APPENDIX D: DETAILED ASSESSMENT OF POTENTIAL IMPACTS

GAMSBERG SMELTER PROJECT
IMPACT ASSESSMENT

Gamsberg Zinc Mine

Prepared for: Black Mountain Mining (Pty) Ltd

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ACRONYMS AND ABBREVIATIONS

Acronym / Abbreviation	Definition
ABA	Acid Base Accounting
ABET	Adult Basic Education and Training
AEL	Atmospheric Emission Licence
BBBEE	Broad Based Black Economic Empowerment
BMM	Black Mountain Mine
CBA	Critical Biodiversity Area
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
CSI	Corporate Social Investment
DHSWS	Department of Human Settlements, Water and Sanitation
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
ERM	Environmental Resources Management
ETP	Effluent Treatment Plant
FDI	Foreign Direct Investment
GHG	Greenhouse Gas
Ha	Hectare
HDSA	Historically Disadvantaged South Africans
HIV	Human Immunodeficiency Virus
IDP	Integrated Development Plan
IEC	International Electro Technical Commission
IFC	International Finance Corporation
IPCC	The Intergovernmental Panel on Climate Change
Km	Kilometre
KOP	Key Observation Point
LAeq's	A-weighted equivalent sound pressure level
LED	Local Economic Development
mbgl	meters below ground level
MES	Minimum Emissions Standards
MPRDA	Mineral and Petroleum Resources Development Act
MRA	Mining Right Area
Mt	Million tons
mm	millimetre
NAAQS	National Ambient Air Quality Standards

NCDENC	Northern Cape Department of Environment and Nature Conservation
NDCR	National Dust Control Regulations
NGO	Non-Governmental Organisation
NO_X	Nitrous Oxides
NQF	National Qualifications Framework
NSR	Noise Sensitive Receptors
NWA	National Water Act, 1998 (Act No. 36 of 1998)
ORP	Oxidation-Reduction Potential
$PM_{2.50}$	Particulate Matter 2.5 Microns in size
PM_{10}	Particulate Matter 10 Microns in size
RCP	Representative Concentration Pathways
ROM	Run of Mine
SAHRA	South African Heritage Resources Agency
SANS	South African National Standards
SCC	Species of Conservation Concern
SDF	Spatial Development Framework
SEZ	Special Economic Zone
SETA	Sector Education and Training Authority
SLM	Sound Level Meter
SLP	Social and Labour Plan
SMME	Small, Medium and Micro-Enterprises
SO_2	Sulphur Dioxide
STD	Sexually Transmitted Diseases
STP	Sewage Treatment Plant
tpa	tons per annum
TSF	Tailings Storage Facility
VOC	Volatile Organic Compounds
WRC	Water Research Commission
WRD	Waste Rock Dump

DETAILED ASSESSMENT OF POTENTIAL IMPACTS

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

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

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

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

A) IMPACT ON BIOPHYSICAL ENVIRONMENT

1. ISSUE 1 IMPACT ON GROUNDWATER LEVELS AND GRADIENT

1.1 DESCRIPTION OF IMPACT

The average groundwater levels measured during the Golder (2007), SRK (2010), and ERM (2013a) hydrocensus investigations were 31.7 mbgl, 28.1 mbgl, and 29.4 mbgl, respectively. The groundwater levels ranged between artesian conditions and 178.8 mbgl.

Regional monitoring boreholes had an average groundwater level of 30.8 mbgl and the mine monitoring boreholes had an average groundwater level of 30.6 mbgl for the April 2019 monitoring round. Groundwater levels of the monitoring network boreholes were quasi-stable and there were no adverse effects due to the pit dewatering affecting mine and regional groundwater levels.

The aquifer hydraulic test results from previous studies indicated that the aquifer units in the Gamsberg area generally have very low to low permeability and increased groundwater occurrence is only associated with secondary structures such as faults and fractures.

The TSF, smelter complex and secured landfill facility are all located on basal gneiss of the Gladkop Group and no regional scale lineaments are located within the footprint of these facilities. However, the geophysical survey did indicate the presence of potential fractures within the TSF site area.

The total seepage of water moving through the secured landfill facility was estimated to range between 50% and 5% of MAP. A portion of this seepage will enter the subsurface as increased groundwater recharge at the base of the secured landfill facility. This increased groundwater recharge was estimated to range between 10% and 1% of MAP during the operational phase and between 5% and 0.5% of MAP during the closure phase, approximately a fifth of the total seepage moving through the secured landfill facility.

The saturated numerical groundwater flow and transport model cannot quantify the seepage rate from the secured landfill facility which will be under unsaturated conditions. Furthermore, the reduction in seepage due to the aging of the Jarofix and installation of a cap on the secured landfill facility cannot be quantified by a saturated numerical groundwater flow and transport model.

As the secured landfill facility would be constructed with a Class A liner, the volume of seepage into groundwater is likely to be very low. In addition, the presence of cement in the Jarofix is likely to cause it to solidify with time, significantly reducing the potential for infiltration into the secured landfill facility.

No significant change to groundwater levels is expected due to additional run-off that may result during rainfall events during the operation of the smelter complex and no further assessment is therefore included. .

1.2 IMPACT ASSESSMENT

1.2.1 Construction Phase

Potential Impacts

The construction phase of the secured landfill facility and the smelter complex would require clearing of the footprint areas, building of roads and other construction related activities. Increased permeability could result in localised altering of the flow and levels of the groundwater in the vadose zone/ shallow aquifer.

The identified impacts during the construction phase are likely to result in a minor disturbance over the short-term of the construction phase. The extent of impact is likely to affect only a portion of the site and as such, without mitigation, the impact is assessed to be VERY LOW. The impact remains VERY LOW with the implementation of mitigation (Table 1-1).

Table 1-1: Impact Summary - Change in Groundwater Levels and Gradient during Construction Phase

Issue: Change in Groundwater Levels and Gradient		
Phases: Construction		
Criteria	Without Mitigation	With Mitigation
Intensity	Minor change or disturbance (L)	Minor change or disturbance (L)
Duration	Short-term (L)	Short-term (L)
Extent	Part of site (VL)	Part of site (VL)
Consequence	Low (L)	Low (L)
Probability	Probable (H)	Conceivable (L)
Significance	Very Low (VL)	Very Low (VL)
Nature of cumulative impacts	Cumulative impacts from the mining activities within the Mining Right Area (MRA) are not anticipated.	
Degree to which impact can be reversed	The impact can be fully reversed once the construction period is completed and management measures are put in place and adhered to	
Degree to which impact may cause irreplaceable loss of resources	Very low	
Residual impacts	The residual impact is considered to be VERY LOW with only minor impacts on groundwater resources and surrounding receptors.	

Mitigation/ Enhancement Measures

The following measures should be implemented:

- No mitigation is recommended, however, monitoring should be undertaken as discussed below.

Monitoring

The following monitoring is recommended:

- Continuation and expansion of the mine and regional groundwater monitoring plan to ensure that water levels are continuously monitored. The collected information should be used as part of an active water management system and act as an early warning system which should be used for the application of mitigation measures - should the data show unacceptable levels of impacts.

1.2.2 Operational Phase

Potential Impacts

Disposal of Jarofix into the secured landfill facility during the operational phase may result in an increase in local groundwater levels and a change in groundwater gradient.

No notable difference in groundwater levels were observed for the proposed secured landfill facility and smelter complex areas for Scenario 1 (worst case) – Scenario 3 (liner installation). The total seepage emanating from the proposed secured landfill facility would be minimal if a Class A liner is installed thus limiting any significant change in local and regional groundwater levels.

The impact on groundwater levels and gradient during the operational phase, would occur over the long-term, is not expected to impact beyond the site boundary and is thus assessed without mitigation to have a LOW impact. With the implementation of mitigation measures the impact can be reduced to VERY LOW (Table 1-2).

Table 1-2: Impact Summary – Groundwater Levels and Gradient from Secured Landfill Facility during Operational Phase

Issue: Change Groundwater Levels and Gradient from Secured Landfill Facility		
Phases: Operational Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Minor change or disturbance (L)	Minor change or disturbance (L)
Duration	Long-term (H)	Long-term (H)
Extent	Part of site (VL)	Part of site (VL)
Consequence	Low (L)	Low (L)
Probability	Definite (VH)	Conceivable (L)
Significance	Low (L)	Very Low (VL)
Nature of cumulative impacts	Cumulative impacts from the mining activities within the MRA are not anticipated.	
Degree to which impact can be reversed	Low during operational phase.	
Degree to which impact may cause irreplaceable loss of resources	Very low	
Residual impacts	The residual impact is considered to be VERY LOW with only minor impacts on groundwater resources and surrounding receptors.	

Mitigation/ Enhancement Measures

The following measures should be implemented:

- Construction of the secured landfill facility with a Class A liner.

Monitoring

The following monitoring is recommended:

- Continuation of the mine and regional groundwater monitoring plan to ensure that water levels are continuously monitored. The collected information should be used as part of an active water management system and act as an early warning system which should be used for the application of mitigation measures - should the data show unacceptable levels of impacts.

1.2.3 Decommissioning Phase

Potential Impacts

The decommissioning and closure phases of the secured landfill facility may result in a continuation of increased local groundwater levels. Similar to the operational phase, the total seepage emanating from the proposed

secured landfill facility would be minimal thus limiting any significant change in local and regional groundwater levels. This is largely attributed to the secured landfill facility being required to be constructed with a Class A liner which would limit seepage into groundwater resources by at least one order of magnitude compared to no liner installation. Furthermore, the rehabilitation of the smelter complex area and secured landfill facility (cap installation) is expected to further reduce any potential impact on local groundwater levels and gradient.

The impact on groundwater levels and gradient during the closure phase from the secured landfill facility is expected to have a minor intensity with impacts remaining within the site boundary. Therefore, even though the impact could occur over the long-term the significance is expected to be LOW without mitigation and VERY LOW with the implementation of mitigation measures (Table 1-3).

Table 1-3: Impact Summary – Groundwater Levels and Gradient due to from Secured Landfill Facility Post Closure

Issue: Groundwater Levels and Gradient due to from Secured Landfill Facility		
Phases: Decommissioning and Closure Phases		
Criteria	Without Mitigation	With Mitigation
Intensity	Minor change or disturbance (L)	Minor change or disturbance (L)
Duration	Long-term (H)	Long-term (H)
Extent	Part of site (VL)	Part of site (VL)
Consequence	Low (L)	Low (L)
Probability	Probable (H)	Conceivable (L)
Significance	Low	Very Low
Nature of cumulative impacts	Cumulative impacts from the mining activities within the MRA are not anticipated.	
Degree to which impact can be reversed	The impact can be reversed to a large degree once the smelter complex and secured landfill facility have been rehabilitated.	
Degree to which impact may cause irreplaceable loss of resources	Very low	
Residual impacts	The residual impact is considered to be VERY LOW with only minor impacts on groundwater resources and surrounding receptors.	

Mitigation/ Enhancement Measures

The following measures should be implemented:

- Remediation of groundwater impacts due to the physical activity (secured landfill facility and smelter complex) forms part of the recommended rehabilitation of the remaining facilities or footprint areas by re-shaping, top-soiling, and seeding and/or removal of redundant infrastructure.
- It is recommended that the parts or footprints of the facilities (any surface water/ pollution storage facilities that could possibly seep to groundwater resources) remaining after decommissioning be rehabilitated. The rehabilitation should entail the re-shaping of the remaining areas to encourage surface runoff (with smooth transitions to the surrounding topography) and prevent any ponding to minimise

water ingress. The remaining areas should, furthermore, be covered with soil and seeded to promote evapotranspiration (where possible).

Monitoring

The following monitoring is recommended:

- The groundwater monitoring programme should be implemented and reviewed regularly and updated if necessary. Monitoring of the groundwater system must be implemented to act as an early warning system, especially in the smelter complex and secured landfill facility areas. Should impacts be identified, management and mitigation measures must be implemented to prevent or reduce potential impacts on the groundwater environment as far as possible.

2. ISSUE 2 IMPACT ON GROUNDWATER QUALITY

2.1 DESCRIPTION OF IMPACT

Water seepage and associated contamination to groundwater from the smelter complex was not modelled as it is expected that potential spillages from water and/or chemical storage facilities would only occur as a result of an unplanned event.

For the secured landfill facility sulphate, sodium, lead, and antimony were included in the operational phase numerical groundwater contaminant transport models for various seepage rate scenarios. These chemical constituents were identified from the geochemical assessment as potential contaminants.

The potential receptors are:

- Groundwater resource; and
- Neighbouring groundwater users.

2.2 IMPACT ASSESSMENT

2.2.1 Construction Phase

Potential Impacts

The construction phase of the secured landfill facility and smelter complex and associated infrastructure may result in potential groundwater contamination caused by diffuse pollution sources which includes ad hoc spills and discharges of polluting substances from vehicles, vehicle maintenance, accidents, and fuel storage (e.g. diesel and oil), etc.

The groundwater quality impact during the construction phase is predicted to be VERY LOW with and without mitigation due to the short-term of the construction phase as well as the minor potential impact and limited extent over which the impact may be felt (Table 2-1).

Table 2-1: Impact Summary – Deterioration of Groundwater Quality during Construction Phase

Issue: Deterioration of Groundwater Quality		
Phases: Construction Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Minor change or disturbance (L)	Minor change or disturbance (L)
Duration	Short-term (L)	Short-term (L)
Extent	Part of site (VL)	Part of site (VL)
Consequence	Low (L)	Low (L)
Probability	Probable (H)	Conceivable (L)
Significance	Very Low (VL)	Very Low (VL)
Nature of cumulative impacts	Monitoring results between November 2017 and April 2019 indicated that current mining operations that include the pit areas, waste rock dump and tailings storage facility were not affecting groundwater quality. The cumulative impact is thus expected to be VERY LOW.	
Degree to which impact can be reversed	The impact can be fully reversed once the construction period is completed and management measures are put in place and adhered to	
Degree to which impact may cause irreplaceable loss of resources	Very low	
Residual impacts	The residual impact is considered to be VERY LOW with only minor impacts on groundwater resources and surrounding receptors.	

Mitigation/ Enhancement Measures

The following measures should be implemented:

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

Monitoring

The following monitoring is recommended:

- It is recommended that the status quo surface and groundwater monitoring programme be continued. Three new monitoring boreholes are recommended to be drilled within the secured landfill facility and smelter complex areas. The three new boreholes are described in more detail in Table 2-2 and illustrated in Figure 2-1.

Table 2-2: Recommended new monitoring borehole details.

Borehole ID	X	Y	BH Purpose
	UTM 34 South (WGS84)		
GB_SLF_01	299770.702	6766218.247	Up gradient of secured landfill facility
GB_SLF_02	298642.612	6765493.123	Down gradient of secured landfill facility
GB_SMT_01	300986.992	6766712.313	Smelter complex monitoring

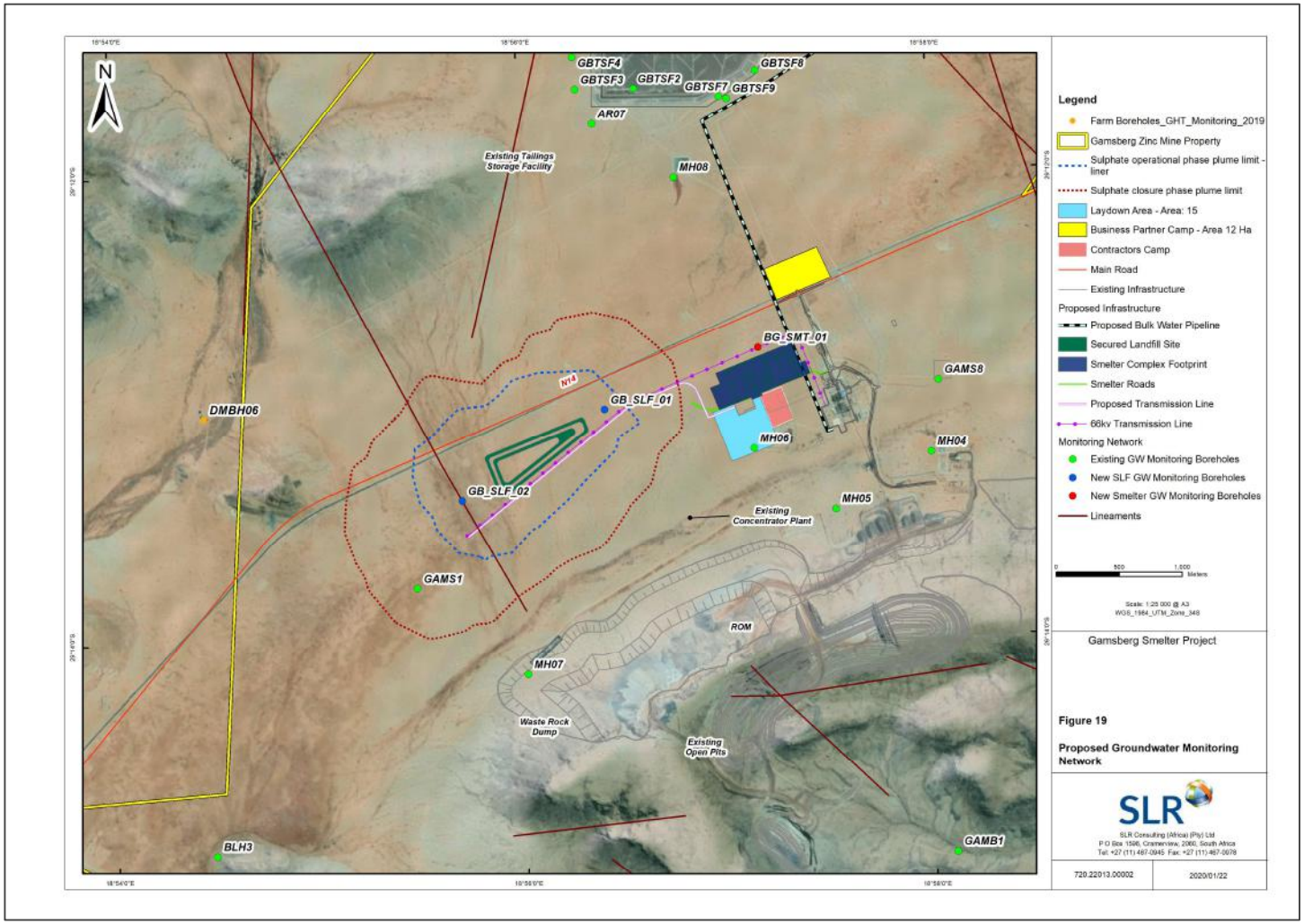

Figure 2-1 Positions of Recommended Additional Monitoring Boreholes for Proposed Secured Landfill Facility and Smelter Complex

2.2.2 Operational Phase

Potential Impacts

The numerical groundwater model showed that at the end of the operational phase (15 years) a maximum plume migration of sulphate, sodium, lead, and antimony of ~600 m, ~580 m, ~600 m, and ~700 m respectively would result with the installation of the liner. Without the liner installation with seepage rates described in Scenario 1 (worst case), all four contaminant plumes migrate approximately an additional ~100m from the secured landfill facility. The migration of the sulphate, sodium, lead, and antimony plumes at the end of the operational phase are illustrated in Figure 2-2, Figure 2-3, Figure 2-4 and Figure 2-5 respectively for both Scenario 1 (worst case) and Scenario 3 (liner installation) seepage rates. Scenario 2 resulted in similar plume extents to Scenario 3 and is not illustrated in the operational plume Figures. The minimum concentration contour for each Figure has been specified to the SANS 241-1 2015 limits for each potential contaminant. The nearest privately owned farm borehole, DMBH06, is not affected by any of the four plumes and is approximately 1.7 km away from the worst case Scenario 1 plume extents.

Although the change in seepage rates between Scenario 1 and Scenario 3 did not result in a significant change in the plume extents, the installation of a Class A liner does decreases the salt load to the aquifer by up to 23%. Since all contaminants were modelled as conservative tracers, a similar reduction in total mass flux for sodium, lead, and antimony were calculated as that of sulphate.

The Jarofix material was classified as a Type 1 waste therefore requiring a Class A liner. Therefore, if the Jarofix is to be stored in the secured landfill facility it is non-negotiable that a Class A liner be installed. The impact would occur over the long-term and would be retained within the site boundary. With the installation of the liner the intensity of contamination plumes can be reduced to minor. The impact without the liner is considered to be MEDIUM and with the liner is reduced to VERY LOW (Table 2-3).

Table 2-3: Impact Summary – Impacts on Groundwater Quality from Secured Landfill Facility during Operational Phase

Issue: Deterioration of Groundwater Quality due to Secured Landfill Facility		
Phases: Operational Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate change or disturbance (M)	Minor change or disturbance (L)
Duration	Long-term (H)	Long-term (H)
Extent	Part of site (VL)	Part of site (VL)
Consequence	Medium (M)	Low (L)
Probability	Probable (H)	Conceivable (L)
Significance	Medium (M)	Very Low (L)
Nature of cumulative impacts	Provided there are no changes to the mining plan as it currently stands, the open pit would act as a sink thus minimising the movement of contaminants away from the site. The cumulative impact is thus considered to be LOW.	
Degree to which impact can be reversed	The impact cannot be reversed during the operational period, but impact can be minimised if management measures are put in place and adhered to.	

Issue: Deterioration of Groundwater Quality due to Secured Landfill Facility	
Degree to which impact may cause irreplaceable loss of resources	Medium as this impact will affect groundwater quality and the use of the resource during operations (within the site boundary).
Residual impacts	The residual impact is considered to be LOW with only localised impacts on groundwater resources, but with no surrounding receptors or groundwater users being negatively affected.

Water seepage and associated contamination to groundwater from the smelter complex was not modelled as it is expected that potential spillages from water and/or chemical storage facilities would only occur during unplanned events. Therefore, the groundwater impact significance is VERY LOW to INSIGNIFICANT. The impact on groundwater quality during the operational phase for the smelter is summarised in Table 2-4.

Table 2-4: Impact Summary – Deterioration of Groundwater Quality due to Smelter Complex Operational Phase

Issue: Deterioration of Groundwater Quality due to Smelter Complex		
Phases: Operational Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Negligible (VL)	Negligible (VL)
Duration	Long-term (H)	Long-term (H)
Extent	Part of site (VL)	Part of site (VL)
Consequence	Low (L)	Low (L)
Probability	Possible (M)	Unlikely (VL)
Significance	Low (L)	Insignificant
Nature of cumulative impacts	The cumulative impact due to the smelter complex during the operational phase is considered INSIGNIFICANT	
Degree to which impact can be reversed	The impact can be mostly reversed if management measures are put in place and adhered to.	
Degree to which impact may cause irreplaceable loss of resources	Very low	
Residual impacts	The residual impact is considered to be INSIGNIFICANT with only minor impacts on groundwater resources and surrounding receptors.	

Mitigation/ Enhancement Measures

The following measures should be implemented:

- Construction of the secured landfill facility with a Class A liner.
- Regular inspection of the secured landfill facility and leak detection measures.

- The water balance of the secured landfill facility should be updated on a regular basis, this data will benefit future groundwater modelling updates and predictions.
- Drilling of secured landfill facility specific monitoring boreholes to detect any potential groundwater plumes from the secured landfill facility (Table 2-2). If environmentally unacceptable concentrations of constituents of concern are identified during monitoring, an updated hydrogeological study should be initiated to provide updated source term characteristics, aquifer characterisation, and possible plume containment measures (amongst others).
- The installation of lining systems in all surface water holding facilities within the smelter complex, such as storm water dams to minimise any potential seepage of poor water quality to the underlying groundwater systems, should be undertaken.
- One of the most effective mitigation measures is the use and update of the existing numerical groundwater model as a management and predictive tool.
    - Long-term monitoring data and optimised groundwater monitoring network would provide valuable information to update and re-run the model at least every two years.
    - Updates to the model developed for the smelter complex and secured landfill facility in future to include mining plan and processing activities. Regular updates would increase the prediction accuracy as well as providing long-term trends and allowing for intervention and timeous prevention measures.
- Improved confidence in the existing geochemical assessment results can be obtained by the continuation of geochemical sampling and analyses during the operational phase, including:
    - Analysis of Jarofix produced in the local plant as soon as this becomes available;
    - Undertaking a detailed geochemical analysis of at least five representative Jarofix and Effluent Treatment Plant (ETP) cake disposal samples, including the following static tests:
        - chemical composition (whole sample and elemental analysis);
        - mineralogical analysis of the material to understand changes in composition as the Jarofix ages;
        - acid-base accounting (ABA) and net acid generation (NAG); and
        - water extraction tests.
    - Conducting kinetic leach tests of at least two representative Jarofix disposal samples to confirm how the leachate quality will change with time.
    - Update the geochemical model to determine any changes in source term concentrations.
    - Undertake a detailed mineralogical analysis of the material to understand changes in composition as the Jarofix ages.
- Additional laboratory analyses and unsaturated flow modelling to quantify seepage rates due to various closure capping options and the change in hydraulic conductivity as the Jarofix ages.
- It is assumed that the site will adhere to the following:
    - Smelter complex infrastructure, should be constructed and operated so as to comply with the National Water Act (NWA) guidelines:
        - Clean water systems are separated from dirty water systems;
        - Clean runoff and rainfall water are diverted around dirty areas and back into the environment;

        - The size of dirty water areas is minimised, and dirty water is contained in systems that allow the reuse and/or recycling of this dirty water; and
        - 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.
    - 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.
    - The design of potentially polluting structures should take account of the requirements for long-term surface water pollution prevention.

Monitoring

The following monitoring should be implemented:

- Monitoring of all monitoring boreholes (Figure 2-1) to be undertaken on a quarterly basis.
- The existing water quality parameters should continue to be monitored:
    - Chemical parameters:
        - Anions and cations (Na, Ca, Mg, Ca, Mg, K, Cl, SO_4, F, nitrate (NO_3-N), Fe, Zn, Pb, Al, Cd, Cu, Mn, and U.
        - Other parameters (pH, electrical conductivity, total dissolved solids, and total alkalinity).
- The following parameters, based on findings from this study, are proposed to be included in the water monitoring programme:
    - Physical in-field parameter observations:
        - Colour/ clarity, temperature, oxidation-reduction potential (ORP) and odour.
    - Anions and cations (Sb, Hg, As, Se, PO_4, Total Cr and Cr (VI), nitrite, and Ba).
    - Petroleum hydrocarbons contaminants (where applicable, near workshops and petroleum handling facilities).
    - Sewage related contaminants (E.coli, faecal coliforms) in surface water and boreholes in proximity to septic tanks or sewage plants.
- The groundwater monitoring network should be reviewed and updated (where necessary) together with any numerical groundwater model update studies.
- The groundwater-monitoring database (quality and quantity) should be expanded to include the smelter complex infrastructure ground water monitoring network. It is recommended that the data continue to

be stored in a dedicated database and that quarterly and annual reports continue to be generated for mine management.

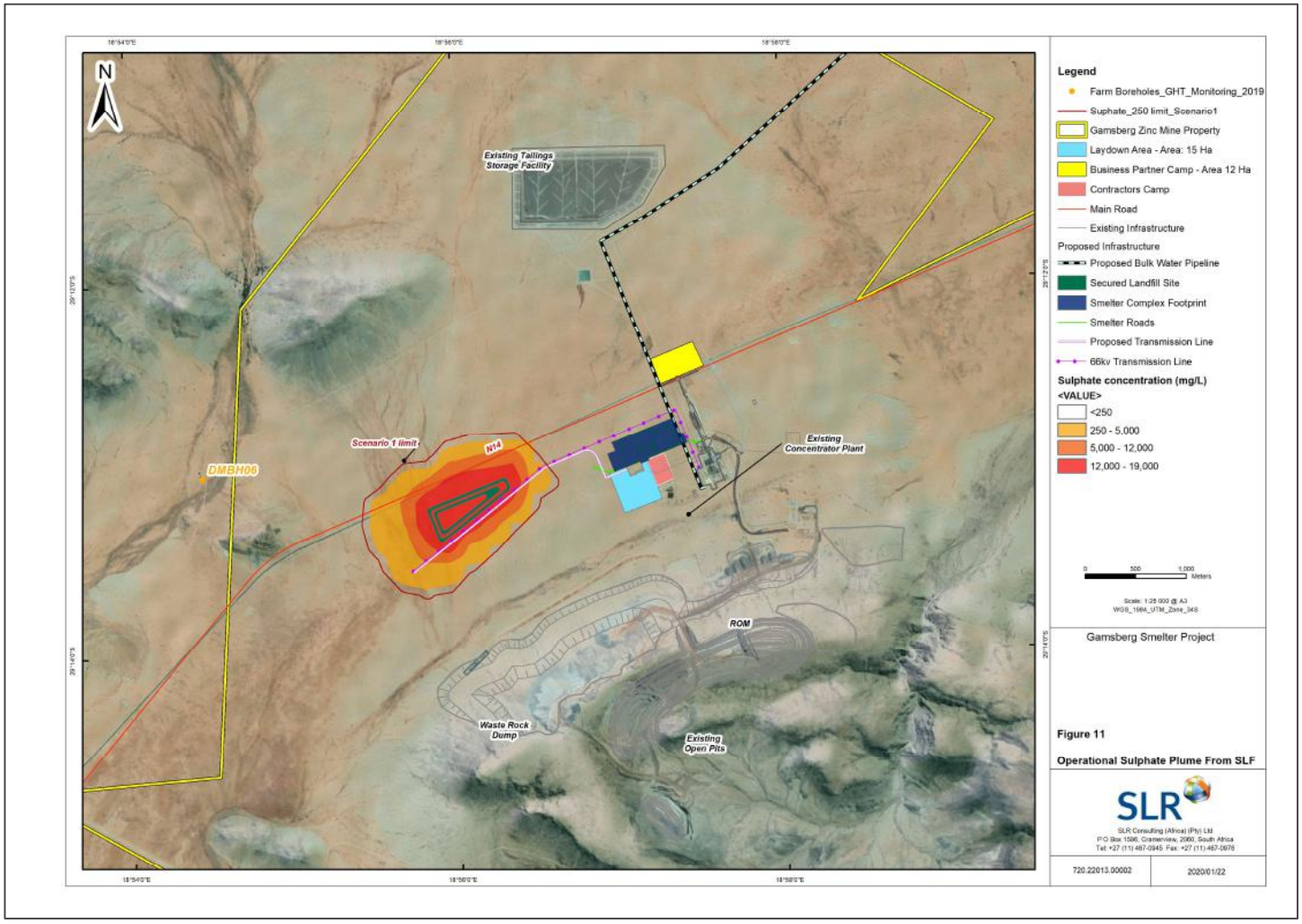

Figure 2-2 Operational (15 Years) Sulphate Plume from Secured Landfill Facility – Scenario 1 (Worst Case) and Scenario 3 (Liner)

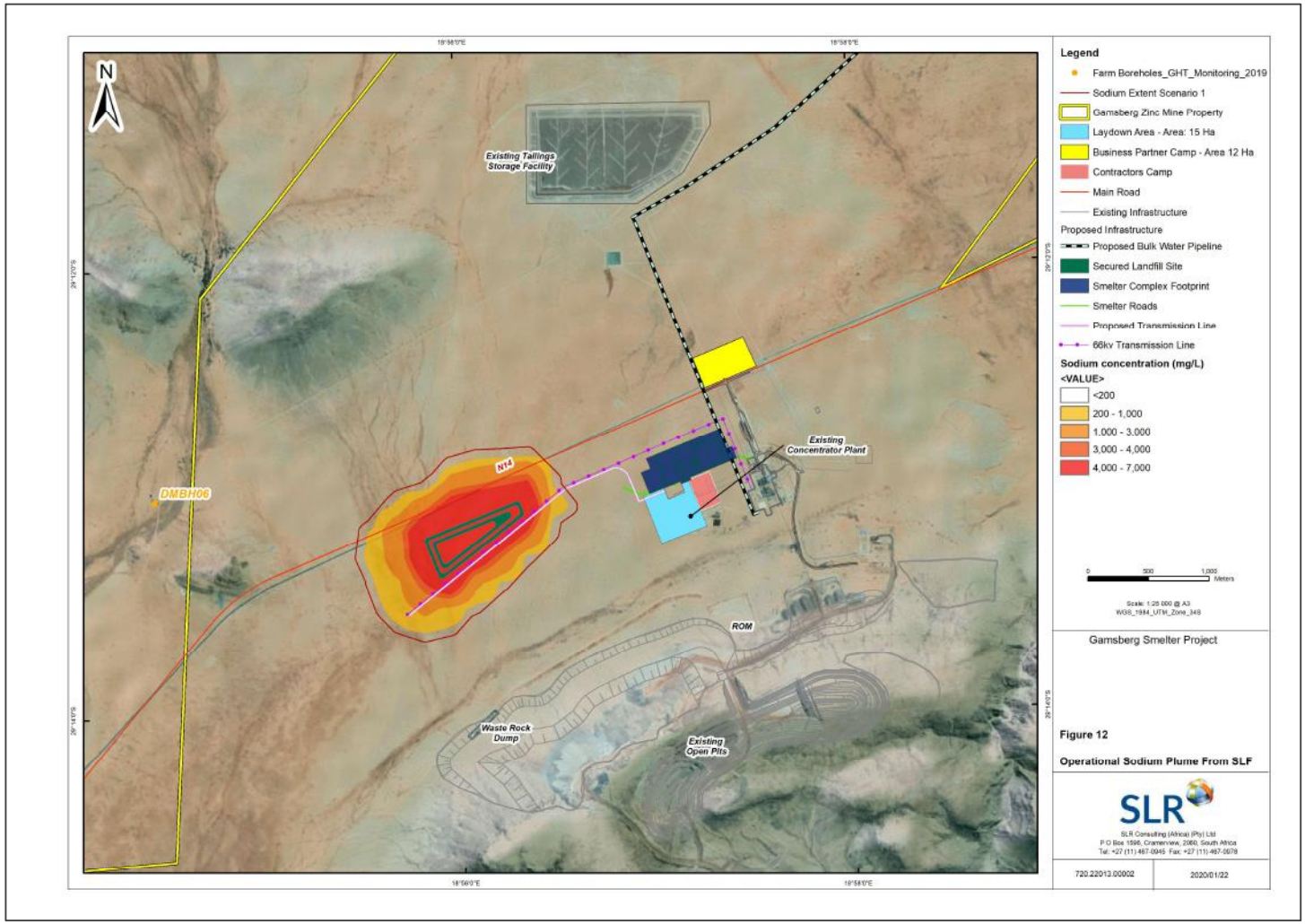

Figure 2-3 Operational (15 Years) Sodium Plume from Secured Landfill Facility – Scenario 1 (Worst Case) and Scenario 3 (Liner)

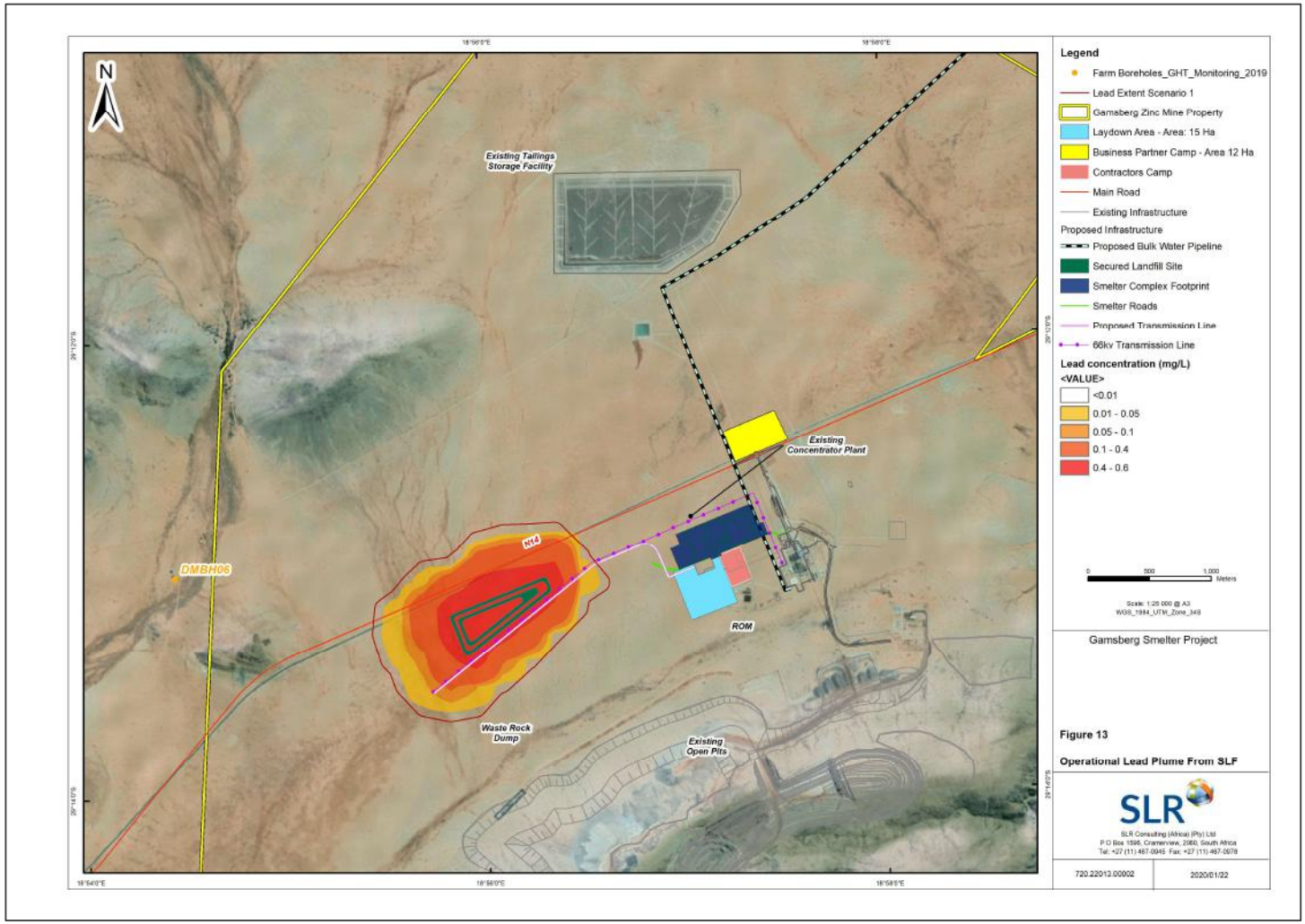

Figure 2-4 Operational (15 Years) Lead Plume from Secured Landfill Facility – Scenario 1 (Worst Case) and Scenario 3 (Liner)

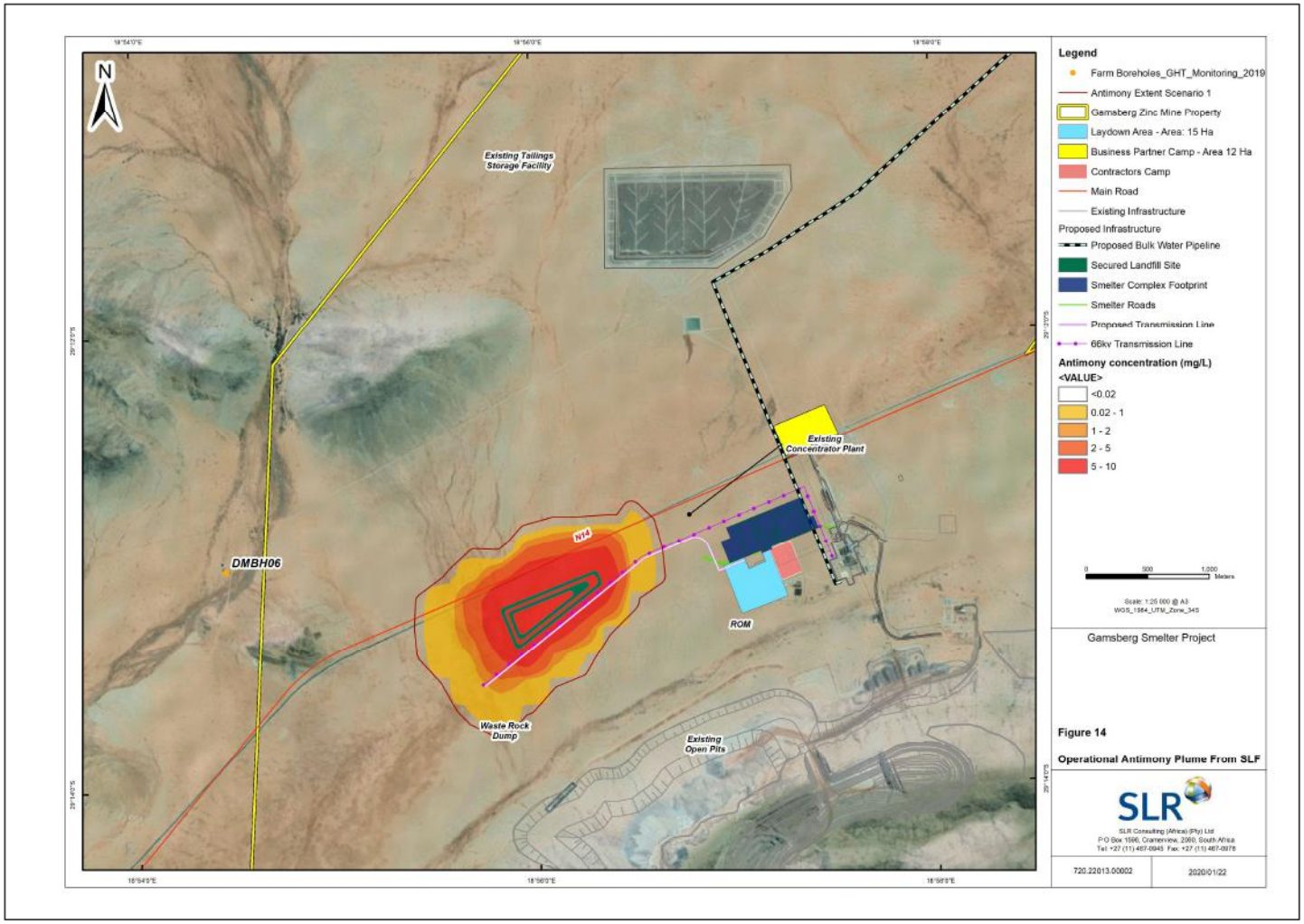

Figure 2-5 Operational (15 Years) Antimony Plume from Secured Landfill Facility – Scenario 1 (Worst Case) and Scenario 3 (Liner)

2.2.3 Decommissioning Phase

Potential Impacts

The decommissioning and closure of the smelter complex and secured landfill facility would involve rehabilitation of the areas and facilities.

Sulphate, sodium, lead, and antimony were included in the closure phase numerical groundwater contaminant transport models for various seepage rate scenarios. The numerical groundwater contaminant transport models at the end of the closure phase (50 years) resulted in a maximum plume migration of sulphate, sodium, lead, and antimony of ~850 m, ~600 m, ~800 m, and ~1 000 m (Figure 2-6, Figure 2-7, Figure 2-8 and Figure 2-9) respectively with the installation of the liner. Without the liner installation with seepage rates described in Scenario 6, all four contaminant plumes migrate approximately an additional ~120 m from the secured landfill facility. The nearest privately owned farm borehole, DMBH06, is not affected by any of the four plumes and is approximately 1.3 km away from the worst case Scenario 1 plume extents.

Although the change in seepage rates between Scenario 4 (worst case) and Scenario 6 (liner installation) did not result in a significant change in the plume extents, the installation of a Class A liner does significantly reduce the contaminant salt load to the aquifer. The installation of the liner results in a decrease of up to 23% in total salt load to the aquifer. Since all contaminants were modelled as conservative tracers, a similar reduction in total mass flux for sodium, lead, and antimony were calculated as that of sulphate.

These identified decommissioning/ closure phase impacts are localised and not likely to negatively affect any private groundwater resources or users.

The impact on ground water post closure with the Class A liner in place for the secured landfill facility is assessed to have a minor intensity and would remain within the site boundary, remaining ~1.3 km from other groundwater users. Therefore, even though the impact is likely to exist over the long-term, the impact with the required mitigation in place has been assessed to be VERY LOW (Table 2-5).

Table 2-5: Impact Summary – Deterioration of Groundwater Quality from Secured Landfill Facility during Closure Phase

Issue: Deterioration of Groundwater Quality from Secured Landfill Facility		
Phases: Decommissioning and closure		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate change or disturbance (M)	Minor change or disturbance (L)
Duration	Long-term/ Permanent (VH)	Long-term/ Permanent (VH)
Extent	Part of site (VL)	Part of site (VL)
Consequence	Medium (M)	Low (L)
Probability	Probable (H)	Conceivable (L)
Significance	Medium (M)	Very Low (VL)
Nature of cumulative impacts	Provided there are no changes to the mining plan as it currently stands, the open pit would act as a sink thus minimising the movement of contaminants away from the site. The cumulative impact is thus considered to be VERY LOW.	

Issue: Deterioration of Groundwater Quality from Secured Landfill Facility	
Degree to which impact can be reversed	The impact cannot be reversed fully but the impact can be minimised if management measures and closure/rehabilitation plans are put in place and adhered to.
Degree to which impact may cause irreplaceable loss of resources	Medium as this impact will affect groundwater quality and the use of the resource after closure (within the site boundary).
Residual impacts	The residual impact is considered to be VERY LOW with only localised impacts on groundwater resources, but with no surrounding receptors or groundwater users being negatively affected.

Water seepage and associated contamination to groundwater from the smelter complex was not modelled as it is expected that potential spillages from water and/or chemical storage facilities would only occur during unplanned events. Additionally, once the removal of surface infrastructure and rehabilitation have taken place, this would reduce potential pollution sources from the site. Therefore, the intensity of any potential groundwater contamination is considered to be negligible with significance prior to mitigation being LOW and with the implementation of mitigation measures, INSIGNIFICANT (Table 2-6).

Table 2-6: Impact Summary – Deterioration of Groundwater Quality from Smelter Complex Closure Phase

Issue: Deterioration of Groundwater Quality from Smelter Complex		
Phases: Decommissioning and closure		
Criteria	Without Mitigation	With Mitigation
Intensity	Negligible (VL)	Negligible (VL)
Duration	Long-term/ Permanent (VH)	Long-term/ Permanent (VH)
Extent	Part of site (VL)	Part of site (VL)
Consequence	Low (L)	Low (L)
Probability	Possible (M)	Unlikely (VL)
Significance	Low (L)	Insignificant
Nature of cumulative impacts	The cumulative impact of the smelter complex post closure is expected to be INSIGNIFICANT.	
Degree to which impact can be reversed	The impact can be mostly reversed if management measures are put in place and adhered to.	
Degree to which impact may cause irreplaceable loss of resources	Very low	
Residual impacts	The residual impact is considered to be INSIGNIFICANT with only minor impacts on groundwater resources and surrounding receptors.	

Mitigation/ Enhancement Measures

The following measures should be implemented:

- The smelter complex site and secured landfill facility should be rehabilitated according to the approved site closure and rehabilitation plan and relevant legislation to avoid subsequent negative environmental impacts that may occur.
- It is recommended that the site conduct a hydrogeological closure assessment to include.
    - 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 Gamsberg Zinc Mine operation, including the smelter complex and secure landfill facility.
- Continuation of the site and regional groundwater monitoring plan.
    - Frequency of monitoring and the groundwater closure monitoring network should be determined from a hydrogeological closure assessment.
- One of the most effective mitigation measures is the use of the numerical groundwater model as a management and predictive tool.
    - Long-term monitoring data and optimised groundwater monitoring network would provide valuable information to update and re-run the model at least every two years during closure.
    - The updated groundwater model should be used in the closure modelling and closure planning.
    - Updates to the model would 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.

Monitoring

The following monitoring is required:

- Continuation and expansion of the site and regional groundwater monitoring plan.
    - It is recommended that long-term groundwater level measurement transducers are maintained and operated during closure.
    - This will ensure that water quality and water levels are continuously monitored. The collected information should be used as part of closure water management system and act as an early warning system which should be used for the application of mitigation measures should the data show unacceptable levels of impacts.
- Regular groundwater model updates should provide recommendations to the existing site groundwater monitoring network and any required changes.

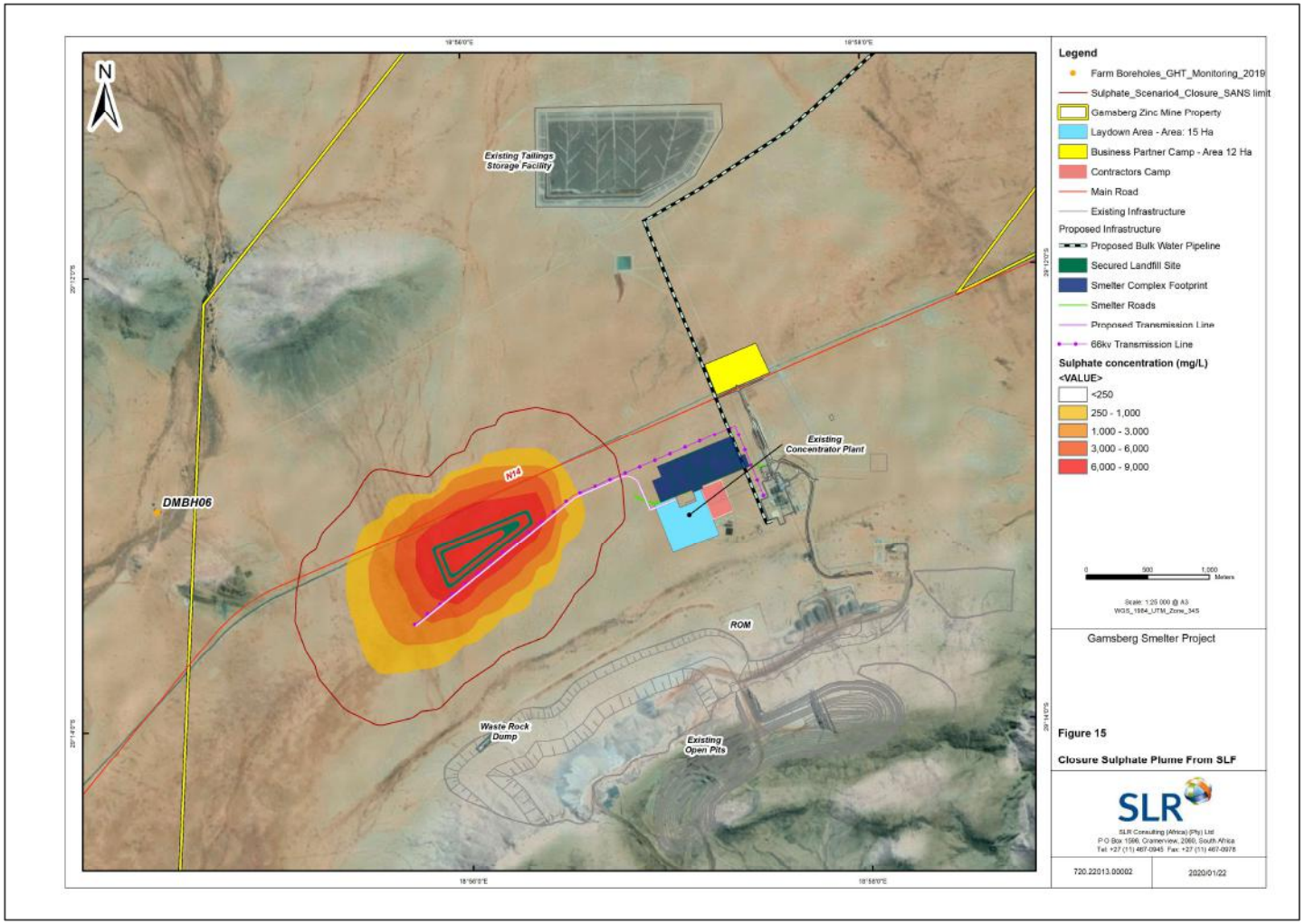

Figure 2-6 Closure (50 Years) Sulphate Plume from Secured Landfill Facility – Scenario 4 (Worst Case) and Scenario 6 (Liner)

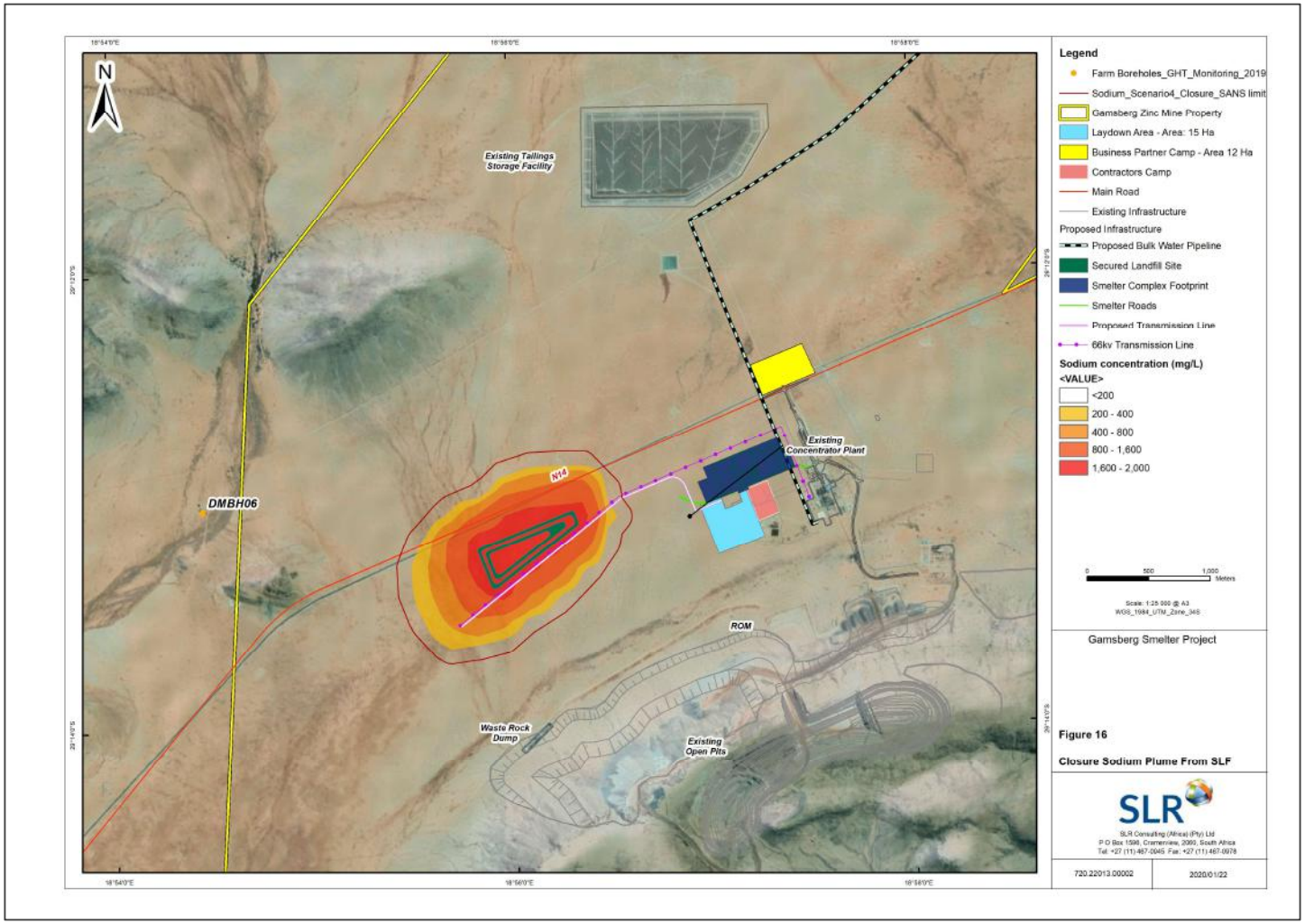

Figure 2-7 Closure (50 Years) Sodium Plume from Secured Landfill Facility – Scenario 4 (Worst Case) and Scenario 6 (Liner).

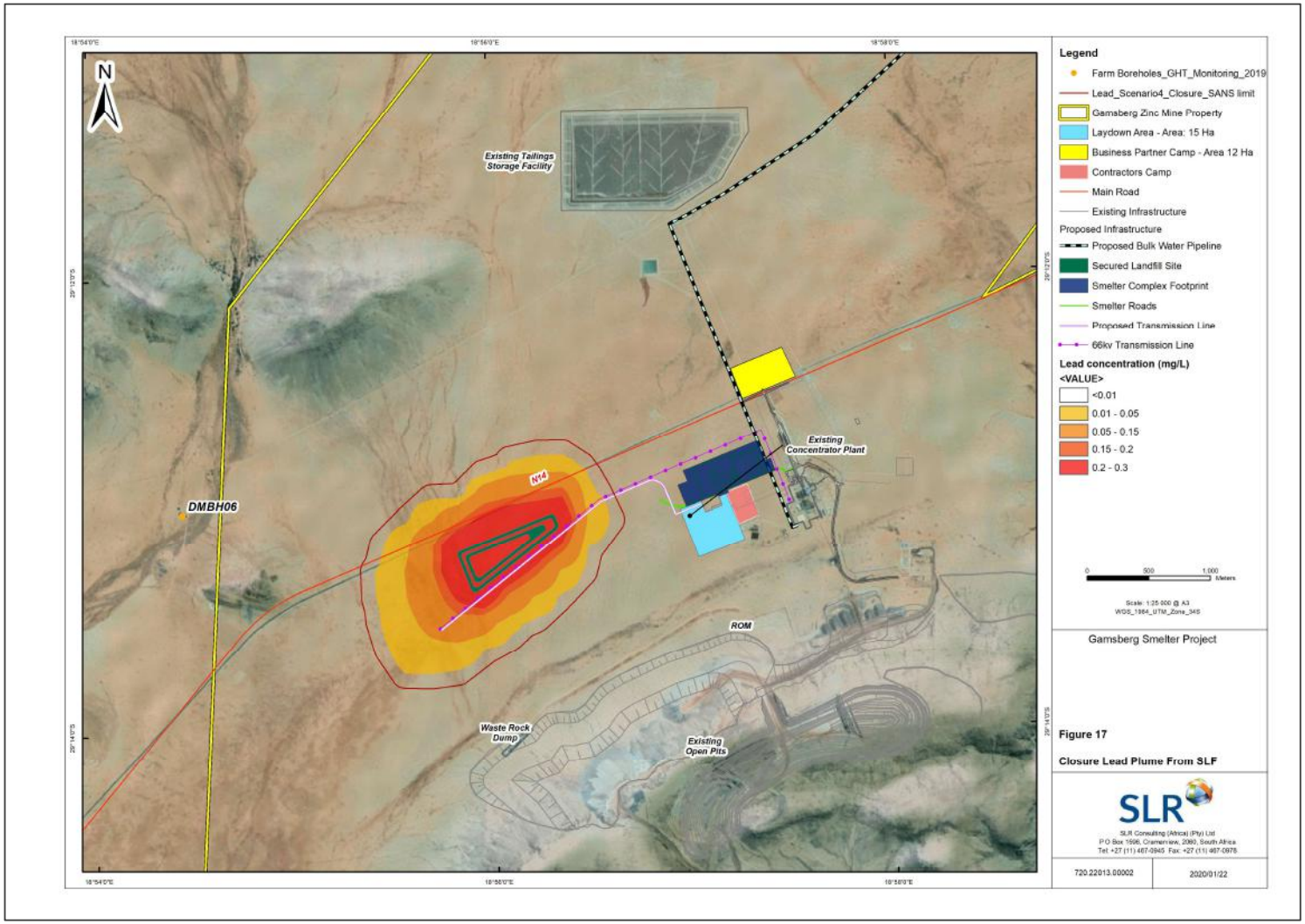

Figure 2-8 Closure (50 Years) Lead Plume from Secured Landfill Facility – Scenario 4 (Worst Case) and Scenario 6 (Liner)

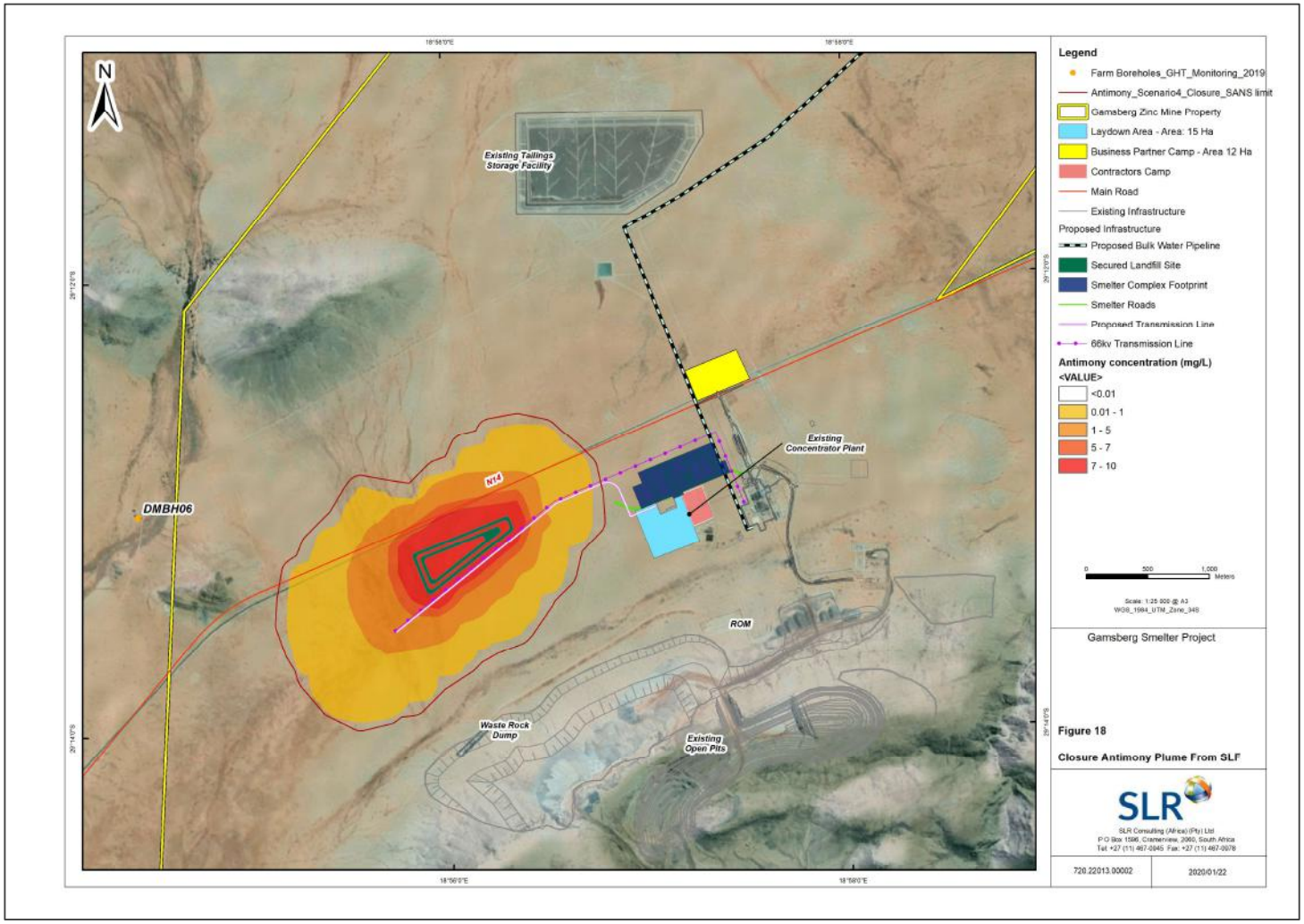

Figure 2-9 Closure (50 Years) Antimony Plume from Secured Landfill Facility – Scenario 4 (Worst Case) and Scenario 6 (Liner)

3. ISSUE 3 IMPACT ON SURFACE WATER RESOURCES

3.1 DESCRIPTION OF IMPACT

There are several sources in all project phases that have the potential to pollute surface water, particularly in the unmitigated scenario. In the construction, decommissioning and closure phases these potential pollution sources are temporary and diffuse in nature. Although these sources may be temporary, the potential pollution may be long-term. The operational phase would present the longer-term potential pollution sources. However, all assessed watercourses are dry for large periods of the year allowing for long periods of time in order to address any spills before natural runoff begins.

3.2 IMPACT ASSESSMENT

3.2.1 Construction Phase

Potential Impacts

Construction activities that include the use of vehicles and machinery, storage of chemicals, fuels and materials as well as the storage of domestic and industrial waste have the potential to result in contamination of watercourses. Soluble construction materials also have the potential to dissolve in runoff from the area. This can result in the increase of dissolved solids in downstream waterbodies during periods of rainfall and subsequent flow resulting in a water quality impact.

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

- Clearing of the surface area and site preparation for the new infrastructure would result in exposure of soil surfaces to potential erosion. When a large area of vegetation is cleared and topsoil disturbed, it exposes loose material which is susceptible to erosion.
- Water contamination could result from poor management of waste from the smelter complex and secured landfill facility during the construction phase if not adequately managed. Typically, the following pollution sources exist at the smelter complex: fuel and lubricants, sewage etc.
- Water quality deterioration as a result of discharge of dirty water into the catchment around the smelter complex when unplanned events do occur, some of the structures may overtop and overflow, causing dirty material to wash into nearby streams.

The impact on surface water during the construction phase is assessed to have a moderate intensity and would occur over the short-term. It could impact immediate neighbours and as such the significance prior to mitigation is assessed to be MEDIUM. With the implementation of mitigation measures the impact can be reduced to LOW (Table 3-1).

Table 3-1: Impact summary – Contamination of Surface Water Resources in Construction Phase

Issue: Contamination of Surface Water Resources		
Phases: Construction Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate change or disturbance (M)	Minor change or disturbance (L)
Duration	Medium-term (M)	Short-term (L)
Extent	Beyond the site boundary, affecting immediate neighbours (M)	Whole site (L)
Consequence	Medium (M)	Low (L)
Probability	Probable (H)	Conceivable (L)
Significance	Medium (M)	Low (L)
Nature of cumulative impacts	Considering the temporary nature of the construction phase, the cumulative impact is assessed to be MEDIUM.	
Degree to which impact can be reversed	Provided mitigation measures are implemented the impact should be able to be fully reversed.	
Degree to which impact may cause irreplaceable loss of resources	Low as this area receives low rainfall.	
Residual impacts	The residual impact is considered to be LOW with only limited impacts on the environment.	

Mitigation/ Enhancement Measures

The following measures should be implemented:

- Minimise the disturbance of vegetation and soils as much as possible by restricting construction activities to within demarcated areas.
- Progressive rehabilitation, where feasible, of disturbed land should be carried out to minimise the amount of time that bare soils are exposed to the erosive effects of rain and subsequent runoff.
- Traffic and movement over stabilised areas should be controlled (minimised and kept to certain paths), and damage to stabilised areas should be repaired timeously and maintained.
- In case of an occurrence of a discharge incident that could result in the pollution of surface water resources, the emergency response procedure should be implemented.
- Water quality monitoring should be undertaken as per the monitoring programme outlined below.
- Smelter complex infrastructure should be constructed and operated so as to comply with the NWA to include:
    - Clean water systems should be separated from dirty water systems;

- Clean runoff and rainfall water should be diverted around dirty areas and back into the environment ; and
- The size of contaminated water generating areas should be minimised, and contaminated water contained in systems that allow for the reuse and/or recycling of this contaminated water.

Monitoring

The following monitoring is recommended:

- Analytical suites as outlined in Table 3-2 for recommended water quality analysis should be undertaken until a longer-term baseline has been established. Monitoring should additionally be done after storm events when flow is present in the dry water courses.
- The monitoring plan should be reviewed regularly, no more than every three years to ensure appropriateness of sites and sampling frequency during operation.

Table 3-2 : Surface Water Quality Parameters of Concern

Determinant	
pH	Nitrate as N
Electrical conductivity	Ammonia
Total dissolved solids	Potassium
Total suspended solids	Nickel
Aluminium	Manganese
Calcium	Magnesium
Fluoride as F	Iron
Total alkalinity as $CaCO_3$	Copper
Chloride as Cl	Lead
Sulphate as SO_4	Sodium
Uranium	*E.coli*

Reporting

Reporting on the above monitoring should be as follows:

- Internal Reporting – monthly for:
  - Water levels in holding dams; and
  - Drainage inspections.
- External Reporting – annual for:
  - Water quality; and
  - Spillages/ emissions.

Accidental spillages and overflows should be reported as and when they occur to the Department of Human Settlements, Water and Sanitation (DHSWS).

3.2.2 Operational Phase

Potential Impacts

Even though the rainfall in the area is highly irregular, long term contamination of surface areas could result in contamination of the water courses during heavy downpours or in the case of unplanned events e.g. spills or leaks. Potential operational phase pollution sources could, therefore, include:

- Spills from the Sewage Treatment Plant (STP), spills of Jarosite or Jarofix during transportation to the secured landfill facility, spillage of operational fuel, lubricants, cement or leaks from vehicles and equipment.
- Contaminated discharges from the dirty water systems including recycled water ponds, dirty water pipelines and STP.
- Residue from the dirty water circuit, chemicals, non-mineralised waste (hazardous, general) and concrete wash water.
- Contaminated runoff and seepage from the secured landfill facility.

The impact on surface water during the operational phase is assessed to have a prominent intensity and would occur over the long-term. It could impact immediate neighbours and as such the significance prior to mitigation is assessed to be HIGH. With the implementation of mitigation measures the impact can be reduced to MEDIUM (Table 3-3).

Table 3-3: Impact summary – Contamination of Surface Water Resources in Operational Phase

Issue: Contamination of Surface Water Resources		
Phases: Operational Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Prominent change or disturbance (H)	Moderate change or disturbance (M)
Duration	Long-term (H)	Long-term (H)
Extent	Beyond the site boundary, affecting immediate neighbours (M)	Whole site (L)
Consequence	High (H)	Medium (M)
Probability	Probable (H)	Probable (H)
Significance	High (H)	Medium (M)
Nature of cumulative impacts	Operational activities that include the use of vehicles, storage of chemicals, fuels and materials as well as the storage of domestic and industrial waste have the potential to result in contamination of the water resource. Due to the mining activities taking place on the same site, the cumulative impact is assessed to be HIGH.	
Degree to which impact can be reversed	Provided mitigation measures are implemented the impact should be able to be fully reversed.	
Degree to which impact may cause irreplaceable loss of resources	Low as this area receives low rainfall.	
Residual impacts	The residual impact is considered to be MEDIUM with only moderate impacts on the environment.	

Mitigation/ Enhancement Measures

The following mitigation measures should be implemented:

- All hazardous chemicals (new and used), mineralized waste and non-mineralised waste must be handled in such a manner that they do not pollute surface water. The following should be implemented:
    - Pollution prevention through basic infrastructure design such as waste storage containment, hardstanding and bunds.
    - Pollution prevention through maintenance of equipment.
    - Pollution prevention through education and training of workers (permanent and temporary).
    - A Spill clean-up plan to enable containment and remediation of pollution incidents.
- In case of an occurrence of a discharge incident that could result in the pollution of surface water resources, the emergency response procedure should be implemented.
- Good housekeeping practices should be implemented and maintained with timeous clean-up of accidental spillages, as well as ensuring all dislodged material from the secured landfill facility is kept within the confined storage footprints. In addition, spill clean-up kits and

material safety data sheets for chemical and hazardous substances should be accessible and available where needed for immediate clean-up of accidental spillages of pollutants.

Monitoring

Monitoring should be implemented as per Section 3.2.1.

3.2.3 Decommissioning and Closure Phases

Potential Impacts

Compacted surfaces from moving vehicles and machinery during the decommissioning and closure phase could potentially lead to an increase in runoff into the nearby streams. Surface water resources are receptors of fine materials and contaminants arising from the demolition of infrastructure and earthworks and transported by rainwater and surface runoff. This may be deposited in watercourses resulting in siltation and contamination of surface water with chemical pollutants. Due to the highly irregular rainfall in the area when there is rain should there be an accumulation of contaminants on the surface these can be concentrated if not properly cleaned up and disposed of.

At elevated concentrations contaminants can exceed the relevant surface water quality limits imposed by local guidelines. In the unmitigated scenario, the moderate intensity contamination of surface water resources could occur for periods longer than the life of the proposed Gamsberg Smelter Project thus having a MEDIUM significance. With mitigation, pollution can be prevented and/or managed and as such the impacts can be reduced within the life of the proposed project to a LOW significance.

Table 3-4: Impact summary – Contamination of Surface Water Resources in Decommissioning and Closure Phases

Issue: Surface Water Resources Contamination		
Phases: Decommissioning and Closure Phases		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate change or disturbance (M)	Minor change or disturbance (L)
Duration	Medium-term (M)	Short-term (L)
Extent	Whole site (L)	A part of the site (VL)
Consequence	Medium (M)	Low (L)
Probability	Possible (M)	Possible (M)
Significance	Medium (M)	Low (L)
Nature of cumulative impacts	Considering the temporary nature of the decommissioning and closure phase, the cumulative impact is assessed to be MEDIUM.	
Degree to which impact can be reversed	The impact can be fully reversed because once the decommissioning and closure period is completed and area occupied by the secured landfill facility is rehabilitated.	
Degree to which impact may cause irreplaceable loss of resources	Low as this area receives low rainfall.	
Residual impacts	The residual impact is considered to be LOW with only minor impacts on surrounding receptors.	

Mitigation/ Enhancement Measures

The following measures should be implemented:

- In case of an occurrence of a discharge incident that could result in the pollution of surface water resources, the emergency response procedure should be implemented.
- Phasing/ scheduling of earthworks should be implemented in order to minimise the footprint that is at risk of erosion at any given time, or schedule works according to the season.
- In the case of linear earthworks, phasing of working areas and progressive rehabilitation would be necessary to minimise the footprint and the extent of the disturbance at any given time.
- Water quality monitoring should be undertaken as per the monitoring programme outlined below.
- A post rehabilitation audit should be undertaken at the end of life of mine to ascertain whether the remediation has been successful and if not, further measures should be recommended and implemented.

Monitoring

Monitoring should be implemented as per Section 3.2.1.

4. ISSUE 4 IMPACT ON FLOODING

4.1 DESCRIPTION OF IMPACT

Pre-development natural drainage across the project area is via preferential flow paths. Development can alter the hydrologic response of an area and, ultimately, an entire watershed. The removal of vegetation as well as the compaction of surfaces during construction of the secured landfill facility and smelter complex would very likely result in increased runoff. The location of surface infrastructure in relation to surface water bodies is imperative to understanding the impacts of flooding.

4.2 IMPACT ASSESSMENT

4.2.1 All Phases

Potential Impacts

The secured landfill facility is located within a 1:100-year flood line and as such it is susceptible to flooding. This activity would continue throughout the construction, operational and decommissioning phases. During heavy rainfall events the secure landfill facility may be flooded by the stream located to the west.

Prior to the implementation of any mitigation the overall intensity in the unmitigated scenario (all phases) is very high and would exist over the long-term impacting surface water resources outside of the MRA. The overall significance prior to mitigation is thus HIGH. With mitigation the overall significance can be reduced to MEDIUM (Table 4-1).

The rating provided in Table 4-1 is reliant on the flood protection berm as a mitigation measure.

Table 4-1: Impact Summary – Flooding in All Phases

Issue: Flooding		
Phases: Construction, Operation, Decommissioning and Closure Phases		
Criteria	Without Mitigation	With Mitigation
Intensity	Severe change or disturbance (VH)	Prominent change or disturbance (H)
Duration	Long-term (L)	Medium-term (M)
Extent	Beyond the site boundary (M)	Site Boundary (L)
Consequence	High (H)	Medium (M)
Probability	Definite (VH)	Probable (H)
Significance	High (H)	Medium (M)
Nature of cumulative impacts	The cumulative impact with the installation of the berm is considered to be LOW.	
Degree to which impact can be reversed	As the secured landfill facility is a permanent structure the impact can be minimise, but not reversed.	
Degree to which impact may cause irreplaceable loss of resources	Provided the flood protection berm is developed the degree to which the impact could cause irreplaceable loss is LOW.	
Residual impacts	The residual impact is considered to be Medium with moderate impacts on surrounding receptors.	

Mitigation/ Enhancement Measures

The following measures should be implemented:

- It is recommended that the secured landfill facility be relocated and placed outside of the 1:100-year flood line in order to prevent the impact of flooding. It is proposed that the secured landfill facility be relocated to an estimated 150-meter distance east of the original location.
- In the event that the secured landfill facility is not moved, a flood protection berm that aims to protect against flooding is recommended. The design specification of the flood protection berm is presented the Surface Water Report (August 2020).

Monitoring

The following monitoring is required:

- Monitoring and inspection of channels, silt traps, culverts, pipelines, dam walls and dams for signs of erosion, cracking, silting and blockages of inflows, to ensure the performance of the storm water infrastructure is recommended should the flood protection berm be developed as a mitigation measure. Monitoring should be undertaken monthly during the wet season and after storm events or as per the site management schedule.

5. ISSUE 5 IMPACT ON NATURAL DRAINAGE PATTERNS

5.1 DESCRIPTION OF IMPACT

Natural drainage across the project area is via preferential flow paths (natural drainage line). Development of the secured landfill facility can alter the hydrologic response of an area and, potentially, an entire watershed. Development of the secured landfill facility can remove beneficial vegetation and replace it with turf grass lawns and impervious roofs, driveways, parking lots, and roads, thereby reducing the site's pre-developed evapotranspiration and infiltration rates. The location of surface infrastructure in relation to surface water bodies is imperative to understanding the impacts of the alteration of drainage and natural flow. Construction of the smelter complex and the road between the smelter complex and the secured landfill facility would reduce runoff reporting downstream due to stormwater management measures.

The alteration to drainage patterns would continue for the construction, operational and decommissioning phases, until such time as project infrastructure can be removed.

5.2 IMPACT ASSESSMENT

5.2.1 All Phase

Potential Impacts

Surface water runoff would be managed utilising engineered infrastructure, which is to be designed and constructed as required by legislation and specified in the Surface Water Report. When the storm water management measures that attenuate surface runoff are constructed on site, clean stormwater would be diverted around the infrastructure and would alter the drainage pattern. Although the region is generally dry, significant rainfall events do occur and these events cause temporary flow of surface water.

Prior to the implementation of any mitigation the overall intensity in the unmitigated scenario (all phases) is minor and would exist over the long-term potentially impacting surface water resources across the MRA. The overall significance prior to mitigation is thus MEDIUM. With the implementation of mitigation measures the overall significance can be reduced to VERY LOW (Table 5-1).

Table 5-1: Alteration of Natural Drainage Patterns and Flow in All Phases

Issue: Alteration of Natural Drainage Patterns and Flow		
Phases: Construction, Operation, Decommissioning and Closure Phases		
Criteria	Without Mitigation	With Mitigation
Intensity	Minor change or disturbance (L)	Negligible change or disturbance (VL)
Duration	Long-term (H)	Long-term (H)
Extent	Whole site (L)	A part of the site (VL)
Consequence	Medium (M)	Low (L)
Probability	Probable (H)	Conceivable (L)
Significance	Medium (M)	Very Low (VL)
Nature of cumulative impacts	In the context of the affected quaternary catchments this is considered to be a medium severity as the change in flow patterns is not expected to result in a substantial deterioration in the water reserve and downstream water uses. The cumulative impact is assessed to be LOW.	
Degree to which impact can be reversed	The impact can be largely reversed once the decommissioning and closure period is completed and area occupied by the smelter complex and the secured landfill facility is rehabilitated.	
Degree to which impact may cause irreplaceable loss of resources	Should the secured landfill facility not be relocated there could be a permanent alteration to the drainage patterns on the site.	
Residual impacts	The residual impact is considered to be VERY LOW with minor impacts on surrounding watercourses	

Mitigation/ Enhancement Measures

The following measures should be implemented:

- It is recommended that the secured landfill facility be relocated in order to avoid alteration of drainage and flow, or the construction of the protection berm. There are no other mitigation measures to minimise the flow and alteration of drainage paths.
- Development and implementation of a storm water management plan to minimise the alteration of flow of clean water around the smelter complex and the secured landfill facility. The flow must be diverted around the infrastructure then allowed to enter preferential flow areas into the environment.

Monitoring

The following additional monitoring is required:

- The project's water circuit has been documented and the water management strategy defined. The reuse of process water must be prioritised, thereby ideally reducing the impacts

from the project on the surface water resources. The site wide water balance should be refined on an on-going basis with the input of actual flow volumes and then used as a decision-making tool for water management and impact mitigation.

- Water Conservation and Water Demand Management (WC/WDM) measures are essential and necessary for this project to ensure that water is collected and reused and the abstraction of water from the Sedibeng Water Scheme is minimised.

6. ISSUE 6 IMPACT ON VEGETATION AND FLORA DUE TO CONSTRUCTION PHASE SITE CLEARANCE

6.1 DESCRIPTION OF IMPACT

Habitat loss resulting from the development is unavoidable and cannot be fully mitigated, but long-term loss of biodiversity has been minimised to some extent through the selection of alternatives and routing options that avoid areas of irreplaceable biodiversity. The extent of habitat loss during construction would be largely equivalent to the footprint of the development (i.e. about 90 ha), comprising Flat Sandy Plains vegetation, evaluated as Least Concern, and a widespread habitat type within the Bushmanland arid grassland area. Notable flora found in the proposed Gamsberg Smelter Project footprint comprises of three Northern Cape protected species *Euphorbia braunsii, Hoodia gordonii* (Data Deficient)*, Aloidendron dichotomum* (Quiver Tree) (Vulnerable); several individuals of all three species were confirmed in the secured landfill facility location, while the proposed smelter complex footprint only had a few *E. braunsii*. The preferred site for the smelter complex and secured landfill facility fall within an area classified as a Critical Biodiversity Area Category 1 (CBA1).

6.2 IMPACT ASSESSMENT

Potential Impacts

Site clearance and the associated use of earthmoving equipment and trucks could impact on the vegetation within the Gamsberg Smelter Project footprint and may also encroach onto adjacent habitats thus posing a risk to the irreplaceable calcrete gravel patches if not effectively restricted. In addition, construction staff may have additional impacts on sensitive habitats and flora if able to trample areas around the site or collect succulents or other plants.

As site clearance is a necessary and unavoidable requirement, there is little mitigation that can be applied to effectively mitigate the impacts on the vegetation within the footprint. Loss of vegetation and flora are likely to be restricted to the local area within and immediately adjacent to the construction sites, the impact would be of high intensity and permanent duration and as such the significance prior to and after mitigation is expected to be MEDIUM (Table 6-1).

Table 6-1: Impact summary – Impact on Vegetation and Flora due to Construction Phase Site Clearance

Issue: Impact on Vegetation and Flora due to Site Clearance		
Phases: Construction Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate change or disturbance (M)	Moderate change or disturbance (M)
Duration	Very long, permanent (VH)	Very long, permanent (VH)
Extent	Part of the site (VL)	Part of the site (VL)
Consequence	Medium (M)	Medium (M)
Probability	Definite (VH)	Definite (VH)
Significance	Medium (M)	Medium (M)
Nature of cumulative impacts	Should the irreplaceable calcrete gravel patches be encroached upon the potential cumulative impact would be HIGH.	
Degree to which impact can be reversed	Modification of the 90 ha of habitat is necessary for the project and would persist for the project lifetime. Site clearance would result in residual habitat loss in the smelter complex and secured landfill facility footprints even after decommissioning and rehabilitation. The potential to reverse the impact is thus low.	
Degree to which impact may cause irreplaceable loss of resources	All vegetation within the footprint would be destroyed apart from any flora that can be gathered during the search and rescue.	
Residual impacts	Loss of 90 ha of Flat Sandy Plains habitat of Least Concern and considered to be of medium sensitivity. The residual impact of land clearance is expected to be of MEDIUM significance.	

Mitigation/ Enhancement Measures

The following measures should be implemented:

- Undertake pre-construction surveys of the approved footprints (by a qualified botanist that is familiar with the area) to identify Red Listed and protected plant species and confirm search and rescue requirements, or other avoidance measures, where possible. Search and rescue of species of conservation concern should be conducted prior to clearing activities which shall include the above-mentioned species. The plant translocation programme should be aligned with ongoing search and rescue protocols developed for the Gamsberg Zinc Mine.
- Sensitive calcrete areas to be fenced before construction activities commence to prevent access by construction crews in these areas.
- Obtain permits for vegetation clearing and the translocation of protected species from Northern Cape Department of Environment and Nature Conservation (NCDENC) prior to initiating site clearance. Removal of any protected trees within the footprint requires an additional permit from the Department of Environment, Forestry and Fisheries (DEFF) for which the lead time is about three months.

- Ensure any lay-down or other temporary infrastructure sites are located within low sensitivity areas.
- Minimise the development footprint as far as possible and rehabilitate construction-affected areas that are no longer required by the operational phase of the development.
- Demarcate sensitive areas or individual trees in close proximity to the development footprint as no-go areas with construction tape, temporary fencing or signage and mark these on-site development plans for construction staff.
- Clearly mark vehicle routes and turning points and ensure all vehicle operators are made aware of restrictions on off-road driving in undesignated areas.
- Ensure construction workers are aware of prohibition on collecting succulent or other plants (e.g. through induction and toolbox talks) and are restricted from free movement outside of the demarcated construction sites.

Monitoring

The following monitoring is required:

- Continue with the existing Monitoring Plan with protocols for monitoring flora and dust (Desmet et al 2018) and priority fauna (Endemic Vision 2018).

7. ISSUE 7 IMPACT ON VEGETATION AND FLORA DUE TO CONSTRUCTION-RELATED DUST

7.1 DESCRIPTION OF IMPACT

Limited research has been conducted globally on the effects of dust and other particulates (including a range of heavy metals) on succulents. Different types of emissions have variable effects depending on the climate, soil, plant physiology and local conditions, and it is difficult to extrapolate results of these emissions on one vegetation type in a different climatic zone to potential effects on succulents in an arid environment. As such ongoing monitoring would be significant in the understanding of this impact.

7.2 IMPACT ASSESSMENT

Potential Impacts

Site clearance of the 90 ha for the proposed Gamsberg Smelter Project footprint is likely to create windblown dust during and after vegetation clearance of the footprint areas. In some cases, this could result in a plume of dust spreading across adjacent patches of irreplaceable calcrete gravel patches. These patches contain unique and range-restricted succulents many of which are only millimetres in size and are dependent on the white calcrete surface substrate. These are at risk of being smothered by increased dust and sand from existing mining activities as well as the clearance of the footprint areas. The majority of the dust generated during the construction phase would be from the sandy plains habitats cleared for the Gamsberg Smelter Project, but may have some limited fraction of mine dust from entrainment of particulates along roads adjacent to the smelter complex. Most deposition of dust during the construction phase would be located close to the edges of the sites, probably within 100 m, and would decrease with increasing distance.

Prior to mitigation the effects are likely to have a moderate intensity and be relatively short-term, limited mainly to the construction phase, with impacts largely within the site boundary. The impact significance prior to mitigation is thus assessed to be MEDIUM. With mitigation the impact can be reduced to LOW (Table 7-1).

Table 7-1: Impact Summary – Impact on Vegetation and Flora due to Construction-Related Dust

Issue: Impact on Vegetation and Flora due to Construction-Related Dust		
Phases: Construction Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate change or disturbance (M)	Minor change or disturbance (L)
Duration	Short-term (L)	Short-term (L)
Extent	Whole site (L)	Whole site (L)
Consequence	Medium (M)	Medium (M)
Probability	Probable (H)	Possible (M)
Significance	Medium (M)	Low (L)
Nature of cumulative impacts	Although the impact of dust on the irreplaceable calcrete gravel patches is not well understood the cumulative impact of dust is expected to be MEDIUM.	
Degree to which impact can be reversed	The effect of construction dust on adjacent vegetation is likely to be of short duration and most dust is expected to dissipate naturally during windy conditions.	
Degree to which impact may cause irreplaceable loss of resources	Unlikely - sensitive calcrete gravel patch habitats in adjacent sites (the closest of which is approximately 60 m to the west of the proposed laydown area) may be susceptible to spread of windblown dust during construction. However, windblown dust is a common feature of the arid flat landscape and it is uncertain the extent to which the calcrete patch may be affected.	
Residual impacts	Residual impacts (post-mitigation) of construction dust deposition on adjacent habitats would be of LOW significance and likely to dissipate within a short period.	

Mitigation/ Enhancement Measures

The following measures should be implemented:

- Implement dust suppression measures during construction and erect screening devices to minimise impacts of dust when clearing footprints near or adjacent to sensitive habitats and flora, such as calcrete gravel patches. This will be especially important at the selected laydown area and smelter complex sites.
- Clearly mark vehicle routes and turning points and ensure all vehicle operators are made aware of restrictions on off-road driving in undesignated areas.
- Undertake regular daily or weekly checks of the proposed smelter complex and secured landfill facility areas to record evidence of the extent of dust generation from unvegetated/bare areas to confirm the need for additional mitigation; and
- Fencing of calcrete patches must be done to prevent any vehicles access into calcrete patches

- Cover, shield or protect all stockpiles or other sources that could generate dust from wind, where possible.

Monitoring

The following monitoring is required:

- Continue with the existing Monitoring Plan with protocols for monitoring flora and dust (Desmet et al 2018) and priority fauna (Endemic Vision 2018).

8. ISSUE 8 IMPACT ON FAUNA DUE TO CONSTRUCTION PHASE SITE CLEARANCE

8.1 DESCRIPTION OF IMPACT

While some uncommon, threatened or range-restricted fauna are confirmed to occur in the wider project area, none are resident and restricted to the footprint of the proposed Smelter Project.

In addition, due to the proposed Gamsberg Smelter Project's proximity to the existing Gamsberg Zinc Mine, fauna activity presence in the proposed Gamsberg Smelter Project area is likely to be already reduced and restricted to more tolerant species. The proposed secured landfill facility site is located further away from the mining activities and faunal activity in this area is likely to be less influenced by current activities and possibly near-natural (at least for smaller fauna species).

8.2 IMPACT ASSESSMENT

Potential Impacts

During construction, the clearing of 90 ha of sandy plain habitats would cause permanent loss of faunal habitat for resident fauna such as snakes, lizards, rodents, and small mammals. Other construction impacts on fauna may result from increased mortality of some species through collision with construction vehicles or death from construction workers.

The impact significance rating takes into consideration the likelihood that the existing mining activities are generating significant noise and dust and traffic disturbance in the area around the Smelter infrastructure. With that in mind, prior to mitigation the clearance of faunal habitat while permanent would be of local extent and minor intensity and therefore has a MEDIUM significance. Due to the permanent loss of habitat the impact with mitigation is still assessed to be MEDIUM (Table 8-1).

Table 8-1: Impact Summary – Impact on Fauna due to Construction Phase Site Clearance

Issue: Impact on Fauna due to Construction Phase Site Clearance		
Phases: Construction Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Minor change or disturbance (L)	Minor change or disturbance (L)
Duration	Very long, permanent (VH)	Very long, permanent (VH)
Extent	Whole site (L)	Whole site (L)
Consequence	Medium (M)	Medium (M)
Probability	Probable (H)	Probable (H)
Significance	Medium (M)	Medium (M)
Nature of cumulative impacts	Due to existing mining activities at the Gamsberg Zinc Mine, the cumulative impact on fauna is expected to be LOW as no threatened or range restricted species are predicted to be affected.	
Degree to which impact can be reversed	Site clearance would cause permanent loss of faunal habitat in the footprint and is thus not reversible.	
Degree to which impact may cause irreplaceable loss of resources	Not likely as there do not appear to be any significant fauna populations of concern within the proposed footprint for the Gamsberg Smelter Project.	
Residual impacts	Site clearance of 90 ha would have a long-term residual impact on faunal habitat of the flat sandy plains around Gamsberg. However, no threatened or range restricted species are predicted to be affected. .	

Mitigation/ Enhancement Measures

The following measures should be implemented:

- Conduct search and rescue for any reptiles prior to site clearance. Particular attention should be paid to tortoises and clearing of bush clumps, stone/rubble piles and any other areas where reptiles are likely to be sheltering. Snakes to be removed by trained snake handlers and records maintained of snakes removed.
- Any fauna directly threatened by the construction activities should be removed to a safe location.
- All construction vehicles using internal roads should adhere to a low speed limit (40 km/h for light vehicles and trucks) to avoid collisions with susceptible species such as snakes, tortoises, rabbits or hares. Speed monitoring of construction vehicles and regular awareness raising of staff on this issue should be implemented.
- If any parts of the site are to be fenced, no electrified strands should be placed within 30 cm of the ground as some species such as tortoises are susceptible to electrocution as they do not move away when electrocuted but rather adopt defensive behaviour and are killed by repeated shocks. Alternatively, the electrified strands should be placed on the inside of such fenced areas and not the outside.
- Ensure construction workers are aware of prohibitions on collecting fauna such as lizards, tortoises or snakes, and are restricted from free movement outside of the construction sites.

Monitoring

The following monitoring is required:

- Continue with the existing Monitoring Plan with protocols for monitoring priority fauna (Endemic Vision 2018).

9. ISSUE 9 IMPACT ON FAUNA DUE TO CONSTRUCTION PHASE NOISE AND DISTURBANCE

9.1 DESCRIPTION OF IMPACT

During construction, the noise and disturbance generated by clearing of vegetation and earthmoving equipment would cause localised displacement and disturbance for fauna such as snakes, lizards, rodents, and small mammals. However, due to the proposed Gamsberg Smelter Project's proximity to the existing Gamsberg Zinc Mine activities, the presence of fauna in the proposed smelter complex area is likely to be already reduced and restricted to more tolerant species. Since the mine is operational day and night the Gamsberg area already experiences major noise levels from blasting and the operation of heavy haulage vehicles in the mine pit and on the top of the Gamsberg Plateau as well as the transporting of ore down to the concentrator plant. The existing concentrator plant and crusher, located approximately 500 m from the smelter, also generates significant noise.

The proposed secured landfill facility is located further away from the mining activities and faunal activity in this area is likely to be less influenced by current mining and possibly near-natural (at least for smaller fauna species).

9.2 IMPACT ASSESSMENT

Potential Impacts

Noise and disturbance impacts would be high during the construction phase and then may decline to some degree during the operational phase. The impact of lighting would start during construction and continue until closure of the site. Night lighting would also attract insects which has a negative impact on their populations as there can be high mortality rates due to lights. Increased insect activity can also attract bats to the area.

While some fauna become accustomed and habituated to noise, there are also some fauna which rely extensively on their hearing to find their prey or to avoid their predators. Such species are likely to move away from the mine or become eliminated from areas impacted by noise. Bat-eared foxes are a typical example of a species which relies heavily on sound for prey detection. Gerbils are also a typical species found in arid areas and have enlarged auditory bullae for enhanced hearing for predator avoidance. Although these are not species of concern, impacts on these species can lead to ecosystem-wide impacts as they play important roles as predators and as agents of soil disturbance, both of which are important for general biodiversity maintenance.

The impact significance rating takes into consideration the likelihood that the existing mining activities are generating significant noise and dust and traffic disturbance in the area around the Gamsberg Smelter Project. Since fauna are not equally sensitive to disturbance, the extent of noise impacts on fauna is difficult to quantify objectively but for the purposes of this assessment, it is assumed that noise and other construction related impacts on fauna, without mitigation, would occur within a 200 m to 300 m radius from the infrastructure and occur over the short-term construction phase. The

intensity of the disturbance is assessed to be minor and as such the significance is LOW. With the implementation of mitigation measures the significance remains LOW (Table 9-1).

Table 9-1: Impact Summary – Impact on Fauna due to Construction Phase Noise and Disturbance

Issue: Loss of biodiversity due to surface clearance		
Phases: Construction Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Minor change or disturbance (L)	Minor change or disturbance (L)
Duration	Short-term (L)	Short-term (L)
Extent	Whole site (L)	Whole site (L)
Consequence	Medium (M)	Medium (ML)
Probability	Probable (H)	Probable (H)
Significance	Low (L)	Low (L)
Nature of cumulative impacts	Much of this impacted area would overlap with the adjacent areas that are already experiencing increased disturbance from mine activities. However, there do not appear to be any significant fauna populations of concern within the affected area and thus the cumulative impact is thus assessed to be LOW.	
Degree to which impact can be reversed	Construction disturbance on fauna would significantly reduce at the end of construction (although some noise will continue throughout operations).	
Degree to which impact may cause irreplaceable loss of resources	Not likely as there do not appear to be any significant fauna populations of concern within the affected area.	
Residual impacts	Noise and disturbance during construction cannot be mitigated, but would be short-term and the residual impact on fauna is predicted to be LOW.	

Mitigation/ Enhancement Measures

The following measures should be implemented:

- Lighting should be done with low-UV type lights (such as most LEDs) as far as practically possible, which do not attract insects and which should be directed downwards.

Monitoring

The following monitoring is required:

- Continue with the existing Monitoring Plan with protocols for monitoring priority fauna (Endemic Vision 2018).

10. ISSUE 10 IMPACT ON VEGETATION DUE TO DUST DEPOSITION DURING OPERATIONAL PHASE

10.1 DESCRIPTION OF IMPACT

Dust is a particular issue associated with the existing Gamsberg Zinc Mine due to the nature of the specialised habitats and plant species associated with the area. The dwarf succulents associated with the quartz and calcrete gravel patches in proximity to the mine are edaphic specialists, with very specific and narrow habitat requirements. Both their small size and the specificity of their habitat requirements are likely to make them vulnerable to the dust from the mine.

Dust can have physical effects on plants, it can interfere with leaf function, decrease photosynthesis, increase transpiration and change plant moisture dynamics. Critical dust loads that result in significant alterations in sensitive plant functions vary with the particle size distribution and colour of the dust.

From a summary review of the air quality effects on vegetation it appears that smaller dust particles may have a greater impact than larger particles. This is of significance because smaller dust particles travel further from their source than larger particles, with the result that dust impacts do not necessarily decline in proportion to overall dust fallout rates, but may extend across the depositional area of the smaller dust particles. Dust can impact leaf physiology of plants through causing abrasion, blocking stomata, and affecting the plants ability to regulate water content of cells and to photosynthesise. Photosynthesis is further reduced through direct shading, while dust can also increase leaf temperatures, resulting in an overall decline in plant vitality. In a desert environment, where plants are physiologically challenged in terms of managing heat and water supply, these dust impacts could potentially have significant negative impacts on long-term survival and reproductive rates. Although it is difficult to speculate on the impact of dust on the dwarf succulents which characterise many of the important species of the Gamsberg and surrounding plains, it is possible that their thick cuticles and sunken stomata may make them more resistant to dust impacts than normal plants. However, the seedling stage may be more vulnerable to dust impacts as the young plants are often only a few millimetres in size across when freshly germinated and are vulnerable to heat, desiccation and physical damage from dust.

10.2 IMPACT ASSESSMENT

Potential Impacts

While increased deposition from the Gamsberg Smelter Project may change the temperature of the soil in areas close to the Gamsberg Zinc Mine with potential negative impacts on dwarf succulents (which are already close to their temperature maxima.), this is likely to be limited as most dust generated by the Gamsberg Smelter Project would be from the smelter stacks and expected to be light in colour. It is likely that some of the succulent species, such as *Lithops* or *Conophytum,* will suffer dust-related damage to their exposed leaf surfaces, which have specific transparent 'windows' which allow light into the interior of succulent leaves where the chloroplasts are located. Damage to these windows is likely to be a significant problem for these plants as they usually only replace their leaves once a year. Grasses and deciduous shrubs are likely to be more tolerant of dust than perennial species as they grow quickly after rains and drop their leaves at the end of the growing season so dust-induced water loss and temperature increases are less likely to be an issue than with species with longer-lived leaves. Shrubs with perennial leaves face a greater risk as their leaves are usually longer-lived and would be exposed to dust for longer periods. The implications of these findings are that there is likely to be a gradual shift over time towards species that are tolerant of dust. These are also likely to be species that are less favoured by herbivores with the result that this would ultimately generate a zone

of dust impact around the mine, with associated changes and gradients in the vegetation and faunal communities.

Another factor that may influence the response of vegetation to dust is that the Gamsberg Zinc Mine dust is a darker grey colour in contrast to the lighter quartz sand of the natural environment, some of which is likely to have settled in the area around the smelter complex and is likely to be remobilised from vehicle entrainment. This could have adverse thermal consequences for plants situated on the plains, especially in the pale calcrete gravel patches. The dust is also likely to be nitrate enriched from blasting and over time could form an acidic solution when it comes in contact with water. However, although it cannot be ruled out, it is possible that the limited rainfall and natural windy conditions in the area, at times, may reduce the acidic influence on succulents.

The original Gamsberg Zinc Mine ESIA (ERM, 2013) considered dust impacts to be significant for sensitive habitats (Quartz and Calcrete Gravel patches, Gamsberg Kloof and south slopes) if the dust input from mining results in a 10% change in baseline dust deposition or 20 mg/m^2/day, and for all other habitats if the dust input from mining results in a 25% change in baseline dust deposition or 50 mg/m^2/day. The same thresholds for dust are used to compare the potential impacts of the proposed Gamsberg Smelter Project against the modelled Gamsberg Zinc Mine impacts as there is no new evidence that this should be adjusted otherwise. These thresholds (of 20 mg/m^2/day and 50 mg/m^2/day) are considered conservative and precautionary and are believed sufficient to cater for the uncertainties in predicting dust impacts on the different plant types in the project area. However, it is important to recognise that there is a high degree of uncertainty as to the long-term impact of dust, and long-term monitoring at the site should be used to address this uncertainty.

Comparison of modelled dust deposition for the Gamsberg Zinc Mine and for the mine with the proposed Gamsberg Smelter Project (Figure 10-1 and Figure 10-2) shows that the smelter would have a small contribution to dust fall-out relative to the mine. Results clearly show that the 20 mg/m^2/day modelled dust contour for the smelter operations (dark purple line in Figure 10-1) for all scenarios of dust mitigation falls well within and occupies a significantly smaller footprint than the same modelled dust output contour for the Gamsberg Zinc Mine operation (lime green line on outer edge). This is the same line used for the existing mine offset calculations which suggests that, in theory, for the habitat units mapped by Desmet (2013), no additional offset should be required for dust generated by the Gamsberg Smelter Project. However, the identification of a ‘new’ calcrete gravel patch of approximately 100 ha to the east of the existing TSF and within the 20 mg/m^2/day contour for mine (and smelter) dust deposition confirmed during the January 2020 survey may need to be factored into any revised offset calculations. Additional surveys of this calcrete gravel patch during more optimal survey periods (after rain) are recommended to confirm its conservation importance and presence of threatened plants.

Prior to mitigation the impact of dust of the sensitive vegetation in the area is considered to be of moderate intensity, would occur throughout the operational phase and could impact species outside of the MRA. The significance is thus assessed to be MEDIUM. With the implementation of mitigation measures the impact would remain MEDIUM (Table 10-1).

Table 10-1: Impact Summary – Impact on Vegetation due to Dust Deposition

Issue: Impact on Vegetation due to Dust Deposition		
Phases: Operational Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate change or disturbance (M)	Moderate change or disturbance (M)
Duration	Long-term (H)	Long-term (H)
Extent	Beyond site boundary, affecting immediate neighbours (M)	Beyond site boundary, affecting immediate neighbours (M)
Consequence	Medium (M)	Medium (M)
Probability	Probable (H)	Probable (H)
Significance	Medium (M)	Medium (M)
Nature of cumulative impacts	The cumulative impact of modelled dust deposition from the Gamsberg Zinc Mine and Gamsberg Smelter Project in relation to the biodiversity offsets secured for the mine are discussed in Section 36.1.1.	
Degree to which impact can be reversed	Unlikely, once plant communities have experienced negative impacts due to dust, it is likely that even if the impact cause is ceased, that the species of concern are not likely to return to the specialised habitats they have been lost from.	
Degree to which impact may cause irreplaceable loss of resources	Potentially, if there is significant impact on the calcrete gravel patches and other habitats of concern. However, the impact of mining is considered of significantly higher consequence relative to dust generated by the Gamsberg Smelter Project.	
Residual impacts	There will be some habitat degradation that is an unavoidable impact of the development and cannot be fully mitigated (although the area predicted to be affected is within the area already calculated for the Gamsberg Zinc Mine offset). The residual impact is assessed to be MEDIUM.	

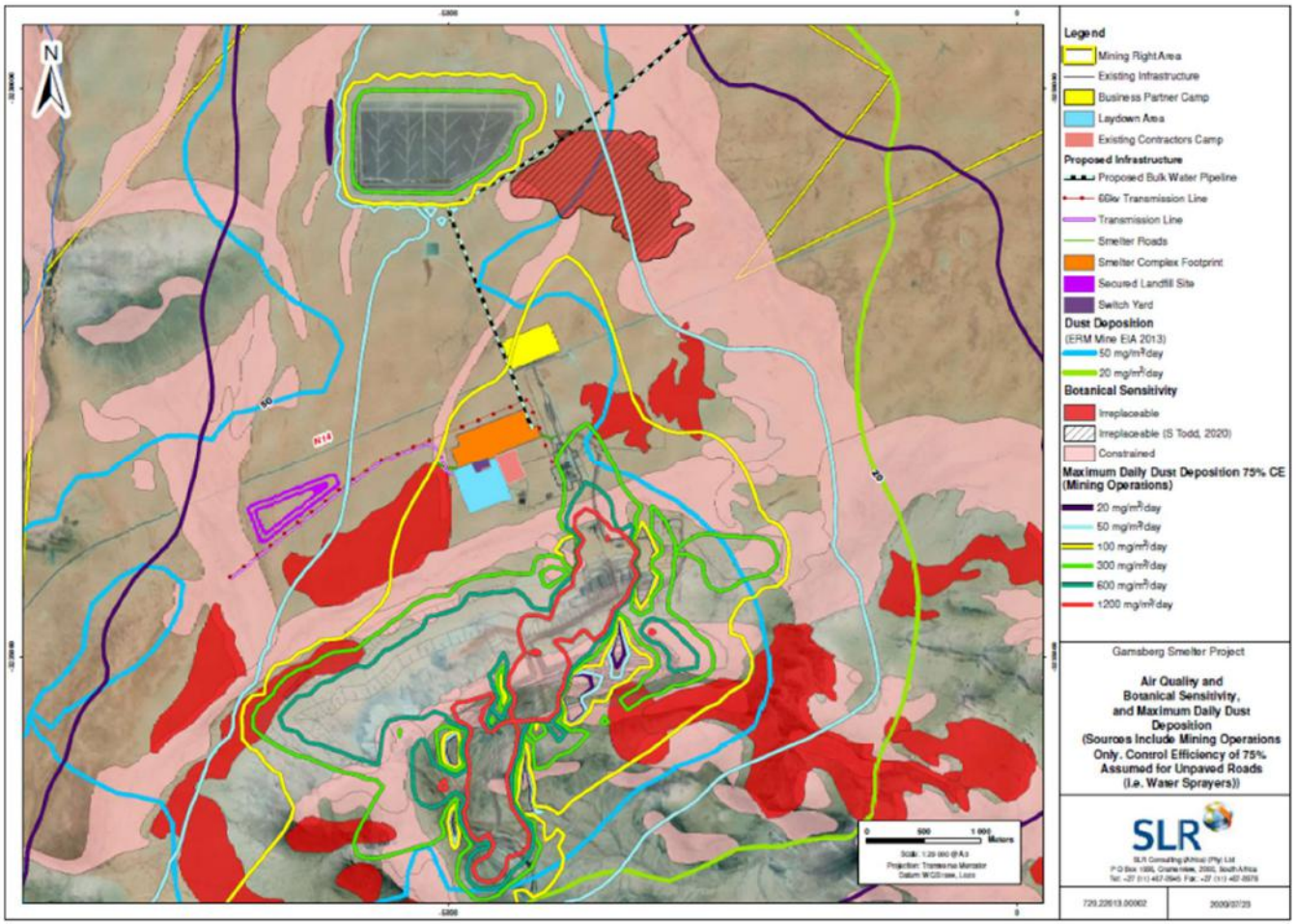

Figure 10-1. Extent of dust deposition (assuming 75% control efficiency) from the existing Gamsberg Zinc Mine only relative to previously modelled mine dust (outer light blue and green lines). Note: the 20 and 50 mg/m²/day deposition for the mine modelled by Airshed (2020) and for the EIA (2013) show a similar pattern but contours do not exactly coincide due to different model and meteorological parameters

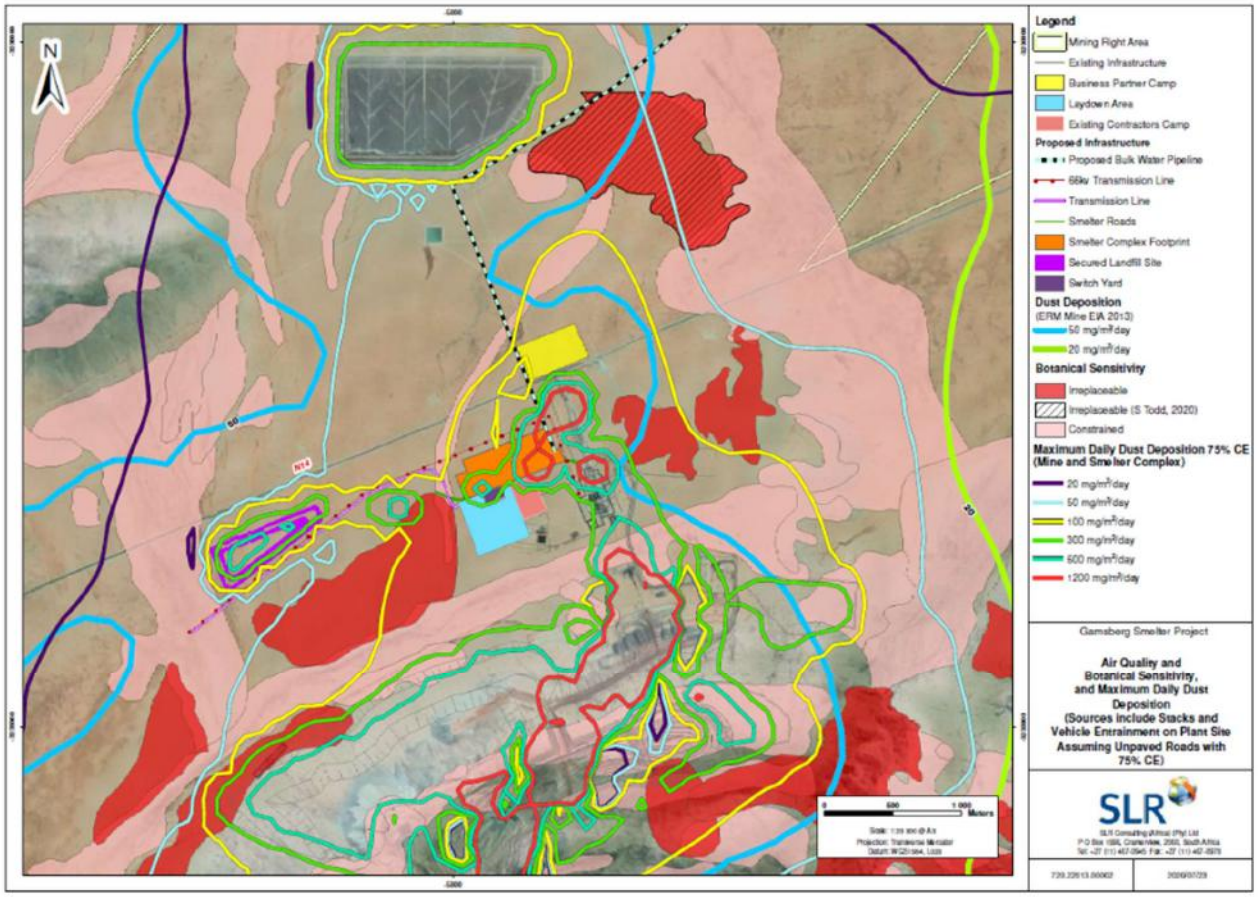

Figure 10-2. Extent of dust deposition (assuming 75% control efficiency) from the existing Gamsberg Zinc Mine and proposed Gamsberg Smelter Project relative to previously modelled mine dust (outer light blue and green lines). Note: this assumed mitigation of dust on unpaved roads which are now planned to be bitumen paved to minimise dust.

Mitigation/ Enhancement Measures

The following measures should be implemented:

Note: The road between the proposed Gamsberg Smelter and SLF is planned to be paved with bitumen which will significantly reduce dust emissions from the transport of Jarofix to the secured landfill facility and this is taken into account in the pre-mitigation significance rating. The air quality modelling was done assuming an unpaved road and therefore the 75% CE model results are considered a reasonable basis for the impact assessment.

- Undertake regular daily or weekly checks of the proposed smelter complex and secured landfill facility areas to record evidence of the extent of dust generation from unvegetated/bare areas to confirm the need for additional mitigation.
- Cover, shield or protect all stockpiles or other sources that could generate dust from wind, where possible.

Monitoring

The following monitoring is required:

- Dust bucket monitoring should be conducted at various sites around the smelter complex and secured landfill facility within the various modelled dust deposition zones to check the extent of dust fallout and congruence with the model's predictions. This dust bucket data should be correlated with vegetation monitoring data to determine long-term dust impacts on sensitive vegetation.

11. ISSUE 11 IMPACT ON VEGETATION DUE TO INCREASED AIR EMISSIONS (SO_2, NO_2, LEAD (PB) AND ZINC (ZN) DURING OPERATIONAL PHASE

11.1 DESCRIPTION OF IMPACTS

The air quality model evaluated the ground level concentrations of NO_2 and SO_2 and deposition of zinc and lead from the smelter process as these are likely to be emitted from the stacks.

The proposed Gamsberg Smelter Project would undoubtedly result in a decline in ambient air quality especially with regards to ground level NO_2 and SO_2 concentrations. The impacts of such air quality changes on vegetation are poorly understood in arid ecosystems. Although, the levels of NO_2 and SO_2 are considered low by human health standards, this says little about the potential response of the vegetation or particular plant species to these gasses. As the vegetation would be exposed on a continuous and cumulative basis to these gasses, a long-term effect at levels below thresholds for human health is a possibility. The air quality plots (Figure 11-1 to Figure 11-4) indicate that increases likely to have noticeable impacts on vegetation would be restricted to a relatively small area in close proximity to the proposed smelter complex but overlapping with the adjacent calcrete gravel patches. However, the impact zones for all the modelled emissions (Figure 11-1 to Figure 11-2) is predicted to be restricted to within the 20 mg/m^2/day modelled dust deposition area predicted to be impacted from the mine operations and which has technically been included in the calculation of the Gamsberg Zinc Mine biodiversity offset.

Sulphur Dioxide: Plants are sensitive to SO_2 and are affected by it both directly and indirectly; the direct effects may be acute or chronic, depending on the duration and intensity of the exposure. Sulphur dioxide inhibits photosynthesis by disrupting the photosynthetic mechanism. The opening of the stomata is promoted by sulphur dioxide, resulting in an excessive loss of water. Since SO_2 generally also acts to decrease plant performance, it may have a cumulative impact with dust fallout, and with other emissions such as NO_x. Although acid rain is not likely to be a significant issue at the mine, the ability of SO_2 to dissolve in mist is a potential problem because early morning fog is an occasional occurrence in the area and likely provides many small succulents with a significant additional moisture source. The possibility that this fog could become acidic as a result of SO_2 could impact on the local vegetation, even if this does not occur on a regular basis. Based on the predicted levels of SO_2 concentrations from the proposed Gamsberg Smelter at and below a conservative critical annual concentration of 10 µg/m^3 the area of potential impact from SO_2 around the mine is predicted to be localised (Figure 11-1). Only at annual concentrations of SO_2 above 10 ug/m^3 does the air quality model predict there will be impacts on calcrete gravel patches. The area potentially affected by annual concentration of SO_2 at low concentrations of 1-2 ug/m^3 remains well within the residual impact area for which the existing Gamsberg Zinc Mine biodiversity offset has been calculated.

Nitrogen Dioxide: The increased NO_2 concentrations as a result of emissions from the smelter complex are likely to function in combination with SO_2 to increase acidification of the local environment. Similar to SO_2, the extent of this impact at conservative annual concentrations of 1, 2 and 2.5 ug/m^3 (i.e. well under the critical annual concentration value of 30 µg/m^3) is, however, likely to be restricted to a relatively small area around the smelter complex, only affecting the calcrete gravel patches at annual concentrations of above 2 ug/m^3 (Figure 11-2). At all modelled NO_2 levels the impacts are expected to remain well within the area that has been used to calculate the Gamsberg Zinc Mine biodiversity offset. In the longer-term, it is possible that nitrogenous fallout from the blasting activities in the mine may stimulate plant growth following rainfall events, but it may also decrease drought tolerance, thereby making plant biomass more variable over time. A question that remains to be seen is the response of different growth forms and especially dwarf succulents to increased nitrogen.

Zinc: Although zinc is generally well-tolerated by plants in natural environments, in strongly acidic soil, zinc phytotoxicity is the most extensive microelement phytotoxicity after natural phytotoxicity from aluminium or magnesium, and is far more important than Cu, Ni, Co, Cd, or other metals. No standard vegetation threshold or critical value for zinc exists and internet research on zinc toxicity on plants is difficult to confirm in relation to the vegetation of the proposed Gamsberg Smelter Project. In general, with decreasing soil pH, zinc solubility and uptake increase and potential for phytotoxicity increases. In acidic soils, zinc usually causes severe iron-deficiency chlorosis in dicots and grasses are usually much more zinc tolerant than dicots. However, in neutral or alkaline soils, grasses are more sensitive to soil zinc than are dicots, apparently due to the interference of zinc in phytosiderophore function. The soils of the Gamsberg area are generally neutral to fairly alkaline and given the underlying high zinc content (hence the presence of the zinc mine), zinc phytotoxicity is considered unlikely. It is possible, however, that zinc phytotoxicity could occur in areas with highest zinc fallout rates and possibly where high SO_2 and NO_2 ground level concentrations may result in soil acidification under moist conditions. Modelled deposition for zinc at 5 mg/m^2/day (Figure 11-3) extends over the eastern portion of the calcrete gravel patch to the west of the smelter complex while much lower levels of 0.5 mg/m^2/day of zinc deposition extends across a larger area (although remains well within the modelled 50 mg/m^2/day dust deposition zone used to calculate the existing Gamsberg Zinc Mine biodiversity offset.

Lead: Lead exerts adverse effects on morphology, growth and photosynthetic processes of plants. High levels of lead also cause inhibition of enzyme activities, water imbalance, alterations in membrane permeability and disturbance of mineral nutrition. Despite its' apparent toxicity for plants and animals, critical thresholds of lead for vegetation in semi-natural environments have not been well-studied and

there do not appear to be any accepted thresholds that can be applied to the current situation. Overall, there appears to be little consistency with regards to lead, zinc or other heavy metals and their thresholds with regards to significant negative impacts on natural ecosystems. Soils with a higher pH (neutral to alkaline) appear to be significantly better at buffering vegetation from negative impact than acid soils. Critical thresholds appear to be largely case and site specific due to the reasons mentioned above. Lead deposition of 5 mg/m^2/day has a similar modelled deposition zone to zinc (Figure 11-4), and may impact the calcrete gravel patch to the west of the smelter complex. At much lower levels of 0.5 mg/m^2/day of lead the modelled deposition zone extends north and west overlapping with calcrete gravel patches but (as with the other emissions), remains within the area calculated for the existing Gamsberg Zinc Mine biodiversity offset.

11.2 IMPACT ASSESSMENT

Potential Impacts

Although zinc is an essential micronutrient for plants, it can cause toxicity in plants, especially where the soil pH is low. Lead on the other hand has no known purpose in plants and is not well tolerated by plants. In general, toxic effects in plants occur at lead concentrations about an order of magnitude lower than those required to generate zinc impacts. The levels of lead predicted to be emitted by the plant are low, but it is not clear how these would accumulate in the environment and while a short-term negative impact seems unlikely, there may be some long-term negative impacts of lead on the vegetation of the area in close proximity to the proposed smelter complex.

As the negative impacts of both of these metals are mediated by soil pH, the acidification of the soil near the proposed smelter complex may increase the susceptibility of the vegetation to negative impacts from these metals in the long-term. However, given the low levels of SO_2 and NO_2 predicted to be generated by the proposed Gamsberg Smelter Project, the rapid acidification of the soil near the plant is considered unlikely. Furthermore, the abundance of calcrete in the affected area may provide a buffering and ameliorating role for vegetation as the soil is alkaline in these areas, with the result that acidification of the soil would likely require large amounts of acidic fallout before a significant change in pH occurred. However, these predictions have a low degree of confidence as they are based on best possible deductions and inferences about the potential responses of arid zone flora to increased emissions and the interplay of soil and climatic factors. A precautionary approach is required which ensures optimal avoidance and mitigation measures are implemented, and the implementation of a targeted and comprehensive monitoring programme to verify the basis for any vegetation changes over time.

Taking all this into consideration, the intensity of the impact is assessed to be moderate but would have an impact outside of the MRA boundary and could have long-term to permanent impacts on vegetation. The significance prior to mitigation is therefore assessed to be MEDIUM. Due to the uncertainty and that there is limited mitigation available once the Gamsberg Smelter is operational, unless new process measures or new air emission reduction technology becomes available and is fitted, the impact significance remains the same, MEDIUM, for the pre-mitigation and residual impact (Table 11-1).

Table 11-1: Impact Summary – Impact on Vegetation due to Increased Air Emissions (SO2, NO2, Lead (Pb) And Zinc (Zn) during Operational Phase

Issue: Impact on Vegetation due to Increased Air Emissions (SO2, NO2, Lead (Pb) And Zinc (Zn)		
Phases: Operational Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate change or disturbance (M)	Moderate change or disturbance (M)
Duration	Very long, permanent (VH)	Very long, permanent (VH)
Extent	Beyond site boundary, affecting immediate neighbours (M)	Beyond site boundary, affecting immediate neighbours (M)
Consequence	Medium (M)	Medium (M)
Probability	Possible (M)	Possible (M)
Significance	Medium (M)	Medium (M)
Nature of cumulative impacts	The cumulative impact of modelled air emissions from the Gamsberg Zinc Mine and Gamsberg Smelter Project in relation to the biodiversity offsets secured for the mine are discussed in Section 36.1.	
Degree to which impact can be reversed	Any changes to irreplaceable succulent vegetation as a result of altered air quality is likely to persist for years especially due to potential for soil contamination. It is likely that grasses and other annuals would increase or restore more quickly after decommissioning of the smelter.	
Degree to which impact may cause irreplaceable loss of resources	Possibly, if there is significant impact on the plants within calcrete gravel patches and other habitats of concern.	
Residual impacts	As there would be pollutants emitted from the smelter, some residual impact is highly likely to occur on vegetation around the smelter complex, although it is modelled to remain within the dust impact zone of the mine that has been quantified for the mine offset, the residual impact remains MEDIUM.	

Mitigation/ Enhancement Measures

The following measures should be implemented:

- Limited mitigation would be possible once the smelter is operational unless new process measures or new air emission reduction technology becomes available and is fitted.

Monitoring

The following monitoring is required:

A comprehensive monitoring plan must be implemented to verify the project-related impacts relative to natural background variability linked to rainfall or climate change. If impacts due to the proposed Gamsberg Smelter Project become apparent over time, the project shall be required to investigate additional options that may be available over time to ensure the Gamsberg Smelter remains equipped with best available technology for air quality control to further mitigate air pollution impacts.

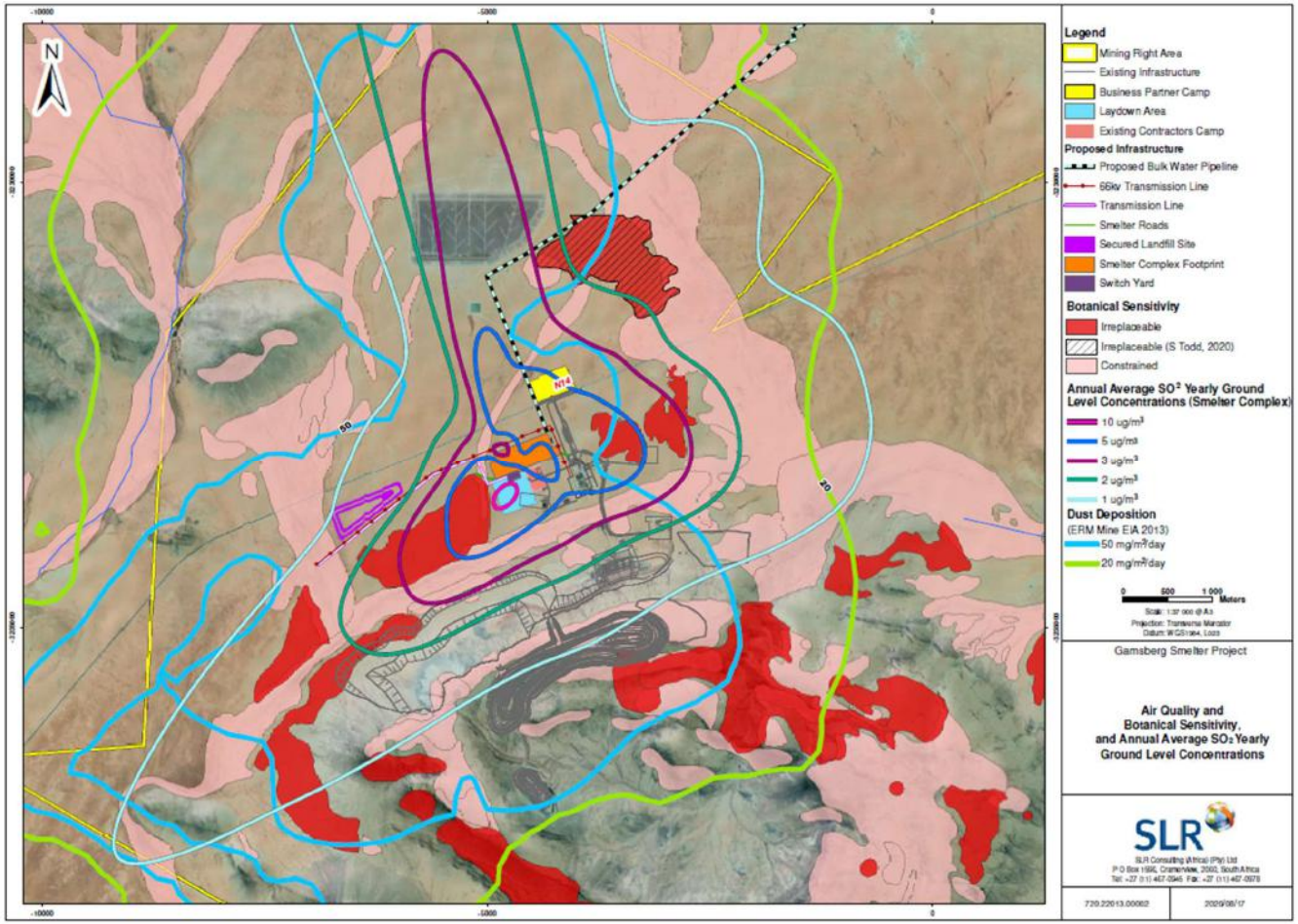

Figure 11-1. Modelled SO_2 annual ground level concentrations of 1, 2, 3, 5 ug/m^3 and 10 ug/m^3 relative to previously modelled mine dust contours used to determine the Gamsberg Zinc Mine biodiversity offset (outer light blue and green lines). Note: the lower limit of critical values of SO_2 for vegetation is 10 ug/m^3/year for lichens (CLRTAP 2017)

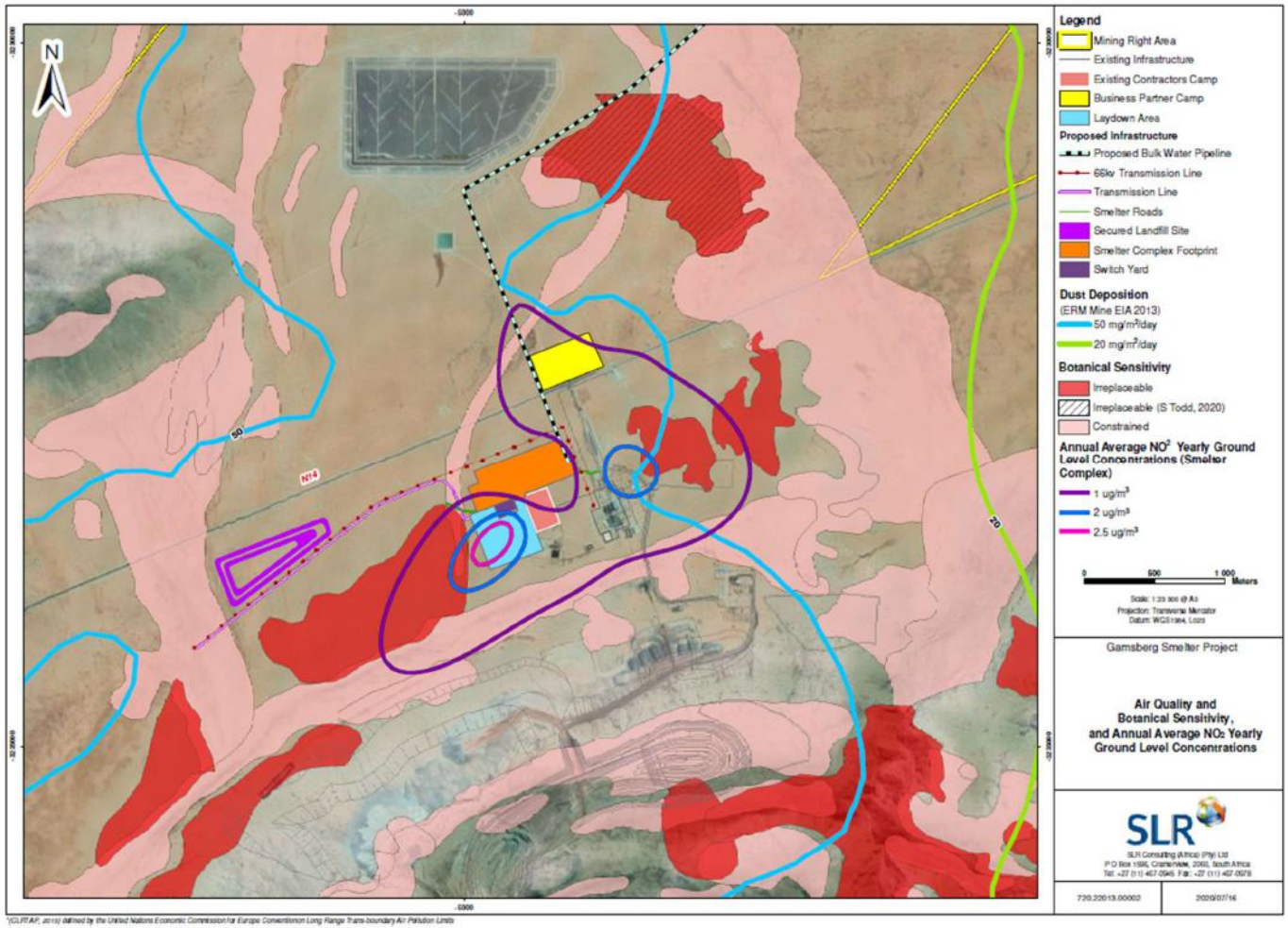

Figure 11-2 Modelled NO_2 annual ground Level concentrations of 1, 2 and 2.5 ug/m³ relative to previously modelled mine dust contours used to determine Gamsberg Zinc Mine biodiversity offset (outer light blue and green lines)

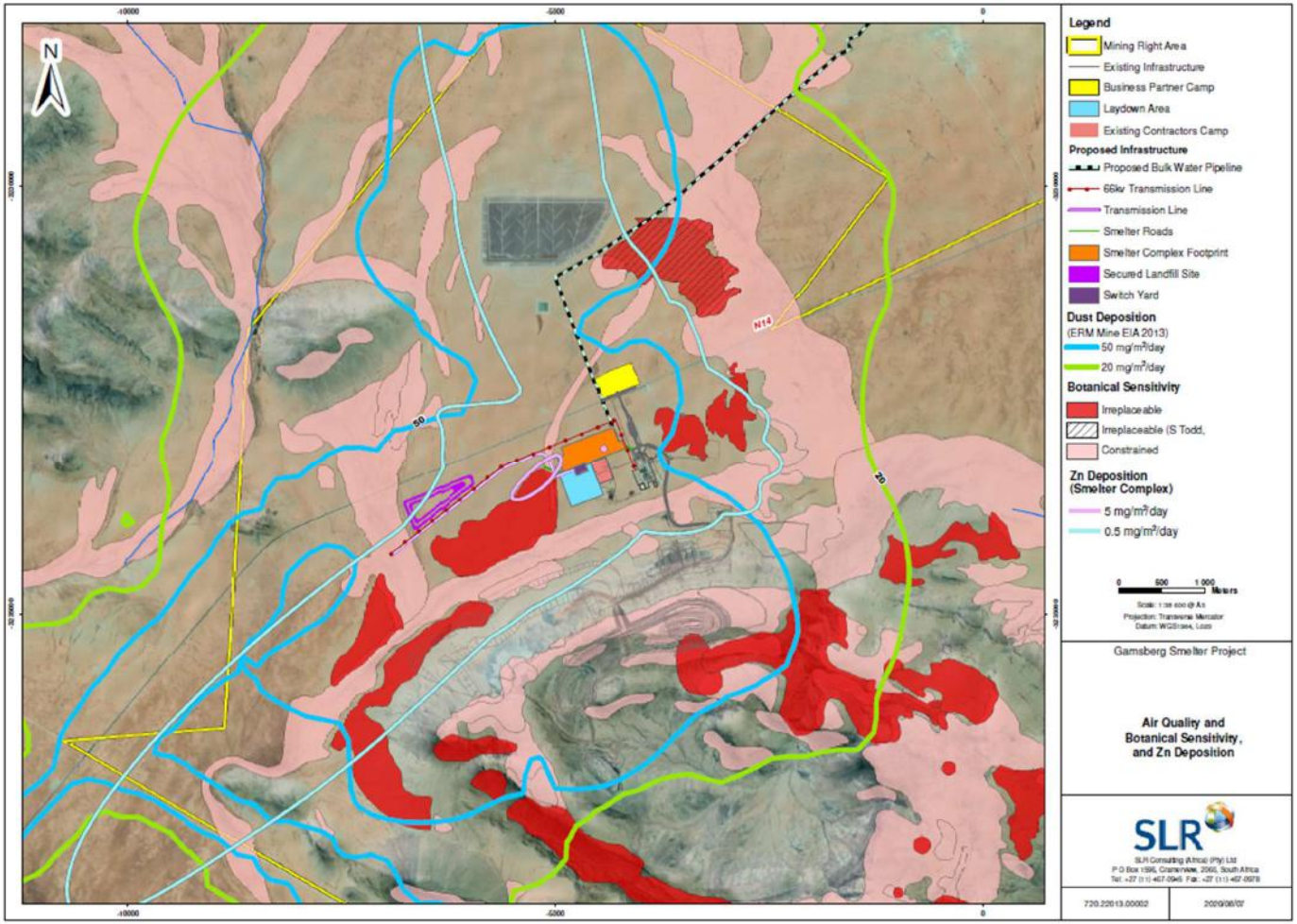

Figure 11-3 Modelled zinc deposition levels relative to previously modelled mine dust contours used to determine Gamsberg Zinc Mine biodiversity offset (outer light blue and green lines)

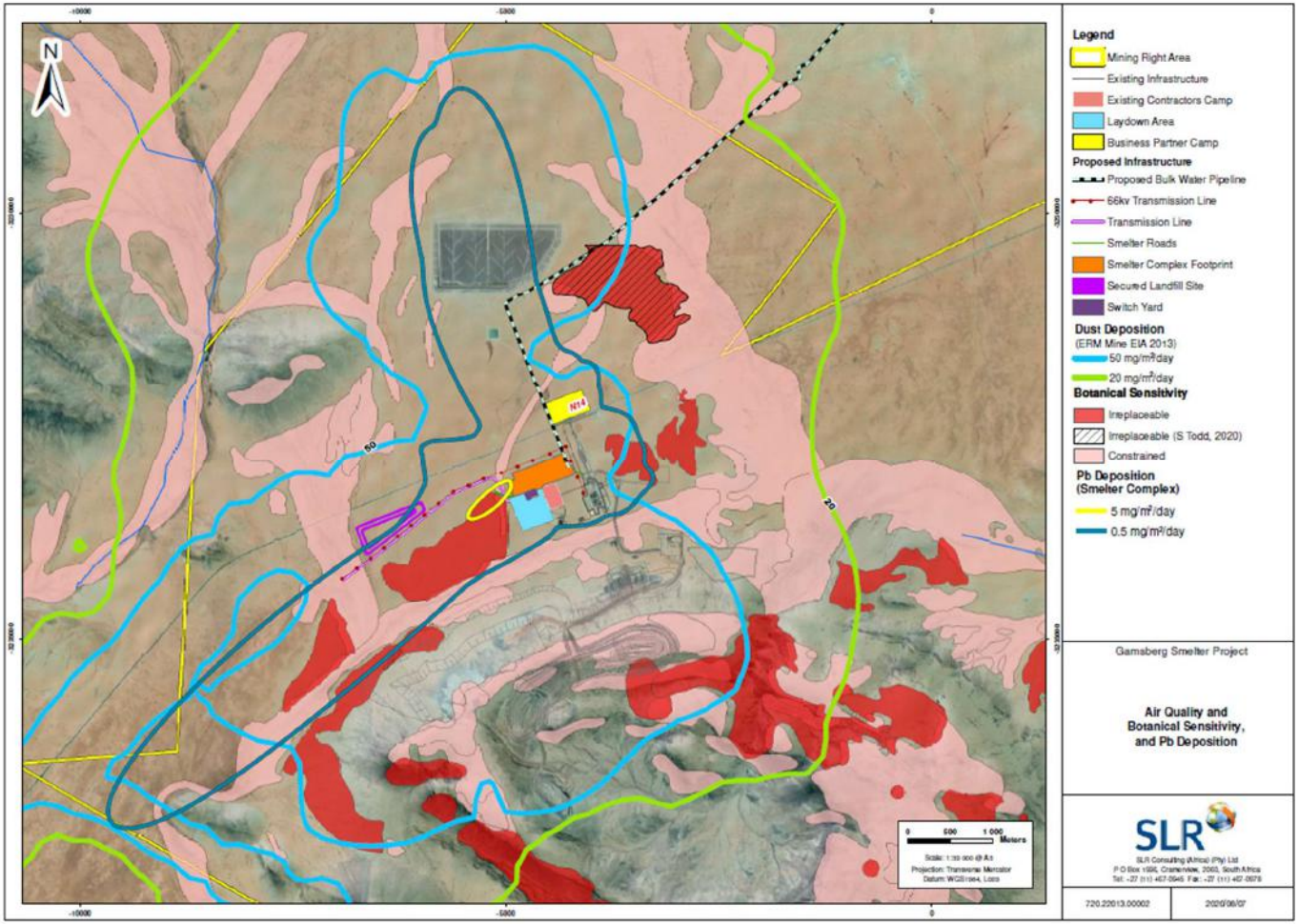

Figure 11-4 Modelled lead deposition levels relative to previously modelled mine dust contours used to determine Gamsberg Zinc Mine offset (outer light blue and green lines)

12. ISSUE 12 IMPACT ON VEGETATION DUE TO GROUNDWATER CONTAMINATION IN OPERATIONAL PHASE

12.1 DESCRIPTION OF IMPACTS

The secured landfill facility would be lined with a Class A liner to prevent contamination and leachate entering the groundwater or soil horizons. The seepage captured by this liner would be captured and returned to the effluent treatment plant for re-use in the smelter complex. The secured landfill facility is located adjacent to a 1:100-year flood line and protection measures have been proposed to protect the western margin of the secured landfill facility by the construction of a berm to prevent flooding of the secured landfill facility.

Groundwater modelling undertaken for the proposed Gamsberg Smelter Project predicts minimal change in groundwater quantity but does predict a potential for some leachates (such as sulphates, sodium, arsenic and lead) from the secured landfill facility to contaminate groundwater at depths of approximately 30 m below ground level. While the contaminated groundwater plume is predicted to spread over time, results suggest it is not predicted to impact on the Gamsberg kloof due to the presence of a groundwater barrier.

12.2 IMPACT ASSESSMENT

Potential Impacts

The majority of grasses and shrubs in the affected area have rooting depths that do not exceed 2 m and the only species with roots that are known to reach the required depths is *Boscia albitrunca* which does not occur in the area around the secured landfill facility and *Boscia foetida* subsp. *foetida* which does occur in the vicinity. While it is possible the groundwater aquifer below the calcrete gravel patch to the south of the secured landfill facility may become contaminated over the lifespan of the proposed Gamsberg Smelter Project and beyond, the irreplaceable flora in this area is shallow-rooted and not predicted to be affected from groundwater contamination.

Due to the depth of the groundwater and the shallow root systems of the bulk of the vegetation in the area, the intensity of the impact is assessed to be minor. The impact could occur over the long-term but would be localised. As such prior to mitigation the impact is assessed to be LOW. Installation of the liner would be required under the National Norms and Standards for the Storage of Waste (published in terms of NEM: WA) and as such there is limited additional mitigation that can be implemented, the residual impact thus remains LOW (Table 12-1).

Table 12-1: Impact summary – Impact on Vegetation due to Groundwater Contamination in Operational Phase

Issue: Impact on Vegetation due to Groundwater Contamination in Operational Phase		
Phases: Operational Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Minor change or disturbance (L)	Minor change or disturbance (L)
Duration	Very long, permanent (VH)	Very long, permanent (VH)
Extent	Beyond site boundary, affecting immediate neighbours (M)	Beyond site boundary, affecting immediate neighbours (M)
Consequence	Medium (M)	Medium (M)
Probability	Conceivable (L)	Conceivable (L)
Significance	Low (L)	Low (L)
Nature of cumulative impacts	The cumulative impact of groundwater contamination on vegetation is assessed to be LOW.	
Degree to which impact can be reversed	Should this impact occur it would be difficult to reverse as the groundwater pollution would persist for a long time.	
Degree to which impact may cause irreplaceable loss of resources	Unlikely as there is little vegetation in the area that utilises groundwater.	
Residual impacts	Based on information available to the specialist, the residual impact of groundwater contamination on vegetation is unlikely and evaluated as LOW significance.	

Mitigation/ Enhancement Measures

The following measures should be implemented:

- Implement all mitigation measures in Sections 2.2 and 3.2.
- It is expected that the secured landfill facility would be designed and constructed in accordance with international best practice requirements.

Monitoring

The following monitoring is required:

- Routine monitoring of groundwater should be implemented at new monitoring wells proposed on either side of the secured landfill facility.

13. ISSUE 13 IMPACT ON FAUNA DUE TO OPERATIONAL ACTIVITIES: DUST, NOISE, AND TRAFFIC

13.1 DESCRIPTION OF IMPACT

The operation of the proposed Gamsberg Smelter Project would result in impacts on fauna through increased noise, lighting, dust, and human and vehicle disturbance, as well as the direct loss of habitat.

13.2 IMPACT ASSESSMENT

Potential Impacts

Increased dust deposition may make the vegetation less palatable for herbivores while noise disturbance is likely to displace resident animals and deter others from the area. Increased traffic moving between the proposed smelter complex and secured landfill facility on a daily basis would likely result in some mortality of lizards, snakes, tortoises, or rodents when crossing the road. However, since these impacts are already occurring as a result of the ongoing mining activities the proposed Gamsberg Smelter Project would cause minor intensification of these impacts in the localised operational area around the smelter complex and secured landfill facility footprints. It is expected these impacts would be limited to a radius of 200-300 m from the smelter complex infrastructure.

The impact on fauna due to operational activities is assessed to be moderate and would affect the whole site for the life of operations (and potentially beyond). The impact prior to mitigation is assessed to be of MEDIUM significance. With the implementation of mitigation measures the significance can be reduced to LOW (Table 13-1).

Table 13-1: Impact summary – Faunal Impacts due to Operational Activities: Dust, Noise, and Traffic

Issue: Faunal Impacts due to Operational Activities: Dust, Noise, and Traffic		
Phases: Operational Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate change or disturbance (M)	Moderate change or disturbance (M)
Duration	Long-term (H)	Long-term (H)
Extent	Whole site (L)	Whole site (L)
Consequence	Medium (M)	Medium (M)
Probability	Probable (H)	Possible (M)
Significance	Medium (M)	Low (L)
Nature of cumulative impacts	The cumulative impact is assessed to be LOW.	
Degree to which impact can be reversed	Operational impacts on fauna would persist for the life of existing Gamsberg Zinc Mine and proposed Gamsberg Smelter Project. The footprint of the secured landfill facility would likely persist in perpetuity and is unlikely provide faunal habitat.	
Degree to which impact may cause irreplaceable loss of resources	Unlikely as there do not appear to be any significant populations of species of conservation concern within the affected area.	
Residual impacts	The residual impact is assessed to be LOW.	

Mitigation/ Enhancement Measures

The following measures should be implemented:

- Any fauna such as snakes, lizards or small mammals that are trapped or otherwise threatened by operational activities should be caught and removed to a safe location by trained snake handlers who should be available on site at all times.
- Where possible, night lighting should be done using downward-directed low-UV type lights (such as most LEDs) to minimise attracting insects, bats and nocturnal birds.
- All vehicles operating within the proposed Gamsberg Smelter Project area should adhere to a low speed limit (40 km/h max for light vehicles and trucks) to avoid collisions with susceptible species such as snakes and tortoises. Speed monitoring of vehicle and regular awareness raising of staff on this issue should be implemented.

Monitoring

The following monitoring is required:

- Visual monitoring to ensure adherence to speed limits.
- Records of all awareness training conducted.

14. ISSUE 14 IMPACTS ON ECOLOGY DURING DECOMMISSIONING PHASE

14.1 DESCRIPTION OF IMPACTS

Decommissioning of the proposed smelter complex would involving dismantling of infrastructure and some degree of reclamation in accordance with an agreed land use vision. The secured landfill facility is likely to remain in place although it is possible that some Jarofix may be reusable for road construction material.

14.2 IMPACT ASSESSMENT

Potential Impacts

Removal of the hard infrastructure from the Gamsberg Smelter Project footprints would leave extensive areas of exposed substrate that would be vulnerable to invasion by weedy species and soil and wind erosion. It is, however, unlikely that any of the proposed footprints would be rehabilitated to a condition that they can support any SCCs. Depending on the level of restoration, it may be possible to restore much of the footprint to a vegetated state that can support some natural fauna.

The intensity of the impact is assessed to moderate prior to mitigation and would affect the whole site. However, due to the short-term disturbance related to the decommissioning phase the overall significance is likely to be MEDIUM. With the implementation of mitigation measures and the rehabilitation of the site, the impact can be reduced to LOW significance (Table 14-1).

Table 14-1: Impact Summary – Ecological Impacts during Decommissioning Phase

Issue: Ecological Impacts during Decommissioning Phase		
Phases: Decommissioning Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate change or disturbance (M)	Moderate change or disturbance (M)
Duration	Short-term (L)	Short-term (L)
Extent	Whole site (L)	Whole site (L)
Consequence	Medium (M)	Medium (M)
Probability	Probable (H)	Possible (M)
Significance	Medium (M)	Low (L)
Nature of cumulative impacts	Along with the decommissioning and closure of the Gamsberg Zinc Mine the cumulative impact is likely to be MEDIUM.	
Degree to which impact can be reversed	Decommissioning-phase disturbance would be transient, and in the long-term would restore some functionality to the affected site.	
Degree to which impact may cause irreplaceable loss of resources	Decommissioning would not result in a loss of irreplaceable resources provided that the site is effectively rehabilitated.	
Residual impacts	It would not be possible to fully recover the diversity, composition and productivity of the affected areas to their previous state, however, the residual impact is considered to be LOW due to the cessation of activities on site.	

Mitigation/ Enhancement Measures

The following measures should be implemented:

- A closure and decommissioning plan with detailed restoration plan and costing should be compiled for the Gamsberg Zinc Mine and Gamsberg Smelter Project with a goal of restoring the affected land back to a condition to be agreed with relevant authorities and stakeholders.
- All hard infrastructure should be removed from the site and recycled or disposed of in the appropriate manner.
- Any potentially dangerous fauna such as snakes or fauna threatened by the decommissioning activities should be removed by appropriately trained persons to a safe location (such as secured offset properties in the Gamsberg Nature Reserve) prior to the commencement of decommissioning activities.
- All hazardous materials such as fuel, oil, etc. should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills or contaminated soils should be cleaned up in the appropriate manner and disposed of as hazardous waste.
- All vehicles accessing the site should adhere to a low speed limit (30km/h for heavy vehicles and 40km/h for light vehicles) to avoid collisions with susceptible species such as snakes and tortoises.
- No excavated holes or trenches should be left open for extended periods as fauna may fall in and become trapped.
- Rip or scarify hardened soils and reseed and revegetate bare areas to allow regrowth and colonisation of a near natural ground cover of indigenous plants. Decompaction and other earthworks to mitigate further dust generating impacts.

- All cleared and disturbed areas remaining after decommissioning should be rehabilitated with locally occurring species. Due to the arid nature of the area, active rehabilitation may be impractical in some areas and more passive approaches such as using seed traps and increasing surface roughness may yield acceptable results.
- Any alien vegetation or erosion problems observed should be rectified as soon as possible using the appropriate revegetation and erosion control works.

Monitoring

The following monitoring is required:

- An alien vegetation and erosion management monitoring and management programme should be put in place for at least 3 years after decommissioning.

15. ISSUE 15 IMPACT ON AMBIENT AIR QUALITY

15.1 DESCRIPTION OF IMPACT

The project area is characterised by sparse vegetation and exposed soil which is typical of a semi-arid region. Therefore, there are a number of activities in all phases of the Gamsberg Smelter Project that have the potential to contribute to changes in the ambient air quality. During the construction and decommissioning phases these activities are usually temporary in nature, existing for a few weeks to a few months. The operational phase consists of long-term activities and the closure phase would present the final rehabilitated areas.

It should be noted that the Gamsberg Zinc Mine is an active mining operation and as such is currently generating significant dust due to the open pit operations and dumping of waste rock. Figure 15-1 shows the baseline modelled dust levels generated for the current mining operations only.

In terms of air quality, atmospheric emissions represent the environmental aspects of concern for the assessment of the proposed Gamsberg Smelter Project. The sources of these emissions were determined by first identifying the inputs and outputs to the various processes and secondly considering the disturbance to the environment by the proposed operations. Possible aspects associated with the proposed operations, in terms of air quality impacts, are listed in Table 15-1.

Table 15-1 Potential Air Pollutants Emitted from the Proposed Gamsberg Smelter Project

Aspects	Source	Activities
Vehicle entrainment		
Particulate emissions; fugitive dust	Vehicle activity on paved and unpaved roads	Transportation of raw materials Transportation of waste Transportation of product
Materials handling		
Fugitive dust	Materials handling operations	Loading and offloading of waste material Offloading of raw material
Storage Piles		
Fugitive dust	Wind erosion	Windblown dust from storage piles and waste facilities

Aspects	Source	Activities
Stacks		
Gaseous and particulate emissions	Acid Plant Stack Casting Stack Dross Treatment Stack Zinc Dust Plant Stack	Stack emissions

Air quality related impacts on biodiversity are discussed in the Biodiversity section (Section 7, 10 and 11) and therefore this section focuses on the potential for human health impacts.

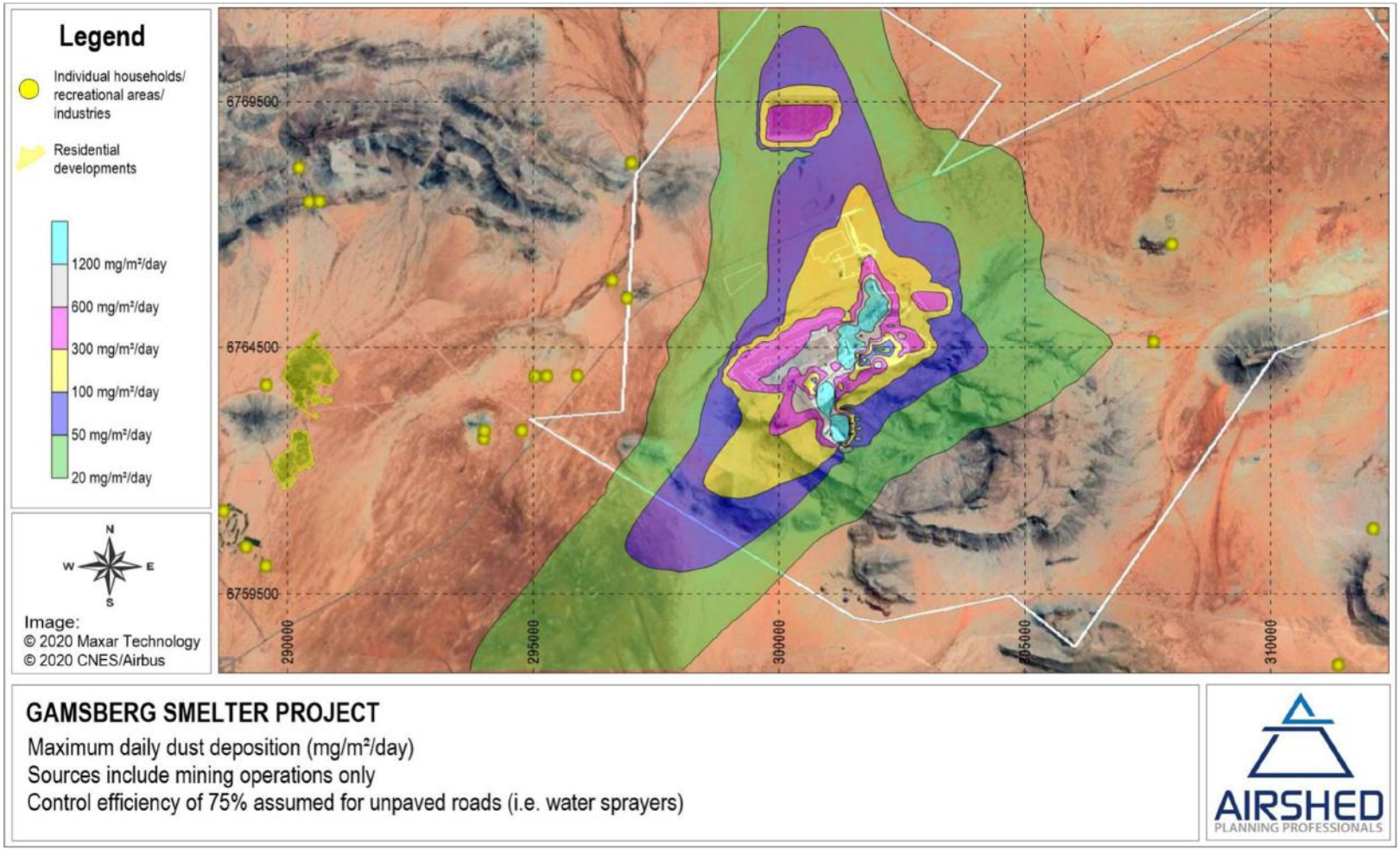

Figure 15-1 Total Particulate Deposition due to Baseline Mining Operations (without the Gamsberg Smelter Project)

15.2 IMPACT ASSESSMENT

15.2.1 Construction Phase

Potential Impacts

During the construction phase dust generated from vegetation clearing, soil grubbing, material handling and the movement of vehicles on unsurfaced areas may contribute to elevated particulate matter levels in the air. In addition, wind erosion from exposed materials could also contribute to elevated particulate matter levels, particularly in the dry and windy summer and spring seasons. This could result in increased dustfall on a local scale and higher particulate matter loads.

The extent of dust generation would vary substantially from day to day depending on the level of activity, the specific activities, and the prevailing meteorological conditions.

Typical sources of fugitive particulate emissions associated with the construction phase are listed in Table 15-2. Unmitigated construction activities provide the potential for impacts on local communities, primarily due to nuisance and aesthetic impacts associated with fugitive dust emissions, and impacts on the sensitive vegetation. On-site dustfall may also represent a nuisance to employees.

Table 15-2 Typical Sources of Fugitive Particulate Emission Associated with Construction

Impact	Source	Activity
Gaseous	Vehicle tailpipes	Transport and general construction activities
PM_{10} and $PM_{2.5}$	Stockpile areas and open areas	Clearing of groundcover
		Levelling of area
		Wind erosion from open areas
		Materials handling
	Transport infrastructure	Clearing of vegetation and topsoil
		Levelling of areas

The main receptors likely to be impacted by the reduced air quality include:

- Aggeneys (~10 km west-southwest) which is the closest residential development to the proposed Gamsberg Smelter Project; and
- the closest individual homestead which is ~3.7 km west-southwest.

Emissions would also be generated by vehicles and other combustion-driven equipment (e.g. generators) that release nitrogen oxides (NO_X), carbon dioxide (CO_2), carbon monoxide (CO) and volatile organic compounds (VOC). Given that the construction phase is short-term/temporary and the impacts of reduced ambient air quality for the Gamsberg Smelter Project are unlikely to reach far beyond the site boundary, the related significance is considered to be VERY LOW without mitigation and VERY LOW with mitigation (Table 15-3).

Table 15-3: Impact Summary – Change in Ambient Air Quality during Construction

Issue: Change in Ambient Air Quality		
Phases: Construction Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Minor change or disturbance (L)	Minor change or disturbance (L)
Duration	Short-term (L)	Short-term (L)
Extent	Beyond the site boundary (M)	Whole site (L)
Consequence	Low (L)	Low (L)
Probability	Possible (M)	Conceivable (L)
Significance	Very Low (VL)	Very Low (VL)
Nature of cumulative impacts	The Gamsberg Zinc Mine is a major dust generating activity in the general area. However, considering the temporary nature of the construction phase for the Gamsberg Smelter Project, the cumulative impact is assessed to be LOW.	
Degree to which impact can be reversed	The impact can be largely reversed once the construction period is completed and the area has been rehabilitated.	
Degree to which impact may cause irreplaceable loss of resources	Low, this section considers the impact on human health only and as there are no nearby sensitive receptors there is unlikely to be a loss of resources.	
Residual impacts	The residual impact is considered to be VERY LOW with only minor, short-term impacts on surrounding receptors.	

Mitigation/ Enhancement Measures

The following measures should be implemented:

- Concurrent rehabilitation and re-vegetation of all areas to be undertaken as decommissioning activities are completed, as far as possible.
- Construction related vehicles should adhere to a low speed limit (40 km/h for light vehicles and for trucks).
- Dust suppression should be used on areas where there is significant vehicle movement and dust generating activities through chemical binding agents and/or water sprays.
- Any generators and vehicles/equipment should be operated and maintained according to supplier specification at maintenance workshops.
- Implementation of a grievance procedure whereby air quality issues can be raised / reported and transparently and timeously addressed.

Monitoring

The following monitoring is required:

- Visual inspections should be undertaken on a daily basis during the construction phase.
- Baseline monitoring should be undertaken for a minimum of 24 months prior to commissioning of the smelter to collect ambient air quality data. The ambient monitoring should as a minimum include daily concentrations of PM_{10}, $PM_{2.5}$ and monthly dust deposition. The ambient monitoring of hourly SO_2 and NO_2 concentrations as well as the metal analysis of the particulate matter would also provide value to the understanding of impacts on the vegetation. The ambient monitoring is recommended to continue once the smelter is operational in order to understand the impacts of the smelter on the vegetation.
- Emission monitoring should be undertaken according to the Air Emissions Licence.

15.2.2 Operational Phase

Potential Impacts

Gaseous concentrations and dustfall rates due to the proposed operations were simulated using the United States Environmental Protection Agency (US-EPA) approved AERMET/AERMOD dispersion modelling suite. Ambient concentrations were simulated to ascertain highest hourly, daily and annual averaging levels occurring as a result of the Gamsberg Smelter Project operations. These were then compared to National Ambient Air Quality Standards (NAAQS) and National Dust Control Regulations (NDCR) (legal limits for criteria pollutants) and health effect screening levels (for non-criteria pollutants). The potential pollutants emitted during the operational phase of the Gamsberg Smelter Project are identified in Table 15-1.

The main findings for the proposed project operations were as follows:

- The simulated $PM_{2.5}$ and PM_{10} impacts due to baseline and project operations (PM_{10} and $PM_{2.5}$ NAAQS extends for an area of 17 322 528 m² and 2 557 345 m² respectively) are similar to impacts due to baseline operations only (PM_{10} and $PM_{2.5}$ NAAQS extends for an area of 17 035 090 m² and 2 533 821 m² respectively) and are well below NAAQS at sensitive receptors within the study area (Figure 15-2). The incremental increase in simulated $PM_{2.5}$, PM_{10} concentrations and total dust deposition from baseline to proposed project operations is negligible.
- The highest simulated lead, NO_2 and SO_2 concentrations due to project operations were in compliance with NAAQS at all sensitive human receptors within the study area.
- The highest simulated $PM_{2.5}$ and PM_{10} concentrations due to baseline and project operations is in compliance with NAAQS at all human sensitive receptors within the study area for all averaging periods.
- Maximum daily dust deposition due to baseline and project operations are within the NDCR for residential areas at all sensitive offsite human receptors within the study area.
- Simulated lead, NO_2 and SO_2 impacts due to Gamsberg Smelter Project activities, are within the NAAQS at all offsite human sensitive receptors within the study area for all averaging periods (Figure 15-3, Figure 15-4 and Figure 15-5).
- The maximum simulated acute and chronic zinc ground level concentrations are below the most stringent human health effect screening levels.
- The potential cancer risk due to dioxins and furans is “very low”.

The simulations indicate that, in terms of human health, emissions from the Gamsberg Smelter Project fall within the levels specified by the relevant guidelines and regulations and the intensity is thus considered to have a minor impact on sensitive receptors. The Gamsberg Smelter Project operations would continue in the long-term

and could extend beyond the site boundary. The significance prior to mitigation is thus assessed to be LOW which can be reduced to VERY LOW with the implementation of the mitigation measures (Table 15-4).

Table 15-4: Impact Summary – Change in Ambient Air Quality during Operations

Issue: Change in ambient air quality		
Phases: Operational Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Minor change or disturbance (L)	Negligible change (VL)
Duration	Long-term (H)	Long-term (H)
Extent	Beyond the site boundary (M)	Whole site (L)
Consequence	Medium (M)	Low (L)
Probability	Conceivable (L)	Conceivable (L)
Significance	Low (L)	Very Low (VL)
Nature of cumulative impacts	The Gamsberg Zinc Mine is already a major dust generating activity and with Phase 2 (already approved) due to be constructed in the near future, the minor contribution from the Gamsberg Smelter Project is likely to have a VERY LOW contribution to the cumulative impact. In terms of the other emissions from the stack produced during the process, there are no other facilities currently existing or planned in the project area emitting SO_2, NO_2, lead or zinc and as such the cumulative impact is INSIGNIFICANT.	
Degree to which impact can be reversed	Once the smelter complex is decommissioned and removed from the area the impacts from the emissions would cease. The secured landfill facility could result in some dust until fully rehabilitated.	
Degree to which impact may cause irreplaceable loss of resources	Low, this section considers the impact on human health only and as there are no nearby sensitive receptors there is unlikely to be a loss of resources.	
Residual impacts	The residual impact is considered to be VERY LOW with only minor impacts expected.	

Mitigation/ Enhancement Measures

The following measures should be implemented:

- Best available technology should be implemented for the stacks in order to minimise the emissions from these sources.
- An Atmospheric Emission Licence (AEL) must be applied for, for the operation of the smelter complex and all stipulated mitigation measures implemented.
- As part of the AEL, for sources that trigger Minimum Emission Standards (MES), mitigation measures need to be selected in order to meet the stipulated emission limits.
- The road surface from the smelter complex to the secured landfill facility must be swept, or similar, on a regular basis to minimise the vehicle entrainment from this surface.

Monitoring

The following monitoring is required:

- Emission monitoring should be undertaken according to the AEL.
- Ambient air quality monitoring should continue once the smelter is operational in order to provide for continuous understanding of ambient air quality and the impact this has on the surrounding environment.

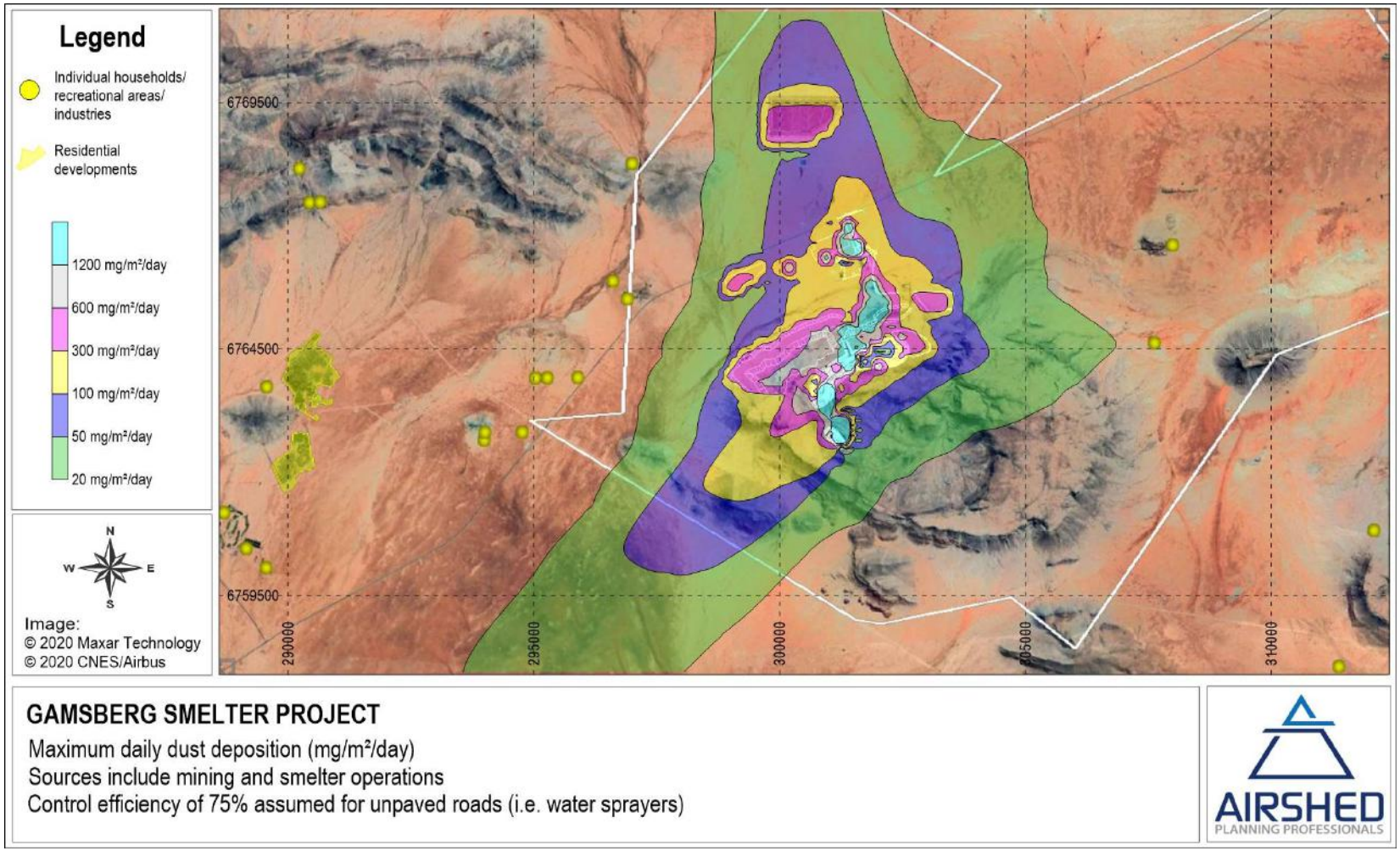

Figure 15-2 Total Particulate Deposition due to Baseline Mining and Proposed Gamsberg Smelter Project Operations

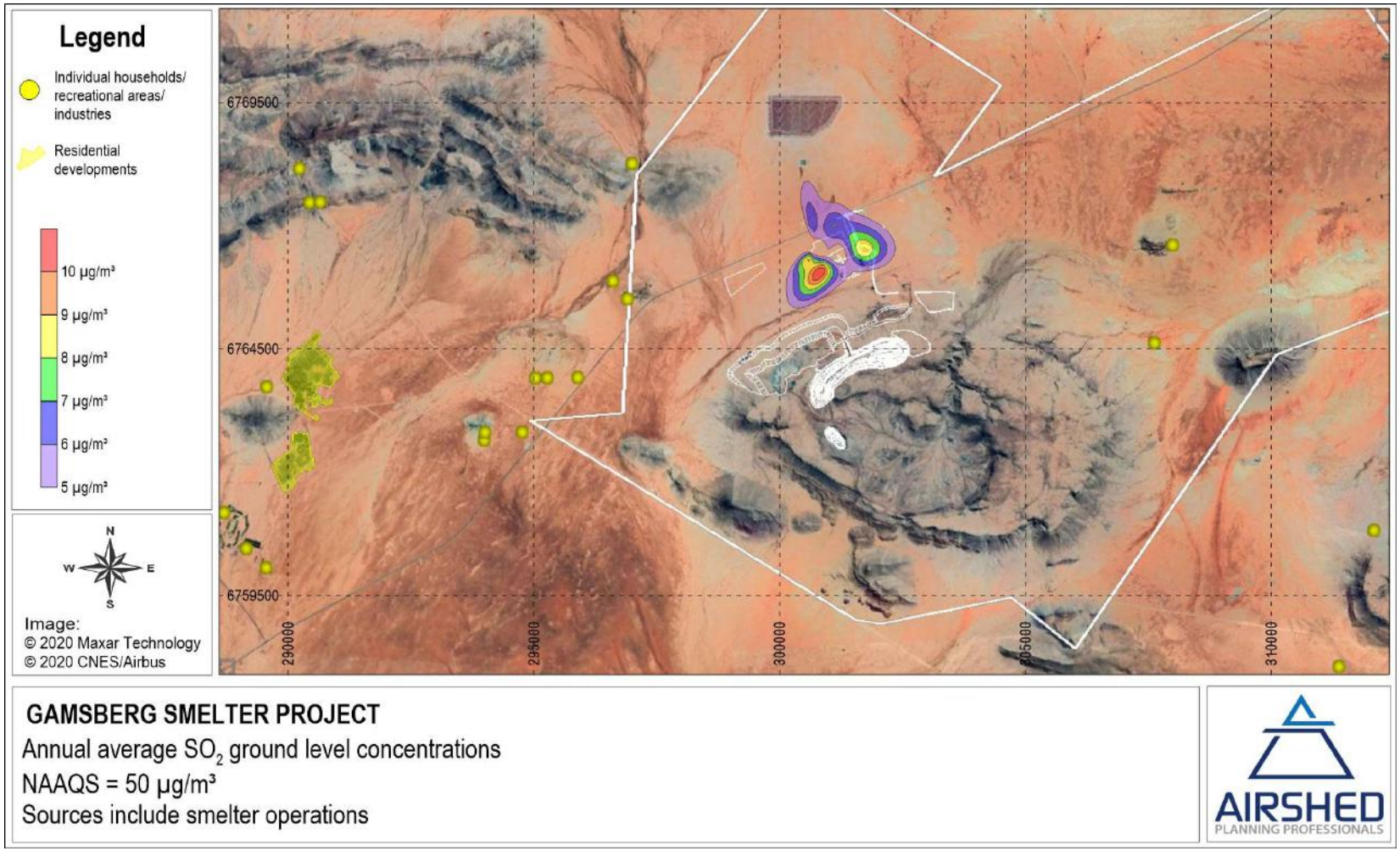

Figure 15-3 Annual Average SO_2 Ground Level Concentrations due to Proposed Gamsberg Smelter Project Operations Only

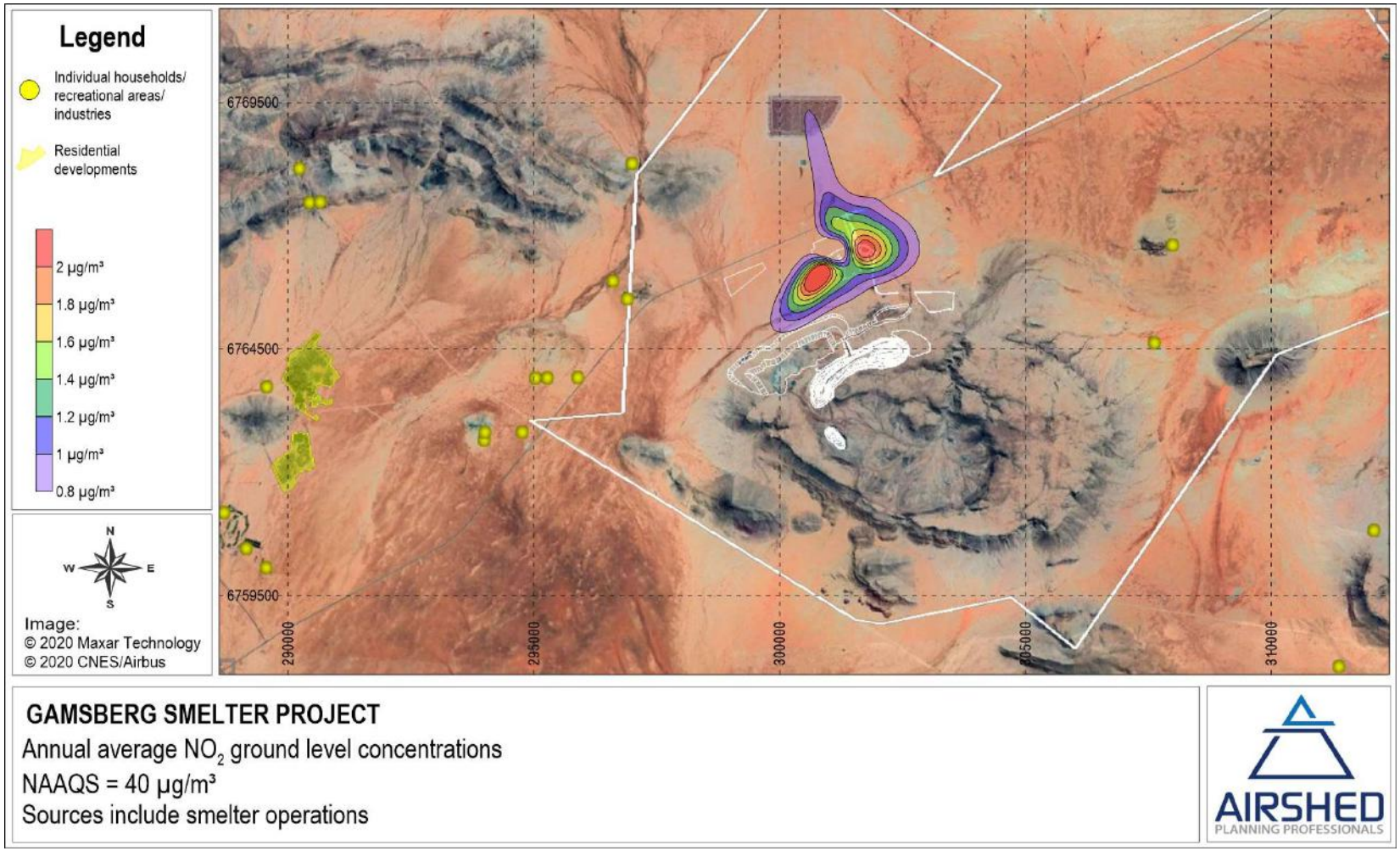

Figure 15-4 Annual Average NO_2 Ground Level Concentrations due to Proposed Project Operations Only

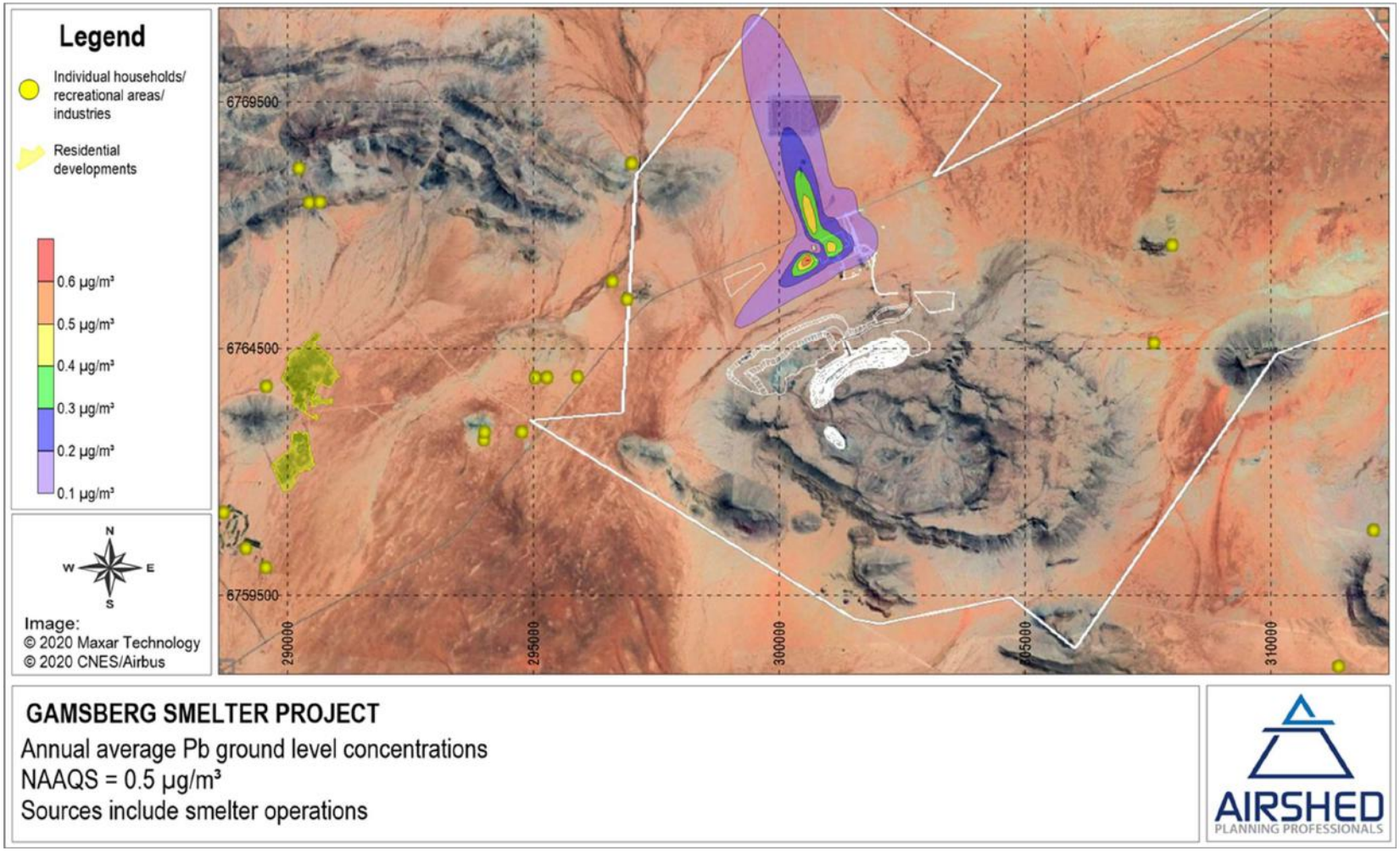

Figure 15-5 Annual Average Lead Ground Level Concentrations due to Proposed Project Operations Only

15.2.3 Decommissioning Phase

Potential Impacts

Impacts during the decommissioning phase are similar in nature to those for the construction phase. During the decommissioning phase dust is generated from demolition of the smelter complex, ripping and removal of roads and associated infrastructure, rehabilitation activities and movement of vehicles on unsurfaced areas. There would also be some emissions from diesel powered vehicles and machinery. In addition, wind erosion from exposed materials could also contribute to elevated particulate matter levels. This could result in increased dustfall on a local scale and higher particulate matter loads.

Given the predicted minor intensity of the impact and that the decommissioning phase is short-term/temporary with impacts unlikely to reach far beyond the site boundary, the related significance is considered to be VERY LOW without and with mitigation (Table 15-5).

Table 15-5: Impact Summary – Change in Ambient Air Quality during Decommissioning

Issue: Change in ambient air quality		
Phases: Decommissioning Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Minor change or disturbance (L)	Minor change or disturbance (L)
Duration	Short-term (L)	Short-term (L)
Extent	Beyond the site boundary (M)	Whole site (L)
Consequence	Low (L)	Low (L)
Probability	Possible (M)	Conceivable (L)
Significance	Very Low (VL)	Very Low (VL)
Nature of cumulative impacts	Considering the temporary nature of the decommissioning phase the cumulative impact is assessed to be LOW.	
Degree to which impact can be reversed	The impact can be reversed once rehabilitation is complete.	
Degree to which impact may cause irreplaceable loss of resources	Low, this section considers the impact on human health only and as there are no nearby sensitive receptors there is unlikely to be a loss of resources.	
Residual impacts	The residual impact is considered to be VERY LOW with only minor, short-term impacts on surrounding receptors.	

Mitigation/ Enhancement Measures

The following measures should be implemented:

- Limit the disturbance of land to what is absolutely necessary;
- Land clearance should only be undertaken when necessary to limit land being left open for long periods of time.
- Decommissioning related vehicles should should adhere to a low speed limit (40 km/h for light vehicles and for trucks).

- Dust suppression should be used on areas where there is significant vehicle movement and dust generating activities through chemical binding agents and/or water sprays
- Any generators and vehicles/equipment will be operated and maintained according to supplier specification at maintenance workshops.
- A comprehensive Rehabilitation Plan should be developed and rehabilitation undertaken as soon as decommissioning activities have been completed.
- Implementation of a grievance procedure whereby air quality issues can be raised / reported and transparently and timeously addressed.

Monitoring

The following monitoring is required:

- Visual inspections should be undertaken on a daily basis during the decommissioning phase.

16. ISSUE 16 IMPACT ON AMBIENT NOISE LEVELS

16.1 DESCRIPTION OF IMPACT

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

The 1992 Noise Control Regulations defines a “disturbing noise” as a noise level which exceeds the zone sound level or, if no zone sound level has been designated, a noise level which exceeds the ambient sound level at the same measuring point by 7 dBA or more. The predicted increase in noise levels due to project activities at all noise sensitive receptors (NSRs) are below 7 dBA.

In terms of existing noise in the project area, the Gamsberg Zinc Mine is an operating mine with open pit activities, dumping of waste rock, crushers and processing at the concentrator plant, as well as the transport of concentrate from the site. The baseline acoustic environment, is within IFC guidelines (as no legally enforceable environmental noise limits have yet been set in South Africa) at the closest NSR, approximately 3.8 km to the west and north west of the project site. Potential NSRs within the greater project area include individual homesteads, residential areas (i.e. Aggeneys), areas of industrial activities and recreational areas.

16.2 IMPACT ASSESSMENT

16.2.1 Construction Phase

Potential Impacts

Construction activities are expected to result in noise impacts similar to or less significant than impacts associated with the operational phase (Section 16.2.2). Due to the nature of these activities, the noise levels would also vary from one day to the next. Typical activities that would impact the ambient noise levels during the construction phase include site clearance; earth works and civil works.

The intensity of the unmitigated impact on ambient noise levels is assumed to be moderate and has the potential to extend beyond the site boundary and affect nearby sensitive receptors. The duration would, however, be

short-term due to the temporary nature of the construction phase and as such the overall significance is determined to be LOW and can be reduced to VERY LOW with the implementation of mitigation measures (Table 16-1).

Table 16-1: Impact Summary – Increase in Ambient Noise Levels during Construction Phase

Issue: Increase in ambient noise levels		
Phases: Construction Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate change or disturbance (M)	Minor change or disturbance (L)
Duration	Short-term (L)	Short-term (L)
Extent	Beyond the site boundary (M)	Whole site (L)
Consequence	Low (L)	Low (L)
Probability	Possible (M)	Possible (M)
Significance	Low (L)	Very Low (VL)
Nature of cumulative impacts	The Gamsberg Zinc Mine is currently the major source of noise in the area with some noise from the N14 highway. Due to the remoteness of the site and the small number of noise sensitive receptors as well as the short-term duration of the construction phase, the cumulative impact is assessed to be LOW.	
Degree to which impact can be reversed	The impact can be fully reversed once the construction period is completed.	
Degree to which impact may cause irreplaceable loss of resources	N/A	
Residual impacts	The residual impact is considered to be VERY LOW with only minor noise impacts on surrounding sensitive receptors.	

Mitigation/ Enhancement Measures

The following measures should be implemented:

- Construction activities should be limited to day-time hours as far as possible.
- Equipment should be reviewed to ensure the quietest available technology is used. Equipment with lower sound power levels should be selected in such instances and vendors/contractors should be required to guarantee optimised equipment design noise levels.
- Machines and mobile equipment used intermittently should be shut down between work periods or throttled down to a minimum and not left running unnecessarily. This will reduce noise and conserve energy.
- Acoustic covers of engines should be kept closed when in use or idling.
- Doors to pump houses and generators should be kept closed when in use.
- Equipment should be regularly and effectively maintained.
- Implementation of a grievance procedure whereby issues associated with noise can be raised/ reported and transparently and timeously addressed.

Monitoring

The following monitoring should be undertaken:

- Daily visual inspection to ensure that sound reducing equipment is in good working order.
- In the event that noise related complaints are received short-term ambient noise measurements (at the complainant) should be conducted as part of the investigation. The results of the measurements should be used to inform any follow up interventions. The investigation of complaints should include an investigation into equipment or machinery that likely resulted in the complaint.
- The following procedure should be adopted for all noise surveys (for complaints):
    - 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 Electro Technical 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 sufficient for statistical analysis should be taken with the use of portable SLMs capable of logging data continuously over the time period. Samples representative of the day- and night-time acoustic environment should be taken.
    - The following acoustic indices should be recoded and reported: LA_{eq} (T), statistical noise level LA_{90}, LA_{Fmin} and LA_{Fmax}, 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 environment of each site.

16.2.2 Operational Phase

Potential Impacts

During the operational phase of the Gamsberg Smelter Project noise is expected from the following sources:

- Stacks;
- Rotating machinery such as motors, pumps, fans, etc;
- Roaster and casting areas; and
- Transport of material (concentrate, waste, product and by-product).

The simulated equivalent continuous day-time rating level ($L_{Req,d}$) due to project operations of 55 dBA (IFC guideline level) extends ~900 m from the smelter complex (Figure 16-1). The simulated equivalent continuous

night-time rating level ($L_{Req,n}$) of 45 dBA (IFC guideline level) due to project operations extends ~1.8 km from the smelter complex (Figure 16-2). The simulated operational phase related noise due to the project is predicted to be in compliance with the IFC guidelines at all sensitive receptors off-site.

The intensity of the unmitigated impact on ambient noise levels is assumed to be minor but does have the potential to extend beyond the site boundary and affect nearby sensitive receptors. The duration would be long-term as the impact would continue for the proposed operational period (15 years). The significance of the impact is assssed to be LOW without mitigation and VERY LOW with the implementation of mitigation measures (Table 16-2).

Table 16-2: Impact Summary – Increase in Ambient Noise Levels during Operational Phase

Issue: Increase in ambient noise levels		
Phases: Operational Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Minor change or disturbance (L)	Negligible change (VL)
Duration	Long-term (H)	Long-term (H)
Extent	Beyond the site boundary (M)	Whole site (L)
Consequence	Medium (M)	Low (L)
Probability	Conceivable (L)	Conceivable (L)
Significance	Low (L)	Very Low (VL)
Nature of cumulative impacts	The Gamsberg Zinc Mine is currently the major source of noise in the area with some noise from the N14 highway. Due to the remoteness of the site and the small number of noise sensitive receptors as well as the low intensity of noise expected to be generated from the smelter complex, the cumulative impact is assessed to be LOW. There is, however, likely to be a LOW cumulative impact with regard to the noise generated by the increased traffic numbers transporting the sulphuric acid and zinc ingots on the N14 highway.	
Degree to which impact can be reversed	The impact can be fully reversed once operation of the smelter complex ceases.	
Degree to which impact may cause irreplaceable loss of resources	N/A	
Residual impacts	The residual impact is considered to be VERY LOW with only minor noise impacts on surrounding sensitive receptors.	

Mitigation/ Enhancement Measures

The following measures should be implemented:

- Non-routine noise generating activities such as start-up and maintenance should be limited to day-time hours.
- Equipment should be reviewed to ensure the quietest available technology is used. Equipment with lower sound power levels should be selected in such instances and vendors/contractors should be required to guarantee optimised equipment design noise levels.

- Machines and mobile equipment used intermittently should be shut down between work periods or throttled down to a minimum and not left running unnecessarily. This will reduce noise and conserve energy.
- As far as is practically possible, sources of significant noise should be enclosed. The extent of enclosure would depend on the nature of the machine and their ventilation requirements. Generators, pumps and blowers are examples of such equipment.
- Acoustic covers of engines should be kept closed when in use or idling.
- Doors to pump houses and generators should be kept closed when in use.
- Equipment should be regularly and effectively maintained. Increases in equipment noise are often indicative of eminent mechanical failure.
- Implementation of a grievance procedure whereby issues associated with noise can be raised/ reported and transparently and timeously addressed.

Monitoring

- Daily visual inspection to ensure that sound reducing equipment is in good working order.
- In the event that noise related complaints are received short-term ambient noise measurements (at the complainant) should be conducted as part of the investigation. The results of the measurements should be used to inform any follow up interventions. The investigation of complaints should include an investigation into equipment or machinery that likely resulted in the complaint (methodology as for construction phase).

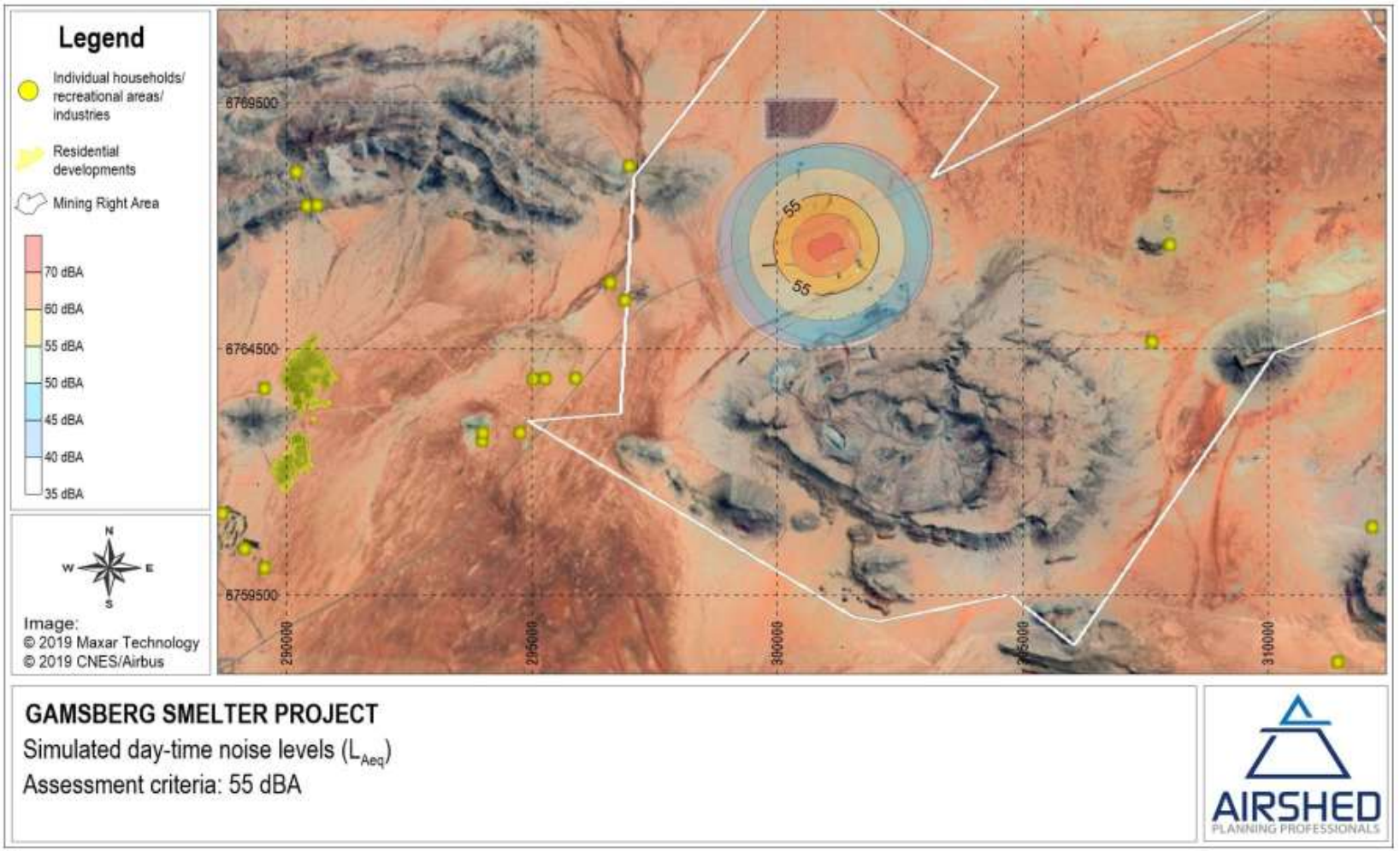

Figure 16-1 Simulated Equivalent Continuous Day-Time Rating Level ($L_{req,d}$) for Gamsberg Smelter Project Activities

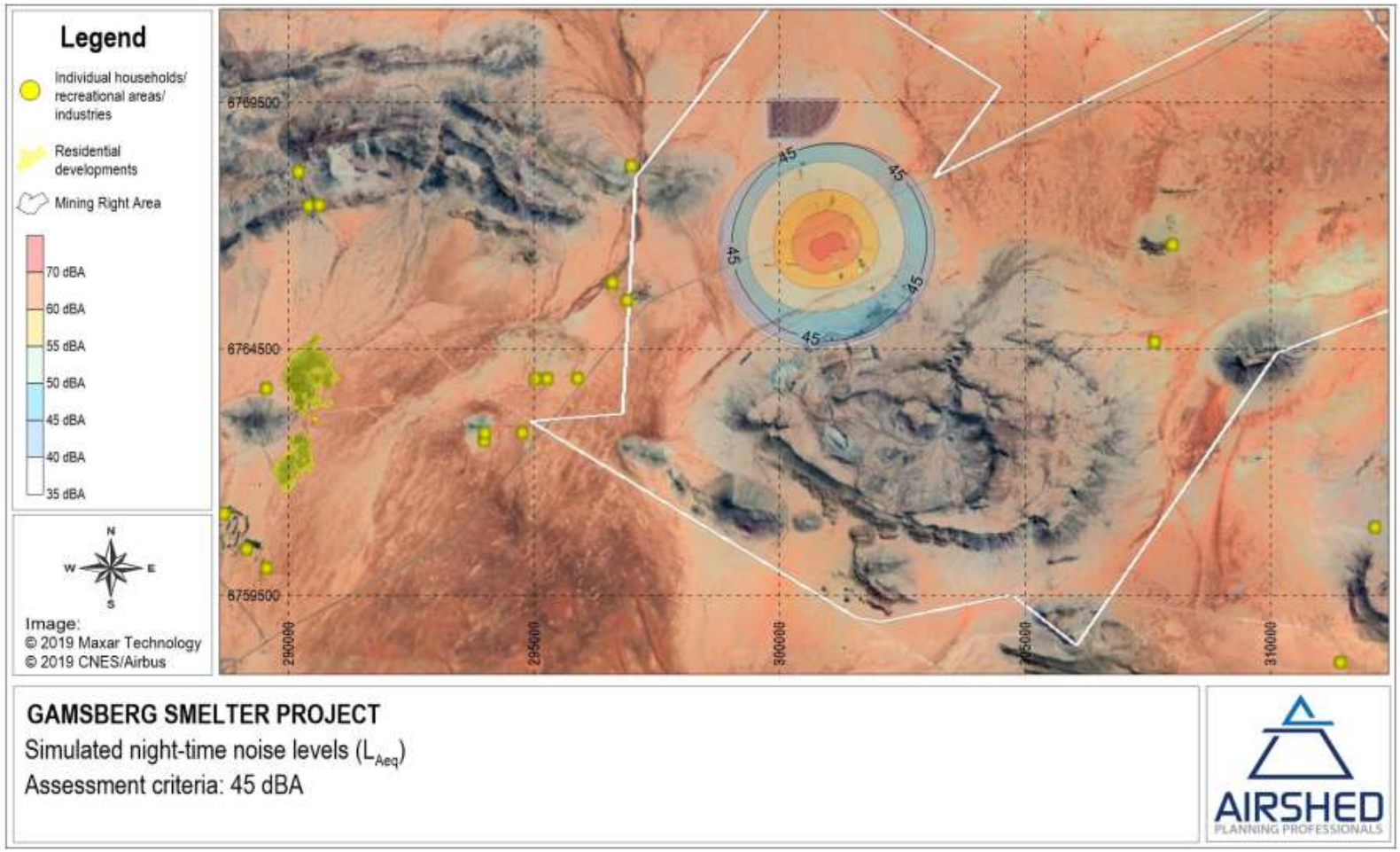

Figure 16-2 Simulated Equivalent Continuous Night-Time Rating Level ($L_{req,n}$) for Gamsberg Smelter Project Activities

16.2.3 Decommissioning Phase

Potential Impacts

Decommissioning activities are expected to result in noise impacts similar to the construction phase (Section 16.2.1). Typical activities that would impact the ambient noise levels during the decommissioning phase include demolition of infrastructure and the removal of materials from site, as well as earth works associated with the levelling of the site and rehabilitation activities.

The intensity of the unmitigated impact on ambient noise levels is assumed to be moderate and has the potential to extend beyond the site boundary and affect nearby sensitive receptors. The duration would, however, be short-term due to the temporary nature of the decommissioning phase and as such the overall significance is determined to be LOW and can be reduced to VERY LOW with the implementation of mitigation measures (Table 16-3).

Table 16-3: Impact Summary – Increase in Ambient Noise Levels during Decommissioning Phase

Issue: Increase in ambient noise levels		
Phases: Decommissioning Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate change or disturbance (M)	Minor change or disturbance (L)
Duration	Short-term (L)	Short-term (L)
Extent	Beyond the site boundary (M)	Whole site (L)
Consequence	Low (L)	Low (L)
Probability	Possible (M)	Possible (M)
Significance	Low (L)	Very Low (VL)
Nature of cumulative impacts	The Gamsberg Zinc Mine is currently the major source of noise in the area with some noise from the N14 highway. Due to the remoteness of the site and the small number of noise sensitive receptors the cumulative impact is assessed to be LOW.	
Degree to which impact can be reversed	The impact can be fully reversed once the smelter complex has been decommissioned and all activities on site cease.	
Degree to which impact may cause irreplaceable loss of resources	N/A	
Residual impacts	The residual impact is considered to be VERY LOW with only minor noise impacts on surrounding sensitive receptors.	

Mitigation/ Enhancement Measures

The following measures should be implemented:

- Decommissioning activities should be limited to day-time hours as defined by the DMRE as far as possible.
- Equipment should be reviewed to ensure the quietest available technology is used. Equipment with lower sound power levels should be selected in such instances and vendors/contractors should be required to guarantee optimised equipment design noise levels.

- Machines and mobile equipment used intermittently should be shut down between work periods or throttled down to a minimum and not left running unnecessarily. This will reduce noise and conserve energy.
- Acoustic covers of engines should be kept closed when in use or idling.
- Doors to pump houses and generators should be kept closed when in use.
- Equipment should be regularly and effectively maintained. Increases in equipment noise are often indicative of eminent mechanical failure.
- Implementation of a grievance procedure whereby issues associated with noise can be raised/ reported and transparently and timeously addressed.

Monitoring

The following monitoring should be undertaken:

- Daily visual inspection to ensure that sound reducing equipment is in good working order.
- In the event that noise related complaints are received short-term ambient noise measurements (at the complainant) should be conducted as part of the investigation. The results of the measurements should be used to inform any follow up interventions. The investigation of complaints should include an investigation into equipment or machinery that likely resulted in the complaint (methodology as for construction phase).

17. ISSUE 17 IMPACT ON SOIL RESOURCES AND LAND CAPABILITY DUE TO PHYSICAL DISTURBANCE

17.1 DESCRIPTION OF IMPACT

Soil is a valuable resource that supports a variety of ecological functions and is key to re-establishing post closure land capability. A number of activities/infrastructure and sources have the potential to disturb soil and related land capability through removal, compaction and/or erosion.

According to a study undertaken by SRK (2009) the Gamsberg area is characterised by an extensive peneplain and the soils present in the peneplain are predominantly shallow and stony. The soil predominantly found on the gentler slopes around the inselberg comprises of the shallow Knersvlakte soil form which is easily identified by the lack of vegetation and quartz gravel on the surface. This soil has a limited depth which limits potential agricultural activity.

Land capability was also assessed by SRK Consulting in December 2009. SRK's findings were that the land capability in the study area ranged from low (Class VI) to very low (Class VIII), largely as a result of the arid climate of the area and the sandy nature of soils. According to the Chamber of Mines land capability classification system, the affected area may only be used as a 'wilderness' area.

The loss of soil resources has a direct impact on the potential loss of the natural capability of the land. This section therefore focuses on the potential for disturbance of the soil resources and the effect this has on land capability.

17.2 IMPACT ASSESSMENT

17.2.1 Construction Phase

Potential Impacts

The establishment of surface infrastructure for the Gamsberg Smelter Project (up to approximately 90 ha) has the potential to affect the soils' ability to sustain natural vegetation and alter land capability. Potential impacts could include:

- Soil erosion resulting from cleared and disturbed areas, leading to the loss of soils;
- Soil compaction resulting from increased traffic and the presence of infrastructure; and
- Loss of soil depth and volume due to excavation.

In the unmitigated scenario, physical soil disturbance can result in a loss of soil functionality as an ecological driver. In the case of erosion, the soils would be lost to the area of disturbance, and in the case of compaction the soils functionality would be compromised through a lack of rooting ability and aeration. In addition, the compacted soils are likely to erode because with less inherent functionality there would be little chance for the establishment of vegetation that naturally would protect the soils from erosion.

Due to the poor quality of the soils and associated 'wilderness' land capability, the intensity of the impact on soils is expected to be minor and would occur within the site boundary. The impact is considered to be long-term. Therefore, the significance prior to mitigation is expected to be LOW. With mitigation implemented the significance is still expected to be LOW due to the poor potential for rehabilitation in this arid climate and poor quality soils. (Table 17-1).

Table 17-1: Impact Summary – Loss of Soil Resources and Land Capability due to Physical Disturbance during Construction Phase

Issue: Loss of Soil Resources and Land Capability due to Physical Disturbance		
Phases: Construction Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Minor change or disturbance (L)	Minor change or disturbance (L)
Duration	Long-term (H)	Long-term (H)
Extent	A part of the site (VL)	A part of the site (VL)
Consequence	Low (L)	Low (L)
Probability	Definite (VH)	Probable (H)
Significance	Low (L)	Low (L)
Nature of cumulative impacts	The soils found in the proposed footprint of the Gamsberg Smelter Project are shallow and stony and have a resultant land capability that is classified as wilderness. The cumulative impact is considered to be MEDIUM due to the poor quality soils.	
Degree to which impact can be reversed	Post decommissioning of the project the soils can to some extent be reinstated. Due to the current wilderness land capability it is expected that there is a low potential for reversal.	
Degree to which impact may cause irreplaceable loss of resources	High	
Residual impacts	The residual impact is considered to be LOW due to the poor quality of the soils in the area.	

Mitigation/ Enhancement Measures

The following measures should be implemented:

- The footprint of the proposed infrastructure area should be clearly demarcated to restrict soil clearing activities to within the infrastructure footprint as far as practically possible.
- Stripping should only occur where soils are to be disturbed by activities and infrastructure that are described in the EIA and EMPr report, and where a clearly defined end rehabilitation use for the stripped soil has been identified. Soil stripping should be conducted a suitable period ahead of construction.
- Bare soils should be protected in a suitable manner to suppress dust during the construction phase. Plans for soil stripping should be compiled on the basis that certain soils are inherently suitable for rehabilitation purposes, whilst others are not.
- All disturbed areas adjacent to the infrastructure complexes should be re-vegetated with an indigenous vegetation mix, if necessary, to re-establish a protective cover, in order to minimise soil erosion and dust emission.
- Excavation and long-term stockpiling of soil would be limited as far as practically possible. Stockpiled soils should be stored for as short a period as possible. Concurrent rehabilitation should be conducted where practically possible to reduce the duration of stockpile storage in order to ensure that the quality of stored soil material does not deteriorate excessively.

- Where possible (or available), topsoil horizons (A and B-horizons) are of higher quality and should be stored separately from lower quality underlying material for use in rehabilitation.
- Stockpiling areas should be identified in close proximity to the source of the soil to limit handling and to promote reuse of soils in the correct areas.
- Stockpiles should be revegetated to establish a vegetation cover as an erosion control measure, as far as possible. These stockpiles should also be kept free of alien vegetation at all times to prevent loss of soil quality.

Monitoring

The following monitoring should be undertaken:

- Daily visual monitoring during the construction phase to identify any potential dust and/ or erosion issues.
- Daily visual monitoring for alien invasive species.

17.2.2 Decommissioning Phase

Potential Impacts

At decommissioning the smelter complex would be demolished and removed from the site as required. Associated infrastructure such as roads and hardstanding would also be demolished and disposed of. Potential impacts expected to soils during the decommissioning phase include:

- Soil erosion resulting from cleared and disturbed areas, leading to the loss of soils; and
- Soil compaction resulting from increased traffic.

Due to the poor quality of the soils and associated 'wilderness' land capability, the intensity of the impact on soils is expected to be minor and would occur within the site boundary. The impact is considered to be short-term. Therefore, the significance prior to mitigation is expected to be LOW. With mitigation implemented the significance is still expected to be LOW due to the poor potential for rehabilitation in this arid climate and poor quality soils. (Table 17-1).

Table 17-2: Impact Summary – Loss of Soil Resources and Land Capability due to Physical Disturbance during Decommissioning Phase

Issue: Loss of Soil Resources and Land Capability due to Physical Disturbance		
Phases: Decommissioning Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Minor change or disturbance (L)	Minor change or disturbance (L)
Duration	Short-term (L)	Short-term (L)
Extent	A part of the site (VL)	A part of the site (VL)
Consequence	Low (L)	Low (L)
Probability	Definite (VH)	Probable (H)
Significance	Low (L)	Low (L)

Nature of cumulative impacts	The soils found in the proposed footprint of the Gamsberg Smelter Project are shallow and stony and have a resultant land capability that is classified as wilderness. The cumulative impact is considered to be MEDIUM due to the poor quality soils.
Degree to which impact can be reversed	Post decommissioning of the project the soils can to some extent be reinstated. Due to the current wilderness land capability it is expected that there is a low potential for reversal.
Degree to which impact may cause irreplaceable loss of resources	High
Residual impacts	The residual impact is considered to be LOW due to the poor quality of the soils in the area.

Mitigation/ Enhancement Measures

The following measures should be implemented:

- The footprint for the proposed decommissioning activities should be clearly demarcated to restrict soil clearing activities to within the infrastructure footprint as far as practically possible.
- Bare soils should be protected in a suitable manner to suppress dust during the decommissioning phase.
- During rehabilitation soil should be replaced to appropriate soil depths in the correct order, and areas covered to achieve an appropriate topographic aspect and attitude so as to achieve a free draining landscape that is as close as possible to the previous land capability rating.
- Infrastructure footprint areas should be ripped to alleviate compaction post closure before rehabilitation.
- The infrastructure footprints should be re-vegetated with an appropriate vegetation mixture as soon as possible, preferably in spring and early summer to stabilize the soil and prevent soil loss during the rainy season.

Monitoring

The following monitoring should be undertaken:

- Daily visual monitoring during the decommissioning phase to identify any potential dust and/ or erosion issues.
- Daily visual monitoring for alien invasive species and to ascertain whether rehabilitation is taking.

18. ISSUE 18 IMPACT ON SOIL RESOURCES DUE TO CONTAMINATION

18.1 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.

In addition, long term seepage from the secured landfill facility could have an impact on the land capability of the area surrounding the site. This impact is assessed in detail in Section 12.

18.2 IMPACT ASSESSMENT

18.2.1 Construction, Operational and Decommissioning Phases

Potential Impacts

Pollution of soils from numerous incidents such as spills from machinery, spills from trucks transporting waste products to the secured landfill facility, leaks from chemical storage etc. can result in a loss of land capability as an ecological driver as it can create a toxic environment for vegetation and ecosystems that rely on the soil. It could also negatively impact on the chemistry of the soils such that current growth conditions are impaired.

During all phases of the Gamsberg Smelter Project there would be various activities being carried out which could result in spills, the intensity is thus considered to be moderate. The impact is considered to be long-term but would remain within the portion of the site where the activities are taking place. Therefore, the significance prior to mitigation is expected to be MEDIUM. In the mitigated scenario soil chemical pollution can be prevented or successfully mitigated with the residual impact assessed to be LOW (Table 18-1).

Table 18-1: Impact Summary – Loss of Soil Resources Due to Contamination during All Phases

Issue: Loss of Soil Resources Due to Contamination		
Phases: Construction, Operational and Decommissioning Phases		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate change or disturbance (M)	Minor change or disturbance (L)
Duration	Long-term (H)	Long-term (H)
Extent	A part of the site (VL)	A part of the site (VL)
Consequence	Medium (M)	Low (L)
Probability	Probable (H)	Possible (M)
Significance	Medium (M)	Low (L)
Nature of cumulative impacts	Due to the already poor quality soils and the potentially sensitive biodiversity in the vicinity the cumulative impact is assessed to be MEDIUM.	
Degree to which impact can be reversed	Medium as the secured landfill facility could affect the soil quality post-decommissioning.	
Degree to which impact may cause irreplaceable loss of resources	Medium due to the secured landfill facility that could affect the soil quality post-decommissioning.	
Residual impacts	With the implementation of mitigation measures the residual impact is assessed to be LOW.	

Mitigation/ Enhancement Measures

The following measures should be implemented:

- During the construction, operational and decommissioning phases, all hazardous chemicals (new and used), dirty water, mineralized wastes and non-mineralised wastes must be transported, handled and

stored in such a manner that they do not pollute soils. This will be implemented through a procedure(s) covering the following:

- All hazardous liquids should be stored within a bunded facility to prevent leaks and spills to the surrounding environment.
- Maintenance of vehicles and equipment should be done either on impermeable surfaces or drip trays should be used.
- All waste should be stored in specified areas and should be on impermeable surfaces where required.
- Spill kits must be available on site to ensure that any fuel or oil spills are cleaned up immediately and disposed of correctly.
- Awareness training should be provided to all workers (temporary and permanent) on the required steps to enable fast reaction to contain and remediate pollution incidents. In situ treatment is generally considered to be the preferred option because with successful in situ remediation the soil resource can 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
- Post rehabilitation audits should be undertaken 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.

Monitoring

The following monitoring should be undertaken:

- Daily monitoring during the construction and decommissioning phases to identify any potential spills/ leaks.
- Weekly monitoring during the operational phase to identify any potential spills/ leaks.

19. ISSUE 19 IMPACT ON LANDSCAPE AND RELATED VISUAL IMPACTS DUE TO THE SMELTER COMPLEX

19.1 DESCRIPTION OF IMPACT

Receptors travelling Eastbound on the N14 National Highway are likely to first view the proposed landscape modification at approximately 24km from the site, with clearer views taking place at approximately 12km due to the natural dust of this arid region creating a haze in the air. The view is dominated by the straight tarred road of the highway, the rugged dark coloured hills on the mid-distance, and some man-made industrial related modifications in the background in the vicinity of the proposed smelter complex from the existing mining activities located adjacent to the site. Although lighting at night could generate some additional colour contrast, the existing mining facility night lighting is well established and likely to increase with planned (authorised) expansions to the mine works.

Although the area does have mountain landscape features that increase scenic quality, the adjacent Gamsberg Zinc Mine does dominate the local and regional landscape character, with the town of Aggeneys historically being a mining town and the residents associated with mining landscape modifications. From a regional and local planning perspective there is a strong emphasis on tourism in the area, particularly the wilderness areas to the

north of Aggeneys along the Orange River as well as a recognition that the N14 National Highway is an important tourist view corridor that could be used to further tourism initiatives in the area. The scenic quality of the landscape for the proposed Gamsberg Smelter Project is, however, rated as low.

The main sensitive receptors in terms of visual impacts are the N14 Highway users, nearby farmers and residents of Aggeneys. Receptor Sensitivity to landscape change is likely to be medium .

19.2 IMPACT ASSESSMENT

19.2.1 Construction Phase

Potential Impacts

The area identified for the construction of the smelter complex is within the Gamsberg Zinc Mine MRA and in close proximity to the existing operations. However, the intensity of the construction phase, for the smelter complex in particular, is likely to be high due to the heights of the cranes, the plant components and the tall stack, in relation to the relatively flat terrain along the N14 Highway. Additional impacts to sensitive visual receptors would occur due to the following.

- Alteration of surface topography as a result of infrastructure placement and positioning, leading to loss of visual quality and visual exposure;
- Construction-related earthworks resulting in increased dust;
- Strong contrast generated by increased vehicular movement, large cranes and night lighting; and;
- Construction of a large-scale industrial complex with large structures and tall towers.

Without mitigation the intensity of the construction phase of the smelter complex is likely to be high due to strong contrast generated due to construction activities, bright cladding and roofing colours and highly reflective materials. This would be visible from up to 24 km away for eastbound traffic. Even though the impact would be felt over the short-term, the significance prior to mitigation is assessed to be HIGH. With the implementation of mitigation measures the impact can be reduced to MEDIUM (Table 19-1).

Table 19-1: Impact Summary – Change in Landscape and Related Visual Impacts due to the Smelter Complex during Construction Phase

Issue: Change in Landscape and Related Visual Impacts due to the Smelter Complex		
Phases: Construction Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Major change or disturbance (H)	Moderate change or disturbance (M)
Duration	Short-term (L)	Short-term (L)
Extent	Local area, extending far beyond site (H)	Local area, extending far beyond site (H)
Consequence	High (H)	Medium (M)
Probability	Definite (VH)	Definite (VH)
Significance	High (H)	Medium (M)

Nature of cumulative impacts	The construction of the additional Gamsberg Mine concentrator plant is likely to begin late 2020/ beginning 2021, there is thus the possibility that the construction phases could to some extent overlap. However, due to the short duration of the construction phases the cumulative impact is considered to be LOW.
Degree to which impact can be reversed	The short-term impacts related to the construction phase can be largely reversed once the construction phase is complete.
Degree to which impact may cause irreplaceable loss of resources	Very low as this area has been disturbed in the past by the Gamsberg Zinc Mine operations.
Residual impacts	The residual impact is considered to be MEDIUM as it is not possible to reduce the impacts completely.

Mitigation/ Enhancement Measures

The following measures should be implemented:

- The structure design should be reviewed to incorporate more external cladding for the structures located on the N14 side of the development to help reduce visual contrast. The cladding should make use of desert grey-brown hues and needs to incorporate a two-toned grey-brown colouring for the cladding. The Vedanta Blue branding should not be incorporated into the cladding design.
- Other than the aircraft warning lights on the stacks, any uplighting of the stacks (or uplighting of large areas of the sides of the structure for advertising purposes) should not be used. Lighting should be downward, and inward facing to reduce light spillage.
- Minimise the removal of natural vegetation by demarcating specific areas within which all construction activities must be undertaken.
- As far as possible, the cut platform for the complex needs to be set into the ground to create raised ground between the complex and the N14 to assist in visual screening of the lower complements of the smelter complex. Excess material should be stockpiled to the north of the cut platform and shaped into a low screening berm. The berms should be naturally shaped with crests rounded off and rehabilitated to natural veld grass (as far as possible).
- Rehabilitate all disturbed areas as soon as possible after construction is complete in an area.
- If very dry conditions prevail and dust becomes a nuisance, water should be sprayed on the road surface or areas cleared of vegetation (or other dust suppression measures implemented), without creating undue runoff.
- Although the gradients are flat, the hardened surfaces could lead to erosion. Soil stabilisation measures need to be implemented as soon as possible to ensure that erosion does not take place.
- The construction sites should be kept neat and tidy at all times with litter and dust management measures in place.
- Visually cluttered material storage yards and laydown areas should be screened through the use of material fencing.
- As far as possible, and within safety limitations, all lights used for illumination should be faced inwards and shielded to avoid light spillage to the surrounding areas.
- Reduce extra lighting by making use of motion detectors on security lighting, in office and maintenance areas.

- Schedule construction commencement as soon as possible after vegetation removal to reduce the amount of time during which surfaces are exposed.
- No large signage or advertising should be painted onto the cladding or roof sheeting.
- Other than required aircraft warning colours specified, stacks that are metal should be painted a mid-grey colour.
- For aircraft warning on the tall stack, flashing lights (white during day, red at night) on the stack is preferable to painting the top of the stack red. However, if aircraft warning regulations stipulate that the top portion of the stack is to be painted, white is preferable to red (if there is a colour preference).

Monitoring

The following monitoring is recommended:

- Visual inspections should be undertaken on a daily basis during the construction phase.

19.2.2 Operational Phase

Potential Impacts

A viewshed analysis was undertaken to ascertain the approximate zone of visual influence that the proposed smelter complex would have in the surrounding landscape. Within the 2 km High Exposure areas, the smelter complex would be clearly visible, with views limited to the south by the Gamsberg Mountain, to the east by undulating terrain and to the north and west by smaller hill features. Within the 6 km to 12 km distance range, views of the smelter complex would mainly be obscured by topography, with a small exception to the northeast. Beyond the 12 km, the viewshed extends mainly to the southwest over gently undulating terrain, as well as catching higher elevation portions of local mountains. Due to the fragmentation of the viewshed by undulating terrain and mountain features, the zone of visual influence is likely to be contained within the 6 km area. As such, the visual influence of the smelter complex is defined as localised (Figure 19-1). In terms of the stack, the viewshed model made use of 80 m above ground as the viewshed offset height (therefore the worst case scenario as stack is proposed to be 70 m in height) (Figure 19-2). The visibility of the stack to the east is likely to be contained just past the 8 km distance mark. As with the plant viewshed, fragmentation of the viewshed by undulating terrain and mountain features does influence the spread of the viewshed. However, as the stack is much higher (and with the added height of the plume), the zone of visual influence is likely to extend beyond the 12 km.

Five receptor locations were identified with four points fulfilling key observation point (KOP) status. The Aggeneys KOP is a residential area and, although a mining town, is not highly exposed to mining landscapes from this locality. Maintaining this precedence increases the opportunities for future tourism. The other KOPs are all related to the N14 National Route (Figure 19-3).

While the existing mining landscape does increase the visual carrying capacity for industrial type landscape modifications, strong reflecting colours and texture and light spillage are likely to increase the visual intensity of the landscape change and detract from the local sense of place.

Operational phase visual impacts have been identified as the following:

- Increased vehicular activity in the vicinity;
- Light at night from night-time operations and security measures;
- Possible continued use of large cranes for lifting of heavy equipment;

- Operation of a large-scale industrial node that would include large structures, tall stacks, smoke plumes as well as the release of gases; and
- Aircraft warning lights on the top of the stack.

Without mitigation the intensity of the operational phase of the smelter complex is likely to be high due to strong contrast generated by bright cladding and roofing colours, highly reflective materials and light spillage which would be visible far beyond the site boundary (up to 24 km) (Figure 19-4 and Figure 19-5). The impact would be felt over the long-term and thus the significance prior to mitigation is assessed to be HIGH. With the implementation of mitigation measures the impact can be reduced to MEDIUM (Table 19-2).

Table 19-2: Impact Summary – Change in Landscape and Related Visual Impacts due to the Smelter Complex during Operational Phase

Issue: Change in Landscape and Related Visual Impacts due to the Smelter Complex		
Phases: Operational Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Major change or disturbance (H)	Moderate change or disturbance (M)
Duration	Long-term (H)	Long-term (H)
Extent	Local area, extending far beyond site (H)	Local area, extending far beyond site (H)
Consequence	High (H)	High (H)
Probability	Probable (H)	Possible (M)
Significance	High (H)	Medium (M)
Nature of cumulative impacts	Currently due to the other mining infrastructure in the vicinity of the Gamsberg Smelter Project the cumulative impact is likely to be LOW. However, should other industries be attracted to the area due to the smelter operations, the future cumulative visual impact could increase significantly. This would be exacerbated considering the generally flat topography and desert like conditions, as well as that the N14 Highway passes right next to the Gamsberg Zinc Mine thus maximising the visual impact.	
Degree to which impact can be reversed	High once the smelter complex has been decommissioned and the site rehabilitated.	
Degree to which impact may cause irreplaceable loss of resources	Low as the smelter complex would be removed at decommissioning and the site rehabilitated.	
Residual impacts	The residual impact for the smelter complex is considered to be MEDIUM.	

Mitigation/ Enhancement Measures

The following measures are recommended:

- Adopt responsible operational practices aimed at containing the operational activities to specifically demarcated areas thereby limiting the need to expand the operational footprint and further removal of natural vegetation.
- Continued rehabilitation of all disturbed areas to acceptable visual standards as soon as possible.

- If very dry conditions prevail and dust becomes a nuisance, water should be sprayed on the road surface or other dust suppression measures implemented, without creating undue runoff.
- The sites should be kept neat and tidy at all times with litter and dust management measures in place.
- Visually cluttered material storage yards and laydown areas should be screened through the use of material fencing.

Monitoring

The following monitoring is recommended:

- Visual inspections should be undertaken on a weekly basis during the operational phase.

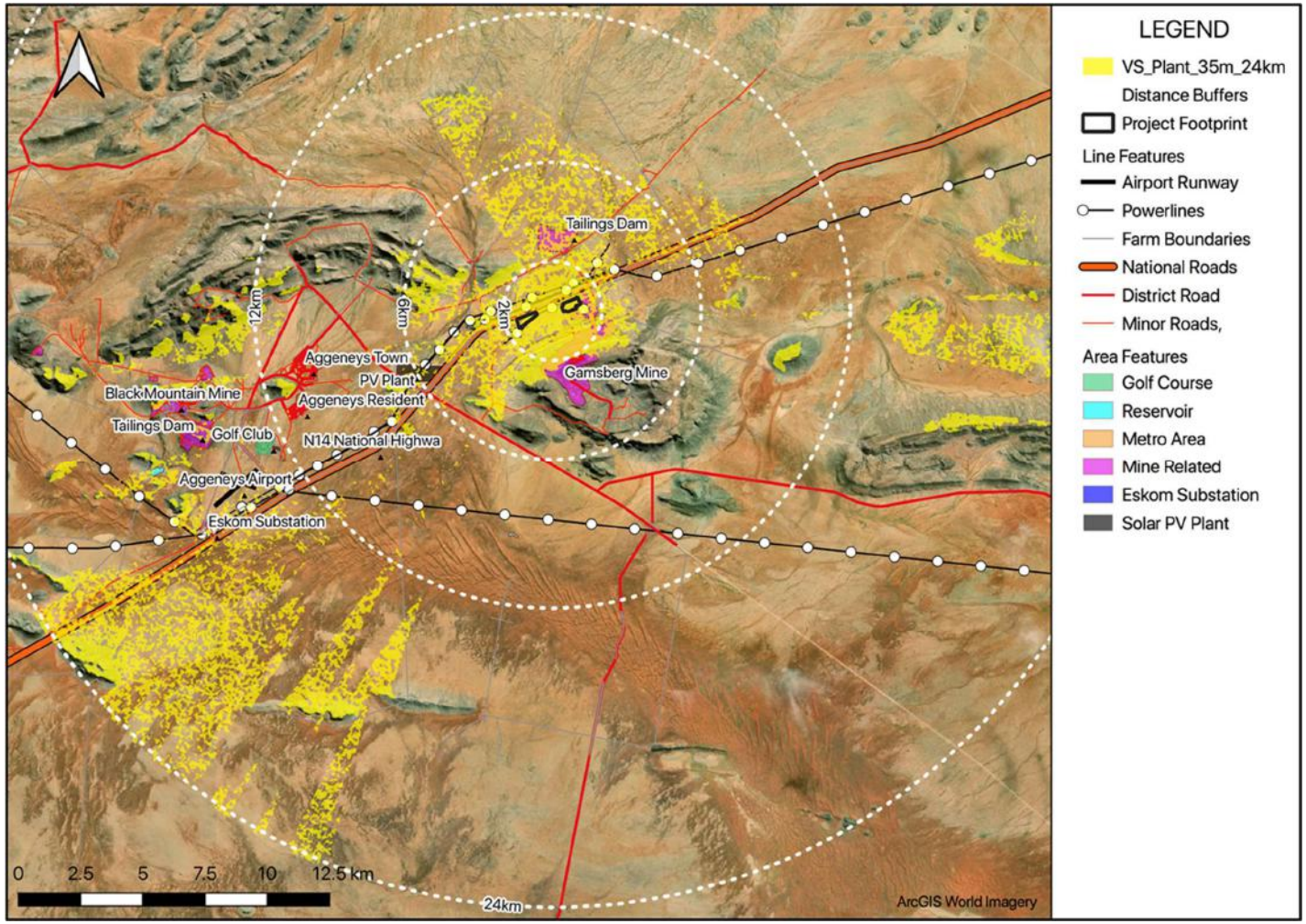

Figure 19-1 Proposed viewshed for the 35m smelter complex

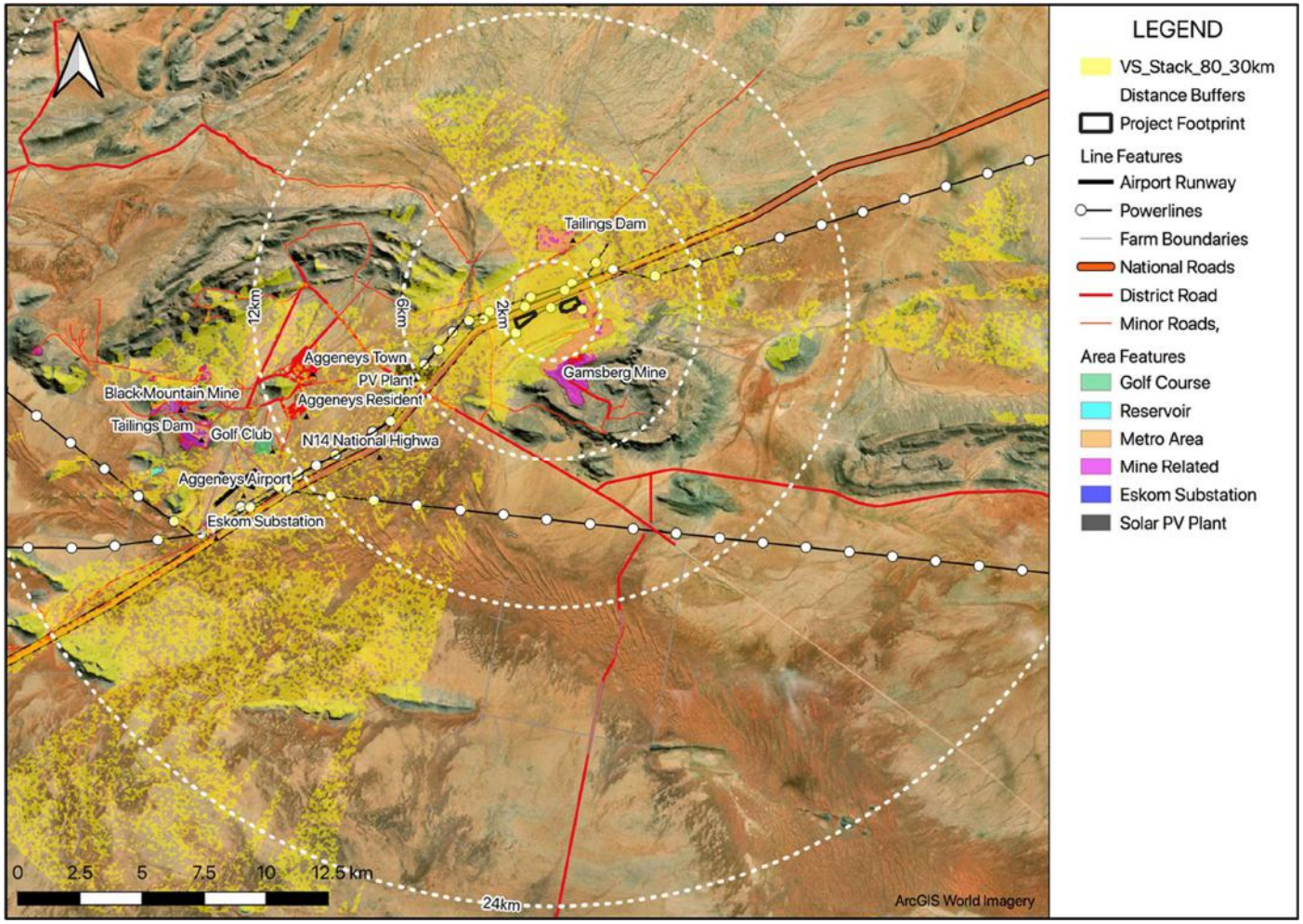

Figure 19-2 Proposed viewshed for the 80m stack

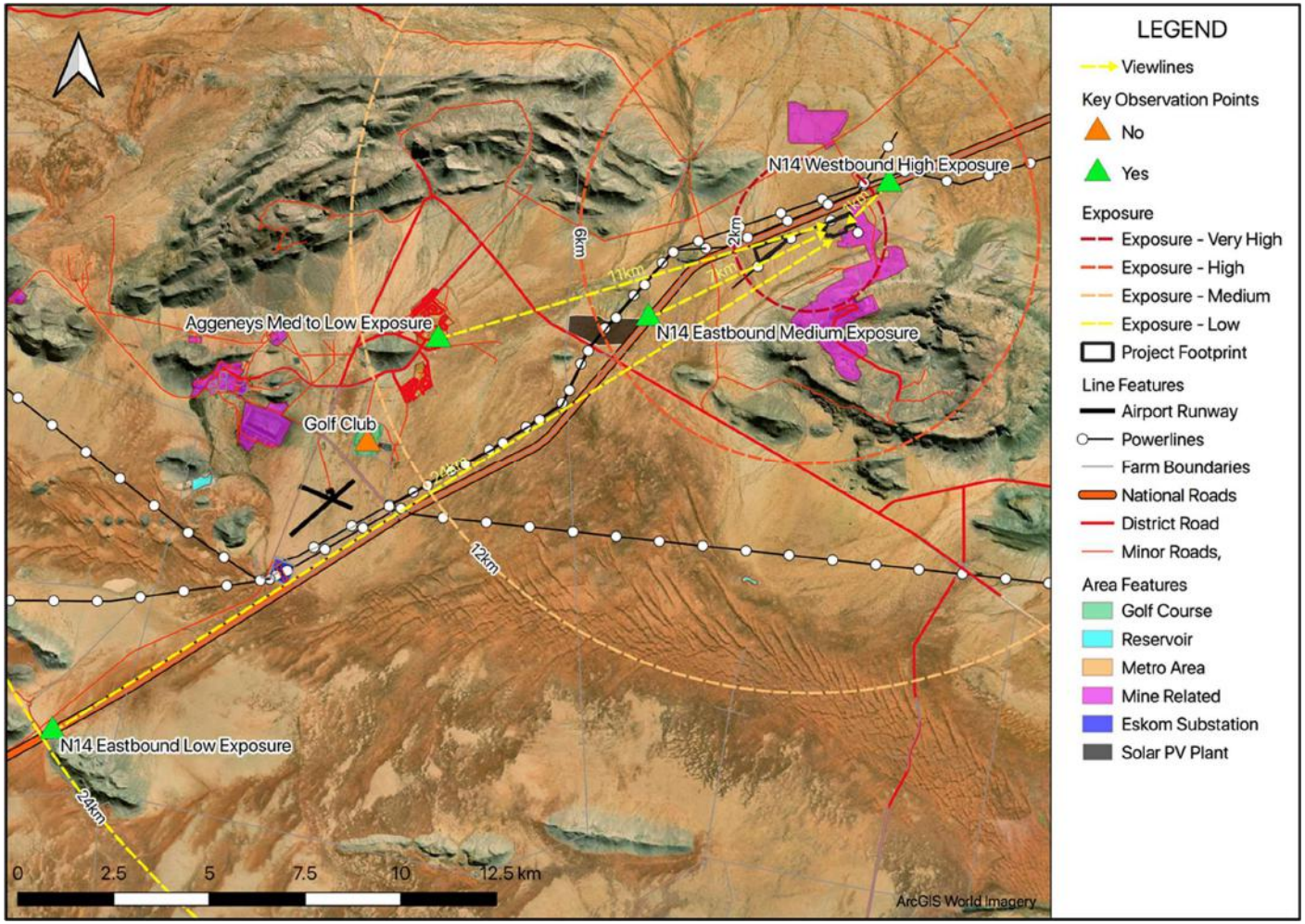

Figure 19-3 Project Receptor Exposure and KOP Location Map

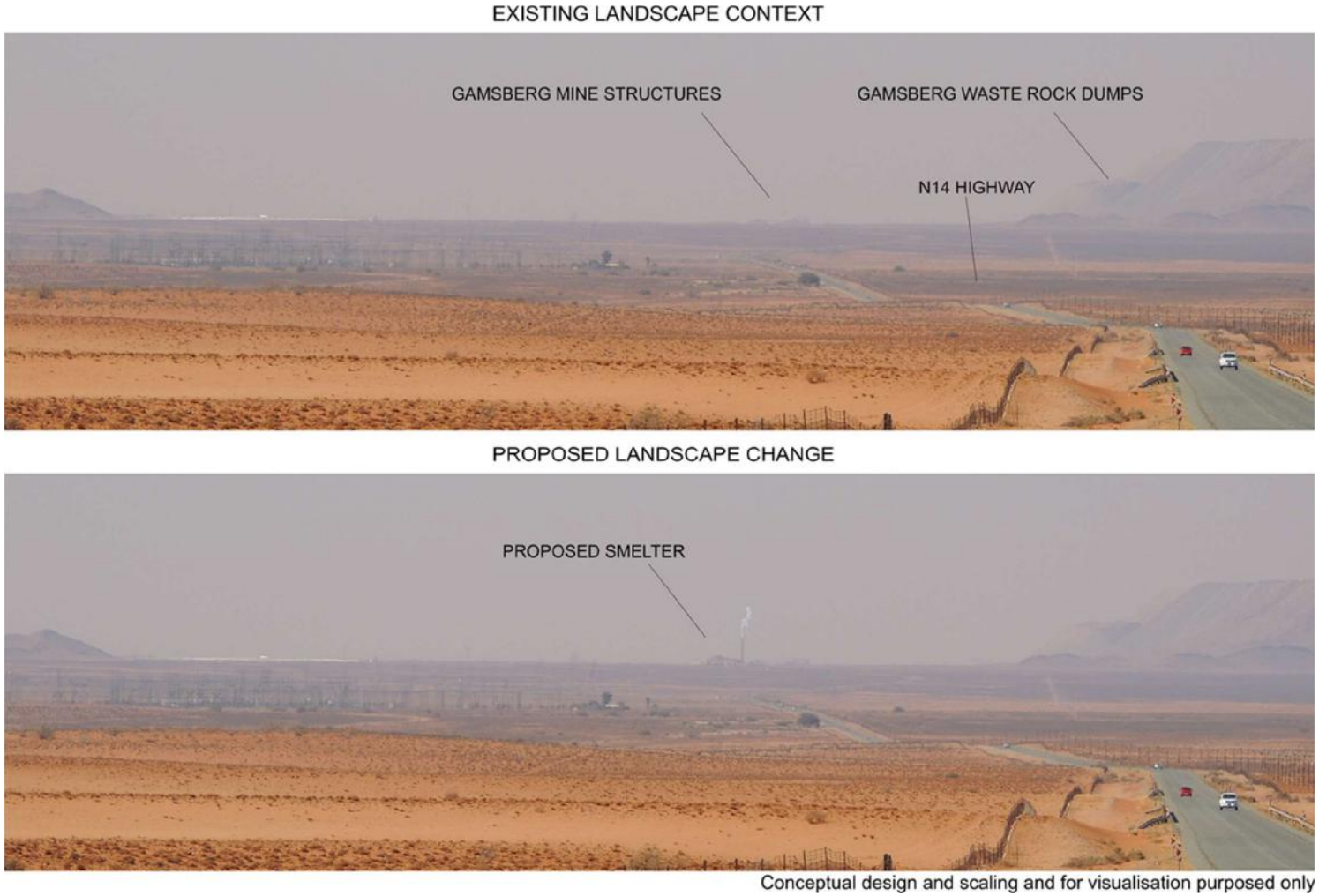

Figure 19-4 Existing and Proposed View from the N14 National Highway 24km to the West of the Smelter Site

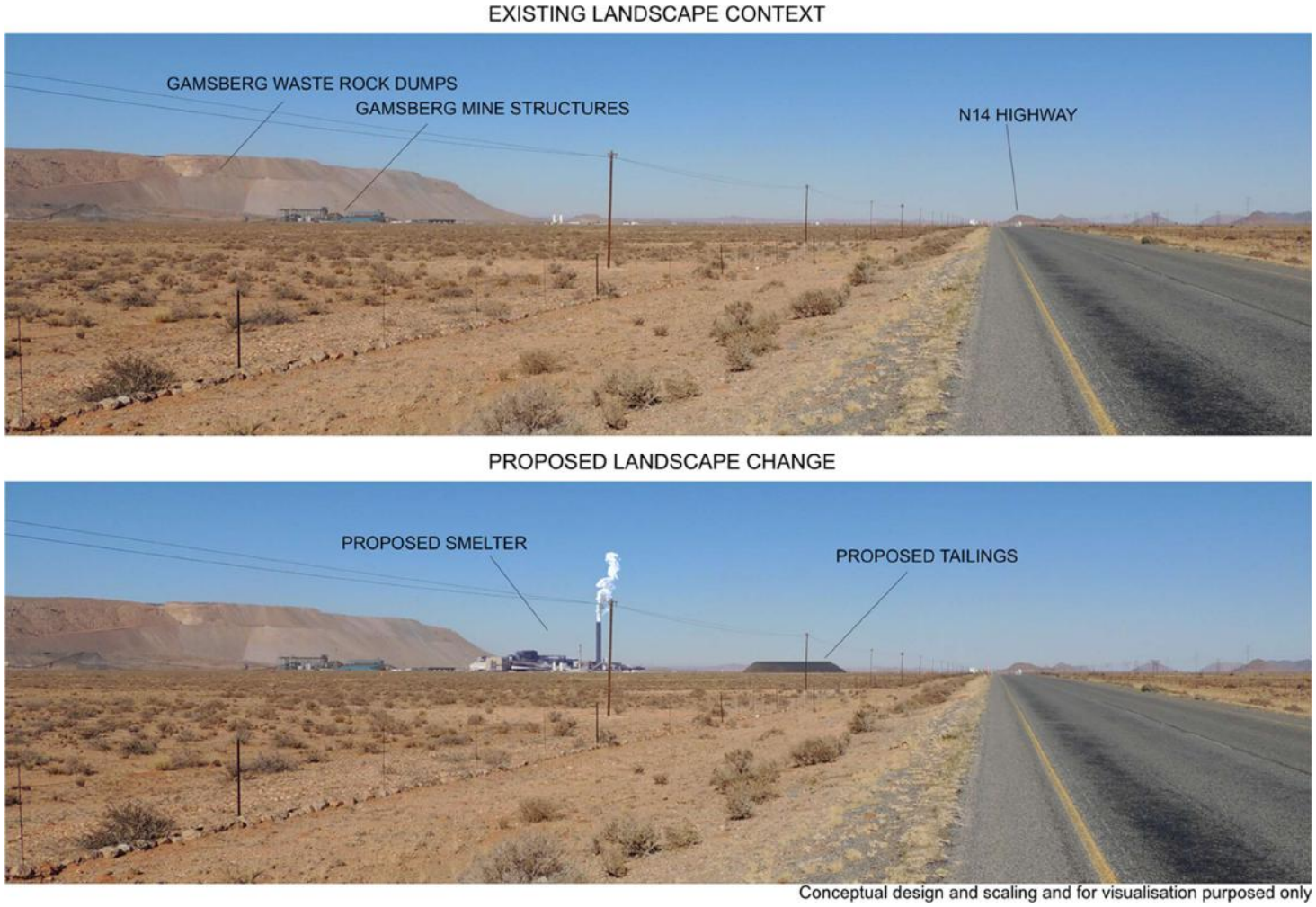

Figure 19-5 Existing and Proposed View from the N14 National Highway 1km to the East of the Smelter Site

19.2.3 Decommissioning/ Closure Phase

Potential Impacts

Once the operational phase has been completed the smelter complex should be fully decommissioned and removed from the site. The impact, should this not happen, remains very high as the visual impact would continue until the infrastructure is removed.

Decommissioning/ closure phase visual impacts have been identified as the following:

- Increased vehicular movement in the vicinity for the decommissioning;
- Possible use of large cranes for lifting of heavy equipment; and
- Dust from controlled implosion and moving vehicles.

Should the decommissioning and ultimate removal of the smelter complex infrastructure from the site not be undertaken, the significance would remain HIGH. However, if the materials are deconstructed and removed the visual impact would be reduced to a VERY LOW significance (Table 19-3).

Table 19-3: Impact summary – Change in Landscape and Related Visual Impacts due to the Smelter Complex during Decommissioning/ Closure Phase

Issue: Change in Landscape and Related Visual Impacts due to the Smelter Complex		
Phases: Decommissioning/ Closure Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Major change or disturbance (H)	Minor change or disturbance (L)
Duration	Long-term (H)	Short-term (L)
Extent	Local area, extending far beyond site (H)	Whole site (L)
Consequence	High (H)	Low (L)
Probability	Definite (VH)	Conceivable (L)
Significance	High (H)	Very Low (VL)
Nature of cumulative impacts	If the smelter complex is decommissioned and removed from the site the cumulative impact would be VERY LOW.	
Degree to which impact can be reversed	High as the smelter complex can be decommissioned and the landscape returned to pre-smelter conditions.	
Degree to which impact may cause irreplaceable loss of resources	Low as the smelter complex would be removed at decommissioning and the site rehabilitated.	
Residual impacts	The residual impact for the smelter complex is considered to be VERY LOW.	

Mitigation/ Enhancement Measures

The following measures are recommended:

- Breaking down/ removal and processing of all structures and stacks constructed for the operational phase must be undertaken. Rubble generated from the deconstruction should be spread across the cut platform (unless contaminated) and covered with the excess cut material stockpiles. Any contaminated

material would need to be processed in terms of applicable South African waste management Norms and Standards.

- For all tarred roads, the tarred sections must be rehabilitated as per the Closure Plan and tar removed as far as possible. The road should be ripped to 0.5m below surface to reduce compaction prior to rehabilitation.
- Rehabilitation of all disturbed areas should be undertaken as soon as possible after deconstruction is complete in an area.
- If during deconstruction, very dry conditions prevail and dust becomes a nuisance, water should be sprayed on the road surface or other dust suppression measures implemented, without creating undue runoff.
- Although the gradients are flat, the hardened surfaces could lead to erosion. Soil stabilisation measures should be implemented to ensure that erosion does not take place.
- The deconstruction sites should be kept neat and tidy at all times with litter and dust management measures in place at all times.
- As far as possible and within safety limitations, all lights used for illumination during deconstruction should be faced inwards and shielded to avoid light spillage to the surrounding areas.

Monitoring

The following monitoring is recommended:

- Visual inspections should be undertaken on a daily basis during the decommissioning phase.

20. ISSUE 20 IMPACT ON LANDSCAPE AND RELATED VISUAL IMPACTS DUE TO THE SECURED LANDFILL FACILITY

20.1 DESCRIPTION OF IMPACT

See Description of Impact in Section 19.1.

20.2 IMPACT ASSESSMENT

20.2.1 Construction Phase

Potential Impacts

The area identified for the construction of the secured landfill facility is within the Gamsberg Zinc Mine MRA and in close proximity to the existing operations.

The following impacts have been identified for the construction phase:

- Removal of vegetation leading to increased visual contrast, degradation of the landscape character and visual intrusion to sensitive receptors;
- Alteration of surface topography as a result of infrastructure placement and positioning of the secured landfill facility, leading to loss of visual quality and a negative impact to the sense of place;
- Construction-related earthworks resulting in increased dust; and

- Light at night from night-time construction activities and security.

The construction of the secured landfill facility is short-term and the intensity is assumed to be moderate. The extent could be felt slightly beyond the MRA and as such the overall significance is determined to be MEDIUM. Visual impact mitigation is largely limited to dust suppression and as such the residual impact for the construction phase would remain MEDIUM (Table 20-1).

Table 20-1: Impact Summary – Change in Landscape and Related Visual Impacts due to the Secured Landfill Facility during Construction Phase

Issue: Change in Landscape and Related Visual Impacts due to the Secured Landfill Facility		
Phases: Construction Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate change or disturbance (M)	Moderate change or disturbance (M)
Duration	Short-term (L)	Short-term (L)
Extent	Beyond the site boundary, affecting immediate neighbours (M)	Beyond the site boundary, affecting immediate neighbours (M)
Consequence	Medium (M)	Medium (M)
Probability	Probable (H)	Probable (H)
Significance	Medium (M)	Medium (M)
Nature of cumulative impacts	The construction of the additional Gamsberg Mine concentrator plant is likely to begin late 2020/ beginning 2021, there is thus the possibility that the construction phases could to some extent overlap. However, due to the short duration of the construction phases the cumulative impact is considered to be LOW.	
Degree to which impact can be reversed	Low as the secured landfill facility would be a permanent feature in the landscape.	
Degree to which impact may cause irreplaceable loss of resources	The secured landfill facility would be a permanent feature in the landscape post closure and as such the visual impacts would remain.	
Residual impacts	The residual impact is considered to be MEDIUM.	

Mitigation/ Enhancement Measures

The following measures are recommended:

- Contain construction activities within specifically demarcated areas thereby limiting the removal of natural vegetation.
- Rehabilitate all disturbed areas as soon as possible after construction is complete.
- Dust suppression measures should be implemented as required, without creating undue runoff.
- Implement soil stabilisation measures and concurrent rehabilitation to minimise erosion and associated visual impacts.
- The site should be kept neat and tidy at all times with litter and dust management measures in place.
- Visually cluttered material storage yards and laydown areas should be screened through the use of material fencing and not be located between the secured landfill facility and the N14 National Highway.

- Lighting should be checked on a bi-annual basis by the Environmental Control Officer (ECO) to ensure that undue light spillage is contained.

Monitoring

The following monitoring is recommended:

- Visual inspections should be undertaken on a daily basis during the construction phase.

20.2.2 Operational and Closure Phases

Potential Impacts

The following potential impacts have been determined for the operational and closure phases (these phases have been combined as visual mitigation of the secured landfill facility is limited):

- Light at night from night-time operations and security measures;
- Possible continued use of heavy equipment for raising of retaining walls; and
- Raising of the secured landfill facility creating a pyramidal shape form with a uniform colour that is likely to generate strong levels of contrast as seen by the adjacent N14 National Road users.

The presence of the secured landfill facility would be permanent feature in the landscape and would be visible from beyond the site boundary. The significance of the impact is thus assessed to be HIGH. Beyond some rehabilitation of the surface of the secured landfill facility there is little mitigation that can be implemented to reduce the impacts. The residual impact is thus also HIGH (Table 20-2).

Table 20-2: Impact summary – Change in Landscape and Related Visual Impacts due to the Secured Landfill Facility during Operational and Closure Phases

Issue: Change in Landscape and Related Visual Impacts due to the Secured Landfill Facility		
Phases: Operational and Closure Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Prominent change or disturbance (H)	Prominent change or disturbance (H)
Duration	Permanent (VH)	Permanent (L)
Extent	Local area, extending far beyond boundary (H)	Local area, extending far beyond boundary (H)
Consequence	Very High (VH)	Very High (VH)
Probability	Possible (M)	Possible (M)
Significance	High (H)	High (H)
Nature of cumulative impacts	Without mitigation there would be a permanent, residual visual impact that will detract from the N14 National Road scenic quality. As the N14 is identified in local and regional planning documents as an import tourist view corridor, the secured landfill facility in this locality is likely to result in a permanent degradation of this section of the N14 National Road. The cumulative impact along with the Waste Rock Dumps (WRDs) is likely to result in a MEDIUM cumulative impact.	
Degree to which impact can be reversed	Low as the secured landfill facility will become a permanent feature in the landscape.	
Degree to which impact may cause irreplaceable loss of resources	Medium, as the secured landfill facility will remain as a permanent feature, however, this will be in the context of the modified topography due to the Gamsberg Zinc Mine structures, such as the WRDs.	
Residual impacts	The secured landfill facility would remain as a prominent feature in the landscape and as such is considered as a HIGH residual impact.	

Mitigation/ Enhancement Measures

The following measures are recommended:

- Adopt responsible operational practices aimed at containing the operational activities to specifically demarcated areas thereby limiting the need to expand the operational footprint and further removal of natural vegetation.
- Continued rehabilitation of all disturbed areas as soon as possible after activities are complete.
- Dust suppression measures should be implemented as required on road surfaces or other areas, without creating undue runoff.
- The site should be kept neat and tidy at all times with litter and dust management measures in place.
- Visually cluttered material storage yards and laydown areas should be screened through the use of material fencing and not be located between the secured landfill facility and the N14 National Highway.
- Lighting should be checked on a bi-annual basis by the ECO to ensure that undue light spillage is contained.

Monitoring

The following monitoring is recommended:

- Visual inspections should be undertaken on a regular basis during the operational and closure phases.

21. ISSUE 21 IMPACT OF THE PROJECT ON CLIMATE CHANGE

21.1 DESCRIPTION OF IMPACT

The greenhouse gas (GHG) emission impacts of the proposed Gamsberg Smelter Project are analysed in terms of both South Africa's national GHG inventory and climate change, as well as the global inventory and climate change. The impact on South Africa's inventory is the departure point for this assessment because the inventory is one of the tools which government uses to determine national and sectoral GHG mitigation targets, which are set within the context of the global emissions inventory and climate change.

The proposed Gamsberg Smelter Project's construction and operational GHG emissions are summarised below (Table 21-1). The emissions are grouped into direct (scope 1), indirect (scope 2) and other indirect (scope 3) sources for both phases of the project's lifetime.

Table 21-1 Summary of the GHG emissions calculated for the proposed Gamsberg Smelter Project

Emission categories	Total (construction and operations)	Construction (for whole construction period)	Operations (over the life of project)
Direct (Scope 1) Emissions	62 340 tCO_{2e}	12 598 tCO_{2e}	49 742 tCO_{2e}
Indirect (Scope 2) Emissions	21 636 859 tCO_{2e}	4 859 tCO_{2e}	21 632 000 tCO_{2e}
Other Indirect (Scope 3) Emissions	2 890 653 tCO_{2e}	88 486 tCO_{2e}	2 802 167 tCO_{2e}
Total Emissions	24 589 852 tCO_{2e}	105 942 tCO_{2e}	24 483 909 tCO_{2e}

The proposed Gamsberg Smelter Project is expected to generate approximately 62 340 tonnes of carbon dioxide equivalent (tCO_2e) of direct emissions over the proposed smelter's lifetime, which is approximately 0.3% of the total calculated emissions. The direct emissions are from the combustion of diesel and are considered to be within the direct control of the proposed Gamsberg Smelter Project. The bulk (99.7%) of the proposed Gamsberg smelter's lifetime emissions are, however, categorised as indirect emissions which arise during the operations phase.

Emissions from the consumption of grid-based electricity (energy indirect emissions) during operations accounts for the majority (87.9%) of the project's lifetime emissions. The bulk of the other indirect emissions (scope 3) arise from fuel and energy related activities as a result of the large electricity consumption.

Some activity and technological alternative scenarios have been considered as part of the proposed Gamsberg Smelter Project's environmental authorisation application to the DMRE. Therefore, an alternative GHG inventory scenario has been calculated. The layout alternatives of the proposed Gamsberg Smelter Project do not impact on the project's GHG inventory. The scenarios relate to the percentage of electricity consumption sourced from renewable energy. The results of these scenarios can be seen in Table 21-2.

Table 21-2 Renewable Energy Scenarios - Emissions

	30% Renewable	50% Renewable	90% Renewable	100% Renewable
Total electricity consumption	20 800 GWh	20 800 GWh	20 800 GWh	20 800 GWh
Electricity consumed from renewables	6 240 GWh	10 400 GWh	18 720 GWh	20 800 GWh
Electricity consumed from Eskom	14 560 GWh	10 400 GWh	2 080 GWh	-
Scope 1 emissions (Construction)	12 598 tCO_2e	12 598 tCO_2e	12 598 tCO_2e	12 598 tCO_2e
Scope 1 emissions (Operation)	49 742 tCO_2e	49 742 tCO_2e	49 742 tCO_2e	49 742 tCO_2e
Scope 2 emissions (Construction)	4 859 tCO_2e	4 859 tCO_2e	4 859 tCO_2e	4 859 tCO_2e
Scope 2 emissions (Operation)	15 142 400 tCO_2e	10 816 000 tCO_2e	2 163 200 tCO_2e	-
Scope 3 emissions (Construction)	88 486 tCO_2e	88 486 tCO_2e	88 486 tCO_2e	88 486 tCO_2e
Scope 3 emissions (Operation)	2 105 056 tCO_2e	1 640 316 tCO_2e	710 834 tCO_2e	478 464 tCO_2e
Total emissions	**17 403 141 tCO_2e**	**12 612 000 tCO_2e**	**3 029 719 tCO_2e**	**634 148 tCO_2e**

To gain a comprehensive understanding of the impacts of the proposed Gamsberg Smelter Project's emissions, one must consider the emissions within the context of the national and international GHG reduction plans.

South African Context

The Intergovernmental Panel on Climate Change (IPCC's) Fifth Assessment Report[1] indicates that in order to limit the effects of climate change to a 2°C average temperature increase, the world can emit 1 010 gigatons of CO_2e from 2012 onwards. This figure is termed the global carbon budget. South Africa's share of this budget can be calculated based on the national population as a percentage of the global population. According to Stats SA in 2018[2], the national population was 58 million people while the global population is 7.7 billion people[3]. South Africa's carbon budget is therefore roughly 7 572 Mt CO_2e.

[1] DEA, 2017a. South Africa's Third National Communication under the United Nations Framework Convention on Climate Change, Pretoria: Department of Environmental Affairs.

[2] Stats SA, 2018. Mid-year population estimates 2018. Available at http://www.statssa.gov.za/?p=11341

[3] Department of Energy, 2016. Integrated Resource Plan Update Assumptions, Base Case Results and Observations [Online]., Pretoria: Department of Energy.

The following impact ratings have been identified as a means of benchmarking GHG inventories, over the lifetime of the specific activity, regarding emissions occurring within the boundary of South Africa:

- Low (inventory of 10 thousand tCO_2e): 0.00013% of South Africa's carbon budget;
- Medium (inventory of 1 million tCO_2e): 0.013% of South Africa's carbon budget; and
- High (inventory of 10 million tCO_2e): 0.13% of South Africa's carbon budget.

The proposed Gamsberg Smelter Project's calculated emissions inventory in terms of South Africa's remaining portion of the global carbon budget is presented in Table 21-3.

Table 21-3 The Gamsberg Smelter Project's emissions relative to South Africa's carbon budget

Category	Emissions	Percentage
South Africa's carbon budget	7 572 $MtCO_2e$	
Scope 1 and 2 emissions (project life)	21.7 $MtCO_2e$	0.29% of SA's carbon budget
Scope 1, 2 and 3 emissions (project life)	24.6 $MtCO_2e$	0.32% of SA's carbon budget

The impact of the proposed Gamsberg Smelter's GHG inventory is considered to be high due to the total inventory being approximately 0.2% of South Africa's carbon budget.

The emission intensity of zinc produced in proposed Gamsberg Smelter Project is shown in Table 21-4.

Table 21-4 Emission Intensities from Project

Emission source	Intensity	International benchmark
Scope 1 emissions	0.015 tCO_2e/tonne zinc	0.002 - 0.030 tCO_2e/tonne zinc[4]
Scope 2 emissions	6.7 tCO_2e/tonne zinc	1.8 – 4.6 tCO_2e/tonne zinc[5]
Scope 3 emissions	0.86 tCO_2e/tonne zinc	Not quoted

Table 21-4 shows that the direct emission from the proposed Gamsberg Smelter Project will be in the range of internationally accepted values. The same is not true for the energy indirect emissions (Scope 2), but this should be seen in the context that the South African electricity grid has a very high emission factor. Should the proposed Gamsberg Smelter Project be able to access lower emission electricity, the energy indirect (Scope 2) emissions can come down significantly. The impact of sourcing electricity from renewable sources on the scope 2 and 3 intensities are shown in Table 21-5.

[4] Methodology for the free allocation of emission allowances in the EU ETS post 2012, Sector report for the non-ferrous metals industry, By order of the European Commission, Study Contract: 07.0307/2008/515770/ETU/C2
[5] Bosch P, Kuenen J, GHG efficiency of industrial activities in EU and Non-EU, TNO report, TN0-034-UT-2009-01420 RPT-ML

Table 21-5 Renewable Energy Scenarios - Emission intensities

	30% Renewable	50% Renewable	90% Renewable	100% Renewable
Scope 2 intensity	4.66 tCO_2e/tonne zinc	3.33 tCO_2e/tonne zinc	0.7 tCO_2e/ tonne zinc	0 tCO_2e/ tonne zinc
Scope 3 intensity	0.65 tCO_2e/tonne zinc	0.5 tCO_2e/tonne zinc	0.2 tCO_2e/ tonne zinc	0.15 tCO_2e/tonne zinc

21.2 IMPACT ASSESSMENT

21.2.1 Construction Phase

Potential Impacts

The GHG emissions produced as a result of the construction phase would contribute to the global phenomenon of anthropogenic climate change. Numerous global changes are likely to manifest due to climate change, although none that can be attributed directly or indirectly to the specific GHG emissions of any individual source, such as the proposed Gamsberg Smelter Project. The total Scope 1 and 2 emissions from the construction phase of the project are calculated to be 17 456 tCO_2e, which is 0.002% of the South African carbon budget of 7 572 $MtCO_2e$. The total emissions from the Gamsberg Smelter Project's construction are therefore between the 0.00013% 'low' rating threshold and the 0.013% 'medium' rating in relation to the national carbon budget.

The majority of the emissions during the construction phase are generated from the combustion of diesel by vehicles and machinery.

The impact of GHGs in the atmosphere on climate change during the construction phase would continue over the short-term (although the impact would be permanent) and can have an impact on a regional/ international scale. The consequence is thus low to medium resulting in a LOW to MEDIUM overall significance, even with mitigation measures implemented (Table 21-6).

Table 21-6: Impact summary – Impact of the Project on Climate Change during Construction Phase

Issue: Impact of the Project on Climate Change		
Phases: Construction Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Negligible to Minor (VL-L)	Negligible to Minor (VL-L)
Duration	Short-term (L)	Short-term (L)
Extent	National/International (VH)	National/International (VH)
Consequence	Low to Medium (L-M)	Low to Medium (L-M)
Probability	Definite (VH)	Definite (VH)
Significance	Low to Medium (L-M)	Low to Medium (L-M)
Nature of cumulative impacts	The emissions from the construction phase of the project are cumulative. The increase of GHGs in the atmosphere lead to an increase in global temperatures and resultant climatic changes. However, due to the short-term of the emissions the cumulative impact is considered to be LOW.	
Degree to which impact can be reversed	Irreversible	
Degree to which impact may cause irreplaceable loss of resources	GHGs have the ability to remain in the atmosphere over significant periods of time and can contribute to the rapid increase in global temperatures.	
Residual impacts	The effects of these emissions are not immediately felt but are residual in that the impacts of climate change, as a result of the proposed Gamsberg Smelter Project's emissions during construction, would remain even after the smelter has been decommissioned. The residual impact is thus LOW to MEDIUM.	

Mitigation/ Enhancement Measures

The following measures are recommended:

- The use of fuel additives which improve fuel economy should be investigated for vehicles and machinery.
- Vehicles and machinery should be regularly serviced to ensure optimal fuel efficiency.

Monitoring

The following monitoring is recommended:

- The proposed Gamsberg Smelter Project should, as part of its continuous GHG assessment and monitoring processes, include an analysis of the trends related to solar technology changes.

21.2.2 Operational Phase

Potential Impacts

The GHG emissions produced as a result of the proposed Gamsberg Smelter's operations will contribute to the global phenomenon of anthropogenic climate change. Numerous global changes are likely to manifest due to climate change, although none that can be attributed directly or indirectly to the specific GHG emissions of any individual source, such as the proposed Gamsberg Smelter. The total Scope 1, 2 and 3 emissions from the operational phase of the smelter are calculated to be 24.4 $MtCO_2e$, which is 0.2% of the South African carbon budget of 7 572 $MtCO_2e$. The total emissions from the smelter's operation are therefore above the 0.13% 'high' rating threshold in relation to the national carbon budget.

The majority of the proposed Gamsberg Smelter Project's operational emissions arise from the use of purchased electricity (Scope 2 emissions).

Currently there are some renewable energy options being considered, however, the impact significance rating would remain "High". Even though the impact rating for the project remains high due to the regional/ international extent of the impact and the permanent duration, the use of renewable energy would significantly mitigate the potential impacts of the project on climate change.

For the purpose of this impact assessment it was assumed that the Gamsberg Smelter Project would be constructed using the most energy efficient technologies available. The intensity is thus assessed to be minor but would have a permanent impact on a regional/ international scale. The Impact is thus assessed to be HIGH prior to and with mitigation (Table 21-7). Should renewable energy be utilised at a later stage it would be possible to reduce the residual impact to some extent.

Table 21-7: Impact Summary – Impact of the Project on Climate Change during Operational Phase

Issue: Impact of the Project on Climate Change		
Phases: Operational Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Low (L)	Low (L)
Duration	Permanent (VH)	Permanent (VH)
Extent	Regional/ International (VH)	Regional/ International (VH)
Consequence	High (H)	High (H)
Probability	Definite (VH)	Probable (H)
Significance	High (H)	High (H)
Nature of cumulative impacts	The emissions from the operational phase of the smelter are cumulative. The increase of GHGs in the atmosphere leads to an increase in global temperatures and resultant climatic changes. The cumulative impact is assessed to be LOW.	
Degree to which impact can be reversed	Irreversible	
Degree to which impact may cause irreplaceable loss of resources	GHGs have the ability to remain in the atmosphere over significant periods of time. This contributes to the rapid increase in global temperatures.	

Residual impacts	The effects of these emissions are not immediately felt but are residual in that the impacts of climate change, as a result of the smelter emissions, would remain even after the various activities within the smelter have been decommissioned. The residual impact is HIGH.

Mitigation/ Enhancement Measures

The following measures are recommended:

- Consider the use of zero emission energy technologies like solar power and energy efficient technologies.

Monitoring

The following monitoring is recommended:

- The proposed Gamsberg Smelter Project should, as part of its continuous GHG assessment and monitoring processes, include an analysis of the trends related to solar technology changes.

Decommissioning Phase

Potential Impacts

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

22. ISSUE 22 IMPACT OF CLIMATE CHANGE ON THE PROJECT

22.1 DESCRIPTION OF IMPACT

Due to the interdisciplinary and cross cutting nature of climate change, climate vulnerability is not limited to direct operations only but includes the social, economic, environmental and institutional contexts that interact with the changing climate. As a result, climate change impacts and risks cut across a number of sectors including the economy, the water sector and social ecosystems.

The Northern Cape is already experiencing detrimental climate change impacts such as drought. The Namakwa District Municipality has acknowledged that climate change poses a significant threat to the development of the region, the environment and its residents. To adequately account for the potential climate change effects in planning processes, companies need to consider how climate related risks and opportunities, as well as the associated impacts, may evolve under different conditions.

The proposed Gamsberg Smelter Project faces a number of climate change related risks across its core operations, value chain, and broader network. The risks are classified as either low or high depending on the emissions scenario.

Emissions scenarios for this report are described by using Representative Concentration Pathways (RCPs) which are scenarios that include time series of emissions and concentrations of GHGs, aerosols and chemically active gases together with land use/land cover. Four RCP's are used in the Fifth IPCC Assessment as a basis for climate predictions and projections. The scenarios include a stringent mitigation scenario (RCP2.6), two intermediate scenarios (RCP4.5 and RCP6.0) and one scenario with high GHG emissions (RCP8.5). RCP2.6 is representative of

a scenario that aims to keep global warming likely below 2°C above pre-industrial temperatures. The two emissions scenarios considered in this assessment are:

- No GHG mitigation scenario RCP 8.5: business as usual or baseline scenario where global average temperatures are expected to increase by 6°C from pre-industrial levels, which could, for example, increase the risk of heat stress; and
- Mitigation scenario RCP 4.5: intermediate measures are put in place with a view to limiting global average temperatures to 2°C.

Focus was placed on these two scenarios due to the fact that the business as usual scenario gives a good indication of how climate change would precipitate as a function of the current conditions. RCP 4.5 was selected as an intermediate scenario with a conservative representation of limited efforts to reduce global average temperatures. This is more consistent with most national policies that aim to effect limited change within one area of national life over a timeframe such as South Africa.

The climate change projections for the Khâi-Ma Local Municipality are provided in Table 22-1.

Table 22-1 Future Climate change within the Gamsberg area[6][7]

Climate change impact	Current	RCP 4.5	RCP 8.5
Temperature	Annual average temperature of 21,6°C for the Gamsberg area.	Average increase of between 2°C and 2.9°C. Average temperatures would increase up to approximately 22.9°C.	Average increase of between 2.6°C and 3.3°C Average temperatures would increase up to approximately 23.3°C.
Very Hot Days (>35°C)	Up to 45 very hot days for the Gamsberg area.	Increase of up to 64 very hot days. This indicates an increase of up to 42%.	Increase of up to 65 very hot days. This indicates an increase of up to 44%.
Rainfall	Mean annual rainfall of 110mm[8]	Annual average rainfall could change between minus 50mm and plus 28mm.	Annual average rainfall could change between minus 72mm and plus 30mm.
		RCP 8.5[9] (Additional resources used)	
Floods Risk	Low flood risk for the Gamsberg area.	Low flood risk for the Gamsberg area.	
Droughts Risk	The Northern Cape region is currently going through a drought period.	There is an increase in drought tendencies projected in the Gamsberg area with extreme drought predicted in Aggeneys high drought risk predicted in Pofadder and medium drought risk predicted in Pella.	

[6] CSIR. 2019. Green Book: Adapting South African settlements to climate change. Available at: www.greenbook.co.za
[7] SAEON. 2019. SA Risk and Vulnerability Atlas Online Spatial Database 2.0. Available at: http://sarva2.dirisa.org/atlas
[8] ERM, 2013. Climate change specialist Study, Vendanta Gamseberg ESIA.
[9] Floods, drought and fires are the most destructive and have the greatest environmental and social impact. RCP 8.5 scenario was selected to give a good indication of how climate change would precipitate as a function of the current conditions under these three aspects. Providing a current and worst case scenario will help to provide a more conservative approach upon which actions can be based.

Climate change impact	Current	RCP 4.5	RCP 8.5
Fire Risk	Isolated fire incidence is considered rare for the majority of the area.	The towns of Aggeneys, Pella and Pofadder all show a slight increase in fire risk.	

22.2 IMPACT ASSESSMENT

22.2.1 Construction and Operational Phase

Potential Impacts

The impacts of climate change are discussed in relation to the proposed Gamsberg Smelter Project core operations, value chain, social environment and the natural environment by considering changes in temperature and water. The main impacts that have been identified are:

- The Gamsberg area is expected to see a very high increase in average temperature of between 2˚C and 3.3˚C by 2050 which will pose a significant concern in terms of heat stress for humans and machinery. Additionally, an increase in the number of very hot days (>35˚C) will further necessitate an increased cooling demand which will need to be adequately managed to ensure productivity is maintained.
- Water is of concern. Projections indicate water supply to decrease for the majority of the Orange River Basin area while demand is projected to increase particularly in the northern and eastern areas of the basin. This results in much of the eastern regions of the catchment indicating an increase in overall water stress by between 1.4 and 2 times the baseline status. These projections are likely to result in dry periods that will impact water flow in the Orange River and can impact water supply both in terms of quantity and quality for the proposed Gamsberg Smelter Project.
- The Succulent Karoo Biome and Nama Karoo Biome surrounding the Gamsberg area are expected to experience increased pressure in terms of biome shift towards Desert Biome conditions. These conditions will increase the risk of biodiversity loss as these conditions do not favour growth conditions for succulent plant species which are currently endemic to the area. Offsetting species of concern will thus become more challenging.
- The Khâi-Ma and Nama Khoi Local Municipalities have a vulnerable population. Poverty rates within these municipalities are high, highlighting a large proportion of individuals who cannot afford sufficient quantities of food to sustain a healthy lifestyle and thereby illustrating a low adaptive capacity to the disruptive impacts of climate change such as drought.

Table 22-2 summarises the potential impacts of climate change on the core operations, value chain, social environment and natural environment in terms of exposure, sensitivity, adaptive capacity and vulnerability for both temperature and water. Table 22-3 explains the rating system used for this assessment.

Table 22-2: Impact summary – Impact of Climate Change on the Project during Construction and Operational Phases

Key Areas	Exposure	Sensitivity	Adaptive Capacity	Vulnerability
Temperature				
Core operations	High	High	High	High
Value chain	Medium	Medium	Low	Medium
Social environment	High	Medium	Low	High
Natural environment	High	Medium	Medium	Medium
Water				
Core operations	High	High	Low	High
Value chain	High	High	Low	High
Social environment	High	High	Low	High
Natural environment	High	High	Low	High

Table 22-3 Exposure, Sensitivity and Adaptive Capacity Ratings

Impact	Definition	Impact
Exposure, sensitivity and vulnerability		Adaptive capacity
High	Aspect of Climate Change likely to result in prominent impact associated with significant consequences to site operations/value change/broader community. Significant susceptibility to the effects of climate change and climate variability due to a prominent magnitude and rate of change in climate.	Low
Medium	Aspect of Climate Change likely to result in moderate impact associated with material consequences to site operations/value change/broader community. Moderate susceptibility to the effects of climate change and climate variability due to a material magnitude and rate of change in climate.	Medium
Low	Aspect of Climate Change likely to result in a minor impact associated with insignificant consequences to site operations/value change/broader community. Minor susceptibility to the effects of climate change and climate variability due to an insignificant magnitude and rate of change in climate.	High

Mitigation/ Enhancement Measures

Due to the potential exacerbation of the various social and environmental impacts of the proposed Gamsberg Smelter Project's activities as a result of climate change, the following measures are recommended:

- The Social and Labour Plan (SLP) – Climate change can significantly impact the socio-economic conditions under which the surrounding communities live. The SLP should therefore consider the impacts of climate change on its workforce, immediate local communities and its potential to support climate resilience in the local municipality.
- Closure and Rehabilitation Plan – An extensive and ambitious rehabilitation plan should be developed which refers to both concurrent biodiversity offsetting and post-operational rehabilitation measures which shall be implemented by the project owners. The closure plan and rehabilitation strategies must therefore consider climate change and climate modelling and the potential impacts thereof. These measures should make consistent reference to the predicted climate change impacts which are anticipated to affect the project areas and the possible adaptation measures proposed.

Monitoring

No monitoring is required.

B) IMPACT ON SOCIO-ECONOMIC ENVIRONMENT

23. ISSUE 23 IMPACT ON THE ECONOMY AS A RESULT OF PROJECT EXPENDITURE

23.1 DESCRIPTION OF IMPACT

The construction and operational phases of the Gamsberg Smelter Project would result in spending injections that would lead to increased economic activity and associated incomes in the local area and region.

Spending by the Gamberg Smelter Project would be new spending as it would not displace or substitute for spending by other companies given that that there are no other existing competing production facilities in the country. All expenditures would lead to linked direct, indirect and induced impacts on employment and incomes.

23.2 IMPACT ASSESSMENT

23.2.1 Construction Phase

Potential Impacts

Construction expenditure would constitute a positive injection of new investment. The Gamberg Smelter Project's preliminary estimates indicate that a total of approximately R16.6 billion would be spent on all aspects of the construction phase over roughly three years. The Gamberg Smelter Project has the potential to have a significantly positive impact on commercial activity in the local area during construction given its size and the expenditure associated with it. During the construction phase the building construction, civil and other construction and specialist industrial machinery sectors would benefit substantially. The structural metal products, wholesale and retail trade and construction materials sectors would also stand to gain due to indirect linkages. The project would provide a major injection for contractors and workers in the local area, region and province leading to positive impacts.

Figure 23-1 provides a tentative indication from the Gamberg Zinc Mine of the proportions of construction expenditure that would go to suppliers from the Khâi-Ma Local Municipality, the rest of the Namakwa District Municipality and further afield. It is anticipated that approximately R333 million should be spent on suppliers/contractors from within the Khâi-Ma Local Municipality. A further R499 million is the expected expenditure in the rest of the Namakwa District Municipality and roughly R1.66 billion for the rest of the Northern Cape.

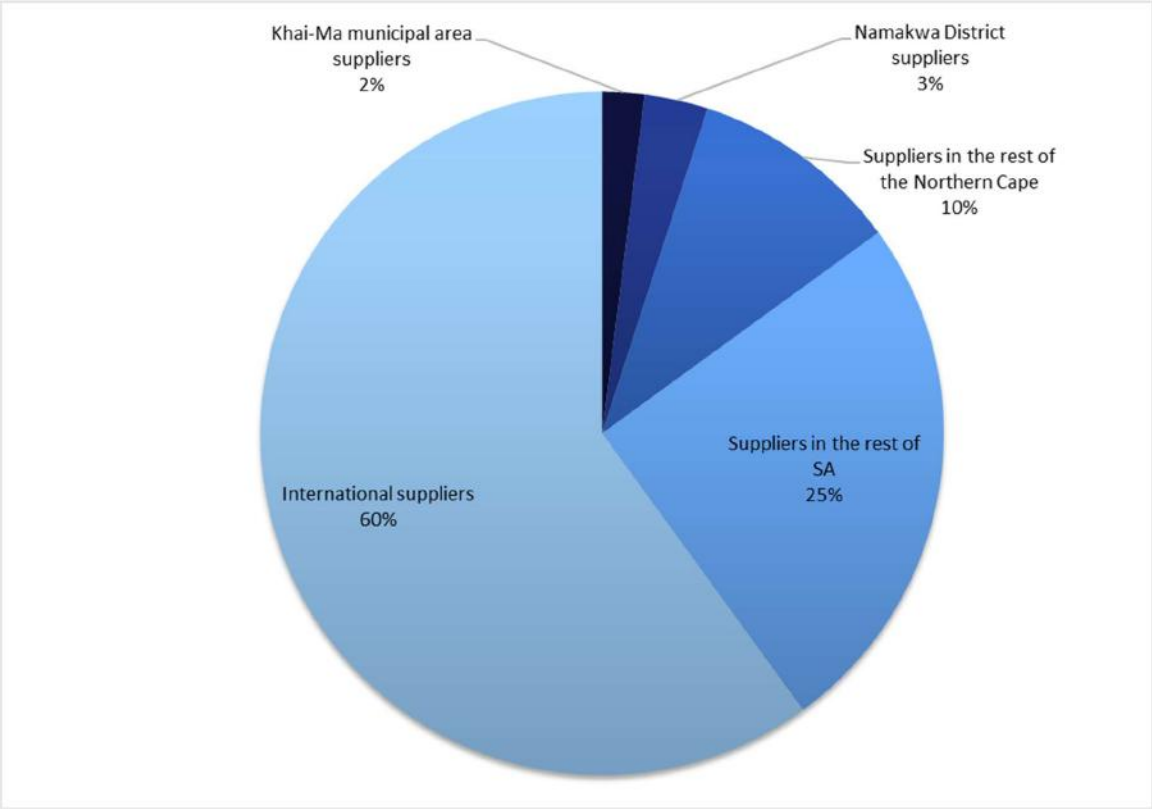

Figure 23-1: Construction phase expenditure per geographic area

In addition to the above direct employment and associated income opportunities, a significant number of temporary indirect opportunities would be associated with the project. These would stem primarily from expenditure by the Gamberg Smelter Project in the local area and region as well as expenditure by workers hired for the construction phase.

Without mitigation the intensity of project expenditure during the construction phase is likely to be minor (positive) and would occur over the short-term and at the regional scale and is therefore assessed to have a MEDIUM POSITIVE impact. With the implementation of enhancement measures the impact can be increased to HIGH POSITIVE (Table 23-1).

Table 23-1: Impact Summary – Project Expenditure during the Construction Phase

Issue: Project Expenditure		
Phases: Construction Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Minor + (L+)	Moderate + (M+)
Duration	Short-term (L)	Short-term (L)
Extent	Regional/National (VH)	Regional/National (VH)
Consequence	Medium + (M+)	High + (H+)
Probability	Probable (H)	Probable (H)
Significance	Medium + (M+)	High + (H+)
Nature of cumulative impacts	The project's cumulative impacts should be MEDIUM when they are added to current and future potential expenditure on the construction of other projects in the area. The project should also set a positive precedent for further investment and development in the area by others.	
Degree to which impact can be reversed	Once spending has taken place, money can't be 'taken back out' of the economy so reversibility of impacts associated with spending that has already happened is very low. Future expenditure can, however, be stopped.	
Degree to which impact may cause irreplaceable loss of resources	Very low	
Residual impacts	The residual impact is considered to be HIGH Positive.	

Mitigation/ Enhancement Measures

The following measures are recommended:

- An up-to-date skills database would greatly facilitate local employment. It is suggested that the Gamsberg Smelter Project engage with the relevant municipal departments and/or active non-governmental organisations (NGOs) in developing this database. The database should be in place in advance of the Business Partners being appointed. The database should include documentation verifying the eligibility status of applicants.
- Ensure, through a structured stakeholder engagement programme, that communities are aware of local employment requirements and opportunities that are available. Where required, the local resident status of applicants should be verified in consultation with community representatives and municipal structures.
- Review current targets for how much local labour should be used based on the needs of the Gamsberg Smelter Project and the availability of existing skills and people that are willing to undergo training. Opportunities for the training of unskilled and skilled workers from local communities should be maximized. Decisions would be required from the Gamberg Smelter Project in consultation with local communities, the authorities and building contractors as to the percentage of jobs that are to be earmarked for the local community, and the percentage of jobs that are to be granted to residents of the wider region.

- Review current targets for the use of local suppliers and sub-contractors where possible requiring that contractors from outside the local area that tender also meet targets for how many locals are given employment.
- Formalise preferential employment of women and youth in the company recruitment policy. Performance indicators for promoting the employment of women and youth should be developed and implemented by the Gamsberg Smelter Project and its Business Partners. The positions reserved for these groups may only be filled with persons outside of these categories when it can be clearly demonstrated that no suitable persons are available.
- Consider the unbundling of suitable tenders to provide opportunities for local service providers.
- Assist smaller enterprises where possible in tendering for contracts and in accessing finance for their participation in projects. Tender forms need to be kept as simple as possible so as not to act as a barrier to entry and the Gamberg Smelter Project must be willing to provide assistance with tendering where required.
- Avoid potential employment and service provider decisions that may lead to abuse or local dissatisfaction. For example, only appointing one accommodation rental agent or one catering supplier may lead to local dissatisfaction regarding the spreading of project benefits. As far as possible, avoid significant variation in salaries between various contractors for the same types of jobs. When variations are too high, the likelihood of dissatisfaction increases.
- The local authorities, community representatives, and organisations on the interested and affected party database should be informed of the final decision regarding the potential job opportunities for locals and the employment procedures that the Gamberg Smelter Project intends following for both the construction and operational phases of the project. There are likely to be people whose (potentially unrealistic) expectations would not be met leading to dissatisfaction. This is difficult to avoid and can affect community relations. However, its impacts can be lessened by ensuring that all local benefits are carefully monitored and also communicated to local communities.

Monitoring

The following monitoring is recommended:

- Annual audits to ensure compliance.

23.2.2 Operational phase impacts

Potential Impacts

The key operational phase impacts associated with the Gamsberg Smelter Project would flow from expenditure on operational activities. Operational expenditure would increase in line with production to R4.42 billion at full production approximately two to three years after construction. It is predicted that once full production is reached, roughly R88 million per annum will be spent in the Khâi-Ma Local Municipal area, R133 million in the rest of the Namakwa District Municipality and R221 million in the rest of the Northern Cape.

Approximately R13 million of salaries and payments to contractors should accrue annually to workers from Khâi-Ma Local Municipal once full production is reached. A further R35 million of salaries and payments to contractors should accrue annually to workers from the rest of the Namakwa District Municipality.

These estimates do not take into account employment that would be generated by the transport of materials to and from the site, which is likely to be significant.

In addition to these direct employment and associated income opportunities, indirect opportunities would be associated with the operational phase of the project. These would stem primarily from increased expenditure by the Gamberg Smelter Project and its employees in the local area and region.

Without mitigation the intensity of project expenditure during the operational phase is likely to be minor (positive) and would occur over the long-term and at a regional scale and is therefore assessed to have a HIGH POSITIVE impact. With the implementation of enhancement measures the impact remains HIGH POSITIVE. (Table 23-2).

Table 23-2: Impact Summary – Project Expenditure During the Operational Phase

Issue: Project Expenditure		
Phases: Operational Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Minor + (L+)	Moderate + (M+)
Duration	Long-term (H)	Long-term (H)
Extent	Regional/National (VH)	Regional/National (VH)
Consequence	High + (H+)	High + (H+)
Probability	Probable (H)	Probable (H)
Significance	High + (H+)	High + (H+)
Nature of cumulative impacts	The project's cumulative impacts should be HIGH when they are added to current and future potential expenditure on the operation of other projects in the area. The project should also set a positive precedent for further investment and development in the area by others.	
Degree to which impact can be reversed	Once spending has taken place, money can't be 'taken back out' of the economy so reversibility of impacts associated with spending that has already happened is very low. Future expenditure can, however, be stopped.	
Degree to which impact may cause irreplaceable loss of resources	Very low	
Residual impacts	The residual impact is considered to be HIGH positive.	

Mitigation/ Enhancement Measures

Mitigation measures would be the same as for the construction phase focused on local employment and procurement.

Monitoring

The following monitoring is recommended:

- Annual audits to ensure compliance.

23.2.3 Decommissioning phase impacts

The impacts of decommissioning are assessed as a discreet phase and consequently do not include a consideration of the withdrawal of the Gamsberg Smelter Project's operational phase benefits from the economy. Decommissioning activities would be similar to construction activities resulting in similar impacts, although less expenditure and job creation are expected from decommissioning/ closure activities and over a shorter timeframe when compared with construction.

Without mitigation the intensity of project expenditure during the decommissioning phase is likely to be minor (positive) and would occur over the short-term and at a regional scale and is therefore assessed to have a MEDIUM POSITIVE impact. With the implementation of enhancement measures the impact remains MEDIUM POSITIVE (Table 23-3).

Table 23-3: Impact Summary – Project Expenditure During the Decommissioning Phase

Issue: Project Expenditure		
Phases: Decommissioning Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Minor + (L+)	Moderate + (M+)
Duration	Short-term (L)	Short-term (L)
Extent	Regional/National (VH)	Regional/National (VH)
Consequence	Medium + (L+)	Medium + (M+)
Probability	Probable (L)	Probable (L)
Significance	Medium + (M+)	Medium + (M+)
Nature of cumulative impacts	The project's cumulative impacts should be MEDIUM when they are added to current and future potential expenditure on other projects in the area.	
Degree to which impact can be reversed	Once spending has taken place, money can't be 'taken back out' of the economy so reversibility of impacts associated with spending that has already happened is very low. Future expenditure can, however, be stopped.	
Degree to which impact may cause irreplaceable loss of resources	Very low	
Residual impacts	The residual impact is considered to be MEDIUM positive.	

Mitigation/ Enhancement Measures

Mitigation measures would be the same as for the construction phase focused on local employment and procurement.

24. ISSUE 24 IMPACTS ON KEY MACRO-ECONOMIC VARIABLES

24.1 DESCRIPTION OF IMPACT

Key economic impacts associated with project expenditure have been assessed in the preceding section. These are the positive impacts with the greatest potential to affect communities in the local area and wider region. Aside from these impacts, the project would be a major source of foreign direct investment (FDI). Positive

impacts are, therefore, also expected to flow primarily from project income and profits during the operational phase which are best measured using the following macro-economic indicators:

- Increased foreign exchange earnings (Gamberg Smelter Project expects to export around 230 000 tpa of zinc ingots, or 77% of the 300 000 tpa total zinc production together with sulphuric acid).
- Balance-of-payments benefits resulting from import substitution (Gamberg Smelter Project expects to sell the remaining 70 000 tpa of zinc production on the domestic market. This equates to approximately 70% of total domestic demand of 100 000 tpa, all of which is currently imported. Sulphuric acid will also be sold as a poduct in the domestic market).
- Increased tax revenues associated with the project.

24.2 IMPACT ASSESSMENT

24.2.1 Operational Phase

Potential Impacts

Total revenues generated through sales of zinc ingots and sulphuric acid on the domestic market are expected to amount to around R144.5 million per annum (R140 million from zinc ingots and R4.5 million from sulphuric acid) once the Gamsberg Smelter Project is at full production. Total revenues resulting from exports should be around R520 million once full production is reached. Of this amount, R460 million would result from zinc ingot exports and the remaining R60 million from sulphuric acid exports. Tax payments are expected to amount to between R23.42 million and R51.5 million per year once full production has been reached.

Without mitigation the intensity of macro-economic variables during the operational phase is likely to be minor (positive) and would occur over the long-term and at a regional scale and is therefore assessed to have a HIGH POSITIVE impact. Impacts with enhancement measures would remain a HIGH POSITIVE significance during the operational phase given the magnitude of foreign exchange and tax revenues in particular (Table 24-1).

Table 24-1: Impact Summary – Macro-Economic Variables During the Operational Phase

Issue: Macro-economic Variables		
Phases: Operational Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Minor + (L+)	Moderate + (M+)
Duration	Long-term (H)	Long-term (H)
Extent	Regional/National (VH)	Regional/National (VH)
Consequence	High + (H+)	High + (H+)
Probability	Probable (H)	Probable (H)
Significance	High + (H+)	High + (H+)
Nature of cumulative impacts	The project's cumulative impacts should be MEDIUM when they are added to current and future major foreign direct investments at a national scale. The project should also set a positive precedent for further investment in the country by others.	
Degree to which impact can be reversed	Once foreign exchange and tax revenues have accrued, they can't be easily reversed so reversibility is considered very low. Benefit that have not yet accrued can, however, be stopped.	
Degree to which impact may cause irreplaceable loss of resources	Very low	
Residual impacts	The residual impact is considered to be HIGH positive.	

Mitigation/ Enhancement Measures

Mitigation should focus on ensuring that South African suppliers of goods and services are favoured where possible and that profit repatriation is kept as low as possible. See more details on enhancement measures in Section 23.2.1.

25. ISSUE 25 IMPACT ON TOURISM

25.1 DESCRIPTION OF IMPACT

Tourism plays an important role in the economy of the wider area and has the potential to play an increasingly prominent role as a driver of economic development. It is thus important to consider the potential impacts of the proposed development on this sector. Key risks to tourism could stem primarily from visual, air quality, noise and traffic impacts.

Current tourism activity and future potential in the wider area is prominent along the identified corridors and in general along the Orange River and in the mountainous areas around Pella and Klein Pella to the north of the N14. Much of this area is best accessed by 4X4 and 4X4 trails within the area are a particular attraction. The N14 itself is also recognised as the most important tourism route in the area. However, the only tourism accommodation facilities identified within 20 km of the Gamsberg Smelter Project would be guest houses in Aggeneys town (roughly 10 km from the site). The Klein Pella Guest Farm is the next nearest facility and is 23 km away.

25.2 IMPACT ASSESSMENT

25.2.1 Construction Phase

During the construction phase there are a number of activities that can have negative effects on the tourism potential of an area, these include reduced air quality due to dust, increased noise, visual impact due to construction related activities such as site clearance, and increased traffic. In the case of the Gamsberg Smelter Project the negative impacts from significantly increased pressure on traffic have the potential to impact on the experience of tourists.

Adversely, experience indicates that a number of technical, management and sales staff generally associated with the construction of a project of the large and complex nature such as the Gamsberg Smelter Project are required to periodically visit the project site to conduct business and would require accommodation. These staff also generally fall into middle to higher income brackets opportunities could be created for accommodation and other tourist facilities and services such as restaurants, transport, retail, etc. These opportunities would primarily be available to businesses in the Khâi-Ma Local Municipal area and in larger towns outside of the municipality such as Springbok. These positive impacts could to some extent balance out the negative impacts on tourism.

Without mitigation the intensity of the impact on tourism during the construction phase is likely to be moderate occurring over the short-term and largely affecting areas immediately adjacent to the Gamsberg Smelter Project. The significance prior to mitigation is thus assessed to be MEDIUM. With mitigation (and enhancement where necessary) the negative impact on tourism can be reduced to LOW (Table 25-1).

Table 25-1: Impact Summary – Impacts on Tourism During the Construction Phase

Issue: Impacts on Tourism		
Phases: Construction Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate (M)	Minor (L)
Duration	Short-term (L)	Short-term (L)
Extent	Beyond the site, affecting neighbours (M)	Beyond the site, affecting neighbours (M)
Consequence	Medium (M)	Low (L)
Probability	Probable (H)	Probable (H)
Significance	Medium (M)	Low (L)
Nature of cumulative impacts	Other projects have and continue to also introduce industrial elements to the area which entail risks to tourism. The project's cumulative impacts should be LOW when they are added to current and future projects in the area.	
Degree to which impact can be reversed	The impacts of the project are highly reversible if it is stopped, decommissioned and rehabilitated.	
Degree to which impact may cause irreplaceable loss of resources	Very low	
Residual impacts	The residual impact is considered to be LOW.	

Mitigation/ Enhancement Measures

Impacts on tourism are primarily dependent on how the project's operations are designed, constructed and operated to minimise negative biophysical and social impacts and enhance positive ones. The measures recommended in other specialist studies to minimise negative impacts (primarily visual, air quality, noise, traffic, ecological and social measures) and enhance positive impacts would thus also reduce negative impacts and enhance the benefits (during construction) on tourism and should be implemented.

25.2.2 Operational Phase

As for the construction phase, during the operational phase the most significant negative impact is likely to be the large numbers of trucks using the N14 Highway carrying zinc ingots and sulphuric acid to the various points of sale/ export. In the case of the Gamsberg Smelter Project the negative impacts from significantly increased pressure on traffic have the potential to impact on the experience of tourists.

Again, there is likely to be some positive impact on tourism due to increased business tourism flows (although not as significant as during the construction phase), particularly given the presence of new technology requiring suppliers, servicing, etc. At a minimum, the positive impacts associated with business tourism would act as a counter to negative impacts on tourism.

Without mitigation the intensity of the impact on tourism during the operational phase is likely to be moderate occurring over the long-term and largely affecting areas immediately adjacent to the Gamsberg Smelter Project. The significance prior to mitigation is thus assessed to be MEDIUM. With mitigation (and enhancement where necessary) the negative impact on tourism can be reduced to LOW (Table 25-2).

Table 25-2: Impact Summary – Impacts on Tourism During the Operational Phase

Issue: Impacts on Tourism		
Phases: Operational Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate (M)	Minor (L)
Duration	Long-term (H)	Long-term (H)
Extent	Beyond the site, affecting neighbours (M	Beyond the site, affecting neighbours (M)
Consequence	Medium (M)	Low (L)
Probability	Probable (H)	Probable (H)
Significance	Medium (M)	Low (L)
Nature of cumulative impacts	Other projects have and continue to also introduce industrial elements to the area which entail risks to tourism. The project's cumulative impacts should be LOW when they are added to current and future projects in the area.	
Degree to which impact can be reversed	The impacts of the project are highly reversible if it is stopped, decommissioned and rehabilitated.	
Degree to which impact may cause irreplaceable loss of resources	Very low	
Residual impacts	The residual impact is considered to be LOW.	

Mitigation/ Enhancement Measures

Mitigation measures would be the same as for the construction phase (Section 25.2.1).

25.2.3 Decommissioning Phase

Decommissioning would be similar to construction phase impacts, although it may use slightly less labour and be of a shorter timeframe and relatively less intensity. Impacts of the decommissioning phase would thus be similar but less than those experienced during the construction phase from disruption and other nuisance factors such as increase dust levels and heavy traffic.

Without mitigation the intensity of the impact on tourism during the operational phase is likely to be moderate occurring over the short-term and largely affecting areas immediately adjacent to the Gamsberg Smelter Project. The significance prior to mitigation is thus assessed to be LOW. With mitigation the negative impact on tourism can be reduced to VERY LOW (Table 25-3).

Table 25-3: Impact Summary – Impacts on Tourism During the Decommissioning Phase

Issue: Impacts on Tourism		
Phases: Decommissioning Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate (M)	Minor (L)
Duration	Short-term (L)	Short-term (L)
Extent	Beyond the site, affecting neighbours (M)	Beyond the site, affecting neighbours (M)
Consequence	Medium (M)	Low (L)
Probability	Possible (M)	Possible (M)
Significance	Low (L)	Very Low (VL)
Nature of cumulative impacts	Other projects have and continue to also introduce industrial elements to the area which entail risks to tourism. The project's cumulative impacts should be LOW when they are added to current and future projects in the area.	
Degree to which impact can be reversed	The impacts of the project are highly reversible if it is stopped, decommissioned and rehabilitated.	
Degree to which impact may cause irreplaceable loss of resources	Very low	
Residual impacts	The residual impact is considered to be VERY LOW.	

Mitigation/ Enhancement Measures

Mitigation measures would be the same as for the construction phase (Section 25.2.1).

26. ISSUE 26 IMPACTS ON SURROUNDING LANDOWNERS AND LAND USES

26.1 DESCRIPTION OF IMPACT

Aside from the Gamsberg Zinc Mine and associated infrastructure, current use of land immediately surrounding the site (and therefore potentially impacted on due to activities on the site) is focused on agriculture, primarily in the form of low potential grazing.

26.2 IMPACT ASSESSMENT

26.2.1 All Phases

There are a number of impacts during all phases that could potentially have an impact on immediately surrounding properties thus affecting their income. Key risks to surrounding landowners and uses could stem primarily from hydrogeological (Section 1 and 2), air quality (Section 15), noise (Section 16), social (Section 34) and visual (Section 19 and 20) impacts.

Each of these impacts has been separately assessed and the impact being determined here is the economic impact on surrounding land use should there be significant deterioration in one or more of these environmental factors.

Without mitigation the intensity of the impact on surrounding landowners and land uses during all phases of the Gamsberg Smelter Project is likely to be moderate, occur over the long-term and largely affect areas immediately adjacent. The significance prior to mitigation is thus assessed to be MEDIUM. With mitigation, which has been prescribed for each of the potential individual impacts, the negative impact on surrounding landowners and land uses can be reduced to LOW (Table 26-1).

Table 26-1: Impact Summary – Impacts on Surrounding Landowners and Land Uses During All Phases

Issue: Impacts on Surrounding Landowners and Land Uses		
Phases: All Phases		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate (M)	Minor (L)
Duration	Long-term (H)	Long-term (H)
Extent	Beyond the site, affecting neighbours (M)	Beyond the site, affecting neighbours (M)
Consequence	Medium (M)	Low (L)
Probability	Probable (H)	Probable (H)
Significance	Medium (M)	Low (L)
Nature of cumulative impacts	Other projects have and continue to also entail risks to surrounding landowners. The project's cumulative impacts should be LOW to MEDIUM when they are added to current and future projects in the area.	
Degree to which impact can be reversed	The impacts of the project are largely reversible if the Gamsberg Smelter Project is decommissioned and rehabilitated.	
Degree to which impact may cause irreplaceable loss of resources	Very low	
Residual impacts	The residual impact is considered to be LOW.	

Mitigation/ Enhancement Measures

Impacts on surrounding landowners and uses are primarily dependent on how the project is designed, constructed and operated to minimise negative biophysical and social impacts and enhance positive ones. The measures recommended in other specialist studies to minimise negative impacts and enhance positive impacts would thus also reduce impacts on surrounding landowners and should be implemented.

Monitoring

The following monitoring is recommended:

- Ongoing monitoring should be undertaken for the following to determine early warning indicators of any potential contamination or changes to ambient levels:
    - Hydrogeological;
    - air quality; and
    - noise.
- Implementation of a grievance procedure whereby issues can be raised / reported and transparently and timeously addressed.

27. ISSUE 27 IMPACTS ON MUNICIPAL FINANCES

27.1 DESCRIPTION OF IMPACT

New development projects have the potential to improve the financial positions of the local municipalities where they are located through net increases in rates and other income. The opposite, however, is also possible where these developments can place greater strain on services and lead to overall negative impacts on municipal finances.

For direct costs, when a developer proposes a new project, a process of negotiation is essentially entered into with the municipality aimed at determining the financial or other contribution needed from the developer in order to cover the increased cost of the provision of services. Services may include roads, sewerage, water, electricity, waste collection, etc. The accurate estimation of this contribution by the municipality is key to ensuring cost recovery.

27.2 IMPACT ASSESSMENT

27.2.1 Construction Phase

During the construction phase the Khâi-Ma Local Municipality has the potential to improve their municipal finances provided efficient negotiations are held. Should this be the case, prior to measures being implemented the intensity of the impact is considered moderate, would occur over the short-term and would have an impact on the local municipal area, the significance is assessed to be LOW NEGATIVE. With implementation of measures to enhance the contributions to municipal finances, the significance could increase to a LOW POSITIVE (Table 27-1).

Table 27-1: Impact Summary – Impact on Municipal Finances During the Construction Phase

Issue: The project would result in opportunities to improve municipal finances while aspects of the project would also result in risks to municipal finances		
Phases: Operations		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate (M)	Moderate + (M+)
Duration	Short-term (L)	Short-term (L)
Extent	Local area, extending far beyond site boundary (M)	Local area, extending far beyond site boundary (M)
Consequence	Medium (M)	Medium (M)
Probability	Possible (M)	Possible (M)
Significance	Low (L)	Low + (L+)
Nature of cumulative impacts	Other projects have and continue to also introduce opportunities and risks to municipal finances. Given its size, the project's cumulative impacts should be LOW when they are added to current and future projects in the area.	
Degree to which impact can be reversed	The impacts of the project are highly reversible if it is stopped, decommissioned and rehabilitated.	
Degree to which impact may cause irreplaceable loss of resources	Very low	
Residual impacts	The residual impact is considered to be LOW positive.	

Mitigation/ Enhancement Measures

The following measures are recommended:

- The municipality should continue to take responsibility for ensuring that the Gamsberg Smelter Project contributes to municipal financial sustainability and does not burden it with increased costs. Black Mountain Mining (Pty) Ltd would need to engage and negotiate with the municipality in good faith and with the intention to ensure that it does not burden the municipality with additional costs.
- The measures aimed at enhancing local benefits from project expenditure should decrease risks to the municipality through maximising local hiring and procurement.

27.2.2 Operational Phase impacts

During the operational phase the Khâi-Ma Local Municipality has the potential to improve their municipal finances over the long-term. Should this be the case, prior to measures being implemented the intensity of the impact is considered moderate, would occur over the long-term and would have an impact on the local municipal area, the significance is assessed to be MEDIUM NEGATIVE but with implementation of measures to enhance the contributions to municipal finances, the significance could increase to a LOW POSITIVE (Table 27-2).

Table 27-2: Impact Summary – Impacts on Municipal Finances During the Operational Phase

Issue: Impacts on Municipal Finances		
Phases: Operational Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate (M)	Minor+ (L+)
Duration	Long-term (H)	Long-term (H)
Extent	Local area, extending far beyond site boundary (H)	Local area, extending far beyond site boundary (H)
Consequence	High (H)	Medium (M)
Probability	Possible (H)	Possible (M)
Significance	Medium (M)	Low + (L+)
Nature of cumulative impacts	Other projects have and continue to also introduce opportunities and risks to municipal finances. Given its size, the project's cumulative impacts should be LOW when they are added to current and future projects in the area.	
Degree to which impact can be reversed	The impacts of the project are highly reversible if it is stopped, decommissioned and rehabilitated.	
Degree to which impact may cause irreplaceable loss of resources	Very low	
Residual impacts	The residual impact is considered to be LOW positive.	

Mitigation/ Enhancement Measures

Mitigation measures would be the same as for the construction phase (Section 27.2.1).

27.2.3 Decommissioning phase impacts

Decommissioning would essentially result in the reduction or removal of project related contributions to municipal finances as well as potential strains on these finances as project elements are closed. The eventual significance of impacts would be highly dependent on rigorous rehabilitation of the project sites as inadequate rehabilitation has the potential to transfer costs onto the local municipality (e.g. clean-ups).

Prior to measures being implemented the intensity of the impact is considered moderate, would occur over the short-term and would have an impact on the local municipal area, the significance is assessed to be LOW NEGATIVE but with implementation of measures to enhance the contributions to municipal finances, the significance could decrease to a LOW POSITIVE (Table 27-3).

Table 27-3: Impact Summary – Impacts on Municipal Finances During the Decommissioning Phase

Issue: Impacts on Municipal Finances		
Phases: Decommissioning Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate (M)	Moderate+ (M+)
Duration	Short-term (L)	Short-term (L)
Extent	Local area, extending far beyond site boundary (H)	Local area, extending far beyond site boundary (H)
Consequence	Medium (M)	Medium (M)
Probability	Possible (M)	Possible (M)
Significance	Low (L)	Low + (L+)
Nature of cumulative impacts	Other projects have and continue to also introduce opportunities and risks to municipal finances. Given its size, the project's cumulative impacts should be LOW when they are added to current and future projects in the area. However, should there not be additional large projects in the area, there could be a MEDIUM to HIGH cumulative impact on the municipal finances.	
Degree to which impact can be reversed	The impacts of the project are highgly reversible if it is stopped, decommissioned and rehabilitated.	
Degree to which impact may cause irreplaceable loss of resources	Very low	
Residual impacts	The residual impact is considered to be LOW positive.	

Mitigation/ Enhancement Measures

The following measures are recommended:

- Mitigation measures would be the same as for the construction phase (Section 27.2.1).
- The principles that should govern adequate decommissioning and closure would also apply to limiting impacts on municipal finances. Black Mountain Mining (Pty) Ltd should ensure continuous engagement with the municipality and keep it informed of any plans for closure well in advance. The municipality, in turn, should be pro-active and plan for changes well in advance of potential project closure.

28. ISSUE 28 IMPACT ON ROAD USERS AND TRAFFIC SAFETY

28.1 DESCRIPTION OF IMPACT

Traffic impacts are expected from the construction phase through to the end of the decommissioning phase when trucks, buses, and private vehicles make use of the private and public transport network in and adjacent to the proposed Gamsberg Smelter Project site. The key potential traffic related impacts are on road capacity and public safety. The road network most likely to be affected by the increased traffic volumes are the N14 Highway and the N7 Highway (en route to the Port of Saldanha) with various intersections along the route.

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

- Pedestrian accidents
- Vehicle accidents.

Table 28-1 details recommended road upgrades for the Gamsberg Zinc Mine which should be implemented whether or not the Gamsberg Smelter Project goes ahead. The impact assessment assumes these upgrades are undertaken. The intersections discussed in Table 28-1 are depicted in Figure 28-1 and Figure 28-2.

Table 28-1 Recommended Intersection and Road Network Improvements as Part of the Existing Gamsberg Zinc Mine and not Relevant to the Proposed Gamsberg Smelter Project

Ref.	Intersection	Mitigation to be Implemented for the Gamsberg Zinc Mine
A	Road N14 and Gamsberg Zinc Mine Access Road	• Reduce vehicle speed limit at intersection from 120km/h to 80km/h; • Provide public transport loading and off-loading lay-bys along road N14 as close as possible to intersection; • Provide pedestrian walkway around intersection; and • Provide pedestrian crossing.
B	Road N14 and Loop 10 Road	• Reduce vehicle speed limit at intersection from 120km/h to 80km/h.
C	Road N14 and Aggeneys Access Road	• Reduce vehicle speed limit at intersection from 120km/h to 80km/h; • Provide public transport loading and off-loading lay-bys along road N14 as close as possible to intersection; • Provide pedestrian walkway around intersection; and • Provide pedestrian crossing.
D	Road N14 and Road R355	• No additional improvements required as part of the existing Gamsberg Zinc Mine.
E	Road R355 and Kokerboom Road	• No additional improvements required as part of the existing Gamsberg Zinc Mine.
F	Kokerboom Road and Road N7 Southbound On-Ramp	• No additional improvements required as part of the existing Gamsberg Zinc Mine.

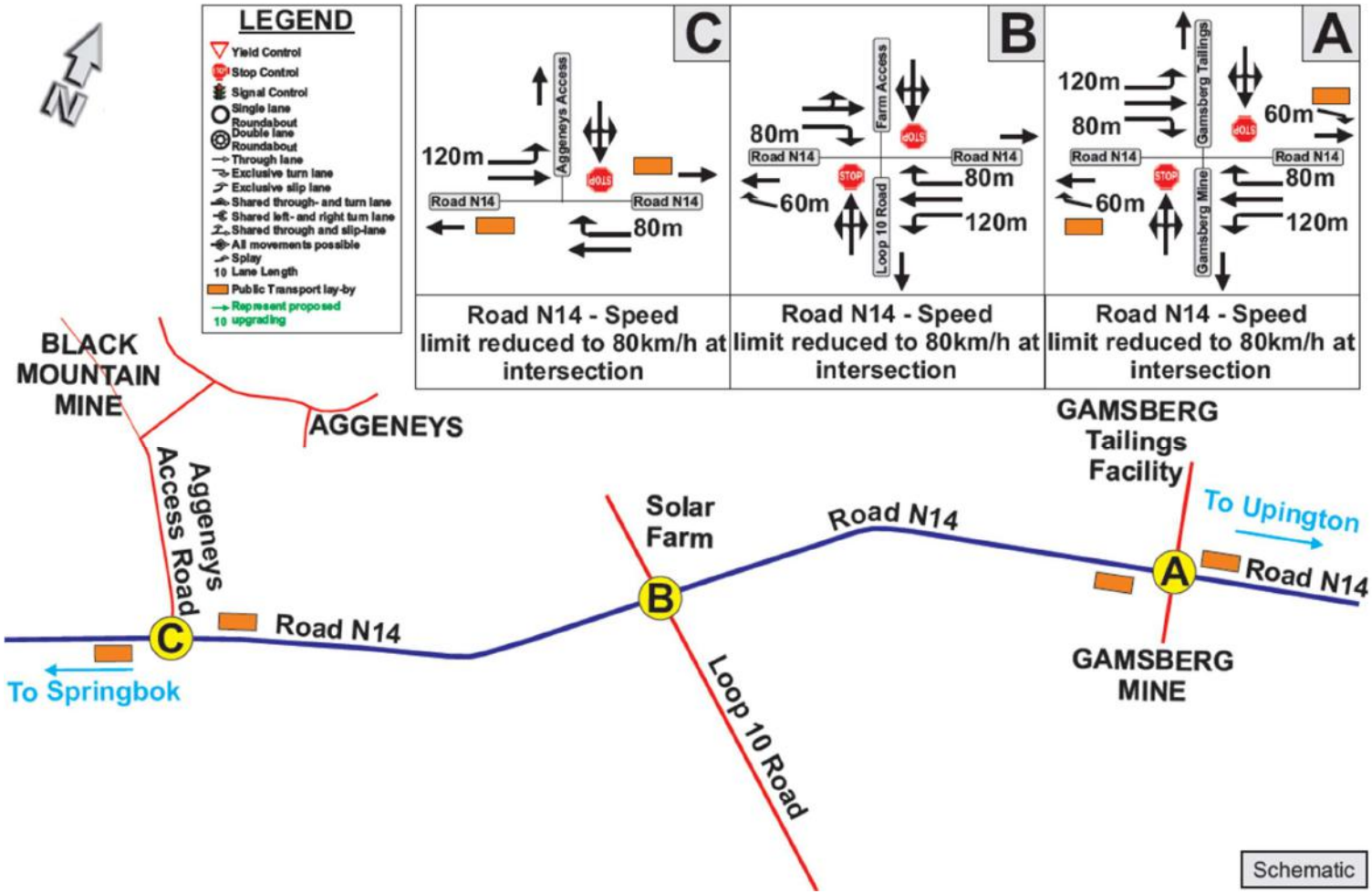

Figure 28-1 Graphical Presentation of the Recommended Intersection and Road Network Improvements as Part of the Existing Road Network and Not Relevant to the Implementation of the Proposed Gamsberg Smelter Project (Aggeneys Area)

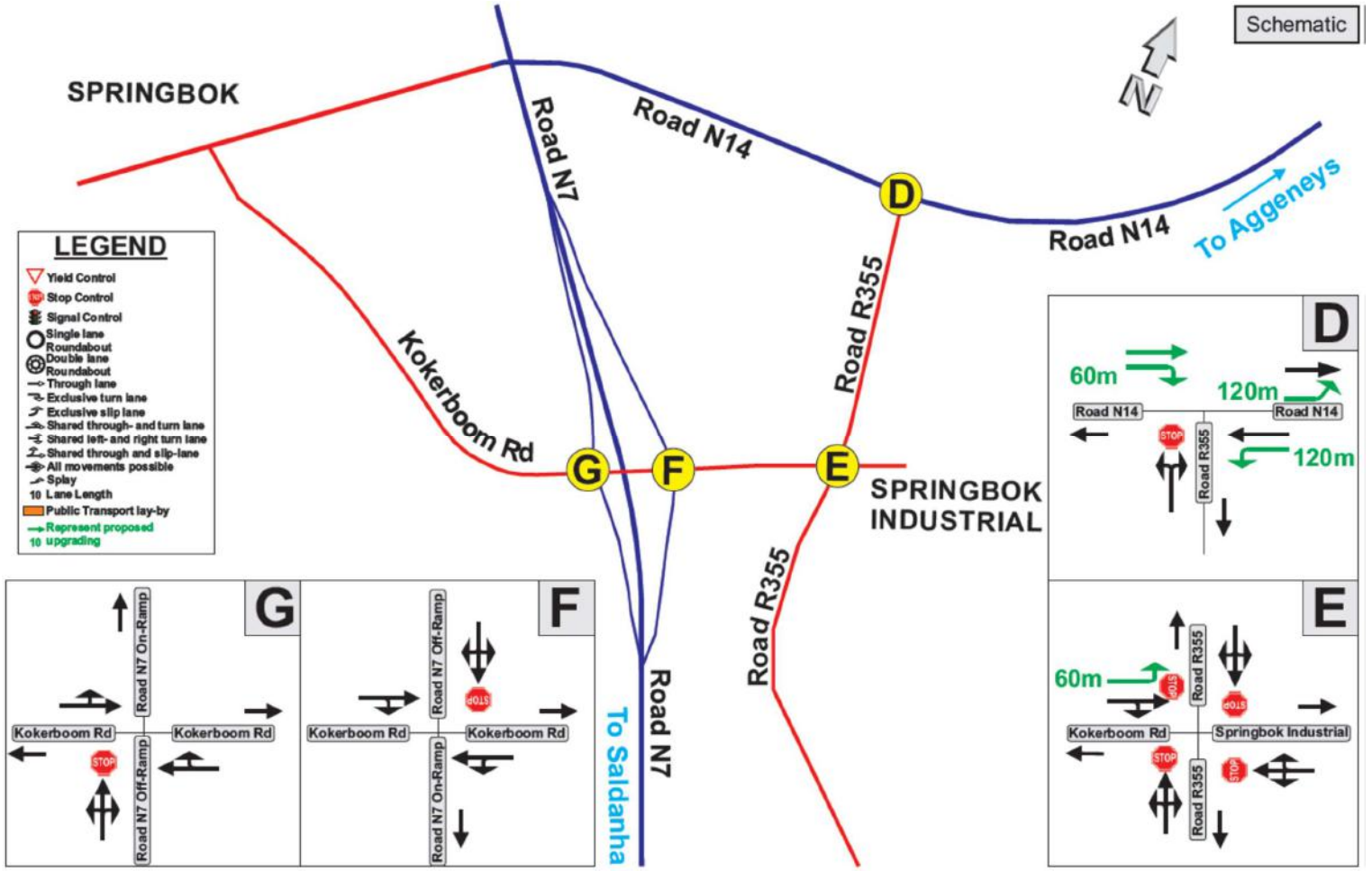

Figure 28-2 Graphical Presentation of the Recommended Intersection and Road Network Improvements as Part of the Existing Road Network and Not Relevant to the Implementation of the Proposed Gamsberg Smelter Project (Springbok Area)

28.2 IMPACT ASSESSMENT

28.2.1 Construction and Decommissioning Phases

Potential Impacts

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

Possible accident sites could be located within or outside the proposed project area given that both private and public roads are and would continue to be used for the transport of equipment, materials and personnel. In the unmitigated scenario the intensity is assessed to be minor and would occur over the short-term. Due to the large distances that vehicles/ trucks would travel impacts could occur on a regional scale. The significance prior to mitigation is therefore assessed to be MEDIUM. In the mitigated scenario the significance reduces to LOW as the frequency of potential accidents is expected to reduce (Table 28-2).

Table 28-2: Impact Summary – Road Disturbance and Traffic Safety during Construction and Decommissioning Phases

Issue: Road Disturbance and Traffic Safety		
Phases: Construction and Decommissioning Phases		
Criteria	Without Mitigation	With Mitigation
Intensity	Minor disturbance or change (L)	Minor disturbance or change (L)
Duration	Short-term (L)	Short-term (L)
Extent	Regional (VH)	Regional (H)
Consequence	Medium (M)	Medium (M)
Probability	Probable (H)	Possible (M)
Significance	Medium (M)	Low (L)
Nature of cumulative impacts	Construction activities at the Gamsberg Zinc Mine and Gamsberg Smelter Project, as well as traffic from other projects in the area (e.g. quarries and solar plants) would increase the disturbance of movement patterns, have impacts on health and safety of other road users and result in increased deterioration of roads, particularly when additional projects are established in the broader project area. Should the recommended mitigation measures be implemented the cumulative impact on traffic in the area is assessed to be LOW.	
Degree to which impact can be reversed	Once the Gamsberg Smelter is decommissioned the impact on traffic would cease.	
Degree to which impact may cause irreplaceable loss of resources	Medium, traffic accidents can result in the loss of the lives of people or livestock.	
Residual impacts	The residual impact provided the required road infrastructure improvements are made is assessed to be LOW.	

Mitigation/ Enhancement Measures

The following measures are recommended:

- Provided the recommended changes as proposed in Table 28-1, Figure 28-1 and Figure 28-2 are implemented no further road infrastructure upgrades are required. Further investigations and collaboration with the relevant road authority must be conducted to finalise the access routes during the detailed design phase for the project.
- Where required, implement appropriate technical measures to provide continued access to residences, farms and facilities, and to minimise traffic disruptions.
- Erect suitable traffic and construction signage to control traffic, raise awareness of potential risks/hazards and indicate alternative access routes, if needed.
- Implement suitable consultation procedures to ensure that potentially affected parties are informed about pending construction activities and potential disruptions.
- All transport associated with the construction/ decommissioning phase activities must adhere to stipulated national speed limits as displayed.
- Peak traffic periods should be avoided as far as possible by heavy delivery vehicles.
- A transport safety programme should be implemented to achieve the mitigation objectives. Key components of the programme include:
    - Education and awareness training;
    - Speed limit enforcement;
    - Maintenance of the transport system where appropriate; and
    - Use of dedicated loading and off-loading areas on site.
- Detailed investigations should be conducted in conjunction with the relevant road authority in terms of the existing quality and potential life span of the existing road surface layers of the roads to be used.
- A road maintenance plan should be prepared in conjunction with the relevant road authority on public roads where trucks will operate as soon as the project has been approved.
- A road safety awareness campaign and traffic monitoring strategy should be developed and implemented.
- Implementation of a grievance procedure whereby traffic related issues can be raised/ reported and transparently and timeously addressed.

Monitoring

The following monitoring is recommended:

- Monitoring as per the traffic monitoring plan.
- Grievance Procedures implemented and timeously responded to.

28.2.2 Operational Phase

Potential Impacts

During the operational phase approximately sixty 30 tonne trucks would be transporting both zinc ingots and sulphuric acid to the Port of Saldanha (and potentially other destinations). These volumes of heavy traffic could have an impact on the safety of other road users as well as pedestrians, particularly where the truck traffic passes through towns on the route.

In the unmitigated scenario the intensity is assessed to be minor and would occur over the long-term (throughout the operational phase of the Gamsberg Smelter). Due to the large distances that vehicles/ trucks would travel impacts could occur on a regional scale. The significance prior to mitigation is therefore assessed to be MEDIUM. In the mitigated scenario the significance remains MEDIUM due to the long-term over which the impact occurs (Table 28-2).

Table 28-3: Impact Summary – Road Disturbance and Traffic Safety during Operational Phase

Issue: Road Disturbance and Traffic Safety		
Phases: Operational Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Minor disturbance or change (L)	Minor disturbance or change (L)
Duration	Long-term (H)	Long-term (H)
Extent	Regional (VH)	Regional (VH)
Consequence	High (H)	High (H)
Probability	Possible (M)	Conceivable (L)
Significance	Medium (M)	Medium (M)
Nature of cumulative impacts	Cumulative impacts are likely due to the potential for numerous developments in the area, particularly in terms of renewable energy projects. Although these projects largely will only have increased traffic levels during their construction phases. Currently there are also a significant number of trucks transporting the concentrate from the Gamsberg Zinc Mine to the Port of Saldanha which would be replaced by trucks transporting finished product and sulphuric acid. The cumulative impact on traffic is assumed to be MEDIUM, particularly on the busy N7 Highway.	
Degree to which impact can be reversed	Once the Gamsberg Smelter is decommissioned the impact on traffic would cease.	
Degree to which impact may cause irreplaceable loss of resources	Medium, traffic accidents can result in the loss of the lives of people or livestock.	
Residual impacts	The residual impact provided the required road infrastructure improvements are made is assessed to be MEDIUM.	

Mitigation/ Enhancement Measures

The following measures are recommended:

- Provided the recommended changes as proposed in Table 28-1, Figure 28-1 and Figure 28-2 are implemented no further road infrastructure upgrades are required.

- Transport during peak traffic periods should be avoided as far as possible.
- A transport safety programme should be implemented to achieve the mitigation objectives. Key components of the programme include:
    - Education and awareness training;
    - Speed limit enforcement;
    - Maintenance of the transport system where appropriate; and
    - Use of dedicated loading and off-loading areas on site.
- A road safety awareness campaign and traffic monitoring strategy should be implemented and updated throughout the operational phase.
- Implementation of a grievance procedure whereby traffic related issues can be raised/ reported and transparently and timeously addressed.

Monitoring

The following monitoring is recommended:

- Ongoing monitoring as per the traffic monitoring strategy.

29. ISSUE 29 IMPACT ON HERITAGE (INCLUDING CULTURAL) RESOURCES

29.1 DESCRIPTION OF IMPACT

Based on the findings of the site visit undertaken in 2013, areas of archaeological importance were ranked according to the northern slope, southern slope and the inselberg basin. For the Gamsberg Smelter Project only the northern slope is of interest as no development will be undertaken in any of the other areas.

The following were identified on the northern slope and are depicted in Figure 29-1:

- Artefact occurrence NG1 (mid-twentieth century drilling site) is located on the northern border of the N14. This site was allocated a low archaeological significance.
- Artefact occurrence NG 2 is located along the northern border of the N14, in close proximity to the road. This artefact was allocated a high archaeological significance, consisting of a series of dome-shaped bedrock outcrops around which are clustered an abundance of Ceramic Later Stone Age artefacts (stone artefacts, pottery, ostrich eggshell). Due to its location well clear of the proposed secured landfill facility and smelter complex, the site is unlikely to be impacted during the construction and operational phases of the Gamsberg Smelter Project.
- Artefact occurrence NG3 is also unlikely be impacted by the construction and operational phases of the Gamsberg Smelter Project and was also allocated a low archaeological significance, as this is an individual instance of an isolated Earlier Stone Age cleaver that lacks context and hence is of limited archaeological importance.

29.2 IMPACT ASSESSMENT

29.2.1 Construction Phase

Potential Impacts

Archaeological artefacts are considered, in each instance, a unique and non-renewable resource. According to the study undertaken in 2013 and correspondence with Dr David Morris in 2020, the Gamsberg Smelter Project is unlikely to result in losses to archaeological artefacts. However, should any artefacts be discovered during the construction and operational phases the impacts can be seen as permanent and irreversible.

Construction phase activities would include land clearance and excavation of different parts of the site in preparation for the development of the secured landfill facility and the smelter complex with associated infrastructure. The primary construction activities would include the following:

- Pre-stripping of the secured landfill facility, smelter complex, laydown area, Business Partner Camp and associated roads;
- Excavation of the secured landfill facility and foundations for the smelter complex;
- Construction of a contractor's camp and smelter complex (including some of associated infrastructure); and
- Construction of bulk service requirements (ie water, sewage and power infrastructure).

The previous HIA identified potential sites of interest, however, due to their generally low archaeological significance and that they fall outside of the footprint areas the intensity of a potential impact is considered to be minor. Should an archaeological resource be unearthed during construction activities the loss of that resource would be permanent. The likelihood is, however, without mitigation assessed to be low and as such the impact is expected to be LOW while with mitigation measures implemented the significance is assessed to be VERY LOW (Table 29-1).

Table 29-1: Impact summary – Damage to or Disturbance of Heritage (Including Cultural)

Issue: Damage to or disturbance of heritage (including cultural)		
Phases: Construction Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Minor change or disturbance (L)	Minor change or disturbance (L)
Duration	Permanent (VH)	Permanent (VH)
Extent	A part of the site (VL)	A part of the site (VL)
Consequence	Medium (M)	Medium (M)
Probability	Conceivable (L)	Unlikely (VL)
Significance	Low (L)	Very Low (VL)
Nature of cumulative impacts	The potential for impact on heritage (including cultural) is considered to be VERY LOW as no sites of significance have been identified in the vicinity of the Gamsberg Smelter Project.	
Degree to which impact can be reversed	Very Low	
Degree to which impact may cause irreplaceable loss of resources	High	
Residual impacts	The residual impact on heritage is considered to be VERY LOW provided the correct measures are implemented should there be a chance find.	

Mitigation/ Enhancement Measures

The following mitigation is recommended:

- Training of personnel must be undertaken to ensure employees are alert as to the potential occurrence of fossil bones, archaeological material and of unrecorded burials.
- Guidelines for monitoring by construction employees, and Chance Find Procedures must be incorporated into the EMPr's for the construction phase.
- Summary Chance Finds Procedure:
    - Should chance finds be encountered, work must cease at the site immediately and the works foreman and the ECO for the project must be immediately informed. Scattered, unearthed parts/fragments of the find must be retrieved and returned to the main find site which must be protected from further disturbance.
    - The South African Heritage Resources Agency (SAHRA), must be informed and supplied with contextual information:
        - A description of the nature of the find.
        - Detailed images of the finds (with scale included).
        - Position of the find (GPS) and depth.
        - Digital images of the context. i.e. the excavation (with scales).

- SAHRA and an appropriate specialist should assess the information and liaise with Black Mountain Mining (Pty) Ltd, the environmental consultants and the ECO and a suitable response should be established.
- If any evidence or archaeological sites or remains (e.g. remnants of stone-made structures, indigenous ceramics, bones, stone artefacts, ostrich eggshell fragments, charcoal and ash concentrations), fossils or other categories of heritage resources are found during the proposed development, the SAHRA APM Unit (Natasha Higgitt / Phillip Hine 021 462 5402) must be alerted.
- If unmarked human burials are uncovered, the SAHRA Burial Grounds and Graves (BGG) Unit (Thingahangwi Tshivashe / Mimi Seetelo 021 320 8490), must be alerted immediately.
- In the event of a significant find, a professional archaeologist or palaeontologist must be appointed, depending on the nature of the finds, must be contracted as soon as possible to inspect the heritage resource. If the newly discovered heritage resources prove to be of archaeological or palaeontological significance, a Phase 2 rescue operation may be required subject to permits issued by SAHRA.

Monitoring

The following monitoring is recommended:

- During construction phase, all excavated areas must be monitored for presence of any artefacts of cultural/ heritage, archaeological or paleontological value.
- The Environmental officer must inspect newly opened trenches for potential presence of artefacts.

Weekly visual inspections must be undertaken.

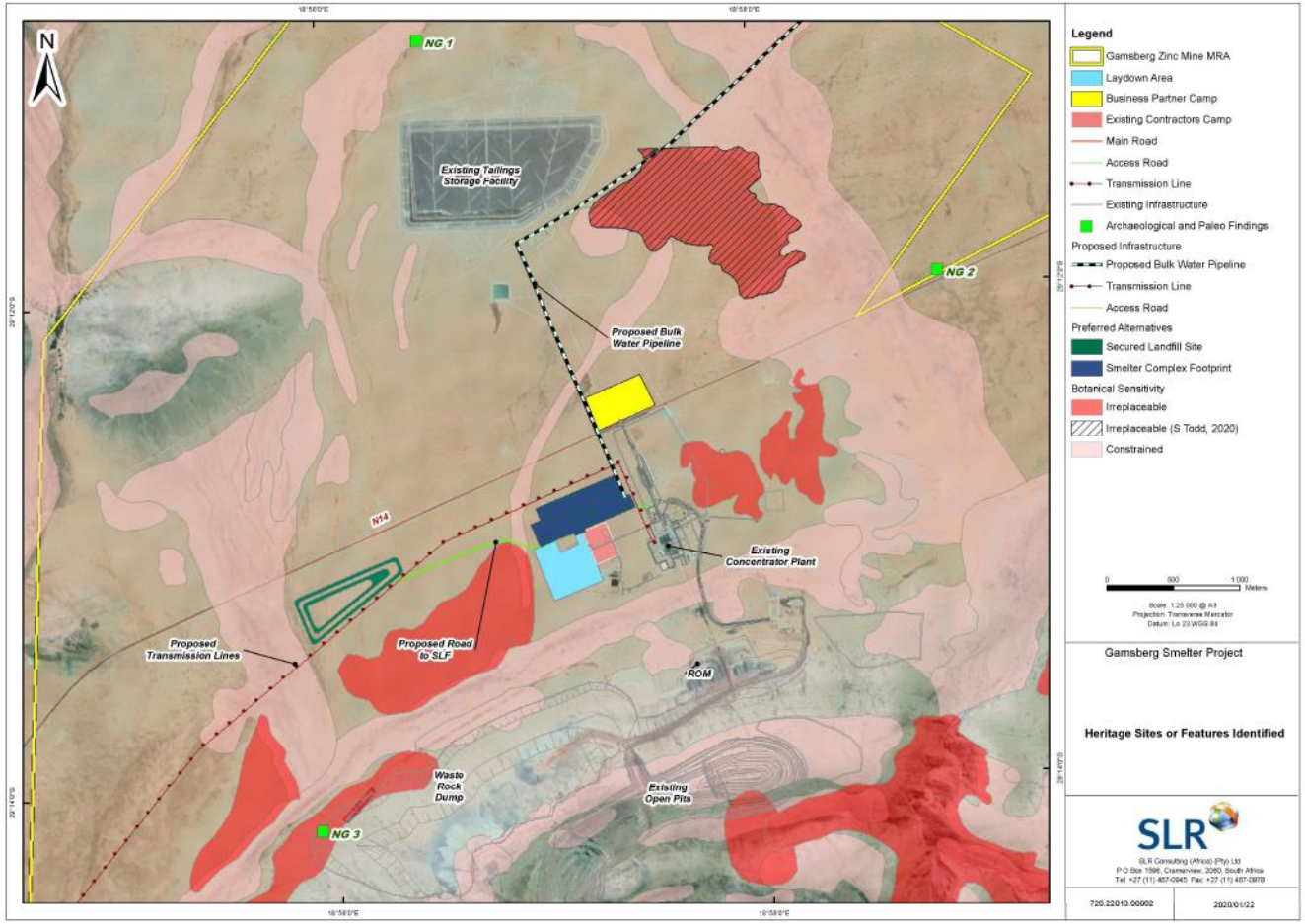

Figure 29-1 Archaeological Artefacts on the Gamsberg Northern Slope

30. ISSUE 30 IMPACT ON PALAEONTOLOGICAL RESOURCES

30.1 DESCRIPTION OF IMPACT

The proposed smelter complex is situated on superficial deposits which form the plains that surround the inselbergs of Bushmanland. These deposits are mapped as Quaternary to Recent Unit Q-s2 which is comprised of aeolian coversands, buried soils, pedocretes such as calcrete, and colluvial sheetwash deposits. Red aeolian dunes of the Gordonia Formation of the Kalahari Group deposits do not occur in the development area. Mapped as surficial unit Q-s1, the red dunes are a feature in the ancient Koa Valley to the southwest of the site. Alluvial deposits occur along ephemeral watercourses. The developments are not on a drainage line or in the vicinity of pan deposits.

The deposits of the subsurface are expected to be young (late Quaternary, Q-s2) and poorly fossiliferous, particularly since most of the material appears to be colluvial in origin. The preservation potential of fossil bones in the colluvial plain environment is low due to the likelihood of long exposure of bones on the surface prior to possible burial, with concomitant disintegration due to weathering. Fossil bones are seldom found in such deposits, but are expected to occur very sporadically as fragmented material and teeth which have been washed into ephemeral, shallow channels during occasional deluges. Fossil bones may occur in burrows that were occupied by jackals and other carnivores, but these occurrences are also rare. Trace fossils such as fossil roots and termite burrows and nests are expected, but these are common features in such deposits.

30.2 IMPACT ASSESSMENT

30.2.1 Construction Phase

Potential Impacts

The potential palaeontological impact is associated with the construction phase bulk earth works required for foundations for the smelter complex, the excavation of the secured landfill facility, and excavations for pipelines, drainage etc.

Although no areas of particular palaeontological sensitivity were identified, should there be a discovery then it would be considered to be of moderate intensity. The impact could result in a permanent loss of the resource at a local extent. The significance of the potential impact prior to mitigation is expected to be LOW while with mitigation measures implemented the significance is assessed to be VERY LOW (Table 30-1).

Table 30-1: Impact summary – Damage to or Disturbance of Palaeontological Resources during Construction Phase

Issue: Damage to or Disturbance of Palaeontological Resources		
Phases: Construction Phases		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate (slight) disturbance (M)	Minor (slight) disturbance (L)
Duration	Permanent (VH)	Permanent (VH)
Extent	Part of the site (VL)	Part of the site (VL)
Consequence	Medium (M)	Medium (M)
Probability	Conceivable (L)	Unlikely (VL)
Significance	Low (L)	Very Low (VL)
Nature of cumulative impacts	The potential for impact on palaeontological resources is considered to be VERY LOW as no areas of particular palaeontological sensitivity were identified in the vicinity of the Gamsberg Smelter Project.	
Degree to which impact can be reversed	Very Low	
Degree to which impact may cause irreplaceable loss of resources	Medium	
Residual impacts	The residual impact on Palaeontological resources is considered to be VERY LOW provided the correct measures are implemented should there be a chance find.	

Mitigation/ Enhancement Measures

The following measures should be implemented:

- Training of personnel must be undertaken to ensure employees are alert as to the potential occurrence of fossil bones, archaeological material and of unrecorded burials.
- Guidelines for monitoring by construction employees, and Fossil Find Procedures must be incorporated into the EMPr's for the construction phase.
- Summary Fossil Finds Procedure:
    - Should fossil bones and teeth be encountered in the deposits, work must cease at the site immediately and the works foreman and the ECO for the project must be informed immediately. Scattered, unearthed parts/fragments of the find must be retrieved and returned to the main find site which must be protected from further disturbance.
    - SAHRA and/or the McGregor Museum, Kimberley, must be informed and supplied with contextual information:
        - A description of the nature of the find.
        - Detailed images of the finds (with scale included).
        - Position of the find (GPS) and depth.
        - Digital images of the context. i.e. the excavation (with scales).

- SAHRA and an appropriate specialist palaeontologist will assess the information and liaise with the mine owner, the environmental consultants and the ECO and a suitable response will be established.
- In the event of a significant fossil find, a professional palaeontologist must be appointed to undertake the excavation of the fossils and to record their contexts. The palaeontologist must also undertake the recording of the stratigraphy and sedimentary geometry of the exposures, must attempt sampling of the ambient small fossil content and must undertake the compilation of the detailed report.
- A permit from SAHRA is required to excavate fossils. The applicant should be the qualified specialist responsible for assessment, collection and reporting (palaeontologist). Should fossils be found that require rapid collecting, application for a palaeontological permit will immediately be made to SAHRA. The application requires details of the registered owners of the sites, their permission and a site-plan map. All fossil finds must be recorded and the fossils and their contextual information (a report) must be deposited at a SAHRA-approved institution.

Monitoring

The following monitoring is required:

- The visual monitoring of excavations by on-site personnel is recommended during construction of the Gamsberg Smelter Project, under supervision of the Environmental Officer.

31. ISSUE 31 IMPACT OF EMPLOYMENT CREATION, SKILLS DEVELOPMENT AND ECONOMIC STIMULUS

31.1 DESCRIPTION OF IMPACT

In the Khâi-Ma Local Municipality approximately 55% of the working age population are unemployed with the majority of the population having limited or no schooling with very few having reached and finished secondary school and even fewer tertiary education. Employment opportunities are thus highly sought after by the local population.

The construction phase of the Gamsberg Smelter Project would last approximately 36 months, during which potentially 6 000 people would be employed. This number excludes permanent staff but includes skilled, semi-skilled and unskilled positions. Workers would be recruited from surrounding areas and towns in the Khâi-Ma Local Municipality, followed by other municipal areas in the Namakwa District and further afield (Northern Cape Province and rest of South Africa and/or internationally).

Informal employment opportunities may be created in the secondary economy through a multiplier effect from the Gamsberg Smelter Project's activities. Therefore, in addition to creating direct job opportunities, construction phase activities and project expenditure may also lead to indirect employment creation. This could involve formal employment (with companies who provide services to the project), or employment in the informal sector (e.g. local residents offering transport or other services for the convenience of construction workers when they are off-duty). However, it is questionable if this benefit would be significant, taking into account that many of these services are already in place as part of the Black Mountain Mine (BMM) and Gamsberg Zinc Mine operations and that it is likely that the construction staff that are not part of the local communities would be housed in a Construction Camp on site.

During the operational phase, the Gamsberg Smelter Project would create a projected 1 200 permanent jobs. It is expected that some employment opportunities would be available to local communities, following the

completion of the Project's construction phase. However, the majority of the workforce would consist of skilled or semi-skilled employees, which may not be available in the local area. Employment during the operational phase of the Gamsberg Smelter Project could entail a long-term positive impact for successful applicants and their dependents in terms of wages and income security.

An important approach to mitigating economic dependency on the Gamsberg Smelter Project is to develop alternative and sustainable livelihoods so that local communities and businesses are able to support themselves through other economic sectors at the time of project closure.

The Gamsberg Smelter Project, should work through the local municipalities and relevant government agencies to support the diversification of the local economy so that, by the time the Gamsberg Smelter Project closes down, non-mining sectors may be able to continue supporting the local economy. Generally, these mitigation measures would be more effective if implemented in partnership with authorities.

The Mineral and Petroleum Resources Development Act (MPRDA) requires that the Project's SLP provide strategies and measures that could prevent job losses in the event of circumstances threatening guaranteed employment. These include the establishment of Future Forums to manage downscaling and retrenchments. Certain processes must be followed when economic conditions cause the profit-to-revenue ratio of a project to drop below 6% on average for a continuous period of 12 months, or where the above scenarios occur.

In the event of retrenchments becoming unavoidable because of downscaling or closure, alternatives to save jobs/avoid downscaling should be investigated beforehand. These could include developing and implementing turnaround strategies and mechanisms. The Gamsberg Smelter Project should, therefore, develop and implement strategies to introduce measures that may prevent job loss in the event of circumstances threatening permanent employment.

31.2 IMPACT ASSESSMENT

31.2.1 Construction Phase

Potential Impacts

Whether unemployed and under-employed individuals within the local area would be able to take up employment depends on their level of education, specific skills and work experience. During the construction phase, many positions may only be for a temporary period, however, acquisition of new skills could make people more employable in the future. Local employment during the construction phase is therefore regarded as a significant positive impact. The MPRDA requires that the Black Mountain Mining (Pty) Ltd's SLP ensure, amongst other things, training and career progression of employees, and in particular Historically Disadvantaged South Africans (HDSAs), as well as participation of women in mining. Similar requirements would be applicable to Business Partners and certain categories of suppliers. It is expected that temporary employees on the Gamsberg Smelter Project would not have the same opportunities as permanent employees to benefit from training programmes. While many construction opportunities would only involve unskilled or semi-skilled positions, the acquisition of new skills during their employment would make these workers more employable in the future.

Local employment by the Gamsberg Smelter Project during the construction phase could improve livelihoods and income stability of future employees and their families, especially if they originate from vulnerable households. Salary remittances by employees, who do not originate from the local area, could also provide some relief and increased purchasing power outside the local area.

It is noted that some temporary employees and their families may find themselves worse off after the construction phase, as they may cease to be able to uphold the elevated quality of life to which they became accustomed. However, as was mentioned, the acquisition of new skills could make people more employable in the future.

According to current planning, the development of Phase 2 of the Gamsberg Zinc Mine may partly overlap with the construction of the Gamsberg Smelter Project. Although the two processes would be separate, the presence of a second large construction workforce could cumulatively contribute to the indirect benefits of local employment. It is expected that the influx of jobseekers may increase due the relatively large number of temporary work opportunities that would become available at the same time. However, many jobseekers will be unsuccessful in obtaining jobs, which could lead to various negative impacts (see Section 33).

The availability of job opportunities during construction phase could result in some farmworkers on surrounding farms abandoning their jobs to seek work at the Gamsberg Smelter Project resulting in an inconvenience for the farm owners.

Based on the above, although the positive impact would occur over the short-term construction period, the intensity prior to mitigation is high with the impact reaching local municipal areas and possibly extending as far as the provincial level (with the implementation of enhancement measures). The significance of employment creation during the construction phase is thus likely to be HIGH positive without mitigation, increasing to VERY HIGH positive with mitigation (Table 31-1).

Table 31-1: Impact summary – Employment Creation during Construction Phase

Issue: Employment Creation		
Phases: Construction Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Prominent change (H)	Substantial change or improvement (VH)
Duration	Short-term (L)	Short-term (L)
Extent	Local area, extending far beyond the site boundary (H)	Regional (VH)
Consequence	High (H)	High (L)
Probability	Probable (H)	Definite (VH)
Significance	High + (H+)	Very High + (VH+)
Nature of cumulative impacts	Worker's wages will contribute to increased spending power, which would have a ripple effect on the local economy. The impact could ensure that benefits such as skills development extend beyond the construction phase and that workers can take on other jobs when new projects/ developments are established in the region. The presence of a second large construction workforce for Phase 2 of Gamsberg Zinc Mine could have a positive cumulative effect on the local and regional economy and living conditions of successful jobseekers.	
Degree to which impact can be reversed	N/A	
Degree to which impact may cause irreplaceable loss of resources	N/A	
Residual impacts	Implementation of enhancement measures could further stimulate food security, and enhance skills development at the local and regional level.	

Mitigation/ Enhancement Measures

It is consistent with national legislation and international best practice standards that local communities and labour sending areas are given special consideration in terms of employment benefits arising from the Gamsberg Smelter Project.

It is anticipated that Black Mountain Mining (Pty) Ltd already have the necessary systems and processes in place to undertake the identification and recruitment of construction workers, since they have been in operation for some time. However, in order to enhance the benefits of job creation for local towns and communities in the Khâi-Ma municipal area, it is recommended that the following measures be considered:

- The Gamsberg Smelter Project should identify its required core skills and extend employee skills audits to investigate the prevalence of required skills in the municipal towns/ communities, and structure its skills development endeavours accordingly.
- Ensure, through a structured stakeholder engagement programme, that communities are aware of local employment requirements and opportunities that are available. Where required, the local resident status of applicants should be verified in consultation with community representatives and municipal structures.
- Clearly advertise the nature and numbers of jobs available during the project phases in surrounding communities, and ensure that communities understand the Gamsberg Smelter Project's local recruitment procedures. Eligibility criteria should be informed by local authorities, or similar, and clearly communicated to any potential beneficiaries.
- Recruitment should be coordinated through local offices of the Department of Labour (if present) or bona fide recruitment agencies. If this is not feasible, locate the recruitment offices at a central point (but not on-site) to control access and movement of jobseekers. A recruitment registry should be created for jobseekers to record relevant qualifications, work experience, and contact details.
- Formalise preferential employment of women and youth in the company recruitment policy. Performance indicators for promoting the employment of women and youth should be developed and implemented by the Gamsberg Smelter Project and its Business Partners. The positions reserved for these groups may only be filled with persons outside of these categories when it can be clearly demonstrated that no suitable persons are available.
- An up-to-date skills database would greatly facilitate local employment. It is suggested that the Gamsberg Smelter Project engage with the relevant municipal departments and/or active NGOs in developing this database. The database should be in place in advance of the Business Partners being appointed. The database should include documentation verifying the eligibility status of applicants.
- Where possible, labour-based methods of construction (e.g. digging of trenches), should be used to maximise the Gamsberg Smelter Project's requirements for unskilled labour. If feasible, offer appropriate training and skills development to improve the ability of local community members to take advantage of employment opportunities arising.
- Consider the unbundling of suitable tenders to provide opportunities for local service providers.
- Tender criteria should require the relevant Business Partners to provide training and skills development to the locally recruited workforce. Where possible, training should be aimed at providing skills to employees that might enable them to apply for some permanent positions that become available once construction is complete, or at other construction companies active in the local and regional study area.
- Continue with established training programmes based on the skills needs and gaps identified for the Gamsberg Smelter Project. Training should preferably be National Qualifications Framework (NQF)

accredited and training providers must be registered with the relevant Sector Education and Training Authority (SETA).

- Develop and implement an Adult Basic Education and Training (ABET) Programme, for both workers and people from local communities. Such programmes could be incorporated into the SLP. Prioritise inclusion of women and vulnerable people in ABET programmes and other training programmes available to the local community.
- Provide opportunities for those locals who received ABET training to be employed on the Gamsberg Smelter Project or be considered for procurement contracts with the Gamsberg Smelter Project.
- Identify suitable students from local schools to participate in company bursaries and internships programmes (if any), through extending the SLP Skills Development Plan to include people from the local area.
- Provide employees with reference letters that they can submit to gain further employment. Also, provide certificates of completion for on-the-job training.

Monitoring

Monitoring of the following indicators is required:

- Local Employment Policy on file;
- Recruitment records;
- Business Partner Management Plans on file;
- Labour pool database is developed and kept up-to-date; and
- Records of employee places of origin.

Follow-up compliance monitoring should also be undertaken to ensure that the Gamsberg Smelter Project and its Business Partners honour local employment policies and other measures to enhance local employment.

31.2.2 Operational Phase

Potential Impacts

Even if only a small number of local people are appointed on the Gamsberg Smelter Project during its operational phase, there would still be minor indirect benefits for the local economy. These include a degree of indirect job creation, such as workers and their families using local people for private maintenance services (e.g. housekeeping or gardening services). An additional economic benefit would be multiplier effects associated with increased local spending on consumables and other services.

The construction and operation of the Gamsberg Smelter Project would require the purchase of equipment and would generate large contracts. Many of these would be for highly specialised and technical work, which would be provided by specialist providers of goods and services. However, there could still be potential for local businesses to feed into the supply chain by supplying goods or services. For those companies that do get the opportunity to be part of this supply chain, there would be significant benefits for the businesses and their employees.

The proposed SLP expenditure for the first 5-year cycle includes approximately R136 million for Human Resources Development and R86.5 million for Local Economic Development (LED). It is expected that the Project SLP and LED Plan would provide benefits to the local economy by stimulating the growth of small businesses and contributing towards skills development. Local businesses that supply the Gamsberg Smelter Project may be able

to expand their businesses. If implemented effectively and sustainably, expenditure could represent progress within the local municipality, thereby creating conditions conducive to economic growth.

Thus, in addition to creating direct local employment opportunities, the Gamsberg Smelter Project could also lead to indirect employment in the formal and informal sectors following project expenditure in the local area and through the creation or expansion of local businesses to serve the Gamsberg Smelter Project and its workforce.

Due to the long-term benefits and that they could extend far beyond the project area for those that are employed, without the implementation of enhancement measures the significance is expected to be HIGH. With enhancement measures the overall significance could be VERY HIGH (Table 31-2).

Table 31-2: Impact summary – Contribution to the Local Economy Through Employment Creation and Economic Stimulus

Issue: Contribution to the Local Economy Through Employment Creation and Economic Stimulus		
Phases: Operational Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate + change (MH)	Prominent + change (H+)
Duration	Long-term (H)	Long-term (H)
Extent	Local area, extending far beyond site boundary (H)	Regional (VH)
Consequence	High (H)	Very high (VH)
Probability	Possible, frequent (M)	Definite (VH)
Significance	High + (H+)	Very high + (VH+)
Nature of cumulative impacts	In an area which currently has a very high unemployment rate, long-term employment for local community members is highly significant in terms of contribution to the local economy. There are a number of other potential indirect employment opportunities related to the Gamsberg Smelter Project as well as other projects in the region which would have a HIGH positive cumulative impact on the local economy.	
Degree to which impact can be reversed	N/A	
Degree to which impact may cause irreplaceable loss of resources	N/A	
Residual impacts	The Gamsberg Smelter Project, with the implementation of enhancement measures, is likely to have a VERY HIGH positive residual impact on the local economy.	

Mitigation/ Enhancement Measures

The following measures are recommended:

- The Project and its Business Partners must consider the use of HDSA companies in their procurement practices. To maximise the empowerment of HDSA companies (and sharing in project benefits by disadvantaged communities in general), the Gamsberg Smelter Project should attempt to procure from local suppliers throughout the life of the project.

- Black Mountain Mining (Pty) Ltd, through its Corporate Social Investment (CSI) initiatives, is investing in local development programmes and is providing sponsorship for community initiatives. It is recommended that the Gamsberg Smelter Project participate in activities that would contribute to addressing underlying development issues such as education and health (including HIV/AIDS).
- It is recommended that CSI initiatives make provision for including vulnerable groups. These investments would afford communities the opportunity to improve their living conditions and environment. Host communities must be well organised to receive such benefits.
- Promote establishment and upgrading of services and infrastructure, where feasible, through Black Mountain Mining (Pty) Ltd SLP and LED priorities.
- Identify and invest in projects that meet the criteria of Black Mountain Mining (Pty) Ltd and relevant legislation (e.g. poverty eradication, infrastructure development and welfare creation projects). Projects could include providing financial support to higher education institutions, as well as providing bursaries to qualifying employees.
- Continually assess the projected Integrated Development Plan (IDP) and LED initiatives of local municipalities to ensure that the SLP commitments remain relevant in terms of the above initiatives.
- Liaise with relevant local and district planning departments responsible for integrated development planning and LED to assess if partnerships could be created as part of Black Mountain Mining (Pty) Ltd IDP and LED initiatives.

The following measures are proposed to realise the potential benefits of local procurements:

- Include local procurement targets in the Gamsberg Smelter Project's procurement policy and Business Partner contract agreements.
- Develop procedures for the procurement policy to ensure preferential procurement in accordance with BBBEE and the Mining Charter requirements.
- Develop a Procurement Progression Plan as required in terms of the SLP to benefit local procurement.
- Develop and implement skills development and training targets for local procurement and include these in Business Partner contracts.
- Compile/ update a database of local and district service providers, and issue new contracts to service providers who show an interest in the provision of specific services. A business survey could be conducted to inform this database. Where applicable, use databases from projects within the local area and municipalities.
- Update the Gamsberg Zinc Mine's existing supplier database to include suppliers that may qualify for procurement opportunities after receiving training/ support. Identify procurement opportunities and goods/ services that could be supplied by local Business Partners.
- Develop internal mechanisms for unbundling contracts where possible to realise the above opportunities.
- Ensure that local businesses are aware of the procurement needs of the Gamsberg Smelter Project and have sufficient information to prepare tenders.

Monitoring

The following monitoring is recommended:

- Annual audits to ensure compliance with the above requirements.

- Monitor procurement practices of Business Partners and enforce requirements.

31.2.3 Decommissioning Phase

Potential Impacts

Several socio-economic impacts could arise when operations cease and the Gamsberg Smelter Project is decommissioned. Socio-economic issues that should be investigated include:

- Impacts on the workforce – Psychological issues (distraction from normal activities, with a negative impact on performance and safety), and personal and family income issues (e.g. concerns about the effect of reduced income on family life).
- Impact on the workforce residing in Aggeneys – Permanent workers may be required to vacate their houses after retrenchment. It is possible that many residents would not make financial provision for alternative housing post closure. This may leave many workers destitute.
- Impacts on the local community – Economic dependency if no new jobs are created or if remuneration levels are lower than those in the mining sector. This might impact negatively on the local economy, demographic changes (e.g. migration of skilled workforce from the area), as well as dependency on some SLP initiatives (e.g. financial support for development programmes may be withdrawn).
- Impacts on the wider community - Financing of decommissioning (adequate funds may not have been provided for site rehabilitation), and maintenance of infrastructure (e.g. the Black Mountain Mining (Pty) Ltd assistance with road maintenance).
- Impacts on surrounding district and local governments - Municipalities would no longer directly or indirectly (through provincial/national government) receive tax and royalty payments.

The life of the Gamsberg Smelter Project could potentially be extended beyond the cessation of mining activities. The potential use of the site for other land uses post-closure should be considered in closure planning.

When the smelter is decommissioned, there would be a reduction in the economic stimulus to maintain the current state of the local economy, and for further growth. This impact would be cumulative with regard to job losses, the closing down of businesses, and decrease in local investment and spending resulting in an overall economic slow-down.

It is not known if the Gamsberg Smelter Project's workforce would be transferred to other projects when the smelter is decommissioned. However, it is likely that local employment at the Gamsberg Smelter Project would be lost at closure. Those locally employed at the Gamsberg Smelter Project are likely to be unskilled or semi-skilled employees and therefore less employable than their skilled counterparts. It would be more difficult for them to secure jobs once they have been retrenched. If they have accumulated sufficient work experience and have benefitted from training and mentorship, they would be more employable and more likely to obtain similar work elsewhere, possibly at another mine. If, however, they are unable to secure alternative employment, the loss of work would mean the loss of a stable income source for their families.

Retrenchments are also possible due to external forces that reduce profitability, and/or technical innovation or changes to the Gamsberg Smelter Project's strategic business plan. Retrenchments would lead to a loss of income and local expenditure, particularly if other projects in the area also approach the end of their economic life at a similar time, and if no new mines/ projects are developed. Retrenched staff may be unable to maintain their lifestyle and see their level of indebtedness increasing. Inability to find alternative employment could also lead to an increase in social pathologies such as alcohol and drug abuse and crime.

Locally, suppliers could also be affected as the opportunity to sell goods and services to the Gamsberg Smelter Project and Aggeneys town would be lost. This would also affect those companies that supply these businesses with goods and services.

It is expected that the Project's LED and CSI initiatives would contribute to the diversification of the local and regional economy and an enabling environment that would foster sustainable community-based development. However, the Project's LED initiatives could increase, rather than reduce dependency of the local economy on the Gamsberg Smelter Project if they are not planned and managed in such a way as to ensure their sustainability beyond the life of the Gamsberg Smelter Project.

A major concern of both Khâi-Ma Local Municipality and Namakwa District Municipality relates to the future of Aggeneys post mining and smelter activities. Currently, the municipalities do not have the resources and capacity to take over the management and maintenance of the town and this situation is expected to continue.

Should nothing be done to plan for the Gamsberg Smelter Project closure and decommissioning the intensity of the impact would be prominent and could have impacts over the long-term on a regional scale. The significance of this impact is thus VERY HIGH negative with no mitigation. Should measures be taken to plan for the closure the impact can be reduced to HIGH negative (Table 31-3).

Table 31-3: Impact Summary – Dependency on the Project for Sustaining the Local Economy at Decommissioning

Issue: Dependency on the project for sustaining the local economy		
Phases: Decommissioning Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Prominent change, disturbance or degeneration (H)	Moderate change, disturbance or degeneration (M)
Duration	Very long, permanent (VH)	Long term (H)
Extent	Local area, extending far beyond the site boundary (H)	Local area, extending far beyond the site boundary (H)
Consequence	Very High (VH)	High (H)
Probability	Probable (H)	Probable (H)
Significance	Very high (VH)	High (H)
Nature of cumulative impacts	Job losses, mine closure and discontinuing of operational expenditure would have a cumulative negative effect on workers, businesses, local towns (including Aggeneys) and local municipalities. If mitigation measures are not effective, deterioration of the situation and further dependence on government can be expected. The cumulative impact is assumed to be MEDIUM as with skills development the workforce could potentially find work in other projects in the area.	
Degree to which impact can be reversed	Low	
Degree to which impact may cause irreplaceable loss of resources	N/A	
Residual impacts	Even with mitigation, closure of the smelter would have a negative effect on those who benefitted from the Gamsberg Smelter Project. The residual impact is assessed to be HIGH negative.	

Mitigation/ Enhancement Measures

The following measures should be implemented:

- Develop a Closure Plan (which includes socio-economic measures) at the start of the Gamsberg Smelter Project to include the following:
    - Predict the likely socio-economic impact of closure on employee households, local communities and the region, and recommended measures to address these impacts;
    - Identify critical issues which could affect the on-going sustainability of employees and communities during closure, by means of a detailed consultation process;
    - Identify alternative livelihood and socio-economic development opportunities for employees, as well as community-based projects which may become sustainable over the long-term; and
    - Provide financial and/ or technical support for the establishment of sustainable community projects.
    - It is recommended that the Closure Plan provide more detail on how the Gamsberg Smelter Project would assess and mitigate/manage the social and economic impacts on individuals, communities and the local economy when retrenchments and closure is certain. When downscaling and/or retrenchment take place, the Gamsberg Smelter Project should assist affected employees in finding alternative employment or livelihood opportunities. This should be done if workers cannot be integrated or redeployed to other operations or if they are not of a retirement age.
- Specific consultative measures related to closure must be defined in the SLP, including:
    - Establishment of a Future Forum for the purposes of:
        - Promoting on-going discussions between employer and employee regarding the future of the Gamsberg Smelter Project;
        - Identifying solutions to problems/challenges which could arise and impact on the operation of the Gamsberg Smelter Project;
        - Discussing issues concerning retrenchment and downscaling, and identifying turnaround strategies;
        - Developing and implementing prevention and/or redeployment strategies in the management of retrenchments;
        - Coordinating the notification process during retrenchments or closure; and
        - Mobilising the Department of Labour Social Plan Services for technical assistance on job advice, and retrenchment during retrenchment and closure.
    - Implementation, in accordance with the MPRDA, of a consultation process in terms of Sections 189 and 189 (A) of the Labour Relations Act. This consultation process would commence when the Gamsberg Smelter Project decides to reduce its operational activities. Project management and members of the Future Forum would administer this consultation process.
    - Approaching the Department of Labour for the utilisation of its resources and support services, such as counselling services and placement services offered by its Labour Centres.

- Informing affected areas, such as the local municipality and labour sending areas, of imminent retrenchments. The full impact of such retrenchments would be disclosed to the municipalities and possible solutions discussed.
- As is required by law, the Gamsberg Smelter Project should in partnership with the relevant government departments, manage any process of this nature. The integration of the workforce into various LED projects, if required, would be done in collaboration with local municipalities, and other stakeholders serving on the LED Forum. Where workers cannot be absorbed into LED initiatives, they should be furnished with skills training opportunities, enabling them to find alternative employment after decommissioning or retrenchment. Other initiatives could focus on assessment and counselling services for affected individuals.
- Liaise with institutions (for example the National Productivity Institute) to identify other economic sectors and ventures that could absorb employees. This would involve the development of alternative livelihoods over a number of years to ensure that these livelihoods are well developed by the time the Gamsberg Smelter Project is decommissioned.
- Partner with LED programmes of other projects and the local municipalities, as this would strengthen project initiatives, whereas initiatives funded by the Gamsberg Smelter Project alone may not be as effective.
- Ensure that employees are trained in alternative skills and link this training to the initiatives described above.
- Provide financial life skills to employees.
- Develop an exit plan for the hand-over of Aggeneys post closure if the smelter would continue to operate after closure of the Gamsberg Zinc Mine. In either event, Black Mountain Mining (Pty) Ltd should take responsibility for developing the exit plan. This should be done in conjunction with the Northern Cape Provincial Government and local authorities. Other large development projects in the area could participate in this process if they would consider taking over some of the accommodation for their staff.

Monitoring

- Annual audit of the Closure Plan.

32. ISSUE 32 IMPACT OF THE MULTIPLIER EFFECT ON THE LOCAL AND REGIONAL ECONOMY

32.1 DESCRIPTION OF IMPACT

There are legal, and other, requirements for the Gamsberg Smelter Project to contribute to the socio-economic development of its host communities. This would result in several economic benefits through direct employment and multiplier effects, further stimulated by capital expenditure during the construction phase.

Construction phase activities could increase the demand for a variety of goods and services (e.g. construction materials, fuel, professional services, consumable items for the workforce, etc.). This may stimulate growth in the local and regional study areas' construction and service sectors. This economic environment may also generate opportunities for SMMEs in the local study area, provided they are formalised and able to meet the procurement requirements of the Gamsberg Smelter Project.

Population influx (see Section 33) is generally associated with negative consequences. However, this influx of people could present improved opportunities for entrepreneurs and could offer other benefits for the economy. Construction workers and jobseekers would require consumable items (food/clothes), various forms of entertainment, etc., while jobseekers would require accommodation – to which local residents may respond by renting out rooms on their properties. Owners of accommodation facilities (e.g. guesthouses) may build additional rooms to accommodate contractors or service providers. These are new opportunities for businesses to emerge and for existing ones to reposition themselves to changing market requirements. This would especially be the case if migrants have higher-level occupations and relatively high disposable incomes.

32.2 IMPACT ASSESSMENT

32.2.1 Construction Phase

Potential Impacts

Local and regional procurement spend could enhance the positive economic impacts of the Gamsberg Smelter Project, as the revenue accruing to enterprises could produce some beneficial downstream impacts on the local and regional economy. In addition, increases in the number of consumers could increase earnings for retail businesses, traders and other consumer services in the local area.

It is expected that a significant proportion of wages would be spent in the local and regional areas, including bigger towns such as Springbok, which supplies a wide range of goods and services. This could create additional revenue for these businesses, thus acting as a catalyst for economic growth. This impact could extend to other local municipalities following salary remittances to these areas.

As was mentioned, the development of Phase 2 of the Gamsberg Zinc Mine may overlap with the construction of the Gamsberg Smelter. The influx of jobseekers may be significant due the large number of available work opportunities.

Local municipalities may also benefit from rates and taxes imposed on the Project, as well as, potentially, from an increased tax base. This injection into local municipalities could contribute to development, thereby creating conditions conducive to economic growth.

The further development of Aggeneys (e.g. to accommodate the smelter permanent workforce) may, however, lead to a growth in businesses in Aggeneys to provide goods and services to the increased number of residents in the town. This concentration of businesses in Aggeneys could mean that businesses in other towns would not benefit from this positive impact.

Without enhancement measures being implemented the positive impact is expected to have a moderate intensity over the short-term construction phase affecting the local municipal areas. The significance of multiplier effects on the local and regional economy during the construction phase and beyond is thus anticipated to be MEDIUM positive without mitigation. This can be increased to HIGH positive with the implementation of enhancement measures (see Table 32-1).

Table 32-1: Impact Summary – Multiplier Effect on the Local and Regional Economy during Construction Phase

Issue: Multiplier Effect on the Local and Regional Economy		
Phases: Construction Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate + change (M)	Prominent + change or improvement (H+)
Duration	Short-term (L)	Short-term (L)
Extent	Local area, extending far beyond the site boundary (H)	Regional (VH)
Consequence	Medium (M)	High (H)
Probability	Probable (H)	Definite (H)
Significance	Medium + (M+)	High + (H+)
Nature of cumulative impacts	The impact could ensure that local businesses and new entrepreneurs could grow their businesses, improve their income, gain considerable business experience and improve their skills. These benefits may put them in a better position to provide their goods and services to other development projects and beyond the local study area. The economic multiplier effect in general could further boost the growth of SMME's, improve the living conditions of marginal groups and boost service delivery by local governments. The presence of a second large construction workforce for Phase 2 of the Gamsberg Zinc Mine could have a cumulative positive effect on the local and regional economy.	
Degree to which impact can be reversed	N/A	
Degree to which impact may cause irreplaceable loss of resources	N/A	
Residual impacts	Implementation of enhancement measures could further stimulate the local/regional economy, which could improve the conditions of the local business sector in particular and the local communities in general. The residual impact is expected to be HIGH.	

Mitigation/ Enhancement Measures

The recommended measures for maximising local employment would also stimulate the positive impacts of the Gamsberg Smelter Project on the local and possibly the regional economy. The following additional measures are recommended to enhance the significance of this impact:

- Identify procurement opportunities and goods/services that could be supplied by local contractors and service providers.
- Give preference to suitable sub-contractors or SMMEs located firstly in the surrounding towns/ settlements, then in Namakwa District and then to contractors located outside the Namakwa District.

- Develop a register of SMMEs and the types of goods and services they provide. Work with local municipalities to develop SMMEs through relevant forums and committees.
- Where feasible, promote procurement from local enterprises above the targets set out in the Mining Charter.
- Include local procurement requirements/ targets in procurement policies and Business Partner agreements. Monitor the procurement practices of Business Partners and enforce requirements. If contracts are awarded to non-local service providers, Business Partners should demonstrate that reasonable action was taken to identify a local service provider.
- Clearly advertise the nature and extent of local procurement opportunities during all project phases. Ensure that local communities understand the procurement procedures. Ensure that local businesses are aware of the procurement needs of the Gamsberg Smelter Project and have sufficient information to prepare tenders.
- Develop mechanisms for unbundling contracts to realise the above opportunities. This could enhance economic opportunities in areas such as entrepreneurship development and the development of skills for employment and economic development.
- Empower local businesses in centres such as Pofadder, and possibly Pella and Onseepkans, and support development initiatives in the Gamsberg Smelter Project's labour sending areas and towns. Where SMMEs do not exist locally, investigate the possibility of launching a training/ skills development initiative under the auspices of the skills development programme required for the SLP.
- Establish/ uphold applicable communication mechanisms with district and local government, communities, as well as community engagement forums or similar functions.

Monitoring

Monitoring of the following indicators is required:

- Record of identified procurement opportunities;
- Record of enquiries/ responses received to advertised tenders;
- Record of tenders awarded; and
- Plan is developed for SMME support and partnerships and is kept on file.

33. ISSUE 33 IMPACT AS A RESULT OF PROJECT-INDUCED POPULATION INFLUX

33.1 DESCRIPTION OF IMPACT

As news regarding the proposed Gamsberg Smelter Project spreads, expectations with regard to possible employment opportunities at the smelter (and at the Gamsberg Zinc Mine) will increase. Consequently, local communities and towns may experience an influx of job seekers. The magnitude of this impact is influenced by the severity of poverty and unemployment as people are more inclined to travel longer distances in search of improved livelihoods through employment. The impact could commence prior to construction and continue throughout the operational phase.

The Project's location is relatively isolated, with the nearest town being Aggeneys. Other towns and communities, such as Pofadder, Pella, Witbank and Onseepkans are located more than 40 km from the Gamsberg Smelter Project and it is therefore not expected that population influx would be significant at the Gamsberg Zinc

Mine, however, it could have an impact on the abovementioned towns. Informal settlement and illegal land occupation at Aggeneys town and surroundings areas are stringently prohibited and controlled by the BMM Security and the local police.

Of concern is the possibility that residents of Aggeneys could provide accommodation for job seekers (both prior to and during the construction and operational phases of the Gamsberg Smelter Project) to increase their income. This could lead to overcrowding and associated health issues, as well as pressure on local services (e.g. police and clinic), and possibly an increase in social pathologies.

Towns such as Pofadder and Pella already have to deal with increasing informal settlement, which places a burden on both the towns and local authority. An additional influx of jobseekers and, potentially, their families, would put additional pressure on the Khâi-Ma Local Municipality for the provision of basic services and collecting rates and taxes. Furthermore, the proportion of the workforce that would be recruited from outside the local municipality would also constitute an additional influx of people.

The presence of a large workforce requires the establishment of sizeable construction camps. Should the construction of the Gamsberg Smelter Project coincide with Phase 2 of Gamsberg Zinc Mine development, a new construction camp would need be established within the MRA.

While circumstances in the construction camp can be monitored to a large degree, it would not be possible to control the interaction between workers and locals. It is expected that the influx of construction workers and jobseekers would have a variety of negative social consequences.

33.2 IMPACT ASSESSMENT

33.2.1 Construction Phase

Potential Impacts

Increased pressure on local services and facilities

It is expected that an increase in population within the local area would increase pressure on infrastructure and service delivery, especially in areas where service delivery is already lacking. Furthermore, it is expected that newcomers would mostly consist of socio-economically depressed households, meaning that there would be an increased demand on public healthcare, schools, and other municipal services and facilities.

Establishment and growth of informal settlements

The shortage of services in the local area includes a shortage of affordable housing, which could fuel the establishment and growth of informal settlements. Informal settlements, because of their lack of access to services, tend to be associated with several economic, social and health-related problems, such as increased dependency on local government.

Increase in social pathologies

The influx of jobseekers is also often associated with an increase in social pathologies, such as substance abuse, prostitution, crime, increased incidence of sexually transmitted diseases and other communicable diseases. Several social pathologies, especially HIV/AIDS, petty crime, drug and alcohol abuse and gender violence, are already a problem within impoverished communities in the local area. This situation makes impoverished households especially susceptible to this impact.

It is possible that risky behaviour, such as substance abuse and sexual promiscuity, could increase because of irresponsible spending associated with newly available and/or increased disposable income among construction workers in the local area.

Many jobseekers would be also left unemployed. Hence, the incidence of crime could increase if failed jobseekers remain in the local area and revert to criminal strategies for survival. Even if some criminal activities are not

associated with the newcomers, they may still be attributed to them by local communities. In addition, an increase in crime would also negatively affect farmers in the project area, both in terms of their health and safety and their sense of security.

Hostility or conflict between newcomers and incumbent population

Although a proportion of the construction workforce could originate from the Khâi-Ma Local Municipality, it is expected that a significant number of employees would be sourced from elsewhere in the region/province. It is possible that hostility and conflict would arise between those perceived as foreigners and local residents. One reason for such conflict could be the perception among locals that outsiders are taking up jobs that could have gone to people in the local municipality. Similar conflict could arise if Business Partners recruit non-locals.

Without the implementation of mitigation measures the impact could affect the population in the local area and would continue for the short-term of the construction phase when jobs are most available. The significance of project-induced population influx during the construction phase prior t mitigation is thus expected to be HIGH negative without mitigation, decreasing to LOW negative with mitigation (Table 33-1).

Table 33-1: Impact Summary – Project-Induced Population Influx during Construction Phase

Issue: Project-Induced Population Influx		
Phases: Construction Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Prominent change (H)	Moderate change or disturbance (M)
Duration	Short-term (L)	Short-term (L)
Extent	Local (M)	Local (M)
Consequence	High (H)	Medium (M)
Probability	Probable (H)	Possible/frequent (M)
Significance	High (H)	Low (L)
Nature of cumulative impacts	New activities at the Gamsberg Zinc Mine and/or other projects in the area (e.g. solar projects) could increase the number of jobseekers, many of whom would be unsuccessful in securing employment. This situation would intensify the issues related to population influx. The presence of a second large construction workforce for Phase 2 of Gamsberg Zinc Mine would have a cumulative negative effect. The cumulative impact is assessed to be MEDIUM.	
Degree to which impact can be reversed	Low	
Degree to which impact may cause irreplaceable loss of resources	N/A	
Residual impacts	Experience has shown that development projects and their host municipalities often struggle to manage this impact. This means that the impacts described above are often left to district/ provincial government to mitigate. It is therefore critical that the Project accepts its potential contribution to mitigate this impact. The residual impact is assessed to be LOW negative provided mitigation measures are implemented.	

Mitigation/ Enhancement Measures

The following mitigation measures are recommended:

- Measures to address population influx:
    - Depending on the severity of the impact, the Gamsberg Smelter Project could financially assist the municipalities in undertaking a high-level situation analysis and, depending on the findings of this analysis, commission a detailed management plan together with Government role players. The Gamsberg Smelter Project may also be in a position to provide technical support.
    - Robust regulatory measures must be instated to manage informal settlement, unlawful land occupation at/ near the Gamsberg Smelter Project site, as well as unauthorised sub-letting of houses in Aggeneys. Suitable protocols should be instated to identify and manage instances where unlawful occupation and overcrowding of houses occur.
    - The recruitment of employees and Business Partners should be executed as per Section 31.2.1 (especially in terms of preferentially employing from the local area), thereby discouraging loitering near the Gamsberg Smelter Project site or in Aggeneys.
    - Ensure that recruitment policies are clearly communicated to discourage influx of jobseekers from other areas and to prevent potential community conflict.
    - Involve the local municipality and community structures (e.g. ward councillors) to assist in communicating the intention to give preference to local labour, and to assist in identifying the recruitment stations and protocol.
    - It is strongly recommended that the Project liaise with the local municipality to ensure that housing shortages and expected population influx are taken into account in the SLP and LED programmes.
- Measures to minimise the occurrence of social pathologies:
    - Black Mountain Mining (Pty) Ltd should ensure that the Gamsberg Smelter Project and its Business Partners develop and implement an HIV/AIDS awareness and prevention programme amongst its employees, and make this a condition of contract for any suppliers and sub-contractors.
    - The Gamsberg Smelter Project should provide an adequate supply of free condoms to workers.
    - Access at the construction sites must be controlled to prevent sex workers and petty traders from visiting and/or loitering near the construction camps.
    - Support suitable government agencies, clinics, schools and NGOs involved in raising community awareness and education on sexually transmitted diseases (STDs) and substance abuse.
- Measures to address crime include:
    - Construction workers should be clearly identifiable by wearing construction uniforms displaying the logo of the construction company. This could prevent opportunistic persons wandering near the sites under the guise of being construction employees.
    - Black Mountain Mining (Pty) Ltd should consult with the South African Police Service (SAPS) and/ or security firms active in the area to establish standard operating procedures for the control and removal of loiterers at the aforementioned sites.
    - Appropriate liaison structures should be established with local police services to monitor social changes in crime patterns. Liaison should also be established with existing crime control organisations, such as community policing forums.

- Through the abovementioned forums, identify if recorded criminal activities (for example housebreaking) has any connection with the Gamsberg Smelter Project workforce. Verify claims of surrounding communities in this regard and take appropriate action.

- Measures to address potential conflict between locals and non-locals:
  - The Gamsberg Smelter Project's recruitment and employment policies should be fair, transparent and readily available.
  - Selection criteria for the recruitment of construction workers should be clearly communicated and carefully explained to all stakeholders. Selection criteria should be applied transparently to prevent speculations regarding corruptive practices in recruitment processes.
  - Establish a grievance procedure and mechanism at a location that is accessible to aggrieved members of the surrounding communities.
  - Develop standby procedures with the local police and private security services to assist with any security incidents.
  - In the event of notable friction/ conflict between locals and non-locals, a conflict management plan may have to be developed and implemented in conjunction with other key stakeholders.

Monitoring

The following monitoring should be undertaken:

- Annual audits to ensure compliance.

34. ISSUE 34 IMPACTS RELATED TO THE PRESENCE OF CONSTRUCTION WORKERS

34.1 DESCRIPTION OF IMPACT

There is existing accommodation (construction camp) at the Gamsberg Zinc Mine to accommodate the construction workforce for the Gamsberg Smelter Project. However, a new construction camp would be established if Phase 2 development of the Gamsberg Zinc Mine overlaps with the construction phase of the Gamsberg Smelter Project.

It has been well documented for other development projects that a construction workforce is often a key concern for local property owners and surrounding communities. They could also pose health and safety related risks, in addition to aspects such as the social pathologies and conflict between locals as discussed in Section 33.2.1. In addition, the actions of workers could result in environmental damage (e.g. littering and veld fires).

34.2 IMPACT ASSESSMENT

34.2.1 Construction Phase

Potential Impacts

The presence of food stalls near the Gamsberg Zinc Mine/ Gamsberg Smelter Project access roads to provide goods to construction workers, may result in nuisance issues and risks (e.g. safety risks related to the movement of heavy vehicles, as well as health risks related to un-hygienically prepared food). While it is unlikely that this would occur (given the long distances between the Gamsberg Smelter Project and surrounding settlements), such activities should be prohibited.

Specific impacts from the presence of a construction workforce could stem from the following:

- Negligence with regard to starting fires near the Gamsberg Smelter Project construction site, which could pose a fire hazard;
- Lack of control over the movement of contract employees in terms of unauthorised access to property;
- Perceived or actual safety/security risks and increases in crime emanating from the presence of construction workers;
- Littering and loitering by construction workers;
- Damage to the biophysical environment; and
- Crime, poaching and stock theft.

A construction workforce often comprises a high proportion of single males, which is generally associated with an increase in social disturbances, such as substance abuse and other negative factors. The Gamsberg Smelter Project should exercise a high degree of control over its construction workforce and Business Partners in line with contract agreements and regulations with regard to the management of these partners. However, it is recognised that it would not be possible, or tolerable, to control interaction between workers and local communities.

The impact due to the presence of construction workers would be short-term with a medium intensity and would likely affect immediate surrounding areas. The overall significance during construction is thus anticipated to be MEDIUM negative without mitigation, decreasing to VERY LOW negative with mitigation (Table 34-1).

Table 34-1: Impact summary – Negative Impacts Related to the Presence of Construction Workers

Issue: Negative Impacts Related to the Presence of Construction Workers		
Phases: Construction Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate change, disturbance or discomfort (M)	Minor change or disturbance (L)
Duration	Short-term (L)	Short-term (L)
Extent	Beyond the site boundary, affecting immediate neighbours (M)	Beyond the site boundary, affecting immediate neighbours (M)
Consequence	Medium (M)	Low (L)
Probability	Definite (VH)	Possible, frequent (M)
Significance	Medium (M)	Very Low (VL)
Nature of cumulative impacts	New activities at BMM and Gamsberg Zinc Mine would increase the number of workers and the associated need for accommodation. This situation would intensify the issues due to construction workers in the area. The presence of a second large construction workforce for Phase 2 of Gamsberg Zinc Mine would have a cumulative negative effect. The cumulative impact is assessed to be MEDIUM largely due to the distance from other towns in the area thus minimising the interaction between construction workers and the local communities.	
Degree to which impact can be reversed	Low	
Degree to which impact may cause irreplaceable loss of resources	Low	
Residual impacts	With mitigation, this impact can be managed at the construction site level. However, since the Project has little control over the construction workers' activities and behaviour off-site, some negative social consequences will remain. The residual impact is assessed to be VERY LOW provided mitigation measures are implemented.	

Mitigation/ Enhancement Measures

The following measures are recommended:

- A Business Partner Management Plan should include requirements with regard to health and safety, as well as conduct and controls for construction workers.
- Workers should be well informed of camp policies and safety requirements and should be educated with regard to their conduct in local communities.
- Appropriate facilities for washing, sanitation, sleeping, cooking, etc. must be provided, based on predetermined standards and location of such facilities. Rules of conduct must be enforced with regard to sanitation, water and waste.

- A fire safety and firefighting plan should be included in the Gamsberg Smelter Project's management plans, which should describe actions to be taken in case of a fire starting on site or at the construction camp.
- Construction workers must be trained in the use of firefighting equipment, which should be available on site.
- Refuse on site should be discarded in sealed bins and/or covered refuse containers. Refuse should be removed from the site at regular intervals and disposed of at the approved BMM waste disposal site.
- Security must monitor and control worker movement in terms of environmental, crime and related occurrences.
- Implementation of a grievance procedure whereby issues can be raised/ reported and transparently and timeously addressed.

Monitoring

The following monitoring should be undertaken:

- Annual audits to ensure compliance.

35. ISSUE 35 IMPACTS ON COMMUNITY HEALTH, SAFETY AND SECURITY

35.1 DESCRIPTION OF IMPACT

The potential impact of the Gamsberg Smelter Project activities on the health, safety, and security of the local population is assessed in this section. This includes nearby farms (people and animals), as well as adjacent enterprises, such as the guesthouse, solar farm and quarries. The potential impact would exist during all phases of the Gamsberg Smelter Project. Impact assessment

35.1.1 Construction, Operational and Decommissioning Phases

Potential Impacts

The construction of the Project could result in a number of aspects that could negatively affect the health and safety of host communities. These impacts relate to the following aspects:

- Health risks due to air and dust (Section 15) and noise (Section 16) pollution during the construction and operation activities;
- Safety risks (e.g. risk due to increased traffic – Section 28) during construction of project infrastructure, as well as during the operational and decommissioning phases;
- Effects on people's quality of life and psychological health due to stress of actual and perceived negative impacts and feelings of insecurity; and
- Increase in the spread of communicable diseases and social pathologies, because of population influx (Section 33).

Based on these potential impacts the impact on the health, safety and security of the local population is considered to have a moderate intensity, continue over the long-term and could extend beyond the site boundary. The overall significance of health, safety and security issues during the construction, operational and decommissioning phases is anticipated to be MEDIUM negative prior to mitigation and LOW negative with mitigation (Table 35-1).

Table 35-1: Impact Summary – Health, Safety and Security during All Phases

Issue: Health, Safety and Security		
Phases: Construction, Operational and Decommissioning Phase		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate change, disturbance or discomfort (M)	Minor change, disturbance or discomfort (L)
Duration	Long-term (H)	Long-term (H)
Extent	Beyond the site boundary, affecting workers and immediate neighbours (M)	Whole site (L)
Consequence	Medium (M)	Medium (M)
Probability	Probable (H)	Possible, frequent (M)
Significance	Medium (M)	Low (L)
Nature of cumulative impacts	Without implementation of all relevant mitigation measures presented by the specialist studies, incidents and risks could escalate and result in opposition to the Gamsberg Smelter Project, as well as actions by relevant government departments to ensure adherence to regulations. The cumulative impact with the implementation of mitigation measures is expected to be LOW.	
Degree to which impact can be reversed	Low	
Degree to which impact may cause irreplaceable loss of resources	Low	
Residual impacts	Health, safety and security incidents would still occur even after implementation of mitigation measures. However, the residual impact is assessed to be LOW.	

Mitigation/ Enhancement Measures

The following measures are recommended:

- In addition to the relevant mitigation measures recommended in the previous sections it is proposed that the Gamsberg Smelter Project develop and implement a project-specific Health, Safety and Security Plan (if not already in existence) which should include measures to mitigate on adjacent farms.
- Establish efficient communication strategies or stakeholder engagement programme and establish a grievance procedure and mechanism at a location that is accessible to aggrieved members of the surrounding communities.

Monitoring

The following monitoring should be undertaken:

- Monitoring of air quality, noise, groundwater etc. as per the relevant sections.
- Monitoring of the grievance procedure to ensure close out of issues.

36. CUMULATIVE IMPACTS

In this section the potential cumulative impacts on various environmental aspects are considered taking into account current operations or projects in the area as well as potential know new projects which could be developed in the area. The environmental aspects that have been assessed cumulatively in this section include:

- Biodiversity (including cumulative impact of dust);
- Groundwater; and
- Socio-economic benefits.

36.1 BIODIVERSITY

The proposed Gamsberg Smelter Project and associated infrastructure would add to the overall footprint of the existing Gamsberg Zinc Mine. The footprint comprises the direct footprint where there has been habitat loss and transformation of intact vegetation to infrastructure and the mine void as well as the indirect footprint where noise, dust and other forms of disturbance extend some distance from the actual footprint area. The following cumulative impacts have been identified as likely to be associated with the construction and operation of the proposed Gamsberg Smelter Project:

36.1.1 Contribution of the proposed Gamsberg Smelter Project to Cumulative Impacts on CBAs and Sensitive Habitats

Both the existing Gamsberg Zinc Mine and proposed Gamsberg Smelter Project are located in a designated CBA1. The direct footprint of the existing Gamsberg Zinc Mine pit, WRD and TSF will occupy approximately 1 400 ha to which the proposed Gamsberg Smelter Project would add an additional 90 ha or 6.4%. Therefore, the Gamsberg Smelter Project footprint contributes a relatively small additional impact on the CBA1 and would not directly impact irreplaceable habitat or habitats of high conservation value.

The impacts from air emissions comprising particulates and gaseous emissions is more difficult to quantify as i) the extent of impact is only modelled and not verified by any in-field monitoring results so there is no certainty on the actual level of impact on vegetation likely to occur over time; and ii) the proposed Gamsberg Smelter Project emissions directly overlaps with the dust deposition zone modelled for the Gamsberg Zinc Mine which may intensify the expected impacts on vegetation. While the air quality impacts on vegetation from the Gamsberg Smelter Project largely remain within the modelled mine dust deposition footprints it is expected that the extent and intensity of impact would diminish along a gradient with increasing distance from the primary impact source (i.e. the smelter complex).

All of the proposed Gamsberg Smelter Project impacts on sensitive habitats within the CBA1 overlap with the existing and future dust deposition impacts of the mine. Therefore, air emission-related impacts on vegetation generated by the Gamsberg Smelter Project is expected to result in impacts of increased intensity on the same habitats that have already been calculated as an area of total habitat loss for the Gamsberg Zinc Mine offset. However, the 'new' Calcrete Gravel patch (occupying an area of approximately 100 ha) identified to the north of the proposed Gamsberg Smelter Project footprint was not quantified in the Gamsberg Zinc Mine offset within which sensitive flora could be impacted to some extent by air emissions, mainly SO_2 or NO_2, from the proposed Gamsberg Smelter Project as well as dust from mining. The risk of air emissions affecting this calcrete gravel patch is highly uncertain given that it falls within the 1-2 mg/m^3 annual concentration contour for SO_2 (Figure 11-1) (which is well under the global critical annual concentration value for lichens of 10 ug/m^3/a and is situated a minimum of 1.8 km from the smelter complex at its closest point.

The Gamsberg Zinc Mine offset process still needs to implement additional conservation actions to compensate for the loss or degradation of irreplaceable calcrete and quartz patches (which are also likely to be affected by the proposed Gamsberg Smelter Project) as per recommendations by Botha *et al.* (2013). It is recommended, therefore, that the 'new' 100 ha calcrete gravel patch is i) further surveyed during the optimal season to verify its conservation importance; ii) included in the flora monitoring plan to confirm air quality impacts (Section 11), and iii) considered in any compensation measures determined for the other calcrete gravel patches.

It is essential that monitoring of the proposed Gamsberg Smelter Project impacts is detailed and included in the overall Gamsberg Zinc Mine monitoring programme and that this is fast-tracked to start obtaining a robust dataset to track changes to biodiversity over time and to verify the basis for the mine offset.

There is minimal effective mitigation for impacts on the CBA within which the Gamsberg Smelter Project is located. Applicable mitigation for vegetation impacts is listed in Sections 6, 7, 10 and 11. Of greater concern is the cumulative impact associated with additional future development planned for the area. This is discussed in Section 37.1.3.

The potential cumulative impacts are assessed to be MEDIUM.

36.1.2 Contribution of the proposed Gamsberg Smelter Project to Cumulative Air Quality Impacts on Biodiversity Offsets Secured for the Gamsberg Zinc Mine

The modelled dust deposition for the Gamsberg Zinc Mine and proposed Gamsberg Smelter Project in relation to the biodiversity offsets secured to date are shown in Figure 10-1 and Figure 10-2. The mining activities contribute significantly more to dust deposition than predicted from the Gamsberg Smelter Project based on modelled results (Airshed 2020). The cumulative dust deposition for both projects (mine and smelter) have a similar 'modelled' area of influence although the Airshed 2020 model shows a shift in deposition to the east and south compared to the original air quality model for the mine due to model and parameter differences.

Of relevance to potential impacts on the existing biodiversity offset areas, results show that i) the cumulative impacts of dust deposition from the mine and smelter complex are not expected to impact the offset farms as modelled dust below the 20 mg/m^2/day threshold (used to calculate the mine's biodiversity offset) does not overlap offset farms secured to date; and ii) the cumulative dust deposition may however impact part of the set aside area remaining within the Gamsberg MRA, potentially impacting an additional 105 ha of irreplaceable habitat that falls outside the original 2013 modelled 20 mg/m^2/day threshold. Notwithstanding the differences in dust deposition between the 2013 and 2020 models, it is emphasised that any actual impacts from dust deposition would be generated primarily by the Gamsberg Zinc Mine and not by the Gamsberg Smelter Project, which has a negligible influence on overall dust deposition.

As described in Section 11, modelled ground level concentrations of SO_2 at conservative thresholds of 2 ug/m^3/day (well under the critical value of 10 ug/m^3/day for lichens) falls within the 2013 modelled 20 mg/m^2/day dust deposition zone used to determine the mine offset. Therefore, no impact on secured offset areas for the Gamsberg Zinc Mine is expected to occur and no offset is specifically required for the Gamsberg Smelter Project.

In future, any recalculations of offset requirements for the Gamsberg Zinc Mine should take into consideration monitoring results which confirm actual impacts, rather than predicted impacts based on air quality models.

If, due to monitoring results, impacts due to the proposed Gamsberg Smelter Project become apparent over time, the project would be required to investigate additional options that may be available over time to ensure the smelter complex remains equipped with the best available technology for air quality control to further mitigate air pollution impacts.

The potential cumulative impacts are assessed to be INSIGNIFICANT.

36.1.3 Cumulative Impacts of Future Development

The potential for cumulative impacts on biodiversity in the wider Aggeneys area is a concern given the other planned developments that are taking place in this area or which may be attracted to the proposed Namakwa Special Economic Zone (SEZ). This includes both the expansion of the Gamsberg Zinc Mine (already authorised) which has a total footprint of approximately 1 400 ha as well as increasing renewable energy projects planned for the wider area.

The Northern Cape Department of Economic Development and Tourism, in conjunction with the national DTI, is in the process of finalising submission documents for the declaration of the Namakwa SEZ to be established in the Aggeneys region of the Namakwa District (https://www.globalafricanetwork.com/investment-projects/catalyst-to-economic-growth-in-northern-cape-for-south-africa/, 12 June 2020). The anchor investor of the SEZ would be the Gamsberg Zinc Mine and the Gamsberg Smelter Project.

Key goals behind the establishment of SEZ are:

- To encourage industries to develop in clusters, leading to economies of scale, skills-sharing and easier access by suppliers;
- To create industrial infrastructure to promote investment;
- To promote cooperation between the public and private sectors; and
- To use the zones as a launching pad for other developments.

Additional area for the development of the above-mentioned industries in close proximity to the Gamsberg Zinc Mine and the Gamsberg Smelter Project is likely to be required. This would result in additional pressure on the CBAs and their important biodiversity features in the area.

An estimated 9 000 ha of renewable energy projects are also planned in the wider area, although it is uncertain how many would be constructed. It can be expected that approximately 2 000 ha of additional habitat loss may be affected by renewable projects[10]. The renewable energy projects are largely concentrated within the open plains habitat of the Bushmanland arid grassland vegetation type, which is a widespread habitat of low general diversity. The major corridors of the area, such as the Koa River valley south of the site and the inselberg mountain chains, which includes the current area around Gamsberg Inselberg, would not be impacted by renewable energy development but have been targeted by mining, with the Gamsberg Zinc Mine and Black Mountain Mines being the primary footprint areas.

The primary concern with regards to cumulative impact is the specific impact of the Gamsberg Zinc Mine on unique and rare habitats and their associated species. The proposed Gamsberg Smelter Project would add approximately 90 ha to the expected mine footprint of 1 400 ha, which is considered to represent a low contribution in terms of gross habitat loss. However, should the SEZ go ahead it is likely to require significantly greater area in close proximity to the Gamsberg Zinc Mine and the Gamsberg Smelter Project and this is of particular concern given the important biodiversity of the area.

36.2 GROUNDWATER

Cumulative impacts from the entire mining activities are not anticipated. Other sources of impacts on groundwater originate from the open pit mining operations, WRDs and TSF. Impacts predicted included a drawdown cone development around the pit area due to dewatering. The drawdown of groundwater levels

[10] Calculations derived from https://egis.environment.gov.za/data_egis/data_download/current

around the Gamsberg Zinc Mine were predicted to capture and prevent the migration of any potential contaminant plume migration beyond the pit and WRD during the operational phase. The impact prediction on groundwater levels during the closure phase made by ERM (2013a) indicated that groundwater levels would not recover around the pit area and would continue to act as a groundwater sink due to high evaporation rates, which would prevent the migration of any potential contaminant plumes away from the pit area. However, SLR Consulting received feedback from the client (email from Pieter David Venter, 14 January 2020) that future mining would not progress below regional groundwater levels and that the geology in the area is such that the mountain aquifer is not connected with the aquifer in the plains/ valley. If this is the case, then no groundwater drawdown in anticipated. SLR was not tasked to conduct hydraulic testing and no hydraulic properties were available to confirm these findings. Should future mining plans indicate mining depths below regional groundwater level, then an intrusive groundwater assessment should be conducted (including hydraulic aquifer testing), to prove the two aquifers are not connected and separated by a distinct geological unit acting as a barrier to groundwater flow. Nonetheless, this would change the predictions made by SRK (2010) and ERM (2013a) regarding potential contaminant plumes being captured by the drawdown cone due to mine dewatering.

A seepage analysis was conducted in 2010 for the TSF to the northwest using underdrains beneath the underflow material in the wall zone of the TSF and cut off trenches, 5 m deep, around the proposed site. The results of the seepage analysis indicate a total flow to the cut off trench of 622 m^3/hour and the total flow not intercepted by the cut off trenches was <1 m^3/annum. Therefore, it was predicted that virtually no seepage to the underlying groundwater would occur and the potential of any contaminant movement into the groundwater was insignificant. It is anticipated that impact on groundwater quality from the existing TSF will continue to be insignificant, assuming all factors, assumptions, and limitations made by SRK (2010) remain to be true.

Current site and privately-owned regional borehole monitoring results indicated that between November 2017 and April 2019 there was no indication of pollution emanating from the Gamsberg Zinc Mine site that could affect the groundwater quality of the surrounding farm boreholes.

Groundwater levels of the monitoring network boreholes were quasi-stable and there were no adverse effects due to the pit dewatering affecting mine and regional groundwater levels.

The monitoring results between November 2017 and April 2019 indicated that current mining operations that include the pit areas, WRDs and TSF were not affecting groundwater quality and levels.

36.3 LOCAL SOCIO-ECONOMIC BENEFITS

The socio-economic benefits of the Gamsberg Smelter Project are assessed to have a high positive impact on the local community and local towns. This is primarily as a result of the spend of the project during both the construction and operational phases, together with the job and skills development opportunities that would be created for local communities. These opportunities would, however, only be realised if appropriate mechnisms are put in place to enhance the opportunities for local businesses to participate and to allocate a maximum number of jobs possible for local community members.

These benefits combined with similar benefits related to the Phase 2 expansion of the Gamsberg Zinc Mine, the creation of a SEZ around the mine and the development of numerous renewable energy projects in the area could result in significant economic benefits for the Northern Cape as a whole and the surrounding local municipalities and towns specifically. However, special effort would need to focus on upskilling the local communities to allow them to be able to take advantage of the job opportunities that would become available. Furthermore, contracting and tendering strategies would need to be structured in a way that allows for smaller local companies to take advantage of the opportunities. If managed appropriately, the positive cumulative impact on the Northern Cape economy could be significant.

Conversely, the most significant cumulative impact at the decommissioning phase (for the Gamsberg Smelter Project and Gamsberg Zinc Mine) would be the negative impact on the local area as a result of the loss of employment and the associated benefits linked to the spend of the Gamsberg Smelter Project and Gamsberg Zinc Mine in the local economy. If not managed properly and planned for well in advance, through a well-structured and implemented mine closure plan, the negative impacts on the local communities and surrounding towns would be of extremely high significance. Careful consideration needs to be given to creating alternative economic activities throughout the life of mine and upskilling staff to allow them to source alternative work when post closure. Closure planning must adopt an approach to reviewing the mine closure plan on a regular basis in consultation with local communities, local authorities and relevant government departments.

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