7. DESCRIPTION AND ASSESSMENT OF POTENTIAL IMPACTS

7.1. Introduction

This section will describe the impacts that the proposed development could potentially have on the receiving biophysical and socio-economic environment during construction, operation, decommissioning and post-closure phases. The impacts will be rated using a standardised impact rating methodology (outlined below). The impacts have been rated per phase and according to the affected receptors.

7.1.1. Specialist Studies

Specialist studies were undertaken to investigate the baseline conditions and assess the potential impact of the proposed development on the receiving environment. The following specialist studies were conducted:

SPECIALIST FIELD	SPECIALISTS
Air Quality	Airshed Planning Professionals
Aquatic Ecology	Dr. Johan Engelbrecht for Koos De Wet Environmental Consultant
Archaeology and Heritage	Archaetnos Culture and Cultural Resources Consultants
Blasting	Blast Analysis Africa
Ecology	Koos De Wet Environmental Consultant
Groundwater and Hydrogeology	Future Flow
Noise	J H Consulting
Soil	Terrasoil Science (ESS)
Socio-Economic	Core Earth Resources
Surface water	African Environmental Development (AED)
Traffic	UWP Consultants
Wetlands	Anton Linström for Koos De Wet Environmental Consultant

The specialists were requested to determine the potential impacts of the proposed development within their existing field of study and then to determine the significance thereof using the standardised impact rating methodology (Section 7.2) while also providing management measures and the resultant effect on the impact significance. In order to avoid repetition, the information and assessment is tabulated according to the relevant activities relating to each resource (Section 7.3, 7.4, 7.5 and 7.6), and cross-references are made to this section in subsequent sections of the report.

7.1.2. Impact Ratings

The environmental impacts are listed according to the relevant environmental receptors associated with a particular activity. These impacts are rated according to an impact rating methodology (discussed in Section 7.2). Mitigation measures are suggested for all medium to high significance impacts (low-significance impacts do not require further intervention) and these impacts are then re-rated post-mitigation (these are the values indicated within square brackets). The tabulated impact assessments and mitigation measures are further elaborated upon within Sections 7.3, 7.4, 7.5 and 7.6 per receptor / specialist study.

7.1.3. Capacity to manage and rehabilitate the environment

The approximate costs associated with the proposed impact management and rehabilitation measures have been derived either by specialists or contractors. These costs are specific to the project and each management measure, however some of these management measures are either already covered by operational costs or rehabilitation closure costs or do not have an applicable cost.

Operational cost: has been catered for within the mine design and will be implemented by default when the mine is constructed from capital costs set aside for the development, or operated as per costs assigned to the development in the Mining Works Programme.

Closure cost: has been catered for in the financial provision (Section 15) closure and rehabilitation costs.

No cost applies: this management measure does not have a specific cost associated with it.

It should be noted that a *Plant Relocation and Rescue Plan (R 40 000.00)*, a *Biodiversity Action Plan (R 60 000.00)* and an *Alien Invasive Eradication and Monitoring Plan (R 50 000.00)* will be drafted and implemented over the entire mine. The costs allocated to these cover the entire mining area and are not specific to terrestrial biodiversity, aquatic biodiversity or wetlands.

7.1.4. Cumulative Impacts

This section ends with a qualitative assessment of cumulative impacts, which has been defined as the potential contribution of this proposed mine to the overall existing impacts in the Nkomazi region of the Mpumalanga Province, resulting from other mines and industries such as agriculture.

7.2. Impact Rating Methodology

As stipulated in Regulation 50(c) of the MPRDA, the EIA must include "an assessment of the nature, extent, duration, probability and significance of the identified potential environmental, social and cultural impacts of the mining operation, including the cumulative environmental impacts". The significance of both positive and negative potential impacts will be determined through the evaluation of impact consequence and likelihood of occurrence.

The following risk assessment model will be used for determination of the *significance* of impacts.

SIGNIFICANCE = (MAGNITUDE + DURATION + SCALE) X PROBABILITY

The maximum potential value for significance of an impact is 100 points. Environmental impacts can therefore be rated as high, medium or low significance on the following basis:

- High environmental significance 60 – 100 points
- Medium environmental significance 30 – 59 points
- Low environmental significance 0 – 29 points

MAGNITUDE (M)	DURATION(D)
10 – Very high (or unknown)	5 – Permanent
8 – High	4 – Long-term (ceases at the end of operation)
6 – Moderate	3 – Medium-term (5-15 years)
4 – Low	2 – Short-term (0-5 years)
2 - Minor	1 - Immediate
SCALE (S)	**PROBABILTY (P)**
5 – International	5 – Definite (or unknown)
4 – National	4 – High probability
3 – Regional	3 – Medium probability
2 – Local	2 – Low probability
1 – Site	1 – Improbable
0 – None	0 – None

7.3. Construction Phase

Construction of the mine and mine infrastructure has an estimated start date of 2014 and will be undertaken over a period of approximately six months. The initial construction of the opencast pits will require clearing of vegetation and stripping of topsoil across the opencast pit area. Drilling, blasting and overburden removal will occur during the initial pit excavation and all topsoil removed will be stockpiled separately to the overburden material. There will be two topsoil dumps, two non-carbonaceous dumps and one carbonaceous dump. Opencast mining will develop in the first of the two opencast pits where, two or three strips will be exposed to allow room for further roll-over mining operations. Thereafter, overburden material extracted from the strips being mined will be progressively placed into the excavation remaining from the previously mined strips (i.e. progressive rehabilitation).

Land will be cleared for the construction of PCDs and dirty water drainage system including berms and canals to contain contaminated water and divert clean stormwater, as well as for the construction of access and haul roads on site, bulk service infrastructure, the CHPP, sewage treatment plant and administration offices. These facilities will also be constructed / installed during this time.

7.3.1. Air Quality

Impact Assessment

During construction only excavation of open cast pit 1 will be taking place and the annual average PM_{10} concentrations were predicted to be within the National Ambient Air Quality Standards (NAAQS) as set out in the National Environmental Management Air Quality Act (Act No. 39 of 2004) (NEMAQA) at all of the nearby receptors. Exceedances of the annual $PM_{2.5}$ NAAQS limit value were predicted to occur only on site. Predicted dust fallout rates are well within the SA NEMAQA draft dust fallout standards with high dust fallout localised to the site.

The following activities which may impact on the air quality in the area during the construction phase were identified:

- During construction vehicles will be used to transport materials and personnel for the construction of the surface infrastructure as well as for the transportation of topsoil and overburden from the excavation of the opencast pit to the topsoil stockpile and waste rock dump. All road surfaces onsite will be unpaved. Vehicle-entrained dust emissions from unpaved roads represent a potentially significant source of fugitive dust which will reduce the surrounding air quality. Increased fugitive dust may be a nuisance to local residents, employees and fauna in the area. Increased fugitive dust may also affect the photosynthetic activity and growth of flora in the area. The significance of the impact of increased fugitive dust from vehicle entrainment is **medium** without mitigation and **low** if the mitigation measures listed below are implemented.
- Vehicle tailpipe emissions contain particulate matter (hydrocarbon compounds) including inhalable particles (PM_{10}) and fine particles ($PM_{2.5}$) as well as other gaseous emissions. The impact of gaseous emissions from vehicle tailpipes was regarded to be low and was omitted from this study. The suspension of particulate matter in the air will reduce the surrounding air quality which may have an impact on the health of local residents, employees and fauna in the area. The significance of the increased particulate matter suspended in the air is **medium** without mitigation and **low** if the mitigation measures listed below are implemented.
- Clearing of vegetation across the opencast mining area and areas where surface infrastructure will be located will be required. This clearing of vegetation will result in increased fugitive dust due to the loosening of the soil. Drilling and blasting will also be required for the excavation of the opencast pit. Drilling and blasting operations are intermittent sources of fugitive dust. Increased fugitive dust may be a nuisance to local residents, employees and fauna in the area. Increased fugitive dust may also affect the photosynthetic activity and growth of flora in the area. The significance of the impact of increased fugitive dust from vehicle entrainment is **medium** without mitigation and **low** if the mitigation measures listed below are implemented.

Mitigation Measures

<table>
<tr><th>MANAGEMENT AND MITIGATION MEASURES</th><th>APPROXIMATE COST</th></tr>
<tr><td>▪ To reduce dust from vehicle entrainment and windblown dust from materials being transported:
o wet suppression or chemical stabilization of unpaved roads should be implemented;
o trucks are to be covered;
o vehicles should adhere to strict speed limits (speed limit of 40km/hr recommended on the access roads); and
o unnecessary traffic on unpaved roads should be reduced.</td><td>Operational cost</td></tr>
<tr><td>▪ To reduce particulate matter from vehicle tailpipe emissions unnecessary traffic on roads should be reduced.</td><td>No cost applies (forms part of service level agreements with equipment suppliers)</td></tr>
<tr><td>▪ To suppress windblown dust from materials handling, wind speed around the material stockpiles can be reduced through sheltering and the material can be weighted through wet suppression.</td><td>Operational cost</td></tr>
<tr><td>▪ To reduce dust from earth moving (land clearing) operations wet suppression should be implemented where feasible.</td><td rowspan="2">Operational cost</td></tr>
<tr><td>▪ To reduce windblown dust from cleared areas the:
o extent of the cleared areas should be reduced;
o frequency of disturbance to cleared areas should be reduced;
o disturbed soil should be stabilised though chemical or vegetative measures; and
o disturbed areas should be re-vegetated as early as possible.</td></tr>
<tr><td>▪ Dust emanating from drilling and blasting should be reduced by:
o drilling with vacuum packs or drill covers;
o wet suppression to ensure minimal dust generation; and
o blasting to only occur between 12h00 and 15h00 and only during cloudless days.</td><td>Operational cost</td></tr>
</table>

7.3.2. Blasting and Vibrations

Impact Assessment

- The proposed mine site is bordered to the north and to the west by the villages of Tonga and eMangweni. The open areas between the villages are comprised of either farm land or natural bush.
- The points of concern are the closest houses to the planned open cast pits. The northern perimeter of the north pit lies approximately 500 m from the nearest houses in Tonga village. The western perimeter of the northern pit lies approximately 270 m from the

eastern most houses of Tonga village. The southern perimeter of the south pit lies approximately 200 m away from the northern most houses of eMangweni village.

- During construction, two main operations will be occurring, namely: (1) Overburden removal and (2) Pit excavation. These operations will both involve drilling and blasting.
- The overburden consists approximately 11 metres of soft material which overlies hard sandstone and will require blasting.
- There are four main impacts that may occur as a result of blasting operations, namely: (1) Ground vibrations, (2) Air blast, (3) Dust and (4) Fly-rock.
  - The ability of ground vibrations to cause damage to buildings is proportional to the Peak Particle Velocity (PPV) of that shock wave and is inversely proportional to the frequency. Thus a ground vibration with a high PPV and low frequency will most likely cause damage to buildings. Buildings can generally withstand ground vibration amplitudes of 12.7 mm/s or more; however, humans and animals are easily disturbed by ground vibrations at low levels. The significance of the negative impact caused by ground vibrations during the construction phase is predicted to be **high**; however, once the recommended mitigation measures and monitoring programmes are implemented the significance of the impact will decrease to **medium**.
  - Air blast amplitudes up to 134 dB should not result in any adverse impacts. Air blasts greater than 134 dB will cause human irritation and may generate complaints during blasting operations; air blasts of this magnitude will not result in any damage to property but may alert nearby residents to the fact that blasting operations are in progress. It is not possible to make a reliable prediction on the impacts of air-blast due to the effect of wind, cloud and temperature inversion; however, it is suggested that blasting at other opencast mining sites is carried out successfully at air-blast amplitudes below 130 dB. The significance of the negative impact caused by air blasts during the construction phase is predicted to be **high**; however, once the recommended mitigation measures and monitoring programmes are implemented the significance of the impact will decrease to **medium**.
  - Dust and smoke are inevitable by-products of blasting operations and will potentially heighten any existing irritations created in local residents. The significance of the negative impact caused by air blasts during the construction phase is predicted to be **medium**; however, once the recommended mitigation measures and monitoring programmes are implemented the significance of the impact will decrease to **medium**.
  - Fly rock is the greatest hazard in blasting operations as it may result in injuries and / or loss of life. For this reason fly rock should be given priority in blast design. The significance of the negative impact caused by air blasts during the construction phase is predicted to be **high**; however, once the recommended mitigation measures and monitoring programmes are implemented the significance of the impact will decrease to **medium**.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ In view of the fact that there is a large and unknown number of people residing within 500 m of the opencast pit operations, exceptional measures need to be taken in order to reduce the negative impact of blasting operations. While it may be possible to evacuate people and animals from these areas houses and other structures will remain (and will more than likely be damaged). For this reason it is a requirement that the blast design(s) proposed to be used at KaNgwane should make use of a blasting accessory known as a "Tulip Plug" which should be used in all blasts. The Tulip Plug is designed to contain the explosive energy released in a blast by altering the mechanics of the rock-breaking process. Tulip plugs have been shown to reduce the impact of: ○ Ground vibrations (by reducing the mass of explosives in all blast-holes); ○ Fly-rock (by directing more explosive energy down-wards) and ○ Air blast (by containing more explosive energy within the blast)	R 140 000.00 p/a. (Based on a 102mm X 450mm Tulip plug, 50 plugs per blast, 3 blasts per week, 52 weeks per year.)
▪ Tulip Plugs will achieve the above benefits provided all other blasting parameters are strictly controlled. Incorrect drilling, charging, stemming and/or timing of the blast holes may still result in a dangerous situation where incidents may occur. In view of this, it is a requirement that all blast designs to be used at the mine are produced by a qualified engineer who is familiar with the Tulip Plug technology. Blasters and their crews should be trained in the use of the Tulip Plug in order to achieve the desired results.	
▪ The condition applied to clear all people and livestock within a 500 m radius of the blast is onerous. This process is time consuming and may lead to social disruption. In order to avoid this it is recommended that all blasts be recorded on a suitable HD video camera, the camera will record any fly-rock that may be thrown into the air by any blast. More than one camera may be necessary in order to achieve a full record of all fly rock. These digital videos of blasts must be kept on record by the mine and given a positive reference to the date, time and reference number of the particular blast concerned. After a minimum of ten blasts are fired and shown by the video records to not have thrown any fly-rock beyond the mine boundaries the appointed engineer and the appointee may agree to reduce the radius of the area to be cleared before all subsequent blasts.	R 10 000.00 (Camera & tripod)
▪ The ground vibration should not be allowed to exceed 12.7 mm/s at any building in order to limit the risk of cosmetic or any other	No cost applies

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
damage. These lower frequencies are achieved by large hole diameters and long timing delays between holes. Additionally, the maximum mass of explosives that can be fired per delay at a distance of 200 m should not exceed 140 kg.	
▪ If the HD video recording fly-rock results which are unacceptable, all livestock should be cleared to a radius of 500 metres in order to avoid danger of fly rock; additionally, at this distance the effects of ground vibrations on livestock will be minimal.	No cost applies
▪ Blast vibrations should be carefully monitored (see Section 11.2 below). ▪ Deterioration to buildings should be carefully monitored (as per the monitoring plan in Section 11.2 below).	R 252 000.00 (once-off for monitoring equipment) R 15 000.00/month (monitoring and equipment calibration) See Section 11.2.5
▪ It is recommended that hard sandstone should be drilled and blasted while the soft overlying material is in place, this will have the effect of reducing many of the potential environmental risks associated with blasting operations. o Blasting of the hard overburden with the soft material still in place will greatly reduce the amount of air blast produced as each blast will have a thick layer of cover which will have a positive / muffling effect on the blast. o The amount of dust produced by any blast will be greatly reduced by leaving the soft overburden material in place.	Operational cost
▪ Keep air-blast amplitudes below 130 dB, this requires proper stemming control, burden control, stemmed presplit holes and the use of noiseless initiation systems.	No cost applies
▪ Minimise the effects of dust and smoke by blasting when the wind is blowing in the opposite direction to sensitive receptors.	No cost applies
▪ All blast holes should be stemmed to at least 25 times their diameter.	Operational cost
▪ The setting out and drilling of all blast-holes must be supervised to ensure proper distribution of explosives through the blast.	Operational cost
▪ All blast-holes must be timed with detonators fitted with sufficiently accurate delays in order to ensure that the timing design is complied and it is recommended that electronic detonators are used.	Operational cost

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ All traffic on nearby public roads to the west of the site must be stopped during blasting operations.	No cost applies
▪ Measures that should be taken to minimise fly rock include: ○ Stemming lengths in all blast holes should not be less than 25 hole diameters. ○ All loose rocks should be cleared before blasting. ○ All blast-holes should be initiated at or near the toe. ○ The position and drilling of each blast-hole should be supervised to insure that no hole or part-hole is overburdened or under-burdened. ○ If the HD video recording displays fly-rock results which are unacceptable people and animals within a 500 metre radius should be cleared during blasting operations. ○ The amount of fly rock produced by the blasts may be greatly reduced by leaving the soft over-burden in place when blasting the hard sandstone underneath.	Operational cost

7.3.3. Terrestrial Ecology

Impact Assessment

Flora:

- The study area is situated within the Zululand Lowveld Vegetation Type and construction activities will occur entirely within this vegetation type. The conservation status of this vegetation type is regarded as vulnerable, however, the MBCP - Terrestrial Assessment indicates that construction will occur on areas of "Least Concern" and "No Natural Habitat Remaining". There are thus few elements of the original vegetation type which are still present in this area.
- The proposed construction activities will take place within existing sugar cane fields, non-developed (natural) land or land which is lying fallow from previous agricultural activities.
- Some of the plant species identified on-site are utilised for traditional purposes. Other plant species regarded as being of significance are those that are protected by provincial or national legislation. Few species of significance (a total of five species) were recorded in the study area (due to the pre-disturbed nature of the veld). No plant species protected in terms of the Threatened and Protected Species Regulations were found in the study area.
- During the construction phase land will be cleared within the entire development footprint of the mine (including the proposed on-site haul and access roads). Additionally the initial excavation of the opencast pit will entail the clearance of land. Other processes that will take place during construction such as the transportation of men and materials to site and the use of heavy machinery have the potential to exert a negative impact on the floral environment.

- Considering the above, following potential negative impacts on the vegetation associated with the proposed mine's development footprint may be associated with the construction phase:
  - Existing vegetation communities within the mine's development footprint will be completely destroyed due to clearing of land for the construction of mining infrastructure and haul / access roads.
  - Nationally / Provincially protected plant species may be destroyed when land is cleared for construction activities.
  - The above clearance activities could result in the overall reduction in the floral species diversity of the affected area.
  - Invader floral species and weeds tend to become well established in areas which have been disturbed or cleared. Such floral species may become abundant in areas which have been cleared of natural vegetation.
  - The presence of a large number of construction personnel in the project area may result in the trampling of the footprint area resulting in the destruction of in situ flora.
  - Dust generated by construction activities will settle on the surrounding environment which has the potential to affect the growth vitality of the vegetation.
  - Oil leaking or spilled from motorised equipment can introduce contaminants into the natural environment.
- There are a range of negative impacts that will be exerted on flora during the construction phase. For the significance of the impact of each of these please refer to the construction impact assessment table at the end of this section.

Fauna:

- Land degradation, previous agricultural activities, considered together with high population numbers and human activity, has resulted in the reduction of suitable habitats for faunal species, hence this area is not rich in faunal diversity.
- No mammal species of significance were recorded in the area; however, the Serval (Leptailurus serval) is likely to occur in the study area, the conservation status of which is considered to be near threatened.
- Despite several activities that are currently exerting a negative impact on the baseline environment associated with the proposed development, there are still a variety of suitable habitats present for avifauna in the study area – these habitats are thus important to conserve for refuge purposes.
- Of the nineteen species of reptiles known to occur in the study area, none have had their IUCN (International Union for Conservation of Nature) threatened status evaluated.
- With regards to amphibians, all of the frog species observed in the study area has a conservation status of "Least Concern".
- Considering the above, the construction phase has the potential to exert the following negative impacts on faunal communities:

- Dust generated during construction activities will settle on the surrounding vegetation which can potentially reduce the availability thereof for herbivores which may seek suitable habitat elsewhere.
- Construction activities can also result in mortalities for animals which will not flee the affected areas (e.g. due to collisions with mine or contractor vehicles). These include animals which are territorial, burrowing, slow moving or have young.
- The clearance of the proposed mine infrastructure footprint areas will result in habitat destruction; animals will flee to seek more suitable habitat elsewhere which will result in an overall reduction in faunal species diversity.
- An increase in the amount of people on site (such as building contractors etc.) may cause a disturbance to the faunal community, causing disruptions which could result in an exodus from the area.

- There are a range of negative impacts that will be exerted on fauna during the construction phase. For the significance of the impact of each of these please refer to the construction impact assessment table at the end of this section.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ A suitably qualified person should be appointed before construction commences in order to search and locate any flora/fauna of significance. If floral species of significance are found they should be maintained for re-planting post closure or they should be relocated to an appropriate location.	R 40 000.00 p/a
▪ Appoint a suitably qualified environmental manager to implement an alien invasive eradication and monitoring plan which will include a vehicle wash area where vehicles leaving and entering the site will be hosed down. Employees must be sensitised to the potential impacts of their activities on fauna and flora through the environmental awareness training before construction activities commence.	R 50 000.00 p/a
▪ If at all possible, additional grazing / arable land in surrounding areas should be made available in order to compensate for land lost.	Costing will form part of land tenure agreements to be finalised before mining commences.
▪ Human activity associated with the development should be limited to the construction site through the erection of fencing.	R 520 000.00 throughout LOM
▪ Measures regarding the management of dust-related impacts should be implemented.	See Section 10
▪ Enforce speed limits on internal roads.	Operational cost

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ Appoint a suitably qualified person who will (before construction commences) search and locate any faunal/floral species of significance. Such species should be relocated to a safe and suitable position away from construction activities.	R 40 000.00 p/a
▪ An allowance should be made for the regrowth of natural vegetation in suitable areas; this will partially address the problem of habitat fragmentation and will allow for the eventual restoration of landscape connectivity.	No cost applies
▪ Erect signage for animal crossings where appropriate (particularly for cattle).	Operational cost

7.3.4. Aquatic Ecology

Impact Assessment

- During the construction phase, large areas of land will be cleared for open cast pit excavation as well as footprint areas for all surface infrastructure. These disturbed areas therefore become more susceptible to soil erosion as vegetation is removed. Therefore surface runoff which may come into contact with these construction sites may become polluted and carry increased sediment loads into the surrounding water courses. The existing aquatic habitats can be affected by siltation and sedimentation of in stream environments and changes in physico-chemical water quality related to runoff, may be lethal to sensitive biota. This impact is considered **medium** without mitigation, but can be reduced to **low** if mitigation measures, such as adequate stormwater drainage systems, are implemented.
- Increased sediment and changes is water chemistry, may result in changes to existing aquatic habitats. Aquatic species diversity therefore may be reduced due to changes in habitat suitability (including an increased possibility for microbial growth and algal blooms). This impact is also considered **medium** without mitigation, but can be reduced to **low** if mitigation measures are implemented.
- Disturbance of the natural environment during construction and an increase in human activity is likely to result in the encroachment and establishment of alien and invasive plant species. Invasive species often establish along water ways. This can have a negative impact on stream biota as they out compete indigenous vegetation and habitats change. Alien invasive species also often utilise more water than indigenous species, so have the potential if they become established to alter stream flow. The impact of alien invasive species is considered **high** without mitigation, but can be reduced to **low** if mitigation measures are implemented effectively.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ Monitor seasonal and temporal variation in the selected components of aquatic biodiversity determined during the baseline study at strategically positioned monitoring sites in order to evaluate the potential impact of development on an on-going basis. This will be required because mitigation measures such as water quality and erosion control structures have been included in the development plan. The effectiveness of these measures can only be evaluated by impact monitoring.	R 150 000.00 p/a See Section 11.4.5
▪ Increase the information basis to evaluate the effectiveness of existing control actions and any subsequent restoration activities. Monitoring of impacts to evaluate the effectiveness of existing control actions to guide any subsequent restoration activities.	
▪ An alien invasive eradication and monitoring plan should be implemented.	R 40 000.00 p/a
▪ Any general mitigation measures relating to surface water runoff and erosion prevention will aid in mitigating the mine's negative impact on the aquatic biodiversity in the area.	See Section 10

7.3.5. Surface Water

Impact Assessment

- The construction phase of the discard dumps, stockpiles and pollution control dams will consist of clearing of vegetation and topsoil, compaction of the sites, and actual construction and lining of the pollution control dams and stockpile / discard areas. Surface infrastructure construction includes the building of internal roads, offices, conveyors, workshops, changehouses and ventilation fans. These activities generate dust and may be associated with hydrocarbon and fuel spills as well as construction waste e.g. discarded building materials such as plastic piping and metals. These have the potential to pollute water flowing off the KaNgwane surface area which drains towards the small non-perennial Streams 1, 2 and 3 and the Mambane River.
- Although the possibility of contaminated water reaching the Komati River exists, the water first comes into contact with Streams 1, 2, 3 as well as the Mambane River. Streams 1, 2, 3 and the Mambane River ultimately drain into the Komati River, which is of an exceptionally high quality. The significance of potential impacts to the quality of the Komati River's is **low**. The reason for the low impact rating is that the mine is located in an area characterised by poor quality (saline) surface- and groundwater which is related to the local geology. The proposed mine would not have much of a detrimental effect on the already poor quality of surface water due to the anthracite coal being mined containing very little sulphide material and thus having a low AMD generating potential.

- The clearance of land for construction, and the associated increase in surface water run-off, will lead to soil erosion which in turn leads to greater siltation to the surrounding streams. This has a **low** impact on the quality of the surface water. Clearance of land also promotes increased surface run-off which could erode river banks. During the construction phase of the mine, diversion berms, culverts and canals have not been built yet, further exacerbating the problem of uncontrolled surface run-off.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ Ensure that hydrocarbons and nitrates do not escape from the processes onsite e.g. heavy vehicles utilised, the construction of the processing plant and other surface infrastructure, and the blasting process, which will lead to the pollution of Stream 1, 2, 3, the Mambane River and eventually the Komati River.	Operational Cost
▪ Clean and dirty water must be separated during construction by ensuring that the separation berms, canals and trenches and the polluted water containment facilities and clean water diversion berms are constructed early in the construction cycle.	R 60 000 000.00 for LOM and assigned to capital costs
▪ See also General mitigation measures.	See Section 10

7.3.6. Groundwater

Impact Assessment

- During construction activities, active out-of-pit dewatering will result in groundwater levels being lowered by some 8 to 10m in the immediate vicinity of the box cut.
- The resulting cone of depression is not expected to extend more than 1000m from the pit during construction, mainly due to the comparatively low transmissivities of the fractured rock aquifer.
- The cone of depression may affect the groundwater level in borehole KBHMON2 (a purpose-drilled mine monitoring borehole) by approximately 2m during this time (Figure 42). None of the other existing boreholes are expected to be impacted on during the construction phase.
- During the construction of the box cut at OC1, groundwater seepage rates of around 100 m^3/d (min: 10 m^2/d; max: 600 m^3/d) are expected (i.e. rate of dewatering).
- During excavation of the box-cut the groundwater levels will be directed towards the mining area due to mine dewatering, which will help contain any contamination and prevent migration away from the mining site.
- The construction phase will not span more than a few months, thereby not allowing sufficient time for significant chemical reactions that lead to the possible formation of acid mine drainage conditions to take place.

- Although dewatering of the aquifers may result in reduced baseflow to streams and loss of existing boreholes the significance of this impact is expected to be **low** and no boreholes or streams are expected to be significantly impacted on during the construction phase of the project

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ Implement and maintain the groundwater monitoring programme.	See Section 11.6
▪ Divert clean surface runoff around the mining area, back into the catchment.	Operational cost (R 3 707 929.00)

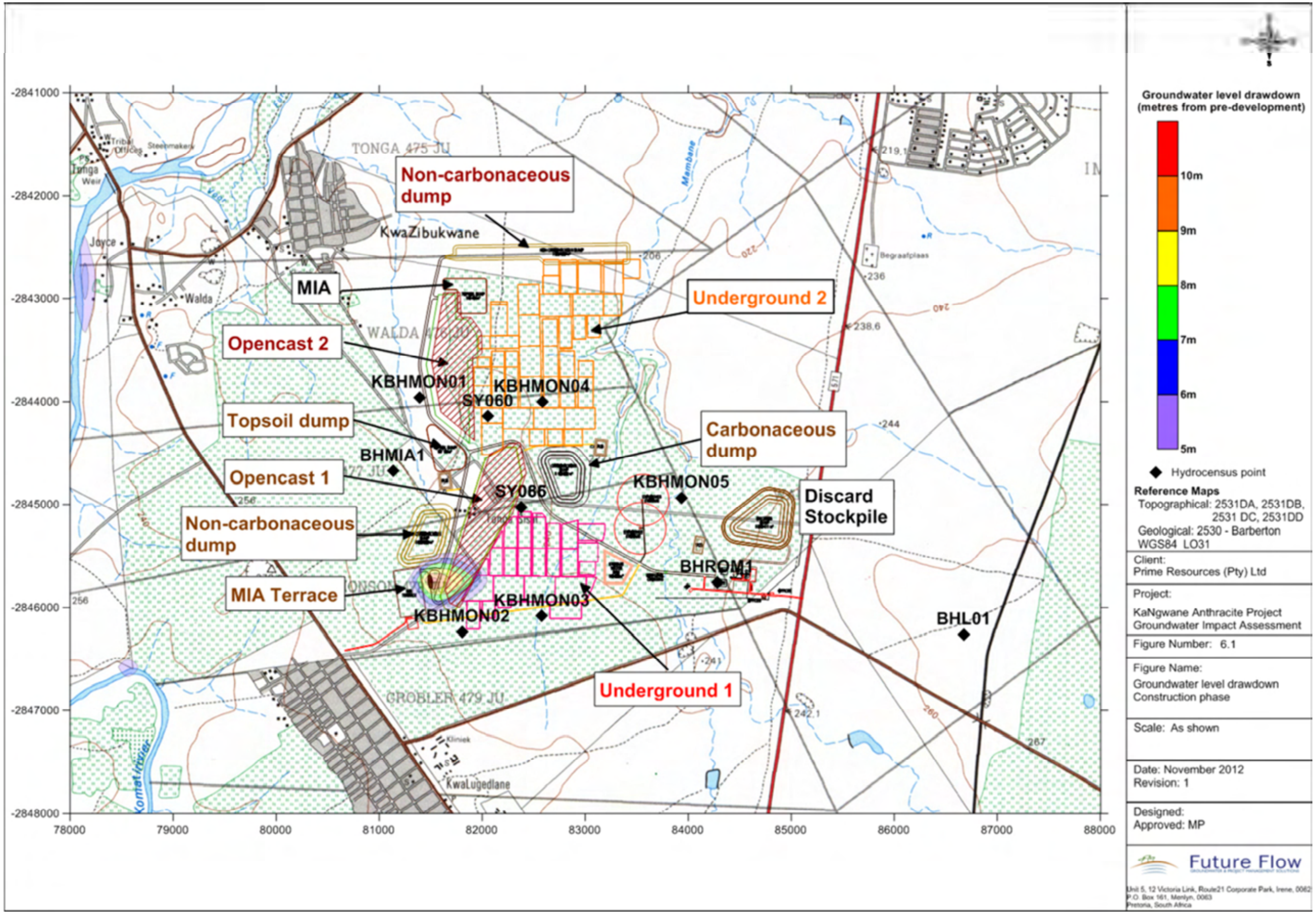

Figure 42: Groundwater level drawdown during the construction phase relative to the mine design and borehole location.

7.3.7. Soil

Impact assessment

The construction of the opencast pits will require the stripping of topsoil followed by the removal of overburden material in order to access the resource to be mined. Topsoil will also be stripped (for the construction of permanent surface infrastructure such as haul and access roads, dams, stockpile footprints, canals etc. or foundations for temporary structures such as containerised offices) or compacted (by vehicle movements on surface). This major disturbance of soil will result in physical changes to the soil structure and chemical changes in terms of the soil composition.

Physical degradation

- Physical degradation is likely to occur in several forms during the construction phase; soil compaction, soil erosion and breakdown of the soil structure.
- Soil compaction will result in the decrease in porosity of the soil with a subsequent increase in bulk density that can lead to impeded water infiltration and root penetration.
- Soil removed or relocated (i.e. stockpiles) will be loosened and thus become far more susceptible to erosion through the action of water or wind and may be transported into watercourses leading to sedimentation of these watercourses.
- Although soils can be stockpiled, once they are removed the breakdown of the soil structure greatly reduces the soil potential ultimately resulting in the loss of soil resource.

Chemical degradation

- The relocation or removal of soils can lead to elevation of potassium and nitrogen levels in soils, as well as the reduction of soil organic carbon levels. This can cause physical problems such as decreased soil nutrient buffer capacity and altered biological activity and organism population composition, which in turn results in lowered soil / agricultural potential and possible loss of the soil resource altogether.
- Pollution of soils by petroleum products invariably occurs in environments where vehicles are used and serviced or where petroleum depots are located.

The significance of construction activities on the physical and chemical soil properties is expected to be **high**. The significance hereof can be mitigated by implementation of the following management measures.

Mitigation Measures

In order to minimise and manage the impact on soils, a detailed soil utilisation guide specific to the proposed site for development should be compiled by a soil specialist. The implementation hereof should be monitored by a soil specialist or a suitably trained individual during construction as failure to adhere to the guideline precisely can negate its efficacy. This guide should at least consider the following aspects;

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ Stripping of topsoil should only occur where necessary for the	No cost applies

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
construction activities described in project description (Section 3).	
▪ A clearly defined end -use for stripped soils must be identified for each area where soils are to be removed by considering the pre-construction conditions thereof.	No cost applies
▪ Soils should be handled in dry weather conditions so as to cause as little compaction as possible. Utilizable soil (topsoil and upper portion of subsoil) must be removed and stockpiled separately. The deepest extent of the soil horizon should be removed as possible (i.e. until underlying material is encountered). The depth hereof should be determined as part of the utilisation guideline.	Operational cost
▪ Soils from each of the soil types and the separate horizons hereof should be removed and separately stockpiled together with any vegetation cover present (only large vegetation to be removed prior to stripping).	Operational cost
▪ Areas targeted for stockpile storage should remain in close proximity to the source of the soil to limit handling and to promote reuse of soils in the correct areas. All stockpiles will be founded on stabilized and well-engineered "pads".	Operational cost
▪ The requirements for application of nutrients to stockpiles should be determined and implemented throughout the life of storage.	See Section 11.7.4

The technical difficulties with the implementation of such a soil utilisation guide, however, often render the implementation of such an exercise financially unfeasible for the Mining Operation. While the management measures described above can still be implemented to some degree (such i.e. stockpiling and management thereof), the chemical and physical changes arising during the stripping and storage of soils results in the permanent loss of the soil resource in its original form and the exact rehabilitation thereof to match the pre-mining soil capability becomes impossible. These soils can still, however, be utilised in rehabilitation activities depending on the management thereof during operation (see further below).

7.3.8. Wetlands

Impact Assessment

- Disturbances to the local sensitive vegetation, e.g. trampling by human movements at the construction site or removal of vegetation for clearance of the development footprint, can result in invasion and encroachment of exotic plant species. This gives rise to habitat changes e.g. increased bank instability or erosion potential. This impact to wetland vegetation is considered to be of **high** significance, but which can be reduced to **medium** significance if the mitigation measures described below are implemented.
- Floral species diversity associated with wetlands may be reduced due to the change in the surface water flow regime (i.e. development of the Mine's dirty water catchment which,

while slight, can result in a minor reduction in the catchment yield, or alternatively increased runoff to wetland systems from areas where vegetation has been removed and before the dirty water catchment system is constructed). Aquifer dewatering in the vicinity of the opencast pits can also result in a decrease in groundwater base flows. These impacts decrease the ability of the wetlands to absorb impacts and thus have a reduced buffer capacity for Streams 1, 2, 3 and the Mambane River.

- A loss of sensitive species or impacts on the physical habitats as described above may result in abundance changes, where individuals of certain species increase or decrease in response to the impacts. This affects the balance of the wetland system which reduces the viability thereof, making wetlands more susceptible to degradation.
- The process of clearing vegetation for construction activities can further initiate soil erosion which increases the availability of sediment to wetland ecosystems due to the altered runoff patterns (before the mines dirty water catchment is constructed). Construction activities generate dust that may settle on adjacent wetland ecosystems, impacting on sedimentation and siltation of the wetlands and leading to reduced photosynthesis and transpiration in flora. Siltation and sedimentation can smother wetland habitats downstream which lead to aquatic species mortalities which in turn can contaminate the water resource.
- The significance of impacts to the vegetation community and the quality of the wetland system arising from the construction activities is considered to be **medium**, reducing to a ***low*** significance if the mitigation measures described below are implemented.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ The dirty water catchment system at the proposed development should be constructed at the earliest stage possible during construction activities. If this is not feasible, however, energy dissipaters must be temporarily placed at effluent generation points to control the flow of surface water run-off. This will reduce the erosion potential of the run-off of the surface water which reduces the sedimentation load that may be carried to wetlands.	Operational Cost, capital value of R 60 000 000.00 assigned for LOM
▪ While it is envisaged that the potential stream crossing areas identified in the development proposal will be low-level to reduce the potential impact to stream flow, for wetlands, care should be taken to construct large enough culverts beneath road crossings. It must be noted that culverts have the potential to initiate head-cut erosion that can destroy wetlands, therefore sufficient energy dissipaters should be put in place downstream from the culverts (such as gabions). Ensure that the culverts are constructed in such a way as to allow for in-stream organisms to migrate during both high and low flow conditions.	Operational Cost

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ Good construction practices, such as only clearing the areas necessary for immediate construction, must be followed. This will reduce the erosion potential of the soil and lower the impact on the vegetation community. The management measures pertinent to soil resources (see Section 7.3.7) should be adhered to, both to ensure soil quality doesn't deteriorate in order for wetland vegetation to re-grow and also to reduce soil erosion (and thus dust generation which affects the quality of the surrounding watercourses). This can be further enhanced through implementation of the air quality management measures for construction activities described in Section 7.3.1	Operational Cost
▪ Throughout the construction process, activities within the buffer zone of the wetland must be prevented.	R 520 000.00 throughout LOM
▪ A nursery should be established to grow indigenous vegetation species of significance and for use in any plant relocation or rescue activities. These plants can be used to re-vegetate areas where the vegetation has been destroyed or where the encroachment of exotic species leads to the loss of indigenous species.	R 40 000.00 p/a
▪ Implement an alien invasive eradication and monitoring plan throughout the construction phase. This strategy must include vehicle wash down and employee awareness training. To reduce the leakages of hydrocarbons, the general mitigation measures described in Section 10 as regards hydrocarbon management should be adhered to.	R 50 000.00 p/a
▪ For the study area, a wetland buffer zone of 100m will adequately fulfil functions and values such as promoting bank stability, affecting stream microclimate, ensuring biotic requirements are adhered to and the protection of stream microclimate/general habitat. A larger buffer may, however, be necessary in order to adequately cater for biotic requirements. It is thus recommended that the buffer width should be expanded to cover the wet zones in the cultivated areas adjacent to the delineated wetland habitat as indicated by the pedologist report.	R 520 000.00 throughout LOM

7.3.9. Soundscape

Impact Assessment

- The area experiences the generally low ambient noise levels typical of rural environments.

- The area is predominantly comprised of open veld and cultivated / grazing land with no excessively noisy industries or similar sources of noise. The ambient noise levels do not typically exceed 45 dB(A) during the day.
- Blasting activities are infrequent and transient, the nature and magnitude of the response to noise from blasting operations will depend critically on: the blasting regime chosen, the nature of the rock to be blasted, the size and depth of the charge, the type of explosive, the local topography and the detonation sequence (which is expected to take place at intervals of one or two weeks). At these intervals, noise generated during blasting activities is unlikely to have any significant impact on humans or livestock (provided the blasts are done and carried out with due regard to normal good blasting practice).
- Drilling, shovelling and truck loading during pit excavation will increase the ambient noise levels in the area. Additionally, there will be an increase in vehicle traffic as personnel, machinery and equipment are transported to site. An increase in vehicle traffic will exert a negative impact on the existing noise levels in the area.
- Only the nearest dwellings would be negatively impacted on (the combination of drilling and the shovel and truck loading process will result in a predicted noise value of 87.2 dB(A) at 15 m); the initial excavations of the pit will be at the surface and will occur for a short duration during the construction phase.
- The significance of the noise impact during the construction phase is predicted to be **medium**; once the recommended mitigation measures and monitoring programme is implemented the significance of this impact will drop to **low**.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ Diesel powered equipment should be fitted with silencers, these silencers should be properly designed and maintained.	Most diesel powered equipment comes fitted with silencers
▪ Where possible earthworks and material stockpiles should be placed so as to protect the boundaries from noise from individual operations.	No cost applies
▪ If a levee is constructed it should be of such a height so as to effectively act as a noise barrier.	No cost applies
▪ Select vehicle routes carefully by internalising the road network.	No cost applies
▪ Reduce noise at source by acoustic treatment i.e. isolate source by acoustic enclosure, compressors and generators (if used on site) should be installed in separately acoustically treated buildings.	Operational cost
▪ Additionally refer to the general mitigation measures.	See Section 10

7.3.10. Traffic

Impact Assessment

The impact assessment will be discussed according to the various sections that the transport route has been divided up in. Refer to Appendix 10 for the layout of the various road sections.

- Section 1: The volume of traffic at Point C is so low that the increase in traffic due to the transportation of men and materials to and from site, as well as the creation of Point D, will not be enough to cause a severe impact on the volume of traffic in this section. The introduction of the west access to the Mine at Point D may cause some difficulty for vehicles wanting to turn right onto the haul road due to the volume of traffic on the R571 going in the opposite (southbound) direction.
- Section 2: There is currently already a capacity problem at Point E; this will increase due to the traffic from the mining site e.g. construction vehicles, and vehicles transporting infrastructure onto site. Due to the high through volumes along the R571-1, few opportunities for the minor road traffic to enter the intersection exists. This will become worse as the volume of traffic increases due to the construction of the mine.
- Section 3: The condition of the road is quite poor and the increase in traffic due to the construction of the mine will cause the road to deteriorate at a much quicker rate than it would have done otherwise.
- Section4: The traffic volumes along the N4 highway are low and therefore there will be no severe traffic impact along Section 4. There will not be a real impact on the N4 during the construction phase; impacts will only truly start during the operations phase of the mine.
- The significance impact rating is **low** for all of the impacts on all of the road sections during the construction phase.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ Section 1: The difficulty in crossing the R571 onto the mine haul road can be remedied by reducing the speed when approaching this access point to 60 km / hr. It is recommended that a bypass lane be provided on the northbound approach on the R571 to enable traffic to pass the trucks that are waiting to turn right onto the haul road.	Costs carried by SANRAL
▪ Section 2: The pavement structure of Section 2 once it has been upgraded in 2013/ 2014 by SANRAL will have enough strength to carry the additional loading of the coal transport trucks during its design life. It is estimated that it would be possible to fit an 18 m diameter roundabout with a 7 m circulation lane at Point E. If this intersection is changed to a roundabout, the flow of traffic would improve dramatically.	
▪ Section 3: The pavement structure of Section 3 when it has been partially reconstructed in 2013/ 2014 by SANRAL will have sufficient strength to accommodate the additional loading of the coal transport trucks during its design life.	

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ Also see General mitigation measures.	See Section 10

7.3.11. Socio-Economic

Impact Assessment

Loss of agricultural land:

- The southern to western portion of the project area is currently utilised for agricultural activity dominated by large scale sugar cane production. In addition, a large portion of land in the centre of the southern proposed surface right area comprises small agricultural plots (subsistence farming). The loss of the sugar cane production as well as the subsistence farm plots would have an impact on the households farming and employed at the various portions of land.

Loss of grazing land:

- Cattle are currently being grazed on the proposed mining right area. The proposed mine would result in the loss of access to grazing land as well as the removal of grazing vegetation.

Influx of people into the communities:

- Due to the skills shortage in the proposed area for development, it is anticipated that people from outside the area and potentially the municipality would need to be employed to fill certain positions at the mine. The employment of people outside of the study area could potentially result in strained relationships between the community and the Applicant. In addition, there is likely to be an influx of people into the area as new developments tends to attract people seeking employment.

Impact on services such as water, housing, electricity:

- The proposed mine as well as the potential influx of people into the study area will impact on the already stressed bulk service infrastructure, and could result in the establishment of informal settlements. The negative effects of construction activities such as increased ambient noise levels, blasting impacts and reduced air quality will also negatively affect people.

Impact on surface water and groundwater:

- The Komati River and local groundwater are the primary source of water for communities within the study area. Changes to the quality or quantity of these water resources would have an impact on the sustainability of the communities, however the probability of this posing a significant impact is thought to be low (Sections 7.3.5 and 7.3.6).

The significance of potential cumulative negative impacts on the surrounding communities are considered to be **high** if no mitigation measures are implemented, however with correct mitigation and monitoring, this negative impact could be reduced to a **medium** significance.

Job Creation:

- The construction of the mine however will also bring job opportunities and opportunities for service providers into the area as labour and services will be required for construction activities. The communities will therefore benefit through employment / procurement opportunities and the multiplier effect of this that the development at KaNgwane will bring. With the correct mitigation measures implemented, this positive impact to the community is thought to be of **high** significance.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ An exercise to determine the monetary compensation for the loss of cultivated land is currently being undertaken by the Applicant. The intention is to agree to a compensation strategy and value with all affected farmers prior to commencing with mining operations.	Costing will form part of land tenure agreements to be finalised before mining commences
▪ All commitments made in the final Social and Labour Plan (SLP) for the construction phase should be adhered to, ensuring the local people benefit adequately from the mine.	No cost applies
▪ Management measures in term of blasting must be adhered to in order to reduce the negative impacts operations may have on the surrounding communities.	See Section 7.3.2
▪ All mitigation measure stated for the various environmental aspects (noise, groundwater, air quality, surface water etc.) should be implemented to ensure the lowest possible negative impact on the local people's environment.	No cost applies
▪ Although no graves were found inside of the area of direct impact, there always is a possibility and therefore basic information on the handling of these is given (Section 10.11 of the EMP). If any such chance-finds occur, an archaeologist should always be contacted to mitigate the situation.	R 20 000.00

7.3.12. Cultural / Heritage

Impact Assessment

- Three sites were identified in proposed mine area during the 2011 and 2012 surveys.
- The **first site** identified consisted of old government farm buildings, thought to be younger than 60 years. This site is regarded as having **low** cultural and environmental significance.

- The **second site** identified contains both Middle and Late Stone Age tools as well as Iron Age pottery.
- Preliminary analysis of the pottery seems to indicate that it belong to the Mzonjani facies of the of the Kwale branch of the Kalundu pottery tradition and this would place it in the Early Iron Age with dates ranging from 450 – 750 AD.
- Since not many Early Iron Age are known this site would receive a rating of **high** cultural and environmental significance.
- At the **third site** Middle Stone Age and Iron Age pottery was identified, however as nothing else was identified it is assumed this was washed downstream during a rainstorm.
- The objects are considered to be a feature and therefore have a **low** cultural and environmental significance.
- Grave yards and graves always have a high cultural significance and need to be handled with the utmost sensitivity.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ For Site 1 and 3 the heritage study is considered ample mitigation and the sites may be demolished.	No cost applies
▪ Site 2 will have to be mitigated. The first option would be to fence it in and regard it as a no-go area. In such a case a heritage management plan will have to be written for the continuous preservation of the site.	R 31 000.00
▪ The second option would be to do test excavations so that the information the site holds can be researched. After such a process it may be demolished. Test excavations may only be done by an archaeologist after receiving the necessary permit from SAHRA.	R 93 000.00
▪ The proposed development may continue only after implementation of these mitigation measures.	No cost applies
▪ Although no graves were found inside of the area of direct impact, there always is a possibility and therefore basic information on the handling of these is given (Section 10.11 of the EMP). If any such chance-finds occur, an archaeologist should always be contacted to mitigate the situation.	R 20 000.00

7.3.13. Visual

Impact Assessment

The clearance of land for infrastructure and the opencast pit excavation as well as the erecting of infrastructure will alter the existing natural aesthetics of the area. The visual aesthetic currently comprises of natural veld with some scattered subsistence farming with no significant developments in the form of infrastructure. Without mitigation, this impact is therefore considered to be **high**. With the implementation of mitigation measures however, this impact can be reduced to **medium**.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ In order to reduce the negative visual impact the proposed mine should place strategic berms to reduce the visibility of the pit from the surrounding communities and paint mine infrastructure in neutral colours.	Operational cost (R 3 342 637.00 assigned as capital for berm development over LOM)

RECEPTOR	PROCESS	IMPACT	MAGNITUDE (M)	DURATION (D)	SCALE (S)	PROBABILITY (P)	SIGNIFICANCE		MITIGATION AND MANAGEMENT MEASURES	MONIORING
							RATING	VALUE		
Air Quality	▪ Vehicle movement on site. ▪ Overburden removal and handling. ▪ Clearing of vegetation. ▪ Blasting and drilling during pit excavation.	▪ Increased dust fallout causing a reduction in air quality.	8 [4]	2 [2]	2 [1]	3 [3]	Medium [Low]	36 [21]	Air quality mitigation measures associated with the construction phase in Section 7.3.1.	Implement and maintain air quality monitoring programme in Section 11.1 of the EMP.
		▪ Increased particulate matter reducing the air quality.	6 [2]	2 [2]	2 [1]	3 [3]	Medium [Low]	30 [15]		
Blasting / Vibrations	▪ Overburden removal ▪ Initial pit excavation.	▪ Ground vibrations	10 [8]	4 [4]	2 [2]	4 [4]	High [Medium]	80 [56]	Blasting mitigation measures associated with the construction phase in Section 7.3.2.	Implement and maintain blasting monitoring programme in Section 11.2 of the EMP.
		▪ Air blast	10 [6]	4 [4]	2 [2]	4 [4]	High [Medium]	80 [48]		
		▪ Dust and smoke	8 [6]	4 [4]	2 [2]	4 [4]	Medium [Medium]	70 [48]		
		▪ Fly rock	10 [8]	4 [4]	2 [2]	4 [4]	High [Medium]	80 [56]		
Terrestrial Ecology	▪ Clearance of land and disturbance of the natural environment for	▪ Destruction of vegetation communities.	4 [2]	4 [4]	1 [1]	5 [3]	Medium [Low]	45 [21]	Terrestrial ecology mitigation measures associated with the	Implement and maintain terrestrial ecology monitoring

RECEPTOR	PROCESS	IMPACT	MAGNITUDE (M)	DURATION (D)	SCALE (S)	PROBABILITY (P)	SIGNIFICANCE		MITIGATION AND MANAGEMENT MEASURES	MONIORING
							RATING	VALUE		
	the construction of mining infrastructure in footprint areas and access roads. ▪ Surface and construction activities ▪ Transportation of personnel, equipment and infrastructure to site. ▪ Increased human activity.	▪ Loss of protected plant species	4 [2]	4 [4]	1 [1]	3 [2]	Low [Low]	27 [14]	construction phase in Section 7.3.3.	programme in Section 11.3 of the EMP.
		▪ Reduction in floral species diversity	4 [2]	4 [4]	1 [1]	4 [2]	Medium [Low]	36 [14]		
		▪ Increase in invasive species.	4 [2]	4 [4]	2 [2]	5 [3]	Medium [Low]	50 [24]		
		▪ Dust	4 [2]	4 [4]	2 [1]	4 [2]	Medium [Low]	40 [14]		
		▪ Hydrocarbons contamination of soil resources	4 [2]	4 [4]	1 [1]	3 [1]	Low [Low]	27 [7]		
		▪ Loss of faunal communities	4 [2]	4 [4]	1 [1]	5 [3]	Medium [Low]	45 [21]		
		▪ Reduction of faunal diversity	4 [2]	4 [4]	1 [1]	4 [2]	Medium [Low]	36 [14]		

RECEPTOR	PROCESS	IMPACT	MAGNITUDE (M)	DURATION (D)	SCALE (S)	PROBABILITY (P)	SIGNIFICANCE RATING	SIGNIFICANCE VALUE	MITIGATION AND MANAGEMENT MEASURES	MONIORING
		▪ Faunal mortalities as a result of vehicle collisions.	6 [4]	1 [1]	1 [1]	3 [2]	Low [Low]	24 [12]		
Aquatic Ecology	▪ Surface run-off to Komati River intercepted by mine ▪ Surface and construction activities resulting in surface water pollution ▪ Increased human activity.	▪ Habitat affected by siltation and changes in physico-chemical water quality	4 [2]	4 [3]	2 [1]	4 [3]	Medium [Low]	40 [24]	Aquatic Ecology impact mitigation measures associated with the construction phase in Section 7.3.4.	Aquatic Ecology monitoring is detailed in Section 11.4 of the EMP.
		▪ Changes in habitat suitability ▪ Reduced aquatic species diversity	4 [2]	4 [2]	2 [1]	4 [1]	Medium [Low]	40 [5]		
		▪ Increase in invasive species due to disturbance	6 [2]	4 [2]	2 [2]	4 [2]	High [Low]	48 [12]		

RECEPTOR	PROCESS	IMPACT	MAGNITUDE (M)	DURATION (D)	SCALE (S)	PROBABILITY (P)	SIGNIFICANCE		MITIGATION AND MANAGEMENT MEASURES	MONIORING
							RATING	VALUE		
Surface Water	▪ Surfaces cleared to make way for surface infrastructure and opencast pits ▪ Vegetation removed from land surfaces ▪ Berms and canals intended to contain contaminated water and divert clean water not constructed yet	▪ Increased run-off giving rise to greater erosion during the rainy season • Greater siltation to the surrounding streams	2 [2]	1 [1]	1 [1]	2 [2]	Low [Low]	8 [8]	Surface water mitigation measures associated with the construction phase are found in Section 7.3.5.	A surface water monitoring programme is to be implemented and maintained as set out in Section 11.5 of the EMP.
Groundwater	▪ Dewatering of aquifers	▪ Reduced baseflow to streams ▪ Loss of existing boreholes	2 [2]	2 [2]	1 [1]	4 [4]	Low [Low]	20 [20]	Groundwater mitigation measures associated with the construction phase in Section 7.3.6.	Implement and maintain groundwater monitoring programme in Section 11.6 of the EMP.
Soil	▪ Stripping of topsoil ▪ Construction of surface infrastructure and additional heavy vehicles on site	▪ Loss of soil resource through structural, chemical and biological degradation and erosion.	10 [10]	5 [3]	1 [1]	5 [5]	High [High]	80 [80]	Soil mitigation measures associated with the construction phase in Section 7.3.7.	Implement and maintain soil monitoring programme in Section 11.7 of the EMP.

RECEPTOR	PROCESS	IMPACT	MAGNITUDE (M)	DURATION (D)	SCALE (S)	PROBABILITY (P)	SIGNIFICANCE RATING	SIGNIFICANCE VALUE	MITIGATION AND MANAGEMENT MEASURES	MONIORING
		▪ Loss of agricultural resource through structural and chemical degradation	10 [10]	5 [3]	1 [1]	5 [5]	High [High]	80 [70]		
Wetlands	▪ Clearing of land for construction ▪ Cleared land increases surface run-off ▪ Construction activities lead to an increase of people on site ▪ Top soil removed as part of opencast excavation ▪ Movement of traffic and the use of machinery leads to hydrocarbon spills	▪ Vegetation communities next to mining area impacted	4 [2]	3 [2]	2 [1]	4 [3]	Medium [Low]	36 [15]	Mitigation measures of wetlands associated with the construction phase in Section 7.3.8.	Implement and maintain the wetlands monitoring programme in Section 11.8 of the EMP.
		▪ Change in surface water flow and ground water flow affects floral and faunal species diversity.	4 [2]	4 [3]	2 [2]	3 [2]	Medium [Low]	30 [14]		
		▪ Vegetation disturbances lead to exotic plant invasions. Causes bank instability	10 [2]	5 [2]	2 [2]	5 [2]	High [Low]	85 [12]		
		▪ Grazing in wetlands impacted due to impacts from the mining in the catchment	4 [2]	2 [2]	1 [1]	5 [2]	Medium [Low]	35 [10]		
		▪ Increase in number of people trampling vegetation.	6 [4]	2 [2]	3 [2]	3 [2]	Medium [Low]	33 [16]		

RECEPTOR	PROCESS	IMPACT	MAGNITUDE (M)	DURATION (D)	SCALE (S)	PROBABILITY (P)	SIGNIFICANCE RATING	SIGNIFICANCE VALUE	MITIGATION AND MANAGEMENT MEASURES	MONIORING
		▪ Removal of topsoil increases availability of sediment and dust to wetland	4 [2]	2 [2]	2 [1]	4 [1]	Medium [Low]	32 [5]		
		▪ Oil spills contaminate the wetland	10 [2]	4 [2]	2 [1]	3 [1]	Medium [Low]	48 [5]		
Soundscape	▪ Use of heavy machinery and vehicles ▪ Noise generated by initial pit excavation.	▪ Increase in ambient noise levels	4 [2]	2 [2]	2 [2]	5 [5]	Medium [Low]	45 [30]	Noise mitigation measures associated with the construction phase in Section 7.3.9.	Implement and maintain noise monitoring programme in Section 11.9 of the EMP.
Traffic	▪ Increase in heavy traffic on roads due to mine construction	▪ Increased traffic volumes may lead to possible congestions at points	2	1	2	2	Low	15	Traffic mitigation measures associated with the construction phase can be found in Section 7.3.10.	
Socio-Economic	▪ Opencast pit excavation	▪ Loss of land ▪ Surface and groundwater pollution ▪ Loss of sense of place ▪ Increase in Nuisance impacts (noise, air quality, blasting etc.)	8 [6]	4 [4]	3 [3]	4 [3]	High [Medium]	60 [39]	Details of mitigation measures to reduce negative impacts and increase potential positive impacts on the socio-economic environment are described in Section 7.3.11.	The SLP should be adhered to as well monitoring as described in Section 11.10 of the EMP.

RECEPTOR	PROCESS	IMPACT	MAGNITUDE (M)	DURATION (D)	SCALE (S)	PROBABILITY (P)	SIGNIFICANCE		MITIGATION AND MANAGEMENT MEASURES	MONIORING
							RATING	VALUE		
	▪ Mine employment	▪ Increased job opportunities	6 [8]	4 [4]	3 [3]	3 [4]	Medium [High]	39 [60]		
Cultural / Heritage	▪ Site clearance	▪ Loss of old government farm buildings at Site 1	2	3	1	4	Low	24	Heritage resource mitigation measures associated with the construction phase and a description of sites 1, 2 and 3 can be found in Section 7.3.12.	Implement and maintain heritage resources general mitigation measures (Section 10.11)
		▪ Loss of Middle Stone Age / Late Stone Age and Iron Age tools and pottery at Site 2	10 [8]	4 [4]	4 [3]	5 [5]	High [High]	90 [75]		
		▪ Loss of Middle Stone Age and Iron Age remains at Site 3	2	3	1	4	Low	24		
Visual/ Aesthetics	▪ Clearance of land / site for opencast pit excavation ▪ Clearance of land for infrastructure footprints ▪ The construction of mine infrastructure	▪ Alteration of the natural landscape	6 [6]	4 [4]	2 [1]	5 [4]	High [Medium]	60 [44]	Detailed visual mitigation measures associated with the construction phase can be found in Section 7.3.13.	

7.4. Operation Phase

Through roll-over mining and progressive rehabilitation opencast mining will develop into two opencast pits. The underground mining operation will be accessed via the Open Cast 1 highwall and has been designed as a bord and pillar operation, utilising a continuous miner in three mining sections and supported by one stone section.

There will be dirty water drains surrounding all waste rock dumps, the discard dump and the processing plant, which will all feed into the PCDs. The PCD's will be kept dry at all times by pumping water from the PCDs into the service water supply line, which will feed into the Storage Water Dam.

A CHPP will be established on surface with a capacity to treat 1.2 Mt pa Run of Mine (ROM) material, which will be trucked and tipped at the plant feed-end with dump trucks. Front-end loaders will shovel the ROM material onto an apron feeder arrangement feeding onto the plant feed belt via a primary crusher at a rate of 200 tons per hour. Anthracite product will be stockpiled by means of a spreader conveyor, which creates the opportunity for stockpiling different ash products as required. Discard and dewatered fines will be discharged to a discard bin from where they will be loaded onto Articulated Dump Trucks (ADTs') for deposition to the discard dump on surface.

The product will be loaded onto trucks with front-end loaders and transported via the R571 and N4 to Maputo for the export coal market.

7.4.1. Air Quality

Impact Assessment

The operation will start with open cast pit 1 then underground mining 1 moving over to open cast pit 1 underground mining 2. During the operational phase when mining is only taking place at open cast pit 1 or with only underground mining taking place the annual average PM10 concentrations were predicted to be within the NAAQS limit value as set out in the NEMAQA at all of the nearby receptors. However, for mining operations at opencast pit 2, it was predicted that without the implementation of mitigation measures the annual average PM10 NAAQS limit value would be exceeded at Tonga and Tonga East, due to the proximity of these villages to opencast pit 2. With mitigation measures in place, daily PM10 concentrations only exceed about 500 m to the west of opencast pit 2, as well as at the receptors close to the access road entrance to the mine. Exceedances of the annual PM2.5 NAAQS limit value were predicted to occur only on site. Exceedances of the daily PM2.5 NAAQS limit however were predicted to occur up to 500 m to the west of opencast pit 2, even with the implementation of mitigation measures. Predicted dust fallout rates are well within the SA NEMAQA draft dust fallout standards. High dust fallout is localised to the site, with the predicted highest dust fallout towards the west of opencast pit 2 (predicted to be 100 mg/m^2.day, or 16% of the SA NEMAQA draft dust fallout standard).

The following activities which may impact on the air quality in the area during the operational phase were identified:

- Clearing of vegetation across the opencast mining area as well as drilling and blasting operations will continue during the operational phase for the continual excavation of the opencast strips. Therefore, these operations will be sources of fugitive dust which may be a nuisance to local residents, employees and fauna in the area and also affect the photosynthetic activity and growth of flora in the area. The significance of the increased fugitive dust from the clearing of vegetation as well as blasting and drilling activities is **medium** without mitigation and **low** if the mitigation measures listed below are implemented.
- Vehicles will be used for the transportation of topsoil and overburden from the excavation of the opencast pit to the waste rock dump and topsoil stockpile as well as back to the pit for progressive rehabilitation once a strip has been mined, transportation of ore from the open cast pit and the underground mining operations to the coal handling and preparation plant, the transportation of discard from the coal handling and preparation plant to the discard dump, the transport of product from the coal handling and preparation plant off-site and personnel use of access roads by personnel. Vehicle-entrained dust emissions from unpaved roads represent a potentially significant source of fugitive dust. Increased fugitive dust in the air may be a nuisance to local residents, employees and fauna in the area and also affect the photosynthetic activity and growth of flora in the area. The significance of the impact of increased fugitive dust from vehicle entrainment is **medium** without mitigation and **low** if the mitigation measures listed below are implemented. Vehicle tailpipe emissions contain particulate matter (hydrocarbon compounds) including inhalable particles (PM_{10}) and fine particles ($PM_{2.5}$) which may have an impact on the health of local residents, employees and fauna in the surrounding area. The significance of the increased particulate matter suspended in the air is **medium** without mitigation and **low** if the mitigation measures listed below are implemented.
- Materials handling activities such as unloading of overburden at the waste rock dump, unloading of the ore at the coal handling and preparation plant and unloading of discard at the discard dump will result in fugitive dust. Increased fugitive dust in the air may be a nuisance to local residents, employees and fauna in the area and also affect the photosynthetic activity and growth of flora in the area. The significance of the impact of increased fugitive dust from materials handling activities is **medium** without mitigation and **low** if the mitigation measures listed below are implemented.
- Ore processing at the coal handling and preparation plant which include screening and crushing operations will result in increased fugitive dust and particulate matter (primarily coal dust) including inhalable particles (PM_{10}) and fine particles ($PM_{2.5}$) suspended in the air which will reduce the surrounding air quality. Increased fugitive dust in the air may be a nuisance to local residents, employees and fauna in the area and also affect the photosynthetic activity and growth of flora in the area. The significance of the increased fugitive dust is **medium** without mitigation and **low** if the mitigation measures listed below are implemented. The suspension of particulate matter in the air will reduce the surrounding air quality which may have an impact on the health of local residents, employees and fauna in the surrounding area. The significance of the increased particulate

matter suspended in the air from ore processing and handling is **high** without mitigation and **medium** if the mitigation measures listed below are implemented.

- Ventilation from underground mining operations will result in increased particulate matter (primarily coal dust) including inhalable particles (PM_{10}) and fine particles ($PM_{2.5}$) suspended in the air which will reduce the surrounding air quality which may have an impact on the health of local residents, employees and fauna in the surrounding area. The significance of the increased particulate matter suspended in the air from ventilation shafts is **high** without mitigation and **medium** if the mitigation measures listed below are implemented.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ To reduce dust from vehicle entrainment and windblown dust from materials being transported: o wet suppression or chemical stabilization of unpaved roads should be implemented; o trucks are to be covered; o continuous water sprays on in-pit roads and haul roads to and in-pit where front-end-loaders, shovels and other vehicles move; o vehicles should adhere to strict speed limits (40km/hr on the access roads and 10 km/hr on haul roads is recommended); and o unnecessary traffic on unpaved roads should be reduced.	Operational cost
▪ To suppress windblown dust from materials handling: o wind speed around the material stockpiles can be reduced through sheltering; o water sprays should be employed at all main loading and offloading points, including in pit loading of trucks and unloading of trucks at the overburden dumps, topsoil stockpiles and ROM stockpiles; o ensure water sprays at and around all stockpiles; o ensure vegetation of overburden stockpiles and topsoil stockpiles side slopes up to 1m from the top, vegetation cover should be dense; and o ensure tip distance is minimal i.e. drop height into truck and onto stockpiles.	Operational cost
▪ To reduce dust from earth moving (land clearing) operations wet suppression should be implemented where feasible.	Operational cost
▪ To reduce windblown dust from cleared areas the: o extent of the cleared areas should be reduced;	Operational cost

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
○ frequency of disturbance to cleared areas should be reduced; ○ disturbed soil should be stabilised though chemical or vegetative measures; and ○ disturbed areas should be re-vegetated as early as possible.	
▪ Dust emanating from drilling and blasting should be reduced by: ○ drilling with vacuum packs or drill covers; ○ wet suppression to ensure minimal dust generation; and ○ blasting to only occur between 12h00 and 15h00 and only during cloudless days.	Operational cost
▪ To reduce dust and emissions from ore processing and handling operations: ○ ensure water sprays at primary crushers.	Operational cost

7.4.2. Blasting and Vibrations

Impact Assessment

- The proposed mine site is bordered to the north and to the west by the villages of Tonga and eMangweni. The open areas between the villages are comprised of either farm land or natural bush.
- The points of concern are the closest houses to the planned open cast pits. The northern perimeter of the north pit lies approximately 500 m from the nearest houses in Tonga village. The western perimeter of the northern pit lies approximately 270 m from the eastern most houses of Tonga village. The southern perimeter of the south pit lies approximately 200 m away from the northern most houses of eMangweni village.
- During operation, the opencast mine will be mined in consecutive strips, this will involve: drilling and blasting.
- The overburden consists approximately 11 metres of soft material which overlies hard sandstone and will require blasting during the mining of consecutive opencast pits.
- There are four main impacts that may occur as a result of blasting operations, namely: (1) Ground vibrations, (2) Air blast, (3) Dust and (4) Fly-rock.
  - The ability of ground vibrations to cause damage to buildings is proportional to the Peak Particle Velocity (PPV) of that shock wave and is inversely proportional to the frequency. Thus a ground vibration with a high PPV and low frequency will most likely cause damage to buildings. Buildings can generally withstand ground vibration amplitudes of 12.7 mm/s or more; however, humans and animals are easily disturbed by ground vibrations at low levels. The significance of the negative impact caused by ground vibrations during the operational phase is predicted to be **high**; however, once the recommended mitigation measures and monitoring programmes are implemented the significance of the impact will decrease to **medium**.

- Air blast amplitudes up to 134 dB should not result in any adverse impacts. Air blasts greater than 134 dB will cause human irritation and may generate complaints during blasting operations; air blasts of this magnitude will not result in any damage to property but may alert nearby residents to the fact that blasting operations are in progress. It is not possible to make a reliable prediction on the impacts of air-blast due to the effect of wind, cloud and temperature inversion; however, it is suggested that blasting at other opencast mining sites is carried out successfully at air-blast amplitudes below 130 dB. The significance of the negative impact caused by air blasts during the operational phase is predicted to be **high**; however, once the recommended mitigation measures and monitoring programmes are implemented the significance of the impact will decrease to **medium**.
- Dust and smoke are inevitable by-products of blasting operations and will potentially heighten any existing irritations created in local residents. The significance of the negative impact caused by air blasts during the operational phase is predicted to be **medium**; however, once the recommended mitigation measures and monitoring programmes are implemented the significance of the impact can be reduced.
- Fly rock is the greatest hazard in blasting operations as it may result in injuries and / or loss of life. For this reason fly rock should be given priority in blast design. The significance of the negative impact caused by air blasts during the operational phase is predicted to be **high**; however, once the recommended mitigation measures and monitoring programmes are implemented the significance of the impact will decrease to **medium**.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ In view of the fact that there is a large and unknown number of people residing within 500 m of the opencast pit operations, exceptional measures need to be taken in order to reduce the negative impact of blasting operations. While it may be possible to evacuate people and animals from these areas houses and other structures will remain (and will more than likely be damaged). For this reason it is a requirement that the blast design(s) proposed to be used at KaNgwane should make use of a blasting accessory known as a "Tulip Plug" which should be used in all blasts. The Tulip Plug is designed to contain the explosive energy released in a blast by altering the mechanics of the rock-breaking process. Tulip plugs have been shown to reduce the impact of: ○ Ground vibrations (by reducing the mass of explosives in all blast-holes); ○ Fly-rock (by directing more explosive energy down-wards) and ○ Air blast (by containing more explosive energy within the blast)	R 140 000.00 p/a. (Based on a 102mm X 450mm Tulip plug, 50 plugs per blast, 3 blasts per week, 52 weeks per year.)

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ Tulip Plugs will achieve the above benefits provided all other blasting parameters are strictly controlled. Incorrect drilling, charging, stemming and/or timing of the blast holes may still result in a dangerous situation where incidents may occur. In view of this, it is a requirement that all blast designs to be used at the mine are produced by a qualified engineer who is familiar with the Tulip Plug technology. Blasters and their crews should be trained in the use of the Tulip Plug in order to achieve the desired results.	
▪ The condition applied to clear all people and livestock within a 500 m radius of the blast is onerous. This process is time consuming and may lead to social disruption. In order to avoid this it is recommended that all blasts be recorded on a suitable HD video camera, the camera will record any fly-rock that may be thrown into the air by any blast. More than one camera may be necessary in order to achieve a full record of all fly rock. These digital videos of blasts must be kept on record by the mine and given a positive reference to the date, time and reference number of the particular blast concerned. After a minimum of ten blasts are fired and shown by the video records to not have thrown any fly-rock beyond the mine boundaries the appointed engineer and the appointee may agree to reduce the radius of the area to be cleared before all subsequent blasts.	Addressed in Construction Phase See Section 7.3.2
▪ The ground vibration should not be allowed to exceed 12.7 mm/s at any building in order to limit the risk of cosmetic or any other damage. These lower frequencies are achieved by large hole diameters and long timing delays between holes. Additionally, the maximum mass of explosives that can be fired per delay at a distance of 200 m should not exceed 140 kg.	No cost applies
▪ If the HD video recording fly-rock results which are unacceptable all livestock should be cleared to a radius of 500 metres in order to avoid danger of fly rock; additionally, at this distance the effects of ground vibrations on livestock will be minimal.	No cost applies
▪ Blast vibrations should be carefully monitored (see Section 11.2 below).	Addressed in Construction Phase See Section 7.3.2
▪ Deterioration to buildings should be carefully monitored (as per the monitoring plan in Section 11.2 below).	
▪ It is recommended that hard sandstone should be drilled and blasted while the soft overlying material is in place, this will have the effect of reducing many of the potential environmental risks associated with blasting operations.	Operational cost

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
○ Blasting of the hard overburden with the soft material still in place will greatly reduce the amount of air blast produced as each blast will have a thick layer of cover which will have a positive / muffling effect on the blast. ○ The amount of dust produced by any blast will be greatly reduced by leaving the soft overburden material in place.	
▪ Keep air-blast amplitudes below 130 dB, this requires proper stemming control, burden control, stemmed presplit holes and the use of noiseless initiation systems.	No cost applies
▪ Minimise the effects of dust and smoke by blasting when the wind is blowing in the opposite direction to sensitive receptors.	No cost applies
▪ All blast holes should be stemmed to at least 25 times their diameter.	Operational cost
▪ The setting out and drilling of all blast-holes must be properly supervised to ensure proper distribution of explosives through the blast.	
▪ All blast-holes must be timed with detonators fitted with sufficiently accurate delays in order to ensure that the timing design is complied with; additionally, it is recommended that electronic detonators are used.	
▪ All traffic on nearby public roads to the west of the site must be stopped during blasting operations.	No cost applies
▪ Measures that should be taken to minimise fly rock include: ○ Stemming lengths in all blast holes should not be less than 25 hole diameters. ○ All loose rocks should be cleared before blasting. ○ All blast-holes should be initiated at or near the toe. ○ The position and drilling of each blast-hole should be supervised to insure that no hole or part-hole is overburdened or under-burdened. ○ If the HD video recording displays fly-rock results which are unacceptable people and animals within a 500 metre radius should be cleared during blasting operations. ○ The amount of fly rock produced by the blasts may be greatly reduced by leaving the soft over-burden in place when blasting the hard sandstone underneath.	Operational cost

7.4.3. Terrestrial Ecology

Impact Assessment

Flora

- During the operational phase, the opencast pit will be mined in consecutive strips; vegetation will be cleared consecutively as mining progresses. The utilisation of transportation routes including haul and access roads will induce a further negative impact on the floral environment.
- Considering the aforementioned, the operational phase will exert the following negative impacts on the vegetation associated with the proposed opencast mine's development footprint could occur:
  - Existing vegetation communities within the opencast footprint will be completely destroyed due to clearing of land during the mining of the consecutive opencast strips. Any Nationally / Provincially protected plant species may be destroyed as a result.
  - Impacts associated with the clearance of land have the potential to reduce the overall floral species diversity of the affected area.
  - Invader floral species and weeds tend to become well established in areas which have been disturbed or cleared. Such floral species may become abundant in areas which have been disturbed during the operational phase.
  - The potential will also exist for the movement ofstaff at KaNgwane in the project area to result in the trampling of the footprint area and the associated destruction of in situ flora.
  - Dust generated during operation will settle on the surrounding environment which can potentially reduce the vitality of the vegetation communities.
  - Oil leaking or spilled from vehicles and machinery utilised in operational mining activities can introduce contaminants into the natural environment.
- There are a range of negative impacts that will be exerted on flora during the operational phase. For the significance of the impact of each of these please refer to the operation impact assessment table at the end of this section.

Fauna

- During the operational phase, the following potential negative impacts on faunal communities may arise due to activities at KaNgwane:
  - Dust generated during mining activities will settle on the surrounding vegetation reducing the availability thereof for herbivores which may flee the area as a result.
  - Mining activities arising in the use of heavy vehicles and machinery may result collisions with animals still resident in the area. These include animals which are territorial, burrowing, slow moving or have young.
  - The clearance of the proposed consecutive opencast strip footprint areas will result in habitat destruction which can reduce faunal species diversity.
- There are a range of negative impacts that will be exerted on flora during the operational phase. For the significance of the impact of each of these please refer to the operation impact assessment table at the end of this section.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ A suitably qualified person should inspect areas targeted for consecutive opencast strips before clearance thereof in order to search and locate any plants or animal species of significance. If floral/faunal species of significance (including protected species) are found they should be relocated to an appropriate location (this process should include the relevant authorities should permission be required first).	R 40 000.00 p/a
▪ Ongoing implementation of alien invasive eradication and monitoring plan and environmental awareness training for employees whose activities may exert an impact in this regard.	R 50 000.00 p/a
▪ The activities of staff members associated with mining activities should be limited to the site.	R 520 000.00 throughout LOM
▪ Areas where the regrowth of natural vegetation has been promoted should be maintained constantly to ensure the continual provision of habitat to bridge fragmented habitats arising due to the proposed development as this will allow for the eventual restoration of landscape connectivity.	R 50 000.00 p/a

7.4.4. Aquatic Ecology

Impact Assessment

- During the operational phase, there is the potential that the existing aquatic habitat can be impacted upon due to siltation arising from clean water runoff from exposed surfaces. There is further potential for changes in physico-chemical water quality to occur due to contaminated runoff which may arise in the event of a failure of the dirty water containment system. It should be noted however, that the dirty water containment system has been designed to accommodate a 50-year flood event of 24-hours duration and thus only should a situation arise where this system is breached (such as if a PCD were not adequately emptied and the capacity thereof was reduced to the point where overtopping occurs). This is considered to be an unlikely occurrence. Furthermore, the hydrological study illustrated that the surface flow gradients are such that the energy of runoff would be insufficient for significant sediment transport to occur. This impact is thus considered **medium** without mitigation, but can be reduced to **low** if mitigation measures are implemented.
- During operation, the mine's dirty water catchment system may result in reduced surface runoff reaching aquatic environments. The total area of the proposed development is approximately 1 151.1 Ha. The volume of surface water runoff from this area to the receiving water resources is calculated as 89.1 Ml/a to the Komati River annually via Stream 3 and 160.1 Ml/a via the Mambane River and its tributaries (Streams 1 and 2), i.e. a total of 249.2 Ml/a of surface run-off to the Komati River (about 682.8 m^3/day). This

reduction in runoff reaching the rivers may have an impact on fauna and flora that are sensitive to flow velocity and water levels. This impact is also considered **medium** without mitigation, but can be reduced to **low** if mitigation measures are implemented.

- The introduction and establishment of alien invasive species will be an on-going impact throughout the LOM due to areas being disturbed and high levels of human activity. This can have a negative impact on stream biota as they out compete indigenous vegetation and habitats change. Alien invasive species also often utilise more water than indigenous species, so have the potential if they become established to alter stream flow. The impact of alien invasive species is considered **high** without mitigation, but can be reduced to **low** if mitigation measures are implemented effectively.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ In order to reduce possible sedimentation, topsoil, leaf and plant litter as well as subsoil must be stockpiled separately in low heaps. Topsoil or any overburden material removed from the pit should be stockpiled separately for later rehabilitation.	Operational cost
▪ An effective storm water management system should be implemented.	Operational cost
▪ Current information about the areas aquatic biodiversity should be improved to evaluate the effectiveness of existing control actions and any subsequent restoration activities. A follow up Aquatic Biodiversity Action Plan should be completed during the rainy season. Monitoring of impact to evaluate the effectiveness of existing control actions to guide any subsequent restoration activities.	R 60 000.00 p/a
▪ An alien invasive eradication and monitoring plan should be implemented; particularly in drainage lines. Natural trees, shrubbery and grass species must be retained wherever possible and surrounding natural vegetation should not be disturbed to minimize chances of invasion by alien vegetation. Manual or mechanical removal is preferred to chemical control and all vehicles and equipment, as well as material should be free of plant material. Therefore, all equipment and vehicles should be thoroughly cleaned prior to access on to the site. This should be verified by the ECO.	R 50 000.00 p/a
▪ Any general mitigation measures relating to surface water runoff and erosion prevention will aid in mitigating the mine's negative impact on the aquatic biodiversity in the area.	See Section 10

7.4.5. Surface Water

Impact Assessment

- Water runoff on the surface at KaNgwane could potentially acquire contaminants such as hydrocarbons, carbonaceous runoff oils, fuel, grease, etc. from discard or overburden dumps, the processing plant, or vehicles used in the transport of materials. This then has the potential to come into contact with the Komati River through drainage via the Mambane River and Streams 1, 2 and 3 which ultimately report to the Komati River. It should be noted, however, that management measures described below have been incorporated into the design of the proposed KaNgwane Anthracite Mine. The significance rating of the impact that contaminated water may have on the Komati River is **low** seeing as the Mambane River and Streams 1, 2, and 3 act as buffers for the Komati river in carrying the pollution load generated by the mining activities.
- The anthracite coal that will be mined will contain very little sulphide material because through the processes of heat and pressure ordinary bituminous coal is metamorphed into anthracite. A significant fraction of the volatile substances e.g. SO_2 is driven off the anthracite. The potential for AMD generation at the site will thus be very **low.**
- The pollution control dams and the mine water dam are sufficiently sized to contain surface run-off from all contaminated areas produced by a storm with a return period of 50 years, falling over the catchment areas of these dams. However, this is only the case if the dams have a freeboard of 600 mm at the time of the 50-year storm. Proper sizing of the pollution control dams ensure contaminated water is contained and thus has a **low** impact rating.
- Surface infrastructure and opencast mining is outside the 50-year floodlines of Streams 1, 2, 3 and the Mambane River. The impacting risk of surface infrastructure being affected by floods is thus **low**.
- During the operational phase, the use of the discard dump, stockpiles and pollution control dams as well as the operation of the processing plant will involve the stockpiling of material, clearing of additional topsoil during progressive development of the discard dumps, and transportation of coal product via trucks. Contamination of Streams 1, 2, and 3 as well as the Mambane River from the surface infrastructure could occur due to spills resulting from the pollution control dams, the operation of the processing plant, equipment and machinery.
- The impact of general and hazardous waste and material storage on surface water involves the possible contamination from spills resulting from the operation of the sewage plant, storage of general and hazardous waste, diesel, and explosives, and the refuelling of diesel tanks and mine vehicles.
- Adequate disposal of sewage will reduce possible contamination impacts on Streams 1, 2, and 3 as well as the Mambane River and thus the impact rating of pollution to the streams through the seepage from sewage risk is **low**.
- Proper mining methods must be implemented to ensure that the quality of the Komati River water remains high. This has a **medium** impact rating that can be reduced to a **low** rating if the proper mitigation measures are implemented.

- The volume/salt content of the Komati River will truly not be affected by a reduction in surface run-off due to interception of the run-off by the opencast pits. The impact rating thereof is thus quite **low.**
- By mining within or close to riparian or flood zones of a stream, no allowance is made for a buffer zone between the mine and the watercourse. The impacts will be transferred directly from the location where the incident occurred, e.g. hydrocarbon spills from the processing plant, to the watercourse. Contaminated water will potentially reach the surrounding streams and cause environmental degradation of aquatic ecosystems.
- Anthracite coal mined at the mine will contain very little sulphide material. Sulphides are required to produce acid mine drainage and without them, AMD production would not occur. The expected concentrations (in mg/l) in the water that would decant from the mining areas after closure of the mine and after recovery of the groundwater table would be measured would be in the lower teens rather than in the thousands. The risk of AMD being generated at the site is thus very **low**.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ Berms should be constructed along up-gradient boundary areas where potentially contaminated surfaces may develop. These berms will divert all surface run-off from uncontaminated up-gradient areas around the contaminated surfaces into the local streams. All the contaminated water will be diverted into one of several adequately-sized pollution control dams.	Operational Cost R 3 342 637 allocated as capital for LOM for berm development
▪ The sewage produced will be treated in two sewage treatment plants and the effluent will be discharged into the mine water circuit for re-use.	Operational cost R 3 344 043 assigned as capital for installation of sewage treatment over LOM
▪ By making use of a large mine water dam designed to store the water collected during the rainy season for use during the dry season, there will not be any need to discharge polluted water into the surface waters surrounding the KaNgwane Anthracite Mine. Any surplus water is to be re-used on site as mine service water.	Operational cost R 57 998 377.00 set aside as capital for water management facilities
▪ Careful planning and preparation for closure should occur during the operational phase.	No cost applies
▪ See also General mitigation measures.	See Section 10

7.4.6. Groundwater

Impact Assessment

Groundwater Quantity

- The mine floor elevations are expected to be below the general groundwater level causing groundwater inflows into the mining areas from the surrounding aquifers during operations. The mining areas will therefore have to be actively dewatered to ensure a safe working environment.
- Pumping groundwater that seeps into the mine area to surface will cause further dewatering of the surrounding aquifers and an associated decrease in groundwater level.
    - The zones of influence of each of the dewatering cones depend on the following factors:
        - depth of mining below the regional groundwater level;
        - recharge from rainfall to the aquifers;
        - vertical infiltration of the recharging water;
        - the size of the mining area;
        - the aquifer transmissivity;
        - aquifer storativity.
- The groundwater level fluctuations will be impacted by the effect of on-going rehabilitation of the opencast areas and the elevated recharge from rainfall that is associated with disturbed and rehabilitated areas.
- The 3-D numerical groundwater flow model was used to simulate the development of the drawdown cone over time in the study area. The simulated cone of depression in groundwater levels are presented in Figure 43 to Figure 44 for 2017 (start of underground operations) and 2035 (end of life of mine).
- These figures represent the impact on groundwater level in the fractured rock aquifer. The upper weathered aquifer will be dewatered completely in the vicinity of the mining operations.
- The drawdown in the fractured rock aquifer within the mining area is expected to be 80 to 100m. The cone of depression is not expected to extend more than 2 000m from the mining area at 2017.
- All the existing mine monitoring boreholes (KBHMON01 to KBHMON05) fall within the zone of impact, which indicates that the boreholes are optimally located to monitor the change in groundwater level and quality over time.
- It is noted that both the carbonaceous and non-carbonaceous overburden stockpiles fall within the cone of depression around the mining areas. Seepage originating from the carbonaceous overburden dump will therefore be contained by the impact of dewatering.
- The impact of backfilling and rehabilitation of OC1 was included during simulations. Groundwater levels will start to recover in this area, once rehabilitation of the pit has been completed.

- At the end of the operational life of mine, both opencast pits will be backfilled and rehabilitated so that groundwater levels will start to rebound from these areas. However, the underground area will be dewatered via the boxcut at the OC2 highwall for access and therefore groundwater levels in the OC2 area will not be able to recover fully. Groundwater levels will also start to recover from UG1 at which operations will cease by 2030.
- The maximum drawdown in groundwater level in mine monitoring borehole BHMIA1 is calculated to be around 15m and while it is possible that the yield of the borehole will be affected, it is unlikely that the borehole will become dry.
- Groundwater baseflow to the streams will be reduced. The unnamed, non-perennial stream to the west of opencast pit 2 will be significantly affected by mine dewatering with around 60% of the baseflow contribution to the stream being removed during the rainy season. However, it should be noted that the stream is classified as being non-perennial, and therefore only flowing during the rainy season, and possibly a portion of the dry season (no stream flow volumes on the river are available). Therefore, the majority of the flows in the stream will be derived from surface run-off during rainfall events and baseflow contribution is expected to form a minor portion of the stream flow volumes during most of the time that it does flow; and
- Baseflow contribution to the non-perennial Mambane stream to the east will also be reduced. It is estimated that less than 20% of the baseflow contribution will be removed. This stream is also classified as a non-perennial stream and the impact of the reduction in baseflow contribution will be mitigated by the fact that the majority of the total flows in the stream are expected to come from surface run-off during rainfall events.
- Groundwater seepage rates will increase to around 830 m^3/day (min: 130 m^3/day; max: 1120 m^3/day) in Year 4 as the extent and depth of mining increases with time. During 2017, the groundwater seepage rate to OC1 is expected to reduce slightly to 600 m^3/day (min: 140 m^3/day; max: 820 m^3/day), as dewatering from the start of mining at OC2 lowers groundwater flow gradients on a regional level.
- Groundwater seepage to OC2 is expected to increase annually as the extent and depth of mining increases to around 780 m^3/day (min: 90 m^3/day; max: 920 m^3/day) in 2025.
- The volume of groundwater seepage into UG1 is expected to start at around 140 m^3/day (min: 20 m^3/day; max: 330 m^3/day) in 2017 and increase to around 600 m^3/day (min: 400 m^3/day; max: 840 m^3/day) by 2025 as the mining area and depth of mining increases.
- Underground seepage rates at UG2 is expected to be around 490 m^3/day (min: 130 m^3/day; max: 920 m^3/day) in 2025 and increase to around 890 m^3/day (min: 717 m^3/day; max: 1 020 m^3/day) by the end of mining in 2035.

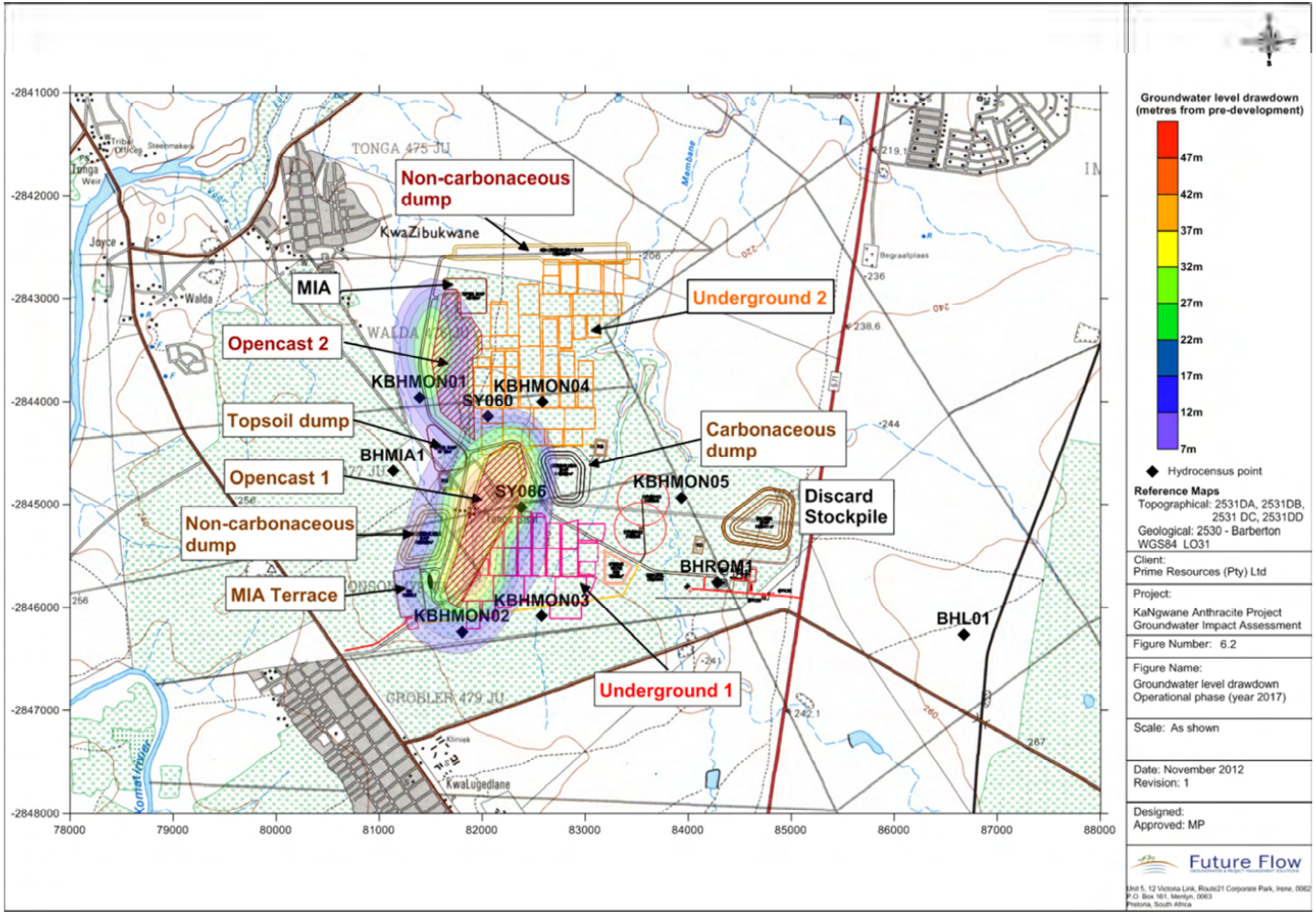

Figure 43: Groundwater level drawdown during the operational phase year 2017.

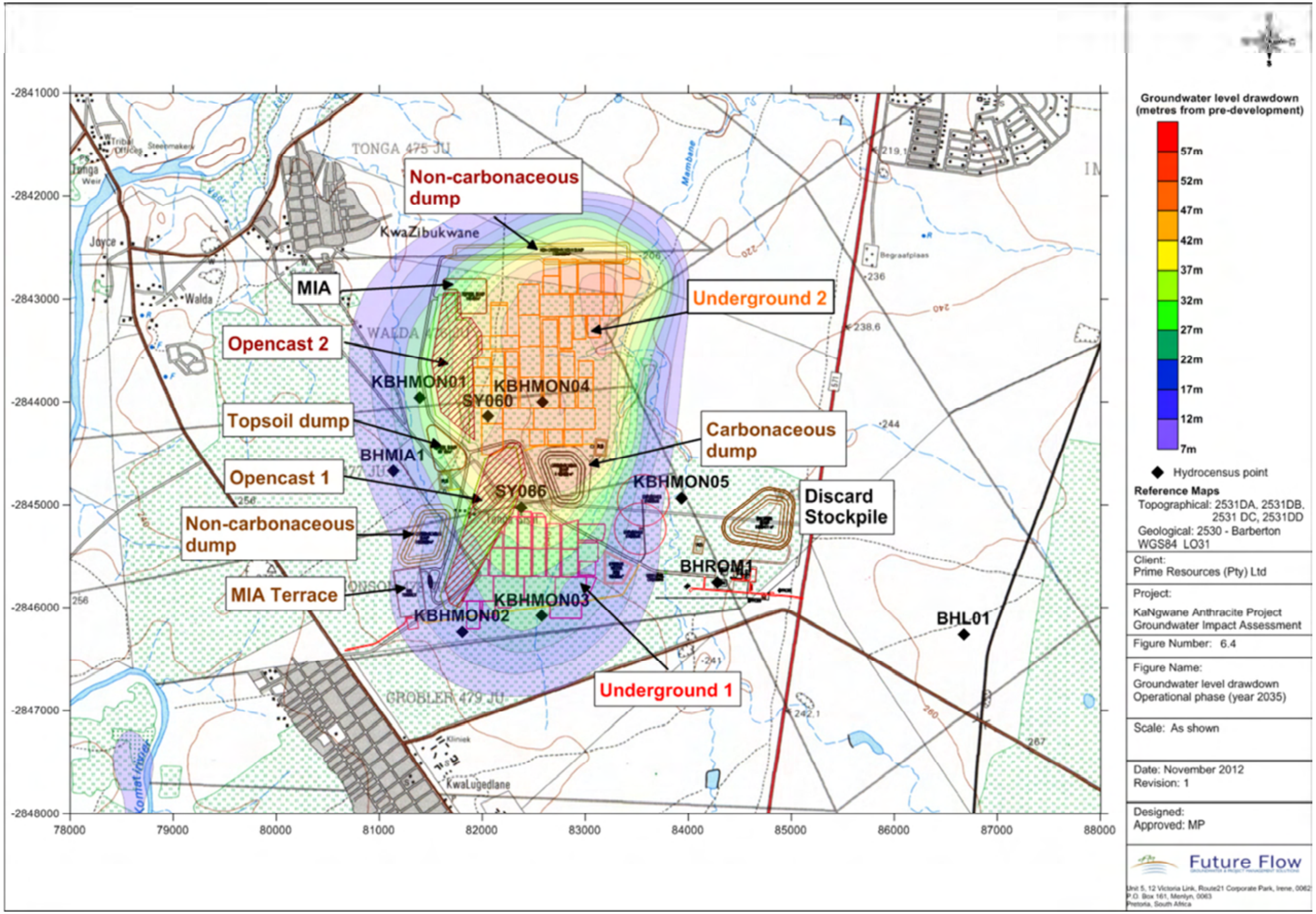

Figure 44: Groundwater level drawdown during the operational phase year 2035.

Groundwater Quality

- Only the discard dump is expected to have an impact on groundwater quality during the operational phase. The impact of the discard dump is expected to be more pronounced on the weathered material aquifer, as it is a surface source of contamination. At the end of the operational life of mine, groundwater sulphate concentrations will increase by around 5 mg/L in the weathered and fractured rock aquifers (the low concentration hereof is discussed in Section 2.10 above.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ Implement and maintain a groundwater monitoring programme.	See Section 11.6
▪ Utilise mine design features to divert clean surface runoff around the mining area and back into the catchment.	R 60 000 000.00 for LOM and assigned to capital costs
▪ Implement concurrent rehabilitation at the opencast pits to reduce the impact of mine dewatering.	Closure cost
▪ Implement a stormwater management plan at the discard dump to reduce the volume of seepage to the underlying aquifers.	Operational cost
▪ Rehabilitate discard dump as soon as possible to reduce recharge rates.	Closure cost

7.4.7. Soil

Impact assessment

The operational phase will see very little change in the development requirements, with the footprint of disturbance remaining constant for all surface infrastructure associated with the development. The impacts of opencast mining, however, will increase to a point where the maximum disturbed footprint is reached and on-going rehabilitation in the form of rollover commences. The impacts associated with this are adequately discussed above for the construction phase.

Maintenance and care of the stockpiled soil resources will be the main management activity required during the operational phase as poor management of the materials can result the loss of the soil resources due to inundation (ponding), the effects of wind and water erosion, compaction and contamination.

Physical degradation

- Ponding or inundation of these soils or the effects of cracking of the inhibiting layer and the drainage of these soils will have an effect on their ability to sustain biodiversity and ecological balance associated with rehabilitation. Changes will be inevitable and the present functionality will be altered.

- Soil compaction will result in the decrease in porosity of the soil with a subsequent increase in bulk density that can lead to impeded water infiltration and root penetration.
- Soil removed or relocated will be loosened and thus become far more susceptible to erosion through the action of water or wind.
- Although soils can be stockpiled, once they are removed the breakdown of the soil structure greatly reduces the soil potential ultimately resulting in the loss of soil resource.

Chemical degradation

- The relocation or removal of soils can lead to elevation of potassium and nitrogen levels in soils, as well as the reduction of soil organic carbon levels. This can cause physical problems such as decreased soil nutrient buffer capacity and altered biological activity and organism population composition, which in turn these results in lowered soil potential and possible loss of soil and agricultural resource.
- Pollution of soils by petroleum products invariably occurs in environments where vehicles are used and serviced or where petroleum depots are located. Furthermore, a failure in the clean and dirty water separation systems can result in contamination of the soil resources.

The significance of construction activities on the physical and chemical soil properties is expected to be **high**. The significance hereof can be mitigated by implementation of the following management measures.

Mitigation Measures

The aforementioned soil utilisation guide should further consider the following for the operational phase;

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ Where necessary, growth of vegetation on all/any areas where soil (in-situ, stockpiles and/or berms) could be affected (e.g. by means of watering and/or fertilisation) should be considered. The purpose of this exercise will be to protect the soils and combat ponding, erosion by water and wind.	R 220 000.00 (Hydroseed re-vegetation)
▪ If areas of potential subsidence are encountered, storm water controls (trenches and berms) should be engineered so as to prevent ingress and inundation of surface ponding, run-off and erosion.	Operational cost
▪ Any soil storage stockpiles will be restricted where possible to heights of less than 4-5m so as to avoid compaction and damage to the soil seed pool. Where stockpiles higher than 1.5m cannot be avoided, these will be benched to a maximum height of 15m.	No cost applies
▪ For storage periods greater than 3 years, vegetative or rock cover (cladding) will be essential, and should be encouraged using	Operational cost

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
fertilisation and induced seeding with water and/or the placement of waste rock.	
▪ The stockpile side slopes should be stabilized at a slope of 1 in 6. This will promote vegetation growth and reduce run-off related erosion;	No cost applies
▪ Only inert waste rock material will be placed on the soil stockpiles if the vegetative growth is impractical or not viable (due to lack of water for irrigation etc.). This will aid in protecting the stockpiles from wind and water erosion until the natural landscape it restored.	No cost applies
▪ Equipment, human and animal movement on the soil stockpiles will be limited to avoid topsoil compaction and subsequent damage to the soils and seed bank.	No cost applies

7.4.8. Wetlands

Impact Assessment

- Due to the clearing of land for the mining of the consecutive opencast strips, existing vegetation communities may be destroyed, leading to the loss of sensitive species and changes in vegetation species abundance. The disturbances in this regard may result in the invasion and encroachment of exotic plant species.
- The operational mining activities are associated with the movement of people within and around the affected area. This may result in the trampling of the wetland area and affect vegetation cover. The wetland habitat may also become fragmented due to road crossings created for transport of materials onsite.
- Oil leaking or spilled from motorised equipment such as the transport of coal from site, as well as chemical spills resulting from the processing plant can potentially contaminate the wetland vegetation and habitat should a failure of the dirty water containment system arise, thereby potentially reducing water quality and affecting fauna dependant thereon.
- The clearing of vegetation and the removal of topsoil for the mining of consecutive opencast strips, as well as activities such as dust entrainment on haul roads and the handling of material in stockpiles can all generate dust that may settle on wetland ecosystems, increasing sedimentation and siltation of the wetlands. Furthermore, any dust settling on the wetland environment can potentially reduce the availability of food sources of wetland faunal species. Any of the above activities which further lead to soil compaction increase the risk of sediment transport and soil erosion.
- Increased flow rates of surface runoff due to vegetation removal and the hardening of surfaces can lead to the creation of preferential flow paths and possible concentration of water flows into channels, which increases the risk of soil erosion and the eventual formation of dongas. This can lead to channel incision, and change in the in-stream

habitat. The altered runoff regime and retention of runoff in the mines dirty water catchment has the potential to desiccate the wetlands.

- The operational phase of the mine and its related activities will have a **medium** significance impact on the wetland habitat but which can be reduced to a **low** significance impact rating if the mitigation measures below are applied.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ The use of an established nursery prepared during the construction phase will ensure the supply of indigenous species of significance for introduction into areas where exotic species have encroached. The invasive alien vegetation management programme must be implemented and maintained throughout the operational phase.	R 40 000.00 p/a
▪ Aim to limit the movement of people to the operational areas of the site. This will reduce the impact of trampling of vegetation and compaction of soils on the wetland.	Operational cost Capital amount of R 520 000.00 allocated to erect fences during LOM
▪ Management measures pertaining to the management of dust and soil during the operational phase should be implemented to reduce the effects of dust, as well as impacts related to soil, on wetlands.	See costs relating to Sections 7.4.1 and 7.4.7
▪ Stream and wetland crossings constructed during the construction phase should be maintained on an on-going basis to allow for the full functioning of the wetland watercourse and not impair it. Maintenance activities should also include any culverts, gabion structures or other energy dissipaters constructed downstream the culvert. This keeps the velocity of the water manageable and thus decreases the risk of erosion.	Operational cost
▪ The wetland buffer areas must remain "no-go" areas throughout the construction phase.	R 520 000.00 throughout LOM

7.4.9. Soundscape

Impact Assessment

- There are two continuously noisy activities that will be occurring within the opencast pits during the operational phase, namely: (1) Drilling and (2) Shovel and truck loading processes. The significance of the impact has been based on the worst case scenario in which both activities will be occurring simultaneously. Should the two activities occur at the same time a predicted noise level of 75.2 dB(A) will be evident at 15m from the opencast pit (taking into consideration the noise barrier effect of the pit wall as mining progresses).

- Blasting activities are infrequent and transient, the nature and magnitude of the response to noise from blasting operations will depend critically on: the blasting regime chosen, the nature of the rock to be blasted, the size and depth of the charge, the type of explosive, the local topography and the detonation sequence (which is expected to take place at intervals of one or two weeks). At these intervals, noise generated during blasting activities is unlikely to have any significant impact on humans or livestock (provided the blasts are done and carried out with due regard to normal good blasting practice).
- The activities occurring within the proposed pit will have a minor impact on the noise climate of the surrounding environment; the mobile nature of the open pit operations suggests that noise emanating from different areas in the opencast pit will affect surrounding communities depending on their proximity to the location of where work is being done within the opencast pit at that particular point in time. Complaints from noise intrusions may be expected from the nearest residents to the opencast pits. The nearest residents were detailed as noise sensitive receptors in the baseline Section 2.14.
- Apart from the aforementioned processes, other continuously noisy activities occurring within the mine boundary are associated with coal stockpile management and materials transport, truck-loading using front-end loaders at the corner of the site (in close proximity to the R571 road). The nearest dwelling from the processing plant is located approximately 650 m away, this dwelling is just close enough to be exposed to a negative noise impact emanating from coal stockpile management and loading; however, this impact will be minimal. The combined activities in loading operations generally emit noises of 81.1 dB(A) at 15 m; at 700 m an exceedance of just 3 dB(A) will be felt which is negligible.
- Anthracite product will be transported by truck, the trucks will operate during daylight hours from 05h00 to 19h00 from Monday to Saturday; it is expected that eight interlink truck trips will occur per hour (in each direction). Noise will be generated from this increase in traffic; there will be no noise impact at distances greater than 320 m from the transport route, there are dwellings within this distance but noticeable impacts will only be felt by dwellings that are in close proximity to the road.
- Taking the above into consideration the significance of the noise impact during construction is predicted to be **medium** once the recommended mitigation measures and monitoring programme is implemented the significance of this impact will drop to **low**.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ Diesel powered equipment should be fitted with silencers, these silencers should be properly designed and maintained.	Most diesel powered equipment comes fitted with a

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
	silencer
▪ Where possible earthworks and material stockpiles should be placed so as to protect the boundaries from noise from individual operations.	No cost applies
▪ If a levee is constructed it should be of such a height so as to effectively act as a noise barrier.	No cost applies
▪ Coal stockpiles should form a berm surrounding loading areas to provide a noise barrier.	No cost applies
▪ Select vehicle routes carefully by internalising the road network.	No cost applies
▪ Reduce noise at source by acoustic treatment i.e. isolate source by acoustic enclosure, compressors and generators (if used on site) should be installed in separately acoustically treated buildings.	Operational cost
▪ The crusher and front end loaders supplying the transport trucks should be centred within the coal stockpiles which should be maintained at a height of 4-5 m (so as to act as noise diversion berms).	No cost applies
▪ Additionally refer to the general mitigation measures.	See Section 10

7.4.10. Traffic

Impact Assessment

- The main impacts related to traffic during the operational phase arise due to the transport of coal product. Coal product will be transported in 32 ton interlink trucks from the East Access of the Mine at Point D, to the Lebombo Borderpost. Therefore, the trucks will be fully laden when travelling in the northbound direction and the mass of the truck, including its own weight, will be approximately 48 tons. In the southbound direction, the unloaded truck will weigh approximately 16 tons.
- The trucks will be operational during daylight hours from 05h00 to 19h00, Monday to Saturday and it is expected that 8 interlink truck trips in each direction, will occur per hour. The route travelled during the transport of coal will be as per Figure 32.
- In order to assess the potential impacts in terms of the above, the various sections making up the route are individually assessed as follows:
  - Section 1: The increase in volume of coal transport trucks on the road surface will cause an increase in the deterioration rate of the road surface. The average daily truck traffic in the northbound direction is currently substantially lower than in the southbound direction. The impact of the heavily laden coal transport trucks in a northbound direction will have a substantially higher impact on the road surface going in the northbound direction. It is estimated that the design life of the pavement layer

will be shortened by 10 years in the northbound direction and five years in the southbound direction. Section 1 has a high stable flow of traffic with a relatively good progression, therefore, there will be no negative impact due to the Mine's operational traffic on the intersection at Point C. The access road to the Mine at Point D will be 9m wide and the R571-1 is 8m wide. This will be wide enough for an Interlink truck to be able to execute turning movements without encroaching on the oncoming lanes. The impacts on the road and traffic flow of Section 1 have a **medium** significance which can be reduced to low if the correct mitigation measures are implemented.

- Section 2: The residual life of Section 2 of the R571 will be reduced by the addition of coal transport traffic generated by the Mine. There is currently already a capacity problem at Point E. The problem occurs on the minor road, being the east and west approaches, due to the high through volumes along the R571-1 leaving few opportunities for the minor road traffic to enter the intersection. This will become worse as the volume of traffic increases due to the operation phase of the mine. Poor drainage at the bellmouths at Point E, coupled with the poor intersection control e.g. stop signs but no road markings to guide and control the traffic or provide delineation for pedestrians to cross, increases the risk of accidents occurring. The impacts' significance on this road section are **medium**, but can be reduced to **low** if mitigation measures are applied.
- Section 3: The increase in traffic due to the transport of coal will affect the road surface; however, due to the upgrade of the road by SANRAL in 2013/2014, the pavement surface will be able to accommodate the increase in traffic. There is the presence of aggregate loss and potholes, bleeding and settlement of tar and deterioration of the road edge in this section. This decrease in road quality will affect the lifespan of the road and will have a negative impact on the ease of transport of coal in heavy vehicles. Informal traders at the side of the road along the section encourage vehicles to stop on a high speed road, which is unsafe; also the steep shoulder cross fall makes pulling off the road unsafe. There is a sharp horizontal bend to the right in this section as indicated in Figure 45. Just before the bend there is a warning sign to indicate the approach of a sharp bend, which should encourage the driver to slow down, but directly after that sign is a 100 km / hr speed restriction sign. The 100 km / hr speed restriction sign effectively contradicts the sharp bend warning sign. This creates a potentially dangerous situation as motorists may attempt the bend at very high speeds. The impacts on this section of road are of a **low** significance.
- Section 4: With the addition of the coal transport trucks, it is estimated that the design life of the pavement layer could be shortened by 3 years in the northbound direction and one year in the southbound direction. No information regarding the rehabilitation of the N4 was received from SANRAL. However, regarding the condition of the road surface, the specialist estimates that the road has a 20 year design life and it is assumed that rehabilitation was done in 2011. Traffic volumes along the N4 highway are low and there is freeflow of traffic. The increase in traffic on the road will

not have an impact on the flow of traffic along this section. Pedestrians walking along the road's shoulder or in the storm water channel increase the risk of accidents occurring e.g. a pedestrian walking in front of a vehicle. The impacts have a **low** significance on Section 4 of the coal transport route.

Figure 45: Section 3 of the R571-1 with the sharp bend in the road (UWP, 2012).

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ Section 1: The upgrading the road in 2010/2011 ought to ensure that the road section will have the ability to carry increase in traffic. KaNgwane will not permit the drivers to deviate from the designated access roads on site or from the proposed national route. The increase in traffic volumes experienced by access Point D due to transport trucks turning onto and form the mining site will be remedied by reducing the speed that vehicles on the R571-1 may travel when approaching this access point to 60 km / hr. A bypass lane must also be provided on the northbound approach of the R571-1 to enable traffic to pass the trucks that are waiting to turn right onto the mining site.	Costs carried by SANRAL
▪ Section 2: All vehicles are to adhere to the legal speed limits within the mining area and on public roads. Appropriate safety signage for road users will be erected on site. The pedestrian crossing sign just south of Point E when entering Kamaquekeza-B must either be removed to avoid confusion or the crossing must be made safer by providing a raised zebra crossing and other traffic calming measures, e.g. speed bumps approaching the zebra crossing, for vehicles approaching the crossing. An 18 m diameter roundabout with a 7 m circulation lane must be constructed at Point E. If the intersection at Point E is changed to a roundabout, the level of congestion experienced at the Point would improve dramatically.	
▪ Section 3: The speed limit along the N4 at this intersection is currently 100 km / hr but a short distance east of the intersection, the speed is reduce to 80 km / hr and then 60 km / hr leading up to the Lebombo Borderpost. It would be safer for traffic turning onto the N4 if the speed limit at the intersection is reduced to 60 km / hr. The pavement structure of this section is quite poor currently, but once it has been partially reconstructed in 2013/2014 will have enough strength to carry the additional loading of the coal transport trucks during its eight year design life.	
▪ Ensure that signage is placed at the correct location on the road section e.g. the 100 km / hr speed restriction sign at a sharp bend must be relocated to after the bend instead of before the bend to avoid motorists attempting the bend at such high speeds.	
▪ Also see General mitigation measures.	See Section 10

7.4.11. Socio-Economic

Impact Assessment

Loss of agricultural and grazing land:

- During the operational phase of the development communities will still not have access to previous agricultural and grazing lands. Monetary compensation for the loss of cultivated land however will have been determined.

Impact on services such as water, housing, electricity:

- The proposed mine as well as the potential influx of people into the study area will impact on the already stressed bulk service infrastructure, and could result in the establishment of informal settlements. The negative effects of construction activities such as increased ambient noise levels, blasting impacts and reduced air quality will also negatively affect people.

Impact on surface water and groundwater:

- The Komati River and local groundwater are the primary source of water for communities within the study area. Changes to the quality or quantity of these water resources would have an impact on the sustainability of the communities, however the probability of this posing a significant impact is thought to be low (Section 7.4.5).

All impacts to the environment are likely to have an effect on the people living in the area. The potential impacts in this regard are discussed under the section for each environmental aspect. Cumulatively these negative impacts to the people in the area are thought to be **high** if the mitigation measures for each aspect are not implemented. With correct mitigation and monitoring however, this negative impact could be reduced to a **medium** significance.

Job Creation:

The mining operation will continue to supply jobs and opportunities for service providers in the area as labour and services will be required for mining. The communities will therefore benefit through employment / procurement opportunities and the multiplier effect of this that the development at KaNgwane will bring. With the correct mitigation measures implemented, this positive impact to the community is thought to be of **high** significance.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ The land owner resolution between the mine, the surrounding communities and DARDLA should be adhered to. All commitments made in the final Social and Labour Plan (SLP) for the operational phase should be adhered to, ensuring the local people benefit adequately from the mine. The Community Engagement Officer (CEO) should review and update the SLP as necessary and engage the community consistently throughout LOM.	No cost applies

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ KaNgwane, through its human resources and community engagement department, should continue to hold meetings with the elected Siboshwa Community Trusts on a monthly basis. Less frequent open house meetings should also be held within the community for people to communicate their concerns with the mine.	No cost applies
▪ The grievance mechanism should cater for any member of the affected community to raise grievances either through the trust or directly with the mine.	No cost applies
▪ All mitigation measure stated for the various environmental aspects (noise, groundwater, air quality, surface water etc.) should be implemented.	No cost applies

7.4.12. Cultural / Heritage

Impact Assessment

- As mentioned in Section 7.3.12, **sites 1 and 3** are of a **low** cultural and environmental significance which means that they could have been demolished during construction.
- **Site 2** is of a **high** cultural and environmental significance and should have been fenced off during the construction phase.
- Grave yards and graves always have a high cultural significance and need to be handled with the utmost sensitivity should they be encountered by chance during ongoing mining operations.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ For Site 1 and 3 the heritage study is considered ample mitigation and the sites should have been demolished during the construction phase.	No cost applies
▪ If Site 2 was fenced off during construction and regarded as a no-go area during construction, any heritage management plan prepared for the continuous preservation of the site must be adhered to throughout the life of the operation.	R 31 000.00
▪ Alternatively to the above, if, prior to development, test excavations, and research of Site 2 lead to the removal guided by an archaeologist and in consultation with SAHRA, then no further intervention would be required during operation.	R 92 000.00
▪ Although no graves were found inside of the area of direct impact, there always is a possibility and therefore basic information on the handling of these is given (Section 10 of the EMP). Once discovered	R 20 000.00

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
an archaeologist should always be contacted to mitigate the situation.	

RECEPTOR	PROCESS	IMPACT	MAGNITUDE (M)	DURATION (D)	SCALE (S)	PROBABILITY (P)	SIGNIFICANCE		MITIGATION AND MANAGEMENT MEASURES	MONIORING
							RATING	VALUE		
Air Quality	▪ Vehicle movement on site. ▪ Clearing of vegetation. ▪ Blasting and drilling during pit excavation. ▪ Overburden removal and handling. ▪ Coal handling and processing. ▪ Ventilation from underground mining operations.	▪ Increased dust fallout causing a reduction in air quality.	4 [4]	4 [2]	2 [1]	4 [4]	Medium [Low]	40 [28]	Air quality mitigation measures associated with the operation phase in Section 7.4.1.	Implement and maintain air quality monitoring programme in Section 11.1 of the EMP.
		▪ Increased particulate matter reducing the air quality.	10 [4]	4 [4]	3 [2]	4 [4]	High [Medium]	68 [40]		
	▪ Underground drilling of coal seams. ▪ Coal handling and processing.	▪ Increased dust fallout.	4 [4]	4 [2]	2 [1]	4 [4]	Medium [Low]	40 [28]		
		▪ Increased particulate matter.	8 [4]	4 [4]	3 [2]	4 [4]	High [Medium]	60 [40]		
Blasting / Vibrations	▪ Overburden removal ▪ Pit excavation ▪ Mining of the coal seams and	▪ Ground vibrations	10 [8]	4 [4]	2 [2]	4 [4]	High [Medium]	80 [56]	Blasting mitigation measures associated with the operation phase in Section 7.4.2.	Implement and maintain blasting monitoring programme in Section 11.2 of the
		▪ Air blast	10 [6]	4 [4]	2 [2]	4 [4]	High [Medium]	80 [48]		

RECEPTOR	PROCESS	IMPACT	MAGNITUDE (M)	DURATION (D)	SCALE (S)	PROBABILITY (P)	SIGNIFICANCE		MITIGATION AND MANAGEMENT MEASURES	MONIORING
							RATING	VALUE		
	interburdens.	▪ Dust and smoke	8 [6]	4 [4]	2 [2]	4 [4]	Medium [Medium]	70 [48]		EMP.
		▪ Fly rock	10 [8]	4 [4]	2 [2]	4 [4]	High [Medium]	80 [56]		
Terrestrial Ecology	▪ Clearing of land for the consecutive opencast pit strips ▪ Transportation route from opencast / underground workings to processing plant. ▪ Product transportation ▪ Clearing of land for the mining infrastructure footprint areas ▪ Increase in human activity	▪ Destruction of vegetation communities	4 [2]	4 [4]	1 [1]	4 [3]	Medium [Low]	36 [21]	Terrestrial ecology mitigation measures associated with the operational phase in Section 7.4.3	Implement and maintain terrestrial ecology monitoring programme in Section 11.3 of the EMP
		▪ Loss of protected plant species	4 [2]	4 [4]	1 [1]	3 [2]	Low [Low]	27 [14]		
		▪ Reduction in floral species diversity	4 [2]	4 [4]	1 [1]	4 [2]	Medium [Low]	36 [14]		
		▪ Increase in invasive species	6 [2]	4 [4]	2 [2]	5 [3]	High [Low]	60 [24]		
	▪ Heavy equipment and	▪ Dust	4 [2]	4 [4]	2 [1]	4 [2]	Medium [Low]	40 [14]		

RECEPTOR	PROCESS	IMPACT	MAGNITUDE (M)	DURATION (D)	SCALE (S)	PROBABILITY (P)	SIGNIFICANCE		MITIGATION AND MANAGEMENT MEASURES	MONIORING
							RATING	VALUE		
	machinery	▪ Hydrocarbon contamination	4 [2]	4 [4]	1 [1]	3 [1]	Low [Low]	27 [7]		
		▪ Loss of faunal communities	4 [2]	4 [4]	1 [1]	5 [3]	Medium [Low]	45 [21]		
		▪ Reduction in faunal diversity	4 [2]	4 [4]	1 [1]	4 [2]	Medium [Low]	36 [14]		
		▪ Faunal mortalities as a result of vehicle collisions	6 [4]	1 [1]	1 [1]	3 [2]	Low [Low]	24 [12]		
Aquatic Ecology	▪ Surface run-off to Komati River intercepted by mine ▪ Surface and mining activities resulting in surface water pollution ▪ Acid rock drainage ▪ Increased human activity.	▪ Habitat affected by siltation and changes in physico-chemical water quality	4 [2]	4 [3]	2 [1]	4 [3]	Medium [Low]	40 [24]	Aquatic Ecology impact mitigation measures associated with the operation phase in Section 7.4.4.	Aquatic Ecology monitoring is detailed in Section 11.4 of the EMP.
		▪ Changes in habitat suitability ▪ Reduced aquatic species diversity	4 [2]	4 [2]	2 [1]	4 [1]	Medium [Low]	40 [5]		
		▪ Increase in invasive species due to disturbance.	6 [2]	4 [2]	2 [2]	4 [2]	High [Low]	48 [12]		

RECEPTOR	PROCESS	IMPACT	MAGNITUDE (M)	DURATION (D)	SCALE (S)	PROBABILITY (P)	SIGNIFICANCE		MITIGATION AND MANAGEMENT MEASURES	MONIORING
							RATING	VALUE		
Surface Water	▪ Surface run-off entering contaminated areas from outside mining areas ▪ Rainwater falling on contaminated surfaces flows into nearby streams ▪ Interception of surface run-off to the Komati River ▪ Mining or constructing surface infrastructure within the riparian/flood zones of a stream/river	▪ Clean surface water acquire oils, fuel, greases, etc. from mining infrastructure	6 [2]	4 [1]	2 [1]	3 [0]	Medium [Low]	36 [0]	Surface water impact mitigation measures associated with the operation phase in Section 7.4.5.	Surface Water monitoring is detailed in Section 11.5 of the EMP.
		▪ Contaminated water reaches aquatic environment and causes environmental degradation	6 [2]	4 [1]	2 [1]	3 [1]	Medium [Low]	36 [4]		
		▪ Reduced stream flow in the Komati River catchment	2 [2]	3 [3]	1 [1]	1 [1]	Low [Low]	7 [7]		
		▪ Mining close to riparian/flood zones makes no allowance for buffer zone between mine and watercourse	6 [2]	4 [1]	3 [0]	4 [0]	Medium [Low]	52 [0]		
	▪ Releasing pollution into the surface water environment	▪ Pollutants released into aquatic environment by discharging water into streams	4 [2]	5 [5]	3 [0]	3 [0]	Medium [Low]	36 [0]		

RECEPTOR	PROCESS	IMPACT	MAGNITUDE (M)	DURATION (D)	SCALE (S)	PROBABILITY (P)	SIGNIFICANCE		MITIGATION AND MANAGEMENT MEASURES	MONIORING
							RATING	VALUE		
Groundwater	▪ Dewatering of aquifers ▪ Acid rock drainage	▪ Loss of existing monitoring boreholes	6 [6]	4 [4]	2 [1]	4 [3]	Medium [Medium]	48 [33]	Groundwater mitigation measures associated with the operation phase in Section 7.4.6.	Implement and maintain groundwater monitoring programme in Section 11.6 of the EMP.
		▪ Deterioration in groundwater quality at the discard dump	4 [2]	4 [4]	2 [1]	4 [3]	Medium [Low]	40 [21]		
Soil	▪ Removal of soil for pit excavation	▪ Loss of soil resource due to collapse of unconsolidated / compacted workings - Roll over management	10 [8]	5 [5]	1 [1]	5 [5]	High [Medium]	80 [70]	Soil mitigation measures associated with the operation phase in Section 7.4.7.	Implement and maintain soil monitoring programme in Section 11.7 of the EMP.
		▪ Loss of resource due to ponding of surface water on collapsed areas. Free draining of rehabilitated topography fails	10 [8]	5 [5]	1 [1]	5 [5]	High [Medium]	80 [70]		
		▪ Loss of resource due to cracking of poorly consolidated rehabilitation at surface	10 [8]	5 [5]	1 [1]	5 [5]	High [Medium]	80 [70]		
Wetlands	▪ Clearing of land due to further excavation of pits	▪ Existing vegetation communities impacted upon	4 [2]	4 [2]	2 [1]	3 [3]	Medium [Low]	30 [15]	Refer to the wetlands impact mitigation measures	Implement and maintain a wetlands monitoring programme in

RECEPTOR	PROCESS	IMPACT	MAGNITUDE (M)	DURATION (D)	SCALE (S)	PROBABILITY (P)	SIGNIFICANCE		MITIGATION AND MANAGEMENT MEASURES	MONIORING
							RATING	VALUE		
	▪ Operations of mine result in high numbers of people on site ▪ Hydrocarbons spills due to motorised equipment being used on site	▪ Floral and faunal diversity in wetland catchment reduced	4 [2]	4 [3]	2 [2]	3 [2]	Medium [Low]	30 [14]	associated with the operation phase in Section 7.4.8.	Section 11.8 of the EMP.
		▪ Disturbances to vegetation result in invasion of exotic plant species.	4 [2]	4 [3]	2 [2]	3 [2]	Medium [Low]	30 [14]		
		▪ Clearing of vegetation generates dust and sediment that settles on wetland ecosystems	4 [2]	2 [2]	2 [1]	4 [1]	Medium [Low]	32 [5]		
		▪ Grazing opportunity reduced	4 [2]	4 [2]	2 [1]	3 [2]	Medium [Low]	30 [10]		
		▪ Increase in people result in wetland flora being tramped and faunal habitats being destroyed	6 [4]	2 [2]	3 [2]	3 [2]	Medium [Low]	33 [16]		
		▪ Oil leaks contaminate habitats and water	10 [2]	4 [2]	2 [1]	3 [1]	Medium [Low]	48 [5]		

RECEPTOR	PROCESS	IMPACT	MAGNITUDE (M)	DURATION (D)	SCALE (S)	PROBABILITY (P)	SIGNIFICANCE		MITIGATION AND MANAGEMENT MEASURES	MONIORING
							RATING	VALUE		
Soundscape	▪ Noise generated by drilling during the mining of the consecutive opencast strips ▪ Noise generated by shovel and truck loading processes	▪ Increase in ambient noise levels	4 [2]	3 [3]	2 [1]	5 [5]	Medium [Low]	40 [30]	Noise mitigation measures associated with the operation phase in Section 7.4.9.	Implement and maintain noise monitoring programme in Section 11.9 of the EMP.
Traffic	▪ Increase in traffic on roads due to transportation of coal	▪ Deterioration of roads in Section 1	6 [4]	3 [3]	2 [2]	3 [2]	Medium [Low]	33 [18]	Traffic mitigation measures associated with the operation phase and a description of sections 1, 3 and 4 can be found in Section 7.4.10.	
		▪ Deterioration of roads in Section 3	4	3	2	2	Low	18		
		▪ Deterioration of roads in Section 4	2	3	2	2	Low	14		

RECEPTOR	PROCESS	IMPACT	MAGNITUDE (M)	DURATION (D)	SCALE (S)	PROBABILITY (P)	SIGNIFICANCE		MITIGATION AND MANAGEMENT MEASURES	MONIORING
							RATING	VALUE		
Socio-Economic	▪ Deterioration of access roads in Section 3	▪ Loss of land ▪ Surface and groundwater pollution ▪ Loss of sense of place ▪ Increase in Nuisance impacts (noise, air quality, blasting etc.)	8 [6]	4 [4]	3 [3]	4 [3]	High [Medium]	60 [39]	Details of mitigation measures to reduce negative impacts and increase potential positive impacts on the socio-economic environment are described in Section 7.4.11.	The SLP should be adhered to as well on-going community engagement as described in Section 11.10 of the EMP.
Cultural / Heritage	▪ Deterioration of access roads in Section 4	▪ Loss of old government farm buildings at Site 1	2	3	1	4	Low	24	Heritage resource mitigation measures associated with the operation phase in Section 7.4.12.	Implement and maintain heritage resources general mitigation measures (Section 10.11)
		▪ Loss of Middle Stone Age / Late Stone Age and Iron Age tools and pottery at Site 2	10 [8]	4 [4]	4 [3]	5 [5]	High [High]	90 [75]		
		▪ Loss of Middle Stone Age and Iron Age remains at Site 3	2	3	1	4	Low	24		

7.5. Decommissioning Phase

At decommissioning, the rehabilitation measures described as per Section 12.4.3.1 will be implemented.

7.5.1. Air Quality

Impact Assessment

During decommissioning only dismantling of surface infrastructure and rehabilitation will be taking place and the annual average PM_{10} concentrations were predicted to be within the NAAQS limit value as set out in the NEMAQA at all of the nearby receptors. Exceedances of the annual $PM_{2.5}$ NAAQS limit value were predicted to occur only on site. Predicted dust fallout rates are well within the SA NEMAQA draft dust fallout standards with high dust fallout localised to the site. The following activities which may impact on the air quality in the area during the decommissioning phase were identified:

- During decommissioning vehicles will be used to transport materials and personnel for the dismantling of the surface infrastructure, the demolition of hard-standing areas and transport of topsoil and overburden for rehabilitation. All road surfaces onsite will be unpaved. Vehicle-entrained dust emissions from unpaved roads represent a potentially significant source of fugitive dust which will reduce the surrounding air quality. Increased fugitive dust may be a nuisance to local residents, employees and fauna in the area. Increased fugitive dust may also affect the photosynthetic activity and growth of flora in the area. The significance of the impact of increased fugitive dust from vehicle entrainment is **medium** without mitigation and **low** if the mitigation measures listed below are implemented. Vehicle tailpipe emissions contain particulate matter (hydrocarbon compounds) including inhalable particles (PM_{10}) and fine particles ($PM_{2.5}$) which may have an impact on the health of local residents, employees and fauna in the surrounding area. The significance of the increased particulate matter suspended in the air from vehicle tailpipe emissions is **medium** without mitigation and **low** if the mitigation measures listed below are implemented.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ To reduce dust from vehicle entrainment and windblown dust from materials being transported: o wet suppression or chemical stabilization of unpaved roads should be implemented; o trucks are to be covered; o vehicles should adhere to strict speed limits 40km/hr on the access roads is recommended); and	Operational cost

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
○ unnecessary traffic on unpaved roads should be reduced.	
▪ To reduce particulate matter from vehicle tailpipe emissions unnecessary traffic on unpaved roads should be reduced.	No cost applies

7.5.2. Terrestrial Ecology

Impact Assessment

- Decommissioning activities will involve implementation of the rehabilitation and closure methodology in the Rehabilitation Plan (and discussed in Section 12.4). Vegetation communities which were once present in the area and destroyed during the construction and operation phases (particularly during the mining of the consecutive opencast pits) should thus begin returning to the area and slowly become re-established whilst decommissioning is taking place.
- Rehabilitated sites are disturbed sites and thus invasive species tend to increase in abundance in areas which have been disturbed; this may be the case along haul roads and other sites that have been disturbed by the mining footprint area.
- Certain faunal species may re-establish themselves in areas which are being rehabilitated during the decommissioning phase due to the increase in suitable habitat.
- Oil leaking or spilled form heavy vehicles and motorised equipment used during the decommissioning phase can potentially contaminate re-establishing habitats should the dirty water catchment be removed prior to the completion of decommissioning activities.
- Heavy vehicles transporting decommissioned infrastructure, rubble and personnel of site may collide with fauna causing mortalities.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ Adhere to the rehabilitation plan so as to meet the objectives for closure.	See Section 12.4
▪ Re-establish suitable indigenous plant species that will represent the natural floral diversity of the area (as it was pre-mining) this includes the re-introduction of species that may have been lost during the construction and operation phases.	Closure cost
▪ Continued implementation of the alien invasive eradication and monitoring plan.	R 50 000.00 p/a
▪ Ensure traffic calming measures on-site are adhered to by decommissioning vehicle operators.	Operational cost

7.5.3. Aquatic Ecology

Impact Assessment

- The decommissioning phase should largely result in positive impacts to the aquatic ecology in the area as the mining area gets rehabilitated. As hard, artificial surfaces are removed and re-vegetated so the effect of soil erosion and the resulting sedimentation will be reduced. Water quality should also improve as the catchment is rehabilitated and re-vegetated.
- Aquatic species diversity should increase as habitat suitability improves as a result of improved runoff and water quality.
- Alien invasive species may still pose a **low** negative impact during decommissioning as there will still be human activity on site. The impact however is reduced and with on-going assessments and removal throughout the decommissioning phase the negative impact low.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ The on-going monitoring of impacts to evaluate the effectiveness of existing control actions to guide any subsequent restoration activities, should continue until decommissioning is complete.	R 150 000.00 p/a See Section 11.4.5
▪ The dismantling and removal of the entire surface infrastructure and the replacement of topsoil and re-vegetation of the catchment so as to return the area, wherever possible, to its pre-mining state.	Closure cost
▪ Regular control of alien invasive eradication and monitoring plan in drainage lines should be continued throughout the decommissioning phase.	R 50 000.00 p/a

7.5.4. Surface Water

Impact Assessment

- Accidental spillage of polluted water or surface run-off from the discard dump could potentially pollute the aquatic environment should the dirty water containment system be removed prior to decommissioning activities being complete.
- Dismantling and demolition of surface infrastructure could lead to pollution of the surface water resources e.g. hydrocarbon spills from transportation vehicles removing the infrastructure from site and cement, grease and oils from the infrastructure itself. The backfilling of the final void and the disturbance of stockpiled material are activities which generate dust, which in turn has the potential to result in sedimentation of watercourses. This could be compounded if the dirty water containment system is removed before exposed surface are rehabilitated and runoff arises from these areas.
- Without mitigation, contaminated run-off water generated due to the dismantling and removal of the infrastructure has the potential to enter Streams 1, 2, and 3 as well as the Mambane River, with the slight chance that these contaminants could in turn impact on downstream use in the Komati River (albeit the volume of water associated with such an occurrence would substantially dilute any contaminants contained therein).

- The impacts that the decommissioning process has on the surface water is of a **medium** significance which can be reduced to **low** if the correct mitigation measures are implemented.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ The discard dumps must be sloped, subsoil and topsoil must be replaced and vegetation planted to encourage run-off and minimise infiltration of rainwater which could lead to seepage of polluted water.	Closure cost
▪ Ensure that the diversion berms and dirty water management system are still in place and are functioning adequately to ensure that contaminated water does not mix with unpolluted surface water.	No cost applies
▪ The pollution control dams must remain on site to intercept and collect all contaminated run-off from the discard dumps, and serve as evaporation pans or ponds.	No cost applies
▪ The pits must be backfilled and rehabilitated so that the final topography is relatively smooth and slightly sloped to avoid ponding and to encourage run-off to natural drainage systems.	Closure cost
▪ See also General mitigation measures.	See Section 10

7.5.5. Groundwater

Impact Assessment

- Groundwater levels in the rehabilitated material will begin to rise during decommissioning. During operation, the underground mining areas will be dewatered via the boxcut at the OC2 highwall for access and therefore groundwater levels in the OC2 area will not be able to recover fully until dewatering of the underground area is stopped, and the mining area completely rehabilitated i.e. during decommissioning.
- Numerical modelling simulations show that the water level in the rehabilitated area will not recover sufficiently during the decommissioning phase to allow for significant contamination to migrate away from the opencast area and therefore contamination will be contained in the opencast pit area.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ Undertake and maintain a groundwater monitoring programme.	See Section 11.6

7.5.6. Soil

Impact assessment

The decommissioning and closure phase of the mine will result in:

- The removal of all infrastructure;
- The demolishing of all concrete slabs and ripping of any hard surfaces;
- The backfilling of any open voids and deep foundations and the reconstruction of the required barrier layer (compaction) wherever feasible and possible;
- Topdressing of the disturbed and backfilled areas with the stored "utilizable" soil ready for re-vegetation;
- Fertilization and stabilization of the backfilled materials and final cover materials (soil and vegetation); and
- The landscaping of the replaced soils to be free draining.

These activities, however, will still require the presence of heavy vehicles and machinery and thus the potential for hydrocarbon spills will still exist as well as that of soil compaction. The potential for stockpiled soils to be affected by erosion due to water and/or wind remains until these soils are utilised in surface rehabilitation activities.

The potential for the utilisation of stockpiled soil resources for rehabilitation activities will be determined by the management thereof during the operational phase.

The significance of construction activities on the physical and chemical soil properties is expected to be **high**. The significance hereof can be mitigated by implementation of the following management measures.

Mitigation Measures

In order to minimise and manage the impact on soils a soil utilisation guide should be complied by a soil specialist and be strictly adhered to during decommissioning and rehabilitation. This guide should precisely define the requirements in terms of the location of deployment and the actual layering, fertilising and seeding and should include the following;

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ Stockpiled soil should be used to rehabilitate disturbed sites. The utilizable soil removed during the construction phase, must be redistributed in a manner that achieves an approximate uniform stable thickness consistent with the approved post development end land use, and will attain a free draining surface profile. A minimum layer of 300mm of soil must be replaced.	Closure cost
▪ A representative sampling of the stripped and stockpiled soils must be analysed to determine the nutrient status and chemistry of the utilizable materials. As a minimum the following elements will be tested for: EC, CEC, pH, Ca, Mg, K, Na, P, Zn, Clay% and Organic	See Section 11.7.4

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
Carbon.	
▪ Erosion control measures should be implemented to ensure that the soil is not washed away and that erosion gullies do not develop prior to vegetation establishment.	Closure cost
▪ If soil is polluted, the first management priority is to treat the pollution by means of in situ bioremediation. The acceptability of this option must be verified by an appropriate soils expert and by the local water authority on a case by case basis, before it is implemented. If not possible, contaminated soil should be removed and disposed of at a suitable facility	Cost cannot be prematurely assigned

Rehabilitation activities to this end should be overseen by a soil specialist or a suitably trained individual.

7.5.7. Wetlands

Impact Assessment

- Previous disturbances to the wetland vegetation which occurred during the construction and operational phase, e.g. the vegetation removal; altered runoff regimes; and soil erosion, which affected the growth ability of the remaining vegetation may lead to the invasion and encroachment of exotic plant species until effective rehabilitation measures are implemented. The result of invasive species invasion can lead to habitat changes e.g. increased stream bank instability, and a decrease in water quality. The invasion of exotic species in the area during the decommissioning phase can exert impacts of **medium** significance on the wetland vegetation. The significance hereof can be reduced to **low** if the mitigation measures described hereunder are applied.
- The decommissioning activities may increase the exposed areas through physical removal of surface structures and the inadvertent clearing of vegetation which has not yet regrown or been adequately rehabilitated. These impacts may increase the availability of sediment to wetland ecosystems. The increase in sediment load to the wetland has the potential to smother the habitat, however, the significance of this potential impact is considered to be **low**.
- Oil leaking or spilling from motorised equipment utilised during decommissioning activities, e.g. heavy vehicles removing the infrastructure from the mine site, or the dismantling of the infrastructure can potentially contaminate the wetland vegetation and habitat should these activities occur after the dirty water containment system is removed. The risk of pollution coming into contact with the wetland vegetation in this regard has a **medium** significance which can be reduced to **low** if the mitigation measures described hereunder are applied.
- Dust generation and transportation, due to decommissioning activities such as the clearing of surface infrastructure, disturbance of stockpiled material, backfilling of the final void the

decommissioning phase, can settle on the wetland habitats and lead to an increase in fine-particulate sediments in the water and an increase in potential Electrical Conductivity and Total Dissolved Solids which alter the quality of the water resources associate with the wetland. The generation of dust by the removal of vegetation has a medium impact which can be reduced to low if mitigation measures describe hereunder are applied.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ The rehabilitation plan must include suitable indigenous plant species which must be implemented to represent the vegetation of the area as it was before mining commenced. The land that was cleared must be re-vegetated as quickly as possible.	Closure cost
▪ Any remaining loose sediment, hydrocarbon spills or contamination must be cleaned up immediately and before the dirty water containment system is removed to reduce the risk of the pollutants coming into contact with sensitive wetland vegetation.	
▪ Make allowance for the re-growth of natural wetland vegetation in suitable areas in order to partially address fragmentation of habitat for restoration of landscape connectivity. Sections of land that are struggling to recover must be rehabilitated through the use of seeding programmes.	
▪ See General Mitigation Measures.	Section 10

7.5.8. Soundscape

Impact Assessment

- Vehicle movement on-site will be associated with the transport of personnel, machinery, equipment, rubble and decommissioned infrastructure off-site; this in conjunction with the dismantling of infrastructure and breaking of hard surfaces will incur a localised, short-term impact on the ambient noise levels in the area during the decommissioning phase.
- The significance of the noise impact during the decommissioning phase is predicted to be **low**; mitigation measures are not required.

7.5.9. Traffic

Impact Assessment

- Seeing as coal is no longer transported along this route and the traffic generated due to the transport of dismantled mine infrastructure is quite low, there will not be any real impact on the road surface.
- The only true impacts that will occur during the decommissioning phase pertain to road safety, and even so, these impacts have a **low** rating.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ Ensure that pedestrian safety measures have incorporated such as the use of appropriate safety signage e.g. signs indicating pedestrians at a zebra crossing.	Costs carried by SANRAL
▪ All vehicles are to adhere to the legal speed limits within the mining area and on public road.	No cost applies
▪ Also see General mitigation measures.	See Section 10

7.5.10. Socio-Economic

Impact Assessment

During the decommissioning phase of the development, many employees will be retrenched as downscaling takes place. This negative socio-economic impact is considered to be **high** if mitigation measures are not implemented.

Although the loss of jobs is a negative impact, decommissioning will also result in the process of rehabilitating the land wherever possible to its original sate. The land will be returned to agricultural land and other nuisance impacts such as increased noise levels and dust levels will cease.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ Wherever possible the land should be returned to its original state. As many employees as possible should be provided with permanent skills that may lead to future jobs, and the procedures outlined in the SLP should be adhered to for decommissioning to mitigate the negative impacts on local people.	Closure cost

7.5.11. Visual

Impact Assessment

The dismantling of mine infrastructure and the commencement of rehabilitation towards the closure objectives (12.4) should ultimately result in the land being returned to a state similar to that pre-development of the proposed KaNgwane Anthracite Mine. If rehabilitation is carried out successfully, this positive impact is considered to be high. If rehabilitation however is not successful, then the mine will continue to have a negative impact on the area’s aesthetics.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ The rehabilitation plan and closure objectives should be adhered to in order to ensure that the area is returned wherever possible to its previous state in terms of visual aesthetics.	See Section 12.4

RECEPTOR	PROCESS	IMPACT	MAGNITUDE (M)	DURATION (D)	SCALE (S)	PROBABILITY (P)	SIGNIFICANCE		MITIGATION AND MANAGEMENT MEASURES	MONIORING
							RATING	VALUE		
Air Quality	▪ Vehicle movement on site. ▪ Dismantling of surface infrastructure. ▪ Demolition of hard-standing areas. ▪ Rehabilitation of mining portal.	▪ Dust fallout from vehicle entrainment and materials handling causing a reduction in air quality.	8 [4]	2 [2]	2 [1]	3 [3]	Medium [Low]	36 [21]	Air quality mitigation measures associated with the decommissioning phase in Section 7.5.1.	Implement and maintain air quality monitoring programme in Section 11.1 of the EMP.
		▪ Suspended particulate matter from vehicle tailpipe emissions reducing the air quality.	6 [2]	2 [2]	2 [1]	3 [3]	Medium [Low]	30 [15]		
Terrestrial Ecology	▪ Removal of decommissioned infrastructure, personnel and equipment off site. ▪ The re-establishment of vegetation communities. ▪ Re-establishment of faunal species diversity that may have been reduced during construction	▪ The rehabilitation of vegetation (Positive)	6 [8]	2 [2]	1 [1]	4 [4]	Medium [Medium]	36 [44]	Terrestrial ecology mitigation measures associated with the decommissioning phase in Section 7.5.2	Implement and maintain Terrestrial ecology monitoring programme in Section 11.3 of the EMP
		▪ Increase in numbers of invasive floral species (Negative)	4 [2]	2 [2]	1 [2]	4 [3]	Low [Low]	28 [15]		
		▪ Encourage the return of faunal diversity (Positive)	2 [4]	2 [2]	1 [1]	3 [3]	Low [Low]	15 [21]		

RECEPTOR	PROCESS	IMPACT	MAGNITUDE (M)	DURATION (D)	SCALE (S)	PROBABILITY (P)	SIGNIFICANCE		MITIGATION AND MANAGEMENT MEASURES	MONIORING
							RATING	VALUE		
	and operation.	▪ Hydrocarbon contamination of soil resources (Negative)	2 [1]	2 [2]	1 [1]	2 [1]	Low [Low]	10 [4]		
		▪ Faunal mortalities as a result of vehicle collisions (Negative)	6 [4]	1 [1]	1 [1]	3 [2]	Low [Low]	24 [12]		
Aquatic Ecology	▪ Rehabilitation of mine footprint ▪ Removal of hard surfaces ▪ Reestablishment of natural vegetation	▪ Runoff regime returned to pre-mining regime resulting in the reestablishment of disturbed habitats	2	2	1	3	Low	15	Aquatic Ecology impact mitigation measures associated with the decommissioning phase in Section 7.5.3.	Aquatic Ecology monitoring is detailed in Section 11.4 of the EMP.
		▪ Improved water quality ▪ Increased habitat suitability ▪ Increased aquatic species diversity	2	2	2	1	Low	6		
		▪ Increase in invasive species due to disturbance.	6 [2]	2 [2]	2 [2]	4 [2]	Medium [Low]	40 [12]		

RECEPTOR	PROCESS	IMPACT	MAGNITUDE (M)	DURATION (D)	SCALE (S)	PROBABILITY (P)	SIGNIFICANCE		MITIGATION AND MANAGEMENT MEASURES	MONIORING
							RATING	VALUE		
Surface Water	▪ Dismantling of surface infrastructure	▪ Seepage or surface run-off pollutes aquatic environment	4 [2]	5 [5]	2 [2]	3 [2]	Medium [Low]	33 [18]	Surface water impact mitigation measures associated with the decommissioning phase in Section 7.5.4.	Implement and maintain a surface water monitoring programme in Section 11.5 of the EMP.
Groundwater	▪ Recovery (rebound) of groundwater levels (positive)	▪ Rewatering of the aquifers	6 [6]	4 [4]	2 [2]	5 [5]	High [High]	60 [60]	Groundwater mitigation measures associated with the decommissioning phase in Section 7.5.5.	Implement and maintain groundwater monitoring programme in Section 11.6 of the EMP.
Soil	▪ Disturbance of soils from heavy vehicle movement ▪ Hydrocarbon or chemical spillages ▪ Heavy vehicle movement over soils ▪ Unprotected areas of ground yet to be re-vegetated ▪ Backfilling and	▪ Reduction in soil capability ▪ Increased erosion potential ▪ Disturbance of soil horizons	8 [6]	4 [4]	1 [1]	4 [3]	Medium [Medium]	52 [33]	Soil mitigation measures associated with the decommissioning phase in Section 7.5.6.	Implement and maintain soil monitoring programme in Section 11.7 of the EMP.
		▪ Contamination of soil and reduced soil quality	6 [6]	4 [4]	1 [1]	4 [2]	Medium [Low]	55 [22]		
		▪ Soil Compaction	8 [6]	4 [4]	2 [1]	4 [2]	Medium [Low]	56 [22]		

RECEPTOR	PROCESS	IMPACT	MAGNITUDE (M)	DURATION (D)	SCALE (S)	PROBABILITY (P)	SIGNIFICANCE		MITIGATION AND MANAGEMENT MEASURES	MONIORING
							RATING	VALUE		
	repositioning of soils ▪ Inadequate rehabilitation	▪ Erosion and loss of soil resource	8 [6]	4 [4]	1 [1]	4 [2]	Medium [Low]	52 [22]		
		▪ Loss of resource through contamination and the incorrect order of soil replacement	8 [6]	4 [4]	1 [1]	5 [3]	High [Medium]	65 [33]		
		▪ Loss of resource due to incorrect or inadequate fertilization of replaced soils and vegetation	6 [6]	4 [4]	1 [1]	4 [3]	Medium [Medium]	44 33		
Wetlands	▪ Dismantling of infrastructure may still cause pollution and affect surrounding faunal communities ▪ Spillage of hydrocarbons e.g. due to transport of infrastructure ▪ Removing of infrastructure	▪ Vegetation communities in wetlands still impacted but re-establishing (Positive)	2	3	2	2	Low	14	Wetlands mitigation measures associated with the decommissioning phase in Section 7.5.7.	Implement and maintain wetlands monitoring programme in Section 11.8 of the EMP.
		▪ Disturbances to vegetation can still result in invasion of exotic plants. May cause further habitat changes, e.g. increased bank instability	4 [2]	4 [3]	2 [2]	3 [2]	Medium [Low]	30 [14]		

RECEPTOR	PROCESS	IMPACT	MAGNITUDE (M)	DURATION (D)	SCALE (S)	PROBABILITY (P)	SIGNIFICANCE		MITIGATION AND MANAGEMENT MEASURES	MONIORING
							RATING	VALUE		
	will eventually allow for habitats to recover and faunal species to establish	▪ Sediment loading in wetland decrease due to vegetation re-establishing (Positive)	2	2	2	1	Low	5		
		▪ Oil contamination wetland vegetation	10 [2]	4 [2]	2 [1]	3 [1]	Medium [Low]	48 [5]		
		▪ Re-establishment of faunal communities (Positive)	2	2	1	2	Low	10		
Soundscape	▪ Use of heavy machinery and vehicles during pit rehabilitation ▪ Dismantling of infrastructure and breaking of hard surfaces	▪ Increase in ambient noise levels	2 [2]	2 [2]	2 [2]	4 [3]	Low [Low]	24 [18]	Noise mitigation measures associated with the decommissioning phase in Section 7.5.8.	Implement and maintain noise monitoring programme in Section 11.9 of the EMP.
Traffic	▪ Lower volumes of heavy traffic on road	▪ Negligible impacts on road safety	2	2	1	3	Low	15	See traffic impact mitigation measures associated with the decommissioning phase in Section 7.5.9.	

RECEPTOR	PROCESS	IMPACT	MAGNITUDE (M)	DURATION (D)	SCALE (S)	PROBABILITY (P)	SIGNIFICANCE		MITIGATION AND MANAGEMENT MEASURES	MONIORING
							RATING	VALUE		
Socio-Economic	▪ Retrenchment and downscaling	▪ Loss of permanent employment	10 [8]	4 [4]	3 [3]	5 [4]	High [High]	85 [60]	Details of mitigation measures to reduce negative impacts and increase potential positive impacts on the socio-economic environment are described in Section 7.5.10.	The SLP should be adhered to as well on-going community engagement as described in Section 11.10 of the EMP.
	▪ Land recovery	▪ Post-closure land-use as per closure objective ▪ Cessation of nuisance impacts	6 [8]	5 [5]	2 [2]	3 [4]	Medium [High]	39 [60]		
Visual	▪ Dismantling of infrastructure and rehabilitation	▪ Post-closure land use objective	6 [6]	4 [4]	1 [2]	4 [5]	Medium [High]	44 [60]	A rehabilitation plan should be adhered to (Section 7.5.11).	

7.6. Post-closure Phase

Post-closure is largely associated with long term rehabilitation of the mining area. During this time, the groundwater table re-establishes. Vegetation and faunal communities will begin to re-establish across the rehabilitated footprint of the mining area.

7.6.1. Terrestrial Ecology

Impact Assessment

- Once closure activities on-site have ceased and rehabilitation is complete, vegetation communities will continue to re-establish, thereby increasing suitable habitats which should promote the return of faunal species.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ Ongoing monitoring of the rehabilitated area to monitor re-establishment of the plant and animal species and, identify and eradicate all invasive and alien species. Intervention may be required as deemed necessary dependant on the monitoring outcomes.	See Section 11.3

7.6.2. Surface Water

Impact Assessment

- Once the surface infrastructure has been removed from site, there will be fewer contamination sources for surface water.
- The backfilling of the final void and removal of the dirty water catchment may result in an increase in the run-off received by the surrounding streams due to the components of the KaNgwane Anthracite Mine no longer intercepting the run-off.
- Although the AMD generating potential of the workings at the mine is quite low, the quality of the water may still be affected. The water contains only a fraction of the sulphide material required to drive the AMD process but it is still enough to register when tested for. The concentration hereof, however, is expected to comply with the SANS241 Drinking Water Standards. The impact of the sulphide content on the quality of the surface water is **low**.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ Ensure that adequate monitoring of the quality of the surface water is maintained after decommissioning has taken place.	See Section 11.5

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ If it appears that there is AMD contamination beyond the quantities and qualities modelled, then an adequate management plan will have to be constructed and remediation methods, e.g. adding of lime to the water, will have to be implemented immediately.	Closure cost
▪ See also General mitigation measures.	See Section 10

7.6.3. Groundwater

Impact Assessment

Groundwater Quantity

- In the post mining period groundwater levels in the rehabilitated opencast as well as underground mine areas will continue to recover to near pre-mining levels.
- Simulations suggest that groundwater levels will recover within 20 – 35 years after mining of the underground area stops.
- The long-term impact of mining on the shallow weathered aquifer is presented in Figure 46 and Figure 47 for the times 50 and 100 years after rebound of groundwater levels have stopped respectively.
- It was assumed that the rate of recharge for all areas is 8% of MAP. The decant rate is linked to the rate of recharge and simulations suggests that this would be around 80 m^3/d from each mining areas. It is noted that the rate of decant will fluctuate seasonally and may therefore increase in summer, but dry up during winter.

Groundwater Quality

- Contamination from the discard dump is expected to migrate radially from the dump, due to the above-natural recharge rate. A groundwater mound is expected to form around the discard dump, with contamination moving towards the Mambane stream to the north and east of the site.
- Figure 46 indicates the concentration contours for the weathered aquifer 50 years after groundwater levels have recovered at the operations, that is about 70 to 85 years after mining stops. Under advective transport, contamination will migrate in a northwesterly direction towards the unnamed, non-perennial stream to the northwest of the mining area.
- After 50 years, sulphate concentrations of less than 1 mg/L are expected to reach the stream to the northwest of OC2 within 50 years after groundwater rebound. In the immediate vicinity of the pits, groundwater quality will be very close to the quality of leachate emanating from the rehabilitated pits.
- The concentration gradient 100 years after rebound of groundwater levels, which is around 120 – 135 years after mining ceases, is presented in Figure 47. The figure demonstrates that at this time, sulphate concentrations of around 7 to 8 mg/L will reach the stream to the unnamed, non-perennial stream northwest of OC2.

- Seepage will continue to spread radially away from the discard dump and the carbonaceous overburden dump. Sulphate concentrations in baseflow to the Mambane stream to the north of the discard dump may reach concentrations of around 2 mg/L. At the Mambane stream to the east of the carbonaceous overburden dump sulphate concentrations of around 5 mg/L may reach the stream in the very long-term.
- Figure 48 shows the concentration gradients for the fractured rock aquifer 50 years after groundwater levels rebound. It is expected that sulphate concentrations of around 5 mg/L will migrate through the area within 50 years. The impact of the underground workings after 50 years is expected to be 2 to 5 mg/L sulphate.
- Contamination in the fractured rock aquifer is expected to follow similar trends compared to the weathered aquifer. Contamination gradient plumes presented in Figure 49 shows the impact on the fractured rock aquifer 100 years after groundwater rebound. In this time, contamination from the pits and underground workings is expected to reach the stream to the northwest of OC2. The stream draining along the east of the underground mining area will also be reached in this time. The stream draining along the east of the underground mining area will also be reached in this time. Sulphate concentrations of between 3 and 5 mg/L reach the northwestern stream and between 1 and 3 mg/L the eastern stream in the long-term.

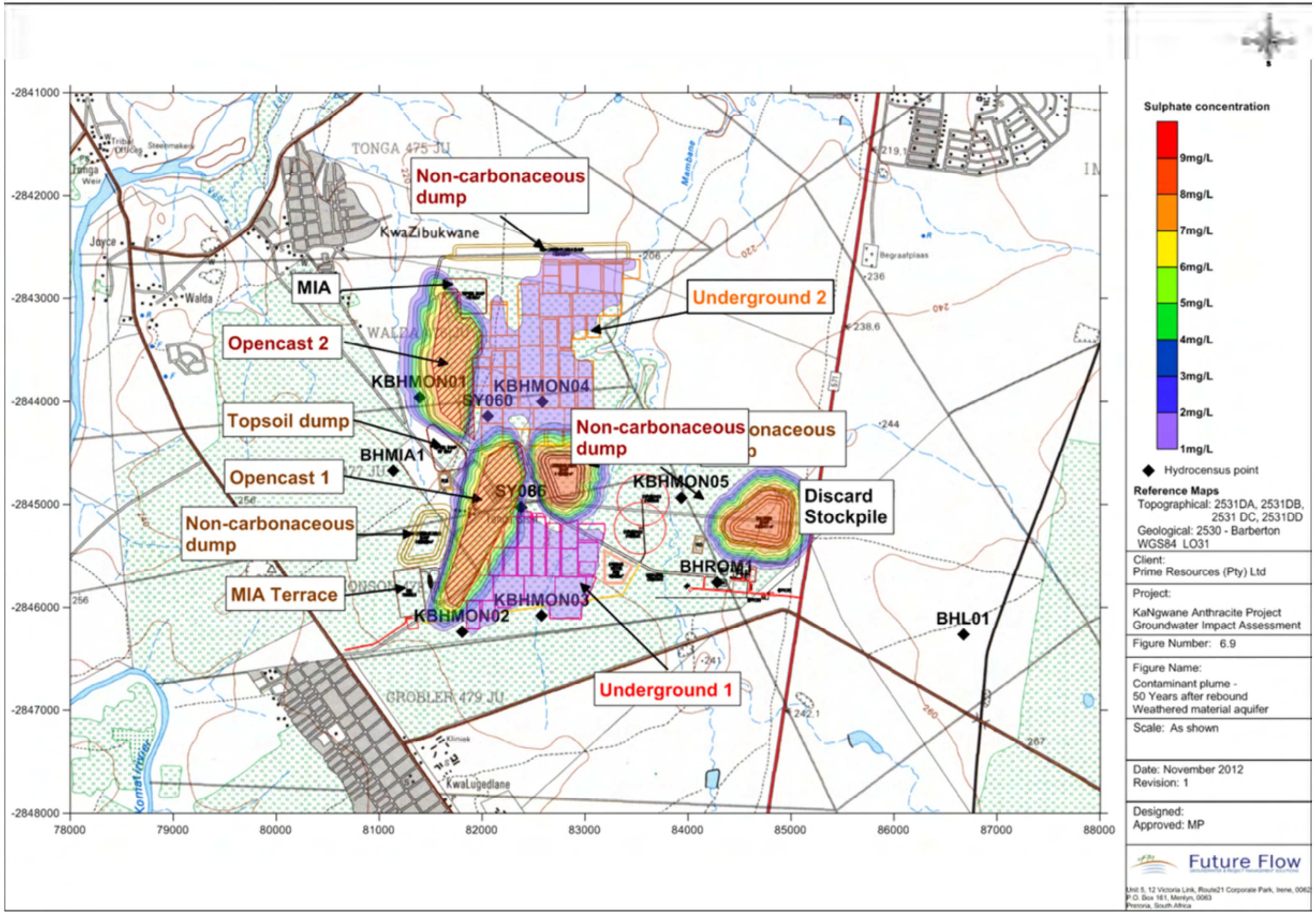

Figure 46: Potential contaminant plume in the weathered material aquifer 50 years after rebound.

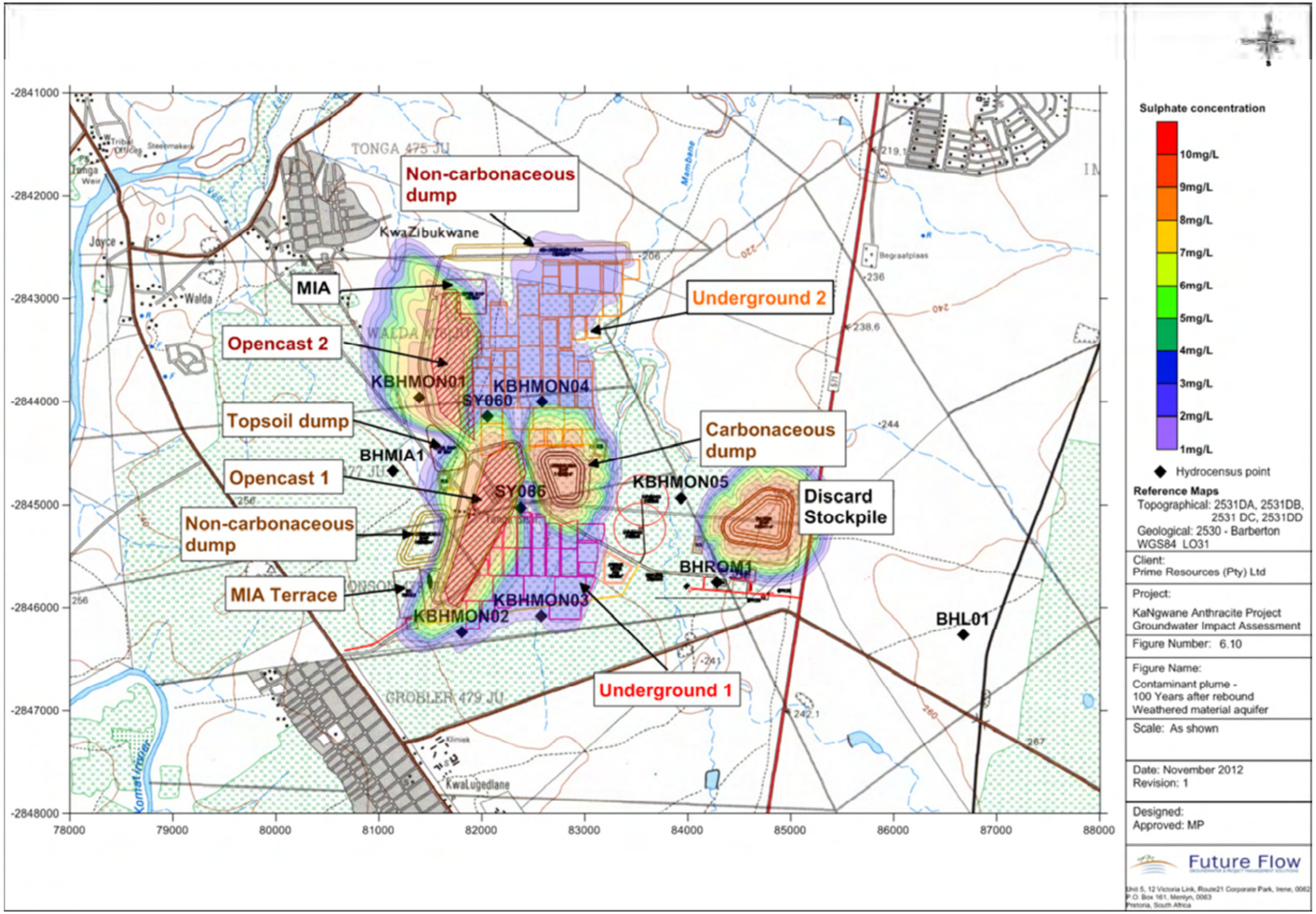

Figure 47: Potential contaminant plume in the weathered material aquifer 100 years after rebound.

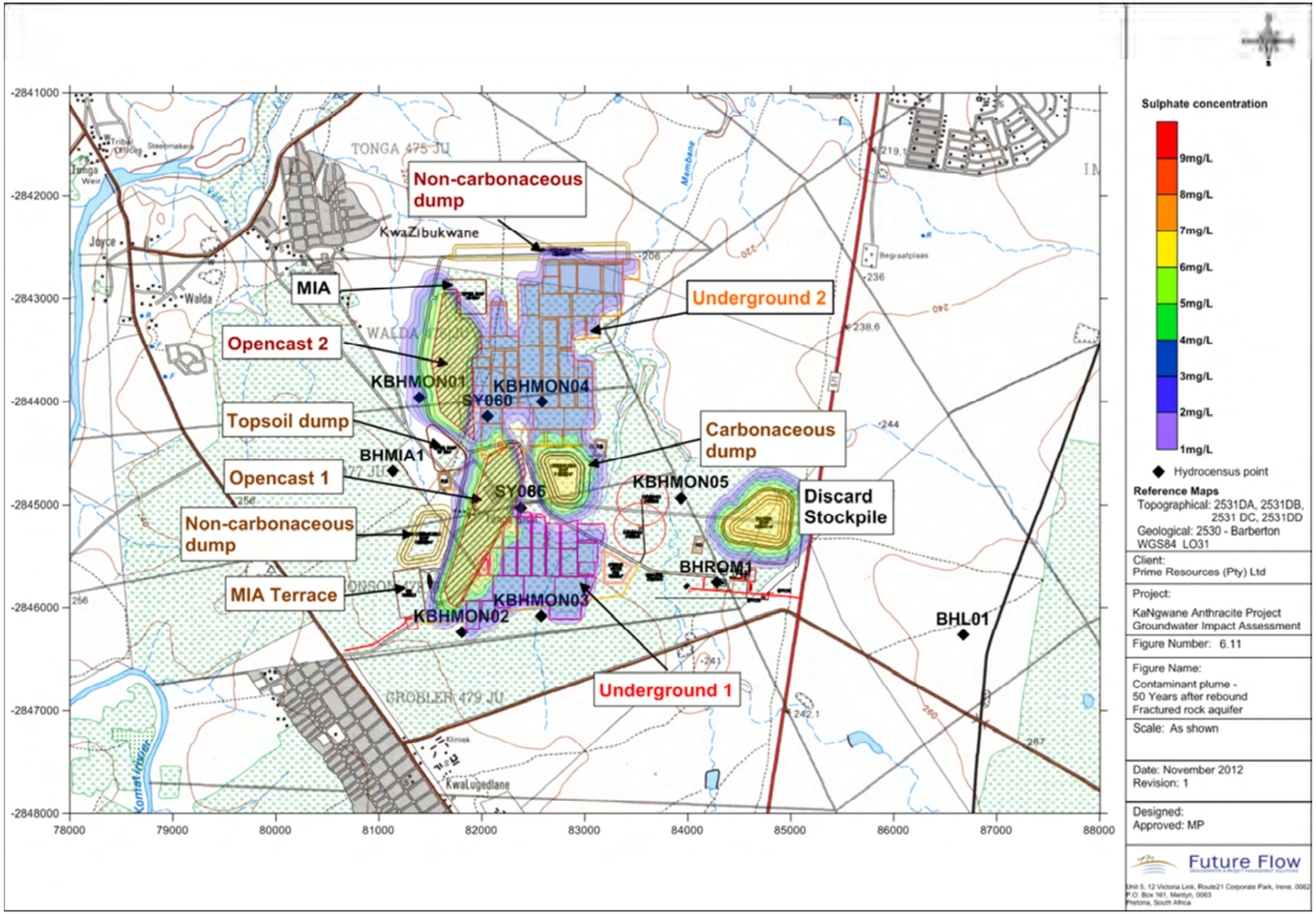

Figure 48: Potential contaminant plume in the fractured rock aquifer 50 years after rebound.

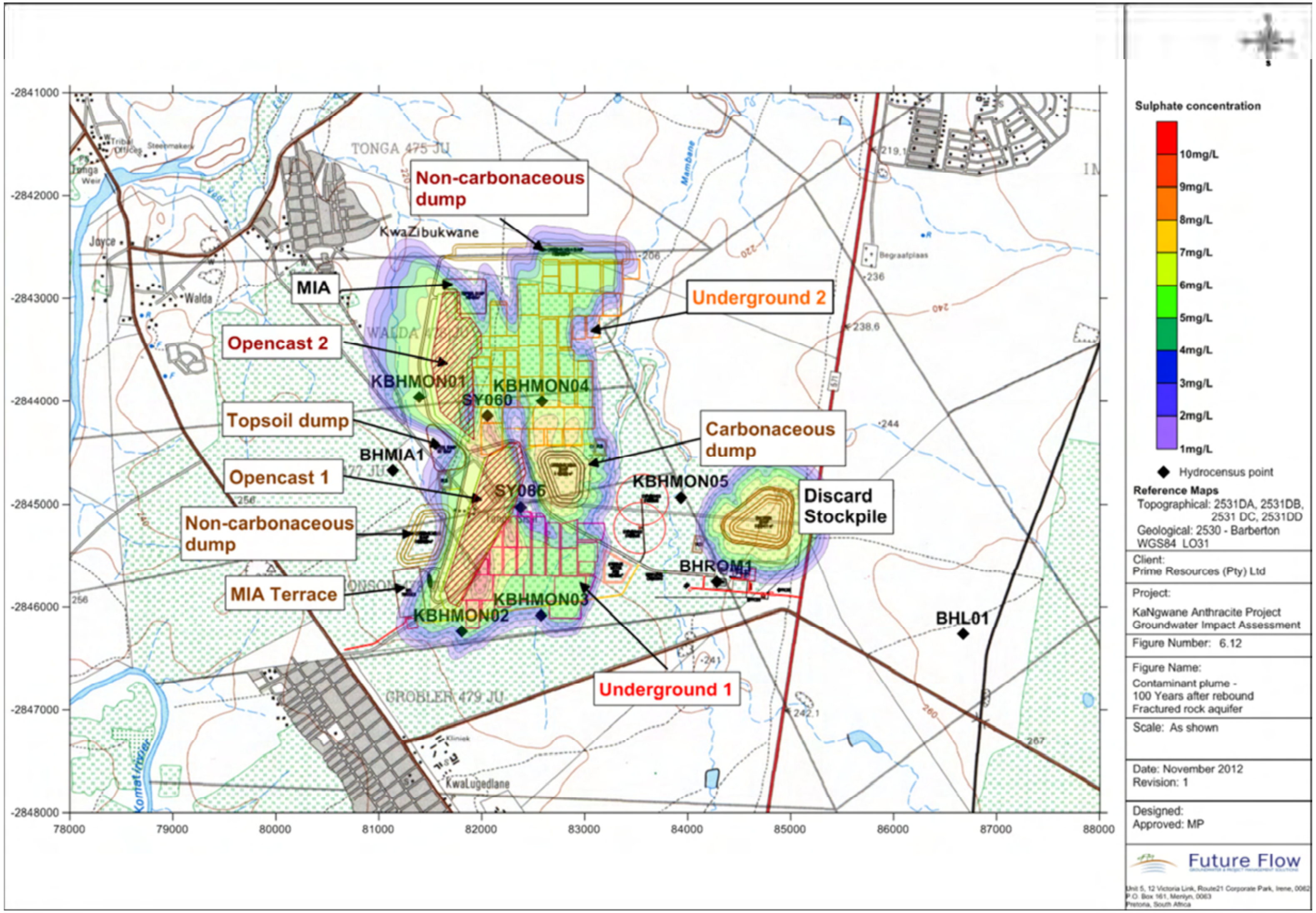

Figure 49: Potential contaminant plume in the fractured rock aquifer 100 years after rebound.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ Decant can be prevented by leaving a final void from which pit water can evaporate.	Closure cost
▪ If pits are completely rehabilitated (no final void), however, the rate of recharge should be reduced through effective vegetation, storm water control and shaping.	Closure cost
▪ Continue groundwater monitoring programme.	See Section 11.6
▪ Consider additional monitoring boreholes at closure, if required.	See Section 11.6

7.6.4. Wetlands

Impact Assessment

- Previous disturbances to the vegetation within the wetland ecosystems due to the activities of the mine may still have residual effects. The vitality of the wetland system may still be weak due to the loss of species diversity from the mining activities and this lowered resistance that the wetland experiences makes it susceptible to the invasion of exotic plant species. The greatest impacts will be experienced by the sensitive riparian and marginal vegetation, however, the significance of the impacts to the wetland systems during the post-closure phase is considered to be **low**.

Mitigation Measures

MANAGEMENT AND MITIGATION MEASURES	APPROXIMATE COST
▪ Ensure any areas that may be still be exposed due to mining activities are re-vegetated before applying for a closure certificate to reduce the levels of sedimentation of affected watercourses in order to reduce the impacts that it will have on the quality of the watercourse and to reduce the impacts of poor water quality on the surrounding area.	Closure cost
▪ Ensure that re-established vegetation communities are maintained to ensure that soil erosion will not take place and that exotic vegetation will not encroach on the wetland and thus reduce the diversity of the vegetation in the area. Appoint a suitably qualified person to follow up on the re-establishment of vegetation in the affected area before applying for a closure certificate.	
▪ See General Mitigation Measures.	See Section 10

RECEPTOR	PROCESS	IMPACT	MAGNITUDE (M)	DURATION (D)	SCALE (S)	PROBABILITY (P)	SIGNIFICANCE		MITIGATION AND MANAGEMENT MEASURES	MONIORING
							RATING	VALUE		
Terrestrial Ecology	▪ Re-establishment of vegetation communities (Positive) ▪ Re-establishment of faunal communities (Positive)	▪ Maintain re-established vegetation communities	2 [4]	2 [5]	1 [1]	4 [4]	Low [Medium]	20 [40]	Terrestrial Ecology mitigation measures associated with the post-closure phase in Section 7.6.1	Maintain the terrestrial ecology monitoring programme in Section 11.3 of the EMP.
		▪ Maintain invasive species control	2 [4]	2 [5]	1 [1]	4 [4]	Low [Medium]	20 [40]		
		▪ Maintain suitable habitat to encourage the return of faunal species diversity that may have been reduced during construction and operation	2 [4]	2 [5]	1 [1]	4 [4]	Low [Medium]	20 [40]		
Surface Water	▪ Groundwater levels rise due to mine ceasing to pump out water	▪ Water decanting from the flooded underground mine voids will affect surface water quality	2	4	2	4	Low	24	Surface water mitigation measures associated with the post-closure phase in Section 7.6.2	Implement and maintain a surface water monitoring programme in Section 11.5 of the EMP.
Groundwater	▪ Decant from rehabilitated pits ▪ Groundwater	▪ Introduction of salts into groundwater and surface water resources	6 [4]	5 [4]	3 [2]	4 [3]	Medium [Medium]	56 [30]	Groundwater mitigation measures associated with the post-closure phase	Implement and maintain groundwater monitoring programme in

RECEPTOR	PROCESS	IMPACT	MAGNITUDE (M)	DURATION (D)	SCALE (S)	PROBABILITY (P)	SIGNIFICANCE		MITIGATION AND MANAGEMENT MEASURES	MONIORING
							RATING	VALUE		
		▪ Migration of groundwater recharge from the mining area into the surrounding aquifers	4 [2]	5 [4]	3 [2]	4 [3]	Medium [Low]	48 [24]	in Section 7.6.3.	Section 11.6 of the EMP.
Wetlands	▪ Re-establishment of vegetation due to cessation of mining activities ▪ Sections of land still possibly cleared due to previous mining activities	▪ Positive effects of the re-establishment of vegetation communities	2	5	2	3	Low	27	Wetlands mitigation measures associated with the post-closure phase in Section 7.6.4.	Implement and maintain wetlands monitoring programme in Section 11.8 of the EMP.
		▪ Decrease in risk of invasion of exotic plant species (Positive)	4	2	2	2	Low	16		
		▪ Reduction sedimentation of watercourses (Positive)	2	2	1	1	Low	5		
		▪ Suitable habitat for species diversity starts to return (Positive)	4	5	2	2	Low	22		

7.7. Cumulative Impacts

7.7.1. Air Quality

The air quality in the area in which the proposed KaNgwane Anthracite Mine is located is affected by various emission sources including biomass burning, household fuel burning, and vehicle tailpipe emissions as well as fugitive dust sources such as agricultural operations, wind erosion and vehicle entrainment. The combined dust fallout and particulate matter emissions from the proposed mining operations, if not mitigated effectively, can serve to further deteriorate the air quality of the project area.

7.7.2. Terrestrial Ecology and Wetlands

The Zululand Lowveld Vegetation Type has a conservation status of vulnerable. The proposed mining development will occur within areas of "Least Concern" or "No Habitat Remaining". There are thus few elements of the original vegetation types still remaining. In addition to this, the majority of the proposed mining activities will take place within current sugar cane fields or fallow land remaining from previous agricultural activities.

The study area has been used extensively for agricultural purposes; overgrazing and subsistence farming have resulted in widespread land degradation. Land degradation compounded with constant human movement through the study area has had an adverse effect on the faunal and floral species diversity of the area. However, there are still some terrestrial habitats which are intact and host an array of bird life (these areas are considered to be of reasonable importance). Additionally, five protected plant species were identified in the study area. It is generally accepted that mining plays a role in reducing the terrestrial biodiversity and species richness of an area (due to land clearance, increased human activity, poaching etc.); mining will exacerbate the adverse impacts which are already prevalent in this stressed environment.

7.7.3. Surface Water

The condition of the surface water of the Komati River in the proximity of the proposed development is currently compliant with all of the SANS 241 standards. The users within the catchment (whether the proposed development, the agricultural industries, settlements and villages) should thus avoid activities which could result in an overall decrease in the surface water quality which could further affect the downstream water uses in Mozambique. The potential for the proposed KaNgwane Anthracite Mine to impact the surface water quality of the Komati River is, however, considered to be minimal.

7.8. Mitigation and Management Costs

Table 25 shows the estimated base rate for the yearly mitigation and management costs throughout the LOM. All figures are in ZAR and based on the date November 2012. This excludes post-closure costing which is accounted for in Section 15.

The following inflation rates were used to estimate future annual management costs, however these are subject to change;

Table 24: Inflation rate used to estimate future management costs.

INFLATION RATE	2014 Y1	2015 Y2	2016 Y3	2017 Y4	2018 Y5	2019 Y6	2020 Y7	LONG TERM	DATA SOURCE
South African CPI	5.40%	6.30%	6.00%	6.00%	5.70%	5.50%	5.50%	**5.50%**	RMB

Table 25: Yearly management and mitigation costs.

MANAGEMENT MEASURE	RECEPTOR	ESTIMATED COST																							TOTAL
		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	YEAR 11	YEAR 12	YEAR 13	YEAR 14	YEAR 15	YEAR 16	YEAR 17	YEAR 18	YEAR 19	YEAR 20	YEAR 21	YEAR 22	YEAR 23	
Plant rescue and relocation plan	Terrestrial Ecology Wetlands	R40000	R42160	R44816	R47505	R50213	R53226	R56153	R59241	R62500	R65937	R69564	R73390	R77426	R81685	R86177	R90917	R95917	R101193	R106759	R112630	R118825	R125360	R132255	R1793849
Alien invasive eradication and monitoring plan	Terrestrial Ecology Aquatic Ecology Wetlands	R50000	R52700	R56020	R59381	R62944	R66721	R70390	R74262	R78346	R82655	R87201	R91998	R97057	R102396	R108027	R113969	R120237	R126850	R133827	R141187	R148953	R157145	R165788	R2248056
Biodiversity Action Plan	Aquatic Ecology	R60000	R63240	R67224	R71258	R75533	R80065	R84469	R89114	R94016	R99186	R104642	R110397	R116469	R122875	R129633	R136763	R144285	R152220	R160592	R169425	R178743	R188574	R198946	R2697667
Tulip plugs	Blasting and Vibrations	R140000	R147560	R156856	R166268	R176244	R186818	R197093	R207933	R219370	R231435	R244164	R257593	R271761	R286708	R302477	R319113	R336664	R355180	R374715	R395325	R417068	R440006	R464207	R6294557
Flyrock monitoring	Blasting and Vibrations	R10000	R10540	R11204	R11876	R12589	R13344	R14078	R14852	R15669	R16531	R17440	R18400	R19411	R20479	R21605	R22794	R24047	R25370	R26765	R28237	R29791	R31429	R33158	R449611
Blasting and Vibration monitoring	Blasting and Vibrations	R250000	R15000	R15945	R16902	R17916	R18991	R20035	R21137	R22300	R23526	R24820	R26185	R27625	R29145	R30748	R32439	R34223	R36105	R38091	R40186	R42396	R44728	R47188	R875633
Heritage Management Plan (once-off fee)	Culture / Heritage	R31000	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R31000
Text excavations (once-off fee)	Culture / Heritage	R93000	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R93000
Chance finds (once-off fee)	Culture / Heritage Socio-economic	R20000	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R20000
Total		R694000	R331200	R352066	R373190	R395438	R419165	R442219	R466541	R492201	R519272	R547831	R577962	R609750	R643286	R678667	R715994	R755374	R796919	R840750	R886991	R935775	R987243	R1041541	R14503374

8. GAP ANALYSIS AND ASSUMPTIONS

8.1. Soundscape

The values measured at operating sites formed the basis of calculations to predict the noise levels at specific locations of interest at the boundaries of the proposed mine. Using the point source and attenuation–by–distance model, the following assumptions were made:

- Noise measurements from opencast activities and loading processes were recorded at an existing mine which is currently operated in a similar manner and with similar equipment and procedures, it is assumed that similar noises will emanate from the activities occurring at the proposed mine.
- The specialist report is an overall assessment designed to predict the collective response of a noise-exposed population and therefore the impact the operation is likely to have on them, and is based on measured and predicted equivalent continuous noise levels according to the relevant SANS code of practice.
- Acoustically hard ground conditions: This assumes that no attenuation due to absorption at the ground level takes place. The effects of frequency-dependant atmospheric absorption were also ignored. Both assumptions represent a worst-case evaluation of the potential noise impact.
- Meteorological conditions: Neutral weather conditions i.e. windless without inversions, and standard conditions of temperature and humidity (20 degrees Celsius and 50% RH) were assumed, representing a neutral evaluation of the noise impact.
- Noise measurements utilised were representative of normal operation and impossible-to-predict (random) single noise events louder than the continuous noise level were not taken into account, although short events that are part of the process, such as the impact noise from material transport and beepers indicating reversing vehicles, for example are fully represented in the measurements (representing a neutral evaluation of the noise impact).
- Ambient noise levels: Measured levels are assumed typical of the environment, representing a neutral evaluation of the noise impact.
- Barrier effect of temporary stockpiles and levees: Because of the highly mobile nature of all operations on the proposed opencast pit, the effects of these temporary structures on the noise climate were ignored, representing a pessimistic evaluation of the potential noise impact.
- Worst case operational noise level assumption: The highest noise level of plant as measured at the operating site was used as the criterion value for the noise predictions at the proposed project, representing a pessimistic evaluation of the potential noise impact.

8.2. Air Quality

The following assumptions and uncertainties regarding air quality were identified:

- No detailed on-site meteorological data was available for the investigation. In the absence of this information, use was made of the simulated data obtained from the dynamic three-dimensional meteorological, PSU/NCAR meso-scale model (known as MM5).
- No measured dust fallout rates or airborne particulate concentrations are available at the KaNgwane Anthracite Mine site to establish a baseline for the project area.
- The quantification of existing sources of emissions are restricted to the proposed KaNgwane Anthracite Mine operations. Although other sources were identified, such sources were not quantified.
- The KaNgwane Anthracite Mine is a proposed operation, and therefore all calculations and simulations were based on design information and layout plans.
- Routine emissions from mining operations were estimated and modelled. This also included drilling and blasting operations, although these are of an intermittent nature. Atmospheric releases occurring as a result of accidents were not accounted for.
- The air quality impact assessment is limited to airborne particulates (including total suspended particulates or TSP, thoracic particulates or particulates with an aerodynamic diameter of 10 micron, i.e. PM_{10} and particulates with an aerodynamic diameter of 2.5 micron, i.e. $PM_{2.5}$). Although the proposed activities would also emit other gaseous pollutants, primarily by haul trucks and mining vehicles, the impact of these compounds was regarded to be low and was omitted.
- The exact locations of all sources within the mining area may change throughout the mine lifetime.
- The dispersion model cannot compute real time impacts. Design maximum processing rates were utilised. Thus even though the nature of the mining operations (active mining areas and smaller roads) change over the life of mine, the proposed open pit mining was modelled to reflect the worst case condition (i.e. resulting in the highest impacts and (or) closest to receptors).
- For the purposes of estimating entrained dust from the dedicated haul road from the opencast operations to the processing plant, it was assumed that the operator would implement a watering programme to minimise vehicle generation fugitive dust. For the purposes of this assessment, it was assumed that the programme is implemented routinely and according to the plan, which would control the emissions by 75%.
- There will always be some error in any geophysical model, but it is desirable to structure the model in such a way to minimise the total error. Nevertheless, dispersion modelling is generally accepted as a necessary and valuable tool in air quality management.

8.3. Terrestrial Ecology

- During the floral assessment a representative number of sites are selected and fifteen randomly selected plots are surveyed at each site, this may not be an accurate representation of the entire study area.

8.4. Blasting

- There are no straightforward methods of assessment of human or livestock response to blast noise which are not based on actual blast event measurements, and no reliable national or international guidelines to accurately predict response to blast noise.
- The nature and magnitude of the response to noise from blasting operations will depend critically on the blasting regime chosen, the nature of the rock to be blasted, the size and depth of the charge, the type of explosive, the local topography, and the detonation sequence.
- Ground vibrations that do not exceed 12.7 mm/s at any building should not result in cosmetic damage to the building.
- The response of livestock to ground vibrations is not well documented locally and/or internationally.
- Air blasts with amplitudes of up to 134 dB should not result in adverse effects to surrounding populations and / or livestock.
- It is not possible to predict air blast reliably, due to the effect of wind, cloud and temperature inversion. Wind direction and velocity can have a large amplifying or damping effect on the levels of air-blast, depending on whether the blast is upwind or downwind of the monitoring position. Cloud and temperature inversion layers can have the effect of reflecting air-blast back down to earth and so amplifying the air-blast levels.

8.5. Groundwater

The accuracy of the numerical groundwater model prepared as part of the geohydrological study depends on the quality of the input data and the available information. Even with an unchanging environment, impacts are difficult to predict with absolute certainty.

Future predictions were calculated with the calibrated model, which is a simplified version of reality. The model represents a tool that can be used to assess the impact of the proposed mining operations on the aquifers and to identify data gaps. The model should be updated and verified as additional monitoring information becomes available.

Aquifer parameters were inferred from existing aquifer tests data. This information cannot provide aquifer characteristics for every fracture, fault, bedding plane or contact zone present. The conceptual numerical models must therefore be updated if additional information becomes available for the project area;

- Aquifer parameters were systematically varied during model calibration to obtain optimal aquifer parameters for simulations. It is recommended that the conceptual and numerical models be updated, if additional hydrogeological and monitoring information becomes available;
- It is assumed that four main sources of pollution will exist within the project area. This assumption is based on available groundwater quality monitoring and geochemical information. These sources include the discard dump, the carbonaceous overburden dump,

the opencast pits and the underground workings. It was assumed that the pollution control dams are lined and would therefore not pose a threat to groundwater contamination;

- Leach testing show sulphate concentrations to be below 10 mg/L for all the sampled lithologies. A starting value of 10 mg/L was assigned to the potential source areas, including pit areas and the surface discard stockpile. No long-term kinetic leach testing was, however, conducted considering the outcomes of the ABA analysis;
- The volume of leachate from the discard and carbonaceous overburden dumps and slimes dams was assumed to be between 10 – 20% of MAP;
- The operational phase of the project was assumed to be from 2013 – 2035, according to the mine plan provided. The long-term impact on groundwater was simulated for a period of 100 years after closure of the operations;
- There are uncertainties regarding the aquifer parameters, including specific yield and the storage coefficient; and uncertainties regarding the groundwater level trends in boreholes BHROM1, KBHMON02 and KBHMON05. This could influence the level of certainty around mine inflow volumes and extent of the zone of influence of the drawdown cone.

8.6. Soil

The technical difficulties with the implementation of a soil utilisation guide often render the implementation of such an exercise financially unfeasible for the Mining Operation. While certain management measures can still be implemented to some degree (such i.e. stockpiling and management thereof), the chemical and physical changes arising during the stripping and storage of soils results in the permanent loss of the soil resource in its original form and the exact rehabilitation thereof to match the pre-mining soil capability becomes impossible. These soils can still, however, be utilised in rehabilitation activities depending on the management thereof during operation.

8.7. Surface Water

It is assumed that the water demand at the KaNgwane Anthracite Mine will be met by sourcing water from the surrounding boreholes and that no water will need to be pumped from the Komati River. Official and accurate meteorological data for any of the quaternary catchments near the study area, which also had a MAP within the same range as that of the study area, could not be obtained. An average rainfall of 614 mm/a had to be derived by using data from the nearest available station

8.8. Traffic

Information on the date when Section 4 (N4) of the coal transport route was built, its design strength and design life, and when it was last rehabilitated was not received from SANRAL. Based on observations it was estimated that the road may have been rehabilitated as recently as 2011 and that it has a design life of 23 years. A traffic study of D2948 (Point J, the west entrance of the mine) was undertaken by Stewart Scott Incorporated in 2009. It was assumed that there have been no major developments to dramatically change traffic movement patterns along the road. It was deemed sufficient by the specialists to use the traffic count information from the 2009 study and apply a constant growth rate.

8.9. Wetlands

The location of the monitoring points is currently assumed based on the assumption that infrastructure will be developed as indicated in the layout plan. The possibility of the monitoring points moving based on the actual positioning of infrastructure constructed thus has to be kept in mind. A representative number of sites are selected during monitoring and fifteen randomly selected plots are surveyed at each site. It is assumed that the monitoring sites will be representative of the conditions in the wetlands.

9. ENVIRONMENTAL IMPACT STATEMENT

The surface water resources at the proposed KaNgwane Anthracite Mine are naturally not of a very high quality due to the underlying geology of the area - the salt load of the Mambane River is quite high, and the salt loads that the mining activities could potentially add to the River will not be of high consequence (refer to discussion of AMD below). The Komati River, which is of a better quality water than the Mambane River, is located further away from the mine than the Mambane River and will not be greatly influenced by the run-off from the mining site. The volumes of surface run-off in the small streams surrounding the mine will not make a difference on the salt load being discharged by the small streams into the Komati River. The design of the dirty water management system has further been validated to have sufficient capacity to manage the volume of water generated in a 50 year flood event of 24-hour duration. All surface infrastructure and opencast mining activities are situated outside the 100-year floodlines of the associated watercourses. The system has also been designed so that all potentially contaminated runoff arising at the Mine will be captured within the series of pollution control dams and re-used. The volume of water to be intercepted by the Mine is, however, negligible in comparison with the greater catchment Mean Annual Runoff.

The aquatic ecology in the surrounding streams and wetlands could potentially be affected by any contaminants arising at the Mine (e.g. hydrocarbons) being introduced into the aquatic ecosystems and wetlands should a failure of the dirty water management system occur. The fauna and flora located around and within the wetlands surrounding the site will likely be affected by the clearing of land. These impacts will be reduced once the mining activities come to a halt and the area is allowed to return to its once normal state through mitigation processes. Alterations in the flow patterns due to the presence of the mine infrastructure and the clean-and-dirty stormwater management system can potentially affect the survival and functioning of the ecology of the wetland.

The groundwater quality of the study area is naturally also of relatively poor quality and associated with high salt loads. The potential impact of Acid Mine Drainage at the proposed KaNgwane Anthracite Mine was calculated to be low in terms of the Acid Base Accounting exercise conducted, which illustrated that the geology is naturally low in sulphur which cannot lead to sustainable acid generation, and that any acid which may arise in the short-term is likely to be neutralised by the high neutralising potential. The dewatering of the mine workings will serve to decrease the volumes of water in the associated aquifers, but not enough to render the hydrocensus borehole identified dry at any point during the LOM. The communities in the area are not dependant on the groundwater for drinking purposes and thus should not be affected by the drawdown of the groundwater. The groundwater levels will recover once mining has ceased over a period of approximately 25 years. The potential long-term groundwater quality associated with recharging groundwater contacting the mine workings and surface infrastructure is anticipated to meet the SANS standard for drinking water.

The loss of topsoil and thus a decrease in the agriculture potential associated with the stripping and stockpiling of topsoil in the area is considered significant during the construction and operational phases of the mine. Adequate rehabilitation will increase the soil's potential for recovery.

10. GENERAL MITIGATION MEASURES

10.1. Handling of Hydrocarbons

The following mitigation measures should be implemented to reduce the impacts on soil, surface water and groundwater resources from oil / lubricants or other hydrocarbon spills:

- All mine and contractor-owned generators will be placed on drip trays to catch all spills and leaks, while all maintenance work on equipment, vehicles, machinery, etc. will be done over a plastic tarpaulin or steel drip trays;
- The servicing of vehicles and equipment will only be permitted at designated areas such as the workshops;
- Ensure that all mechanical equipment and vehicles used during operation are kept in good working order to prevent any leakage of oil, petrol, diesel, hydraulic and other associated fluids;
- Store oils and other lubricants in a bunded storeroom with a capacity of 110%;
- Should an oil spill occur as a result of leaking equipment, machinery or vehicles, it is to be cleaned utilising oil remediation solvents or commercial hydrocarbon spill kits of which the Mine is to maintain a supply on-site;
- Any spillage of hydrocarbons will be reported to the mine Environmental Department;
- Any pumps, machinery or other equipment that require oil, diesel, etc., that are to remain in one position for longer than two days will be placed on drip trays which are to be emptied regularly. Any effluent from the drip trays and any spilled oils and fuels will be collected and stored in 210 litre drums within the service-bay area before being collected and disposed of by a licensed waste removal company;
- Keep spill kits or sorp materials on hand to clean up hazardous of hydrocarbon spills. Once used, this material will be treated as hazardous waste and disposed of accordingly at a permitted hazardous waste site;
- The Environmental Department must keep copies of all disposal certificates on-site.
- A 210 litre drum for the collection of spilled oils and fuels, together with a drip tray to catch spills and leaks before they can contaminate soil and underlying groundwater, must be available on-site at all times;
- Above surface diesel tanks and their associated bund walls will be operated and maintained according to the South African National Standards for the "storage and distribution of petroleum products in above ground bulk installations" (SANS 10089-1:2003, edition 4.1);
- The catchment berms demarcating the dirty water catchment will be maintained at a minimum height of 0.5m to ensure that any spilled hydrocarbons transported by stormwater will not enter areas of accelerated infiltration to underground;
- The contractor(s) supplying fuel and lubricants to the Mine are required to have an emergency management system in place in order to deal with possible vehicle accidents or accidental spillage. This would typically involve emergency teams that would have the capacity to neutralise spills and begin rehabilitation of the affected area within hours;

- Implement a spill response plan and train employees to react efficiently to address any spillage. Large spills of hazardous substances such as oil will initially be controlled by on-site emergency response personnel, who will be aided by professional contractors;
- The mine will monitor the water quality in the clean and dirty water systems as part of their water use license obligations; and
- Soil contaminated with hydrocarbons should be moved to an allocated area where it will be rehabilitated and soil that cannot be rehabilitated should be disposed of at an appropriate landfill site.

10.2. Sewage Treatment

The following mitigation measures should be implemented to reduce the impacts on soil, surface water and groundwater resources from sewage spills:

- The mine will monitor all sewerage infrastructures, if there are blockages or leaks, the mine will repair these within 24 hours; and
- Any spillages from sewerage system will be directed to the mines dirty water system before any contamination of soil, surface water or groundwater resources can occur.

10.3. Handling of General Waste

The following mitigation measures should be implemented to reduce the impacts on soil, surface water and groundwater resources from the incorrect disposal of general waste:

- The mine will ensure that an adequate number of waste drums / bins / skips are available within the storm water berms demarcating the dirty water catchment;
- No waste will be allowed to be buried or burned on site;
- Waste drums / bins / skips will be collected regularly and disposed of by the appointed contractor at the nearest licensed landfill site. Domestic waste includes, but is not limited to plastics, cans, food remains, foil and glass;
- The washing of clothing, lunch dishes or vehicles is prohibited on site, except within specifically demarcated areas (i.e. the wash bay area);
- Where possible, waste will be recycled or re-used (where possible) before disposal is considered. Recyclable material will be collected by a licensed recycling contractor;
- Temporary storage capacity of general waste must be limited to 100 m3. The volumes being temporarily stored should be monitored on a continuous basis and the relevant contractor contacted to clear the temporary facilities on a regular basis or on an ad-hoc basis if it is evident that the facilities are reaching capacity; and
- In such instances, new storage containers should not be placed on-site as this will only serve to increase the storage capacity on-site, thereby requiring a license in terms of NEMWA.
- If, however, it becomes evident that 100 m3 is insufficient capacity, the relevant licensing process must be engaged.

10.4. Handling of Hazardous Waste

The following mitigation measures should be implemented reduce the impacts on soil, surface water and groundwater resources from the incorrect disposal of hazardous waste:

- The mine will comply with the Hazardous Substances Act and apply for the necessary permits from the Department of Health regarding Class I, II & III hazardous substances;
- The mine will comply with the requirements of all Material Safety Data Sheets;
- The bund walls for all storage facilities will have sufficient storage capacity of 110% from the combined storage capacity of the tanks;
- As part of the service level agreement the lamps and batteries will be returned to a reputable supplier who will supply the mine with a safe disposal certificate;
- If no service level agreement can be agreed upon the mine will collect and dispose the batteries and lamps at a suitably licensed landfill site;
- The mine will request a safe disposal certificate that will be kept on-file for the life of the mine;
- Old explosives and the explosives packaging will be dealt with as legally required by industry practice, in an explosive destruction facility;
- Any other hazardous waste generated on-site for disposal will be collected by a licensed hazardous waste contractor for disposal at a licensed landfill site;
- Copies of safe disposal from contractor to be retained on-site;
- Other management measures for hydrocarbon / oily waste as per 10.1 above;
- Temporary storage capacity of hazardous waste must be limited to 35 m3 respectively. The volumes being temporarily stored should be monitored on a continuous basis and the relevant contractor contacted to clear the temporary facilities on a regular basis or on an ad-hoc basis if it is evident that the facilities are reaching capacity;
- In such instances, new storage containers should not be placed on-site as this will only serve to increase the storage capacity on-site, thereby requiring a license in terms of NEMWA; and
- If, however, it becomes evident that 35m3 is insufficient capacity, the relevant licensing process must be engaged.

10.5. Uncontrolled Fires

The following mitigation measures should be implemented to reduce the impacts on air quality and terrestrial ecology from smouldering waste and uncontrolled fires:

- No open fires will be permitted on site;
- No waste will be allowed to be burned on site; and
- Induction sessions for employees and visitors will include fire prevention/ safety precautions, actions and contacts in the event of a fire.

10.6. Stormwater Management

The following mitigation measures should be implemented to reduce the impacts on soil, surface water, and groundwater resources from ineffective stormwater management:

- Separate clean and dirty water. Clean water will be diverted away from dumps, while dirty water will be contained in pollution control dams;
- Pollution control dams will be able to retain a 1:50 year flood event within 24 hours and maintain a freeboard of 0.8 m in accordance with the requirements of GN704;
- Maintain / implement (where necessary) or upgrade measures to separate clean and dirty stormwater;
- Implement measures to minimise dirty water make-up that must to be handled in the water balance e.g. dirty areas will be kept to the minimum size;
- Comply with the surface water monitoring requirements stipulated in the EMP; and
- Ensure that the conditions of the IWWMP are adhered to.

10.7. Erosion Management

The following mitigation measures should be implemented to reduce erosion on site and the associated impacts of erosion on surface water resources:

- A detailed soil utilisation guideline should be investigated which considers and minimises the runoff of sediment;
- The proposed stormwater management system catered for in the design should be implemented as this would prevent sediment runoff;
- The slopes of all dumps must remain compacted and shaped to retain a 1:5 slope;
- Exposed areas on all dumps which have reached capacity must be re-vegetated as far as practicably possible; and
- Contour drains will be maintained to limit erosion and avoid soil losses.

10.8. Topsoil Management

The following mitigation measures should be implemented to reduce the impacts on topsoil from stripping and stockpiling:

- Topsoil from different vegetation communities should be stripped and stockpiled separately;
- Handling of the stripped topsoil should be minimized and vehicle access to stockpiles should be limited;
- Topsoil stock piles must remain at a height to best retain the organic components of the topsoil, therefore maintained at a height lower than 3m;
- Stockpiling should be minimized to periods of 6-12 months to limit deterioration of seed nutrients and soil biota;

- Stockpiles should be seeded with grass or legume mixtures to minimize erosion and loss of beneficial micro-organisms;
- Considering the complexity of the soil resources at the proposed KaNgwane Anthracite Mine, it is recommended that a detailed soil management and utilisation guideline be prepared by a specialist in this field. The implementation thereof should then be carefully monitored;
- All soil stockpiles will be sufficiently maintained to prevent erosion through temporary revegetation and fertiliser application, as well as monitoring / maintaining soil fertility;
- Maintenance of adequate sub-surface drainage should be done to limit the potential for salinisation of the soils and will enhance the arable potential of the soils;
- Ongoing maintenance of stockpiles to monitor re-vegetation and to ensure slopes are kept to less than 1:3; and
- Retaining- and stormwater diversion berms and silt traps at topsoil stockpiles will be maintained to prevent the loss of topsoil.

10.9. Surface Stability

The following mitigation measures should be implemented to reduce the impacts on surface stability from mining operations:

- The pillar strength must be maintained at a level of >1.4;
- Mining practice will be based upon the guidelines for shallow mining as per the Code of Practice to prevent falls of ground and to prevent any subsidence on surface;
- These requirements must be surveyed on a monthly basis;
- Should subsidence occur the incident needs to be investigated and the area rehabilitated. Should agricultural land be affected by surface subsidence, the incident must be investigated and corrective action taken;
- Training of personnel with regard to subsidence;
- Barricade subsided areas - close roads and entrances to subsided areas;
- Monitoring of underground pillars must be conducted;
- Keep excess water away from cavity areas; and
- Additional underground standing support will be used if possible.

10.10. Mine Personnel

The following mitigation measures should be implemented to reduce impacts on terrestrial ecology due to the presence of mine personnel on site:

- No wild animal may under any circumstance be handled, fed, removed or be interfered with by construction workers;
- No wild animal may under any circumstance be hunted, snared, captured, injured or killed. This includes animals perceived to be vermin. Checks of the surrounding natural vegetation must be regularly undertaken to ensure no traps have been set. Any snares or traps found on or adjacent to the site must be removed and disposed of;

- No domesticated animals should be allowed on site;
- No vegetation may be, destroyed or used as fuel; and
- Surrounding natural vegetation should not be disturbed to minimize chances of invasion by alien vegetation.

10.11.Heritage Resources

The following mitigation measures should be implemented to reduce impacts on heritage resources on site:

- The mine will fence and mark all the positions of all known surface heritage resources in the vicinity of the site with signs.
- Heritage resource areas will be "no-go" areas.
- All construction activities will avoid these sites.
- If any unmarked archaeological findings are discovered during activities, the excavation must stop and the ECO must be notified immediately.
- The ECO must then contact the South African Heritage Resources Agency (SAHRA) to investigate the archaeological findings.
- Activities at the unmarked archaeological sensitive area will be allowed to recommence once SAHRA has investigated the site and given their permission to remove the findings and/or to allow the continuation of the proposed operations.

10.11.1. Palaetological Resources

- If construction activities expose extensive mudrocks of the Karoo Supergroup, it will create a unique opportunity to explore the area for fossils.
- It is thus recommended that, should fossils be exposed, a qualified palaeontologist be contacted to assess the exposure of fossils before further development takes place so that the necessary rescue operations can be implemented.
- As important plant fossil localities are known to exist within the Ecca Group, all staff should be educated as to what these fossils may look like so they are able to identify them in chance find situations and inform the ECO to contact a professional palaentologist.
- Depending on the nature of the fossils discovered excavation and removal to a registered palaeontological museum collection may be required. A list of professional palaeontologists is available from SAHRA.

10.12.Socio-Economic Conditions

The following mitigation measures should be implemented to reduce the impacts on socio-economic conditions from mining operations:

- A grievance mechanism will be implemented by the Mine to note all complaints, issues and objections from neighbouring communities; and

- The mine will continually liaise with the community via a site-representative who will be in a position to provide feedback and solutions to issues being raised.

10.13. Road Safety

The following mitigation measures should be implemented to reduce road accidents involving mine vehicles:

- Vehicles will abide by the local speed limits for the area; and
- The Mine will engage any traffic-safety related issue with the relevant roads agency (national, provincial or municipal) and erect appropriate safety signage for road users where public roads are used or crossed by mine vehicles. Appropriate safety signage for road users will also be erected on site.

11. MONITORING AND MANAGEMENT OBJECTIVES OF ENVIRONMENTAL IMPACTS ACCORING TO REGULATION 50 (E) AND (H) GENERAL MITIGATION MEASURES

11.1. Air Quality

11.1.1. Monitoring Programme

Dust Fallout

- Dust fallout monitoring should be carried out using fallout buckets, as stipulated by the SA NEMAQA draft fallout standards (published in May 2011 under Section 32 of NEM:AQA). A fallout bucket should be placed at- and around each of the opencast operations. In total it is recommended that eight fallout buckets be placed around site. The locations of the fallout buckets can be seen in Figure 50.

PM_{10} and $PM_{2.5}$ concentrations

- Monitoring of PM_{10} and $PM_{2.5}$ should be conducted using gravimetric methods.
- A sampler should be placed at the nearest sensitive receptors in terms of mining operations. These are eMangweni (2013-2016), Tonga East (2016-2024) and east of the CHPP (2025 onwards) (Figure 50).

11.1.2. Monitoring Objectives

Dust Fallout

- The monitoring objective is that dust fallout rates at the surrounding sensitive receptors should not exceed 600 mg/m²-day averaged over 30 days as they are residential areas.

PM_{10} and $PM_{2.5}$ concentrations

- Monitoring objectives are that measured particulate matter concentrations at the mine and surrounding sensitive receptors should not exceed SA NAAQS limit values for PM_{10} and $PM_{2.5}$ (Table 26 and Table 27).

Table 26: National air quality standard for inhalable particulates (PM_{10}).

AVERAGING PERIOD	CONCENTRATION (MG/M³)	FREQUENCY OF EXCEEDENCE	COMPLIANCE DATE
24 hours	120	4	Immediate
	75	4	1 January 2015
1 Year	50	0	Immediate
	40	0	1 January 2015

The NAAQS for inhalable particulates (PM_{10}) are given in Table 26. A margin of tolerance of 45 µg/m³ has initially been given to the daily average limit value of 75 µg/m³ for PM_{10}. This margin of tolerance allows existing operations time to develop measures to reduce emissions in those areas already above the limit value. The margin of tolerance is only valid unto the end of 2014, after which the limit value applies. The standard allows 4 exceedances per year of the limit value plus the margin of tolerance. The margin of tolerance for the annual average PM_{10} concentration is 10 µg/m³ and is also valid until end 2014.

Table 27: National air quality standard for fine particulates ($PM_{2.5}$) (reference method for $PM_{2.5}$ as fraction of suspended particulate matter: EN 14907).

AVERAGING PERIOD	CONCENTRATION (MG/M³)	FREQUENCY OF EXCEEDENCE	COMPLIANCE DATE
24 hours	65	4	Immediate to 31 December 2015
	40	4	1 January 2016 to 31 December 2029
	25	4	1 January 2030
1 Year	25	0	Immediate to 31 December 2015
	20	0	1 January 2016 to 31 December 2029
	15	0	1 January 2030

South African $PM_{2.5}$ standards have recently also been published (Government Gazette No. 35463, 29 June 2012). This is given in Table 27. The margin of tolerance of for the daily average is 40 µg/m³ until end 2015 and 15 µg/m³ until end 2029. From 2030, the limit value of 25 µg/m³ applies. As for PM_{10}, the standard allows 4 exceedances per year of the limit value plus the margin of tolerance. Similarly, the margin of tolerance of for the annual average is 10 µg/m³ until end 2015 and 5 µg/m³ until end 2029. From 2030, the annual average limit value of 15 µg/m³ applies.

If the number of exceedances measured at the proposed monitoring sites are higher than that allowed by the National Standards, the mine must take urgent measures to further mitigate emissions until ambient air quality particulate concentrations are brought back into line with the National Standards.

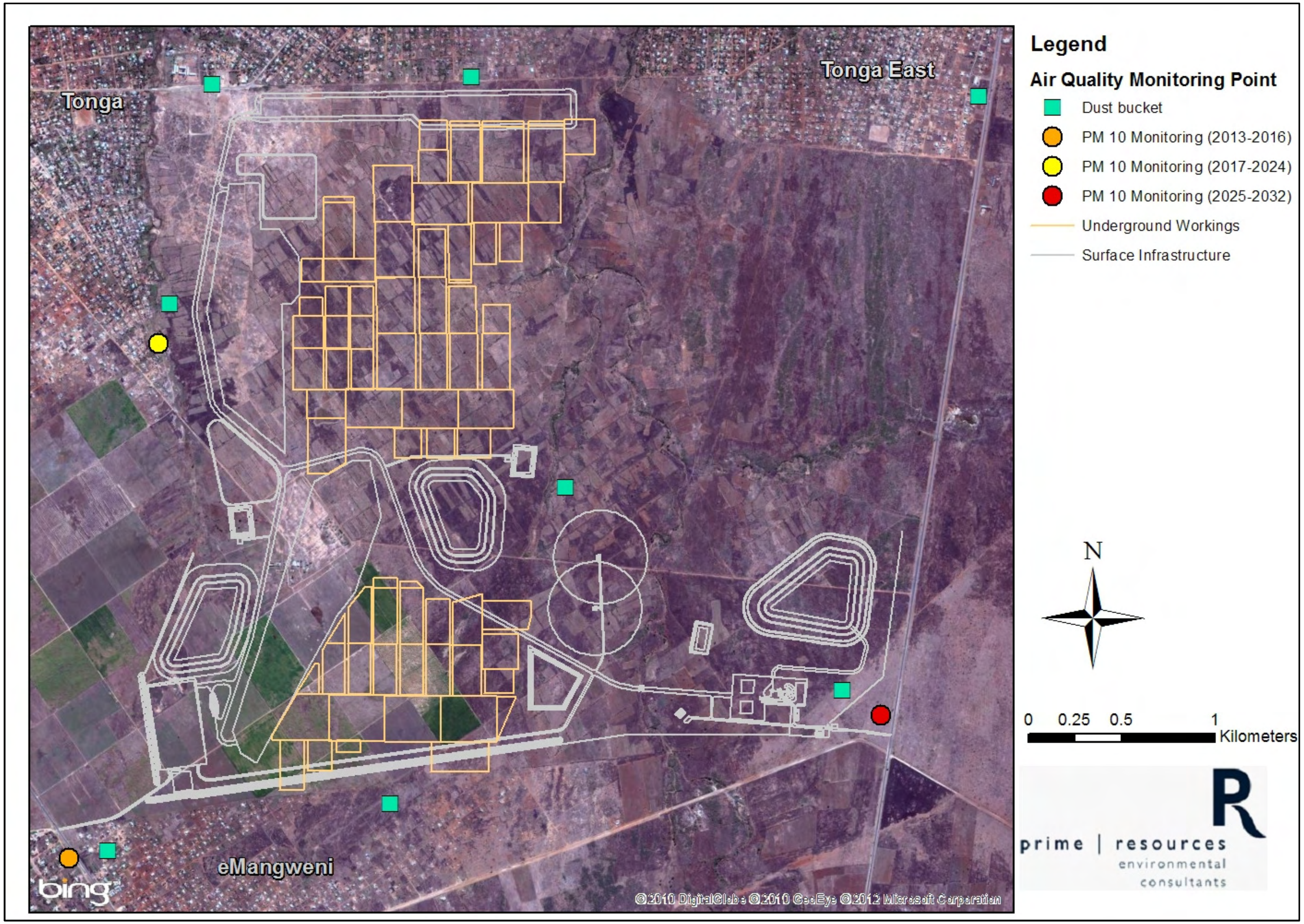

Figure 50: Air quality monitoring locations at the proposed KaNgwane Anthracite Mine.

11.1.3. Monitoring Time Frames

The proposed monitoring network should be installed before the commencement of construction activities to establish a baseline for ambient air quality in the area. Ambient air quality should also be monitored throughout the life of the mine to determine the effectiveness of mitigation measures in place.

Dust Fallout

Dust fallout should be monitored on a monthly basis.

PM_{10} and $PM_{2.5}$ concentrations

Monitoring of PM_{10} and $PM_{2.5}$ monitoring should be conducted intermittently using a sampler which takes a sample every third day.

The results / monitoring data should be reported internally to the ECO who will be responsible to report the findings to the Mine Manager and Management Team on a monthly basis and to the relevant authority (Ehlanzeni District Municipality) on an annual basis.

11.1.4. Responsible Officer

The on-site Environmental Control Officer (ECO) is responsible for appointing a qualified specialist to undertaken monitoring or for undergoing the required training in the sampling techniques and interpretation methods if monitoring will be undertaken in-house. If monitoring objectives are not met, the ECO will be responsible to report the findings to the Mine Manager and Management Team who can then discuss mechanisms to reduce the impact, measure the effectiveness of management measures in place, and where necessary, intervene further. The effectiveness of additional measures will be assessed through further monitoring. The grievance mechanism should also be studied for any reports of excessive dust generation in the community. These reports should be treated similarly to the findings of the ongoing monitoring.

11.1.5. Monitoring Costs

Dust Fallout

The purchase and installation of eight fallout buckets will require a once off payment of R 17 000.00. The gravimetric analysis of samples (monthly) will cost R 35 280.00 per annum.

PM_{10} and $PM_{2.5}$ concentrations

To install the sampler will require a once off payment of R 12 000.00. Annual rental of sampler and gravimetric analysis of samples (sampled every third day) will cost R 76 880.00 per annum.

11.2. Blasting

11.2.1. Monitoring Programme

Monitoring of the seismic and acoustic impact of blasting operations is of utmost importance at blasting operation where there is a risk of damage to any private property which is not owned by the mine. Seismic and acoustic monitoring allows the mine to assess the impact that mining activities are having on the surrounding communities. This allows the mining company to react appropriately by either admitting to the damages caused and settling the claim appropriately, or alternatively by refuting any spurious claims with scientific evidence which suggests that no damages could have been caused by blasting operations.

In view of the fact that there are public and / or private buildings within 200 metres of the proposed mine site it is recommended that seismic / acoustic monitoring stations are installed. BAA (Blast Analysis Africa) have recommended five positions where these monitoring stations should be situated (Refer to Figure 51).

- Station 1 should be placed in the garden of the nearest house south of the south pit;
- Station 2 should be placed in the garden of the nearest house west of the north pit;
- Station 3 should be placed in the garden of the nearest house north of the north pit;
- Station 4 should be placed in the garden in the nearest house east of the north pit; and
- Station 5 should be placed near to the mine offices.

It is important that seismograph stations 1 to 4 are placed in these properties in order to monitor the ground vibrations and air blast to which the houses are being subjected, however, permission to install and access the equipment must be negotiated with the relevant owner first. Placing the seismographs inside the mine security fence will give significantly higher readings than those being experienced by the respective houses and will prejudice the position of the mine (should any dispute arise).

The condition applied to clear all people and livestock within a 500 m radius of the blast is onerous. This process is time consuming and may lead to social disruption. In order to avoid this it is recommended that all blasts be recorded on a suitable HD video camera, the camera will record any fly-rock that may be thrown into the air by any blast. More than one camera may be necessary in order to achieve a full record of all fly rock. These digital videos of blasts must be kept on record by the mine and given a positive reference to the date, time and reference number of the particular blast concerned. After a minimum of ten blasts are fired and shown by the video records to not have thrown any fly-rock beyond the mine boundaries the appointed engineer and the appointee may agree to reduce the radius of the area to be cleared before all subsequent blasts.

11.2.2. Monitoring Objectives

Seismograph stations 1-4 (Figure 51) will record ground vibrations and air blasts for monitoring purposes. The following must be taken into consideration when recordings from the seismographs are interpreted during monitoring:

- If buildings are subjected to ground vibrations which exceed 12.7 mm/s the risk of cosmetic and or damage to buildings increases.
- Air blasts should not record amplitudes greater than 134 dB. Air blast levels greater than 134 dB will cause human irritation which will culminate in complaints.
- All measures should be taken to minimise the amount of air-blast produced by a blast to less than 130 dB in the region of the livestock.
- The present condition (before blasting activities) of the closest housing to the opencast pit(s) should be assessed, if complaints relating to damage to buildings arise this will allow one to establish whether blasting activities are responsible for this damage.
- Ensure that the soft material overlying the hard sandstone is not removed before blasting operations begin.
- The maximum mass of explosives to be used per day must not exceed 140 kg.
- After a minimum of ten (10) HD recorded blasts, both the 3.1 appointee and the qualified engineer supervising the blasts may agree that it has been shown that no blast has thrown fly-rock beyond the mine perimeter fence. At which time the requirement for a 500 metre evacuation radius can be revisited.

Figure 51: Recommended positions of seismograph stations.

11.2.3. Monitoring Time Frames

A report should be prepared every month; this report should be based on the readings derived from the five recommended seismograph stations.

11.2.4. Responsible Officer

- The on-site Environmental Control Officer (ECO) is responsible for appointing the 3.1 appointee or a suitably qualified blast engineer (internal or external) to carry out the monitoring and reporting.
- If these monitoring objectives are not met the blast engineer (or 3.1 appointee) should liaise with the ECO who will have the responsibility of reporting the findings to the mine manager and management team who can then discuss mechanisms to reduce the impact, measure the effectiveness of the management measures which are in place, and where necessary, intervene further. The effectiveness of additional measures will be assessed through further monitoring. A grievance mechanism should be set up by the mine; this allows a channel through which complaints can be directed from the community to the mining company. Once the grievance mechanism is implemented it should be studied for any complaints relating to blasting / vibration activities

11.2.5. Monitoring Costs

Total Capital Cost

The cost per station is R 50 000.00, this cost includes:

- One Numis supergraph seismograph;
- One station housing;
- One solar panel;
- One battery;
- One modem and SIM card;
- One power controller;
- Installation by specialist

It is also recommended that a spare battery be purchased which will be an extra R 2 000.00. The total capital cost will amount to R 252 000.00 (once-off).

Monthly Cost

Monitoring and monthly reporting of blasting events registered on these seismographs by the specialist will cost a further R 3 000.00 per station per month. This cost includes the cost of annual calibration of the seismographs. The total monthly cost will amount to R 15 000.00.

11.3. Terrestrial Ecology

11.3.1. Monitoring Programme

It is necessary to undertake annual monitoring of the footprint of the proposed development to establish the state of the terrestrial ecosystems; this should preferably occur during the months of February or March, at the permanent monitoring sites indicated in Figure 52 (the positions of these sites are provisional, based on the layout plan and should be confirmed once the mining infrastructure has been established). These sites should be suitable to conduct monitoring of both the floral and faunal components. Monitoring should include the following:

Vegetation Biodiversity Monitoring

- Species abundance and distribution: A representative number of sites are selected and fifteen randomly selected plots are surveyed at each site. Abundance of all species within each plot is then recorded in three abundance classes. The survey data are analysed with EstimateS software using the Shannon Index of Diversity in order to assess the floral species diversity or species richness of the vegetation community. Shannon's index accounts for both abundance and evenness of the species present. The proportion of species relative to the total number of species is calculated, and then multiplied by the natural logarithm of this proportion. The value of Shannon diversity is usually found to fall between 1.5 and 3.5 and only rarely it surpasses 4.5 (Khan, 2001). A Shannon Mean Index lower than 2 is regarded as “poor” species diversity, between 2 and 3 as “reasonable” species diversity and higher than 3 is regarded as “good” species diversity. Depending on the complexity of the species occurrence three to four sites can be done per day.
- Standing biomass: Measured with a disk pasture meter at the sampling sites.
- Vegetation structure: Fixed photo-point at each monitoring site.

Small mammal monitoring

Small mammal trapping should be undertaken by means of Willans traps and over a transect containing 20 to 25 traps per transect at each monitoring point. All traps are to be checked each morning and evening. Any specimens trapped are be recorded by means of photography for identification and released or collected and sent to a relevant specialist for identification in the case of species that cannot be reliably identified in the field.

Figure 52: Map indicating the proposed terrestrial monitoring sites in relation to the development footprint.

11.3.2. Monitoring Objectives

<u>Vegetation Biodiversity Monitoring</u>

- Maintain SMI (Shannon Mean Index) equal to that which was evident pre-construction alternatively a SMI of between 2 and 3 (indicating reasonable species diversity) should be maintained.
- Areas not directly affected by construction and mining activities (areas located outside of the development footprint) should not undergo a reduction in standing biomass or vegetation structure.
- Increase the information basis in order to evaluate the effectiveness of existing control actions and any subsequent restoration activity.
- Should the monitoring objectives not be met the monitoring methods should be re-evaluated by the appointed specialist; if need be the specialist should recommend additional management and mitigation measures (such as the implementation of alien species removal and the planting / reseeding of target areas. Offsets may be investigated as a last resort.

<u>Small Mammal Monitoring</u>

- The diversity of small mammal species needs to be maintained; additionally small mammal diversity should return to that of the pre-operational condition
- Should the monitoring objectives not be met the monitoring methods should be re-evaluated by the appointed specialist; if need be the specialist should recommend additional management and mitigation measures (such as the implementation of alien species removal and the planting / reseeding of target areas. Offsets may be investigated as a last resort.

11.3.3. Monitoring Time Frames

Terrestrial ecology monitoring should take place annually, during the months of February or March for the entire life of the operation and for at least five years post-closure.

11.3.4. Responsible Officer

It is suggested that the mine's ECO appoints a suitably qualified specialist service provider with the capacity to conduct the monitoring as indicated to conduct the terrestrial ecology monitoring. Such specialists should be appointed on a 6-month contract basis during construction to undertake any plant and animal relocation or rescue operations which may be required.

11.3.5. Monitoring Costs

The estimated cost of monitoring (for both the floral and faunal components) is approximately R 120 000.00 per annum. The cost of any Floral and Faunal rescue operations during the construction phase can only be determined as construction progresses.

11.4. Aquatic Ecology

11.4.1. Monitoring Programme

The purpose of impact monitoring is to evaluate the seasonal and temporal variation of the selected components of aquatic biodiversity at strategically positioned monitoring sites based on existing bio-monitoring protocols to:

- Establish baseline conditions to include seasonal and temporal variation in the selected components of aquatic biodiversity at strategically positioned monitoring sites;
- Evaluate the potential impact of the proposed development;
- Identify environmental risks;
- Identify relevant standards;
- Increase the information basis to evaluate the effectiveness of existing control actions and any subsequent restoration activities.

A general approach, based on the rapid appraisal methods prescribed by the DWAF in their guidelines for Resource Directed Measures for the Protection of Water Resources, will be utilised. Monitoring will target resident aquatic biota to characterize the existence and severity of impairments in the Komati and Mambane Rivers and to attempt to identify any sources and causes of impairment arising due to the activities at the proposed KaNgwane Anthracite Mine. Some of the aquatic species and taxa that have been recorded in the Komati and Mambane River are considered sensitive to changes in the above-mentioned physical drivers and are expected to respond rapidly to any changes.

Monitoring of aquatic biodiversity

Proposed monitoring sites are shown in Figure 53 and described in Table 28.

Table 28 Details of proposed monitoring sites.

SITE	NAME	DESCRIPTION AND QUATERNARY CATCHMENT	COORDINATES
K1	**Walda Weir**	Perennial river, immediately downstream of Walda Weir selected as upstream control (X13J)	S25.72614 E31.78069
K2	**Tonga Weir.**	Perennial river, downstream of Tonga Weir (X1H003), at existing biomonitoring site, upstream of the confluence with the Lomati River (X13J)	S25.681341 E31.783769
K3	**Elsana Weir**	Perennial, lowland river, immediately downstream of Elsana Weir, at the lower boundary of the study area and downstream of the Mambane confluence. (X13K)	S25,63867 E31.83753
T1	**Unnamed tributary**	Presence of seasonal surface water (X13K)	S25,681341 E31.809084
T2	**Mambane Stream**	Presence of seasonal pools (X13K)	S25.68772 E31.83556
T3	**Mambane Stream**	Presence of more permanent pools (X13K)	S25.68772 E31.83327

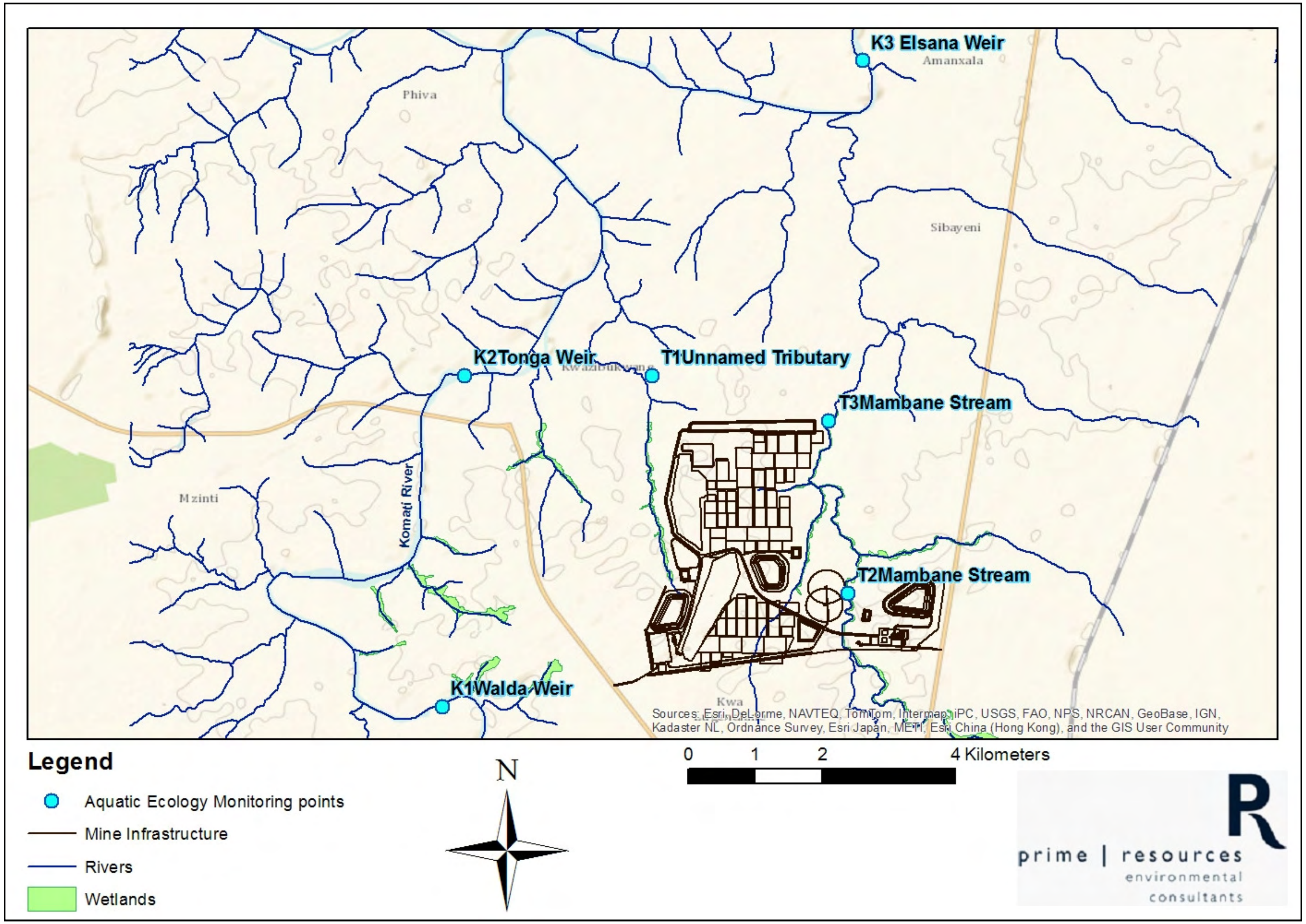

Figure 53: Aquatic Ecology Monitoring sites.

It is suggested that the following Response Indicators be used:

Biotic Indicators

- *Aquatic Invertebrates:* The South African Scoring System Index (SASS5) should be utilised to provide an indication of the biotic integrity of the aquatic environment and will be compared to available and previous SASS data to detect and describe any changes in aquatic ecosystem health.
- *Ichtyofauna (Fish):* The presence and absence of fish species will be evaluated by applying standard protocols and will be evaluated in terms of the response of the fish in terms of possible habitat changes in the river to detect and describe aquatic ecosystem health. The FRAI (Fish Response Assessment Index) is to be used to describe changes in terms of the response of invertebrates in relation to habitat changes.
- *Diatoms:* Diatoms have been shown to be reliable indicators of specific water quality problems such as organic pollution, eutrophication, acidification and metal pollution, as well as for general water quality.

Abiotic Indicators

- *Geomorphology:* Apply the Geomorphologic Assessment Index (GAI Level III version 5) to evaluate the physical structure at each of the determined monitoring points.
- *Water Quality Assessments:* Apply the Physico-Chemical Assessment Index (PAI) to evaluate the physico-chemical changes at the determined monitoring points.

11.4.2. Monitoring Objectives

The baseline biotic and abiotic indicators will serve as monitoring targets throughout the LOM. If during monitoring it is determined that the water quality has deteriorated when compared to the baseline biotic and abiotic indicators, action must be taken. It should be determined whether mitigation measures are being implemented correctly and rectified if this is the cause of the deterioration in water quality. If mitigation measures have been implemented correctly and there is still a deterioration in aquatic habitat, new mitigation strategies need to be investigated.

11.4.3. Monitoring Time Frames

Bi-annual monitoring of waterways should preferably be conducted during drier months (May to October) to represent post-wet (May/June) and post-dry (September/October) conditions at the pre-determined permanent monitoring sites (refer to Figure 53)

11.4.4. Responsible Officer

The on-site Environmental Control Officer (ECO) is responsible for appointing a qualified specialist to undertaken monitoring or for undergoing the required training in the sampling techniques and interpretation methods if monitoring will be undertaken in-house. If monitoring objectives are not met, the ECO will be responsible to report the findings to the Mine Manager and Management Team who can then discuss mechanisms to reduce the impact, measure the effectiveness of management measures in place, and where necessary, intervene further. The effectiveness of additional measures will be assessed through further monitoring. The grievance mechanism should also be studied for any reports of excessive dust generation in the community. These reports should be treated similarly to the findings of the ongoing monitoring.

11.4.5. Monitoring Costs

The estimated cost of the bi-annual waterway monitoring is approximately R 100 000.00 per annum.

11.5. Surface Water

11.5.1. Monitoring Programme

The Komati River drains a large catchment and is representative of a high water quality with a low salt load. In contrast, the small and local Mambane River has a saline character. These two streams are representative of the present state (baseline) of the surface water resources in the region.

The sampling sites shown in Figure 54 are proposed sampling sites that would be sufficient to assess the impact of the mine on the surface water environment. The exact geographic coordinates of the sampling points are given in Table 29. It is recommended that, where possible, the flow in the small streams be estimated during the sampling of the water. In addition to the 3 samples collected from the Komati River as part of the surface water specialist study (Refer to Appendix 3), a fourth sampling site at the weir downstream from the confluence of the Mambane River with the Komati River has been added. This last sample can be used to assess the impact from the Mambane River on the Komati River (if any). Two additional sampling sites in Stream 3, i.e. the stream draining the western side of the mine, have been added.

Table 29: The coordinates of the surface water sampling monitoring points

SAMPLING POINT	LATITUDE	LONGITUDE
Komati 4	-25.63850	31.83787
Komati 3	-25.63620	31.79668
Komati 2	-25.68214	31.78182
Komati 1	-25.72526	31.78081
Mambane Down	-25.66832	31.83745
Mambane Up	-25.72141	31.84000
Stream 3A	-25.68752	31.80864
Stream 3B	-25.67717	31.80066

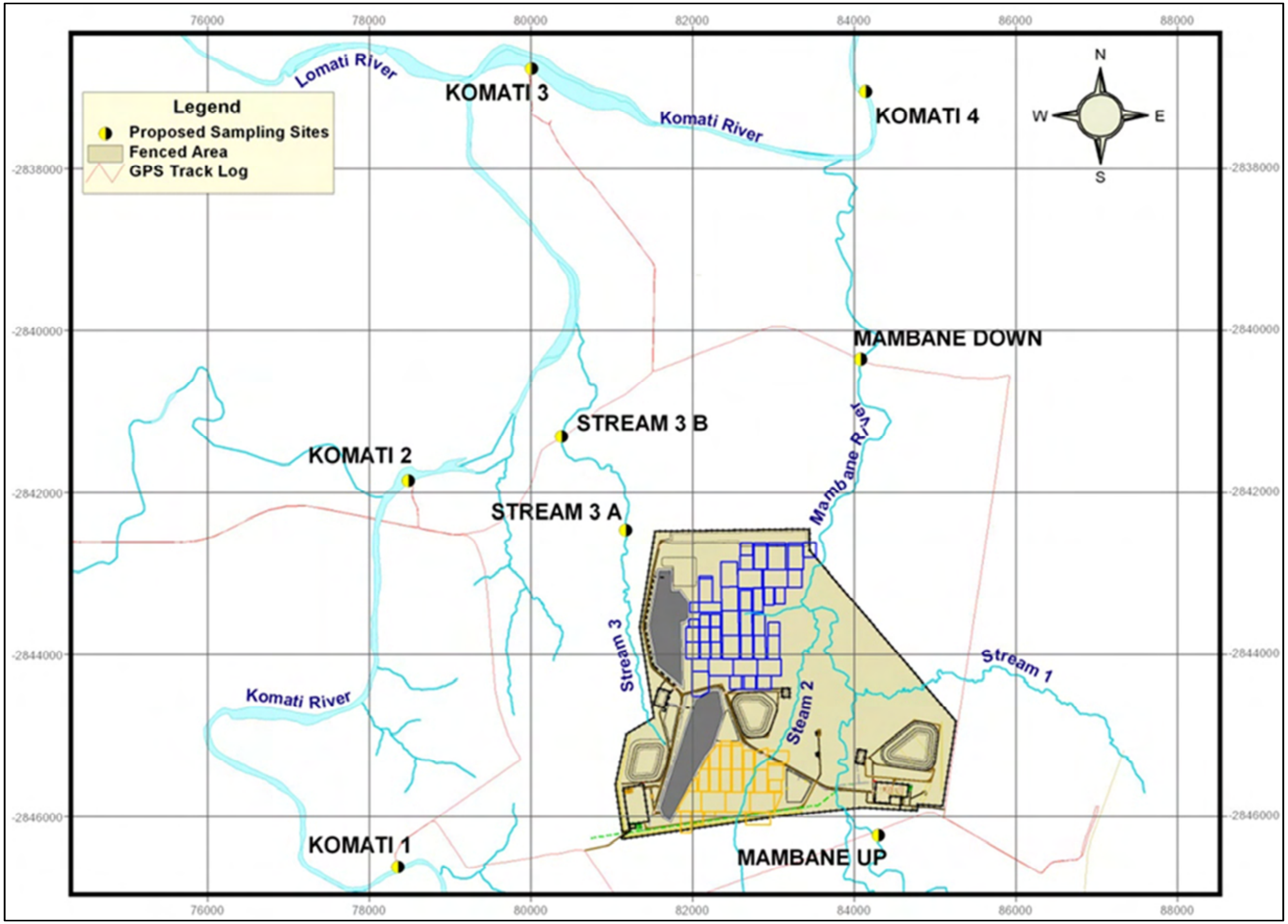

Figure 54: The layout of the various surface water monitoring sites

From an environmental monitoring perspective, an analytical laboratory with SANAS accreditation for at least the major cations and anions and other determinants normally associated with coal mining, should carry out the following minimum analyses every month**:**

- Suspended Solids
- Total Alkalinity
- pH
- EC
- Na^+
- K^+
- Ca^{2+}
- Mg^{2+}
- NO_3^-
- Cl^-
- SO_4^{2-}

It is unlikely that it would ever become necessary to discharge water off the mine. In the case of an accidental spillage or in the event of a storm with a return period of more than 50 years, the mine will have a written engineering procedure on how to handle the incident. The procedure will define the actions that will be taken to identify, sample, contain, actions taken to mitigate, re-sampling and close out procedure of the incident.

Regular inspections of the mining site after rainfall has occurred must be conducted to identify any breach in the storm water conduits. Regular maintenance of the storm water canal system must be conducted in such a manner as to guarantee the serviceability of such conveyances for flows up to and including those arising as a result of a flood with a recurrence of once in 50 years. The visual inspection of the mining site after rainstorms is required, specifically to identify erosion channels that were created due to surface run-off.

Automatic control gear will ensure that pumps are started timeously to transfer water in the pollution control dams to the large mine water dam before the minimum freeboard in the pollution control dam is reached. A visual inspection of dams and silt traps must be conducted after rainstorms. Breaches in any of the dams must be recorded and methods to ameliorate the problem must be proposed.

11.5.2. Monitoring Objectives

The quality of the Komati River is currently very high. The monitoring of the Komati River points will indicate whether the mining operations have any effect on the quality of water flowing in the River. The aim should be to keep the current quality of the water in the River as it is throughout the LOM. If it appears that the mining activities are having an impact on the quality of the water, then investigations have to be made to determine whether contaminated water is escaping from the pollution control dams or the discard dump or pollution such as hydrocarbons, grease, oils, etc are being spilled onsite and coming into contact with the Komati River.

The presence of heavy metals, dissolved solids, the levels of alkalinity, conductivity etc. should be monitored. The aim should be have the levels in Stream 1, 2, 3, the Mambane River as well as the Komati River comply with the South African National Standard (SANS) 241:2011 which is the official drinking water standard in South Africa. Refer to Table 15 for a comparison of the current standard of water measured at the various monitoring points.

Although the risk of AMD being generated at the KaNgwane Anthracite Mine is very low, monitoring should still be done to determine if the levels of sulphate in the surface are kept low enough not to generate AMD. The objective should be to keep the sulphate levels from escalating to the point where AMD is generated.

11.5.3. Monitoring Time Frames

In addition to the above monthly chemical analysis samples for cations, anions and other determinants, a full spectrum ICP-MS (Inductively Coupled Plasma-Mass Spectrometry) scan should also be conducted twice a year, once during the rainy season and once during the dry season, preferably during July and January, respectively. The ICP-MS is used to determine the elemental content of samples and will determine the concentrations of all of the metals present in the water.

Samples must be collected and recorded on a monthly basis and reports must be compiled and submitted to DWA annually. The first should be a summary report, briefly describing the first 6-month period water quality in all surface streams/rivers and should be done once the July analyses results are available each year. The second report should be done after the January sample results are available from the laboratory each year and must include a comprehensive discussion on the surface water quality of the streams around the mine, identifying any impacts from the mine and also discussing trends, if any are discernible. Usually trends will only be noticed after 3 or more years of sampling.

11.5.4. Responsible Officer

The on-site Environmental Control Officer (ECO) is responsible for the sampling and as well as responsible for appointing an independent agency who will interpret the monitoring data.

11.5.5. Monitoring Costs

If mine personnel collect the samples and deliver them to a laboratory, the cost of the surface water sampling programme and production of reports should be approximately R 75 000.00 per annum. This amount includes the laboratory costs and an interpretation and bi-annual report by a professional aquatic scientist, but excludes the travel and collection/delivery of the samples.

11.6. Groundwater

11.6.1. Monitoring Programme

Monitoring of groundwater levels and rainfall will be required to verify the current specialist simulation results. Groundwater monitoring is undertaken to establish the following:

- The impact of mine dewatering on the surrounding aquifers. This is achieved through monitoring of groundwater levels in boreholes;
- Groundwater inflow into the pits and underground workings. This is achieved through monitoring of groundwater levels in the monitoring boreholes as well as metering underground flow volumes;
- Impact of mining and mineral processing on groundwater quality.

It is recommended that groundwater monitoring is undertaken according to SANS and DWA requirements as detailed in Table 30 below (see Figure 21);

Table 30: Proposed monitoring programme.

MONITORING POSITION	SAMPLING INTERVAL	ANALYSIS	WATER QUALITY STANDARDS
CONSTRUCTION PHASE			
Mine monitoring boreholes	Quarterly (April, July, Oct, Jan)	Full chemical analysis to be finalised.	SANS: Class I DWA WQ Standards: Potable
Mine monitoring boreholes	Monthly	Groundwater levels	Not applicable
Hydrocensus boreholes	Bi-Annually (April, Oct)	Full chemical analysis	SANS: Class I DWA WQ Standards: Potable
Hydrocensus boreholes	Quarterly	Groundwater levels	Not applicable
Rainfall	Daily at the mine	No analysis	Not Applicable
OPERATIONAL PHASE			
Mine monitoring boreholes	Quarterly (April, July, Oct, Jan)	Full chemical analysis to be finalised.	SANS: Class I DWA WQ Standards: Potable
Mine monitoring boreholes	Quarterly	Groundwater levels	Not applicable
Hydrocensus boreholes	Bi-Annually (April, Oct)	Full chemical analysis	SANS: Class I DWA WQ Standards: Potable
Hydrocensus boreholes	Quarterly	Groundwater levels	Not applicable
Rainfall	Daily at the mine	No analysis	Not Applicable
DECOMMISSIONING PHASE			
Mine monitoring boreholes	Monthly (April, July, Oct, Jan)	Full chemical analysis to be finalised Groundwater levels	SANS: Class I DWA WQ Standards: Potable
Hydrocensus boreholes	Quarterly (April, Oct)	Full chemical analysis Groundwater level	SANS: Class I DWA WQ Standards: Potable
POST-CLOSURE PHASE FOR 2 YEARS AFTER MINING CEASES			
Mine monitoring boreholes	Quarterly (April, July, Oct, Jan)	Full chemical analysis to be finalised Groundwater levels	SANS: Class I DWA WQ Standards: Potable
Hydrocensus boreholes	Bi-Annually	Full chemical analysis	SANS: Class I

MONITORING POSITION	SAMPLING INTERVAL	ANALYSIS	WATER QUALITY STANDARDS
	(April, Oct)	Groundwater level	DWA WQ Standards: Potable
Rainfall	Daily at the mine	No analysis	Not Applicable

The numerical model used to determine the impact of the mine on groundwater must be updated on a 2 yearly basis as additional monitoring information becomes available. This will provide a platform for including changes in mining, processing or waste deposition at the operations into the numerical model, when such changes occur. In this way, all impact predictions will proceed to the level of detail required for mine closure, at least five years before planned mine closure.

11.6.2. Monitoring Time Frames

It is recommended that groundwater levels are monitored on a monthly basis and rainfall on a daily basis. In order to monitor groundwater quality groundwater monitoring from monitoring boreholes must be undertaken on as per Table 30 above.

The mine must further develop a groundwater-monitoring database that will be updated on a monthly basis as information becomes available. The database will be used to analyse the information and evaluate trends noted. An annual compliance report must be compiled and submitted to the authorities for evaluation and comment. The mine must develop a monitoring response protocol to establish procedures in the event that groundwater-monitoring information indicates that action is required.

11.6.3. Responsible Officer

The on-site ECO is responsible for conducting the groundwater monitoring and collecting groundwater samples however a geohydrologist should be appointed to interpret the data.

11.6.4. Monitoring Costs

Monthly construction monitoring costs are estimated at R 330 000.00 per annum while quarterly operational monitoring costs are estimated to be R 260 000.00 per annum. Decommissioning post-closure monitoring costs are estimated at R 150 000.00 per annum.

11.7. Soil

11.7.1. Monitoring Programme

The soil utilisation guide (discussed in Section 7.3.7 of the EIA) should include recommended monitoring measures to be undertaken during the life of operation and more specifically during rehabilitation. This guide should at least consider and further detail the following monitoring measures;

- In order to ensure stockpiles do not become nutrient deficient on-going evaluation of the nutrient status of the growth medium will be needed throughout the life of the project and into the rehabilitation phase.
- During the rehabilitation exercise preliminary soil quality monitoring should be carried out to accurately determine the fertilizer requirements that will be needed. Additional soil sampling should also be carried out annually until the levels of nutrients, specifically magnesium, phosphorus and potassium, are at the required levels for sustainable growth. Once the desired nutritional status has been achieved, it is recommended that the interval between sampling is increased.
- An annual environmental audit should be undertaken. If growth problems develop, ad hoc, sampling should be carried out to determine the problem.
- Monitoring should always be carried out at the same time of the year and at least six weeks after the last application of fertilizer.
- Soils should be sampled and analysed for the following parameters:
  - pH (H_2O);
  - Phosphorus (Bray I);
  - Electrical conductivity;
  - Calcium mg/kg;
  - Cation exchange capacity;
  - Sodium mg/kg;
  - Magnesium mg/kg;
  - Potassium mg/kg;
  - Zinc mg/kg;
  - Clay; and
  - Organic matter content (C %).

The following maintenance is recommended:

- The area must be fenced, and all animals kept off the area until the vegetation is self-sustaining;
- Newly seeded/planted areas must be protected against compaction and erosion (Vetiver hedges etc.);
- Traffic should be limited were possible while the vegetation is establishing itself;
- Plants should be watered and weeded as required on a regular and managed basis were possible and practical;
- Check for pests and diseases at least once every two weeks and treat if necessary;
- Replace unhealthy or dead plant material;
- Fertilise, hydro seeded and grassed areas soon after germination;
- Repair any damage caused by erosion, bulking, cracking or subsidence, and
- Backfilling and landscaping of areas of ponding to be free draining.

11.7.2. Monitoring Time Frames

As discussed above, soil monitoring should be undertaken annually until the desired nutritional status has been achieved. The interval between sampling should then be increased to ensure this status is maintained.

An annual environmental audit should also be undertaken to ensure problems are identified and mitigation timeously.

11.7.3. Responsible Officer

The ECO should ensure a soil specialist is employed to undertake soil monitoring.

11.7.4. Monitoring Costs

As mentioned in Section 7.3.7 of the EIA the implementation of a soil utilisation guide is often costly to undertake however the annual soil monitoring is estimated at R 50 000.00 per annum.

11.8. Wetlands

11.8.1. Monitoring Programme

Monitoring of the wetlands should be conducted throughout all of the phases of the mine. This has to be done to determine the effects of the mining activities on the wetland ecology. Figure 55 indicates the proposed locations of the monitoring points.

The monitoring of the wetlands should include:

- Species abundance and distribution monitoring: A representative number of sites are to be selected and fifteen randomly selected plots surveyed at each site. Abundance of all species within each plot is then recorded in three abundance classes. Depending on the complexity of the species occurrence, three to four sites can be done per day. This determines the composition of the fauna found in the wetlands areas. The number of species and the abundance of the individual species will help to determine the ecological health of the wetland. Exotic species composition in the wetland habitat must be noted and targeted for eradication as part of the alien invasive vegetation removal strategy.
- Vegetation structure monitoring: Determine the composition of the vegetation structure and assess whether exotic species have encroached on the indigenous vegetation. Ensure that the monitoring sites are fixed photo-points. The composition of the vegetation in the wetland will help determine to what degree the wetland has been impacted or whether the wetland health is being sustained.
- Riparian Vegetation Response Assessments (VEGRAI) are be conducted to determine whether the proposed mining activities are exerting an impact upon the riparian vegetation of the wetlands (results will illustrate whether the riparian habitat is being affected by the

proposed mining operations or whether the proposed mining activities are located far enough away from the riparian vegetation to not exert any real impact).

- Water Quality assessments have to be conducted to determine if the mining activities are affecting the quality of the water in the wetland e.g. increase in sedimentation levels due to soil erosion. This should include a determination of the sediment loads in both the adjacent and downstream wetland ecosystems. The surface water quality monitoring programme is discussed in Section 11.5.1.

The locations for the proposed monitoring points are in Table 31

Table 31: Location of proposed surface water monitoring sites.

MONITORING SITE	LATITUDE	LONGITUDE
RIPARIAN MONITORING		
W01	-25.70978143	31.83511097
W02	-25.69263121	31.83174351
W03	-25.70047875	31.83162743
MONITORING SITE	**LATITUDE**	**LONGITUDE**
WETLAND MONITORING		
W04	-25.70762901	31.81084337
W05	-25.70409356	31.81028597
W06	-25.69019645	31.80861514

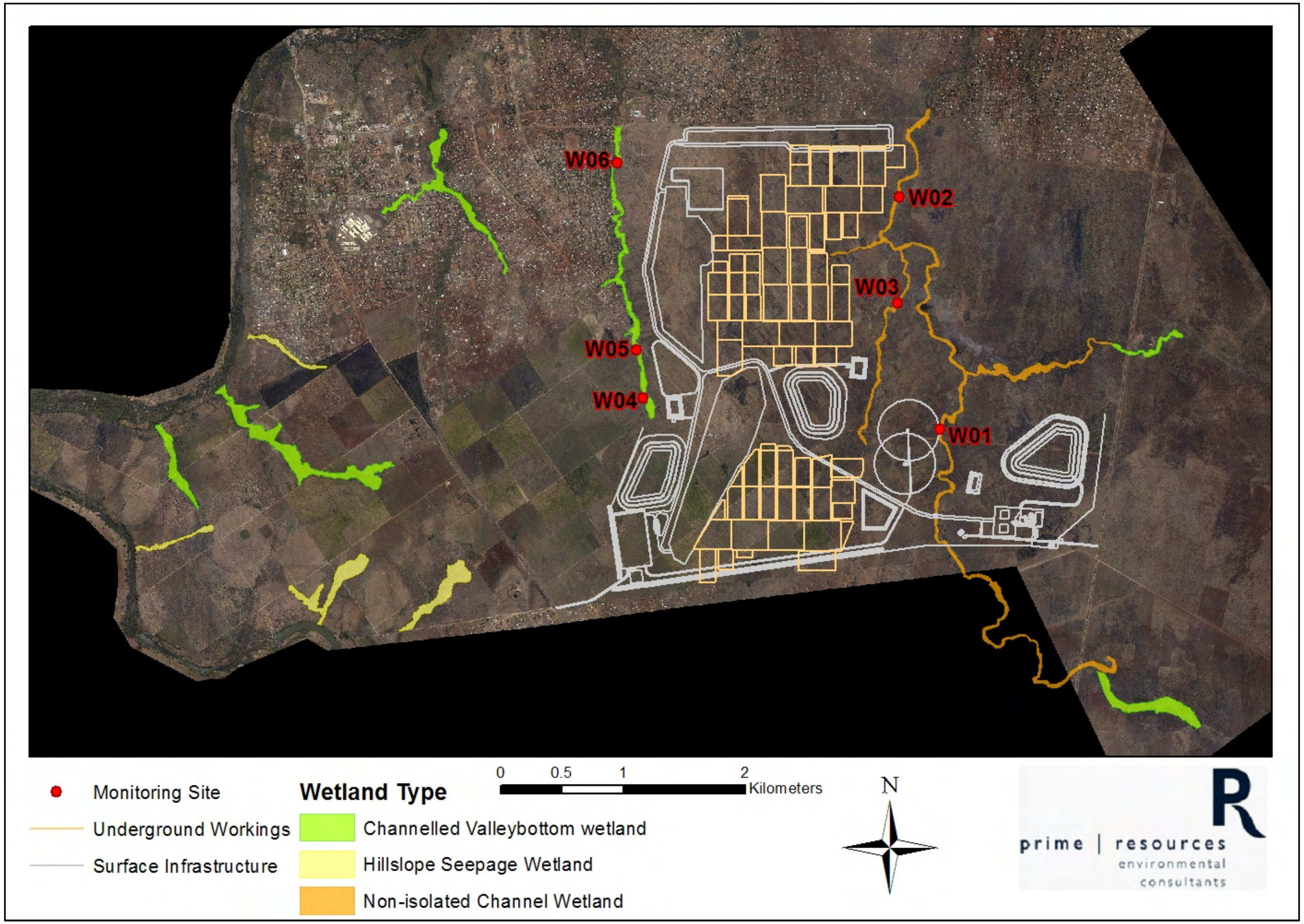

Figure 55: Map indicating the proposed wetland monitoring sites in relation to the development footprint.

11.8.2. Monitoring Objectives

The objectives of the species abundance monitoring are to determine the intricacy of the composition of the wetland at that given point in time (i.e. a simplified wetland ecosystem would arise due to the excessive clearance of wetland vegetation species). The target should thus be to maintain a sufficiently intricate wetland system as this will have a higher chance of being rehabilitated at closure than an overly simplified system. If the system has been severely simplified, the intervention would be to implement a seeding programme or the application of suitable indigenous species of important vegetation from the nursery stock (as suggested by the mitigation methods in Section 7.3.8).

The objective of the monitoring of invasive species in the wetlands habitat is determine whether all of the invasive species have been eradicated and if not, what percentage of the vegetation they make up and whether it is posing a threat to the indigenous vegetation. The target for monitoring should be the complete eradication of all alien invasive species within the monitored wetland systems. Where targets aren’t met, the intervention required is the removal of alien invasive species as per the eradication plan described in the management measures in Section 10.

The monitoring objectives in terms of surface water quality monitoring are discussed in Section 11.5.

11.8.3. Monitoring Time Frames

The monitoring of species abundance of vegetation communities must be conducted once-off during the construction phase and then bi-annually throughout the Operations Phase. The increase of invasive species and the loss of faunal communities should also be monitored bi-annually.

The rate of indigenous vegetation rehabilitation and the presence of invasive species should be monitored once during the Decommissioning Phase and annually thereafter for at least five years during the Post-Closure Phase.

Monitoring should preferably be conducted during the months of February or March.

11.8.4. Responsible Officer

It is recommended that the on-site Environmental Control Officer (ECO) appoint an independent wetland biodiversity specialist to undertake the wetlands monitoring programme.

11.8.5. Monitoring Costs

The cost of the wetland and riparian monitoring once mining is established will be approximately R 120 000.00 per annum.

11.9. Soundscape

11.9.1. Monitoring Programme

Major sources of noise emissions from the proposed anthracite mine and processing plant include (but are not limited to):

- Mobile equipment;
- Conveyor systems;
- Bins and hoppers;
- Coal handling and processing plant;
- Coal loading operations.

Noise monitoring will need to take place during the construction, operation and decommissioning phases and should be undertaken by an independent agency. Noise monitoring should be carried out at monitoring points MP2 and MP3 at the nearest mine boundary to the opencast pits and near MP4 at the plant site in order to detect deviations from predicted noise levels and enable corrective measures to be taken where warranted (Refer to Figure 56). These noise monitoring processes should be carried out according to SANS 10103-2008 requirements.

The data from the noise monitoring sessions will need to be compared to the baseline noise climate. A monitoring report which will need to include the following must be compiled:

- A description and photograph of the site being monitored;
- The date, time and duration of the monitoring session;
- The GPS co-ordinates and the altitude of the sites being monitored
- The meteorological conditions such as wind speed/direction, ambient temperature, cloud cover, humidity and barometric pressure at the time of the monitoring session;
- "A-weighted" sound pressure level data will need to describe the following:
    - The equivalent continuous sound pressure level; and
    - The maximum/minimum sound pressure level during the measurement period.

In addition to this it is recommended that equipment noise audits take place on a regular basis, this is important as it ensures that equipment is not deteriorating. Standardised noise measurements should be carried out on individual equipment at the delivery to site to construct a reference data base and regular checks should be carried out to ensure that equipment is not deteriorating and to detect increases which could lead to an increase in the noise impact over time.

11.9.2. Monitoring Objectives

The following must be taken into consideration when noise measurements are interpreted during monitoring:

- It is important that operations are meeting the noise standard requirements of the Occupational Health and Safety Act (Act No. 5 of 1993).

- During monitoring it is important that noise measurements are carried out according to the SANS code of practice 10103:2008.
- During the mining of the consecutive opencast strips, the monitoring points located just beyond 273 m from the opencast pits (MP2 and MP3 in Figure 56) should not record exceedance values (value above the average recorded ambient noise levels) greater than 5 db(A); exceedance at this level will exert a negative impact of low significance. Refer to the noise baseline section 2.12 for ambient noise levels recorded at MP2 and MP3.
- Coal stockpile management and transport truck loading will increase the ambient noise levels, the nearest dwellings to the processing plant are located approximately 650 m away, and hence the significance of the negative impacts felt by these communities will be very low - low. MP4 is located approximately 440 m away from the proposed processing plant. Noise measurements recorded at MP4 during monitoring should not record exceedance values of greater than 7 dB(A). Refer to the noise baseline section 2.12 for ambient noise levels recorded at MP4.
- Regular checks should be carried out on equipment and machinery to ensure that equipment is not deteriorating and to detect increases which could lead to complaints. These measurements should be compared to standardised noise measures.

11.9.3. Monitoring Time Frames

Noise monitoring should be conducted regularly at six-monthly intervals at the edges of the surrounding communities which are in close proximity to the pit (Monitoring points 2 and 3) and processing plant (Monitoring point 4) in order to detect deviations from predicted noise levels and enable detective measures to be undertaken where warranted.

11.9.4. Responsible Officer

- The on-site Environmental Control Officer (ECO) is responsible for appointing an independent agency who will undertake the noise monitoring.
- If these monitoring objectives are not met independent agency should liaise with the ECO who will have the responsibility of reporting the findings to the mine manager and management team who can then discuss mechanisms to reduce the impact, measure the effectiveness of the management measures which are in place, and where necessary, intervene further. The effectiveness of additional measures will be assessed through further monitoring. A grievance mechanism should be set up by the mine; this allows a channel through which complaints can be directed from the community to the mining company. Once the grievance mechanism is implemented it should be studied for any complaints relating to noise.

11.9.5. Monitoring Costs

The cost for the specialist is approximately R 20 000.00 per session.

Figure 56: Recommended noise monitoring sites.

11.10. Socio-Economic

11.10.1. Monitoring Programme

A grievance mechanism should be put in place where community members can raise any issues or concerns. Regular meetings should be held with local community representatives (Siboshwa Trust) to insure on-going communication between the mine and the community and to provide a platform for community members to raise any issues or concerns they may have. Community open days should also be held at least annually to allow any IAPs the chance to liaise directly with the mine.

11.10.2. Monitoring Time Frames

Socio-economic engagement and monitoring should be on-going throughout the LOM.

11.10.3. Responsible Officer

A Social Economic Coordinator should be appointed for the LOM to ensure that each phase of the mining operation is monitored against the SLP.

11.10.4. Monitoring Costs

Socio-economic monitoring costs are incorporated into SLP costing.

12. ENVIRONMENTAL GOALS AND OBJECTIVES

12.1. Objectives and Goals Relating to the Management of Identified Environmental Impacts

12.1.1. Objectives

The main objective of the mine is to minimise the impacts of operations on the environment as far as possible. The mine commits to the following environmental policy objectives:

- Comply with legal requirements and voluntary commitments;
- Pollution prevention through the implementation of effective management and mitigation measures;
- Continuous improvement in environmental performance; and
- Sharing information on environmental performance with the community.

12.1.2. Goals

The mine's environmental related goals are as follows:

- Implementing the management and mitigation measures stated in the EMP;
- Undertake and implement monitoring programmes stated in the EMP;
- Implement an Environmental Management System (EMS) compliant with current legislation and which encompasses all aspects of environmental impact management, mitigation and monitoring as defined in this EMP;
- Ensure that the employees and the community are aware of the EMS as well as their roles and responsibilities relating thereto;
- Apply for and adhere to any commitments made or conditions of the WUL;
- Reduce particulate matter and dust fallout throughout the life of the operation;
- Comply with the SA NAAQS and the SA NEMAQA draft dust fallout standards; and
- Ensure the personnel noise exposure levels comply with the requirements of the Mine Health and Safety Act, 1996 (Act No. 29 of 1996).

12.2. Objectives and Goals Relating to the Socio-Economic Conditions

12.2.1. Objectives

As stated in the mine's Social and Labour Plan (SLP), the mine aims to:

- Encourage portable skills training in mining related disciplines;
- Facilitate career path development within the mine's workforce;
- Develop core/scarce skills within the mine's workforce;
- Promote further education and qualification in mining related disciplines;
- Meet the Department of Labour's Employment Equity Act principles;

- Facilitate improved housing conditions among the mine's workforce; and
- Foster entrepreneurship in local communities.

12.2.2. Goals

Goals of the SLP pertain to:

- Implement Human Resource Development (HRD) programmes in order to ensure the on-going facilitation of transferable, accredited skills amongst the proposed KaNgwane Anthracite Mine's workforce;
- Implement a skills development plan to meet the requirements as per the Skills Development Act;
- Have discipline-based career management committees which focus on employee career development;
- Implement mentorship programmes to encourage the transfer of experience and attributes from mentor to protégé;
- Offer bursaries for full time tertiary studies in mining related disciplines;
- Make internship positions available to allow students to get experience in the field;
- Implement an employment equity plan;
- Develop strategies to promote affirmative action;
- Provide housing allowances in line with current practice to mine employees;
- Have a home ownership support programme to offer advice and assistance to mine employees regarding housing options that suit their needs;
- Facilitate development of suitable housing for purchase; and
- Implement a procurement progression plan to promote sustainability of Historically Disadvantaged South Africans (HDSA) businesses.

12.3. Objectives and Goals Relating to Cultural and Heritage Aspects

12.3.1. Objective

The proposed KaNgwane Anthracite Mine's objective regarding cultural and heritage aspects, is to ensure that the integrity of the heritage and cultural resources associated with the project area remain intact as far as practically possible.

12.3.2. Goals

The mine's goals relating to cultural and heritage aspects will be to:

- Commit to protecting the heritage resources identified at Site 2 and potential palaeontological resources associated with the site (Refer to Section 2.12.2);
- Ensure that the management measures proposed in the EMP which relate to cultural and heritage resources are implemented; and

- Ensure compliance with the aspects of the National Heritage Resources Act, Act 25 of 1999.

12.4. Objectives and Goals Relating to Mine Closure

12.4.1. Objectives

As per the MPRDA Regulations GNR 527 of 2004, the objectives of the proposed KaNgwane Anthracite Mine relating to mine closure are to ensure that:

- The closure of the mining operation incorporates a process which starts at the commencement of the operation and continues throughout the life of the operation;
- Public health and safety must be protected;
- Environmental damage must be alleviated or eliminated;
- Structural integrity of the site must be ensured for the long term (including the prevention of erosion by wind or water);
- Short and long term impacts on surface and groundwater quality must be minimised and contained at acceptable levels;
- Land use must be returned to original or pre-mining condition or an acceptable and sustainable alternative;
- Socio-economic benefits post-closure must be maximised;
- The need for long term monitoring and maintenance must be reduced or removed; and
- The mining operations must be closed efficiently and cost effectively.

12.4.2. Goals

The most important aspects to focus on in terms of closure include:

- Water management (groundwater and surface water);
- Return of land capability;
- Retention of biodiversity;
- Return of aesthetic quality;
- Minimisation potential health and safety impacts; and
- Contribution to the overall socio-economic well-being.

The goals to accomplish the closure objectives for each of the aforementioned aspects are discussed in the paragraphs that follow:

Groundwater

During construction and operation, good housekeeping will be employed as per the EMP, ensuring that potential sources of groundwater contamination are minimised. The numerical groundwater model should also be updated on an ongoing basis with the results of ongoing groundwater monitoring and kinetic leach testing to confirm the baseline findings made and make recommendations at the earliest possible stage should it become evident that significant AMD-related contamination of groundwater resources may arise.

Surface Water

Once closure is reached, the discard dump will have to be reshaped, capped and suitably vegetated under the direction of an engineer in consultation with a hydrologist so as to divert surface water away from the dump along natural flow paths and to limit water ingress into the dump with the aim of avoiding contamination of ground- and surface water resources by runoff after the closure of the mine.

Land Capability

The current land use on the site is a combination of livestock grazing (low intensity), subsistence agriculture, and rural, low density residential development. The intention is to implement measures to ensure that the rehabilitation of this area renders it suitable for similar aspects post-mining. It is not expected that this area will immediately return to the pre-mining agricultural potential. Grazing of livestock will serve as the preferred option for areas where crop production is not viable. Measures to reduce the erosion potential of the area should also be implemented.

Biodiversity

Biodiversity of the post-closure mine site can be ensured through the re-establishment of appropriate vegetation communities. Rehabilitation must be carried out using native vegetation and species that will create self-sustaining communities. Disturbed areas must be stabilised in order to prevent erosion. Alien invasive species must be managed through integrated control methods including chemical and physical removal schemes.

Aesthetic Quality

The aesthetic quality of the mine site post closure can be achieved by thoroughly decommissioning the mine site which includes and all structures being dismantled, removed and disposed of appropriately (unless prior arrangement to transfer usable structures to the surrounding communities are negotiated). Rehabilitated areas must be inconspicuous in the surrounding landscape in terms of topography and species composition. Rehabilitated areas must also be free draining and appropriately re-vegetated. Any eroded areas must also be re-vegetated.

Health and Safety

Health and safety impacts can be minimised post closure by sealing any excavations and areas of subsidence (should they arise) and all waste material generated during decommissioning must be disposed of appropriately at a registered landfill site. The rehabilitated areas must ultimately be rendered safe.

Social Aspects

The mine must contribute to the overall socio-economic well-being of the affected local communities. There must be transparent communication with the local communities regarding mine closure and downscaling. Mine closure should also be carried out in such a way as to contribute to the long term socio-economic sustainability of the local communities, particularly those that were impacted on by the mine.

12.4.3. Interim Closure Plan

The scope of the interim closure plan (Appendix 17) is to detail the activities required to meet the requirements of the MPRDA and the associated Regulations contained in GN527 of 2004 relating to the Mine's closure objectives.

12.4.3.1. Progressive Rehabilitation

This section serves to define the rehabilitation measures that can be undertaken during the operational phase of the proposed KaNgwane Anthracite Mine.

Opencast Pits

Progressive rehabilitation of the two opencast pits will be undertaken during the operational phase as opencast mining will cease before mine closure. However, the underground workings will be accessed from the high-wall of the opencast pits, hence a void in each of the pits will not be rehabilitated before mine closure in order to allow for man and materials access to underground.

During opencast mining, three or four strips will initially be exposed. The strips will be cleared of vegetation, and topsoil stockpiled. The stockpiled soil will, where practicable, be used in concurrent rehabilitation. All stockpiled soil will be seeded if it is to be kept in-situ for longer than three months. The topsoil is to be stockpiled and vegetated (preferable) to protect it from water or wind erosion. The stockpiles should be placed away from roads and out of 1:100 year floodlines. Soils should be stockpiled as close as possible to areas where they will be replaced.

The overburden will be stripped and stockpiled separately (for carbonaceous and non-carbonaceous overburden). After the target resource has been mined, the topsoil and overburden material extracted from the strips being mined will be progressively placed into the excavation remaining from the previously mined strips. The method of material placement will be: placement of overburden, followed by subsoil, followed by a minimum 300 mm layer of topsoil. The strips and final voids will be filled to surface level and shaped to ensure that the area is free draining and no ponding will occur on the final rehabilitated surface.

A seed mix will be applied to the strips as they are rehabilitated to accelerate vegetation establishment. Rehabilitation should utilise indigenous species of trees, shrubs and grasses propagated from species dominating the surrounding vegetation types to reinstate the original grazing potential of the rehabilitated area. Rehabilitation programmes should be advised by biodiversity management plans aiming to increase species diversity in rehabilitated areas. All alien invasive vegetation should be eradicated before it becomes established. An ecologist should be employed to conduct regular monitoring of the rehabilitated opencast pit areas until the vegetation is well established and self-sustainable. Alien invasive species must be managed through integrated control methods including chemical and physical removal schemes.

12.4.3.2. Closure Measures

The following section details the closure measures, for each mine component, which should be implemented to ensure that the goals to accomplish the closure objectives are met.

Topsoil Handling and Management

Topsoil is an essential component for successful rehabilitation, especially during the initial period of plant growth. Topsoil contains nutrients and micro-organisms that are essential to plant growth and if they are lost then sustainable vegetative cover will take a longer period to establish.

Subsoil conditions are important in the long term. If the subsoil lacks the nutrients or is unsuitable for long term growth the initial vegetation will die off in periods of one to five years depending on the rate of penetration of the roots.

During decommissioning, subsoil and topsoil that has been stockpiled will be returned wherever possible to its original location. Soil resources that cannot be returned to the original position (due to the presence of some other structure) will be used for the rehabilitation of other areas.

To ensure that the proper soil handling and management is carried out the following should be taken into account:

- An inventory should be compiled and a comprehensive assessment conducted on the topsoil available for site reclamation in terms of the soil quality / chemistry and suitability for re-vegetation.
- Applications of topsoil should be prioritised, with specific attention being given to:
  - Cover for discard dumps;
  - Denuded areas due to mining activities; and
  - Areas from which surface infrastructure has been removed.

Dismantling and Demolition of Infrastructure

At this stage it is anticipated that all of the infrastructure will be demolished / removed at mine closure with the discard dump being the only component remaining after closure (and potentially the associated pollution control dam depending on the rate and nature of any seepage from the rehabilitated discard dump).

During demolition, the following should be noted:

- The removal of foundations, ripping and levelling of areas should extend to 1m below the final surface. Such foundations will include hard-standing areas and foundations associated with the terraces established at the processing plant and workshop areas, administration offices, explosive storage areas, pollution control and storage dams which will not remain at closure;
- Demolition waste should be sorted and disposed of accordingly;
  - Inert waste such as concrete should be utilised to backfill excavations such as the mined-out underground workings.
  - Materials such as steel should be recycled by an appointed contractor; and

- Non-recyclable waste must be safely removed and disposed of a by contractor- and at a suitable facility that meets the requirements of the National Environmental Management – Waste Act (No. 58 of 2009). This applies to both general (domestic), industrial and hazardous waste. These waste streams are to be kept separate at all times to ensure that non-hazardous waste does not inadvertently become contaminated.

Underground Workings

Once mining has ceased all the portals are to be sealed to acceptable standards. A rock mechanics specialist will be commissioned to assess the mine and make recommendations in order to prevent any future subsidence or seismic activity. This is to reduce the possible negative effects on land use and land capability in the long term.

The underground mine workings will fill with percolating rain and vertical and lateral groundwater influx within 20 – 35 years after mining stops. Groundwater levels and yields should attain levels similar to those that existed prior to mining. Decant from the rehabilitated pits and underground workings is likely to occur, however, it is expected that sulphate concentrations of the decanted groundwater will not be significant (less than 10mg/l) and will not require treatment before entering the environment.

Several actions will be taken at decommissioning regarding groundwater:

- Provide and maintain structures to divert clean water and to contain seepage and/or migration of contaminants;
- Seal influxes into mine workings where and if possible;
- Ascertain the Best Practicable Environmental Option (BPEO) for mined-out underground workings to assess where seals can possibly be put in place;
- Rehabilitate landscape and vegetate disused mining areas to promote even runoff, to inhibit infiltration and to prevent erosion; and
- Conduct kinetic leach tests and test the hydrochemistry of the groundwater to confirm that it doesn’t contain significant concentrations of sulphate.

All infrastructure associated with the portals and underground workings and ventilation system will be dismantled and removed. The following should be undertaken at mine closure:

- Determine structures with value as recyclable material (particularly metal). These structures should be collected and removed by an appointed recycling contractor;
- The structures should be dismantled / demolished and levelled to ground level;
- Rip and remove foundations to at least 300mm below ground level to reduce compaction;
- Dispose of inert concrete and building material into the portal (final voids of opencast pits) and backfill with overburden;
- Seal the portal with a suitably designed concrete plug;
- Remnants of dismantled infrastructure must either be removed from site and disposed of at a licensed landfill facility by an appointed contractor;
- Deposit a layer of topsoil from stockpiles, with a minimum depth of 300 mm, across the

area;

- The areas will be re-vegetated using a seed mix and indigenous trees, shrubs and grasses. The species used should be propagated from species dominating the area; and
- Ameliorate and fertilise the soil.

Contaminated Water Handling Facilities

The following measures will be applied to the components of the clean and dirty water management system:

- Drain the contents of all PCDs which will not remain after closure (i.e. those not associated with the discard dump);
- Dismantle and remove all components;
- Rip and remove foundations to at least 300mm below ground level to reduce compaction;
- Fill in any cavities with overburden, followed by subsoil and reshape to match the original surrounding topography;
- Deposit a layer of topsoil from stockpiles, with a minimum depth of 300 mm, across the area;
- Re-vegetate the areas using a seed mix and indigenous trees, shrubs and grasses. The species used should be propagated from species dominating the area; and
- Ameliorate and fertilise the soil.
- It is important to note that the clean and dirty water handling facilities should only be removed after any potential sources of contaminants within their respective catchments have been removed and the areas rehabilitated in order to ensure that contaminants are not inadvertently introduced into the receiving catchment during rehabilitation.

Coal Handling and Preparation Plant

Based on Section C of the DMR closure guidelines (2005) the common method of closure for a processing plant ensures that:

- All steel structures and conveyors must be dismantled and removed from site by an appointed recycling contractor;
- Any hazardous material, tanks used to hold hazardous substances and chemicals and contaminated hard-standing areas must be removed from site by an appointed hazardous waste contractor for disposal at a licensed hazardous waste disposal facility,
- Portable facilities must be removed from site by the company from whom these facilities have been rented, or alternatively, if not part of the rental agreement, sold back to a company who deals in such facilities;
- All remaining infrastructure, hard-standing areas, foundations and conveyors should be broken down to natural ground level, and concrete buildings should be demolished to natural ground level and disposed of to a licensed facility by an appointed contractor;
- The compacted footprint of the plant area will be ripped and scarified;
- The areas are to be covered with 1m subsoil, topsoiled with 300mm of topsoil that was removed prior to construction and stockpiled;
- The areas will be re-vegetated using a seed mix and indigenous trees, shrubs and grasses.

The species used should be propagated from species dominating the area; and

- Ameliorate and fertilise the soil.

Discard Dump

The discard dump will remain after decommissioning and will therefore be rehabilitated as best as practicably possible to prevent erosion, wind-blown dust, spontaneous combustion and contaminated runoff which includes:

- Compacting the discard material to minimise oxygen availability and thus reduce the potential for spontaneous combustion;
- Modify the outer slopes of the discard dump to angles of 1:3 (18°) with benches at regular intervals to ensure the modified outer slopes do not exceed 35-40m for stormwater velocity control. Benches should be at least 5m wide and sloping inwards at 1:10.
- Provision of a dedicated cover on the modified outer slopes to protect the integrity thereof. This dedicated cover should comprise an evaporative cover of sandy/loam material 750-1000mm thick, either from the stockpiled materials, or if not available, brought in. This evaporative cover should further comprise an outer 300mm layer of topsoil and vegetative cover as described below; and
- The discard dump will be re-vegetated using a seed mix and indigenous trees, shrubs and grasses. The species used should be propagated from species dominating the area.
- Upstream stormwater diversion berms should be installed if required upstream of the discard dump to prevent localised damage to the cover.

Overburden stockpiles

- All non-carbonaceous overburden stockpiles will be used to backfill the portals and any voids;
- When one considers the bulking factor of approximately 5-10%, there will be an insufficient void volume to backfill all overburden material and thus the carbonaceous overburden dump will remain on surface and will be rehabilitated in situ. These dumps will be shaped to enhance the visual aesthetic and to create a stable landform and then re-vegetated as indicated below.
- For the stockpiles that have been removed, the denuded footprints will be ripped and vegetation re-established.
- The areas will be re-vegetated using a seed mix and indigenous trees, shrubs and grasses. The species used should be propagated from species dominating the area; and
- The soil should be ameliorated and fertilised.

Topsoil Stockpile

Topsoil stockpile footprint:

- Topsoil in these stockpiles will be used for the rehabilitation on the mine;
- Once the soil in these stockpiles has been removed, the footprints will be ripped and vegetation re-established;
- The areas will be re-vegetated using a seed mix and indigenous trees, shrubs and grasses.

The species used should be propagated from species dominating the area; and

- The soil should be ameliorated and fertilised.

Water and Sewage Treatment Plants

The water and sewage treatment plants will be demolished / dismantled and the footprint rehabilitated as follows:

- The contents of any treatment tanks and related structures will be cleared and the structures removed from site by an appointed contractor for disposal at a suitably licensed facility;
- Topsoil removed during construction will be replaced and used to level the disturbed area;
- The areas will be re-vegetated using a seed mix and indigenous trees, shrubs and grasses. The species used should be propagated from species dominating the area; and
- The soil should be ameliorated and fertilised.

Explosive Storage Facility

The explosive storage facility will be demolished / dismantled and the footprint rehabilitated as follows:

- It is assumed that no residual ammonia or nitrate contamination is present on the footprint of the magazine. Tests for the presence of these substances must be undertaken to confirm the absence of residual explosive chemicals at closure;
- Should there be any explosives remaining at closure, they must be destructed by qualified personnel before commencing with rehabilitation;
- Any contaminated soils forming part of the footprint of the explosives magazine will be removed and disposed of at suitably licensed landfill facility as hazardous waste;
- Decommissioning of the non-contaminated footprint will involve:
  - Demolition / dismantling of the structure and foundations;
  - Filling excavations with subsoil;
  - Ripping and scarifying the footprint;
  - Replacement of topsoil; and
  - Re-vegetation;
  - The areas will be re-vegetated using a seed mix and indigenous trees, shrubs and grasses. The species used should be propagated from species dominating the area; and
  - The soil should be ameliorated and fertilised.

Roads

All access and service roads will be removed and rehabilitated as follows:

- The surface of tarred roads must be ripped up and disposed of either during portal backfilling or at a licensed facility off-site;
- Compacted areas to be loosened by ripping or ploughing and re-graded;
- Topsoil, from stockpiles, will be used to cover the denuded areas;

- The areas will be re-vegetated using a seed mix and indigenous trees, shrubs and grasses. The species used should be propagated from species dominating the area; and
- The soil should be ameliorated and fertilised.

Ad Hoc Infrastructure

The removal and rehabilitation of the following ad hoc infrastructure will be discussed below:

- Change-houses;
- Workshops;
- Helipad; and
- Security and administration offices.
- Structures will be demolished / dismantled and removed from site by an appointed contractor for disposal at a suitably licensed facility;
- Hard-standing areas / foundations will be demolished to below ground-level and the inert material used for portal backfilling;
- The excavations where foundations were removed will be rehabilitated by:
  - Backfilling with subsoil;
  - Ripping and scarifying the entire footprint and covering with topsoil;
  - The areas will be re-vegetated using a seed mix and indigenous trees, shrubs and grasses. The species used should be propagated from species dominating the area; and
  - The soil should be ameliorated and fertilised.

12.4.3.3. Maintenance and Monitoring

A post-closure monitoring and maintenance period of three years after operations cease is assumed. It should be noted however that the authorities will ultimately dictate the post-closure monitoring and maintenance period required. Maintenance of rehabilitated areas and monitoring will be conducted for three years after mine closure or until a Closure Certificate is awarded.

Table 32 below summarises the various monitoring programmes as set out in EMP which should continue to be monitored post closure.

Table 32: Monitoring and submission of information post closure

ASPECT		RECIPIENT OF INFORMATION	MONITORING		
EMPR SECTION	SUBJECT		START	FREQUENCY	STOP
10.5	Surface water quality	DWA	Construction phase	Quarterly *	3 years after closure
10.6	Groundwater quality	DWA	Construction phase	Quarterly **	3 years after closure
10.6	Groundwater levels	DWA	Construction phase	Quarterly **	3 years after closure
10.7	Re-vegetation/ rehabilitation	DMR	Decommissioning phase	Every two years	3 years after closure

* Suspended solids, total alkalinity, pH, EC, Na+, K+, Ca2+, Mg2+, NO3-, Cl-, SO42-

** Full chemical analysis to be finalised
Groundwater levels

According to the MPRDA closure guidelines, maintenance and aftercare should cover:

- Annually fertilising of rehabilitated areas;
- Monitoring of surface and groundwater quality and quantity; and
- Control of alien invasive vegetation.

A record of all closure aspects should be kept by the site Environmental Coordinator / responsible person. These records will be important during any auditing process that needs to be undertaken on the closure aspects of the mine. MPRDA Regulation 55 audits (Performance Assessments of the Environmental Management Programme) must be undertaken every two years. In addition, it is expected that the closure plan be updated every 5 years. The closure plan must be finalised 5 years before the planned closure of the mine in accordance with Regulation 62 of the MPRDA.

12.4.3.4. Implementation Schedule for Rehabilitation and Closure

ACTIVITY	YEAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Vegetation clearing		■																										
Topsoil removal and stockpiling		■	■	■	■	■	■	■	■	■	■	■	■	■														
Opencast mining		■	■	■	■	■	■	■	■	■	■	■	■	■														
Underground mining						■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■				
Beneficiation and waste generation		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			
Assessment of structural integrity / stability (subsidence and impoundments)		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			
Regulation 55 performance assessments			■		■		■		■		■		■		■		■		■		■		■					
Groundwater monitoring / specialist input		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Surface water monitoring / specialist input		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Air quality (dust) monitoring		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			
Noise monitoring		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			
Review and update quantum for closure-related financial provision		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			
IAP Engagement		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			
Prepare and update closure plan						■					■					■					■							

ACTIVITY YEAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Finalise and submit: closure plan, environmental risk report and final performance assessment																											
Continuous rehabilitation of opencast pits																											
Rehabilitation of final voids of opencast pits																											
Polluted water in dams processed																											
Empty water and sewage treatment plants																											
Demolish / dismantle remaining surface infrastructure																											
Removal of recyclable waste by appointed contractor																											
Disposal of non-hazardous / inert waste (concrete) as shaft backfill																											
Disposal of remaining general waste to landfill																											
Remaining general waste removed by contractor for disposal at licensed landfill																											
Removal of hazardous / contaminated waste by																											

ACTIVITY	YEAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
contractor for disposal at licensed landfill																												
Denuded areas, compacted / hard-standing areas / footprints ripped to below surface level and scarified																												
Discard dump sloped and capped																												
Apply subsoil to excavations, denuded footprints already ripped / scarified																												
Apply topsoil																												
Seeding with indigenous / agricultural species to match predetermined land-use																												
Maintenance and monitoring of vegetation and soil																												
Allow vegetation to stabilise																												
Record-keeping and reporting																												
Apply for closure certificate from authorities																												

13. ENVIRONMENTAL EMERGENCIES AND REMEDIATION

According to Regulation 51(b) (iii) of the MPRDA, the proposed KaNgwane Anthracite Mine is required to document a procedure for environmentally related emergencies and remediation. This emergency procedure will ensure that employees are able to:

- Identify potential and actual emergency situations;
- Respond appropriately;
- Prevent and mitigate further environmental impacts; and
- Rehabilitate environmental impacts.

The benefits of emergency preparedness and response are that:

- People are able to respond to emergencies quickly and effectively;
- Employees and contractors are aware of their roles and responsibilities; and
- The risk to health and safety of people and the impacts on the environment are reduced.

13.1. Types of Environmental Emergencies

There are various types of emergencies that may threaten the environment at the proposed KaNgwane Anthracite Mine; examples of typical emergencies include:

- Uncontrolled fires;
- Traffic accidents;
- Accidental discharges to water bodies (e.g. contaminated water runoff or spillages);
- Accidental discharges to land (e.g. oil or chemical spills);
- Tremors due to underground blasting;
- Subsidence; and
- Abnormal operating conditions resulting in public complaints (i.e. excessive dewatering, contamination of arable land).

Not all these incidents will necessarily result in an emergency condition. It is the magnitude and severity of the incident that will determine whether it is an emergency.

13.2. Emergency Response Plan

Although the cause of an emergency may differ, the actions to be followed in an emergency situation are generally the same. The following steps should be followed in an emergency situation:

13.2.1. Notification of Emergency

Any employee or person that notices an emergency condition should immediately alert the proposed KaNgwane Anthracite Mine environmental department or the shift supervisor.

13.2.2. Make Safe

Internal and external emergency services must be notified of the emergency so that it can be addressed using the relevant emergency equipment and emergency response teams. Measures must also be taken to stop the continued environmental degradation by either containing the contamination or stopping the contamination at source. Measures must be taken to ensure that personnel and public are safe and removed from the area of danger. Medical treatment and transport must be provided to the injured. Emergency evacuation must occur if the safety of people is compromised.

13.2.3. Obtain Information on the Emergency

The proposed KaNgwane Anthracite Mine environmental department should then obtain information on the nature of the emergency, origin, time that it commenced, persons involved, whether people have been injured and potential or actual environmental risks.

13.2.4. Remediate the Associated Environmental Impacts

The environmental impacts related to the emergency must be assessed and remediated. This may require the input of external environmental expertise to assess the nature of damage incurred. Remediation measures must be implemented to mitigate the impacts e.g. clean-up of spill or rehabilitation of vegetation.

13.2.5. Communication

The relevant affected people must be kept informed of the emergency, including when the situation is over and normal work can be resumed. The emergency must be reported to the relevant authorities (such as local municipality, DMR, DWA, DOA, DEA, local emergency services, fire brigade, etc) and the public when required.

13.2.6. Debriefing Session

After the emergency there should be a debriefing session to discuss the cause of the emergency, extent of damages, extent of emergency preparedness and response. The cause of the emergency must be investigated and corrective and preventative measures implemented to prevent a re-occurrence of the cause of the emergency, or lapses in effective response to the procedure.

13.2.7. Revise Procedure

Any lessons learnt from the emergency must be incorporated into the emergency procedure and it should be revised accordingly.

13.2.8. Training and Emergency Drills

All staff must be trained in how to respond to emergency conditions at the mine and should be aware of the emergency exit points, the actions required in the event of an emergency and which external emergency services to contact.

The emergency procedure for emergencies (with the contact details of external services) must be posted in a visible, easily accessibly place throughout the mine. Emergency drills (e.g. fire and evacuation drills) should be conducted at periodic intervals, at least once per annum.

13.3. Specific Emergencies

13.3.1. Uncontrolled Fires

The proposed KaNgwane Anthracite Mine environmental department should take measures to prevent fires on the site. All parties will ensure that there is adequate fire-fighting equipment, which is regularly maintained. This department will ensure that specified workers will receive formal fire-fighting training. Finally, it is the responsibility of the proposed KaNgwane Anthracite Mine environmental department to ensure that there is an adequate system of firebreaks in place and that all fire hazard 'hotspots' have been identified. The fire emergency procedure is as follows:

- Raise the alarm by sounding the fire alarm system, informing site management and/or the mine manager, and informing the fire fighting representative in the area;
- Determine the location and severity of the fire;
- Apply basic fire-fighting procedures if possible and apply evacuation procedures if necessary;
- Assemble at the emergency control point and obey all instructions from the fire fighting representative;
- The emergency number for the closest fire station must be located at the mine manager's office and all other site notice boards.

13.3.2. Traffic Accidents

This procedure addresses accidents that occur on the site. The following actions must be taken in the event of a road accident:

- Establish what has happened, including the location, nature, and status of the accident; the nature and extent of injuries or damage; and the nature and extent of any spills or leaks (where chemicals may be involved – refer to relevant procedures below).
- Isolate the accident scene and spill area, and treat any casualties.
- Inform the mine manager, emergency response team, Health and Safety Manager and environmental manager. These contact numbers must be on the list of emergency contact details.

- Depending on the seriousness of the accident, notify the closest emergency services the number for which must be located at the mine manager's office and all other site notice boards.

13.3.3. Hazardous Chemical Spills

Standard procedures for hazardous chemical environmental emergencies include:

- Detoxification, clean-up and rehabilitation of spillages;
- All personnel who form part of emergency reaction teams for hazardous chemical spillages will be trained and able to apply detoxification procedures;
- Spillages will be cleaned up as soon as possible to minimise the exposure to members of the public, production personnel and the environment;
- Notification of mine personnel, emergency services and relevant government departments;
- Protection of sensitive habitats, fauna and flora, and livestock; and
- Evacuation of local communities if necessary.

As far as possible, assistance will be obtained from Hazchem emergency response units for dealing with major spills. Where this is not possible, production personnel required to enter the area will be trained and fully equipped with Material Safety Data Sheets (MSDS) and approved Personal Protective Equipment (PPE).

13.3.4. Oil Spills

Oil spills can occur over most of the site and the major sources will be leaks from vehicles and machinery as well as hydrocarbon stores. These spills may be minor (i.e. a few spots) or major (i.e. a 220 ℓ drum falling over onto the soil). Negligence is also a source of oil spills where contractors or site staff are servicing machinery and allow used oil to spill onto the ground. There is also the potential for equipment and machinery breakdowns on the site. MSDS will be kept at the stores for each type of hydrocarbon on the site. These will contain information on decontamination procedures and the correct procedure to follow in the event of a spill. The mine manager will also place emergency spill kits (i.e. plastic tarpaulin, a 220 ℓ drum, a broom and an absorbent to soak up the material) at strategic locations around the site.

The following actions must be taken in the event of an oil spill:

- Establish what has happened, and the nature and extent of the spill. Obtain MSDS.
- The responsible area manager and ECO must be informed. The contact numbers for who must be on the list of emergency contact details.
- To contain and clean a spill, the instructions on the MSDS must be followed. The area must be cordoned off and kept clear, and the spill contained and cleaned up immediately. Any contaminated soil, vegetation or rock must be removed and disposed of at a registered landfill site.

13.3.5. Bulk Fuel Spillage

The following actions must be taken in the event of a bulk fuel spill:

- Establish what has happened, and the nature and extent of the spill, damage to bund walls, when last the tanks were pressure tested and whether this is within the supplier specifications. Obtain MSDS.
- The mine manager, responsible area manager, Health and Safety manager, environmental manager, and emergency response team must be informed. These contact number must be on the list of emergency contact details.
- The spill must be prevented from entering into any watercourses.
- If it is unclear whether the fuel has spilled from, the area must be isolated.
- To contain and clean a spill, the instructions on the MSDS must be followed. The area must be cordoned off and kept clear. Any contaminated soil, vegetation or rock must be removed and disposed of at a registered landfill site, or be treated at a bioremediation facility.

13.3.6. Subsidence / Tremors Due To Underground Blasting

The mine manager in conjunction with the environmental manager and the environmental officer on site will co-ordinate their response with that of the municipal disaster management team. All parties and section managers will ensure that there is adequate equipment (fire fighting, medical, rescue), which is regularly maintained. This team will ensure that all workers will receive training on how to respond in the event of subsidence.

- The disaster management emergency procedure is as follows:
- Raise the alarm by breaking the nearest break-glass unit on the fire alarm system.
- Inform site management, nearest fire station and the municipal disaster management centre. These contact numbers must be on the list of emergency contact details, at the mine manager’s office, and all other site notice boards.
- Determine the location and severity of the event.
- Apply basic disaster management procedures and ensure that staff are moved away from dangerous areas, and apply evacuation procedures if necessary.
- Assemble at the emergency control point and obey all instructions from the emergency representative.

13.3.7. Abnormal Operating Conditions

- For any abnormal operating conditions resulting in public complaints (i.e. excessive dewatering, contamination of arable land as well as any other abnormal operating conditions which may arise the general emergency response plan detailed in Section 13.2 above should be implemented and followed.

14. ENVIRONMENTAL AWARENESS PLAN

14.1. Introduction

This chapter describes the environmental awareness plan as per the requirement of Section 39(3) (c) of the MPRDA. This section details how the proposed KaNgwane Anthracite Mine intends to inform its employees of any environmental risks which may result from their work and the manner in which the risks must be dealt with in order to avoid pollution or degradation of the environment.

The objective of the environmental awareness plan is to ensure the following:

- All personnel are made aware of the environmental management requirements;
- All personnel as a minimum must undergo general environmental awareness training, which would highlight all personnel environmental responsibility; and
- Those personnel whose functions may have a significant impact on the environment receive the appropriate training, so that they may perform their designated tasks adequately.

The benefits of awareness training are numerous and include:

- Awareness of the importance of conforming to the environmental management programme;
- Improvement in environmental performance at the mine; and
- Support for the proposed KaNgwane Anthracite Mine in its efforts to achieve its environmental management objectives and performance targets.

14.2. Roles and Responsibilities

Environmental awareness training at the proposed KaNgwane Anthracite Mine is to be provided to all employees on site, as well as all contractors.

All new employees are to undergo environmental awareness training as part of their induction within the first two weeks of employment. Contractor employees whose work has, or can have, a significant impact on the environment must, upon appointment, have a personalised training programme developed as part of his/her job description and must undergo awareness training prior to the commencement of any such activities. Performance assessments will be conducted on the contractors' compliance on environmental issues under his/her control. After the initial training, refresher courses must be provided annually or upon request from trainee.

The on-site ECO or parties identified and recommended by the ECO, will undertake the environmental awareness training on site. The ECO is responsible for developing training modules, providing environmental training to employees on site, identifying additional training, maintaining a master set of training material, scheduling training sessions, maintaining training records, and updating this procedure as and when necessary. The ECO is to identify additional environmental training (revision and update of course) at least annually.

The environmental awareness plan for the proposed KaNgwane Anthracite Mine outlines the environmental aspects for which training must be provided, optional methods of training, scheduling, and content of training sessions.

14.3. Training Requirements

There are two types of training which will be undertaken, namely awareness and ongoing environmental training / education. Awareness training refers to acquiring knowledge of the Environmental Policy, environmental management programme requirements, legal requirements and key environmental issues.

Awareness training planned will be:

- General in nature;
- Similar in content irrespective of job description;
- Delivered from an environmental perspective; and
- Conducted in a classroom setting or during site visits.

Environmental education will be job-orientated and refers to training delivered to ensure that any task that may have a significant impact on the environment is performed properly. Competency training usually:

- Is specific in nature;
- Is dependent on the job description of the employee;
- Is aimed at ensuring that employees perform key tasks (or set of tasks) correctly; and
- Involves both classroom instruction as well as on-the-job training and task observations.

Both types of training must be performed as part of the proposed KaNgwane Anthracite Mine environmental awareness plan. Personnel may require either awareness or competency training, or both, depending on their organisation, position within that organisation and specific job function. The agenda for the environmental awareness course/ induction would typically consist of the following:

- What is the environment;
- Why must we look after the environment;
- How do we look after the environment;
- Details of the working areas;
- Management of streams and rivers;
- Management of flora and fauna;
- Identification and management of heritage and palaeontological resources;
- Details regarding smoking and fires;
- Management of petrol, oil and diesel;
- Dust management;
- Ablution facilities;
- Waste management;
- Traffic safety; and

- Emergency procedures and numbers.

14.4. Frequency and Scheduling of Training

All new employees will be expected to undergo environmental awareness training as part of their induction. This induction should occur within the first two weeks of employment. Contractor employees whose work has or can have a significant environmental impact must undergo awareness training prior to the commencement of any such activities. The proposed KaNgwane Anthracite Mine employees whose work has, or can have, a significant environmental impact must, upon employment, have a personalised training program developed as part of their job description. Performance assessments will also measure his/ her compliance on environmental issues under his/her control. This schedule will be drawn up by the employee and a 'mentor' assigned to the employee. This program should include any required competencies associated with that employee's environmental management role, and the means and timeframe by which this competency is meant to be achieved. Adherence to this program should be monitored by the employee and mentor, and the mentor should sign-off the employee as competent once the program has successfully been completed.

15. FINANCIAL PROVISION

In order to ensure that Main Street 800 provide sufficient funds for the total quantum to cover the rehabilitation, management and remediation of negative environmental impacts, the quantum for closure-related financial provision in terms of Section 41 of the MPRDA has been determined. The quantum calculation associated with the rehabilitation of the proposed infrastructure is included on the next page. Main Street 800 will make provision in this regard available by the means described in Section 53 of the MPRDA.

The financial provision for the proposed activities at KaNgwane Anthracite Mine was calculated to be R 48 550 396.07 **should rehabilitation activities be undertaken by the** Applicant according to the DMR Guideline for Calculation of the Quantum for Closure Related Financial Provision.

Should the Mine be faced with unforeseen closure the financial provision required by the DMR was calculated to be R 67 523 890.86 according to the DMR Guideline for Calculation of the Quantum for Closure Related Financial Provision.

MPRDA Regulation 41(3) Calculation of the Quantum for Closure Related Financial Provision - Base Case

Site/Facility Name	KaNgwane Anthracite Mine
Mineral Mined/Saleable By-product	Coal / Anthracite
Primary Risk Class	Class A - High Risk
Area Sensitivity	High (Determines multiplication factor for 6, 8(C) and 13)
Level of Information Available	Limited
Closure Components, Closure Costs and Weighting Factors	As below

Closure Component No.	Main Description (as per DME Guideline)	Relevant Component On-site (Description)	Unit	Master Rates as per DMR, 2011	Quantity	Multiplication Factor	Nature of Terrain / Relevant Weighting Factor *Flat = 1*	Amount
1	Processing Plant	Includes provision for dissassembly and removal of plant infrastructure (incl. foundations, structures and conveyors) to ground level. Also incl. breaking down of any concrete buildings / structures **at plant** (& concrete hard-stand areas between buildings) to ground level and disposal to voids on-site.	m^3	R 9.67	85500.00	1	1	R 826 785.00
2(A)	Demolition of steel buildings and structures	Includes portable offices, portable sewage treatment plants and weighbridge	m^2	R 134.76	5096.00	1	1	R 686 736.96
2(B)	Demolition of reinforced concrete buildings and structures	Typically includes weighbridge, minimal fixed structures, foundations and hard-standing areas i.e. helipad	m^2	R 198.59	4392.00	1	1	R 872 207.28
3	Rehabilitation of access roads	Service, haul and access roads to pits, PCDs, dumps and CHPP, within and around plant area.	m^2	R 24.11	217803.00	1	1	R 5 251 230.33
4(A)	Electrified railway lines	None, trucks to be utilised on existing road network.	m	R 234.06	0.00	1	1	R 0.00
4(B)	Non-electrified railway lines		m	R 127.67	0.00	1	1	R 0.00
5	Demolition of housing and facilities	No workers to be housed on-site. Sewage treatment facilities will be a package facilities to be removed off-site at closure.	m^2	R 269.52	0.00	1	1	R 0.00
6	Opencast rehabilitation including final voids and ramps	Opencast strips are 40m x 100m in extent and a max of three will be open at any point during mining. Concurrent infilling with material from subsequent strips and waste rock followed by shaping and covering. Also includes provision for water management measures.	ha	R 141 284.50	60.70	1	1	R 8 575 969.15
7	Sealing of shafts, adits and inclines	Underground mining will occur through the opencast pit and rehabilitation will be undertaken within opencast rehabilitation.	m^3	R 72.34	0.00	1	1	R 0.00
8(A)	Rehabilitation of overburden and spoils	An average of 13 580m^3 of overburden per day will be stockpiled temporarily and thereafter re-introduced into pit during mining operations.	ha	R 94 189.67	60.63	1	1	R 5 710 908.07
8(B)	Rehabilitation of processing waste deposits and evaporation ponds (basic, salt-producing waste)	None	ha	R 117 311.53	0.00	1	1	R 0.00
8(C)	Rehabilitation of processing waste deposits and evaporation ponds (acidic, metal-rich waste)	Discard dump will occupy an approximate footprint of 36ha	ha	R 340 728.59	36.00	1	1	R 12 266 229.24
9	Rehabilitation of subsided areas	Subsidence is not foreseen to occur.	ha	R 78 859.66	0.00	1	1	R 0.00
10	General surface rehabilitation, including grassing of all denuded areas	Includes provision for ripping, applying topsoil and re-vegetating all mine areas aside from the pits which will be subject to rehabiliation measures leaving denuded footprints (mainly plant and site infrastructure, dams and discard dump footpring).	ha	R 76 614.11	132.55	1	1	R 10 155 253.91
11	River diversions	The low level crossing over the Mambane stream will be removed and rehabilitated.	ha	R 76 614.11	0.60	1	1	R 45 968.47
12	Fencing	Along the south of the mining area and along the east of the discard dump and plant area.	m	R 85.11	4830.00	1	1	R 411 081.30
13	Water management	Includes provision for separating clean and dirty water, managing polluted water (draining of storage water dam and pollution control dams) and managing the impact on groundwater, including treatment and management of decant if required.	ha	R 28 370.38	12.12	1	1	R 343 979.79
14	2-3 years of maintenance and aftercare	Maintenance and aftercare of all areas affected by proposed mining activities incl. opencast areas	ha	R 9 929.63	193.25	1	1	R 1 918 907.95
							SUM OF CLOSURE COMPONENT COSTS	R 46 238 472.45
							SUBTOTAL 1 = (SUM OF CLOSURE COMPONENT COSTS) X (WEIGHTING FACTOR 2 = 1.05)	R 48 550 396.07
							PRELIMINARY AND GENERAL MANAGEMENT = 12% OF SUBTOTAL 1	R 5 826 047.53
							CONTINGENCIES = 10% OF SUBTOTAL 1	R 4 855 039.61
							SUBTOTAL 2 = (SUBTOTAL 1) + (PRELIMINARY AND GENERAL MANAGEMENT) + CONTINGENCY	R 59 231 483.21
							SUBTOTAL 3 = SUBTOTAL 2 EXCLUSIVE OF VAT AT 14%	R 59 231 483.21
							VAT = 14% OF SUBTOTAL 3	R 8 292 407.65
							GRAND TOTAL = SUBTOTAL 3 + VAT	**R 67 523 890.86**

16. REFERENCES

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- Middleton B.J., Bailey A.K., 2005. *Water Resources of South Africa*, 2005 (WR2005) Version 1. Water Research Commission Project No. K5/1491
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- Department of Water Affairs and Forestry (DWAF), 2005. *A practical field procedure for identification and delineation of wetlands and riparian areas.* Pretoria.
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