which annual concentrations were found to exceed the various guidelines are presented in
Figure 6-11. Annual average Mn concentrations exceed the WHO GV, TCEQ ESL and ATSDR MRL off-site by a distance ranging from 1.5 km to 2 km. The exceedance is not expected to impact all the AQSRs within the displayed domain. Implementing additional mitigation measures slightly reduces the impacts significantly such that exceedances to these international criteria are likely to occur less than a kilometre from the boundary.

Dustfall Impact

Isopleth plots showing the ground level dustfall rates anticipated per area and screened against the NDCR residential and non-residential limits for dustfall are provided in
Figure 6-9 and
Figure 6-10 for the design and additionally mitigated scenarios respectively. The simulated maximum daily dustfall rates due to the design mitigated option exceeds the NDCR limit for residential areas (600 mg/m²-day) less than a kilometer beyond the southwest boundary of the mine, but not at nearby AQSRs. The NDCR non-residential standard (1200 mg/m²-day) was not exceeded beyond the mine boundary for all scenarios.

The simulated results are comparable with the measured dustfall rates presented in previous baseline results with exceedances to the NDCR non-residential limit occurring at MK3 and MK4 that lie southwest of the mining boundary while the dustfall measured by the other dustfall buckets are below the non-residential limit.

Table 6-4: Impact summary- Human health impacts associated with $PM_{2.5}$

Issue: Human health impacts due to $PM_{2.5}$		
Phases: Operation		
Criteria	Without Mitigation	With Mitigation
Intensity	Low	Low
Duration	Medium	Low
Extent	Low	Low
Consequence	Low	Low
Probability	Medium	Low
Significance	**Medium**	**Low**

Table 6-5: Impact Summary – Human health impacts associated with PM_{10}

Issue: Human health impacts due to PM_{10}		
Phases: Operation		
Criteria	Without Mitigation	With Mitigation
Intensity	Medium	Medium
Duration	Medium	Medium
Extent	Medium	Low
Consequence	Medium	Medium
Probability	Medium	Medium
Significance	**Medium**	**Medium**

Table 6-6: Impact summary – Nuisance impact due to dust fall

Issue: Nuisance impact due to dust fall		
Phases: Operation		
Criteria	Without Mitigation	With Mitigation
Intensity	Low	Low
Duration	Medium	Medium
Extent	Low	Low
Consequence	Low	Low
Probability	Low	Low
Significance	**Low**	**Low**

Table 6-7: Impact summary – Human health impacts due to Respirable Mn (elemental)

Issue: Human health impacts due to Respirable Mn (elemental)		
Phases: Operation		
Criteria	Without Mitigation	With Mitigation
Intensity	Medium	Medium
Duration	Medium	Medium
Extent	Medium	Medium
Consequence	Medium	Medium
Probability	Medium	Medium
Significance	**Medium**	**Medium**

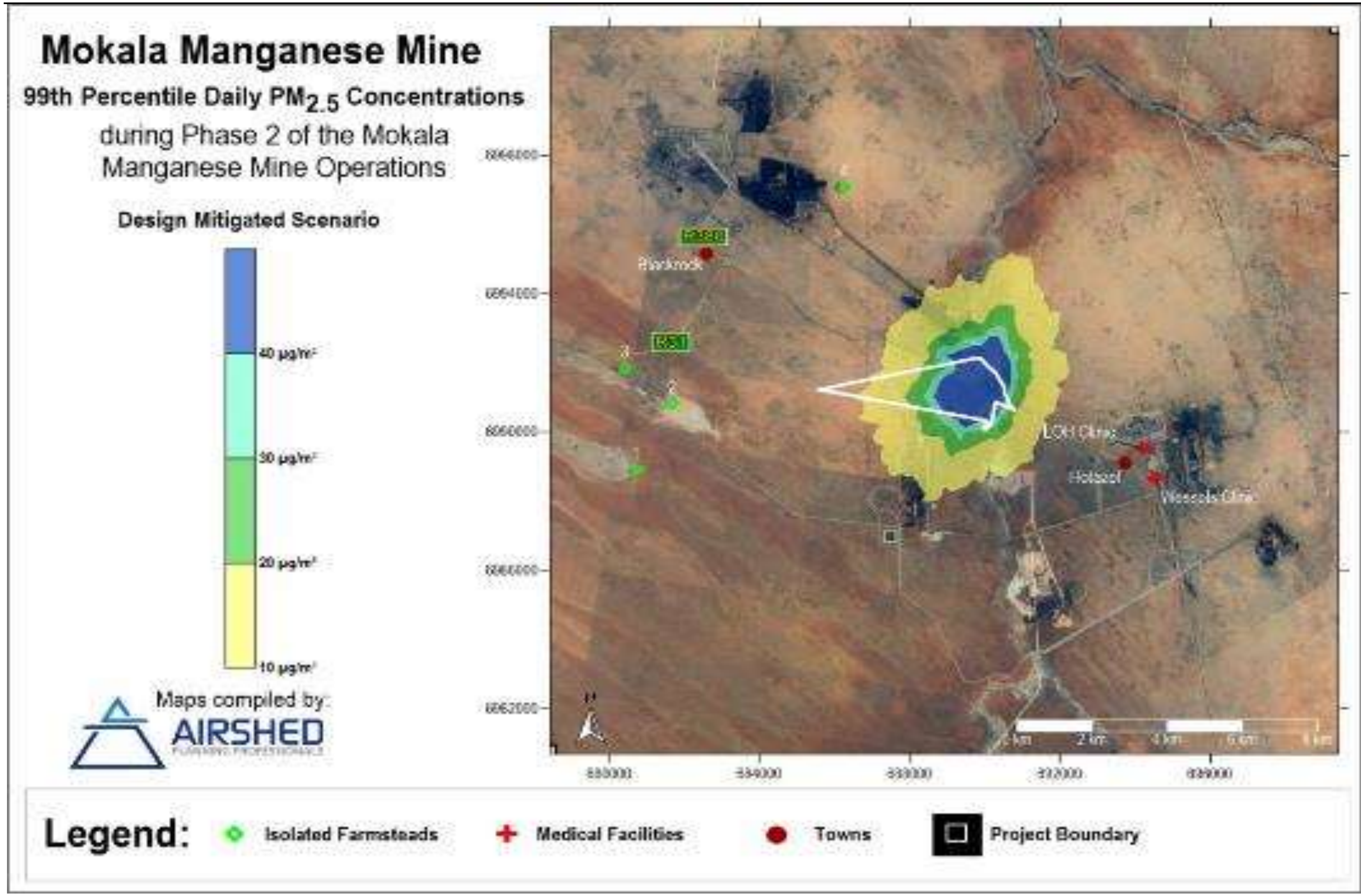


Figure 6-1: Simulated daily average PM2.5 concentrations for design mitigated operational activities

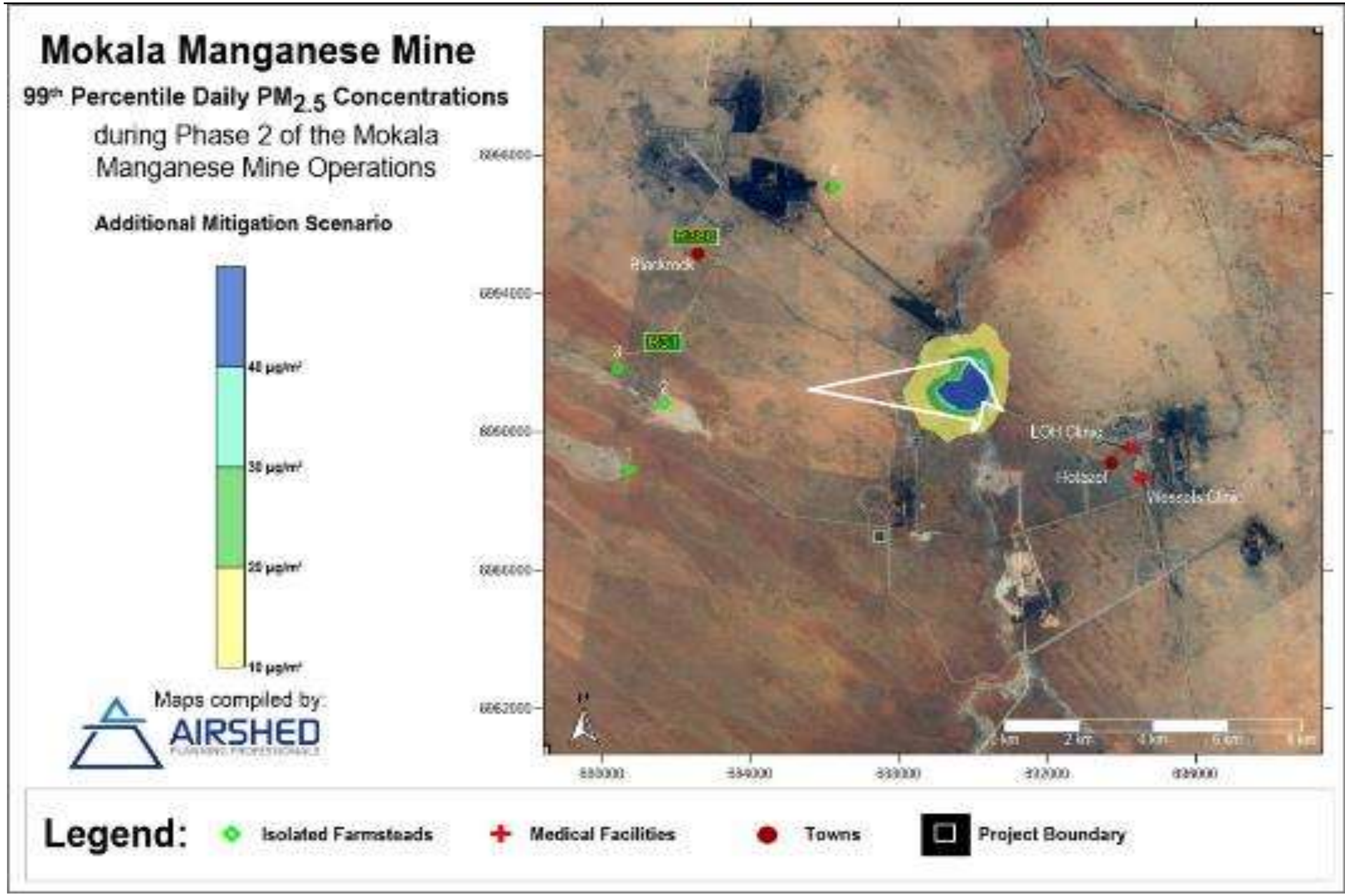


Figure 6-2: Simulated daily average PM2.5 concentrations for additionally mitigated operational activities

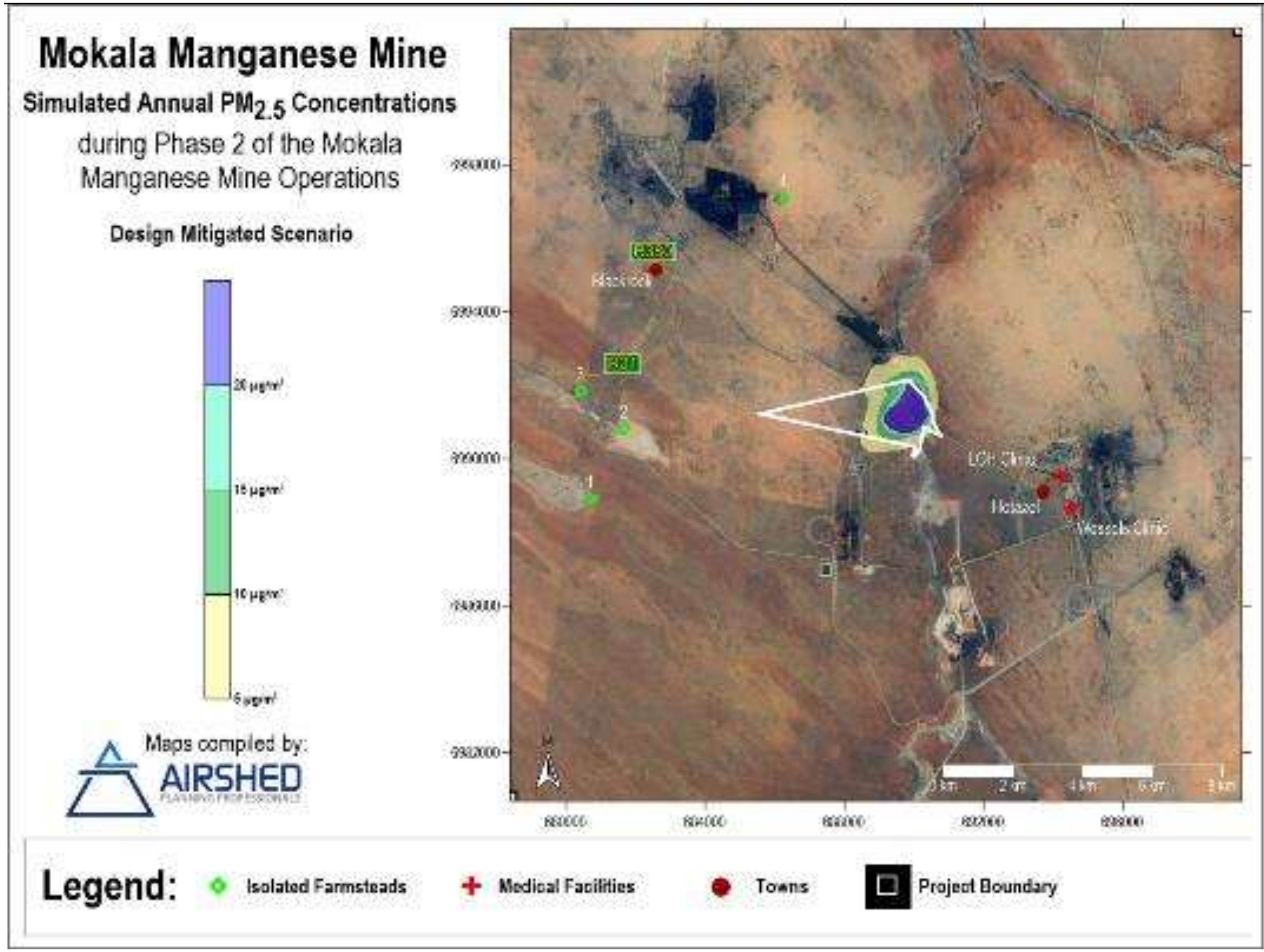


Figure 6-3: Simulated annual average PM2.5 concentrations for design mitigated operational activities

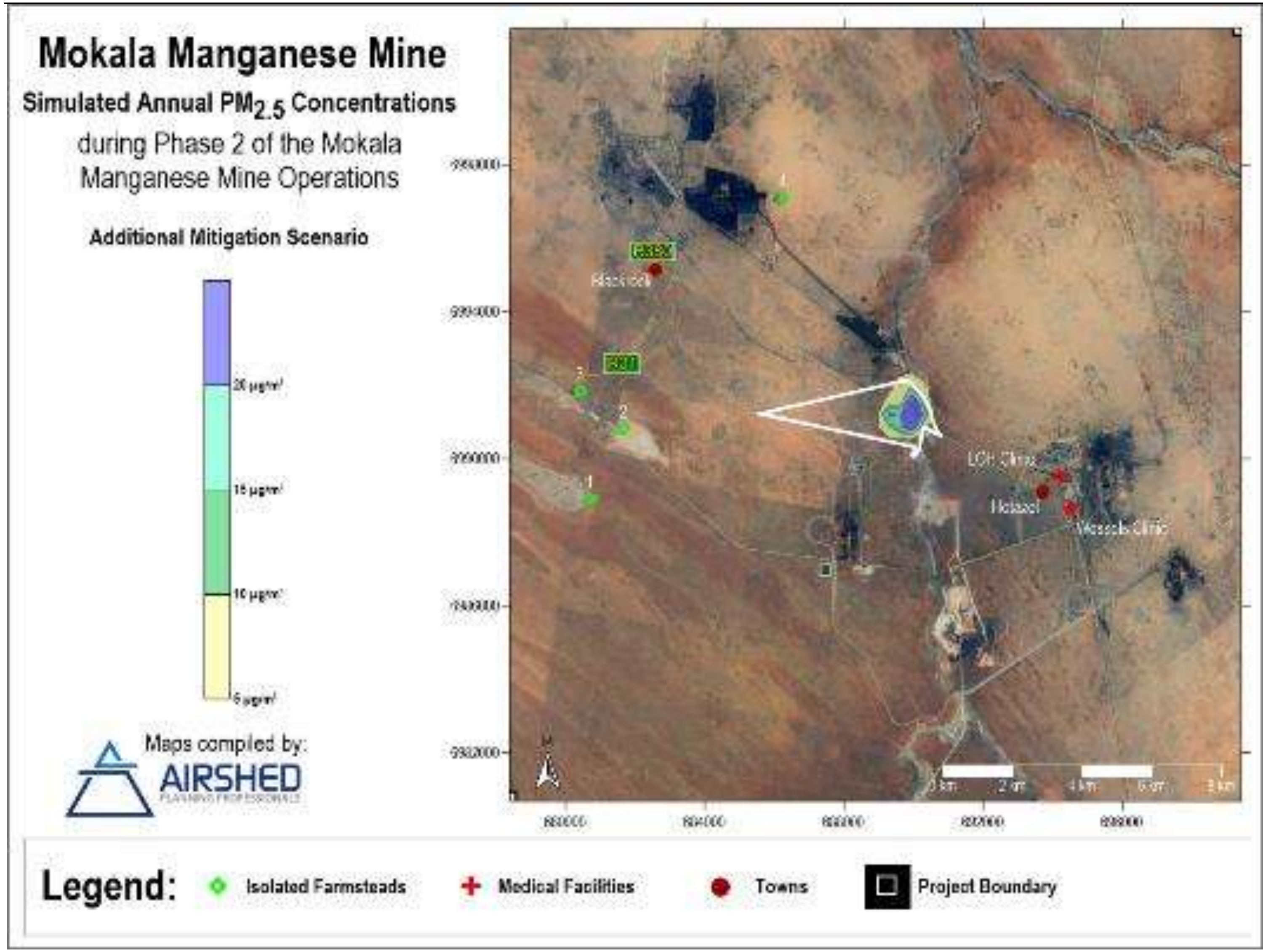


Figure 6-4: Simulated annual average PM2.5 concentrations for additionally mitigated operational activities

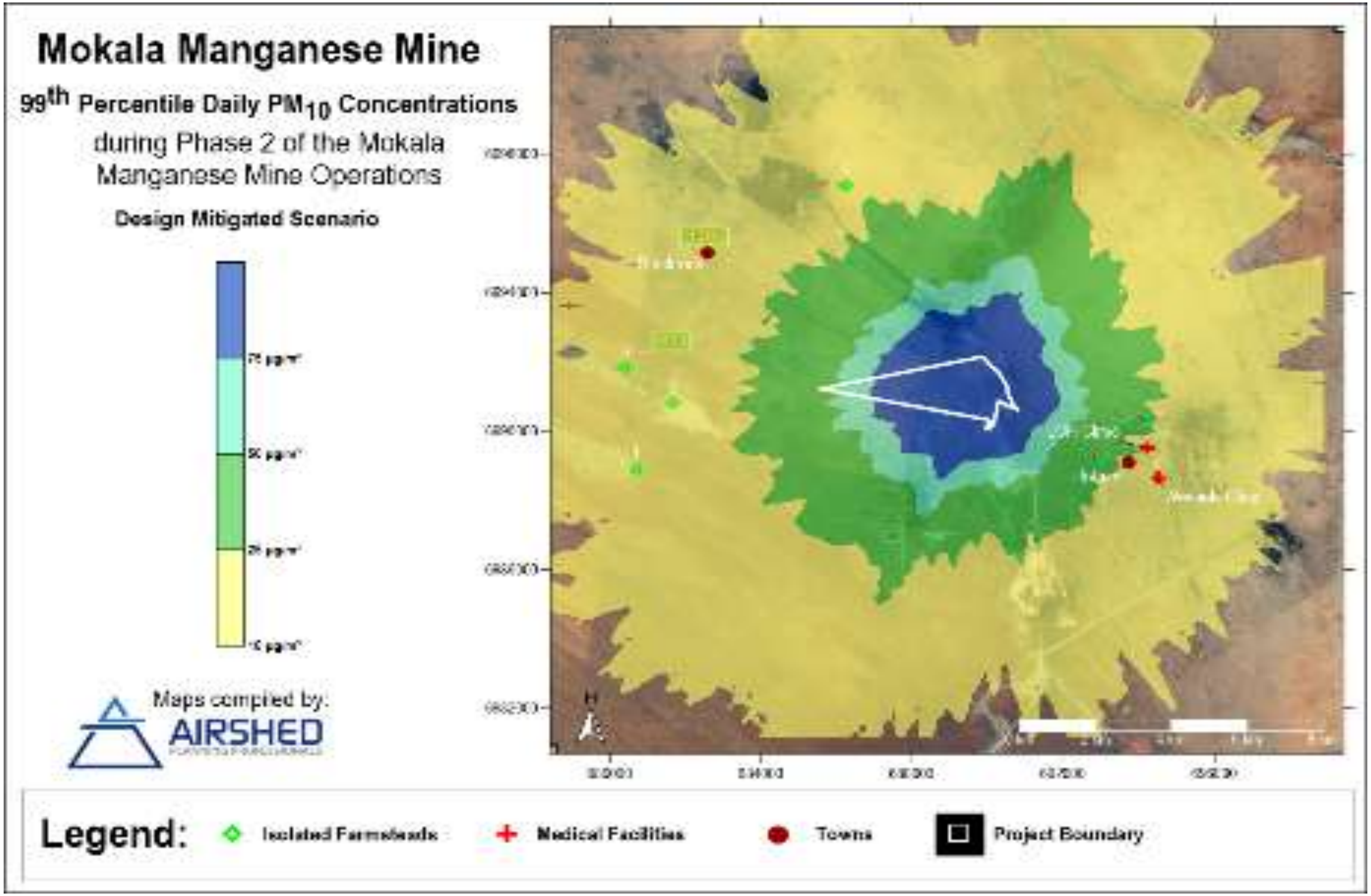


Figure 6-5: Simulated daily average PM_{10} concentrations for design mitigated operational activities

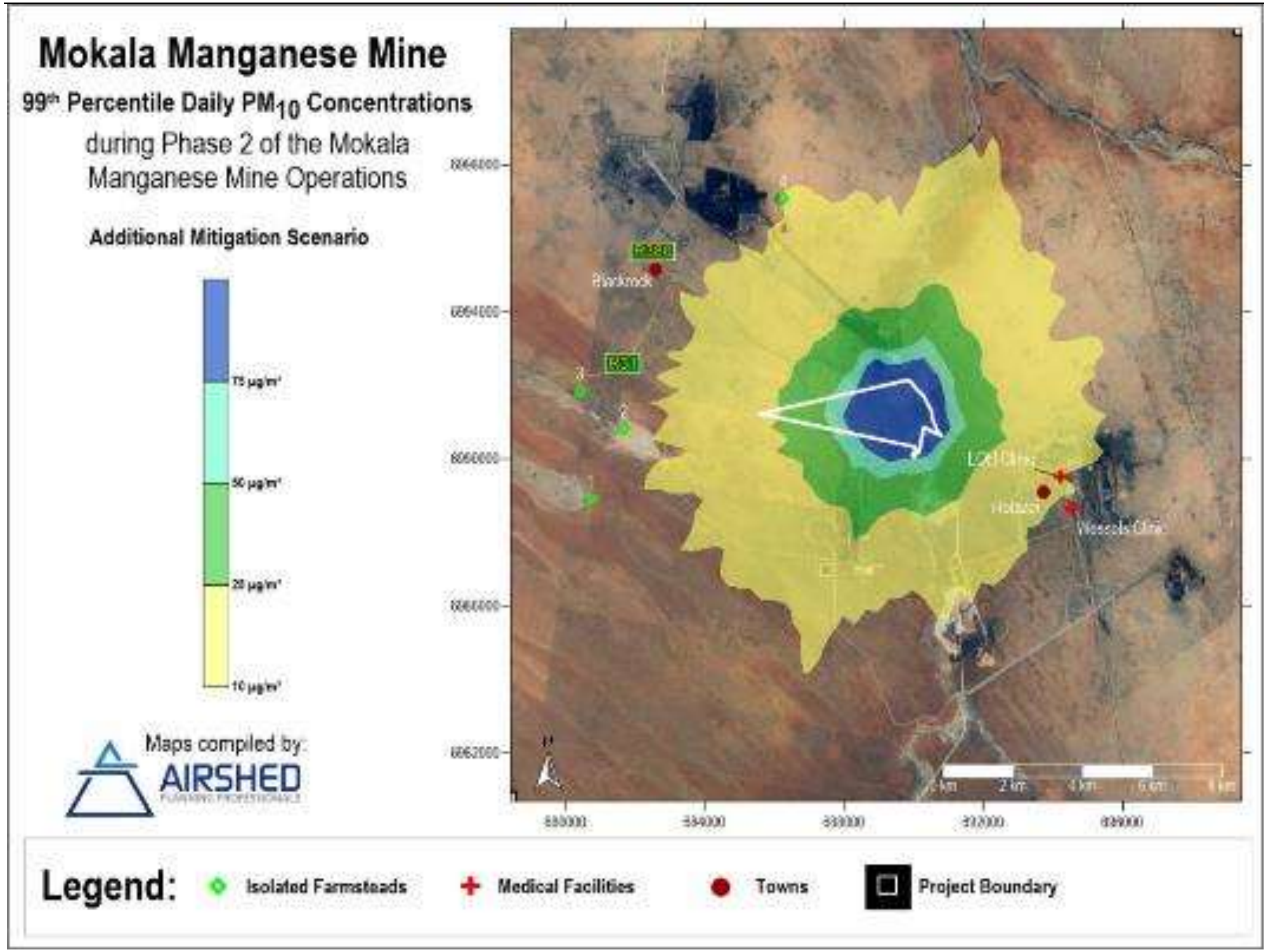


Figure 6-6: Simulated daily average PM_{10} concentrations for the additionally mitigated operational activities

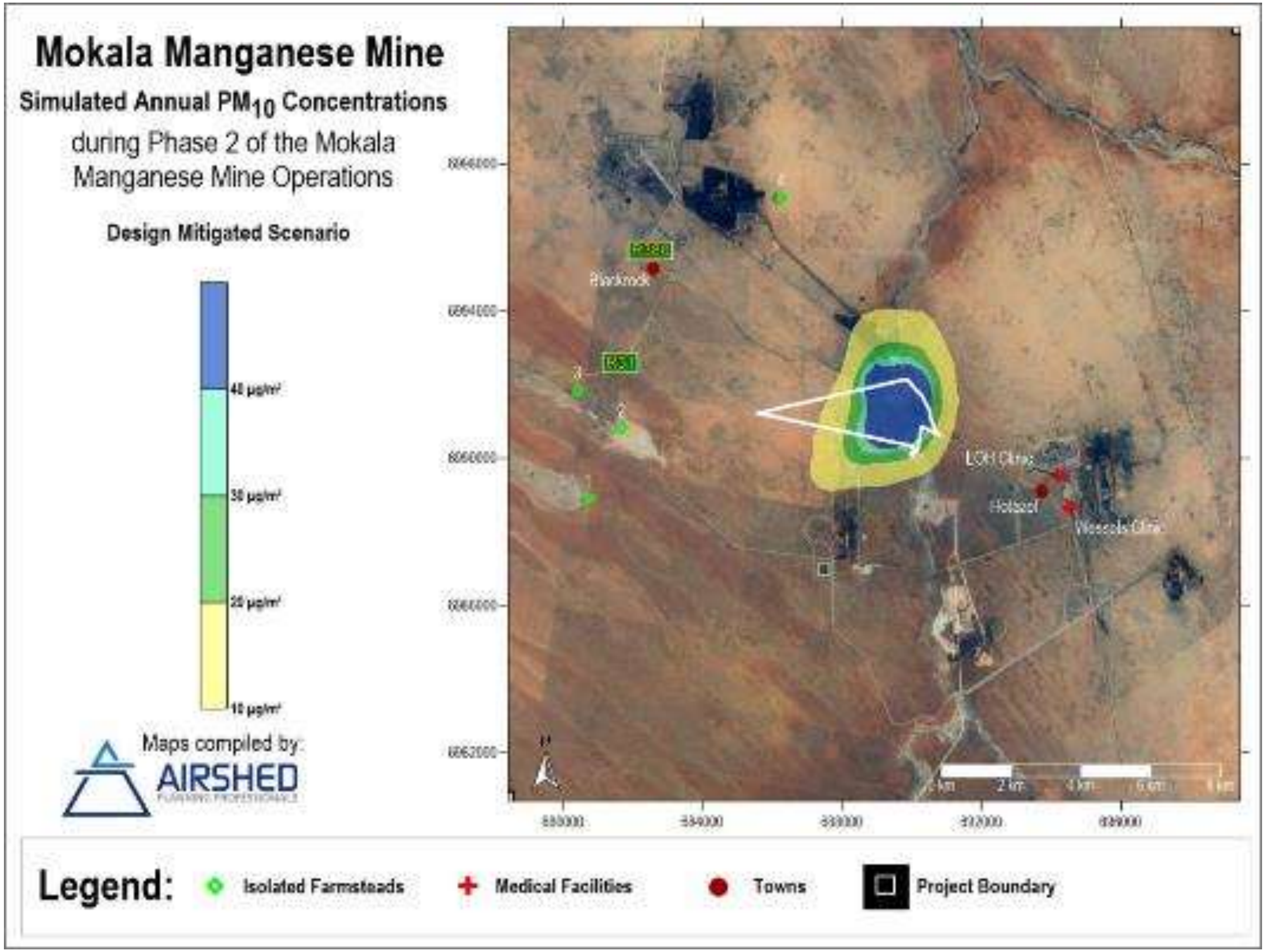


Figure 6-7: Simulated annual average PM_{10} concentrations for design mitigated operational

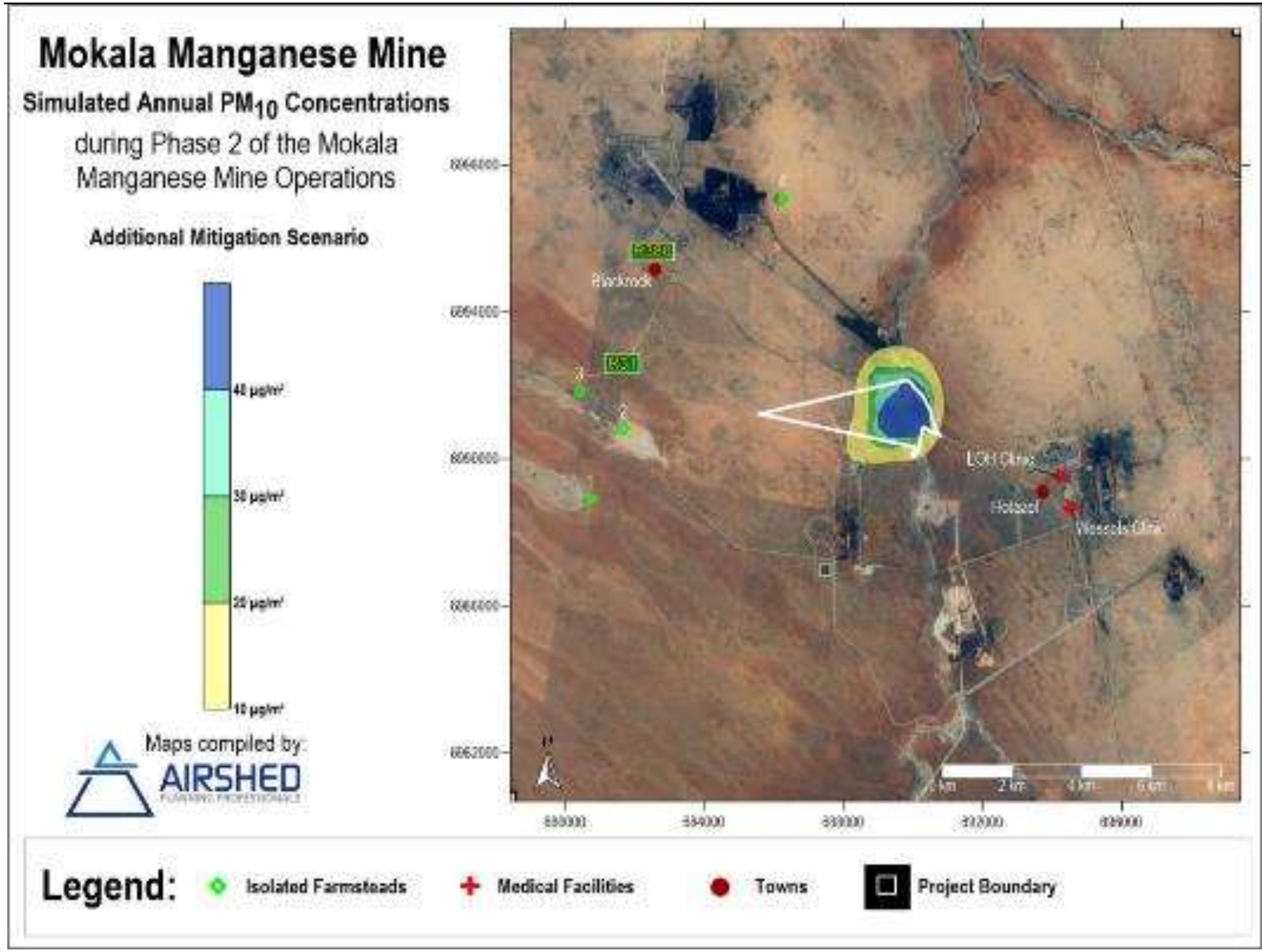


Figure 6-8: Simulated annual average PM_{10} concentrations for the additionally mitigated operational activities

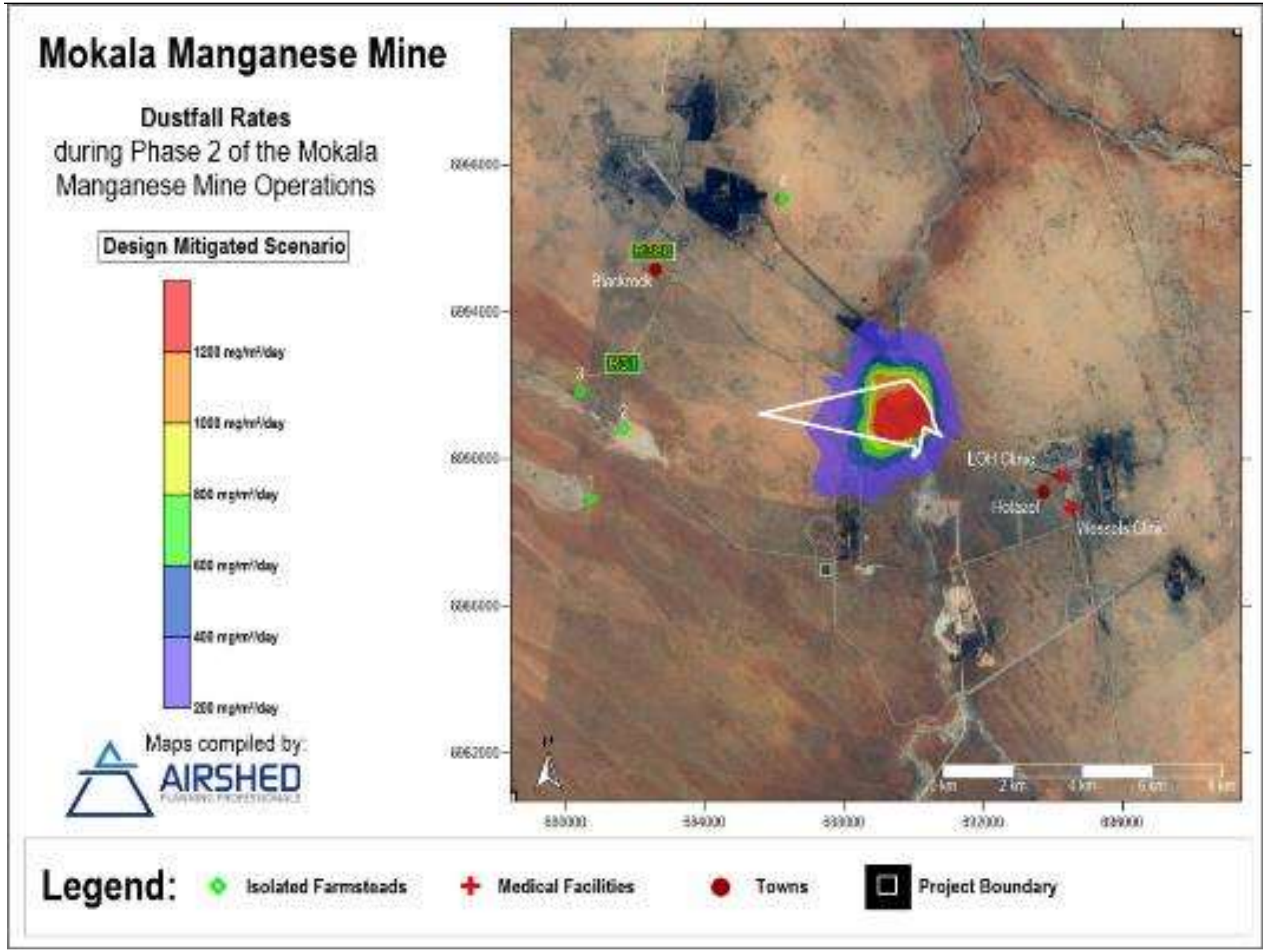


Figure 6-9: Simulated dustfall rates due to unmitigated operational activities for the design mitigated scenario

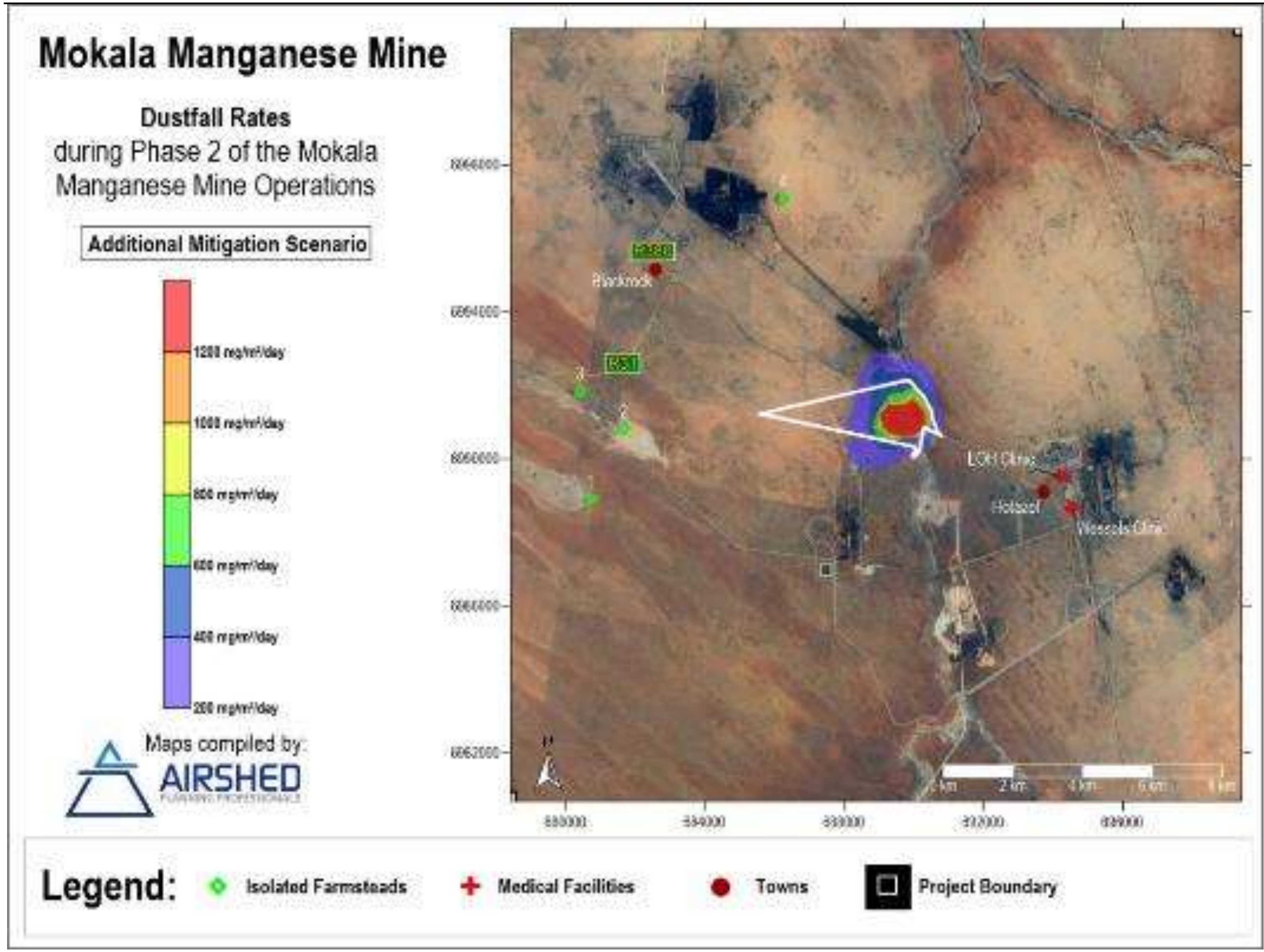


Figure 6-10: Simulated dustfall rates due to unmitigated operational activities for the additional mitigated option

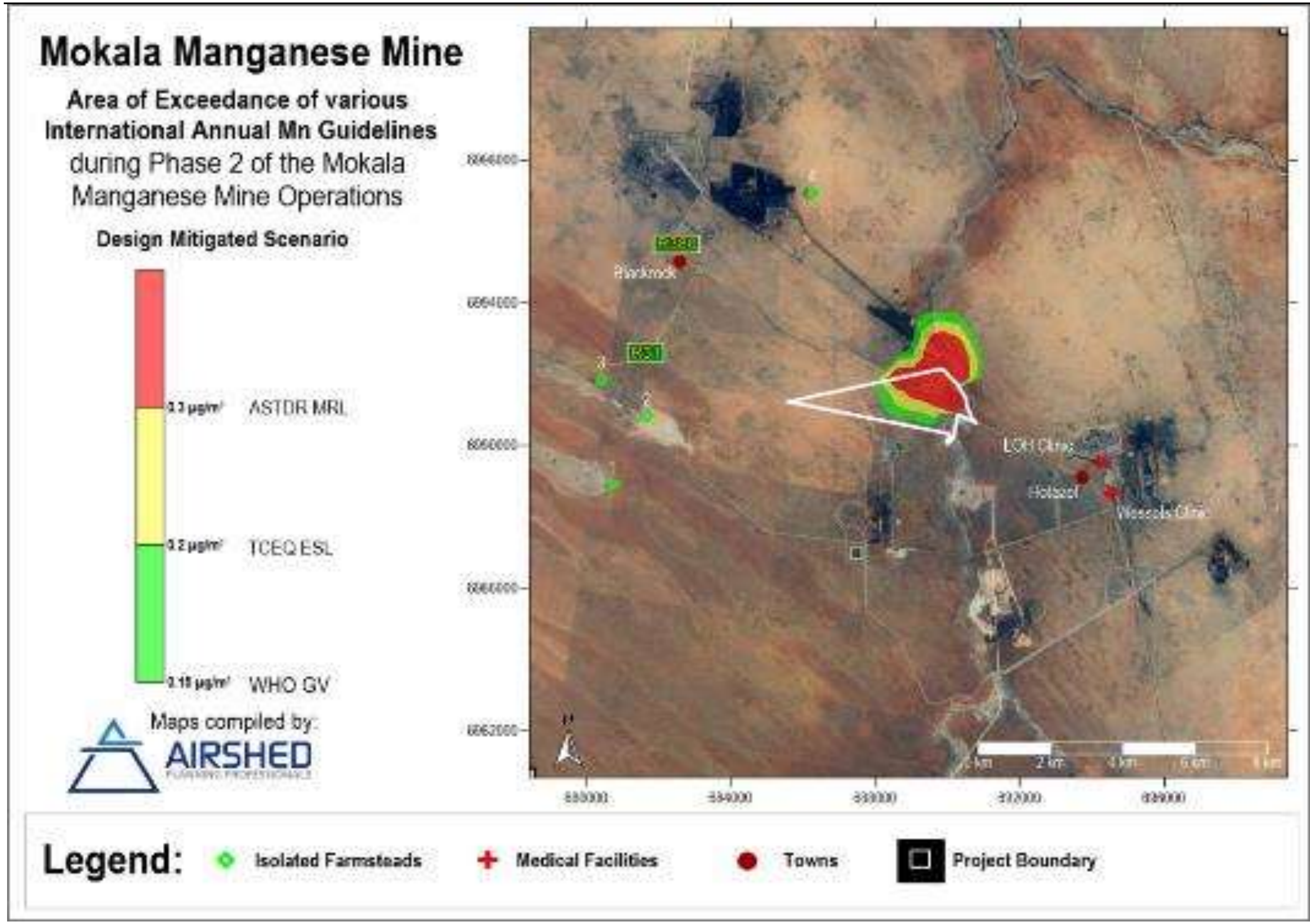


Figure 6-11: Area of exceedance of various international annual guidelines for Mn due to operational activities utilising design mitigation

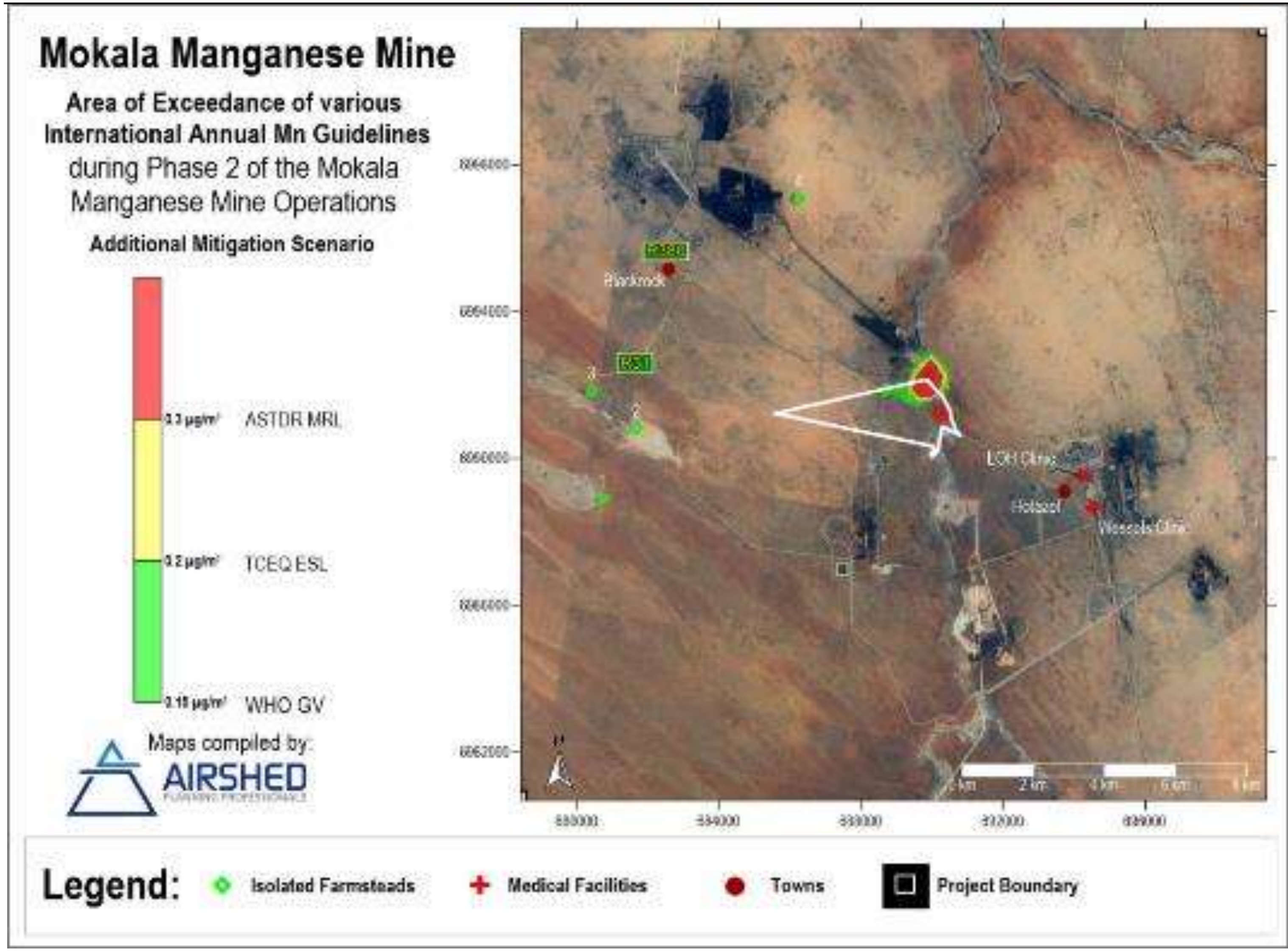


Figure 6-12: Area of exceedance of various international annual guidelines for Mn due to operational activities utilising additional mitigation

VOCs, NO_2, CO and SO_2 Impact

Simulated CO, VOC and SO_2 impacts were very low and did not result in offsite exceedances of assessment criteria. The GLC due to CO and SO_2 emissions are expected to be insignificant, as is typical of similar processes. Hourly and annual NO_2 impacts are presented in
Figure 6-13 and
Figure 6-14 respectively. Typical of most mining operations, there were no exceedances to the hourly and annual SA NAAQS outside the mine boundary while the GLCs inside the mine boundary are mostly insignificant and fall below their respective standards.

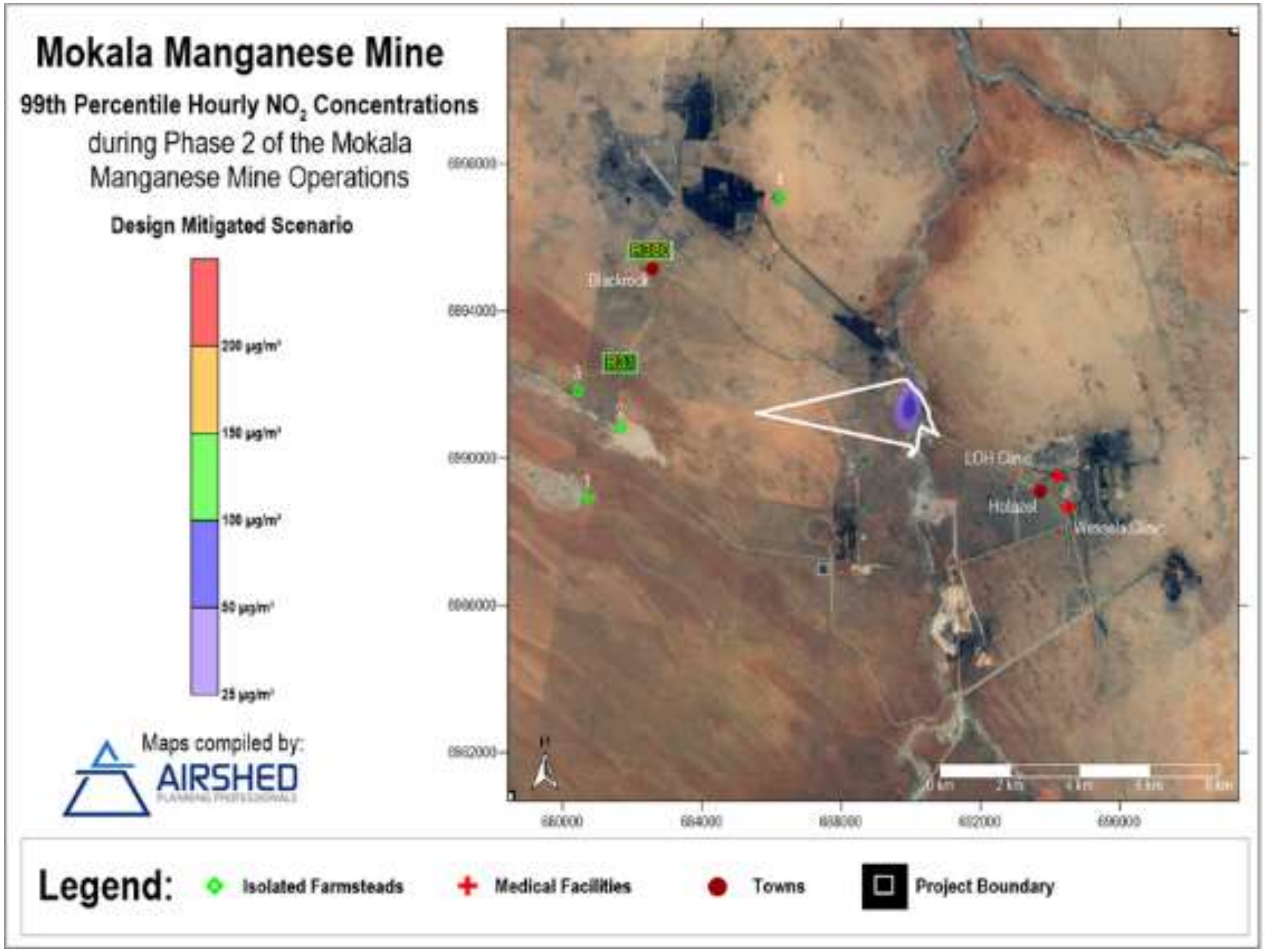


Figure 6-13: Simulated GLCs for hourly NO_2 during normal operational activities

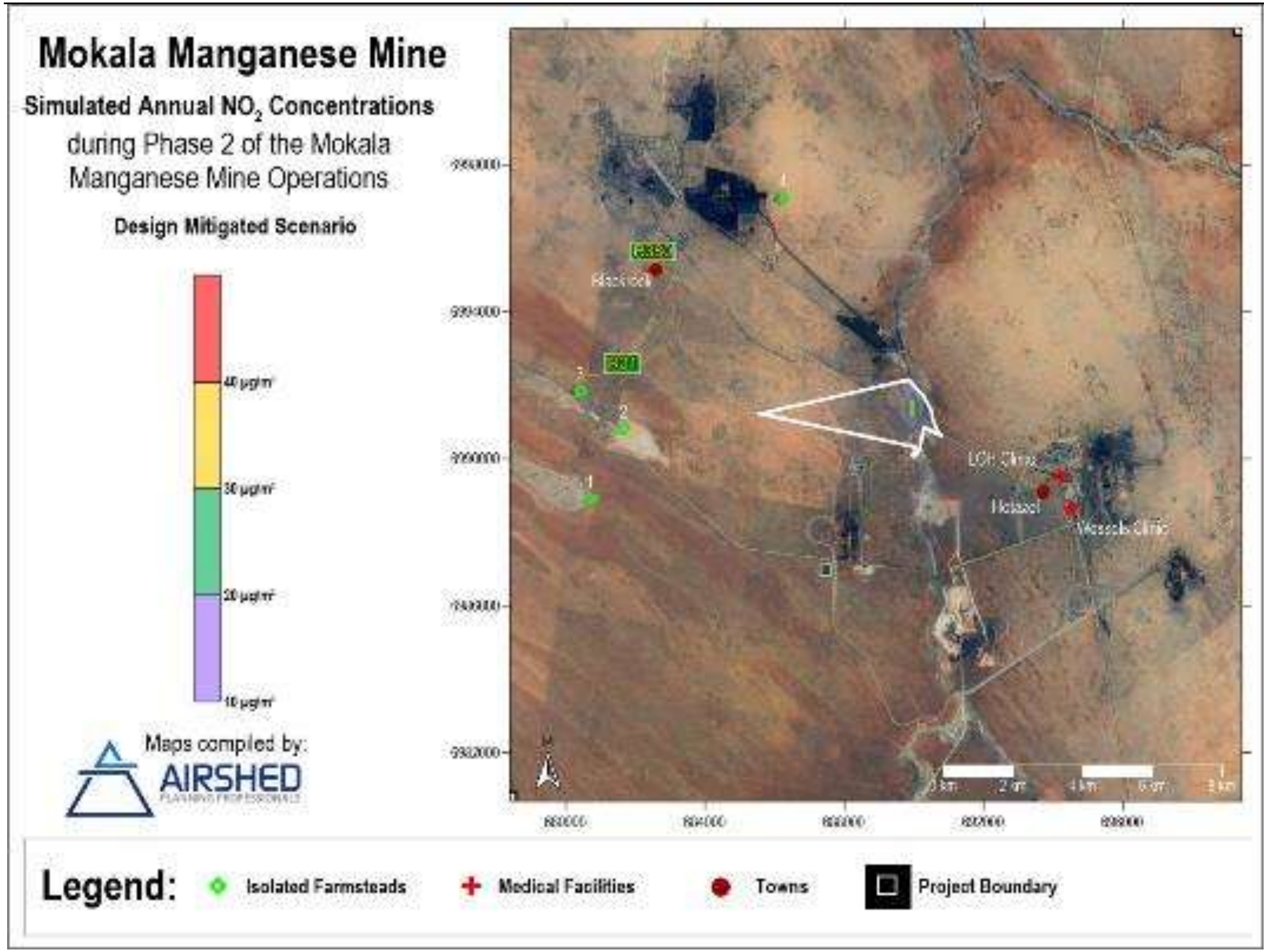


Figure 6-14: Simulated GLCs for annual NO_2 during normal operational activities

An assessment operational phase air quality impacts associated with PM and inhalable Mn emissions is presented in Table 6-8. Due to the absence of any adverse impacts to human health due to inhalation of the gaseous pollutants, there may not be a need for additional mitigation to the impacts.

Table 6-8: Impact summary: Human health and nuisance impacts associated NO_2, CO, SO_2 and VOC emissions

Issue: Human health and nuisance impacts associated NO_2, CO, SO_2 and VOC emissions		
Phases: Operation		
Criteria	Without Mitigation	With Mitigation
Intensity	Low	Low
Duration	Low	Low
Extent	Low	Low
Consequence	Low	Low
Probability	Low	Low
Significance	**Low**	**Low**

6.1.1.3 MINING OF THE BARRIER PILLAR

Mining will also take place adjacent the mining right area at the Kalagadi barrier pillar. If the mining rate and fleet is the same as the current or proposed operations, then the impact will be the same in magnitude, with the impact area likely to shift to the southwest, west-southwest, and south southwest. This attestation is guided by interpretation of the wind field. Given that there are barely any sensitive receptors in the area, the likelihood of any additional or adverse impacts are minimum. If, however it is mined simultaneously with current operations, with additional equipment being brought in to achieve that, the impact will be cumulative with the other operations, hence resulting in exceedances at the closest sensitive receptors. In conclusion, the impacts due to the mining of the Kalagadi Barrier Pillar are expected to be the same in scale and magnitude as those of the proposed project operations.

MANAGEMENT OBJECTIVE

To ensure that any pollutants emitted as a result of the proposed project remain with acceptable limits so as to prevent health related impacts.

EMERGENCY SITUATIONS

Emergency situations should be handled in accordance with the Mokala emergency procedure as detailed in Section 34 of the main EIA document.

6.1.2 MANAGEMENT ACTIONS

6.1.2.1 ON-GOING/ ALL PHASES

- Mokala will implement a dynamic air quality management plan that covers:
    - The identification of sources and emissions inventory
    - The implementation of source based controls
    - The use of source and receptor based performance indicators and monitoring strategies

  - The use of source and receptor based mitigation measures
  - The use of internal and external auditing
  - Review and plan adjustment as required.
- The following specific mitigation measures will be implemented for the main emission sources: roads, crushing and screening, materials handling (tipping points), vehicles and wind erosion. The recommended methods include:
  - Limit the disturbance of land to what is absolutely necessary and in accordance with the mine infrastructure layout
  - For the control of vehicle entrained dust it is recommended that water (at an application rate >2 litre/m2-hour), be applied in combination with dust palliative consisting of a cationic bitumen emulsion to stabilize the surface and prevent dust. Literature reports an emissions reduction efficiency of up to 90%.
  - Dust controls at the crushing and screening operation by water sprays
  - In minimizing windblown dust from stockpile areas (product stockpile), water sprays should be used to keep surface material moist and wind breaks installed to reduce wind speeds over the area.
  - In the transportation of ore and products, trucks should be well covered in order to avoid spillages. This will reduce the release of PM and consequently, elemental Mn emissions (Mn emission is taken as a fraction of PM_{10} emissions).
  - To ensure lower diesel exhaust emissions, equipment suppliers or contractors should be required to ensure compliance with appropriate emission standards for mining fleets.
  - Rehabilitation and re-vegetation of all decommissioned areas
  - Maintenance of all vehicles to achieve optimal exhaust emissions.
- Register as a data provider on the National Atmospheric Emissions Inventory System.
- Mokala must ensure that the relevant PM_{10}/$PM_{2.5}$ monitoring data is provided to Assmang.
- Implementation of an air complaints procedure during all phases.

6.1.2.2 OPERATION

- Undertake a carbon footprint assessment during the operational phase of the project.
- *Re-evaluate the mitigation measures from 2024 - 2038, as the pit expands to accommodate the relocation of infrastructure.*

6.1.2.3 MONITORING

- Mokala will implement a dust fallout monitoring programme.
- *It is recommended that continuous dustfall monitoring be conducted as part of the project's air quality management plan. This should be undertaken throughout the life of mine to provide air quality trends. Recommended dustfall collection locations are presented in Figure 6-15. There is also a need to setup dustfall monitoring locations close to the AQSRs (see*
- *Figure* 6-16*) to determine the footprint of the mine's activities and measure background dust fallout rates. The description of these locations is given in Table 6-9.*
- It is recommended that Mokala collaborate with other mines/industries and relevant authorities in the region to install a gravimetric $_{PM10}$/$PM_{2.5}$ monitor at Gloria Mine Village or Hotazel. This will provide adequate data on cumulative PM_{10} and $PM_{2.5}$ concentrations from the Mokala Manganese Project and other mines/industries in the region. It is recommended that the PM_{10} and $PM_{2.5}$ samples are analysed for manganese content in collaboration with other mines/industries and

relevant authorities. Should exceedances of the long-term assessment criteria occur (as was simulated), a health risk/toxicological assessment should then be conducted to determine the health impact due to manganese emissions at the potentially affected receptors such as Gloria Mine village and Hotazel in collaboration with other mines/industries and relevant authorities. *Recommended dustfall and $PM_{10}/PM_{2.5}$ sampling methodology is provided in the full Air Quality Specialist Report* (Airshed, January 2022).

- *It is recommended that the $PM_{10}/PM_{2.5}$ samples be analysed for manganese content to indicate the manganese concentrations in inhalable and respirable dust. This can be done by conducting an Inductively Coupled Plasma (ICP) analysis on the gravimetric $PM_{10}/PM_{2.5}$ filter sample to determine the trace concentration of elemental manganese in the ambient air. Should exceedances of the long-term assessment criteria occur (as was simulated), a health risk/toxicological assessment should then be conducted to determine the health impact due to manganese emissions at Gloria Mine village or Hotazel.*

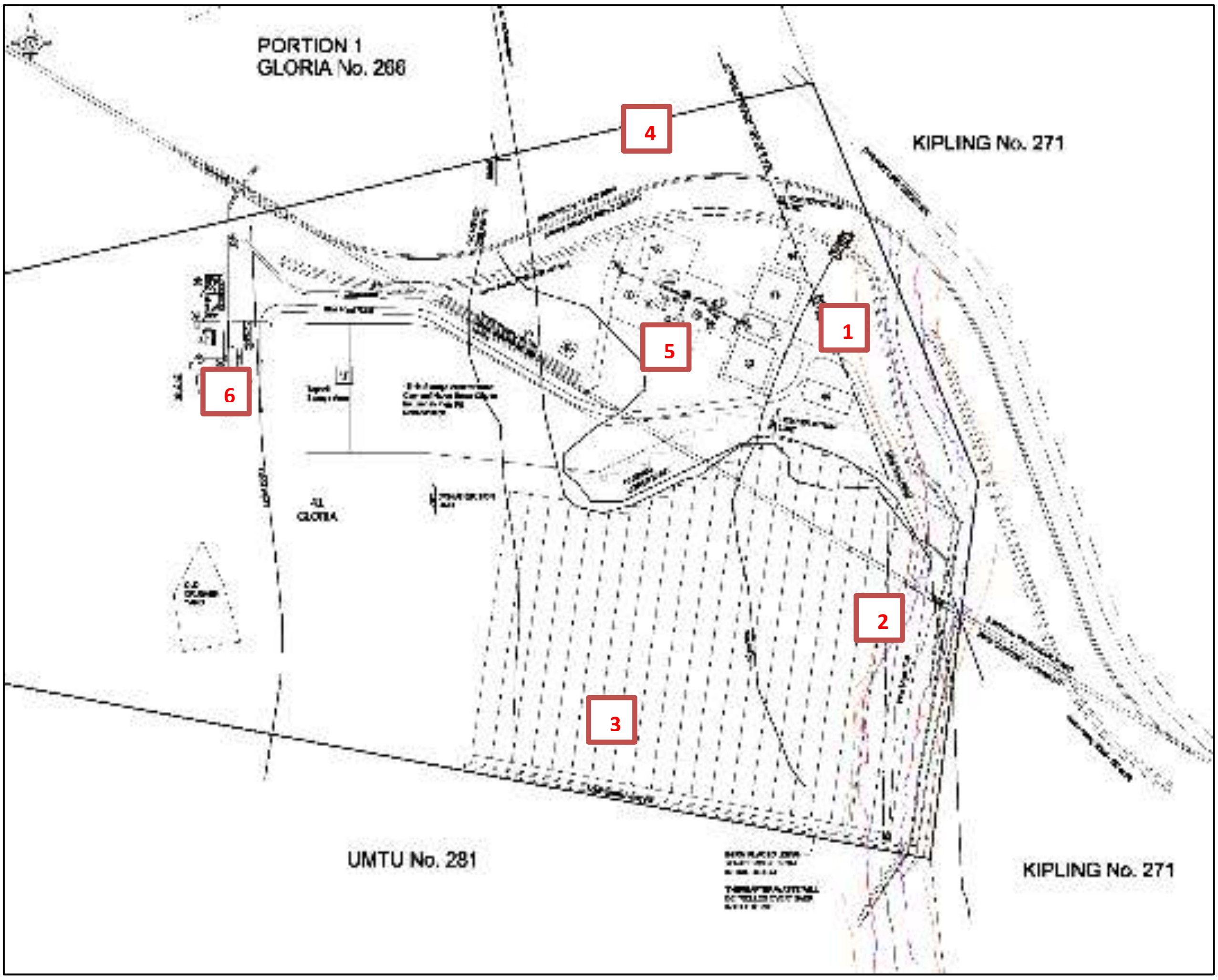


Figure 6-15: Dustfall sampling locations at Mokala Mine

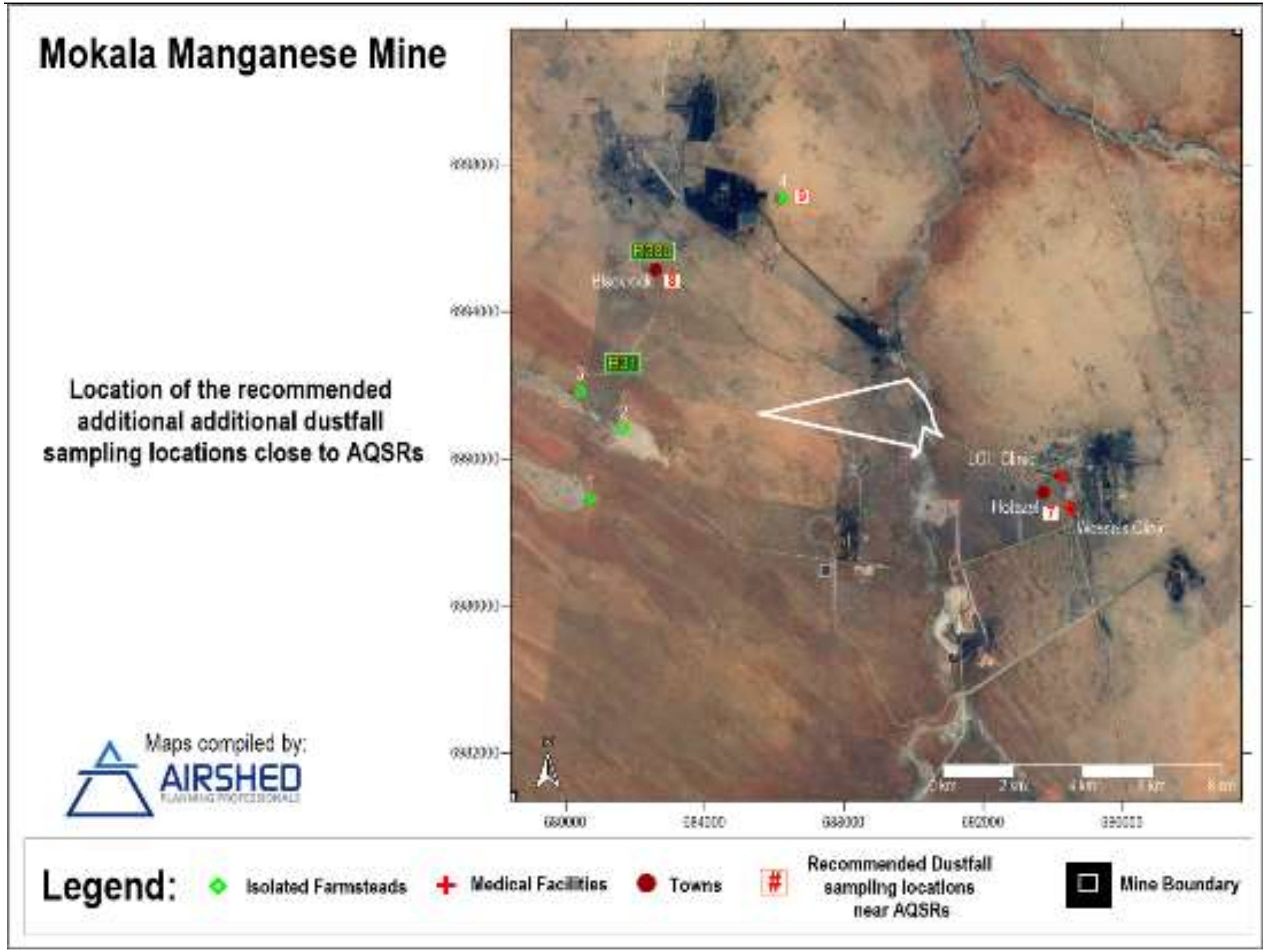


Figure 6-16: Location of dustfall sampling sites near the AQSRs

Table 6-9: Recommended Dustfall sampling locations and parameters

No	Longitude	Latitude	Description	Pollutant(s) to be Sampled
1	22.920544°	-27.187974°	Haul road and northeast boundary	Dustfall
2	22.920825°	-27.194832°	Pit and southeast boundary	Dustfall
3	22.910793°	-27.196549°	Pit and south boundary	Dustfall
4	22.912089°	-27.182532°	North boundary	Dustfall
5	22.914059°	-27.187496°	ROM pad and plant area	Dustfall
6	22.903291°	-27.188475°	Admin area and west of operations	Dustfall
7	22.956018°	-27.207286°	Hotazel Town	Dustfall
8	22.842613°	-27.154102°	Blackrock Town	Dustfall
9	22.879313°	-27.136129°	Isolated Farmstead	Dustfall
NOTE: The coordinates merely serve to provide an indication of the recommended location and should not be seen as an exact point.				

Periodic Inspections and Audits

Periodic inspections and external audits are essential for progress measurement, evaluation and reporting purposes.

- *It is recommended that site inspections and progress reporting be undertaken at regular intervals (at least quarterly) internally by Mokala.*
- *Annual environmental audits should be conducted by an external suitably qualified individual. Annual environmental audits should be continued at least until closure.*
- *Results from site inspections and monitoring efforts should be combined to determine progress against source- and receptor-based performance indicators. Progress should be reported to all interested and affected parties, including authorities and persons affected by pollution.*
- *The criteria to be taken into account in the inspections and audits must be made transparent by way of minimum requirement checklists included in the management plan. Corrective action or the implementation of contingency measures must be proposed to the stakeholder forum in the event that progress towards targets is indicated by the quarterly/annual reviews to be unsatisfactory.*

7 NOISE

The assessment of noise pollution due to the proposed project presented herein was taken from the Noise Impact Assessment undertaken by Airshed (August 2021).

7.1 ISSUE: INCREASE IN DISTURBING NOISE LEVELS

7.1.1 DESCRIPTION OF IMPACT

Two types of noise are distinguished: noise disturbance and noise nuisance. Noise can be registered as a discernible reading on a sound level meter, while nuisance noise 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/infrastructure present the possibility of generating both noise disturbances and noise nuisance in all phases prior to closure. The existing operation generates noise, and the proposed construction and operation of the proposed infrastructure presents additional noise sources and locations. 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.

7.1.2 IMPACT ASSESSMENT

7.1.2.1 OPERATIONAL PHASE

The extent and character of operational phase noise, especially mining, will be variable as the mine progresses. The following operational phase sources of noise were included in the study:

- Diesel mobile equipment, operational within the pit, along haul routes, on the stockpiles and within the plant;
- Loading and unloading of ROM and waste rock;
- Ore processing through crushing and screening;
- Diesel power generation; and
- Transport of ore and waste materials.

During the day, project activities are expected to result in an increase of 3 dBA from baseline levels up to 600 m to the east of the mine boundary, 200 m to the north of the mine boundary and up to 300 m to the south of the mine boundary (impacts to the south and east will of course be dependent on the location of the box cut being worked at any given time) (Figure 7-1). The simulated increase in noise levels is well below 3 dBA at all sensitive receptor locations, meaning that the mining, processing, and hauling operations are unlikely to cause a disturbance at any of these locations. Because of the lower night-time baseline noise levels and atmospheric conditions less conductive to noise attenuation, the increase from baseline levels due to Mokala's mining operations are expected to be more significant during the night, with an increase of 3 dBA simulated up to 800 m to the north, south and east of the mine boundary.

The increase from baseline could reach 10 dBA up to 100 m to the north, south and east of the mine boundary as well (see Figure 7-2). Due to the distance between the operations and any nearby sensitive receptor locations, the impact of the mining operations on noise levels at sensitive receptor locations, both during the day (Figure 7-3) and during the night (Figure 7-4), are expected to be insignificant and well below the IFC guidelines.

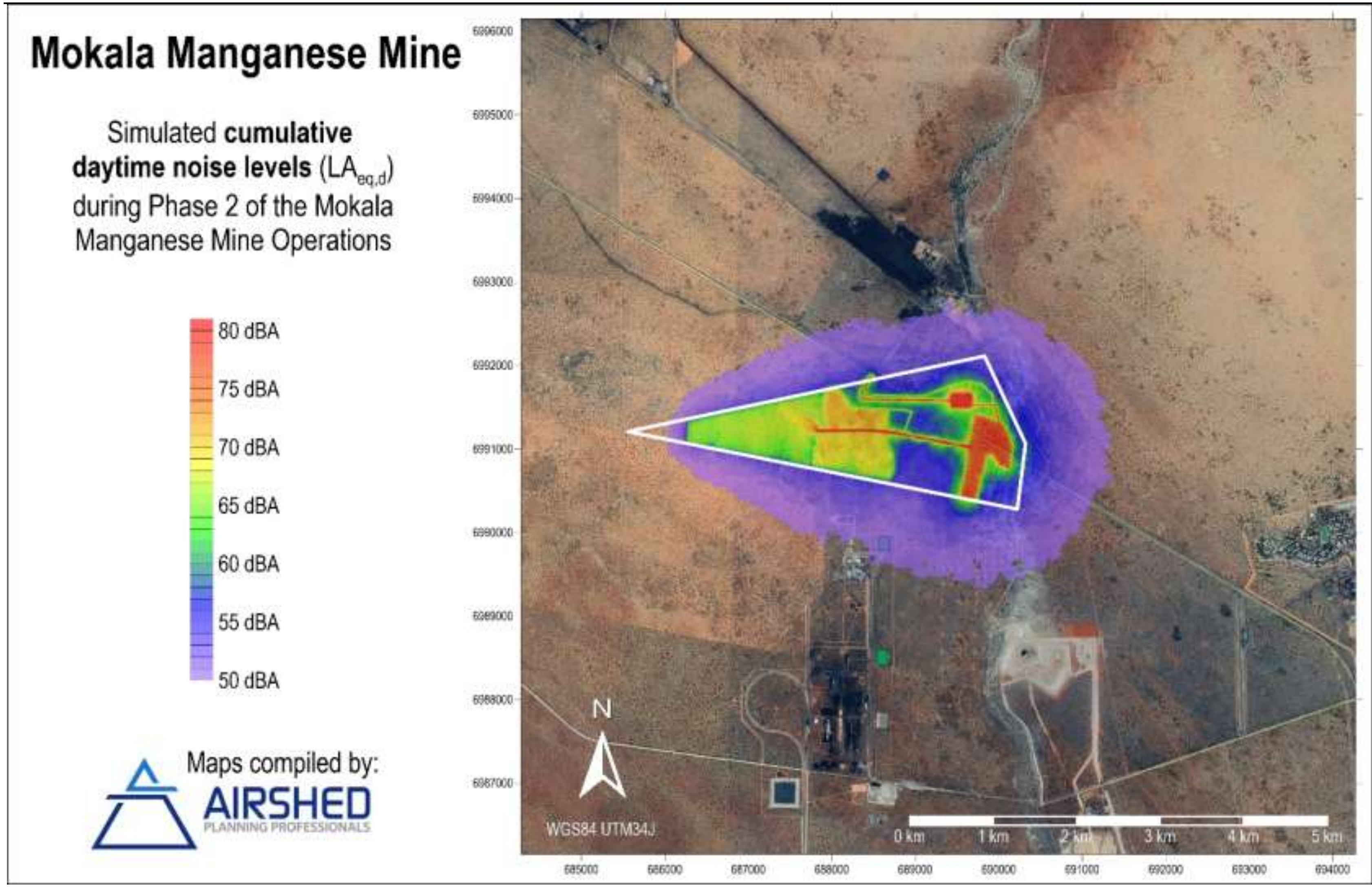


Figure 7-1: Simulated cumulative day-time noise levels as a result of the proposed project

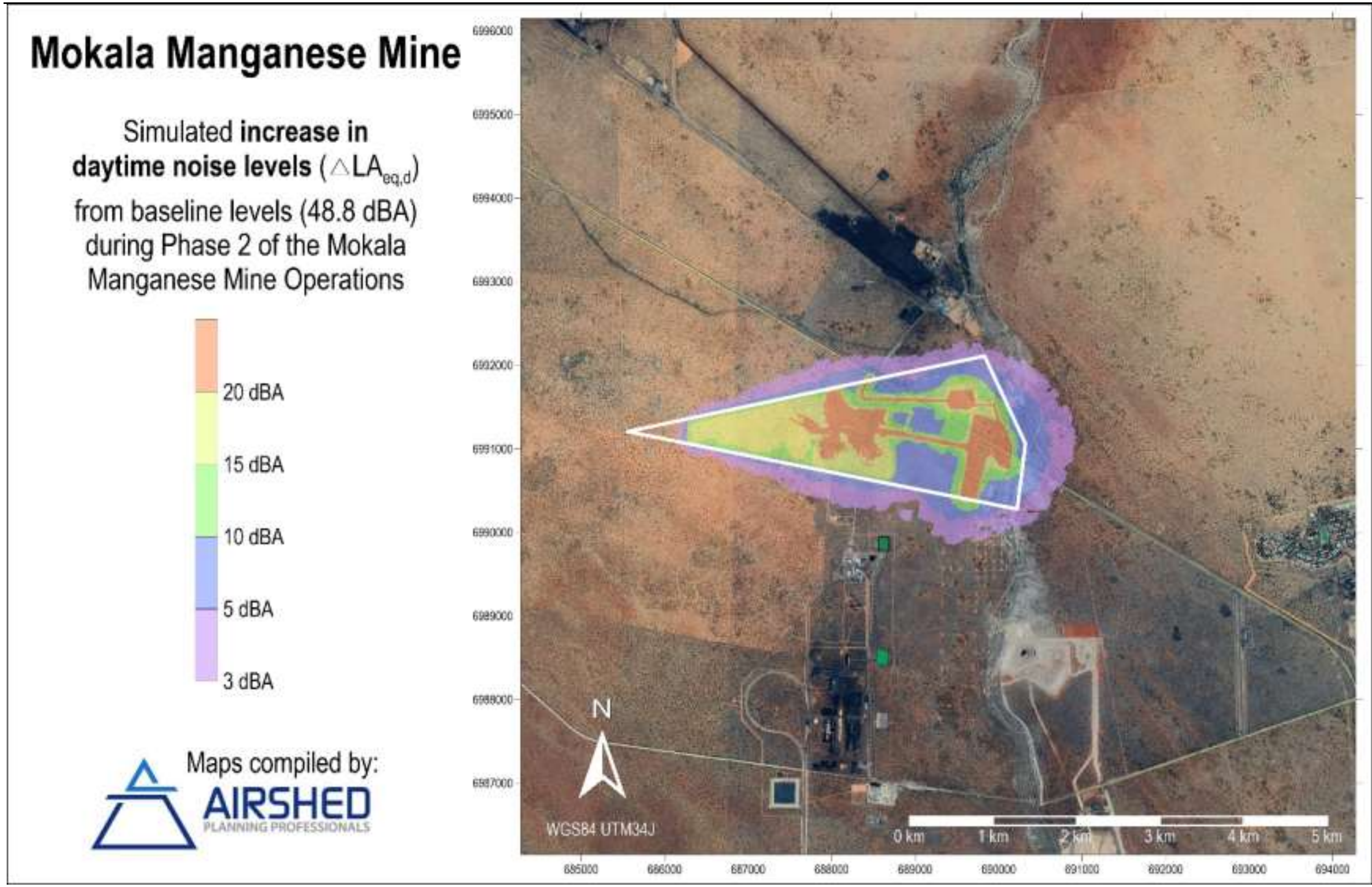


Figure 7-2: Increase in day-time noise levels over the baseline as a result of the proposed project

SLR

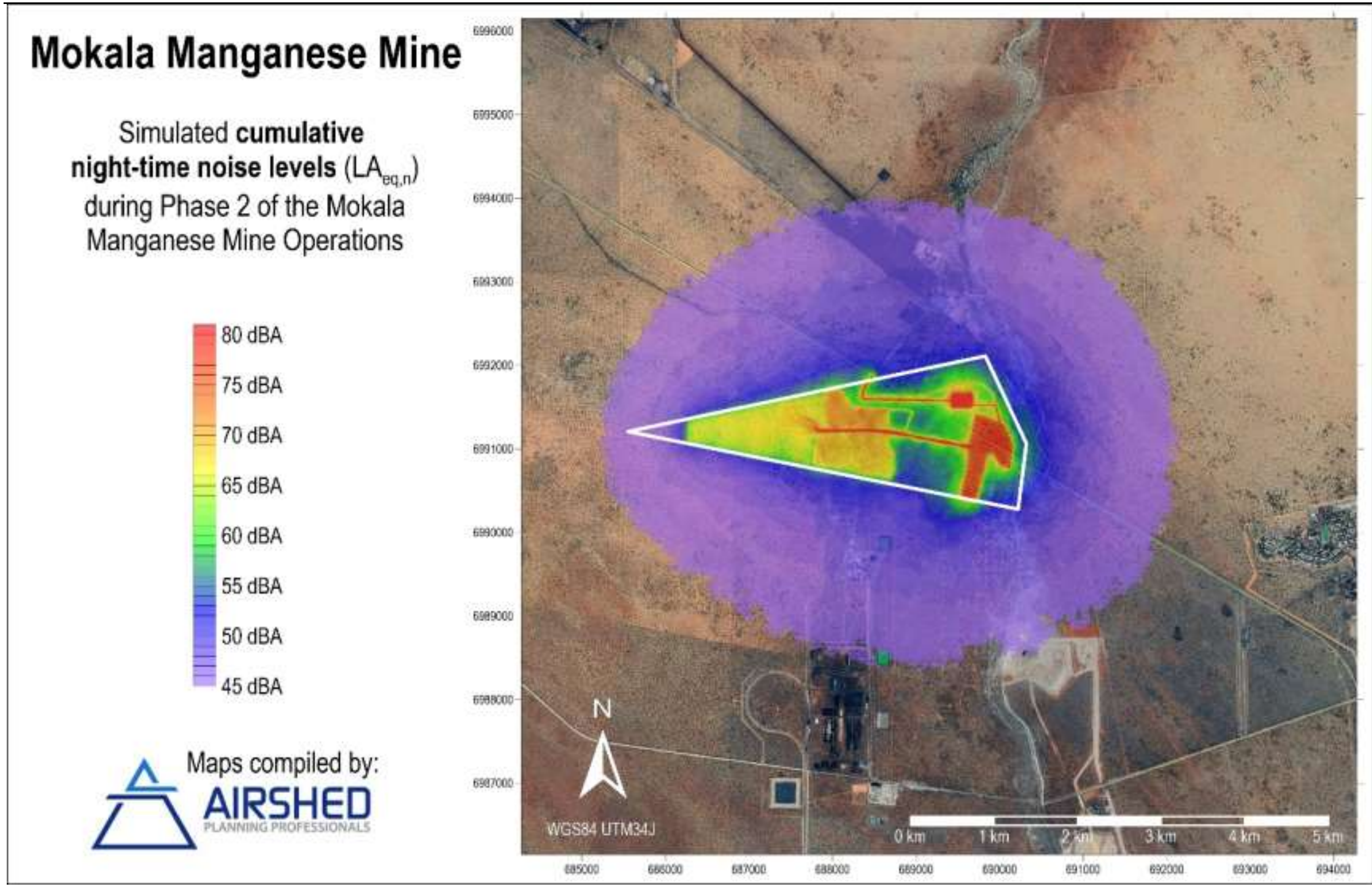


Figure 7-3: Simulated night-time noise levels as a result of the proposed project

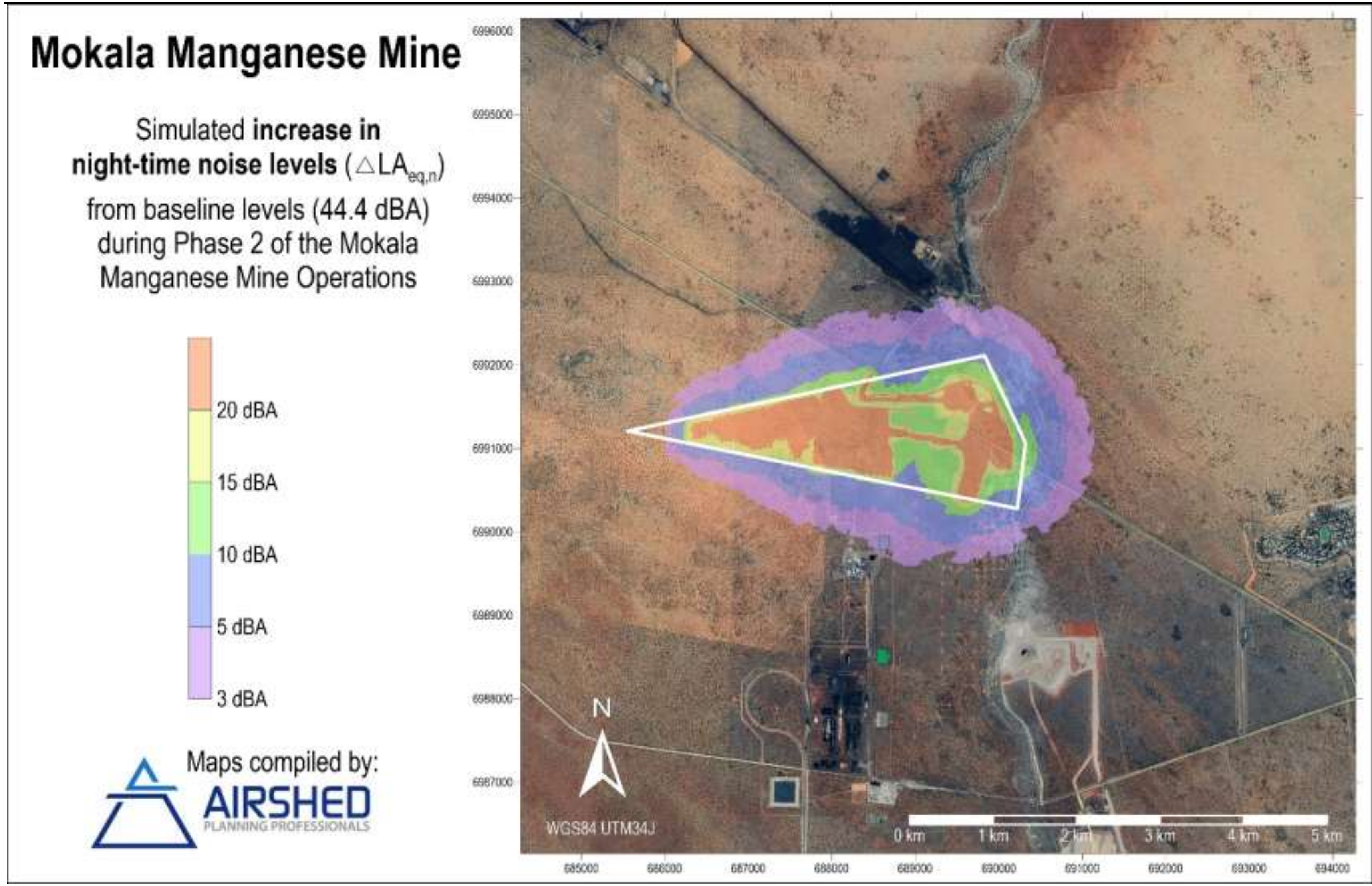


Figure 7-4: Increase in night-time noise levels over the baseline as a result of proposed project

The significance rankings of the noise impacts from the proposed project activities during operations is given in Figure 7-1. Impacts during construction and decommissioning are expected to be similar to or less significant than during the operational phases, and noise impacts are expected to seize post-closure. The impact significance, mainly due to the large spatial separation between the operations and nearby noise sensitive receptors is low.

Table 7-1: Issue: Increase in disturbing noise levels

Issue: Increase in disturbing noise levels		
Phase: Operation		
Criteria	Without Mitigation	With Mitigation
Intensity	Low	Low
Duration	Medium	Medium
Extent	Medium	Medium
Consequence	Low	Low
Probability	Low	Low
Significance	**Low (incremental and cumulative)**	**Low (incremental and cumulative)**

MANAGEMENT OBJECTIVE

To manage increase in noise due to mining operations to an acceptable level.

EMERGENCY SITUATIONS

None identified.

7.1.3 MANAGEMENT ACTIONS

7.1.3.1 ONGOING / ALL PHASES

- The following good engineering practice should be applied:
  - All diesel powered equipment and plant vehicles should be kept at a high level of maintenance. This should particularly include the regular inspection and, if necessary, replacement of intake and exhaust silencers.
  - Optimised equipment design noise levels.
  - A noise complaints register should be kept on site.
- The following measures to manage transport related noise, specifically from trucks should be applied:
  - Minimizing individual vehicle engine, transmission, and body noise/vibration. This is achieved through the implementation of an equipment maintenance program.
  - Minimize slopes by managing and planning road gradients to avoid the need for excessive acceleration/deceleration.
  - Maintain road surface regularly to avoid corrugations, potholes etc.
  - Avoid unnecessary idling times.

   - Minimizing the need for trucks/equipment to reverse. This will reduce the frequency at which disturbing but necessary reverse warnings will occur. Alternatives to the traditional reverse 'beeper' alarm such as a 'self-adjusting' or 'smart' alarm could be considered. These alarms include a mechanism to detect the local noise level and automatically adjust the output of the alarm is so that it is 5 to 10 dB above the noise level in the vicinity of the moving equipment. The promotional material for some smart alarms does state that the ability to adjust the level of the alarm is of advantage to those sites 'with low ambient noise level.
- *Any change in the noise emission characteristics of equipment should serve as a trigger for withdrawing it for maintenance.*
- *To minimise noise generation, vendors should be required to guarantee optimised equipment design noise levels.*
- *Minimizing individual vehicle engine, transmission, and body noise/vibration. This is achieved through the implementation of an equipment maintenance program.*
- *Maintain road surface regularly to avoid corrugations, potholes etc.*

7.1.3.2 CONSTRUCTION PHASE

- In the event that Mokala receives noise related complaints during either construction or operation, monitoring measures outlined in this EMPR should be implemented.

7.1.3.3 OPERATIONAL PHASE

- *Minimize slopes by managing and planning road gradients to avoid the need for excessive acceleration/deceleration.*
- *Avoid unnecessary idling times for operating vehicles.*
- *Minimise the need for trucks/equipment to reverse through optimised route layout and traffic management on site. This will reduce the frequency at which disturbing but necessary reverse warnings will occur.*
- *Consider alternatives to the traditional reverse 'beeper' alarm such as a 'self-adjusting' or 'smart' alarm. These alarms include a mechanism to detect the local noise level and automatically adjust the output of the alarm is so that it is 5 to 10 dB above the noise level in the vicinity of the moving equipment.*
- *Vibrating equipment such as crushers and screens should be mounted on vibration isolation mountings.*
- *Blasting at the surface will be audible over long distances and may cause a startling reaction at receptors in close proximity. This can be mitigated by adhering to blast schedules that have been communicated to the affected parties.*

7.1.3.4 MONITORING

- *A mechanism to monitor noise levels, record and respond to complaints and mitigate impacts should be developed.*
- In the event that Mokala receives noise related complaints, then Mokala should consider conducting short term (24-hour) ambient noise measurements as part of investigating the complaints. The results of the measurements should be used to inform any follow up interventions.
- The following procedure should be adopted for all noise surveys:

- Any surveys should be designed and conducted by a trained specialist.
- Sampling should be carried out using a Type 1 sound level meter (SLM) that meets all appropriate International Electrotechnical Commission (IEC) standards and is subject to annual calibration by an accredited laboratory.
- The acoustic sensitivity of the SLM should be tested with a portable acoustic calibrator before and after each sampling session.
- Samples of at least 24 hours in duration and sufficient for statistical analysis should be taken with the use of portable SLM's capable of logging data continuously over the time period. Samples representative of the day- and night-time acoustic climate should be taken.
- The following acoustic indices should be recoded and reported:
  - L_{Aeq} (T)
  - Statistical noise level L_{A90},
  - L_{Amin} and L_{Amax}
  - Octave band or 3rd octave band frequency spectra.
- The SLM should be located approximately 1.5 m above the ground and no closer than 3 m to any reflecting surface.
- Efforts should be made to ensure that measurements are not affected by the residual noise and extraneous influences, e.g. wind, electrical interference and any other non-acoustic interference, and that the instrument is operated under the conditions specified by the manufacturer. It is good practice to avoid conducting measurements when the wind speed is more than 5 m/s, while it is raining or when the ground is wet.
- A detailed log and record should be kept. Records should include site details, weather conditions during sampling and observations made regarding the acoustic climate of each site.

8 VISUAL

The information contained in this section was informed by the detail of the proposed project components in Section 4.2 of the main EIA and EMPr document, by the approved EIA and EMPr (SLR, December 2015) as well as findings from site visits undertaken by the EIA project team.

8.1 ISSUE: NEGATIVE VISUAL VIEWS

8.1.1 DESCRIPTION OF IMPACT

Visual impacts are assessed by considering changes to the visual landscape. Mine infrastructure and activities will change this landscape and the changes will have different impacts that will vary between the different viewpoints and the associated visual receptors. Related mitigation measures focus on landscaping interventions particularly during the decommissioning and rehabilitation stages. 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 new waste rock dump towards the west of the MRA) which are likely to remain post closure. Lighting can be visible from some distance away and also negatively impact on the visual landscape.

8.1.2 IMPACT ASSESSMENT

8.1.2.1 ALL PROJECT PHASES

The visual landscape within the Mokala Mine area is already transformed due to the presence of approved mining infrastructure and activities. The proposed establishment of the new WRD and to a lesser extent the approved WRD extension and open pit expansion (including barrier pillar), will influence existing negative visual impacts. However, these facilities will be established within and adjacent to existing mine infrastructure and will therefore blend in with the existing infrastructure to some extent. Also given the fact that the proposed project is locally situated within a predominantly mining area, the proposed project will have limited negative visual impact to the cumulative scenic quality of the local area.

As discussed in Section 10.1.1.10 of the main EIA document, the assessment of impacts to the visual landscape is determined by considering; landscape character, sense of place, scenic quality, sensitivity of the visual resource and sensitive views. The proposed project area lies in a flat, open area characterised by semi-arid vegetation and ephemeral drainage lines. Livestock and game farms and associated isolated farmsteads are typical of the region. To the south, north and south east of the proposed project site the landscape is characterised by scattered operational and closed mining operations and supportive infrastructure such as rail and road networks, powerlines, and the residential and business centre of Hotazel. In the unmitigated scenario the negative visual impact is expected to be moderate when considering the proposed project activities within the context of the existing mining operations and immediate surrounding land uses. In the unmitigated scenario the overall significance of the proposed project is rated as **HIGH** and reduced to **VERY LOW** in the unmitigated scenario. Despite the unmitigated scenario being rated high, the existing landscape represents a highly disturbed visual landscape, therefore provided adequate visual impact management measures are undertaken, the proposed project is unlikely to exacerbate the existing visual disturbance.

Table 8-1: Issue: Negative visual views

Issue: Negative visual views		
Phase: Construction, Operation, Decommissioning and Closure		
Criteria	Without Mitigation	With Mitigation
Intensity	Medium	Medium
Duration	High	Medium
Extent	Medium	Medium
Consequence	High	Low
Probability	High	Medium
Significance	**High (incremental and cumulative)**	**Very Low (incremental and cumulative)**

MANAGEMENT OBJECTIVE

To ensure visual views that complement the surrounding environment to limit negative visual views.

EMERGENCY SITUATIONS

None identified.

8.1.3 MANAGEMENT ACTIONS

8.1.3.1 CONSTRUCTION AND OPERATION

- Mokala will ensure the following:
  - Limit the clearing of vegetation
  - Limit the emission of visual air emission plumes (dust emissions)
  - Use of lighting will be limited to project requirements and measures will be implemented to limit light pollution impacts on surrounding areas
  - On-going vegetation establishment on rehabilitated areas
  - Painting infrastructure with colours that blend in with the surrounding environment where possible

8.1.3.2 DECOMMISSIONING AND CLOSURE

- During the decommissioning phase, Mokala will implement a closure plan which involves the removal of infrastructure, and the rehabilitation and re-vegetation of disturbed areas. The pit will be backfilled, and all stockpiles will have been removed.
- During closure final rehabilitated areas will be managed through a care and maintenance programme to limit and/or enhance the long term post closure visual impacts

IMPACTS ON THE HERITAGE/ CULTURAL AND PALAEONTOLOGICAL RESOURCES

9 HERITAGE/ CULTURAL AND PALAEONTOLOGICAL RESOURCES

The assessment of impacts heritage resources presented herein was taken from the Heritage Impact Assessment and Palaeontological Assessment undertaken by HCAC (June 2021) and the desktop Palaeontological Study by Prof Marion Bamford (May 2021) for the proposed project. It is important to note that this assessment does not include an assessment due to the proposed establishment of the potable water pipeline.

9.1 ISSUE: DESTRUCTION OF HERITAGE/ CULTURAL AND PALAEONTOLOGICAL RESOURCES

9.1.1 DESCRIPTION OF IMPACT

There are a number of activities/infrastructures in all phases prior to closure that have the potential to damage heritage and cultural resources, either directly or indirectly, and result in the loss of the resource for future generations. Heritage and cultural resources include sites of archaeological, cultural or historical importance. A Heritage Impact Assessment (HIA) field survey was undertaken over two days on the Mokala Mine and proposed project areas. Large portions of the study area are currently subjected to mining activities that would have impacted on surface indicators of heritage resources.

9.1.2 IMPACT ASSESSMENT

An overview of the impacts at the project phases are given below.

- Pre-construction
  In the pre-construction phase t is assumed that the pre-construction phase involves the removal of topsoil and vegetation as well as the establishment of infrastructure needed for the construction phase. These activities can have a negative and irreversible impact on heritage features if any occur. Impacts include destruction or partial destruction of non-renewable heritage resources.
- Construction Phase
  During this phase, the impacts and effects are similar in nature but more extensive than the pre-construction phase. Potential impacts include destruction or partial destruction of non-renewable heritage resources.
- Operational Phase
  Impacts and effects during open pit mining operations include excavations. Potential impacts include destruction or partial destruction of non-renewable heritage resources.
- Decommissioning phase
  No additional impacts are expected during decommissioning and closure.

The study area was subjected to two previous HIA's in 2013 and 2015 in anticipation of these activities and recorded five Stone Age sites within the general area, close to the Ga-Mogara River. This conforms to the landscape use of the area during Stone Age times when Middle and Later Stone Age sites where concentrated around water sources. In addition to these known sites the current assessment recorded an area within the Mokala mine expansion area where the topsoil has been removed from a small portion of the site where a low density of MSA lithic artefacts were identified in the spoil heaps mapped as Feature 1 (Refer to Section 10.1.2 of main report). The occurrence of lithics here, re-enforces the theory of a much larger general scatter of lithic artefacts across this landscape away from the Ga-Mogara River, now covered by windblown sand. The artefacts are out of context and are scattered too sparsely to be of significance apart. The Heritage significance was rated Low, and a field rating of GP C was assigned.

Based on the SAHRA Paleontological map The area is of moderate paleontological sensitivity and an Independent study was conducted for this aspect. The study by Bamford 2021 found that the proposed changes to the mine and infrastructure, on Farm Gloria 266, and borders of Farms Kipling 271 and Umtu 281, all lie on the Quaternary Kalahari Group aeolian sands, alluvium and calcrete and a small portion of surface limestone. There is a very small chance that fossils may occur in paleo-pans or paleo-springs, but no such feature is visible. The area is already highly disturbed from current mining operations.

The low density scatter of lithics at Feature 1 is out of context and recorded outside of the current study area and will not be directly impacted on. No significant resources were noted in the project area and no adverse impact to heritage resources is expected. Impact to heritage resources is low prior to mitigation and zero post mitigation. Due to the arid nature of the study area focal points for human occupation in antiquity would have been concentrated close to water sources and elevated areas. Therefore, the area around the Ga-Mogara River is considered to be heritage sensitive and this area should be monitored during the expansion of the open cast pit and barrier pillar mining. Any additional effects to subsurface heritage resources can be successfully mitigated by implementing a chance find procedure.

Table 9-1: Destruction of Heritage, Cultural and Palaeontological Resources

Issue: Destruction of heritage resources		
Pre-Construction; Construction and Operational phases		
Criteria	Without Mitigation	With Mitigation
Intensity	Very Low	Very Low
Duration	High	High
Extent	Very Low	Very low
Consequence	Low	Low
Probability	Medium	Medium
Significance	Low	Low

9.1.3 CUMULATIVE IMPACTS

Impacts to heritage resources are permanent, but due to the low significance of the recorded resources this is not considered an irreplaceable loss to the archaeological record of the area. The recorded resources have been sufficiently mitigated by recording the features in the HIA. The cumulative impacts are **LOW** as the recorded heritage features have very low cultural significance.

MANAGEMENT OBJECTIVE

The objective is to avoid the disturbance of significant heritage resources and to protect and preserve heritage and cultural resources.

EMERGENCY SITUATIONS

If there are any chance finds of heritage and/or cultural sites, or if any heritage resources are exposed during mining activity, all development activities must be stopped. Mokala must follow the emergency response procedure as well as the Chance Find Procedures outlined in the management actions below.

9.1.1 MANAGEMENT ACTIONS

9.1.1.1 ON-GOING

- Mokala will ensure that a 50 m buffer zone around heritage site HMK2 is maintained.
- If there are any chance finds of heritage and/or cultural sites, Mokala will also follow the emergency response procedure *as well as the Chance find Procedures outline below.*
- *Due to the arid nature of the study area focal points for human occupation in antiquity would have been concentrated close to water sources and elevated areas. Therefore, the area around the river and barrier pillar mining area are considered heritage sensitive and this area should be monitored by a suitably qualified individual during construction.*

Chance Find Procedure

The possibility of the occurrence of subsurface finds cannot be excluded. Therefore, if during construction any possible finds such as stone tool scatters, artefacts or bone and fossil remains are made, the operations must be stopped, and a qualified archaeologist must be contacted for an assessment of the find and therefor chance find procedures should be put in place as part of the EMP.

Aim

The aim of this procedure is to establish monitoring and reporting procedures to ensure compliance with this policy and its associated procedures.

Responsible persons

This procedure applies to the developer's permanent employees, its subsidiaries, contractors and subcontractors, and service providers.

Heritage/ Cultural

Implementation: If stone tool scatters, artefacts or bone and fossil are found.
Phase: As required

- *Construction crews must be properly inducted to ensure they are fully aware of the procedures regarding chance finds as discussed below.*
- *If during the pre-construction phase, construction, operations or closure phases of this project, any person employed by the developer, one of its subsidiaries, contractors and subcontractors, or service provider, finds any artefact of cultural significance or heritage site, this person must cease work at the site of the find and report this find to their immediate supervisor, and through their supervisor to the senior on-site manager.*
- *It is the responsibility of the senior on-site Manager to make an initial assessment of the extent of the find and confirm the extent of the work stoppage in that area.*
- *The senior on-site Manager will inform the ECO of the chance find and its immediate impact on operations. The ECO will then contact a professional archaeologist for an assessment of the finds who will notify the SAHRA.*

Programme for Palaeontology

Implementation: To commence once the area is surveyed by the surveyor or environmental officer.

Phase: Planning/pre-construction phase

- *The following procedure is only required if fossils are seen on the surface when surveyed and any palaeo-pan or palaeo-spring feature is recognised.*
- *If any fossiliferous material (plants, insects, bone) is seen it should be put aside in a suitably protected place. This way the construction activities will not be interrupted.*
- *Photographs of similar fossil plants must be provided to the developer to assist in recognizing the fossil plants in the shales and mudstones. This information will be built into the EMP's training and awareness plan and procedures.*
- *Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.*
- *If there is any scientifically important fossil material as assessed from the submitted photographs, then the qualified palaeontologist sub-contracted for this project, should visit the site to inspect the site and excavate (having obtained a SAHRA permit).*
- *Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued and housed in a suitable institution where they can be made available for further study.*
- *Annual reports must be submitted to SAHRA as required by the relevant permits.*
- *If no good fossil material is recovered, then the site inspection by the palaeontologist will not be necessary.*
- *If no fossils are found during the survey, then no further palaeontological impact assessment is required.*

9.1.1.2 MONITORING

- *Day to day monitoring can be conducted by the Environmental Officers.*
- *The Environmental Officer or other responsible persons should be trained along the following lines:*
  - *Induction training: Responsible staff identified by the developer should attend a short course on heritage management and identification of heritage resources.*
  - *Site monitoring and watching brief: As most heritage resources occur below surface, all earth-moving activities need to be routinely monitored in case of accidental discoveries. The greatest potential impacts are the initial soil removal and subsequent earthworks during construction. The EO should monitor all such activities daily. If any heritage resources are found, the chance finds procedure must be followed as outlined above.*
- *Implement the monitoring requirements as specified in Table 9-2.*

Table 9-2: Heritage monitoring requirements for the project

Heritage Monitoring					
Aspect	**Area**	**Responsible for monitoring and measuring**	**Frequency**	**Proactive or reactive measurement**	**Method**
Clearing activities and Excavations	Entire project area	Environmental Officer /Environmental Manager	Weekly – during construction phase	Proactively	• If risks are manifested (accidental discovery of heritage resources) the chance find procedure should be implemented: ○ Cease all works immediately; ○ Report incident to the Sustainability Manager; ○ Contact an archaeologist/ palaeontologist to inspect the site; ○ Report incident to the competent authority; and ○ Employ reasonable mitigation measures in accordance with the requirements of the relevant authorities. • Only recommence operations once impacts have been mitigated.
Clearing and excavations	Heritage Sensitive area close to the river	Environmental Officer (Taking photographs of profiles and stone accumulations weekly and sending this to the archaeologist)	Weekly – during construction phase	Pro active	• If risks are manifested (accidental discovery of heritage resources) the chance find procedure should be implemented: ○ Cease all works immediately; ○ Report incident to the manager and archaeologist who will evaluate the find and if necessary, recommend the following steps: - Report incident to the competent authority; and - Employ reasonable mitigation measures in accordance with the requirements of the relevant authorities. • Only recommence operations once impacts have been mitigated.

IMPACTS ON THE SOCIO-ECONOMIC ENVIRONMENT

10 SOCIO-ECONOMIC

The information contained in this section was informed of the proposed project components as detailed in Section 4.2 of the main EIA and EMPr document, approved EIA and EMPr (SLR, December 2015) as well as findings from site visits undertaken by the EIA project team.

10.1 ISSUE: INWARD MIGRATION

10.1.1 DESCRIPTION OF IMPACT

Mining operations tend to bring with them an expectation of employment in all 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. Typical impacts to the socio-economic environment due to inward migration can be significant but can be alleviated with the implementation of mitigation and management measures by the operating mine. In the general mining context, inward migration can potentially lead to the following:

- 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 crime.
- Spread of disease, most notably HIV/Aids and tuberculosis.

10.1.2 IMPACT ASSESSMENT

10.1.2.1 ALL PHASES

The proposed project relates to the expansion of the open pit and proposed additional infrastructure. With regard to the impact of the proposed project on inward migration, one has to consider the current context of mining activities and the employment approach used by Mokala. The Mokala Mine is in the operational phase, with construction activities for already approved infrastructure already taking place. The proposed project will thereby form part of already existing operations (albeit an expansion thereof) and will therefore not be likely to generate any additional employment opportunities.

In addition, all mining activities are currently outsourced to an external contractor who provides the majority of the workforce (132 employees at Mokala). It follows that Mokala will make use of existing contractors and workers on site. Mitigating factors such as the monitoring of workers' living conditions, recruitment disciplines and HIV/Aids awareness and management already exist. As a result, the potential for increased social risks due to the proposed project activities is unlikely, provided the management measures and mitigations are implemented. The assessment of this impact is thus considered for all phases of the proposed project as was found to be **MEDIUM** before mitigation and reduced to **VERY LOW** after mitigation.

Table 10-1: Impact summary – Impact of inward migration

Issue 1: Impact of inward migration		
Phases: Construction, Operation, Decommissioning and Closure		
Criteria	Without Mitigation	With Mitigation
Intensity	Medium	Low
Duration	Medium	Medium
Extent	Medium	Medium
Consequence	Medium	Low
Probability	High	Low
Significance	**Medium**	**Very Low**

MANAGEMENT OBJECTIVE

The objective of the mitigation measures is to establish and maintain a good working relationship with surrounding communities, local authorities and landowners in order to limit the impacts associated with inward migration and related social impacts.

EMERGENCY SITUATIONS

The establishment of any informal settlements is considered to be an emergency situation that will be handled in accordance with emergency response procedure.

10.1.3 MANAGEMENT ACTIONS

10.1.3.1 ONGOING / ALL PHASES

- In terms of recruitment, procurement, and training during all mine phases Mokala will ensure the following:
    - 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.
    - Recruitment and procurement, by Mokala and its contractors, will be preferentially provided to people in the communities where possible, that are closest to Mokala. In order to be in a position to achieve these skills register of people within the closest communities will be maintained. Mokala will also preferentially provide bursaries and training to people that reside in these closest communities.
    - There will be no recruitment or procurement at the gates of the mine. All recruitment will take place off 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.

- Mokala will ensure the following:
  - No mine employees will be housed on-site
  - Mokala will work with neighbouring mines, 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
  - Mokala will implement a health policy on HIV/AIDS and tuberculosis. 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.
  - Mokala will work closely with the local and regional authorities and other mine/industries in the areas to be part of the problem solving process that needs to address social service constraints.
  - Mokala will implement a stakeholder communication, information sharing and grievance mechanism to enable all stakeholders to engage with Mokala on both socio-economic and environmental issues.
- *Mokala must ensure that the Social and Labour Plans are updated as required by the most current relevant legislation at the time. The content should reflect any changes in recruitment approaches or labour sourcing undertaken at the mine.*
- *Mokala should commit to equitable labour sourcing where possible and required as per legislation.*

10.2 ISSUE: ECONOMIC IMPACT

10.2.1 DESCRIPTION OF IMPACT

In the broadest sense, all activities associated with the mine contribute towards a positive economic impact in all phases. Mining has a positive net economic impact on the national, local and regional economy. Direct benefits are derived from wages, taxes and profits. Indirect benefits are derived through the procurement of goods and services, and the increased spending power of employees.

10.2.2 IMPACT ASSESSMENT

10.2.2.1 ALL PHASES

The assessment of the economic impact of the Mokala Mine operations as per the approved EIA and EMPR undertaken for the development of the mine (SLR, December 2015) was a high positive impact and increased to very high significance with the implementation of enhancement measures. According to the original assessment (SLR, December 2015) direct benefits are derived from wages, taxes, and profits. Indirect benefits are derived through the procurement of goods and services, and the increased spending power of employees. The current status of the mine should be considered when assessing the economic impact of the proposed project. The proposed project forms part of an existing approved mine and the proposed project will not generate any significant additional employment opportunities.

Mitigating factors such as recruitment and procurement processes already exist. According to the MWP (Minxcon, 2021) Mokala currently budgeted an average of ZAR 16 678 000,00 over the next 10 years to be spent as part of realising the socio-economic investments as committed in the SLP. However increased economic impact as result of the implementation of the proposed project on the local GDP is limited. The impact rating therefore remains unchanged as per the original EMPr. In the unmitigated scenario the impact is considered **VERY HIGH +** and remains as such with enhancement measures.

Table 10-2: Impact summary – Economic impact

Issue: Economic impact		
Phases: Construction, Operation, Decommissioning and Closure		
Criteria	Without Mitigation	With Mitigation
Intensity	Very High	Very High
Duration	High	High
Extent	High	High
Consequence	Very High	Very High
Probability	High	High
Significance	Very High+	Very High+

MANAGEMENT OBJECTIVE

The objective of the mitigation measures is to enhance the positive economic impacts and limit the negative economic impacts by working together with existing structures and organisations

EMERGENCY SITUATIONS

None identified.

10.2.3 MANAGEMENT ACTIONS

10.2.3.1 ONGOING / ALL PHASES

Mokala will ensure the following:

- *Mokala (and it's contractors) will implement measures to ensure that specified targets as per the approved the Social and Labour Plan are realised, to this end Mokala will undertake the following:*
  - hire local people from the closest communities where possible.
  - Mokala will extend its formal bursary and skills development programmes to the closest communities to increase the number of local skilled people and thereby increase the potential local employee base.
  - Mokala will implement a procurement mentorship programme which provides support to local businesses from the enquiry to project delivery stages.
  - Mokala will ensure it procures local goods and services from the closest communities where possible.
- Mokala will ensure that it incorporates economic considerations into its closure planning from the outset.
- Closure planning considerations cover the skilling of employees for the downscaling, early closure, and long term *closure* scenarios.
- Mokala will identify and develop sustainable business opportunities and skills, independent from mining for members of the local communities to ensure continued economic prosperity beyond the life of mine.

11 BLASTING

The assessment of due to the proposed project presented herein was sourced from the Updated Blasting Memo (Cambrain CC, 2021) as well as the original blasting study undertaken for the Mokala Mine development (Cambrian CC, 2015). Both reports are included as Appendix G.

11.1 ISSUE: BLASTING IMPACTS

11.1.1 DESCRIPTION OF IMPACT

Blast related impacts to third parties and property can be caused by fly rock, vibrations, and air blast. Blasting hazards include ground vibration, air blast and fly rock which can cause damage to buildings and/or harm people and animals. Ground vibrations travel directly through the ground and have the potential to cause damage to buildings and can be disturbing to people. Airblast is an air pressure pulse that has both a high frequency audible sound and a low frequency inaudible concussion. If the pressure is great enough damage can be caused to structures. If the airblast is contained to 130 dB or less, then damage should not be caused to surrounding structures. Fly rock generation is related to the energy or mass of explosives and the containment of the energy on all sides of the blast area. In general, larger blast holes tend both to throw larger rocks over greater distances. Containment of fly rock is important because it has the potential to cause injury and death to people and animals. It can also damage structures.

An updated assessment of the original Blasting Study undertaken by Cambrian CC as part of the approved EIA and EMPR (SLR, December 2021), was undertaken for the proposed project activities which occur on the eastern portion of the MRA, within proximity to the R380. The original Blasting Assessment (Cambrian, 2015) and the updated Assessment memo (August 2021) is provided in Appendix G for further reference.

11.1.2 IMPACT ASSESSMENT

11.1.2.1 OPERATIONAL PHASE

An update of the impact of the blasting impacts analysis was undertaken by Cambrian CC (August 2021) due to the change in drill and blast input parameters by the mine. In addition, the R 380 was re-aligned as part of the approved EIA and EMPr (SLR, December 2015), which now passes in an arc around the northern boundary of the mine. The update to the impact analysis considered the possible impact of the blasting operations on the surrounding areas and provides an assessment of the possible blast related disturbance levels that may be experienced at various distances from the mine.

The findings suggested that the change in input parameters influenced the blast related disturbance levels experienced at various distances from the mine. However, air blast levels were all below the recommended Persson threshold limit, and that damage to structures will not occur at these levels. Vibration levels were modelled using a blast layout of 165 mm diameter holes and 15 m bench height, to predict the ground vibration disturbance levels that could be encountered at various distances from the blast at a worst-case scenario. The shortest distances from the open pit are to the surrounding mine underground workings. These range from 60 m to 240 m. The distances to the buildings adjoining the mine range from 680 m north of the mine to 735 m south of the mine and 2 870 m east of the mine (Hotazel). Although it will be subjected to blast related ground vibrations these are not considered to be significant in terms of the impact on the barrier pillar. The potential impact to buildings located north and south of the mine as well as the houses located at Hotazel show that up to six holes can be fired together before the USBM recommended limit is reached at the closest buildings.

The updated assessment also indicated that the previous assessment and recommendations as stipulated in the 2015 EIA and EMPR remains valid. It follows that the original impact significance ratings will remain applicable. The significance of blasting impacts before mitigation is rated as **HIGH** and is recued to **LOW** with mitigation measures.

Table 11-1: Blasting impacts

Issue: Blasting impacts		
Operation		
Criteria	Without Mitigation	With Mitigation
Intensity	High	Medium
Duration	High	High
Extent	Medium	Medium
Consequence	High	High
Probability	Medium	Low
Significance	High	Medium

MANAGEMENT OBJECTIVE

To limit the negative impact on third-party property and/or infrastructure due to blasting activities (fly rock, vibrations, ground vibrations and air blast).

EMERGENCY SITUATIONS

Emergency situations will be managed in accordance with Mokala's emergency response procedure.

11.1.3 MANAGEMENT ACTIONS

11.1.3.1 ONGOING/ ALL PHASE

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

11.1.3.2 OPERATIONAL

- Implementation of a blast management programme during the operational phase which has the following principles:
  - Pre mining structure and crack survey of structures within the potential impact zone
  - Design of blasts to prevent injury to people and livestock and to prevent damage to structures. As a minimum the blast design will achieve:
  - A fly rock zone limit of less than 500 m
  - A peak velocity limit of less than 12 mm/s at third party structures that are built according to building industry standards and that is further reduced at third party structures that are not built according to building industry standards

  - An air blast limit of less than 130 dB at third party structures
  - Communication of the planned blast programme to interested and affected parties including mine personnel
  - Pre-blast warning and evacuation to clear people, traffic, moveable property and livestock from the potential impact zone
  - Blast monitoring to verify the effectiveness of the blast design and blast execution
  - Audit and review to adjust the blast design where necessary to achieve the stated objectives
  - Formal documented investigation and response for all third party blast related complaints
  - Remediation of all impacts caused by blasting
- No blasting will take place within 500 m of any third party structures. Where Mokala would like to blast in areas within this 500 m distance, a project specific risk assessment will be completed and project specific mitigation measures will be implemented, subject to approval by the relevant authority(ies).
- Blasting activities is limited to day time hours.
- *Closing of roads within a defined safety radius must be implemented. The R380 road must be physically barricaded to prevent movement of traffic in both directions. Side roads (if any) that join the R380 inside the safety radius must also be barricaded to prevent traffic turning onto the R380 after closure.*
- *After the blast, the road must be inspected by mine personnel to ensure that no displacement has occurred and that no flyrock fragments are lying on the surface of the road. If required, the road surface must be swept clean. Once this has been completed then the road can be reopened for normal use.*

11.1.3.3 BLAST MONITORING

- Monitoring of each blast will be taken as part of the proposed project. Points for off-site vibration and air blast monitoring must be identified in consultation with surrounding landowners and a blast monitoring specialist.
- The monitoring results will be documented and maintained for record-keeping and auditing purposes.

12 TRAFFIC

The information contained in this section was informed of the proposed project components as detailed in Section 4.2 of the main EIA and EMPr document, approved EIA and EMPr (SLR, December 2015) as well as findings from site visits undertaken by the EIA project team.

12.1 ISSUE: ROAD DISTURBANCE AND TRAFFIC SAFETY

12.1.1 DESCRIPTION OF IMPACT

Traffic impacts can occur during the construction, operational and decommissioning phases when trucks, buses, and private vehicles make use of the private and public transport network in and adjacent to the Mokala Mine. The key potential traffic related impacts are on road capacity and public safety. Typically, traffic volumes are higher during the construction and decommissioning and closure phases due to the vehicles required to transport materials. Traffic volumes typically taper off during the operational phase.

12.1.2 IMPACT ASSESSMENT

In the context of the proposed project activities, existing traffic volumes on the realigned R380 (located on an arc toward the northern portion of the Mokala Mine) comprises of public traffic and traffic owing to mining operations in the area. The proposed project is expected to generate additional traffic on the R380 and R31. The traffic volumes will vary throughout the life cycle of the proposed project. It is important to note that most of the proposed project activities will be undertaken within the mining right area (proposed WRD expansion, proposed new WRD and the open pit expansion to the north) as such traffic impacts are expected within the project area and mine. The barrier pillar mining activities will also be undertaken on the Kalagadi mining right area and will also pose limited traffic impacts. The proposed water pipeline will however be established along the R380 which may compound traffic volumes during construction.

12.1.2.1 CONSTRUCTION, DECOMMISSIONING AND CLOSURE

During construction and decommissioning larger volumes of vehicles will be required to transport material to and of site. The roads are designed to accommodate trucks from mining operations and therefore is expected to cause a limited disturbance to the road structure. The water pipeline which will be constructed along the R380 will pose a significance disturbance to existing traffic volumes in the construction phase. As such, road disturbances and possible traffic safety impacts are considered high in the unmitigated scenario and reduces to medium because the frequency of potential accidents is expected to reduce. Any serious injury or death is a long-term impact in both the unmitigated and mitigated scenarios. Possible accident sites could occur within or outside the project area because 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 areas to which the injured people belong. The extent is considered medium in both scenarios. The consequence is in the unmitigated scenario and in the mitigated scenario. The probability in the unmitigated scenario is possible and reduces to conceivable in the mitigated scenario. The significance rating is **MEDIUM** without mitigation and **LOW** with mitigation.

Figure 12-1: Impact summary: Road disturbance and traffic safety during construction phase

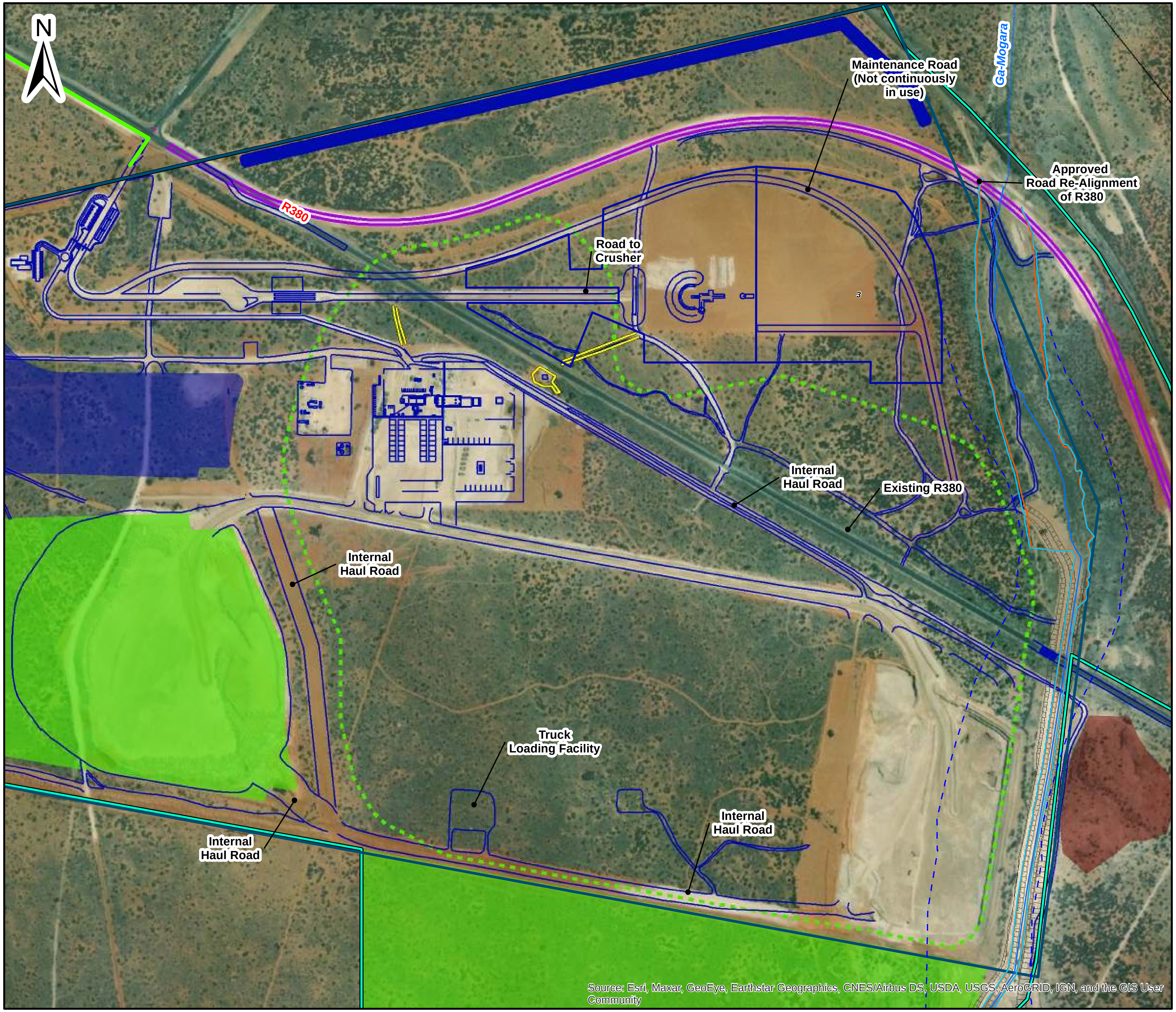
Issue: Road Disturbance and Traffic Safety		
Phases: Construction and Decommissioning and Closure		
Criteria	**Without Mitigation (All phases)**	**With Mitigation (Construction, Operational and Decommissioning)**
Severity	High	Medium
Duration	High	High
Extent	Medium	Medium
Consequence	High	Medium
Probability	Medium	Low
Significance	**Medium**	**Low**

12.1.2.2 OPERATIONAL

During operations the proposed project activities are largely limited to traffic within the mining right area. The expansion of the WRD, establishment of the new WRD, the expansion of the open pit and barrier pillar mining activities will be assimilated within the existing mining operations. The mine has relocated support infrastructure including roads and tuning circles within the mining area to ease traffic and optimise the transport route. Because of this the impact on traffic within the mining area is limited to mining personnel and workers operation vehicles. A map depicting the internal road network at Mokala is shown in . The impact of an increased capacity of product and low grade material will result in additional trucks transporting the materials for export outside the mining area but is expected to not be significant. The intensity of road disturbances and traffic safety is rated as medium before mitigation and reduced to low after mitigation. The duration and extent of the impact is rated as high and medium for both scenarios, respectively. The consequence is rated as high before mitigation and medium after mitigation. The probability is conceivable before mitigation because Mokala has implemented traffic network aimed at ensuring efficient vehicular movement and is reduced to very low with mitigation. The significance is

Table 12-1: Impact summary: Road disturbance and traffic safety during construction phase

Issue: Road Disturbance and Traffic Safety		
Phases: Construction and Decommissioning and Closure		
Criteria	**Without Mitigation (All phases)**	**With Mitigation (Construction, Operationaland Decommissioning)**
Severity	Medium	Low
Duration	High	High
Extent	Medium	Medium
Consequence	High	Medium
Probability	Low	Very low
Significance	**Medium**	**Very low**



Legend

- Mining Right Boundary
- Project Area
- Approved Road Re-Alignment of R380
- Layout Changes Already on Site
- Proposed Layout Changes
- Temporary Construction
- Rivers
- 100m River Buffer
- 100yr Floodline
- 50yr Floodline
- Powerlines
- Railway
- Historical Borrow Pits
- Area Fenced Off By Kalagadi for Game

0 100 200 Meters

Scale: 1:7 200 @ A3

Projection:Transverse Mercator
Datum: Hartebeeshoek, Lo 23

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Routes

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MANAGEMENT OBJECTIVE

To ensure the mine's use of public roads is done in a responsible manner to reduce the potential for safety and vehicle related impacts on road users.

EMERGENCY PROCEDURES

If a person or animal is injured by transport activities this must be handled in accordance with the Mokala emergency response procedure.

12.1.3 MANAGEMENT ACTIONS

The following management measures as outline in the approved EIA and EMPr (SLR, December 2015) remain valid for the proposed project.

12.1.3.1 ON-GOING / ALL PHASES

- Mokala will implement a transport safety programme to achieve the mitigation objectives during the construction, operational and decommissioning phases. Key components of the programme include:
    - Education and awareness training;
    - Maintenance of the transport system; and
    - Use of dedicated loading and off-loading areas on site.
- Mokala should investigate, together with the roads department and neighbouring mines, the possibility of maintaining the road infrastructure by providing the following during the construction, operational and decommissioning phases:
    - Reflective road studs to ensure visibility at night time;
    - Road surface maintenance;
    - Road markings (Highway paint recommended);
    - Road traffic signs;
    - Fencing along public roads to control animal movement;
    - Road safety training to workers and local communities; and
    - Regular inspections of these intersections should take place as part of a risk and safety management process. In case of a person or animal being injured by transport activities the emergency response procedure will be followed.

12.1.3.2 OPERATIONAL PHASE

- Mokala needs to ensure that proper road markings, reflective road studs, road signs, overhead lighting and proper pedestrian crossings should be provided and maintained at the entrance to the mine.
- A road maintenance plan needs to be developed for the proposed project.
- Mokala should investigate the possibility of transporting ore to loadout stations at nearby mines.

13 LAND USE

The information contained in this section was informed of the proposed project components as detailed in Section 4.2 of the main EIA and EMPr document, approved EIA and EMPr (SLR, December 2015) as well as findings from site visits undertaken by the EIA project team.

13.1 ISSUE: CHANGE IN LAND USES

13.1.1 DESCRIPTION IMPACT

Mining-related activities and infrastructure have the potential to affect land uses both within the mine area and in the surrounding areas in all mine phases. This can be caused by physical land transformation and through direct or secondary impacts such as a loss of land use and loss of water supply. The Mokala mining operations have already changed the land use within the mining area and some of the proposed project components have the potential to impact on land uses during all project phases. This section focuses on potential impacts affecting land use on and surrounding the project sites.

13.1.2 IMPACT ASSESSMENT

It is important to consider the potential area of new disturbance when considering the impact of land use changes. Land uses at the Mokala Mine includes mining activities and infrastructure associated with the Mokala operations. These activities are currently limited to the eastern section of the mine site. Project components will largely be situated within the already disturbed area (eastern portion of the mining right area) and is not expected to cause a significant impact on the land use because the components will be assimilated within the existing operations of the mine. The impact of the proposed water supply pipeline is also expected to be limited as the pipeline will be buried. Impacts from the water supply pipeline is expected to be greater, but temporary during the construction and decommissioning phases and negligible during the operational phase.

The impact of land use changes to the western portion of the mine is expected to be significant because the area is currently utilised for game farming by Kalagadi Mine. There is currently a lease agreement in place with Kalagadi Mine this is however a temporary use as the mine is owned by Mokala. The surrounding land uses are primarily mining activities with isolated farmsteads to the north west and west. These areas are located far away and are not expected to result in land use changes.

The intensity of the unmitigated impact on land use changes could be considered high because the surrounding area may be affected by, noise pollution, air pollution, traffic, or inward migration. With mitigation measures the impact is reduced to low. The duration in the unmitigated scenario is very high as it can extend beyond the life of the mine. In the mitigated scenario this is reduced to low. The spatial scale extends beyond the proposed project area in both the mitigated and unmitigated scenario. The consequence is rated as high in the unmitigated scenario and medium in the mitigated scenario. The probability is rated as possible in the unmitigated scenario and conceivable with mitigation. The significance is rated as **MEDIUM** and reduces to **LOW** with mitigation.

Table 13-1: Impact summary – Land use changes

Issue: Land use changes		
Phases: Construction, Operation, Decommissioning and Closure		
Criteria	**Without Mitigation**	**With Mitigation**
Severity	Medium	Low
Duration	Very high	Low
Extent	Medium	Medium
Consequence	High	Medium
Probability	Medium	Low
Significance	**Medium**	**Low**

MANAGEMENT OBJECTIVE

The objective is to prevent unacceptable negative impacts on surrounding land uses and to co-exist with existing land uses.

EMERGENCY SITUATIONS

None identified.

13.1.3 MANAGEMENT ACTIONS

The following management measures as per the approved EIA and EMPr (SLR, December 2015) remain relevant.

13.1.3.1 OPERATIONAL

- Quarterly meetings will be held with surrounding landowners for the purpose of information sharing and problem solving.
- Mokala will ensure that it forms part of existing forums and initiatives within the area in order to aid in the management of environmental matters.
- *During operation, Mokala should develop a comprehensive., site wide rehabilitation plan which considers the final post mining land use.*

13.1.3.2 DECOMMISSIONING AND CLOSURE

- During closure planning Mokala will incorporate measures to achieve the future land use plans for the land within the proposed project area.

13.1.3.3 ON-GOING / ALL PHASES

- Mokala will implement the EMP commitments 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.

RECORD OF REPORT DISTRIBUTION

SLR Reference:	720.09012.00010
Title:	Mokala Manganese EIA and EMPr Amendment - Impact Assessment
Report Number:	01
Client:	Mokala Manganese Mine (Pty) Ltd

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