REPORT

Mamatwan Manganese (Pty) Ltd

Impact Assessment and Mitigation Measures Report

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1. ASSESSMENT METHODOLOGY

The criteria for the description and assessment of environmental impacts were drawn from the EIA Regulations, published by the Department of Environmental Affairs and Tourism (April 1998) in terms of the Environment Conservation Act (ECA), 1989 (Act No. 73 of 1989). Although the ECA EIA Regulations have been repealed, the Guideline Document still provides good guidance for significance determination.

The level of detail as depicted in the EIA regulations were fine-tuned by assigning specific values to each impact. In order to establish a coherent framework within which all impacts could be objectively assessed, it was necessary to establish a rating system, which was applied consistently to all the criteria. For such purposes each aspect was assigned a value, ranging from one (1) to five (5), depending on its definition. This assessment is a relative evaluation within the context of all the activities and the other impacts within the framework of the project. The impact assessment criteria used to determine the impact of the proposed development are as follows:

- Nature of the impact;
- The source of the impact;
- Affected Stakeholders;
- Extent - The physical and spatial scale of the impact;
- Duration - The lifetime of the impact, that is measured in relation to the lifetime of the proposed development;
- Intensity - The intensity of the impact is considered by examining whether the impact is destructive or benign, whether it destroys the impacted environment, alters its functioning, or slightly alters the environment itself;
- Probability - This describes the likelihood of the impacts actually occurring. The impact may occur for any length of time during the life cycle of the activity, and not at any given time;
- Mitigation - The impacts that are generated by the development can be minimised if measures are implemented in order to reduce the impacts. The mitigation measures ensure that the development considers the environment and the predicted impacts in order to minimise impacts and achieve sustainable development;
- Determination of Significance – Without Mitigation. Significance is determined through a synthesis of impact characteristics as described in the above paragraphs. It provides an indication of the importance of the impact in terms of both tangible and intangible characteristics. The significance of the impact "without mitigation" is the prime determinant of the nature and degree of mitigation required.
- Determination of Significance – With Mitigation. Determination of significance refers to the foreseeable significance of the impact after the successful implementation of the identified mitigation measures.
- All identified impacts will be assessed in accordance with the abovementioned criteria and the extended criteria.

1.1 DEVELOPMENT PHASES

Activities within the framework of the proposed development and its respective construction and operational phases, give rise to certain impacts. For the purpose of assessing these impacts, the project has been divided into two phases from which impacting activities can be identified, namely:

a) *Construction phase:*

All the construction related activities on site, until the contractor leaves the site.

b) *Operational phase:*

All activities, including the operation and maintenance of the proposed development.

The activities arising from each of these phases have been included in the tables below. This is to identify activities that require certain environmental management actions to mitigate the impacts arising from them. The criteria against which the activities were assessed are given in the next section.

1.2 ASSESSMENT CRITERIA

The assessment of the impacts have been conducted according to a synthesis of criteria required by the integrated environmental management procedure.

1.2.1. Extent

The physical and spatial scale of the impact is classified as:

a) Footprint

The impacted area extends only as far as the activity, such as footprint occurring within the total site area.

b) Site

The impact could affect the whole, or a significant portion of the site.

c) Regional

The impact could affect the area including the neighbouring properties, the transport routes and the adjoining towns.

d) National

The impact could have an effect that expands throughout the country (South Africa).

e) International

Where the impact has international ramifications that extent beyond the boundaries of South Africa.

1.2.2. Duration

The lifetime of the impact, that is measured in relation to the lifetime of the proposed development.

a) Short term

The impact would either disappear with mitigation or will be mitigated through natural processes in a period shorter than that of the construction phase.

b) Short to Medium term

The impact will be relevant through to the end of the construction phase.

c) Medium term

The impact will last up to the end of the development phases, where after it will be entirely negated.

d) Long term

The impact will continue or last for the entire operational lifetime of the development, but will be mitigated by direct human action or by natural processes thereafter.

e) Permanent

This is the only class of impact, which will be non-transitory. Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact can be considered transient,

1.2.3. Intensity

The intensity of the impact is considered by examining whether the impact is destructive or benign, whether it destroys the impacted environment, alters its functioning, or slightly alters the environment itself. The intensity is rated as:

a) Low

The impact alters the affected environment in such a way that the natural processes or functions are not affected.

b) Medium

The affected environment is altered, but functions and processes continue, albeit in a modified way.

c) High

Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.

1.2.4. Probability

This describes the likelihood of the impacts actually occurring. The impact may occur for any length during the life cycle of the activity, and not at any given time. The classes are rated as follows:

a) Impossible

The possibility of the impact occurring is none, due either to the circumstances, design or experience. The chance of this impact occurring is zero (0%).

b) Possible

The possibility of the impact occurring is very low, due either to the circumstances, design or experience. The chances of this impact occurring is defined as 25%.

c) Likely

There is a possibility that the impact will occur to the extent that provisions must therefore be made. The chances of this impact occurring is defined as 50%.

d) Highly likely

It is most likely that the impacts will occur at some stage of the development. Plans must be drawn up before carrying out the activity. The chances of this impact occurring is defined as 75%.

e) Definite

The impacts will take place regardless of any provisional plans, and or mitigation actions or contingency plans to contain the effect can be relied on. The chance of this impact occurring is defined as 100%.

1.2.5. Mitigation

The impacts that are generated by the development can be minimised if measures are implemented in order to reduce the impacts. The mitigation measures ensure that the development considers the environment and the predicted impacts in order to minimise impacts and achieve sustainable development.

1.2.6. Determination of significance – Without Mitigation

Significance is determined through a synthesis of impacts as described in the above paragraphs. It provides an indication of the importance of the impact in terms of both tangible and intangible characteristics. The significance of the impact “without mitigation” is the prime determinant of the nature and degree of mitigation required. Where the impact is positive, significance is noted as “positive”. Significance is rated on the following scale:

a) No significance

The impact is not substantial and does not require any mitigation action.

b) Low

The impact is of little importance, but may require limited mitigation.

c) Medium

The impact is of importance and is therefore considered to have a negative impact. Mitigation is required to reduce the negative impacts to acceptable levels.

d) High

The impact is of major importance. Failure to mitigate, with the objective of reducing the impact to acceptable levels, could render the entire development option or entire project proposal unacceptable. Mitigation is therefore essential.

1.2.7. Determination of significance – With Mitigation

Determination of significance refers to the foreseeable significance of the impact after the successful implementation of the necessary mitigation measures. Significance with mitigation is rated on the following scale:

a) No significance

The impact will be mitigated to the point where it is regarded as insubstantial.

b) Low

The impact will be mitigated to the point where it is of limited importance.

c) Low to Medium

The impact is of importance however, through the implementation of the correct mitigation measures such potential impacts can be reduced to acceptable levels.

d) Medium

Notwithstanding the successful implementation of the mitigation measures, to reduce the negative impacts to acceptable levels, the negative impact will remain of significance. However, taken within the overall context of the project, the persistent impact does not constitute a fatal flaw.

e) Medium to High

The impact is of major importance but through the implementation of the correct mitigation measures, the negative impacts will be reduced to acceptable levels.

f) High

The impact is of major importance. Mitigation of the impact is not possible on a cost-effective basis. The impact is regarded as high importance and taken within the overall context of the project, is regarded as a fatal flaw. An impact regarded as high significance, after mitigation could render the entire development option or entire project proposal unacceptable.

1.2.8. Assessment weighting

Each aspect within the impact description was assigned a series of quantitative criteria. Such criteria are likely to differ during the different stages of the project's life cycle. In order to establish a defined base upon which it becomes feasible to make an informed decision, it is necessary to weigh and rank all criteria.

1.2.9. Ranking, Weighting and Scaling

For each impact under scrutiny, a scale weighting Factor is attached to each respective impact (refer to Figure 1: Description of biophysical assessment parameters with its respective weighting). The purpose of assigning such weight serve to highlight those aspects considered most critical to the various stakeholders and ensure that each specialist's element of bias is taken into account. The weighting factor also provides a means whereby the impact assessor can successfully deal with the complexities that exist between the different impacts and associated aspects criteria.

Simply, such a weighting factor is indicative of the importance of the impact in terms of the potential effect that it could have on the surrounding environment. Therefore, the aspects considered to have a relatively high value will score a relatively higher weighting than that which is of lower importance.

Extent	Duration	Intensity	Probability	Weighting Factor (WF)	Significance Rating (SR)	Mitigation Efficiency (ME)	Significance Following Mitigation (SFM)
Footprint 1	Short term 1	Low 1	Probable 1	Low 1	Low 0-19	High 0,2	Low 0-19
Site 2	Short to medium 2		Possible 2	Low to medium 2	Low to medium 20-39	Medium to high 0,4	Low to medium 20-39
Regional 3	Medium term 3	Medium 3	Likely 3	Medium 3	Medium 40-59	Medium 0,6	Medium 40-59
National 4	Long term 4		Highly Likely 4	Medium to high 4	Medium to high 60-79	Low to medium 0,8	Medium to high 60-79
International 5	Permanent 5	High 5	Definite 5	High 5	High 80-100	Low 1,0	High 80-100

Figure 1: Description of biophysical assessment parameters with its respective weighting

1.2.10. Identifying the Potential Impacts without Mitigation (WOM)

Following the assignment of the necessary weights to the respective aspects, criteria are summed and multiplied by their assigned weightings, resulting in a value for each impact (prior to the implementation of mitigation measures).

- Equation 1:

Significance Rating (WOM) = (Extent + Intensity + Duration + Probability) x Weighting Factor

1.2.11. Identifying the Potential Impacts with Mitigation (WM)

In order to gain a comprehensive understanding of the overall significance of the impact, after implementation of the mitigation measures, it was necessary to re-evaluate the impact.

a) Mitigation Efficiency (ME)

The most effective means of deriving a quantitative value of mitigated impacts is to assign each significance rating value (WOM) a mitigation effectiveness (ME) rating. The allocation of such a rating is a measure of the efficiency and effectiveness, as identified through professional experience and empirical evidence of how effectively the proposed mitigation measures will manage the impact.

Thus, the lower the assigned value the greater the effectiveness of the proposed mitigation measures and subsequently, the lower the impacts with mitigation.

- Equation 2:

Significance Rating (WM) = Significance Rating (WOM) x Mitigation Efficiency or WM = WOM x ME

b) Significance Following Mitigation (SFM)

The significance of the impact after the mitigation measures are taken into consideration. The efficiency of the mitigation measure determines the significance of the impact. The level of impact is therefore seen in its entirety with all considerations taken into account.

2. DETAILED ENVIRONMENTAL IMPACT ASSESSMENT

2.1 WATER RESOURCES

2.1.1 Impact on groundwater levels

Table 1: Impacts on dewatering of the groundwater aquifer

Activity	**Depletion of the underground aquifer** **Lowering of groundwater levels**			
Nature of the impact	**Dewatering during operational phase of the mine**		**Status**	**-**
Receiving environment	**Underground aquifer**			
Magnitude	*Extent (footprint; site; regional; national; international)*		**REGIONAL**	
	Intensity (low; medium; high)		**LOW**	
	Duration (short; short-med; medium; long; permanent)		**LONG**	
	Probability (Improbable; possible; likely; highly likely; definite)		**LIKELY**	
Weighting factor (WF)	*WF (low; low-medium; medium; medium-high; high)*		**MEDIUM**	
Mitigation Efficiency (ME)	*ME (high; medium-high; medium; low-medium; low)*		**MEDIUM**	
Significance	*Without mitigation (WOM)*	*(Extent + Intensity + Duration + Probability) x Weighting Factor* *(3 + 1 + 4 + 3) x 3 = 33* *Low Medium*		
	With mitigation (WM)	*WOM x ME = WM* *33 x 0.6= 19.8* *Low Medium*		
Significance With Mitigation (WM)	**LOW MEDIUM**			

Source of impact:

Underground mining operations on the Mamatwan Manganese Mine during the operational phase. Water entering the mines will have to be pumped out to enable mining activities.

Description of impact:

Underground mining operations on the Mamatwan Manganese Mine during the operational phase may cause dewatering of the aquifer. Water entering the mines will have to be pumped out to enable mining activities. However, mines in the area are reported to be dry and no groundwater was encountered during exploration drilling. It is thus clear that at least the bedrock in the area is mostly devoid of groundwater. However several farmers in and around the area is reliant on groundwater as a sole source of water supply to the farm household and community. It is thus important to investigate whether the inevitable lowering of the piezometric pressure in the bedrock would influence the perched aquifer.

From the calculated depressurisation of the worst case scenario in the ore body the following assumptions was made:

- The ore body is depressurized as expected. Current pressures should be in equilibrium with the upper layer at 20 m below surface. Mining will lower this to about 290 m, thus 270 m below current values;
- However, in the immediate sand layer overlaying the bedrock (but still below the clay), the piezometric pressure is reduced by 1 to 2 m only, due to the impermeable bedrock. Should significant faulting or fracturing be encountered, these values could increase; and
- Above the clay layer, the perched aquifer is untouched. It is evident from this study that the groundwater piezometric pressure is reduced significantly at the ore body, but the groundwater is unaffected.

It can however be proven that the mining operation is indeed affecting the quantity of groundwater available to certain users.

Significance:

The Significance of the impact is assessed as low medium. Further modelling is required to refine the predictions.

Mitigation:

- Although no significant impact is predicted and no extraordinary mitigation measures are recommended, it is essential to monitor surrounding boreholes to build a reliable database. The groundwater monitoring system must adhere to the criteria as specified within the Geohydrological Report;
- It is important to monitor static groundwater levels on a quarterly basis in all boreholes within a zone of 2 km surrounding the mine to ensure that any deviation of the groundwater flow from the idealized predictions is detected in time and can be reacted upon appropriately. Preferred flow structures (dykes, sills, faults etc.) have not been included in the model due to the unknown hydraulic characteristics, and these structures could alter the actual effects considerably; and
- The affected users of groundwater in the area should be compensated. This may be done through the installation of additional boreholes for water supply purposes, or an alternative water supply.

2.1.2 Ground- and surface water contamination

Table 2: The impact on ground- and surface water by migration of contaminated water from the mining operations

Activity	**Contamination of the underground aquifer and surface water resources**		
Nature of the impact	**Seepage from mining operations etc. and pollution from vehicles operating on site**	**Status**	**-**
Receiving environment	**Underground aquifer and surface water resources during the Construction, Operational and Post-mining Phases**		
Magnitude	*Extent (footprint; site; regional; national; international)*		**REGIONAL**
	Intensity (low; medium; high)		**MEDIUM**
	Duration (short; short-med; medium; long; permanent)		**PERMANENT**
	Probability (Improbable; possible; likely; highly likely; definite)		**DEFINITE**
Weighting factor (WF)	*WF (low; low-medium; medium; medium-high; high)*		**MEDIUM**
Mitigation Efficiency (ME)	*ME (high; medium-high; medium; low-medium; low)*		**MEDIUM HIGH**
Significance	*Without mitigation (WOM)*	*(Extent + Intensity + Duration + Probability) x Weighting Factor* *(3 + 3 + 5 + 5) x 3 = 48* *Medium*	
	With mitigation (WM)	*WOM x ME = WM* *48 x 0.4 = 19.2* *Low*	
Significance With Mitigation (WM)	**LOW**		

Source of impact:

Seepage from the stockpiles from mining operations causes a contamination plume affecting the underground resources which in turn affects surface water resources. Contamination may also occur directly into surface water courses.

Hydrocarbon-based fuels or lubricants spilled from construction vehicles.

Description of the impacts:

Manganese mines are not regarded as severe sources of pollution. However, the potential contaminants associated with any mining activity may emanate from the mining area, crusher area, product stockpile, pollution control dam and Run of Mine area.

Workshops and fuel and oil handling facilities are likely sources of hydrocarbon related contaminants. Oils, grease and other hydrocarbon products (such as petrol and diesel) handled in these areas may contaminate the environment by spillages and leakages. Oils and greases are removed and collected in oil traps. Run-off

(contaminated with hydrocarbons) which is not collected may enter the storm water system from where it may pollute surface water bodies and groundwater. Septic tanks and sewage treatment plants can also contaminate groundwater. Contaminants associated with these plants include coliforms (e.g. E.coli), bacteria viruses, ammonia, phosphate, sulphate and nitrate. Effluent from these systems usually contains elevated concentrations of organic matter which may lead to elevated Chemical Oxygen Demand (COD) and Biochemical Oxygen Demand (BOD), which are both waste water quality indicators. Waste disposal areas may source a wide range of contaminants, ranging from metals, organic matter, hydrocarbons, phosphates, etc.

Also may be worth mentioning, because the nitrate concentrations is already high due to certain factors, is that it was found that the primary source of nitrates on mining sites are the explosives used in the mining operation. Nitrate and ammonia are generally the compounds of greatest concern for water quality degradation potentially resulting in human and animal health impacts.

The majority of the explosives used in the mining industry contain significant amounts of ammonium nitrate, often with some calcium nitrate or sodium nitrate. Nitrates can be introduced into the water in the mine or at a waste rock disposal site. ANFO (Ammonium Nitrate/Fuel Oil) is a widely used bulk industrial explosive mixture in mines and quarry operation. It consists of 94% porous Ammonium Nitrate (NH4NO3), (AN) that acts as the oxidizing agent and absorbent for the fuel – 6 % number 2 fuel oil (FO), popularly known as High Speed Diesel (HSD). This forms a reasonably powerful commercial explosive. ANFO is non cap-sensitive explosives and requires a large shockwave to set it off.

After closure, the water table will rise in the rehabilitated mine to reinstate equilibrium with the surrounding groundwater systems. AS the piezometric level below the clay layers is divorced from the perched aquifer near the surface, this will be of no significance in this situation.

Significance:

The significance after mitigation is assessed to be low due to the high efficiency of mitigation.

Mitigation:

- When chemicals e.g. paint, fuels and oils are handled during construction and maintenance, impermeable material (drip tray) must be placed underneath to prevent spilling on the ground;
- It must be ensured that a credible company removes used oil after vehicle servicing;
- A sufficient supply of absorbent fibre should be kept at the site to contain accidental spills;
- Used absorbent fibre must be land-farmed, using approved methodologies;
- Domestic waste water, especially sewage, must either be treated at site according to accepted principles, or removed by credible contractors;

- Solid waste must similarly either be stored at site on an approved waste dump, or removed by credible contractors;
- To assess the impacts of the stockpile area on the groundwater regime a groundwater analysis need to be undertaken;
- Groundwater monitoring must be conducted according to the specifications in the Geohydrological Report:
    - Although no or little groundwater contamination is expected during the mining phases due to the cone of depression, it is nevertheless recommended that groundwater quality be monitored on a quarterly basis. This is essential to provide a necessary database for future disputes.
    - Water samples must be taken from all the monitoring boreholes by using approved sampling techniques and adhering to recognised sampling procedures. Samples should be analysed for both organic as well as inorganic pollutants, as mining activity often lead to hydrocarbon spills in the form of diesel and oil. At least the following water quality parameters should be analysed for:
        1. Major ions (Ca, K, Mg, Na, SO4, NO3, Cl, F)
        2. pH
        3. Electrical conductivity (EC),
        4. Total Petroleum Hydrocarbons (TPH)
        5. Total Alkalinity
    - These results should be recorded on a data sheet. It is proposed that the data should be entered into an appropriate computer database and reported to the Department of Water Affairs;
- Management of the stockpile in accordance with Section 73 of the MPRDA Regulations (No. R527, 2004).
- Vehicles are to be maintained in good working order so as to reduce the probability of leakage of fuels and lubricants;
- A walled concrete platform, dedicated store with adequate flooring or berm area should be used to accommodate chemicals such as fuel, oil, paint, herbicide and insecticides, as appropriate, in well-ventilated areas;
- Storage of potentially hazardous materials should be above any 100-year flood line, or as agreed with the Environmental Control Officer. These materials include fuel, oil, cement, bitumen etc.;
- Surface water draining off contaminated areas containing oil and fuel would need to be channelled towards a sump which will separate these chemicals and oils;
- All materials prone to spillage are to be stored in appropriate structures with impermeable flooring;
- Chemical toilets are to be provided and maintained for construction crews. Maintenance must include their removal without sewage spillage;

- Under no circumstances may ablutions occur outside of the provided facilities;
- No uncontrolled discharges from the construction crew camps to any surface water resources shall be permitted. Any discharge points need to be approved by the relevant authority;
- In the case of pollution of any surface or groundwater, the Regional Representative of the Department of Water Affairs must be informed immediately;
- Store all litter carefully so it cannot be washed or blown into any of the water courses within the study area;
- Provide bins for staff at appropriate locations, particularly where food is consumed; the construction site should be cleaned daily and litter removed;
- Conduct ongoing staff awareness programs so as to reinforce the need to avoid littering; and
- Care should be taken to contain contaminated water and prevent it from seepage to the aquifer. Therefore it is especially important that, product stockpiles, tailings dams and dirty water dams should be properly lined.

2.2 AIR QUALITY

2.2.1. Air Quality

Table 3: Assessment of the possible impacts on air quality during the mining phase

Activity	**Atmospheric pollution associated with manganese transport, waste stockpiles, uncontrolled spillages, disturbed land and vehicles on un-surfaced roads.**			
Nature of the impact	**Pollution and nuisance from dust emissions.**		**Status**	**-**
Receiving environment	**The immediate and surrounding land owners**			
Magnitude	*Extent (footprint; site; regional; national; international)*		**REGIONAL**	
	Intensity (low; medium; high)		**MEDIUM**	
	Duration (short; short-med; medium; long; permanent)		**LONG**	
	Probability (Improbable; possible; likely; highly likely; definite)		**HIGHLY LIKELY**	
Weighting factor (WF)	*WF (low; low-medium; medium; medium-high; high)*		**LOW MEDIUM**	
Mitigation Efficiency (ME)	*ME (high; medium-high; medium; low-medium; low)*		**MEDIUM HIGH**	
Significance	*Without mitigation (WOM)*	*(Extent + Intensity + Duration + Probability) x Weighting Factor* *(3 + 3 + 4 + 4) x 2 = 28* *Low Medium*		
	With mitigation (WM)	*WOM x ME = WM* *28 x 0.4 = 11.28* *Low*		
Significance With Mitigation (WM)	**LOW**			

Source of impact:

- Materials Handling Operations:

Materials handling operations associated with mining and predicted to result in significant fugitive dust emissions include the transfer of material by means of tipping, loading and off-loading trucks. A temporary storage stockpile will be located near the mining process and heavy vehicles will transport materials from this stockpile area to their destination off site.

- Crushing of materials:

Dust emanating from the crushing of hard rock materials from the crushing facility.

- Wind erosion from exposed areas:

The source that was identified to be significantly prone to wind erosion was the stockpile area. However, studies at other mines have also indicated that the topsoil and overburden stockpiles will be affected.

- Vehicle activity on unpaved roads:

Heavy vehicle movements generate dust which contributes to the overall air quality in the area.

Description of the impact:

Dust emissions will impact on the ambient air quality of the region and contribute to cumulative impacts of mine activities on the air quality (cumulative impacts are discussed in a later section).

Significance:

- PM_{10}

The predicted mitigated daily average ground level concentrations for the proposed operations at the Mamatwan Manganese Mine is not expected to exceed the current daily South African standard of 180µg/m^3 or the proposed South African standard of 75µg/m^3 at the mine boundary or at the sensitive receptor sites surrounding the mine.

The predicted annual average ground level concentrations for the proposed Mamatwan Manganese Mine do not exceed the current annual South African standard of 60µg/m^3 and the proposed South African standard of 40µg/m^3 outside the mine boundary.

- Dust Deposition

The predicted mitigated maximum daily dust deposition rates for the proposed operations do not exceed the SANS residential dust fallout limit of 600mg/m^2/day and the SANS annual target threshold of 300mg/m^2/day at any of the sensitive receptor sites surrounding the proposed mine.

Mine operations (i.e. stockpiling) were identified as having the most significant potential for air pollution however with the implementation of mitigation measures as recommended in the EMPr will significantly reduce the impact. The roads in the study area are to be regularly watered so as to reduce the impact of dust associated with movement of vehicles on dirt roads.

Mitigation:

Dust suppression activities are required during the construction and operational phase in order to minimise dust generation. Air quality monitoring is a requirement as per the EMPr.

2.3 FLORA AND FAUNA

2.3.1. Destruction of Flora and Fauna

Table 4: Destruction of sensitive vegetation types and protected plant and animal species

Activity	**Impacts on Rare and Endangered Flora and Fauna**			
Nature of the impact	**Vegetation clearance, habitat destruction and disruption of natural behaviour**		**Status**	**-**
Receiving environment	**Faunal and Floral Species located on site**			
Magnitude	*Extent (footprint; site; regional; national; international)*		**SITE**	
	Intensity (low; medium; high)		**HIGH**	
	Duration (short; short-med; medium; long; permanent)		**PERMANENT**	
	Probability (Improbable; possible; likely; highly likely; definite)		**DEFINITE**	
Weighting factor (WF)	*WF (low; low-medium; medium; medium-high; high)*		**MEDIUM**	
Mitigation Efficiency (ME)	*ME (high; medium-high; medium; low-medium; low)*		**LOW MEDIUM**	
Significance	*Without mitigation (WOM)*	*(Extent + Intensity + Duration + Probability) x Weighting Factor* *(2 + 5 + 5 + 5) x 4 = 68* *Medium High*		
	With mitigation (WM)	*WOM x ME = WM* *68 x 0.6 = 40.8* *Medium*		
Significance With Mitigation (WM)	**MEDIUM**			

Source of impact:

- The clearance of vegetation on the proposed site during mining operations such as, change houses, offices and workshops;
- Clearing of vegetation for the construction of roads;
- The clearing of vegetation for the construction camp, temporary access onto the site, spoil areas, materials storage and topsoil stockpiles; and
- The clearing of protected species.

Description of the impact:

Construction will destroy natural vegetation and alter the habitat in such a way that species cannot colonise the area. This could lead to certain species becoming rare in the local context. *Acacia erioloba*, *Acacia heamoxtylon* and *Boscia albitrunca* are endangered. These trees are considered important and nationally protected under the National Forestry Act, 1998 (Act No. 30 of 1998).

Significance:

The development of the Mamatwan Manganese Mine surface infrastructure will result in a loss of plant and animal habitats at the site of the surface infrastructure. Necessary habitat disturbance by the Mamatwan Manganese Mine mining and processing activities will be limited and restricted to the construction area. Therefore the significance was assessed as medium.

Mitigation:

- A tree removal license should be applied for at the Department of Agriculture, Forestry and Fisheries (DAFF) for the protected species should the proposed project be authorised;
- Prevention of overspill of the mining activities onto the surrounding environment by making sure that clearance is only confined to the proposed site;
- Access roads should be kept to a minimum, and where possible existing tracks should be used;
- New access roads should be aligned so as to remain on the flattest terrain possible for as long as possible;
- Roads should not be constructed in the Vlermuisleegte water course or the 100m buffer zone;
- Construction vehicles should remain only in the area to be disturbed by the road and other works at the time. Disturbance should be restricted to the actual project area;
- The use of herbicides should be limited as far as possible. Herbicides should only be used under strict control and only when no other options are available. Herbicides should not be used near sensitive environments especially the water course;
- Materials such as sand and stone should, wherever possible, be sourced from areas which are free of alien and invasive species;
- An important aspect of ongoing maintenance is the monitoring of the rehabilitated sites and access road verges for alien and invasive plant species;
- Should alien and invasive plant species be identified then these should immediately be removed;
- Where possible protected trees should be replanted adjacent to the proposed activity site on the same property if possible; and
- Should relocation of trees not be possible these trees should be replaced by trees of the same species or other indigenous and endemic trees on another unaffected location on the same properties where the mining operations will take place.

2.3.2. Destruction of Habitat

Table 5: Destruction of natural habitat

Activity	**Construction and operational activities**			
Nature of the impact	**Vegetation clearance and habitat destruction**		**Status**	**-**
Receiving environment	**Mamatwan Manganese Mine Site**			
Magnitude	*Extent (footprint; site; regional; national; international)*		**SITE**	
	Intensity (low; medium; high)		**MEDIUM**	
	Duration (short; short-med; medium; long; permanent)		**PERMANENT**	
	Probability (Improbable; possible; likely; highly likely; definite)		**DEFINITE**	
Weighting factor (WF)	*WF (low; low-medium; medium; medium-high; high)*		**LOW MEDIUM**	
Mitigation Efficiency (ME)	*ME (high; medium-high; medium; low-medium; low)*		**LOW**	
Significance	*Without mitigation (WOM)*	*(Extent + Intensity + Duration + Probability) x Weighting Factor* *(2 + 3 + 5 + 5) x 2 = 30* *Low Medium*		
	With mitigation (WM)	*WOM x ME = WM* *30 x 1.0 = 30* *Low Medium*		
Significance With Mitigation (WM)	**LOW MEDIUM**			

Source of impact:

- The clearance of vegetation on the proposed site during construction of mining infrastructure such as the washing plant, change houses, offices and workshops.
- Clearing of vegetation for the construction of roads and the processing area;
- The clearing of vegetation for the construction camp, temporary access onto the site, spoil areas, materials storage and topsoil stockpiles.

Description of the impact:

Due to the nature of the construction activities across the site, even with mitigation much of the existing natural habitat will be destroyed. Heavy motor vehicle usage over the study site and adjacent land will expose the soils on the site to erosion and compaction. This will have a negative effect on the terrestrial ecosystems in that habitat fragmentation could occur.

Significance:

The significance of this impact with mitigation measures is thus given as low.

Mitigation:

- Cordon off the vegetation surrounding the construction site to restrict the movement of construction vehicles and construction personnel and prevent destruction of vegetation;
- Construction areas should be inspected for any occurrence of erosion. Appropriate remedial action (rehabilitation) must be undertaken should any eroded areas be identified;
- A comprehensive surface runoff and stormwater management plan should be compiled, indicating how all surface runoff generated as a result of the development (during both the construction and operational phases) will be managed; and
- No unnecessary clearing of vegetation should take place on the study area.

2.3.3. Increase in bush encroachment

Table 6: Increase in bush encroachment

Activity	**Increase in exotic vegetation**		
Nature of the impact	**Bush encroachment by encroaching vegetation species during operational activities**	**Status**	**-**
Receiving environment	**Mamatwan Manganese Mine Site**		
Magnitude	*Extent (footprint; site; regional; national; international)*	**REGIONAL**	
	Intensity (low; medium; high)	**MEDIUM**	
	Duration (short; short-med; medium; long; permanent)	**LONG**	
	Probability (Improbable; possible; likely; highly likely; definite)	**HIGHLY LIKELY**	
Weighting factor (WF)	*WF (low; low-medium; medium; medium-high; high)*	**MEDIUM**	
Mitigation Efficiency (ME)	*ME (high; medium-high; medium; low-medium; low)*	**MEDIUM**	
Significance	*Without mitigation (WOM)*	*(Extent + Intensity + Duration + Probability) x Weighting Factor* *(3 + 3 + 4 + 4) x 3 = 42* *Medium*	
	With mitigation (WM)	*WOM x ME = WM* *42 x 0.6 = 25.2* *Low Medium*	
Significance With Mitigation (WM)	**LOW MEDIUM**		

Source of impact:

Mining operations could cause an increase in bush encroachment on the site.

Description of the Impact:

Mining Phase:

Mining related activities causes disturbance of vegetation and can cause bush encroachment by certain species. If no mitigation is present some of these plants may further spread into the surrounding area increasing the opportunity for bush encroachment.

Significance:

Processes such as urbanisation, acceleration of agricultural production and industrialisation have a drastic impact on terrestrial ecosystems through degradation and alteration of processes. In order to prevent the further destruction of the ecosystem, it is important to plan and co-ordinate human activities and development so as to include studies of the natural environment involving soil, water, floral, faunal and cultural or historical aspects.

The impact is considered to have a low significance after mitigation based on the impact identification matrix. The key impact is that landscaping associated with the development during the operational phase could cause an increase in bush encroachment on the site.

Mitigation measures have been set out in the Environmental Management Programme. The impacts will become more pronounced if the suggested mitigation measures are not implemented.

Mitigation:

- Minimising the loss of variety of flora and fauna in areas that are not directly affected by the mining of manganese;
- Reduce the levels of disturbance on the area during mining;
- All mining areas should be suitably top soiled and vegetated with non-encroaching plants as soon as is possible after mining;
- Disturbed surfaces to be rehabilitated must be ripped, and the area must be backfilled with topsoil or overburden;
- Footprint size should be kept at a minimum so as to maintain as much natural vegetation cover as possible;
- Only vegetation indigenous to the area should be considered for rehabilitation purposes; and
- Wastewater limit values applicable to discharge of wastewater into watercourses as stipulated by the Department of Water Affairs should be strictly adhered to.

2.3.5. Impact on the landscape

2.3.5.1 Impact on change in surface cover

Table 7: Impact on change in surface cover

Activity	**Removing landscape elements that are fundamental in establishing a valued landscape character. This will affect landscape receptors of high sensitivity**		
Nature of the impact	**Removal of vegetation during mining phase.**	**Status**	**-**
Receiving environment	**Mamatwan Manganese Mine Site**		
Magnitude	*Extent (footprint; site; regional; national; international)*	**REGIONAL**	
	Intensity (low; medium; high)	**MEDIUM**	
	Duration (short; short-med; medium; long; permanent)	**LONG**	
	Probability (Improbable; possible; likely; highly likely; definite)	**HIGHLY LIKELY**	
Weighting factor (WF)	*WF (low; low-medium; medium; medium-high; high)*	**LOW MEDIUM**	
Mitigation Efficiency (ME)	*ME (high; medium-high; medium; low-medium; low)*	**LOW MEDIUM**	
Significance	*Without mitigation (WOM)*	*(Extent + Intensity + Duration + Probability) x Weighting Factor* *(3 + 3 + 4 + 4) x 2 = 28* *Low to Medium*	
	With mitigation (WM)	*WOM x ME = WM* *28 x 0.6 = 16.8* *Low*	
Significance With Mitigation (WM)	**LOW**		

Source of impact:

At present, the surface cover of the larger Mamatwan site comprises mainly of Bushveld vegetation, dust roads and existing farm infrastructure. A large portion of the site is currently being used for grazing of livestock.

Portions of the vegetated surface cover will be cleared to make way for the proposed mining of manganese. The exposed soil and the presence of mining equipment, material stockpiles, site offices and staff camps will contrast in colour and form with the receiving environment.

Description of impact:

The mining areas will cause a noticeable change in character due to the greater visual contrast between the construction site and the receiving environment.

The completed development will introduce foreign land uses that will alter the existing Bushveld character. The completed development and landscaping after rehabilitation will be an improvement from the mining phase.

During the mining phase, the landscape is expected to be maintained to a high visual quality. The landscape impact will be moderate.

Significance:

The impact is considered to have a medium significant impact as a result of loss of open space and transformation of the Bushveld land cover. Mitigation measures reduce the impact to a low significance. Mitigation measures have been set out below as well as in the Environmental Management Programme. The impacts will become more pronounced if the suggested mitigation measures are not implemented.

Mitigation:

- The contractors must co-ordinate their activities in order to optimise the utilisation of the excavated trenches and thereby prevent repeated and unnecessary excavations;
- Construction that requires the clearing of large areas of vegetation and excavation should ideally occur during the dry season only. Construction during the rainy season (November to March) should be closely monitored and controlled. However in the Northern Cape Province precipitation is limited and the province receives less than 400mm per annum;
- The run-off from the exposed ground should be controlled with the careful placement of runoff barriers. The placement of the runoff barriers must occur in consultation with the ECO and as part of an overall stormwater management system during the construction phase;
- The soil that is excavated during construction should be stockpiled in layers of no higher than 1.5 m and protected by berms to prevent erosion of stockpiles and loss of nutrients from topsoil;
- Audits must be carried out at regular intervals to identify areas where erosion is occurring. Appropriate remedial action, including the rehabilitation of the eroded areas, and where necessary, the relocation of the paths causing the erosion must be undertaken; and
- Environmentally sensitive design of the cross section of the drainage channel and formalisation of the retention pond.

2.4 NOISE

2.4.1. Increased Noise and vibration

Table 8: Assessment of the possible impacts on Noise and Vibration during the mining phase

Activity	**Noise generation on site during the construction and operational phase**		
Nature of the impact	**Blasting and construction activities which generate noise that exceeds the current ambient noise levels experienced over the site and surrounding areas**	**Status**	**-**
Receiving environment	**Machine operators and workers, surrounding communities**		
Magnitude	*Extent (footprint; site; regional; national; international)*	**REGIONAL**	
	Intensity (low; medium; high)	**LOW**	
	Duration (short; short-med; medium; long; permanent)	**MEDIUM**	
	Probability (Improbable; possible; likely; highly likely; definite)	**DEFINITE**	
Weighting factor (WF)	*WF (low; low-medium; medium; medium-high; high)*	**LOW MEDIUM**	
Mitigation Efficiency (ME)	*ME (high; medium-high; medium; low-medium; low)*	**MEDIUM HIGH**	
Significance	*Without mitigation (WOM)*	*(Extent + Intensity + Duration + Probability) x Weighting Factor* *(3 + 1 + 3 + 5) x 2 = 24* *Low to Medium*	
	With mitigation (WM)	*WOM x ME = WM* *24 x 0.4 = 9.6* *Low*	
Significance With Mitigation (WM)	**LOW**		

Source of the impact:

Possible sources of disturbing noise of the Mamatwan Manganese Mine are listed in Table 9: Possible sources of noise at the Mamatwan Manganese Mine and the potential affected parties of these sources, those with the greatest potential to be disturbing are:

- Increase noise levels from vehicular traffic and other equipment associated with the activities of the proposed mine; and
- Vibrations and noise associated with blasting.

Table 9: Possible sources of noise at the Mamatwan Manganese Mine and the potential affected parties

Process	Noise source	Mitigation
Mine workings	Drilling, blasting, loading and hauling	Hearing protection provided Only allow blasting once a day at the same time every day Warn surrounding workers and residents/ landowners before hand
Waste dumps	Dumping and falling of rocks	Residual sound levels are less than 60dBA at a distance of 100m from the noise source
Transport	Cars, busses and other heavy vehicles	Silencers
Offices, change houses	General domestic activity	-

Description of the impact:

Noise levels within the mining lease area are expected to range from 40 dBA to 50 dBA in the agricultural and residential areas, to be between 60 dBA and 70 dBA in areas where the predominant activity is mining related. There are minimal sensitive environments e.g. schools and churches; situated near the mining activities which may be disturbed by these noise levels. Noise levels outside the mining lease area are expected to be lower than within it.

Considering the general trend whereby sound power levels decrease by 6 dBA with every doubling of distance from the source, it is expected there will be a significant decrease with an increase in distance beyond 50m from the noise source.

Machine operators and workers who work in the noise zones and / or with the noise sources above 85 dBA, and who do not wear approved hearing protection, will suffer permanent hearing loss.

Significance:

The activity will have moderate significance on the surrounding environment. A blasting schedule will be implemented so that blasting occurs once a day at 4pm.

Mitigation:

- Ensure that all machinery and vehicles are well maintained and road worthy;
- Noise at equipment and machinery point source should be damped through acoustic treatment and applying silencing equipment;
- Environmental noise monitoring should be carried out at regular intervals to detect deviations from predicted noise levels and enable corrective measures to be taken where warranted;
- Regularly conduct noise audits on site;
- Erect warning signs where noise levels exceeds 85 dBA noise levels;
- Atmospheric conditions should be considered before charging and blasting;
- Blasting vibrations should be controlled by means of optimising blast hole geometry and altering the time of blasting;
- Implement a dust and noxious gases minimisation strategy that will reduce the impact of atmospheric pollution. This will include the use of noxious gas fixation techniques, using and adhering to blasting schedules, and strategies that minimise dust generation;
- Affected communities must be notified when blasting is scheduled to take place;
- Workers must be issued with the necessary protective equipment, including ear plugs, when working in conditions that may progressively have detrimental effects on their health. Ensure that all personnel have access to hearing protection equipment at site where the 85 dBA noise level is frequently recorded. Issuing of hearing protection will conform to the Mamatwan Manganese Mine strategy;
- All employees, who operate machines / tools which are identified as noise sources, should be subjected to audiometric examinations;
- All hand held machinery will be muffled;
- All fans to be silenced; and
- If complaints about disturbing noise are received from the local community, Mamatwan Manganese Mine will:
    - Respond immediately to the complaints;
    - Identify the noise source;
    - Implement appropriate mitigatory measures in consultation with the affected party; and
    - The responsible environmental officer will investigate all complaints and /or non-compliances and the necessary actions will be taken.

2.5 VISUAL IMPACT

2.5.1. Change in Visual character of the area

Table 10: Assessment of the possible impacts on visual aspects

Activity	**Construction of mining related infrastructure and visibility of mining structures**		
Nature of the impact	**Disturbance of existing aesthetic environment as a result of visibility of the overburden stockpiles and other mine infrastructure**	**Status**	**-**
Receiving environment	**Visual receptors such as the surrounding communities**		
Magnitude	*Extent (footprint; site; regional; national; international)*	**REGIONAL**	
	Intensity (low; medium; high)	**MEDIUM**	
	Duration (short; short-med; medium; long; permanent)	**MEDIUM**	
	Probability (Improbable; possible; likely; highly likely; definite)	**DEFINITE**	
Weighting factor (WF)	*WF (low; low-medium; medium; medium-high; high)*	**LOW MEDIUM**	
Mitigation Efficiency (ME)	*ME (high; medium-high; medium; low-medium; low)*	**LOW**	
Significance	*Without mitigation (WOM)*	*(Extent + Intensity + Duration + Probability) x Weighting Factor* *(3 + 3 + 3 + 5) x 2 = 28* *Low Medium*	
	With mitigation (WM)	*WOM x ME = WM* *28 x 1.0 = 28* *Low Medium*	
Significance With Mitigation (WM)	**LOW MEDIUM**		

Source of the impact:

The risk sources during the construction phase can be considered to be as follows:

- The image of the mining activity could lead to a perceived view of progress and benefit to the community;
- Excessive cleaning and stripping of topsoil for site offices, servitudes and access roads;
- The relative random and disorganised lay down of building materials, vehicles and offices;
- Cut and fill slopes of roads will become highly visible if not re-vegetated and shaped to blend in with existing topography;
- Dust from mining vehicles;
- Open and rehabilitated landscape scarring; and
- The construction of the access roads, surface infrastructure and mining.

All infrastructure relating to mining operations are familiar landmarks within the region. Parts of mine infrastructure notably the overburden stockpile, rock dumps, and other infrastructure may be noticeable from the surrounding arterial routes.

Residential communities in the surrounding area will also be impacted by the visual intrusion. The risk sources during the operational phase can be considered as follow:

- Dust from heavy vehicles;
- Open and rehabilitated landscape scarring;
- Stockpile areas; and
- The operations associated with the access roads, surface infrastructure and mining.

On closure of the mine, the only structures that will remain will be the vegetated open fields and remaining buildings which could be utilised.

Description of the impact:

Table 11 below rates each criterion from high, medium to low according to the specific characteristics of those criteria Table 12 lists for each project component the visual criteria rating and the visual impact of the component on these areas.

Table 11: Visual Assessment Criteria (VAC) ratings

	CRITERIA	HIGH	MEDIUM	LOW
1	Visibility	Very visible from many places beyond 1000 meter zone.	Visible from within the 1000 meter zone but partially obscured by intervening objects.	Only partially visible within the 1000 meter zone and beyond due to screening by intervening objects.
2	Genius Loci	A particular definite place with an almost tangible dominant ambience or theme.	A place, which projects a loosely definite theme or ambience.	A place having little or no ambience with which it can be associated.
3	Visual Quality	A very attractive setting with great variation and interest but no clutter.	A setting, which has some aesthetic and visual merit.	A setting, which has little aesthetic value.
4	Visible social structure	Housing and / or other structures as a dominant visual element.	Housing and / or other structures as a partial visual element.	Housing and / or other structures as a minor visual element.
5	Surrounding Landscape Compatibility	Ideally suits or matches the proposed development.	Can accommodate the proposed development without appearing totally out of place.	Cannot accommodate the proposed development without it appearing totally out of place visually.
6	Character	The site or surrounding area exhibits a definite character.	The site or surrounding area exhibits some character.	The site or surrounding area exhibits little or no character.
7	Scale	A landscape which has horizontal and vertical elements in high contrast to the human scale.	A landscape with some horizontal and vertical elements in some contrast to the human scale.	Where vertical variation is limited and most elements are related to the human and horizontal scale.
8	Visual Absorption Capacity	The ability of the landscape to easily accept visually a particular development because of its diverse landform, vegetation and texture.	The ability of the landscape to less easily accepts visually a particular development because of a less diverse landform texture and vegetation.	The ability of the landscape not to visually accept a proposed development because of a uniform texture, flat slope and limited vegetation cover.
9	View Distance	If uninterrupted view distances to the site are > than 5 km.	If uninterrupted view distance are < 5 km but > 1 km.	If uninterrupted view distances are >500m and <1000m.
10	Critical Views	Views of the projects are to be seen by many people passing on main roads and from prominent areas i.e. communities and settlements.	Some views of the project from surrounding main roads and communities.	Limited views to the project from main roads and communities.

Table 12: Site evaluation

CHARACTERISTICS	VISUAL CRITERIA RATING	VISUAL IMPACT
Visibility	Medium to High	Moderate
Genius Locci	Medium to Low	Moderate
Visual Quality	Medium to Low	Low
Social	Medium to High	Low
Surrounding landscape compatibility	Medium to Low	Low
Character	Medium to Low	Moderate
Scale	High	Low
VAC	Low	High
View Distance	High	Low
Critical Views	High	Low

The results show that Mamatwan Manganese Mine has 1 high, 3 moderate and 6 low visual impact ratings.

The Mamatwan Manganese Mine will exert a negative influence on the visual environment. This is largely due to:

- High visibility of construction activity within a zone of uniform visual pattern;
- The low visual absorption capacity of the setting which is attributable to:
    - Relatively flat topography;
    - The lack of visual diversity; and
    - A general lack of rising landforms as a backdrop.
- The size of the operations will expose it to many viewers; and
- The need to cut across or expose the existing landforms to accommodate the surface infrastructure.

Significance:

The significance of the impact is assessed to be medium to low, however due to not many potential viewers surrounding the study area it is regarded as of low significance.

Mitigation:

- Effective planning of the location of the mine infrastructure and lighting to minimise visual impact and light pollution;
- Screen the plant from the surrounding roads and properties using, for example trees;
- The illumination of Mamatwan Manganese Mine operations should be focussed yet bear in mind safety and security issues. The design should make provision for accent lighting which should be downward to prevent light spills skywards;
- Selective and sensitive location and design of the lighting requirements for the Mamatwan Manganese Mine operations is required. For instance reduce the height from which floodlights are fixed and identify zones of high and low lighting requirements with the focus of the lights being inward rather than outward;
- The building textures and colours should not contrast vividly with the backdrop of colour and textures provided by the landscape. The natural setting and colours of buff, olive greens, dark brows should be respected and where possible, these should be incorporated into the materials used in the exteriors of the buildings and landscape;
- Colours of new infrastructure should be matt, not glossy so as to reduce reflection and glare from the surfaces. This is important when considering the night scene and reflected lights;
- The land forming and planting design of Mamatwan Manganese Mine should respect the surrounding indigenous vegetation. The interface between new planting and the existing should be gradually blended. Plant material should be endemic, indigenous species of trees and other plants;
- The building forms should be broken by roof overhangs and steps in the façade. This will create shadow lines which, in turn, assist in the mottling breaking up of the visible plant form; and
- The requirements for stabilisation of new landforms must be considered so that effective rehabilitation and re-vegetation can be timeously and effectively implemented. This will be determined by slope, access, material, climate etc.

2.6 TERRESTRIAL IMPACTS

2.6.1. Soil Erosion and increased surface runoff

Table 13: The impact of vegetation clearance and topsoil stripping on soil erosion and surface water runoff

Activity	**Soil erosion during the construction and operation phases**		
Nature of the impact	**Vegetation clearing, topsoil stripping, site establishment, movement of people and vehicles on site**	**Status**	**-**
Receiving environment	**Soil structures and adjacent water resources**		
Magnitude	*Extent (footprint; site; regional; national; international)*	**SITE**	
	Intensity (low; medium; high)	**MEDIUM**	
	Duration (short; short-med; medium; long; permanent)	**MEDIUM**	
	Probability (Improbable; possible; likely; highly likely; definite)	**HIGHLY LIKELY**	
Weighting factor (WF)	*WF (low; low-medium; medium; medium-high; high)*	**LOW MEDIUM**	
Mitigation Efficiency (ME)	*ME (high; medium-high; medium; low-medium; low)*	**MEDIUM HIGH**	
Significance	*Without mitigation (WOM)*	*(Extent + Intensity + Duration + Probability) x Weighting Factor* *(2 + 3 + 3 + 4) x 2 = 24* *Low*	
	With mitigation (WM)	*WOM x ME = WM* *24 x 0.4 =9.6* *Low*	
Significance With Mitigation (WM)	**LOW**		

Source of the impact:

The clearance of vegetation and stripping of topsoil to make way for the establishment of mine related infrastructure and structures associated with the various proposed development components.

Description of the impact:

During mining it will be necessary to clear portions of vegetation, where the development will be undertaken. The mining sites will need to be levelled, which will alter the natural soil structure. The major impact of vegetation clearance is the exposure of soil to the agents of erosion, such as wind and water.

Large volumes of spoil material will be generated during the mining phase whilst some of the material will be re-used for fill elsewhere on site, the spoil material generated will also be vulnerable to the agents of erosion, such as wind and water.

Erosion can be expected if mining occurs within the rainy season and therefore may result in the loss of topsoil from topsoil stockpiles. The clearance of vegetation will reduce the capacity of the land surface to limit the flow of

surface water, thus decreasing infiltration, and increasing both the quantity and velocity of surface water runoff and causing erosion.

Significance of the impact:

Topsoil normally has a high nutrient content and is an indigenous seed bank. It is considered to be a national resource of value to current and future generations. It may be lost through the establishment of infrastructure on the soil and through the development excavations. A loss of topsoil will result in a decrease in the productivity of land.

Conservation of topsoil requires attention. Long-term bulk storage of topsoil will degrade the soil fertility, texture and structure. The following factors that cause degradation include:

- Erosion;
- Compaction;
- Loss of nutrients by leaching and anaerobiosis; and
- Decline in essential biological activity.

Mining related activities will disturb land and damage the vegetation that shelters and binds soils. The exposed soils will be more susceptible to erosion by wind and water. Erosion can affect all living organisms through the destruction of habitats, loss of valuable topsoil, which reduces the productivity of the soils, contamination of water with suspended solids and contamination of air with dust. Erosion can also reduce the aesthetic quality of the environment. Among the activities at Mamatwan Manganese Mine that could cause erosion is the construction of infrastructure (such as new buildings, roads, and various facilities.).

Off road movement of vehicles can cause extensive erosion – one trip across the veldt is enough to damage vegetation and initiate the erosion process. Un-surfaced access roads are highly susceptible to erosion. Footpaths are also prone to erosion particularly where there is concentrated pedestrian traffic.

Erosion may be accelerated where water is channelled by linear infrastructure (such as roads and railway lines, power lines and pipelines) and surface water management infrastructure (such as canals and bunds). Erosion may also be accelerated at points where there are concentrated discharges of water to the environment (such as at culverts, outflows of run-off etc.). Mine residue deposits at Mamatwan Manganese Mine include the overburden stockpile. Materials eroded from these deposits could pollute water and air. The contaminants in the water and air could be transferred to soil.

The extent of the impact is on site during the mining phase. The impact is given a medium intensity rating as vegetation growth and other natural processes would continue in areas around the erosion. The duration would

be medium term, since erosion would be discontinued once vegetation has established. The weighting factor attributed to this impact is low-medium and significance of the impact with mitigation is thus low.

Mitigation:

- The implementation of anti-erosion measures such as construction of berms to reduce the velocity of surface water run-off is essential;
- By maintaining the maximum amount of vegetated area on site, the extent of erosion and ecosystems loss can be contained;
- Topsoil and subsoil must be kept totally separated during excavation and must be stored in separate stockpiles;
- It is also imperative that the topsoil layer be retained and used in facilitating the reinstatement of indigenous vegetation;
- Trench areas must be raised to accommodate the bulking factor and subsidence;
- When soil is replaced excavation and installations should be carried out when the soil is at its driest, where possible;
- All access roads must be demarcated, and existing roads must be used as far as possible for the hauling of materials; and
- Disturbed surfaces to be rehabilitated must be ripped, and the area must be backfilled with topsoil over overburden and appropriately re-vegetated.

2.6.2. The potential of soil pollution

Table 14: Soil pollution

Activity	**Improper disposal of wastes during the mining phase, as well as inappropriate storage and handling of hazardous substances (including fuels and lubricants)**			
Nature of the impact	**Contamination of soil through direct contact between hazardous and toxic materials and bare soil surfaces as well as through seepage of leachates from the mine residue deposits**		**Status**	**-**
Receiving environment	**Bare soil surfaces**			
Magnitude	*Extent (footprint; site; regional; national; international)*		**SITE**	
	Intensity (low; medium; high)		**HIGH**	
	Duration (short; short-med; medium; long; permanent)		**MEDIUM**	
	Probability (Improbable; possible; likely; highly likely; definite)		**HIGHLY**	
Weighting factor (WF)	*WF (low; low-medium; medium; medium-high; high)*		**MEDIUM**	
Mitigation Efficiency (ME)	*ME (high; medium-high; medium; low-medium; low)*		**HIGH**	
Significance	*Without mitigation (WOM)*	*(Extent + Intensity + Duration + Probability) x Weighting Factor* *(2 + 5 + 3 + 4) x 3 = 42* *Medium*		
	With mitigation (WM)	*WOM x ME = WM* *42 x 0.2 =8.4* *Low*		
Significance With Mitigation (WM)	**LOW**			

Source of impact:

The accidental spillage of hazardous materials such as fuels, oils and hydraulic fluids, paints and bitumen based products, as well as cement, are an unfortunate reality on large scale developments. Incorrect management of fuels, oils and hydraulic fluids and handling of the substances can also result in unnecessary spillages thereof. Fuel and oil leaks from poorly maintained plant and vehicles can also contribute to soil pollution.

Soils on the Mamatwan Manganese Mine premises and surrounding land could also be contaminated in four main ways:

- Failures of mine residue deposits or pollution control measures;
- Contamination of water;
- Contamination of air; and
- Seepage from mine residue deposits.

Of the above modes of soil contamination the contamination of water is of most concern. The issue of leachates from mine residue deposits is generally addressed in the section on water resources, which cover seepage into surface and groundwater from the deposits.

Description of the impact:

Contamination of soils as a result of accidental spillages will alter the chemical properties of the affected soils and negatively influence the future growth of vegetation on these soils. Surface water run-off over contaminated areas can also transfer pollutants into ground and water resources, thus contributing to the potential contamination thereof.

Significance of impact:

The extent of the impact is on the site during the mining phase. The impact is given a high intensity rating due to the potential thereof to contribute towards ground- and surface water pollution of nearby water resources. The duration would be over the short to medium term, since the potential for soil pollution will persist throughout the mining period. The weighting factor attributed to this impact is low and significance of the impact with mitigation is thus also low.

Mitigation:

- The concrete bathing site (if required) will be appropriately rehabilitated;
- A 'Hazardous materials spillage contingency plan' should be in place;
- All hazardous materials stored on site should also be stored in an appropriately bunded and well-ventilated area;
- All contaminated soils should be immediately removed and placed within a hazardous skip located on site, for end disposal at an appropriately licensed hazardous waste disposal site by a reputable waste disposal contractor;
- All mining vehicles and plant machinery operating on site should be regularly serviced in order to prevent the potential for oil and fuel leaks to occur;
- Drip trays should be placed under vehicles that stand within the contractors yard for extended periods of time; and
- Vehicles should not be serviced out of terrain, but only in designated workshops established for the purposes that are equipped with oil water separators and sumps for the collection of contaminated materials.

2.6.3. The potential of subsidence

Table 15: Subsidence

Activity	**Subsiding of the ground surface**			
Nature of the impact	**Subsiding of the ground surface due to alterations of the overburden due to collapse or failure of underground mine workings. Surface subsidence features usually take the form of troughs.**		**Status**	**-**
Receiving environment	**Geology and Topography**			
Magnitude	*Extent (footprint; site; regional; national; international)*		**SITE**	
	Intensity (low; medium; high)		**HIGH**	
	Duration (short; short-med; medium; long; permanent)		**PERMANENT**	
	Probability (Improbable; possible; likely; highly likely; definite)		**PROBABLE**	
Weighting factor (WF)	*WF (low; low-medium; medium; medium-high; high)*		**HIGH**	
Mitigation Efficiency (ME)	*ME (high; medium-high; medium; low-medium; low)*		**HIGH**	
Significance	*Without mitigation (WOM)*	*(Extent + Intensity + Duration + Probability) x Weighting Factor* *(2 + 5 + 5 + 3) x 5 = 65* *Medium High*		
	With mitigation (WM)	*WOM x ME = WM* *65 x 0.2 = 13* *Low*		
Significance With Mitigation (WM)	**LOW**			

Source of impact:

Room-and-pillar mining can cause subsidence of underground mines, when the pillars are not wide enough.

Description of the impact:

When subsidence of underground mines occur, troughs form when the overburden subsides due to the failure of mine pillars, or when the mine floor and roof are soft and pillars gets hit by mining operations.

Significance of impact:

The extent of the impact restricted to the site only and the duration is permanent. The impact is given a high intensity rating due to the potential thereof to contribute towards ground- and surface alteration and loss of life of mine workers as well as damage to surface infrastructure. The weighting factor attributed to this impact is high and probability is likely. The mitigation efficiency is high and therefore the significance of the impact with mitigation is low.

Mitigation:

- The design of the pillars should be sufficient (i.e. wide enough) to prevent subsidence from occurring.

2.7 HERITAGE IMPACTS

2.7.1. Potential Impacts on Heritage Resources

Table 16: Potential Impact on Heritage Resources

Activity	**Construction of the mine and associated infrastructure**		
Nature of the impact	**Disturbance of historical and cultural resources**	**Status**	**-**
Receiving environment	**Elements of cultural or historic significance as well as the surrounding communities**		
Magnitude	*Extent (footprint; site; regional; national; international)*	**SITE**	
	Intensity (low; medium; high)	**HIGH**	
	Duration (short; short-med; medium; long; permanent)	**PERMANENT**	
	Probability (Improbable; possible; likely; highly likely; definite)	**LIKELY**	
Weighting factor (WF)	*WF (low; low-medium; medium; medium-high; high)*	**HIGH**	
Mitigation Efficiency (ME)	*ME (high; medium-high; medium; low-medium; low)*	**HIGH**	
Significance	*Without mitigation (WOM)*	*(Extent + Intensity + Duration + Probability) x Weighting Factor* *(2 + 5 + 5 + 3) x 5 = 75* *Medium High*	
	With mitigation (WM)	*WOM x ME = WM* *75 x 0.2 =15* *Low*	
Significance With Mitigation (WM)	**LOW**		

Source of the impact:

- Damage to elements of cultural history, uncovering and subsequent damage to architectural finds during excavations and earthworks on site.

Description of the impact:

A Heritage Impact Assessment (HIA) of the site has been undertaken and the following was observed on the study area:

- Remaining Extent of the Farm Mamatwan:
    - A homestead dating from the historical period on the Remaining Extent is thus older than 60 years, and is subsequently protected under the National Heritage and Resources Act, 1999 (Act No. 25 of 1999);

- A graveyard in close proximity to the homestead with five graves, as all graves are protected under the Human Tissue Act, 1983 (Act No. 65 of 1983) and Ordinance on the Removal of Graves and Dead Bodies (Ordinance 7 of 1925), while graves older than 60 years are also protected under the National Heritage and Resources Act, 1999 (Act No 25 of 1999); and
- Presence of Late Stone Age (LSA) artefacts in a 200 m radius of the dry riverbed on the western section of the Remaining Extent, the specialists recommend that no development take place within the buffered area.

- Portions 3, 8 and the demarcated section of Portion 19 of the farm Mamatwan 331:
    - Due to no visible remains pertaining to heritage resources development may continue on these Portions; and

Significance of the impact:

The extent of the potential impact is contained within the boundaries of the site. The impact is given as a Low intensity rating and could possibly occur, but is unlikely.

Mitigation:

The mitigation and management measures as set out in the specifications for a HIA should be applied prior to development taking place, namely:

- No blasting with explosives or heavy drilling within 20 meters of any heritage feature;
- No part of any heritage structure may be removed or altered during the construction period without a permit from the South African Heritage Resources Agency (SAHRA);
- If hidden archaeological and historical finds are exposed during mining, they should immediately be reported to the authorities, so that an investigation and evaluation of the finds can be made.
- Under no circumstances shall archaeological or paleontological artefacts be removed, destroyed or interfered with by anyone on the site. Mamatwan Manganese Mine shall advise their workers of the penalties associated with the unlawful removal of cultural, historical, archaeological or paleontological artefacts, as set out in the National Heritage Resources Act (Act 25 of 1999), Section 51(1).;
- Remaining Extent of the Farm Mamatwan:
    - The homestead on the Remaining Extent is older than 60 years, and is subsequently protected under the National Heritage and Resources Act, 1999 (Act No. 25 of 1999). The specialists recommend that this structure should be retained.
    - The specialists recommend that a conservation buffer of 20 m be placed around the graveyard in close proximity to the homestead, as all graves are protected under the Human Tissue Act, 1983 (Act No. 65 of 1983) and Ordinance on the Removal of Graves and Dead Bodies (Ordinance 7 of 1925), while graves older than 60 years are protected under the National Heritage and Resources Act, 1999 (Act No 25 of 1999).

- Due to the presence of LSA artefacts in a 200 m radius of the dry riverbed on the western section of the Remaining Extent, the specialists recommend that no development take place within the buffered area. Should the need for development within this buffer arise, it is recommended that a Phase 2 Archaeological Impact Assessment be conducted prior to any construction or development activities; and

- Portions 3, 8 and the demarcated section of Portion 19 of the farm Mamatwan 331:
  - Due to no visible remains pertaining to heritage resources development may continue on these Portions; and
  - Should culturally significant material or skeletal remains be exposed during development and construction phases, all activities must be suspended pending further investigation by a qualified archaeologist (Refer to the National Heritage and Resources Act, 25 of 1999 section 36 (6)).

2.8 SOCIO ECONOMIC IMPACTS

2.8.1. Impacts on socio-economic environment

Table 17: Potential Impacts on socio-economic environment

Activity	**Job creation**		
Nature of the impact	**Labour required for development (during mining phases)**	**Status**	**-**
Receiving environment	**Residents of the region** **Developers**		
Magnitude	*Extent (footprint; site; regional; national; international)*	**REGIONAL**	
	Intensity (low; medium; high)	**HIGH POSITIVE**	
	Duration (short; short-med; medium; long; permanent)	**LONG**	
	Probability (Improbable; possible; likely; highly likely; definite)	**DEFINITE**	
Weighting factor (WF)	*WF (low; low-medium; medium; medium-high; high)*	**HIGH**	
Mitigation Efficiency (ME)	*ME (high; medium-high; medium; low-medium; low)*	**HIGH**	
Significance	*Without mitigation (WOM)*	*(Extent + Intensity + Duration + Probability) x Weighting Factor* *(3 + 5 + 4 + 5) x 5 = 85* *High Positive*	
	With mitigation (WM)	*WOM x ME = WM* *85 x 0.2 = 17* *High Positive*	
Significance With Mitigation (WM)	**HIGH POSITIVE**		

Source of the impact:

Creation of job opportunities during mining operations for residents of the region.

Description of the impact:

The mining phase of the development will provide numerous job opportunities to the skilled professionals, less skilled trades (such as truck drivers, operators etc.) as well as the unskilled and semi-skilled workers residing in the region.

Significance:

The impact can be very negative if labour is sourced from elsewhere and the local residents are excluded from economic benefit to be gained from the construction and operation of the proposed manganese mine. Certainly, some skilled labour will have to be imported from other areas but unskilled labour is available, and if work is given to these people it will have a great benefit and have a very positive significant impact on the region as a whole.

Mitigation:

- If and where possible, the local community should be consulted when sourcing semi-skilled labour; and
- The Social and Labour Plan must be implemented.

3. CUMULATIVE IMPACTS

Cumulative impacts (refer to Figure 2: The identification of cumulative impacts), occur because of the combined effect of incremental changes caused by other activities together with the particular project. In other words, several developments with insignificant impacts individually may, when viewed together, have a significant cumulative adverse impact on the environment.

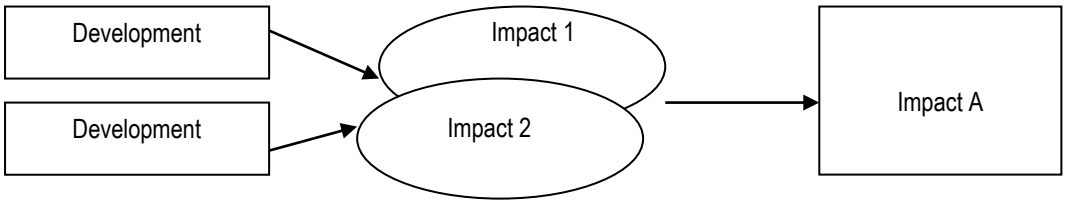

Figure 2: The identification of cumulative impacts

The following cumulative impacts have been identified in terms of the proposed development:

3.1 CUMULATIVE IMPACTS ON GROUNDWATER DUE FROM SEEPAGE OF STOCKPILES AND MINING OPERATIONS

Source of the impact:

Stockpiles of manganese ore for storage and general mining construction and operations.

Description of the impact:

Seepage from the stockpiles and from mining operations from fuels, oils and other chemicals causes a contamination plume affecting the underground resources which in turn affects surface water resources. Together with adjacent mining operations this could cause a cumulative impact of pollution of already scarce water resources in the area.

As the hydraulic conductivity of the bedrock is so low, impacts propagate only locally. The only other line in close vicinity is the existing Middelplaats Underground Mine situated just north of this proposed mine. It seems to be in the same ore body, thus the impact could be elongated to the north. No significant additional impacts are anticipated.

Significance of the impact:

The significance of the impact is medium before and low after mitigation.

Mitigation:

- When chemicals e.g. paint, fuels and oils are handled during construction and maintenance, impermeable material (drip tray) must be placed underneath to prevent spilling on the ground;
- It must be ensured that a credible company removes used oil after vehicle servicing;
- A sufficient supply of absorbent fibre should be kept at the site to contain accidental spills;
- Used absorbent fibre must be land-farmed, using approved methodologies;
- Domestic waste water, especially sewage, must either be treated at site according to accepted principles, or removed by credible contractors;
- Solid waste must similarly either be stored at site on an approved waste dump, or removed by credible contractors;
- To assess the impacts of the stockpile area on the groundwater regime a groundwater analysis need to be undertaken;
- Groundwater monitoring must be conducted according to the specifications in the Geohydrological Report:
    - Although no or little groundwater contamination is expected during the mining phases due to the cone of depression, it is nevertheless recommended that groundwater quality be monitored on a quarterly basis. This is essential to provide a necessary database for future disputes.

- Water samples must be taken from all the monitoring boreholes by using approved sampling techniques and adhering to recognised sampling procedures. Samples should be analysed for both organic as well as inorganic pollutants, as mining activity often lead to hydrocarbon spills in the form of diesel and oil. At least the following water quality parameters should be analysed for:
    6. Major ions (Ca, K, Mg, Na, SO4, NO3, Cl, F)
    7. pH
    8. Electrical conductivity (EC),
    9. Total Petroleum Hydrocarbons (TPH)
    10. Total Alkalinity
- These results should be recorded on a data sheet. It is proposed that the data should be entered into an appropriate computer database and reported to the Department of Water Affairs;
- Management of the stockpile in accordance with Section 73 of the MPRDA Regulations (No. R527, 2004).
- Vehicles are to be maintained in good working order so as to reduce the probability of leakage of fuels and lubricants;
- A walled concrete platform, dedicated store with adequate flooring or berm area should be used to accommodate chemicals such as fuel, oil, paint, herbicide and insecticides, as appropriate, in well-ventilated areas;
- Storage of potentially hazardous materials should be above any 100-year flood line, or as agreed with the Environmental Control Officer. These materials include fuel, oil, cement, bitumen etc.;
- Surface water draining off contaminated areas containing oil and fuel would need to be channelled towards a sump which will separate these chemicals and oils;
- All materials prone to spillage are to be stored in appropriate structures with impermeable flooring;
- Chemical toilets are to be provided and maintained for construction crews. Maintenance must include their removal without sewage spillage;
- Under no circumstances may ablutions occur outside of the provided facilities;
- No uncontrolled discharges from the construction crew camps to any surface water resources shall be permitted. Any discharge points need to be approved by the relevant authority;
- In the case of pollution of any surface or groundwater, the Regional Representative of the Department of Water Affairs must be informed immediately;
- Store all litter carefully so it cannot be washed or blown into any of the water courses within the study area;
- Provide bins for staff at appropriate locations, particularly where food is consumed; the construction site should be cleaned daily and litter removed; and
- Conduct ongoing staff awareness programs so as to reinforce the need to avoid littering.

3.2 CUMULATIVE IMPACT OF HYDROLOGICAL MODIFICATIONS AND STORMWATER

Source of the impact:

Hardened surfaces will impact negatively on the soils and vegetation of the area as the construction of impermeable layers on the surface will prevent infiltration and ultimately result in reduced seepage yields.

Description of the impact:

Increased stormwater runoff with an associated increased erosion potential are also directly related to the expansion of hardened surface inside a catchment. Interventions and mechanisms can be included in the development to facilitate a higher percentage of infiltration (e.g. porous pavements).

Significance of the impact:

The significance of the impact is expected to be of a medium significance without mitigation, this due to the removal of vegetation and the construction of hard surfaces. With mitigation the significance of the impact will be of a low significance even though the impact will not be reversible and is of a permanent nature.

Mitigation:

- Interventions and mechanisms should be included in the proposed development to reduce the impact of stormwater on soil; and
- An ecologically sensitive stormwater management plan will be required to attenuate flood peak events and prevent excessive erosion.

3.3 CUMULATIVE IMPACT OF VEGETATION LOSS

Source of the impact:

Removal of vegetation during construction activities for access roads, buildings and other infrastructure. Stockpiles during the construction and operational phases.

Description of the impact:

Vegetation loss will result in decreased biodiversity on site including and fragmentation of habitat. Vegetation loss also increase soil erosion and increased stormwater runoff.

Significance of the impact:

Because the impact is of a permanent nature to a large extent it is of high significance before mitigation. However when mitigation measures are implemented, the impact will be medium after mitigation.

Mitigation:

- Removal of vegetation should be limited to the construction and mining area only;
- Where possible cleared areas should be rehabilitated as soon as possible during construction;
- Cleared areas should be reseeded with endemic, indigenous vegetation and the topsoil to be used should be declared weed free by a specialist; and

- Replanted areas should be monitored until establishment took place. Should establishment not take place, the process should be repeated until establishment occur.

3.4 CUMULATIVE IMPACT OF FAUNAL HABITAT AND DISPLACEMENT

Source of the impact:

Destruction of faunal habitat and the displacement of species from their traditional home ranges during the construction phases of the proposed development.

Description of the impact:

Faunal species could be displaced during the construction phase. This could result in higher than normal social, grazing and browsing pressures on areas that would otherwise not have these impacts. This could result in degraded vegetation cover from trampling, erosion, grazing or browsing and other forces.

Significance of the impact:

The significance of the impact is expected to be of a medium significance without mitigation, this due to the displacement of faunal species from their habitats on site to allow for the building of the proposed development. With mitigation the significance of the impact will be reduced to that of a low significance.

Mitigation:

- Minimising the loss of flora and fauna in areas that are not directly affected by the new development;
- Where possible trees to be removed should be transplanted at another suitable location;
- Reduce the levels of disturbance on the area during construction;
- All construction areas should be suitably topsoiled and vegetated as soon as is possible after construction, preferably in phases during construction. Care should be taken that alien plant invasion is minimal. This must be monitored at regular intervals and removed and replaced with endemic, indigenous plants / trees where possible; and
- Disturbed surfaces to be rehabilitated must be ripped to a depth of 300mm, and the area must be backfilled with topsoil or overburden and vegetated as described above.

3.5 CUMULATIVE IMPACT ON NATURAL MIGRATORY ROUTES AND FAUNAL DISPERSAL PATTERNS

Source of the impact:

The introduction of barriers such as walls, buildings, roads and other infrastructure during the operational phase of the proposed development would have an impact on the natural migratory routes and faunal dispersal patterns.

Description of the impact:

Walls, buildings, roads and other infrastructure associated with the development may obstruct and constrict faunal dispersal and floral dispersal by limiting and funnelling natural dispersal patterns.

Significance of the impact:

The significance of the impact is expected to be of a medium significance without mitigation, this due to the constriction of natural migratory routes and faunal dispersal patterns. With mitigation the significance of the impact will be reduced to that of a low significance.

Mitigation:

- Sensitive areas e.g. the watercourse should be demarcated to prevent access during the mining phase;
- Reduce the levels of disturbance on areas indicated by the ECO as migratory routes along the Vlermuisleegte watercourse;
- All construction areas should be suitably topsoiled and vegetated as soon as is possible after construction;
- Disturbed surfaces to be rehabilitated must be ripped, and the area must be backfilled with topsoil or overburden;
- Use endemic, indigenous plants wherever possible in the landscaping of the property; and
- Try to maintain the natural vegetation in its original context as far as possible as this will enable species that are sensitive to transplanting to be maintained as well as their associated communities.

3.6 POSITIVE CUMULATIVE IMPACT ON THE SURROUNDING COMMUNITIES, OF SOCIO-ECONOMIC DEVELOPMENT INCLUDING REDUCING UNEMPLOYMENT RATES AND CREATING UPLIFTMENT

Source of the impact:

Employment opportunities will be created if the proposed activity is approved to construct the mining facilities as well as during the operational phase when the actual mining will take place.

Description of the impact:

- Job creation in an area where the main source of income is generated through primary activities e.g. farming;
- Creation of job opportunities during construction and operation for residents of the region;
- The provision of improved infrastructure and social upliftment, by creating short term employment over a period and skills transfer to unskilled and semi-skilled unemployed individuals;
- A project like this will create positive spin-offs in terms of job creation for at least the construction period of the project; and
- Skills and training will be transferred to the local community and the greater area.

Significance of the impact:

The significance before mitigation is medium positive, however it could be very high negative if local labour is not sourced, and after mitigation very high positive.

Enhancement of positive impact measures:

- This economic opportunity should be structured in such a way that it can establish long-term sustainable economic growth both in terms of skilled and unskilled labour and further in terms of establishment of permanent business and economic growth opportunities in Hotazel and Kuruman. The proposed development aims at providing a Manganese mine where individuals will be able to work; and
- The Social and Labour plan attached to the report in *Annexure 3 – Specialists' Reports* should be implemented.

3.7 CUMULATIVE IMPACT: DECREASE IN AIR QUALITY IN THE IMMEDIATE SURROUNDINGS OF THE MINE

Source of the impact:

Current sources of pollution (predominantly in the form of dust) in the vicinity of the site include the following:

- Dust from mining to the south east and north east of the site;
- The handling of ore, at these mines;
- Ore processing operations;
- Stockpiled materials and the mines;
- Disturbed land or land denuded of any vegetation;
- Vehicle movements on un-surfaced roads; and
- Disposal facilities.

Future sources of air pollution at the proposed mine will include:

- Materials handling operations with mining and predicted to result in significant fugitive dust emissions include the transfer of material by means of tipping, loading and off-loading trucks;
- Wind erosion from exposed areas – significant emissions arise due to the mechanical disturbance of granular material from open areas and storage stockpiles;
- Primary crushing operations represent significant dust generating sources if uncontrolled; and
- Particulate emissions will result from the entrainment of loose material from the paved road surface due to the vehicle traffic.

Description of the impact:

Air quality monitoring has not been undertaken at this stage of the project as no mining activities has commenced on site. Sulphur Dioxide and other particulates represent pollutants that raise concerns in assessing the impact of the mines operations. The levels of these pollutants are also known to be elevated in other parts of South Africa and especially in Mpumalanga (also renowned for mining) as a result of mines as well as ESKOM electricity generation activities.

The screening plant could either make use of wet screening or dry screening. It is however a Transnet requirement that ore transported by rail should be wet screened, since wet screened material contains less fine materials than dry screened products. Also the wet screening plant produces significantly less dust than a dry screening plant. No dust emanates from the wet screening operation, and the minimal dust coming from the crushers can be controlled by water sprays.

Significance of the impact:

The cumulative impact of PM_{10} concentrations has a significance of medium before mitigation and low after mitigation.

Mitigation:

- Air quality monitoring and modelling should for future activities concentrate on dust fallout and ambient PM_{10} and sulphur dioxide monitoring. Dust fallout monitoring will be undertaken to assess compliancy with dust fallout limits and will be reviewed annually. Monitoring will also be undertaken during the mining phase to assess sulphur dioxide compliancy with the ambient air quality guidelines and standards. The monitoring is conducted according to the main impact zone of the mine operations;
- Dust suppression activities such as water sprays are required during the construction and operational phase in order to minimise dust generation; and
- Additional mitigation measures are included in the EMP.

3.8 CUMULATIVE IMPACT: INCREASED TRAFFIC VOLUMES AS A RESULT OF MORE HEAVY VEHICLES MAKING USE OF THE ROADS IN THE IMMEDIATE AREA

Source of the impact:

Traffic will increase in and around the proposed development. The increase of especially heavy vehicle movements surrounding the proposed land use locality, such as on Provincial roads, which are in the vicinity of the mining complex, and link up to the project area. In addition to this, traffic within the mine area will also be a contributing fact towards cumulative impacts from an increase in traffic.

Description of the impact:

The proposed development entails the setup of mining activities as well as the construction of mine related infrastructure. Due to the nature of the activity it is likely that there will be a cumulative increase in vehicular traffic on roads adjacent to the proposed land use locality. The cumulative impacts emanating from the increase in traffic may become apparent during the construction phase of the manganese mine. The new permanent and temporary access roads if not surfaced, could contribute to dust impacts, spills and erosion and loss of soil resources.

Significance of the impact:

The transport of materials, people and goods may present the only significant impact. The movement of vehicles on the local roads within the surrounding communities may result in damage to roads from movement of heavy vehicles. Despite the potential cumulative impacts from the traffic increase it is not anticipated that the impact will have a ranking higher than low for as long as the permanent or any non-surfaced roads are not in close proximity to the adjacent communities. As long as the roads are internalised, it is not anticipated that the cumulative impact of traffic will be significant.

Mitigation:

- Only main roads should be used;
- Where feasible vehicles should not operate on public roads during peak hours;
- Vehicles should adhere to the speed limit of the road;
- Heavy vehicles should always travel with their head lights switched on;
- Heavy vehicles should not stop on the road to pick up hitchhikers;
- No stopping on the road approaching the mine will be allowed;
- Limit the extent and degree of change to the biophysical and socio-economic environment; and
- Communicate with and acknowledge concerns of the I&APs and mitigate where possible.