Integrated Water and Waste Management Plan for Kebrafield (Pty) Ltd Roodepoort Colliery

in support of a

Water Use Authorisation in terms of Section 40 of the National Water Act, 1998

On

the farm Roodepoort 151 IS,

Mpumalanga Province

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Title:

Integrated Water and Waste Management Plan in support of a Water Use License Authorisation in terms of Section 40 of the National Water Act, 1998, for Kebrafield (Pty) Ltd on the farm Roodepoort 151 IS, Mpumalanga Province

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IWWMP/KF/201309/R1 (Draft)

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September 2013

EXECUTIVE SUMMARY

Background

Roodepoort Colliery (Pty) Ltd is the operational arm of Kebrafield (Pty) Ltd that applied for a mining right to mine coal on the farm Roodepoort 151 IS near Pullenshope in the Mpumalanga Province. Kebrafields (Pty) Ltd is an emerging coal mining company. The Mining Right Application includes various portions of the farms Driefontein, Geluk, Bultfontein, Wolvenfontein and Roodepoort that is situated within the Steve Tshwete Local Municipality and Nkangala District Municipality, Province of Mpumalanga.

Management objectives and targets

The Management of Kebrafields (Pty) Ltd is committed to adhere to the stipulations of their approved Environmental Management Plan, the commitments as contained in the Integrated Water and Waste Management Plan as well as any condition as contained in an issued environmental authorisation.

Process Description

The Kebrafield project will be a small-scale open cast coal mining activity using truck and shovel methods to abstract the No 1 coal seam found on the properties. Concurrent rehabilitation will be conducted by means of the lateral rollover mining technique. Access to the coal reserves will be via an initial box cut and an access ramp. No beneficiation plant will be constructed as only crushing and screening activities will take place on site.

Environmental Description

Temperature: The extreme temperatures are about 42°C and 31°C respectively. The minimum temperatures range from 18.7°C in January and 6.2°C in July, whilst extreme lows may reach 8°C and - 7°C respectively.

Rainfall: An average of 672 mm of rainfall a year is recorded. The rainy season for the Witbank region is between October and March where 89.7% of the annual rainfall is recorded.

Evaporation: The average annual evaporation is 1 588 mm, which exceeds the average annual rainfall (672 mm).

Wind Field Data: Winds are most frequently recorded from the north, east and east-south-east sectors, occurring for more than 10% of the time in each sector. Stronger winds (>5.6m/s), which can transport dust off-site, has only been recorded for the east and east-south-east sectors, indicating that occurrence of this wind speed is minimal

The proposed mining area is situated within the northern section of the Witbank Coalfield. The strata in which the coal seams occur consist predominantly of fine, medium and coarse-grained sandstone with subordinate mudstone, shale, siltstone and carbonaceous shale. The No 2 and 4

coal seams are economically viable with an average thickness between 0 and 3.5 meters with an average width of 1.6 meters.

The soil chemical status (fertility) is high and reflects a high potential for crop production. The predominant soil type Avalon and Huttons with grazing areas classed as Westleigh and Longlands. The clay percentage differs between 15 and 30%.

The project area is falling within the Mesic Highveld Grassland Biome, specifically the vegetation type classified by Acocks (1988) as Bankenveld (61). Transformation of this vegetation type has mainly been due to cultivation (27.68%), urbanization (7.88%) and mining and quarries (2.12%). Trout and fly-fishing are also common in the area.

Water System Characterisation

The mining area is located in the upper reaches of the Woestalleen Spruit in quaternary drainage area B12B of the Klein Olifants River sub-management area of the Olifants Water Management Area. The Mean Annual Runoff (MAR) for B12B is 105.7 mm.

A bio-monitoring survey was conducted at three monitoring points in the unnamed tributaries of the Woestalleen Spruit. KFBM02 was in the bottom valley channelled wetland on the farm Roodepoort. KFBM03 was upstream of the proposed mining area and KFBM04 was downstream of the proposed mining area. According to the Ecological Reserve Study by Palmer and Rossouw (2001), the water quality of the Klein Olifants River is considered to be D: Moderately modified. This category was used to determine the current reference scores for the stream.

The measured biota-specific water quality variables indicated that it did not limit aquatic life. The Invertebrate Habitat Assessment System (IHAS) showed that KFBM02 and KFBM03 were able to support macro-invertebrate communities, while few macro-habitats were available at KFBM03. The SASS5 scores at all monitoring points were much lower than the reference score. However, of the 19 families that were found at the three points seven families were sensitive to pollution, again indicating that the water was not polluted. Compared to the reference scores, KFBM01 was largely impaired, while KFBM02 and KFBM03 were severely impaired. It must be noted that a low SASS5 in conjunction with a low IHAS should not necessarily be regarded as poor stream quality. Impacts on the monitoring points include the construction of a dam wall nearby KFBM01, grazing, erosion, a storm water culvert, road and pylons at KFBM02 and agriculture, dam erosion, gullies at KFBM03. It is also important to remember that this bio-monitoring was conducted in the dry season. This might have influenced the availability of habitats. Additionally, many macro-invertebrate species undergo seasonal changes and egg and larvae phases are more difficult to identify to family level. This might have influenced the SASS5 scores.

Environmental Impact Assessment

Various specialist investigations were conducted to determine the impact of mining on the receiving water environment. The mine is located within an area that is not regarded for its biodiversity. The impact of the mine on the water environment varies from a high significant rating towards moderate. However, with the implementation of mitigatory measures the impact rating is moderate

to low. Typical expected impacts are water quality deterioration, impact on catchment yield, potential for acid mine drainage and spillage into a potential sensitive environment causing total degradation of wetlands.

Water Management Programmes

Waste minimisation and recycling

Very little waste will be produced on site as no washing of coal will take place. However the following waste management hierarchy will be applied: reduce at source, re-use, and re-cycle. Any waste generated will be disposed in an environmentally responsible manner.

Water Use Efficiency

To increase water use efficiency water spillages will be prevented and if it occurs the problem will be addressed as soon as possible. In addition water will be re-used, i.e. water from the mining area (pit dewatering) will be captured in the water pollution control dams and re-used in dust suppression.

Water Containing Waste

No sewage effluent will be produced as the mining activities will make use of a portable chemical toilet. The only other "waste water" generated on site will be from stormwater runoff and pit dewatering. This water will be channelled to the water pollution control dams for re-use.

Storm Water Management

Storm water management measures will comply with GN704 regulations. Each open pit area will have clean storm water diversion to prevent water from entering the mining areas. In addition, dirty storm water from each mining site will be contained in a HDPE lined pollution control dam that will comply with GN704 regulations.

Groundwater Management

Several impacts had been identified that could influence the ambient groundwater quality of the area. The most significant impact is the formation of Acid Mine Drainage (AMD) and the potential for decanting to occur. Mitigations to prevent decanting of the opencasts include the reduction of the hydraulic conductivity of the opencast backfilled material, reduction of the rainfall recharge at the opencast, evaporating water from the final void in the pit, intercepting decant or redesigning the aerial extent of the opencast.

Remediation and Rehabilitation

The mining areas will be rehabilitated to a state as prescribed by DMR or the land owner. A final rehabilitation and closure plan needs to be drawn up and will be implemented concurrently with closing of the open pits. Proper stripping, stockpiling and shaping of the spoil layer are important to ensure efficient rehabilitation to set post-mining land capability classes.

Water Monitoring

Both surface and groundwater monitoring will take place. Groundwater will be monitored for water

levels and for water quality at existing boreholes and newly drilled boreholes.

Surface water quality monitoring was conducted to characterise the receiving environment. This surface monitoring program will continue, in addition, new monitoring points will be identified as the need arise. The amount of water used in the mining process will be recorded, as the volume of water required for potable use.

The storm water contained in the water pollution control dams and pit dewatering will be monitored for quality and any emergency incident will be reported.

Emergency and Contingency Discharge Management

In case of an extreme rainfall event, the risk of spilling or overflow from the water pollution control dam to the wetland systems are or Woestalleen Spruit catchment considered to be low. However, should this occur these incidents will be monitored and records will be kept.

Public Consultation

Interested and Affected Party consultation was initiated to provide stakeholders an opportunity to raise their concerns regarding the application. The application by Kebrafields for a mining right on the farm Roodepoort 151 IS were attended by stakeholders such as representatives of Optimum Colliery, Steve Tshwete Local Municipality, Pullenshope residence and others.

Regulatory Control

The proposed mine is located on a Greenfield Site and is surrounded by opencast coal mines, Hendrina Power Station, active agricultural practices and residential development located adjacent to the property. The area is therefore disturbed by agricultural, mining and power generation activities and few natural habitats remained on the area earmarked for mining. The proposed mine is also not directly impacting on any sensitive environment but indirectly could contribute towards environmental degradation by means of diffuse pollution sources. The mine is a short term project (5 years).

For any mining activity to commence the required environmental authorisations must be in place. Regulatory control and compliance with environmental legislation must be enforced through the entire life cycle of the mine. Kebrafield: Roodepoort Colliery must monitor progress regarding compliance with conditions of the water use license.

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ACRONYMS

(B)AEMC	(Best) Achievable Environmental Management Class
AEV	Acute Effect Value
AMD	Acid Mine Drainage
BID	Background Information Document
CEV	Chronic Effect Value
CV	Calorific Value (MJ/kg)
DMR	Department of Mineral Resources
DWA	Department of Water Affairs
EIS	Ecological Importance and sensitivity
ELU	Existing Lawful Use
EMF	Environmental Management Framework
EMP	Environmental Management Plan
EMPR	Environmental Management Programme Report
GN	Government Notice
Ha	hectare
I&AP	Interested and Affected Party
IWWMP	Integrated Water and Waste Management Plan
km	Kilometre
km^2	square kilometre
m^2	square meters
m^3	cubic meters
m^3/a	cubic meters per annum
m^3/d	cubic meters per day
m^3/m	cubic meters per month
mbgl	metres below ground level
mm	millimetre
MPRDA	Mineral and Petroleum Resources Development Act, 2002
NEMA	National Environmental Management Act, 1998
NGO	Non Government Organisation
NWA	National Water Act, 1998
SEMP	Standard Environmental Management Plan
SHEQ	Safety, Health, Environment and Quality
SWL	Static water level
TWQR	Target Water Quality Range
WULA	Water Use License Application

1. INTRODUCTION

1.1 BACKGROUND

Roodepoort Colliery (Pty) Ltd is the operational arm of Kebrafield (Pty) Ltd which proposed to mine coal on the farm Roodepoort 151 IS near Pullenshope in the Mpumalanga Province. The proposed area of the coal mining operation is situated in close proximity to the Optimum Colliery operations of the Ingwe Coal Operations (see **Figure 1-1**).

The operation will specialise in the extraction of coal by means of opencast mining methods which entails the conventional truck and shovel mining method using the lateral rollover technique. The number 1 seam will be the targeted coal seams for the proposed mining operation. Access to the coal will be via an initial box cut and an access ramp.

The history of the Project is summarised in **Table 1-1**.

Table 1-1: History of Mining Right Application for Kebrafield

Date	Activities
January 2011	Kebrafield (Pty) Ltd appoints GEM Science to conduct required studies to obtain environmental authorisations for Roodepoort Colliery
June 2011	Environmental Management Program Report approved by DMR
April 2013	Mining Right MP 30/5/1/2/2/479 MR issued to Kebrafield (Pty) Ltd
May 2013	Kebrafield (Pty) Ltd conduct pre-feasibility study to determine viability of Roodepoort Colliery Project near Pullenshope
June 2013	Eco Elementum (Pty) Ltd appointed to coordinate the WULA for Roodepoort Colliery
July 2013	Fieldwork commence to conduct supporting studies in the field of aquatic ecology, geohydrology, surface water and wetland delineation
October 2013	Compile WULAR and IWWMP for Roodepoort Colliery for several section 21 water uses

1.2 CONTACT DETAILS

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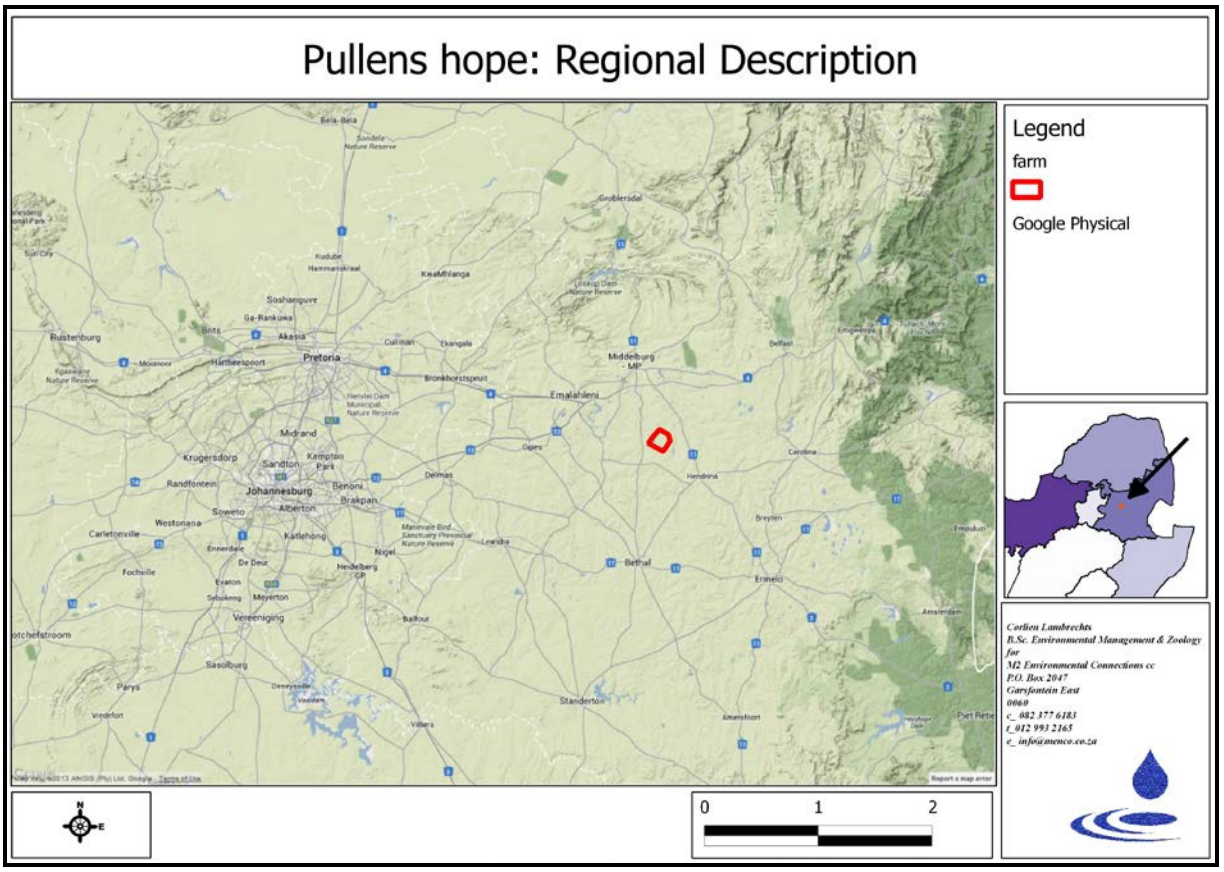

Figure 1-1: Regional Setting of Kebrafields (Pty) Ltd

1.3 LOCATION OF PROJECT

The operation falls under the jurisdiction of the Steve Tshwete Local Municipality, situated within the Nkangala District Municipality in Mpumalanga. In relation to surrounding towns and communities, the operation is situated on the farm Roodepoort 151 IS (see **Figure 1-1**) 22 km northwest of Hendrina on the Woestalleen District Road and 5 km west of the town of Pullenshope.

The area consists of gentle undulating landscapes with open veld, pans and wetlands. There is a small stream (Woestalleen Spruit) with several dams in the channel. The Hendrina and Pullenshope areas are known for its farming and agricultural potential. In addition there are also central pivot irrigation, cattle and stock farming activities taking place in the immediate vicinity of

the project. Surface water resources in the area are indicated in **Figure 1-3**.

1.4 PROPERTY DESCRIPTION

1.4.1 Holders of mineral- and surface rights

The current holders of mineral and surface rights within the project area are given in **Table 1-3**. In terms of an agreement with the Mineral Right Holder the area as depicted in **Table 1-3** will be mined by Kebrafield (Pty) Ltd. The boundaries of the applicable area of the farm Roodepoort 151 IS are illustrated in **Figure 1-2**.

Table 1-2: Mining Right Area

Portions	Farm
11, 15, 17, 18 and 19	Bultfontein 187 IS
1, 4, 6-11, 20-25 and Remaining Extent	Driefontein 153 IS
8, 14, 16, 18-22	Geluk 26 IS
4, 10, 16, 17	Wolvenfontein 471 JS
1, 2, 3, 5, 8, 9, 10, 11, 13, 17, 18	Roodepoort 151 IS

Table 1-3: Property and Mining Right Details of Kebrafield Project Area

Property Name:	Ptn	LPI Code:	Area:	Title Deed:	Owner
Roodepoort 151 IS	17	T0IS000000000115100017	409.3832 ha	T4074/2001	JC van Wyk

1.4.2 Land claims

The farm Roodepoort 151 IS belongs to Mr Joseph Christiaan van Wyk. No land claims have been lodged for the farm Roodepoort 151 IS where Kebrafield (Pty) Ltd as the applicant is envisaged to mine for coal.

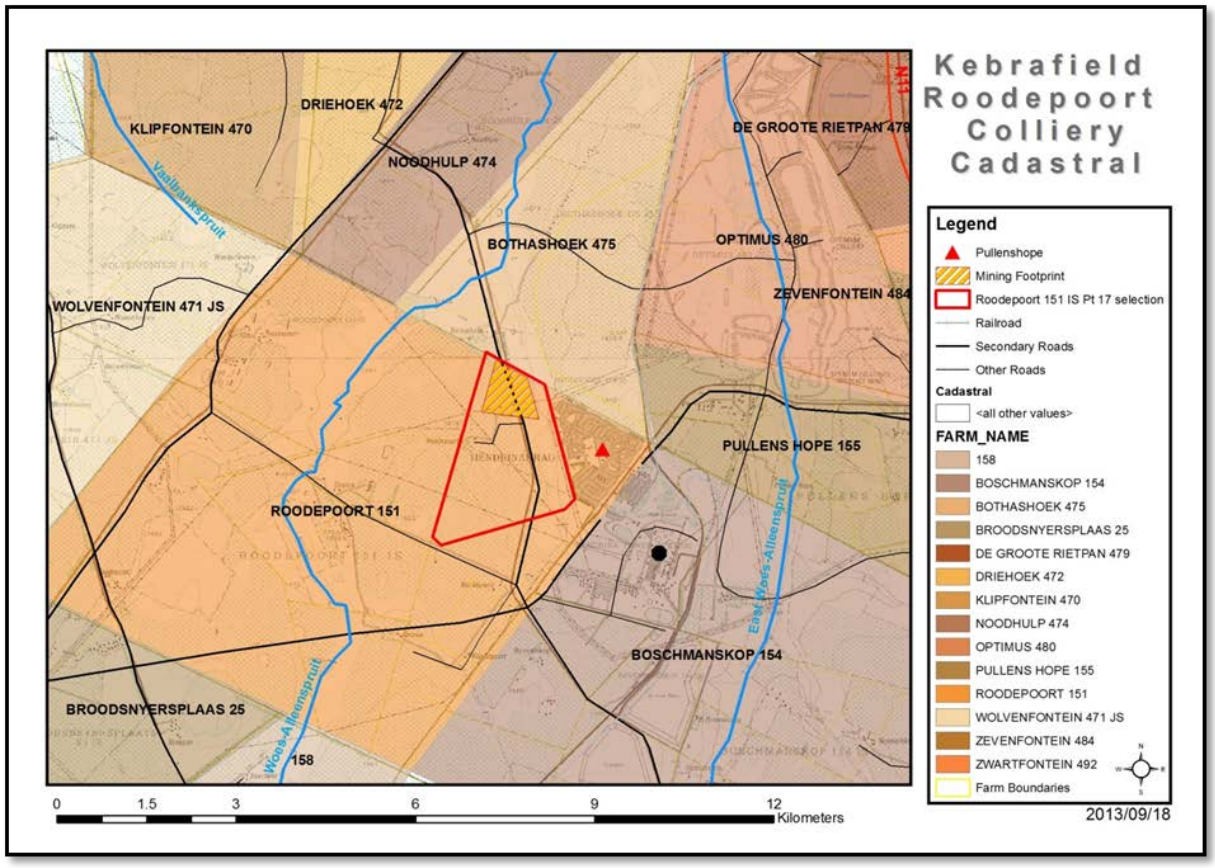

Figure 1-2: Project boundaries of the proposed colliery

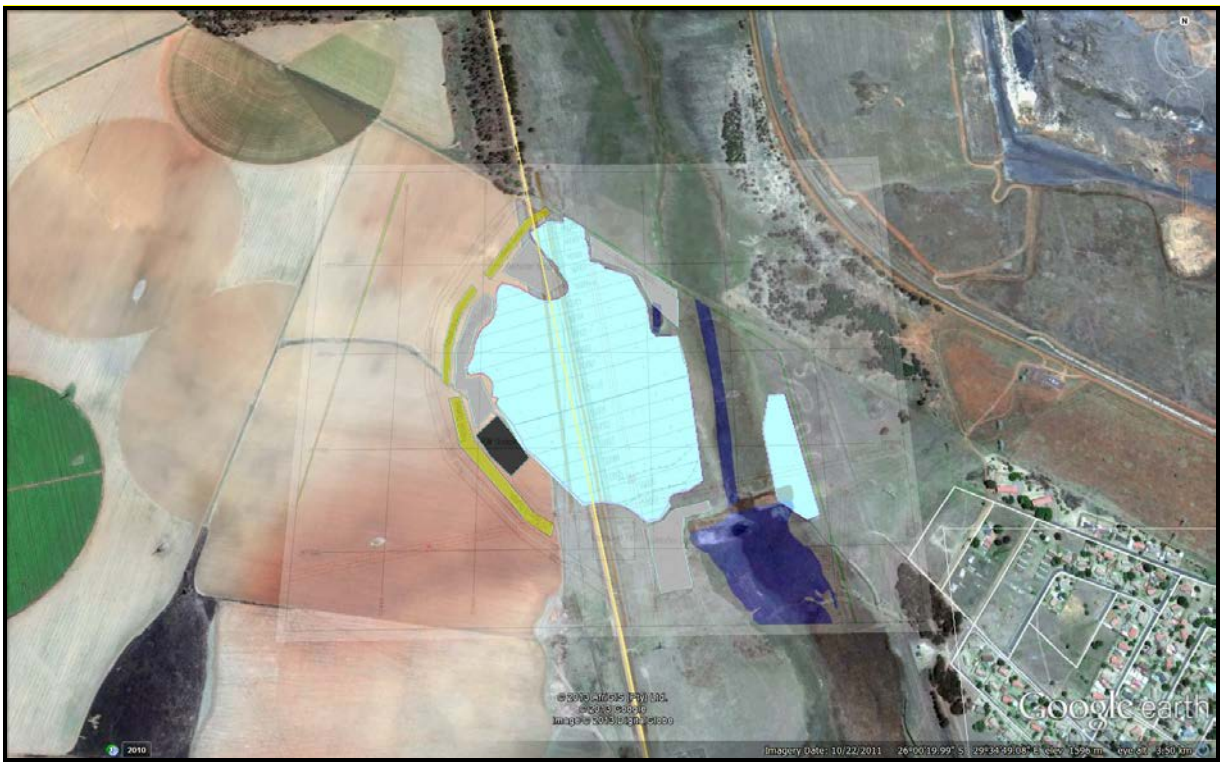

Figure 1-3: Location of water resources within the mining area

1.5 LEGAL ASSESSMENT

1.5.1 Existing Lawful Uses

An Existing Lawful Water Use (ELU) as defined by Section 32 of the National Water Act, 1998 (Act 36 of 1998) is a water use that has taken place at any time during a period of two years immediately before the date of commencement of the Act and was authorised by a law before the date of commencement. As such there is no existing lawful water uses on the farm Roodepoort 151 IS in relation to the current proposed mining activities.

1.5.2 Section 25 transfer of water uses

In terms of Section 25 of the NWA, a person holding an entitlement to use water may surrender that entitlement in order to facilitate a licence application. Mr JC van Wyk, owner of the farm Roodepoort, is not to surrender any water use to the applicant. Kebrafield (Pty) Ltd will however continue to apply for a water use license on the farm for mining (industrial) use.

1.5.3 Summary of Water Uses

The following water uses have been identified and are being applied for (**Table 1-4**), to be licensed in accordance with Section 40 of the National Water Act, 1998 (Act 36 of 1998), namely:

- Section 21 (a) – Taking of water from a resource;
- Section 21 (c) – Impeding or diverting the flow of water in a watercourse;
- Section 21 (g) – Disposing of waste which may detrimentally impact on a water resource (waste rock dump, pollution control dam (2));
- Section 21 (i) - Altering the bed, banks, course or characteristics of a watercourse; and
- Section 21 (j) – Dewatering activities.

It should be noted that the section 21(c) and (i) water uses relates to the fact that the proposed mining footprint will intersect areas where the outer perimeter of delineated wetland areas fall within the 500 meter buffer zone as contemplated in GN 1198 of 18 December 2009. A water use authorisation needs to be lodged with the Department of Water Affairs to mine up to 100 meters of the delineated wetland areas.

A more detailed description of the various water uses are contained in the Water Use License Application Report (WULAR) as compiled by MENCO dated October 2013.

Table 1-4: Detailed information on water uses to be licensed, their location and description

	Activity	Coordinates	Description	Type
S21(a)	Taking water from a resource	S 26° 0'29.01" E 29°34'57.46"	Estimated at 150 m^3/month (30 days)	License
S21(a)	Taking water from open pit	Begin at: S 26° 0'9.21" E 29°34'45.09" End at: S 26° 0'28.59" E 29°34'51.58"	Whole open cast at 630 m^3/d or 10 m^3/d for any 3 cuts open	License
S21(c) & (i)	Impacting on the natural drainage of the channelled bottom valley wetland: Pullenshope system	Begin at: S 26° 0'14.37" E 29°34'54.99" End at: S 26° 0'27.99" E 29°34'56.60"	The mining activities will not impact on this wetland but within 500 meter zone	License
S21(c) & (i)	Impacting on the natural drainage of temporarily wetland	Start: S 26° 0'5.82" E 29°34'43.05" End: S 26° 0'14.21" E 29°34'55.09"	Total length of disturbance: 0.4km or 400 m	License
S21(c) & (i)	Impacting on the natural drainage of water of the non-channelled bottom valley wetland	Start: S 26° 0'14.24" E 29°34'52.28" End: S 26° 0'16.55" E 29°34'52.33"	Total length of disturbance: 0.075 km or 75 m	License
S21(g)	Pollution Control Dam 1	Estimated at: S 26° 0'15.17" E 29°34'52.38"	It is anticipated that a lined dam with an estimated capacity of 18 000 m^3 will be used	License
S21(g)	Disposing of hard overburden material	Estimated at: S 26° 0'30.44" E 29°34'52.63"	Total volume of material to be used in backfill 15843588 m^3	License
	Disposing of soft materials	Estimated at: S 26° 0'11.67" E 29°34'42.94"		License
	Residue dump at crushing and screening plant	Estimated at: S 26° 0'17.69" E 29°34'38.81"	Small volume of water for dust suppression	License
S21(j)	Removing water from the mining pits	Estimated at: S 26° 0'20.31" E 29°34'47.62"	See S21(a) on pit dewatering	License

Section 21 (a) water uses

The proposed mining area falls within Groundwater Taking Zone A which implies that no water may be taken from these drainage regions except as set out under Schedule 1 and small industrial users. As a coal mining activity is not considered a small industrial user, Kebrafield (Pty) Ltd will apply for a section 21(a) water use licence for their Roodepoort Colliery. Approximately 150 m^3/month of groundwater will be required for potable needs. The existing boreholes on the farm will be used to supply potable water for the mine.

Raw water for the mining activities will be abstracted from the pollution control dams on portions of the farm Roodepoort 151 IS. Approximately 20 000 m^3/month will be abstracted for dust suppression purposes.

Section 21 (b) storing of water

In terms of the extended General Authorisation initially promulgated as GN 398 on 26 March 2004 it states that quaternary drainage area B12B is excluded from the GA's for the storage of any water. There are at present 2 dams located on the mining area (**Figure 1-3**) storing an approximate total volume of less than 10 000 m^3. These dams belong to the current surface owner and are not going to be used by the mine. Therefore, the water use needs not to be registered by Kebrafield (Pty) Ltd.

Section 21 (c) Impacting on the natural drainage of the Woestalleen Spruit

The proposed mining right application entails a total area of approximately 409 ha. The footprint for the proposed opencast activities with associated infrastructure entails an area of 50 hectare that constitutes only 12% of the mining right area to be impacted by mining activities. It is anticipated that the two overburden stockpiles will impact less than 2 ha each. The location of these stockpiles will be outside the demarcated wetland areas but located within the buffer zone of 500 meters as contemplated in Government Gazette GN 1199 of 18 December 2009. Kebrafield (Pty) Ltd must apply for a section 21(c) and (i) water use authorisation for the placement of these dumps.

Section 21 (g)

There are four section 21(g) water use activities relating to this application. The first use is the disposal of water pumped from the open pit areas to the pollution control dam which allows for settling of sediments to take place and for the containment of polluted water. In addition the PCD dam will be used to collect the dirty storm water from the open cast areas.

The second use is the disposal of the waste material to discard dumps. It is proposed that there will be discard dumps for the hard overburden, soft material and discard from the crushing and screening plant. It is proposed that the discard dumps will be located outside areas that have been classified as a sensitive receptor. An anticipated 35,000 – 50,000 tons of Run of Mine will be moved per month.

The third section 21(g) water use is the residue dump at the crushing and screening plant.

The fourth waste related water use is for the dust suppression of the haul roads. Possible the backfilling of the void with overburden material will be considered as a section 21(g) water use.

Removing of water pumped from the mining area

An anticipated amount of 220 m^3/day needs to be removed from the proposed pit. This water consists of seepage from groundwater resources. Once removed from the opencast area the water is pumped to a storm water or pollution control dam for reuse or evaporation.

1.5.4 Summary of Relevant Exemptions

Storm water from upstream of the various sections of the operation is diverted away from the areas affected by the proposed mining operation. The diverted runoff is allowed to flow into the natural veld surrounding the sections, from where it flows to the drainage lines. Due to the small sizes of the various sections, the effect on stream flow is negligible.

1.5.5 Compliance with Government Notice (GN) 704

The compliance of the mine with the applicable sections of Government Notice (GN) 704 is indicated in **Table 1-5**.

Table 1-5: Compliance of the mine with applicable sections of Government Notice (GN) 704 of 4 June 1999

Section	Compliance	Exemption
4. Restrictions on locality		
No person in control of a mine or activity may-		
(a) locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year flood-line or within a horizontal distance of 100 metres from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on water-logged ground, or on ground likely to become water-logged, undermined, unstable or cracked;	NO	Included as part of this license application
(b) except in relation to a matter contemplated in regulation 10, carry on any underground or opencast mining, prospecting or any other operation or activity under or within the 1:50 year flood-line or within a horizontal distance of 100 metres from any watercourse or estuary, whichever is the greatest;	YES	Included as part of this license application
(c) place or dispose of any residue or substance which causes or is likely to cause pollution of a water resource, in the workings of any underground or opencast mine excavation, prospecting diggings, pit or any other excavation; or	NO	Part of the rehabilitation will include filling of excavations with waste rock
(d) use any area or locate any sanitary convenience, fuel depots, reservoir or depots for any substance which causes or is likely to cause pollution of a water resource within the 1:50 year flood-line of any watercourse or estuary.	YES	
5. Restrictions on use of material		
No person in control of a mine or activity may use any residue or substance which causes or is likely to cause pollution of a water	YES	

Section	Compliance	Exemption
resource for the construction of any dam or other impoundment or any embankment, road or railway, or for any other purpose which is likely to cause pollution of a water resource.		
6. Capacity requirements of clean and dirty water systems		
Every person in control of a mine or activity must-		
(a) confine any unpolluted water to a clean water system, away from any dirty area;	YES	
(b) design, construct, maintain and operate any clean water system at the mine or activity so that it is not likely to spill into any dirty water system more than once in 50 years;	YES	
(c) collect the water arising within any dirty area, including water seeping from mining operations, outcrops or any other activity, into a dirty water system;	YES	
(d) design, construct, maintain and operate any dirty water system at the mine or activity so that it is not likely to spill into any clean water system more than once in 50 years; and	YES	
(e) design, construct, maintain and operate any dam or tailings dam that forms part of a dirty water system to have a minimum freeboard of 0.8 metres above full supply level, unless otherwise specified in terms of Chapter 12 of the Act.	NOT APPLICABLE	
(f) design, construct and maintain all water systems in such a manner as to guarantee the serviceability of such conveyances for flows up to and including those arising as a result of the maximum flood with an average period of recurrence of once in 50 years.	YES	
7. Protection of water resources		
Every person in control of a mine or activity must take reasonable measures to-		
(a) prevent water containing waste or any substance which causes or is likely to cause pollution of a water resource from entering any water resource, either by natural flow or by seepage, and must retain or collect such substance or water containing waste for use, re-use, evaporation or for purification and disposal in terms of the Act;	YES	
(b) design, modify, locate, construct and maintain all water systems, including residue deposits, in any area so as to prevent the pollution of any water resource through the operation or use thereof and to restrict the possibility of damage to the riparian or in-stream habitat through erosion or sedimentation, or the disturbance of vegetation, or the alteration of flow characteristics;	YES	
(c) cause effective measures to be taken to minimise the flow of any surface water or floodwater into mine workings, opencast workings, other workings or subterranean caverns, through cracked or fissured formations, subsided ground, sinkholes, outcrop excavations, adits, entrances or any other openings;	YES	
(d) design, modify, construct, maintain and use any dam or any residue deposit or stockpile used for the disposal or storage of mineral tailings, tailings, ash or other hydraulic transported substances, so that the water or waste therein, or falling therein, will not result in the failure thereof or impair the stability thereof;	YES	
(e) prevent the erosion or leaching of materials from any residue deposit or stockpile from any area and contain material or substances so eroded or leached in such area by providing suitable barrier dams, evaporation dams or any other effective measures to prevent this material or substance from entering and polluting any water resources;	YES	
(f) ensure that water used in any process at a mine or activity is recycled as far as practicable, and any facility, sump, pumping installation, catchment dam or other impoundment used for recycling water, is of adequate design and capacity to prevent the spillage, seepage or release of water containing waste at any time;	YES	
(g) at all times keep any water system free from any matter or	YES	

Section	Compliance	Exemption
obstruction which may affect the efficiency thereof; and		
cause all domestic waste, including wash-water, which cannot be disposed of in a municipal sewage system, to be disposed of in terms of an authorisation under the Act.	YES	
8. Security and additional measures		
Every person in control of a mine or activity must-		
(a) cause any impoundment or dam containing any poisonous, toxic or injurious substance to be effectively fenced-off so as to restrict access thereto, and must erect warning notice boards at prominent locations so as to warn persons of the hazardous contents thereof;	YES	
(b) ensure access control in any area used for the stockpiling or disposal of any residue or substance which causes, has caused or is likely to cause pollution of a water resource so as to protect any measures taken in terms of these regulations;	YES	
(c) not allow the area contemplated in paragraph (a) and (b) to be used for any other purpose, if such use causes or is likely to cause pollution of a water resource; and	YES	
(d) protect any existing pollution control measures or replace any existing pollution control measures deleteriously affected, damaged or destroyed by the removing or reclaiming of materials from any residue deposit or stockpile, and establish additional measures for the prevention of pollution of a water resource which might occur, is occurring or has occurred as a result of such operations.	YES	
12. Technical investigation and monitoring		
(6) Subject to Chapter 4 of the Act, any person in control of a mine or activity must submit plans, specifications and design reports approved by a professional engineer to the Minister, not later than 60 days prior to commencement of activities relating to-		
(a) the construction of any surface dam for the purpose of impounding waste, water containing waste or slurry, so as to prevent the pollution of a water resource;	YES	
(b) the implementation of any pollution control measures at any residue deposit or stockpile, so as to prevent the pollution of a water resource; and	YES	
(c) the implementation of any water control measures at any residue deposit or stockpile, so as to prevent the pollution of a water resource.	YES	

1.5.6 Summary of General Authorisations

There are no General Authorisations applicable to this application.

1.6 EXEMPTION FROM GN 704 REGULATIONS

1.6.1 Regulation 5: Restrictions on use of material

Kebrafield has no intention to construct any dam wall or any impoundment or haul roads with material that is likely to cause pollution of a water resource. However, the coal residue and overburden will be placed back in the open pit as part of the concurrent rehabilitation program to be initiated at the colliery. In consideration of departmental Operational Policies it is a requirement to obtain approval for backfilling open voids with overburden material.

In terms of Regulation 3 the applicant (Kebrafield) must lodged an application with Director: Resource Protection and Waste to obtain approval for exemption from the requirements of

Regulation 5. It is agreed that certain materials used in the rehabilitation of open voids can influence the pollution potential thereof. The responsibility to prove that the material used will have no impact lies with the applicant. In this instance it is a requirement that sufficient scientific evidence is provided that the material to be used as part of the rehabilitation will not cause long-term residual impacts.

1.7 SECTION 27 MOTIVATION

1.7.1 Existing lawful water uses

Kebrafield has no existing lawful water uses in relation to the proposed mining area.

Kebrafield (Pty) Ltd needs to apply for a water use license in terms of section 40 of the National Water Act of 1998 (Act 36 of 1998) for the following water uses:

- Section 21 (a) – Taking of water from a resource (farm dam or borehole);
- Section 21 (c) and (i) – Altering the natural characteristics of the wetlands;
- Section 21 (g) – Disposing of waste which may detrimentally impact on a water resource (waste rock dump); and
- Section 21 (j) – Dewatering activities.

1.7.2 The need to redress the results of past racial and gender discrimination

Kebrafield (Pty) Ltd is an emerging coal company and registered as a 30% Black Empowered Company (Reg. No. 2009/018854/07) with the majority shares owned by Eyethu Coal (Pty) Ltd.

Kebrafield (Pty) Ltd is committed to the development of the South African workforce and to ensure that at all times it has available the mining operations skills and competence required for the successful mining and production of this commodity. Kebrafield (Pty) Ltd is further committed to compile a Workforce Skills Plan and pay the required skills levies. The company will at all times adhere to the requirements of the skills Development Act, the Skills Development Levies Act and any other legislation that has an impact on the skills development of the employees including the Broad-Based Socio Economic Development Charter for the Mining Industry.

Should mining prove to be feasible after the prospecting phase, Kebrafield (Pty) Ltd, as the appointed contractor of Roodepoort Colliery (Pty) Ltd will ensure that its workforce is trained, developed and empowered to be skilled, functionally literate and numerate and possesses the relevant skills required for the mining and production operation through the following five plans and/or initiatives:

- Skills Development Plan;
- Career Progression (Path) Plan;
- Mentorship Plan;
- Internship Plan; and
- Employment Equity Plan.

1.7.3 Efficient and beneficial use of water in the public interest

Taking of Water

The main source of potable water would be from boreholes at the farm Roodepoort 151 IS. Water for mining activities will be obtained from contained dirty water in the PCD as well as recycling of water from pit dewatering.

Rainfall into the pit areas will be contained and re-used at the mine for dust suppression. The quantities will depend mainly on the rainfall intensities, but is estimated at 25 000 m^3/annum if uncontaminated storm water is diverted around the mining area.

Altering the natural characteristics of the wetland areas

The opencast pit and the resulting waste rock / overburden dump will influence the natural drainage pattern of the area, thus altering the natural characteristics of the resource. However, as the mining areas are relatively small, the impact would be minimal. The Environmental Integrity and Sensitivity of the area is regarded by stakeholders worth protection and that mining should not be allowed as this activity is not considered in the best interest of the public. The areas to be affected are already impacted by either historic mining activities or agriculture activities in the area.

Disposal of waste

There are several section 21(g) applications that need to be licensed at the mining activities of Kebrafield (Pty) Ltd, namely the disposal of waste in a manner that may detrimentally impact on a water resource i.e. waste rock / overburden disposal and the containment of dirty water in pollution control dams.

Removing of water found underground (and opencast workings)

The removal of the water seeping into the opencast workings is a management measure to prevent contaminated water from leaving the area/zone of influence. This is also needed to ensure that the mining activities can continue.

1.7.4 The socio-economic impact of the water use or uses if authorised

The mining operations at Kebrafield (Pty) Ltd: Roodepoort Colliery operations have a positive impact on the regional socio-economic structure. This mining undertaking has the potential to create 100 new employment opportunities, thus impacting indirectly on 600 dependants and the economic environment. Should the application be successful and mining of coal continue it will have a positive effect in the short-term (2-4 years).

The main positive impacts are summarised below.

- Provision of employment to a number of people during the construction and operational phases. The numbers of jobs created are significant to the local and regional economy.
- A large capital investment and substantial offshore revenue generation.

- A large amount of money paid out locally in the form of the company payroll.
- Significant amounts of money paid to the government in the form of local, regional and national taxes and levies.
- Economic multiplier effects linked to the creation and support of service-sector jobs, the procurement of large quantities of consumables annually and the outsourcing of service provision to local service providers.

The positive impacts described above can be even further enhanced in the context of the communities surrounding the project site. Enhancement measures should focus on the promotion and development of small and medium enterprises in the local communities, breaking, where possible, larger contracts down into smaller more accessible contracts and where possible, promoting employment of local people.

The main potential negative impacts are summarised below.

- Both premature and planned closure of the project could have serious negative impacts on local communities reliant on the project. These can be mitigated through the promotion of diversification in the local communities by investment in small and medium enterprises, through advice and encouragement for employees on how to take responsibility of their futures in their own hands, and appropriate rehabilitation of the project site to enable the small scale farming of the land to be exploited post closure of the project.
- Population influx into the area around a project site and associated squatting and crime (including trespassing and stock theft) is often associated with the chance of job opportunities. Well defined employment/recruitment and housing policies will help negate the possibility of squatter settlements and the associated problems. In addition, co-operation with the local police will help to ensure that private property rights are protected on the project site and surrounding farmland.

1.7.5 The socio-economic impact of the failure to authorise the water use

If this project does not continue, the applicant will be prevented to invest large sums of money reaching a desperate community in the form of salaries, which will have a direct impact on the local community. The presence of the mining activity, the employment of local persons and the utilisation of local services will result in an increased income for local communities and business and an increased tax base for traditional authorities and municipalities. These opportunities will be lost should the project not proceed, and will have consequences on local, regional, national and international scale.

1.7.6 The catchment management strategy applicable to the resource

The former Department of Water Affairs and Forestry is responsible for the National Water Resource Strategy for South Africa. This strategy did define key elements for a broad strategic perspective for the Olifants Water Management Area. According to the National Water Act, 1998 (Act 36 of 1998), a Catchment Management Agency should be established for each water management area. The aim of the Catchment Management Strategy is to set principles for

allocating water to existing and prospective water users, taking into account the protection, use, development, conservation, management and control of water resources.

1.7.7 The likely effect of the water use on water users

No other water uses will be directly affected by the authorisation of the Water Use License. There are, however, benefits to the social and economic environment if the water use is authorized. However, in the instance of poor water management practices the mine has the potential to significantly contribute towards the degradation of water quality in the upper reaches of the Elands River. This will also trigger a collapse in the regional hospitality industry as several lodges are dependent on the eco-tourism industry focussing on the sensitive biodiversity of the region entailing wetlands, avifauna and trout fishing.

1.7.8 The class and the resource quality objectives of the water resource

The Minister of Water Affairs is required to establish a classification system, and to determine the class and resource quality objectives for all or part of the resources considered to be significant. No specific surface water reserve for mining has been conducted for the B12B quaternary drainage area but several studies had been completed for Eskom Water Use License Applications situated in B11B, B11F, B11G, B12B and B20F. The applications propose the abstraction of water from the Olifants River for power generation at ten power stations.

The Resource Water Quality Objective CD Vs 4.2 indicate that the B12B quaternary drainage area is at present Moderately Modified (Class C) with the Best Achievable Management class set at Class C. These classes are not different from the River Health Classes as indicated below. Using this classification, the area under investigation is classified as Class C and the best achievable class also as Class C.

An outline of the various classes is indicated below:

River Health Class	Ecological perspective	Management perspective
Natural (Class A)	No or negligible modification of in-stream and riparian habitats and biota.	Protected rivers; relatively untouched by human hands; no discharges or impoundments allowed.
Good (Class B)	Ecosystems essentially in good state; biodiversity largely intact.	Some human-related disturbance but mostly of low impact potential.
Fair (Class C)	A few sensitive species may be lost; lower abundances of biological populations are likely to occur, or sometimes, higher abundances of tolerant or opportunistic species occur.	Multiple disturbances associated with need for socio-economic development, e.g. impoundment, habitat modification and water quality degradation.
Poor (Class D)	Habitat diversity and availability have declined; mostly only tolerant species present; species present are often diseased; population dynamics have been disrupted (e.g. biota can no longer reproduce or alien species have invaded the ecosystem).	Often characterized by high human densities or extensive resource exploitation. Management intervention is needed to improve river health – e.g. to restore flow patterns, river habitats or water quality.

Interim Resource Objectives and Standards

Management area

Drainage area: B12B

River name: Klein Olifants River

Management Unit: Olifant Water Management Area

Preliminary Management Class

River Class	Perspective	Preliminary Management Class	
		Present	Future
Natural	No or negligible modification of the resource.		
Good	Moderately used or impacted resource.		
Fair	Heavily used or impacted resource.	√	√
Poor	Unacceptable degraded resource (This is not a management class but a description of an unacceptable state		

Preliminary Resource Quality Objectives

Due to the largely intact nature of the area it is anticipated that the following will be applicable:

Biological

Indicators	Present Status	Management class / target / objective
 Macro-invertebrate Integrity	 Fair	 Good
 Fish Assemblage Integrity	 Fair	 Good
 Water Quality	 Good	 Good

Habitat

Indicators		Present Status		Management class / target / objective	
	1) In-stream Habitat (Dark green) 2) Riparian Zone Habitat (Light blue) 3) Riparian Vegetation Integrity (Light green)		1) Natural 2) Natural 3) Good		1) Natural 2) Natural 3) Good

1.7.9 Investments already made by the water user

Various investments have been made by the applicant in terms of appointment of specialists to conduct environmental investigations in support of the Water Use License Application.

The potential gains for the local businesses benefiting from the project will be substantial if the mining operation is to commence. In addition the potential secondary economic gains that may flow to the local community in terms of additional revenue for businesses and services may be substantial. An increase in the number of people employed in the local communities results in an increase in the spending capacity of local people. This facilitates local economic growth.

1.7.10 Strategic importance of the water use to be authorised

The mining activity would have positive social and economic benefits that would be experienced on local, regional, provincial and national scales should coal mining be proved viable.

The benefits of the proposed mining activities include:

- Security of employment and subsequent contribution to stabilising the economic activity in the area
- An increase in foreign exchange earnings for the country
- The provisioning of coal to Eskom to provide for the sustainable generation of electricity
- The establishment of contractual agreements with Steve Tshwete Local Municipality to render services to the mine (domestic waste disposal, servicing chemical toilets)

If the project does not proceed, there will be a decrease in foreign exchange earnings for the country, which would alternatively remain at status quo should the project proceed.

2. PROJECT DESCRIPTION

2.1 PURPOSE OF THE DOCUMENT

This report has been drafted for the use by all the parties involved in the Water Use Licence Authorisation Process. The document:

- Gives an overview of the activities taking place at the operation of the Applicant;
- Provides an overview of the surrounding environment;
- Identifies the water uses as defined in Section 21 of the National Water Act, 1998 applicable to the Applicant;
- Identifies and defines issues of concern;
- Determine the possible impacts that the activities of the Applicant might have on other users;
- Provide strategies and objectives for the pro-active management of possible impacts;
- Define management and technological commitments from the Applicant to mitigate possible impacts; and
- Highlight environmental management principles, time schedules and budgets to manage environmental impacts

This report should therefore assist in the water user license authorisation process to streamline the route and ensure compliance to the following criteria:

- The report must be acceptable to the State and other stakeholders
- Measures proposed and committed to must be practical and affordable to implement with the available resources and technology within a reasonable time schedule
- It must be consistent with environmental management initiatives at national, provincial and regional level
- It should highlight sustainable development

2.2 OBJECTIVES OF THE PROJECT

It is the objective of Kebrafield (Pty) Ltd to manage the execution of this project as the safest, most efficient and cost effective project management team in the company.

They wish to meet or exceed the requirements and expectations of the company's Directors, promote the wellbeing of their environment and achieve prosperity for the company and its people.

Kebrafield (Pty) Ltd: Roodepoort Colliery believes that:

- Their greatest asset is people
- Their company objectives comes first
- Their team efforts will lead to project execution success

- Their constant improvement of productivity and open communication will achieve a defect free project execution

Kebrafield (Pty) Ltd will establish and maintain documented proof for review of its objectives. They will set measurable targets where appropriate in light of technological options by considering financial, operational and business requirements as well as the view of other interested parties.

These objectives and targets will be consistent with the company's Business Policy that includes the prevention of pollution, quality management and the health and safety of its contractors and employees. The project management team is committed to show continual improvement of these processes.

The General Integrated Environmental Management Policy including Kebrafield (Pty) Ltd's overall objectives are presented in **Section 6**.

2.3 PHYSICAL PROJECT DESCRIPTION

2.3.1 Extent of Operations

Mining for coal will be conducted on the farm Roodepoort 151 IS near Pullenshope in Mpumalanga. The mining method is by means of small-scale opencast operations entailing truck and shovel and using the lateral rollover technique.

No processing will be conducted at the coal operation. ROM from the mining area will be crushed and screened at a crush and screening plant to be placed on site as indicated on **Figure 2-1**. Coal from the open cast area will be transported via tipper trucks to the ROM stockpile. Haulage trucks will transport the coal product from the product stockpile to ESKOM.

- *Mineral deposit*

The aim of the mining is to exploit the No 2 (and potentially the no 4 coal seams) on the farm Roodepoort 151 IS. The size of the coal deposit on the property is approximately 409 hectares (of which 50 hectares will be mined).

- *Mine product*

The mine product is coal found in the No. 2 and No. 4 coal seams. The depth of the No. 2 and No. 4 coal seams below surface is 30 m and 55 m respectively. The No. 2 lower seam is a medium ash coal with low to moderate calorific value, volatile matter, moisture and fixed carbon content. Sulphur values are also low to moderate. The coal quality of the deposit is depicted in **Table 2-1**.

Table 2-1: Coal quality of the No. 2 and No. 4 seams

	Yield	C.V.	Moist	Ash	Volatile	F.C.	S
Raw coal (ROM)							

2 Seam	100 %	26.20	3.88	15.72	24.7	55.82	0.82
4 Seam	50%	23.00	ND	23.5	ND	ND	ND
Washed @ RD 1,60							
2 Seam	64 %	27.13	3.71	12.68	27.27	56.35	0.51

- *Extent of target area and estimated reserves*

The prospecting activities determined the coal reserves within the mining area. The targeted area as identified in **Figure 1-2** consisted of mainly portion 17 of the farm Roodepoort 151 IS. The estimated reserves consist of 0.80 x 10^6 tons *in situ* coal.

- *Planned production rates*

It is anticipated that a maximum 65 000 tons per month of soil, overburden and waste rock will be moved / screened. No coal washing will take place on the site, only crushing and screening. Kebrafield: Roodepoort Colliery has approximately fourteen (14) months of life as determined from the proposed production rate.

2.3.2 Mining Method and Plant

The available coal reserves will be mined by open cast utilising conventional truck and shovel mining methods. A small mobile crush and screening plant will be used to process the coal.

As soon as the mining is completed, the area will be rehabilitated as described in the Rehabilitation Plan or as agreed between, DWA, DMR and the landowner.

2.3.3 Project Life Description

The total expected life of the mining operation is approximately 1.5 years. The time frames for the various phases of the mine are provided in **Table 2-2**. It is intended to conduct care and maintenance at the mine during the post closure phase for at least one year or until steady state has been achieved.

Table 2-2: Various implementation phases of the intended mining operation

Time frames	2014	2014 – 2015	2016
Construction phase			
Operational phase			
Rehabilitation phase	Concurrent with the coal mining phase		
Closure phase		Closure plan	
ROM tons	250 000	300 000 – 400 000 tons/annum	

Mining will consist of the removal of coal from the No 2 and 4 seams and processing by means of crushing and screening the ROM for local markets as well as Eskom Power Stations. The rehabilitation phase will include backfilling of open voids and seeding of backfilled areas. Backfilled areas will be free draining. The mine closure phase will be dedicated to the maintenance of rehabilitated areas as well as the compilation of a Closure Plan.

2.3.4 Infrastructure requirements

The proposed mining related infrastructure is indicated in **Figure 2-1** and outlined below:

- Open pit
- Access ramps to open pits
- Crushing and Screening Plant
- Haul road for transport of coal to plant
- Discard/Waste Rock Dumps
- Water management facilities
- Topsoil stock pile
- Electrical supply and substation
- Workshop and Mine Office complex
- Weigh-Bridge
- French drain / septic tank waste water treatment system

The following infrastructure will be constructed in accordance with the civil engineering designs as indicated in **Figure 2-2**:

- Opencast pit: Soil, overburden and underlying coal will be removed in sequence, so that soils and overburden being removed from a section being excavated are used to backfill the previous section – lateral roll-over mining technique. ROM coal will be stockpiled and a maximum of three strips will be open at one time. The strip ratio for the opencast mining of the No.2/4 seams will be at a ratio of 4,2:1.

- Pollution Control Dams: They will form an integral part of the waste water management facilities at the mine. Contaminated water from the dirty areas will be collected via drains and storm water systems to settling or pollution control dams. The PCDs will be designed taking cognisance of the requirements as contemplated in GN 704. The design capacity of the PCD will cater for the 1:50 year flood event with 0.8 m provision for free board. The PCDs will be at least 1.5 mm HDPE lined.

- Storm water: Surface water drainage measures will be implemented in accordance with the stipulations as contained in GN 704 Regulations as endorsed by the DWA. Clean water will be diverted around the mining pit and other identified contaminated areas. Clean and dirty water will be separate systems with the emphasis on maximization of clean areas and minimization of dirty areas.

Please refer to the Civil Engineering design report by Avon Engineering (Pty) Ltd for all designs on the mine water management infrastructure as depicted in Appendix 3 of the IWWMP.

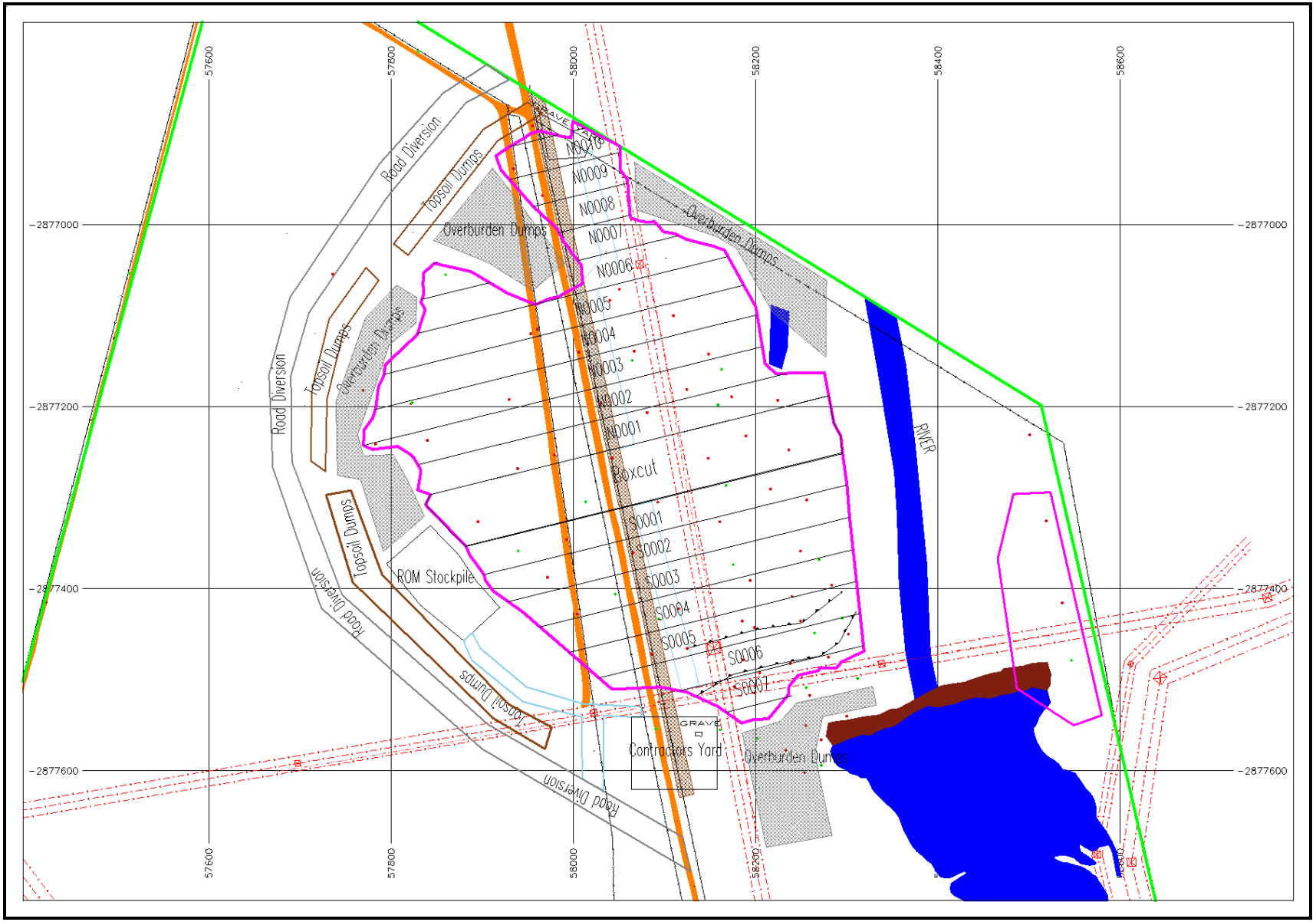

Figure 2-1: Proposed mining area and related infrastructure at Kebrafield located at Pullenshope

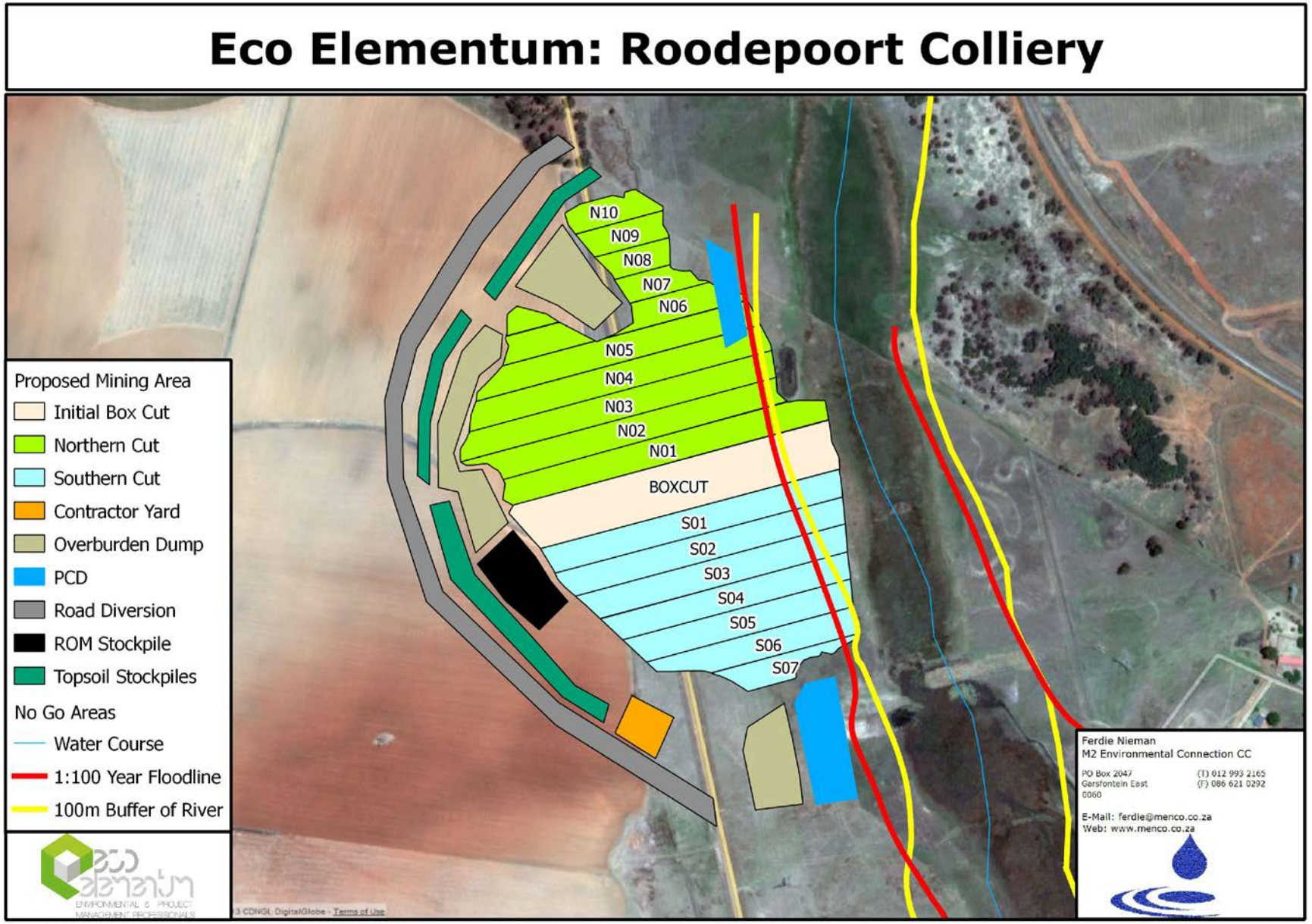

Figure 2-2: Conceptual designed mining related infrastructure for Kebrafield

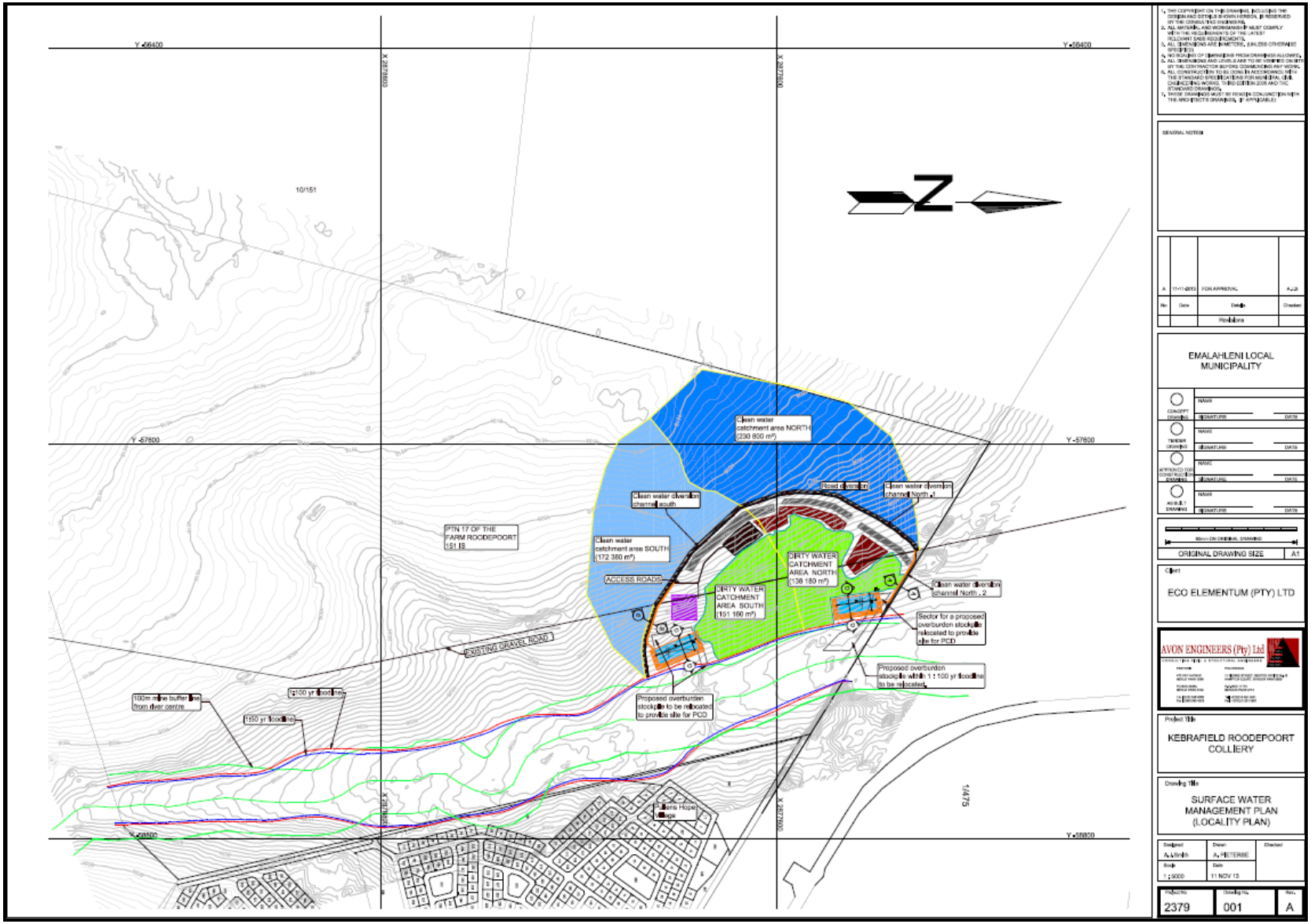

Figure 2-3: Surface water management plan

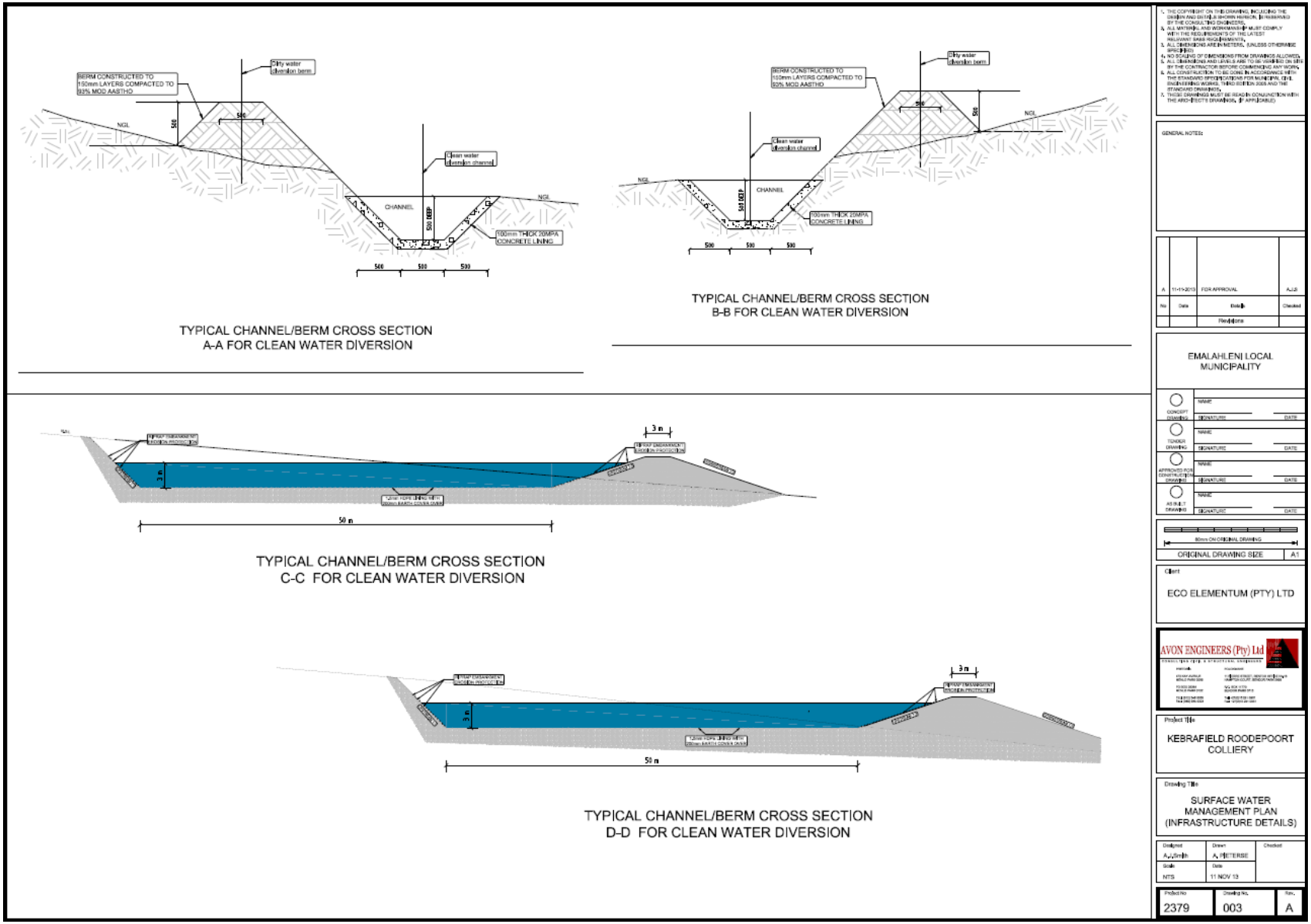

Figure 2-4: Surface water management infrastructure details

2.4 RESIDUE AND EMISSIONS

The operations consist of an opencast pit and haul roads as well as a screening plant and waste discard dumps with associated storm water infrastructure. There are no emissions applicable to the project.

2.4.1 Waste Stream Identification

General Waste

The waste generated is very little and consists of domestic refuse and industrial waste (oil and air filters, batteries, oil rags and other wastes generated as part of the mining activity). These wastes are disposed at the Belfast Landfill site. In the event of any hazardous waste such as used oil it will be recycled through Oilkor or disposal at an appropriate site (such as Holfontein). There is no need to apply for a waste permit in terms of NEMA as all general waste will be removed by the local municipality on contract basis.

Mine Residue Disposal Sites

Waste discard dumps for hard overburden, soft material and discard from the crushing and screening plant will be present as indicated in **Figure 2-1**.

2.4.2 Waste Management

Waste management will be conducted as described in **Section 6.4**.

2.4.3 Waste Recovery and Reduction

The waste discard dumps will be minimised as it will be used in the rehabilitation of the existing mining pits. Waste rock will also be used to better the existing road infrastructure on the property.

2.4.4 Water Balance

A preliminary water balance had been prepared by Avon Civil Consulting Engineers (Pty) Ltd to assist in the calculation of the required storage capacities for the PCD's. As indicated in **Figure 2-5** and **Figure 2-6** it is clear that the miner will have a surplus water make during the wet season. Two PCD will be constructed with a storage capacity of 19,000 m^3 and 17,500 m^3 respectively.

KEBRAFIELD COLLIERY DATE: 11 November 2013

POLLUTION CONTROL DAM SOUTH : DAILY WATER BALANCE SUMMARY

ANNUAL EVAPORATION	1810.39	mm
1:50 YEAR 24 HOUR STORM	126	mm
CATCHMENT	151,160	m^2
CAPACITY PROVIDED (m3)	19,046	(1:50 YEAR 24 HOUR STORM)

Month	Mean Monthly Rainfall (mm)	Days / Month	Mean Daily Rainfall (mm)	Mean Daily Capacity (m^3)	Daily Evaporation (mm)	Net Daily Balance (mm)	Net Daily Balance from Catchment (m^3)	Net daily groundwater inflow (m^3)	Daily Water Usage (m^3)	Net Daily Water Balance (m^3)	Net Monthly Water Balance (m^3)	PCD Capacity Provided (m^3)	Capacity Provided Sufficient
JAN	123.36	31	3.98	602	6.18	-2.20	-332.55	120	-450	-662.55	-20,539.11	19,046	Yes
FEB	90.15	28	3.22	487	6.17	-2.95	-445.76	120	-450	-775.76	-21,721.28	19,046	Yes
MAR	74.13	31	2.39	361	5.12	-2.73	-413.01	120	-450	-743.01	-23,033.25	19,046	Yes
APR	31.92	30	1.06	161	4.23	-3.16	-478.32	120	-450	-808.32	-24,249.62	19,046	Yes
MAY	11.06	31	0.36	54	3.39	-3.03	-457.92	120	-450	-787.92	-24,425.44	19,046	Yes
JUN	7.99	30	0.27	40	2.87	-2.61	-394.02	120	-450	-724.02	-21,720.71	19,046	Yes
JUL	10.47	31	0.34	51	3.17	-2.84	-428.86	120	-450	-758.86	-23,524.52	19,046	Yes
AUG	15.89	31	0.51	77	4.21	-3.70	-558.76	120	-450	-888.76	-27,551.42	19,046	Yes
SEP	27.68	30	0.92	139	5.73	-4.81	-727.13	120	-450	-1,057.13	-31,713.90	19,046	Yes
OCT	75.12	31	2.42	366	6.10	-3.68	-555.78	120	-450	-885.78	-27,459.22	19,046	Yes
NOV	111.22	30	3.71	560	6.17	-2.47	-372.76	120	-450	-702.76	-21,082.82	19,046	Yes
DEC	128.23	31	4.14	625	6.26	-2.12	-321.09	120	-450	-651.09	-20,183.89	19,046	Yes

WATER BALANCE (PCD SOUTH)

DAILY AVERAGE		m^3/day
Daily without 1:50 24 hour rainfall		
Max Monthly Rainfall (Dec)	128.23	mm
Average Rainfall Days	7.7	days
Average Daily Rainfall	4.1	mm/day
Annual Evaporation	1,810	mm
Average Daily Evaporation	-5.0	mm/day
Daily on site usage	-450.0	m^3/day
Groundwater inlow	120	m^3/day
Dam Surface Area	6,349	m^2

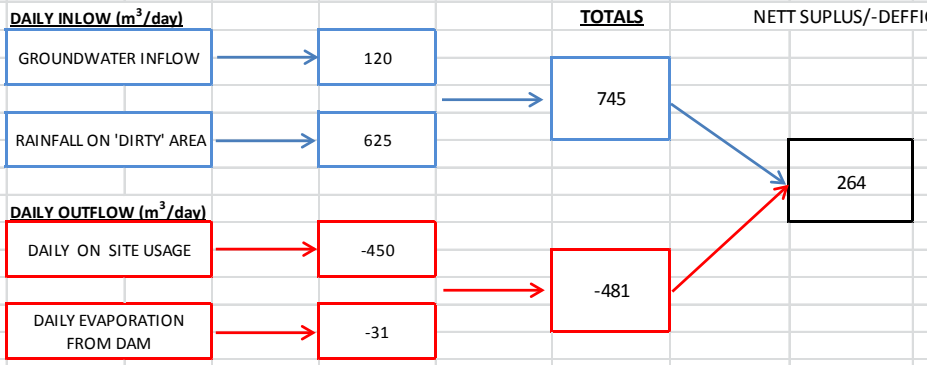

Figure 2-5: Water balance for PCD South

KEBRAFIELD COLLIERY DATE: 11 November 2013

POLLUTION CONTROL DAM NORTH : DAILY WATER BALANCE SUMMARY

ANNUAL EVAPORATION	1810.39	mm
1:50 YEAR 24 HOUR STORM	126	mm
CATCHMENT	138,175	m2
CAPACITY PROVIDED (m3)	17,410	(1:50 YEAR 24 HOUR STORM)

Month	Mean Monthly Rainfall (mm)	Days / Month	Mean Daily Rainfall (mm)	Mean Daily Capacity (m^3)	Daily Evaporation (mm)	Net Daily Balance (mm)	Net Daily Balance from Catchment (m^3)	Net daily groundwater inflow (m^3)	Daily Water Usage (m^3)	Net Daily Water Balance (m^3)	Net Monthly Water Balance (m^3)	PCD Capacity Provided (m^3)	Capacity Provided Sufficient
JAN	123.36	31	3.98	550	6.18	-2.20	-303.99	120	-450	-633.99	-19,653.54	17,410	Yes
FEB	90.15	28	3.22	445	6.17	-2.95	-407.47	120	-450	-737.47	-20,649.11	17,410	Yes
MAR	74.13	31	2.39	330	5.12	-2.73	-377.53	120	-450	-707.53	-21,933.42	17,410	Yes
APR	31.92	30	1.06	147	4.23	-3.16	-437.23	120	-450	-767.23	-23,016.95	17,410	Yes
MAY	11.06	31	0.36	49	3.39	-3.03	-418.58	120	-450	-748.58	-23,206.01	17,410	Yes
JUN	7.99	30	0.27	37	2.87	-2.61	-360.18	120	-450	-690.18	-20,705.29	17,410	Yes
JUL	10.47	31	0.34	47	3.17	-2.84	-392.02	120	-450	-722.02	-22,382.49	17,410	Yes
AUG	15.89	31	0.51	71	4.21	-3.70	-510.76	120	-450	-840.76	-26,063.47	17,410	Yes
SEP	27.68	30	0.92	127	5.73	-4.81	-664.67	120	-450	-994.67	-29,840.03	17,410	Yes
OCT	75.12	31	2.42	335	6.10	-3.68	-508.04	120	-450	-838.04	-25,979.19	17,410	Yes
NOV	111.22	30	3.71	512	6.17	-2.47	-340.74	120	-450	-670.74	-20,122.19	17,410	Yes
DEC	128.23	31	4.14	572	6.26	-2.12	-293.51	120	-450	-623.51	-19,328.82	17,410	Yes

WATER BALANCE (PCD NORTH)

DAILY AVERAGE		m^3/day
Daily without 1:50 24 hour rainfall		
Max Monthly Rainfall (Dec)	128.23	mm
Average Rainfall Days	7.7	days
Average Daily Rainfall	4.1	mm/day
Annual Evaporation	1,810	mm
Average Daily Evaporation	-5.0	mm/day
Daily on site usage	-450.0	m^3/day
Groundwater inlow	120	m^3/day
Dam Surface Area	5,800	m^2

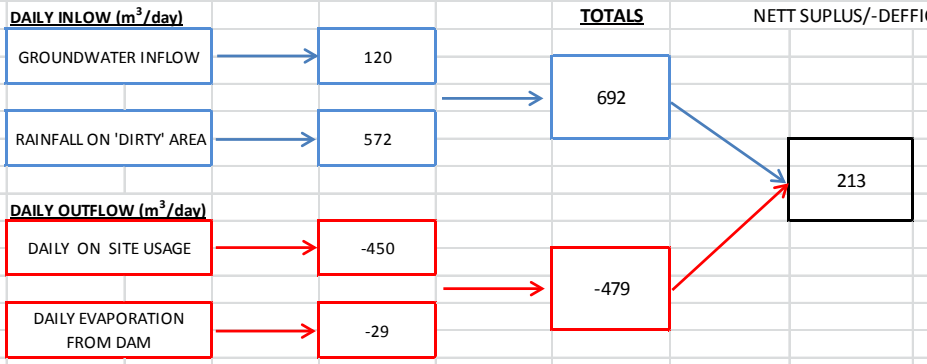

Figure 2-6: Water balance for PCD North

3. ENVIRONMENTAL STATUS AND DESIRED STATE

3.1 CLIMATE

Kebrafield Roodepoort Colliery is situated on the Mpumulanga Highveld. The usual highveld weather conditions prevail with warm summers and cold winters with the main temperature at 14:00 in winter being about 17°C. The climate of the area under investigation is classified as the Highveld region (Region H), which is defined as a climate with a temperate to warm temperature and summer rains.

3.2 RAINFALL

The average annual precipitation in the Highveld region varies from about 900 mm on its eastern border to about 650 mm in the west. The rainfall is almost exclusively due to showers and thunderstorms and falls mainly in summer, from October to March, the maximum fall occurring during January. The winter months are normally dry and about 85% of the annual rainfall falls in the summer months; heavy falls of 125 mm to 150 mm occasionally fall in a single day. This region has about the highest hail frequency in South Africa; about 4 to 7 occurrences may be expected annually at any one spot.

Kebrafield Roodepoort Colliery lies within quaternary sub-catchment B12B of rainfall zone B1B. The average precipitation for this region at weather station 0516 480 is 672 mm. The rainfall iso-lines of the area are presented in **Figure 3-1** and the rainfall characteristics as highest and lowest per month are indicated in **Table 3-1**. The project area is located within the summer rainfall region with 85% of the annual rainfall occurring between the months of October to March

Table 3-1: Average rainfall in mm for sub-catchment B12B

Stn	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
516480	115.9	87.4	72.3	42.1	14.9	7.7	6.5	6.9	25	68.5	113.4	109.7
516414	115.7	87.2	72.2	42	14.9	7.7	6.4	6.8	24.9	68.4	113.2	109.5

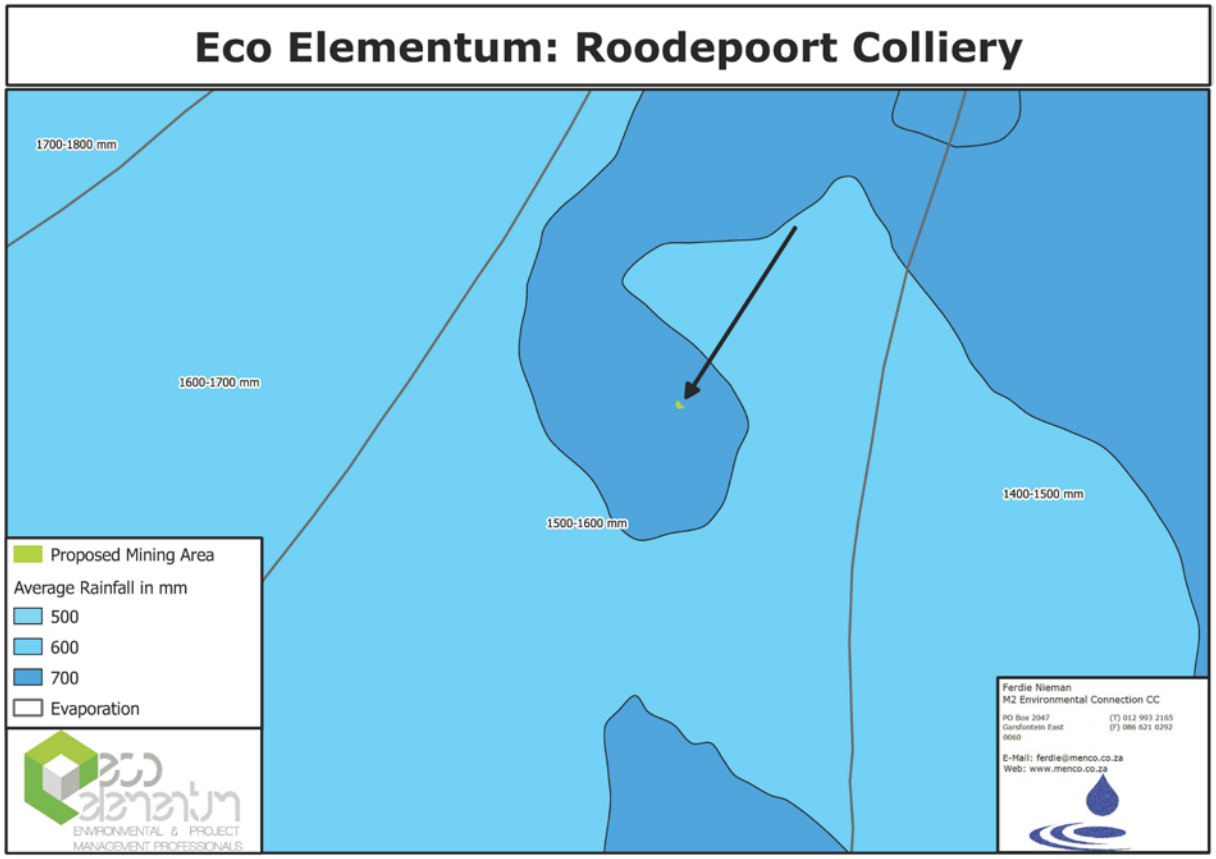

Figure 3-1: Rainfall and Evaporation Iso-lines (*Midgeley et al, 1990*)

3.2.1 Evaporation

Evaporation data was obtained from the Witbank weather station. The evaporation iso-lines as obtained from Midgeley et al (1990) are presented in **Figure 3-1**.

3.2.2 Temperature

Weather information was obtained from the database of Climate of SA (WB weather station 42) and is outlined in **Table 3-2**.

Table 3-2: Maximum, Minimum and mean monthly temperatures (degrees centigrade)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Des	Year
Max	25.6	25.2	24.6	21.8	19.5	16.5	17.1	19.9	23.2	23.9	24.0	25.3	22.2
Min	13.8	13.2	11.8	8.6	4.4	0.8	1.0	3.8	7.5	9.9	11.8	13.1	8.3
Mean	19.7	19.2	18.2	15.1	11.9	8.7	9.0	11.9	15.3	17.0	17.9	19.2	15.3
Range	11.8	12.1	12.8	13.2	15.1	15.6	16.2	16.1	15.7	14.1	12.3	12.2	13.9

The extreme temperatures are about 42°C and 31°C respectively. The minimum temperatures range from 18.7°C in January and 6.2°C in July, whilst extreme lows may reach 8°C and - 7°C respectively.

3.2.3 Wind

Wind information was obtained from the Witbank weather station (Climate SA, WB 42). On the whole winds are light except for the short periods during thunderstorms. Very occasionally tornadoes do occur and cause tremendous damage if they happen to a strike a populated area. The figure indicating wind roses below provides period wind roses for the proposed Roodepoort Colliery, with the next figure including the seasonal wind roses for the same site. The predominant wind direction is north-westerly and easterly with a >10% frequency of occurrence. Winds from the south-westerly sectors are relatively infrequent occurring <5% of the total period. Calm conditions (wind speeds < 1 m/s) occur for 11% of the time.

3.2.4 Extreme weather conditions

Frost is common in the Middelburg and Hendrina areas and snow can also occur from time to time.

3.3 GENERAL GEOLOGY

The general geology in the region is illustrated in **Figure 3-3**. The investigated area falls within the 2528 Pretoria and 2628 East Rand 1:250 000 geology series maps and is situated approximately 2 km north-west of Pullens Hope, Mpumalanga.

The proposed opencast mining areas falls within the Witbank coalfield, which extends from Belfast in the north-east to Springs in the south-west covering a surface area of approximately 9000 km2. There are five coal seams present regionally. These coal seams are numbered from 5 (top) to 1 (bottom) and the distribution of these coal seams are affected by the topography of the pre-Karoo basement and the present day erosional surface. The area is characterised by consolidated sedimentary layers of the Karoo Supergroup. It consists mainly of sandstone, shale and coal beds of the Ecca Group (Vryheid Formation) and is underlain by the Dwyka Group. Jurassic dolerite intrusions occur throughout the area in the form of sills and dykes with outcrops found throughout the whole area.

The Ecca Group (Vryheid Formation), which is part of the Karoo Supergroup, comprises of sediments deposited in shallow marine and fluvio-deltaic environments with coal accumulated as peat in swamps and marches associated with these environments. The sandstone and coal layers are normally reasonable aquifers, while the shale serves as aquitards. Several layered aquifers perched on the relative impermeable shale are common in such sequences. The Dwyka Formation comprises consolidated products of glaciation (with high amounts of clay) and is normally considered to be an aquiclude.

Figure 3-2: Regional Geology

The generally horizontally disposed sediments of the Karoo Supergroup are typically undulating. The extent of the coal is largely controlled by the pre-Karoo topography. Steep dips can be experienced where the coal buts against pre-Karoo hills. Displacements, resulting from intrusions of

diabase sills, are common. These intrusions comprise sills, which vary from being concordant to transgressive in structure, and feeder dykes. Although these structures serve as aquitards and tend to compartmentalise the groundwater regime, the contact zones with the pre-existing geological formations also serve as groundwater conduits. There are common occurrences of minor slips or faults, particularly in close proximity to the dolerite intrusives. Within the coalfield, these minor slips, displacing the coal seam by a matter of 1 to 2 metres, are likely to be commonplace.

Rocks of the Selons River Formation (Rooiberg Group) and quaternary alluvium are also present regionally. The Selons River Formation consists of porphorytic rhyolite with interbedded sandstone and mudstone.

Other lithologies that are apparent in the area include the Dwyka tillite overlain by various cycles of interbedded sandstones, shales, mudstones and coal beds.

The Pullenshope coal deposit is situated close to the northern margin of the Karoo basin and is localised to a small sub-basin to form part of the main Witbank Coalfield. The typical sequence of the Karoo Supergroup sedimentary rocks is depicted in **Figure 3-3**. Only one of the five seams (No. 1 seam) was intersected during exploration as indicated in **Table 3-3**.

Table 3-3: Coal seam intersected during exploration

Average Depth (mbgl)	Average Thickness (m)	Description
0 – 5.79	5.8	Shale
5.79 – 15.84	10.1	Shale
15.84 – 24.84	8.2	Coal
24.04 – 28.04	4.0	Shale
28.04 – 34.44	6.4	Sandstone
34.44 – 36.57	2.1	Diabase

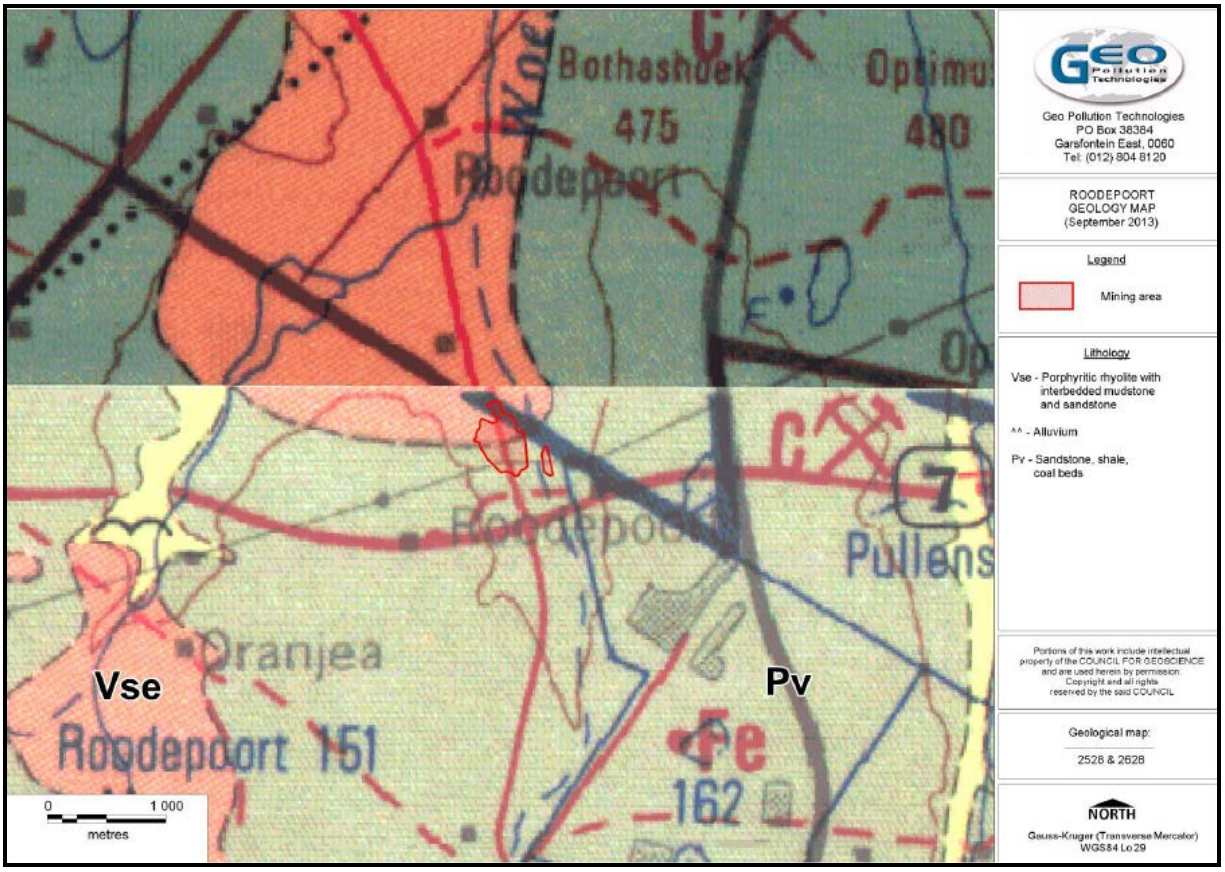

Figure 3-3: Geology of the study site

3.4 SOIL AND LAND CAPABILITY

3.4.1 Soils

According to SANBI (2011), the soil class found within the Roodepoort Colliery Mining Right area is of the association of Classes 13 and 16: undifferentiated shallow soils and land classes. The favourable properties of this soil class include:

- soil may receive runoff from associated rock and has water-intake areas;
- restricted land use options apply to this soil type.

The soils were interpreted and evaluated with the purpose of obtaining sufficient information on an exploration scale with regards to the soils present. The following information is included:

- A description of the soil types that could be disturbed;
- Soil fertility;
- Soil erodibility;
- Soil depth;
- Dry land production potential; and
- Irrigation potential.

The soil survey (LantekSA, 2013) was conducted by means of test pits augered on different positions (refer **Figure 3-4**) to obtain a spatial view of the project area. Soil characteristics such

as effective depth, colour and texture were noted. The soils are classified according to the taxonomic system for South Africa. Refer to **Table 3-4** for the classification of soils on site.

Table 3-4: Soil Classification for the project area

Test Pit	Clay %	Colour	Depth (mm)	Limiting layer	Soil Type	Crop Potential
1	20	Brown	800	Soft Plinthite	Avalon	Medium
2	20	Red	1200	Unspecified	Hutton	High
3	20	Brown	300	Soft Plinthite	Westleigh	Low
4	15	Brown	300	E-horizon	Longlands	Low
5	15	Brown	300	E-horizon	Longlands	Low
6	20	Red	1200	Unspecified	Hutton	High
7	25	Red	1200	Unspecified	Hutton	High
8	20	Yellow	500	Soft Plinthite	Avalon	Medium

Table 3-5: Soil description

DIAGNOSTIC HORIZON AND MATERIALS	DESCRIPTION OF SOIL
Soil Form: Hutton Topsoil: Orthic *Subsoil:* Red aedal B	This soil consists of an Orthic A-horizon over a Red apedal B-horizon: An Orthic A-horizon is a surface horizon that does not qualify as an Organic, Humic, Vertic or Melanic topsoil although organic matter may have darkened it. Red apedal B-horizon is non-calcareous within any part of the horizon, which occurs within 1500mm of the surface. It has no structure but in moist conditions it can show signs of weakly developed blocky structure. The **Hutton Form** is freely drained and is well suited for crop production in dry land conditions and under irrigation. This is a fertile soil, but with extensive leaching the soil can become acidic. The soil is deeper than the soil auger (1,5m) and has a high risk of erosion as the soil has little to no structure. The erosion factor can be diminished if it is well vegetated.
Soil Form: Arcadia *Topsoil*: Vertic *Subsoil:* Unspecified	This soil consists of a Vertic A-horizon over Unspecified material: The Vertic A-horizon has a strongly developed structure and clearly visible, regularly occurring slickensides. It is a very dark coloured horizon and has high clay content. The **Arcadia Form** is very resistant to erosion due to the highly structured nature of the soil form. Structure implies that the soil particles tend to stick together in peds. This soil is deeper than the soil auger (1,5m) The soil is chemically fertile and has a high cat ion exchange capacity (CEC). These soil particles are more resistant to erosion because of the cohesive forces between them. On the other hand because of the swell and shrinking capabilities of the vertic A-Horizon, the top few centimetres of the soil expand during a rain storm to eliminate penetration of water into the soil. This causes the soil to absorb the minimum amount of water. This not only increases runoff volume but also runoff speed of rainwater.

	Due to the highly structured, high smectite clay content of the soil, cultivation of crops is not recommended as a land use. Plants will struggle to get their roots into the soil, which will lead to badly developed root systems. Another issue is the fact that the water retention capability of the soil is quite high and causes water stress among plants because the plants are unable to extract the water from the soil. There are however some crops that can be planted in such soils under the correct cultivation practices. The more optimum dry land use will be grazing.
Soil form: Plintic	Plinthic catena: Upland duplex and Margalitic soils rare; Dystrophic and/or mesotrophic; red soils not widespread. In land types Ba and Bb, the Plinthic catena soils dominate. Plinthic soil forms could form perched aquifers and therefore wetland conditions

3.4.2 Land Capability

The area falls within the Moist Sandy Highveld Grassland vegetation type and natural vegetation is represented by indigenous grass types such as rooigrass and common thatch grass. The agricultural potential for crop production on the existing arable land is high. The area used as grazing has low to medium potential as crop production areas. The farms existing agricultural use of the area is optimum. The best agricultural purpose for the area is as it is currently being used.

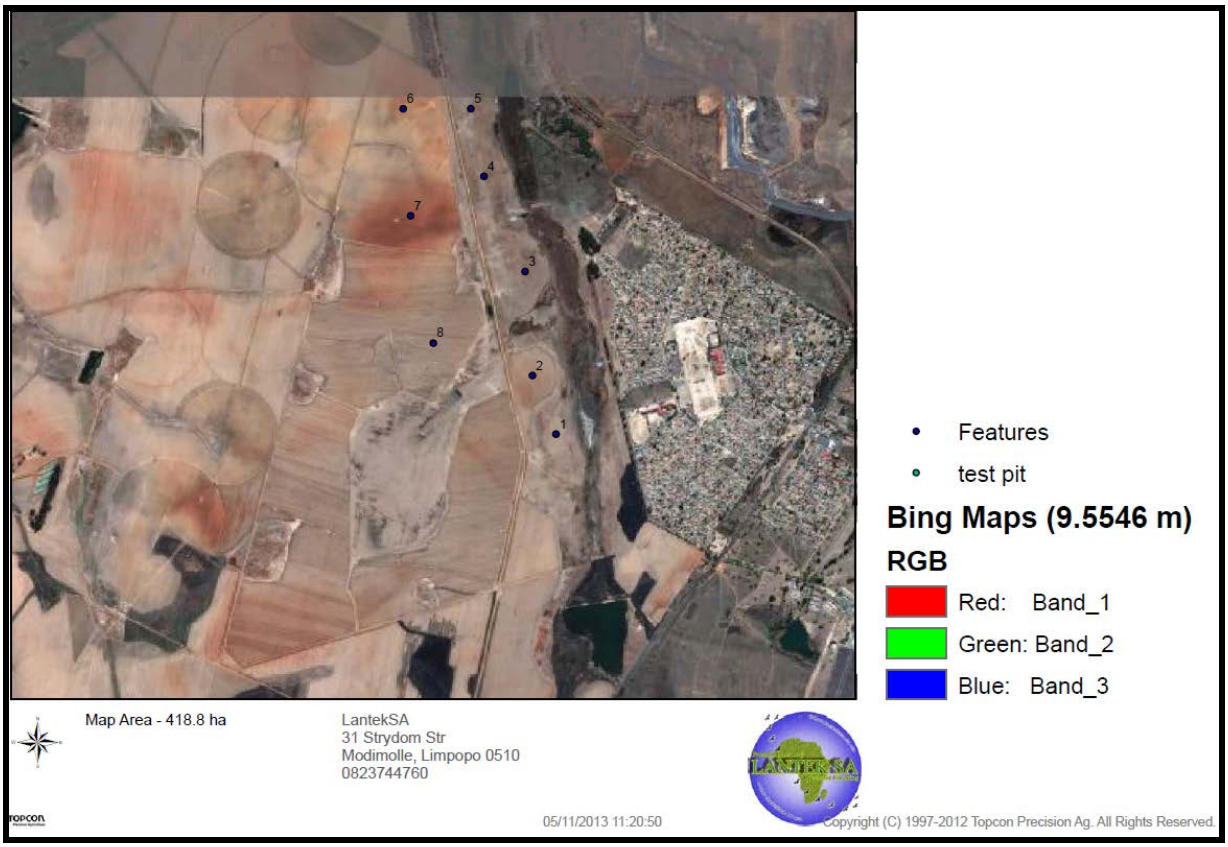

Figure 3-4: Locality of Land Capability Test Pits

According to the terrestrial biodiversity assessment (**Figure 3-5**) of the CPlan, the site falls on

areas of "Least Concert" and "No Natural Habitat Remaining". The direct location therefore has low conservation importance. A neighbouring area is, however, classified as "Important and Necessary", while areas in the nearby vicinity towards the north and north west are classified as "Irreplaceable" and "Highly Significant".

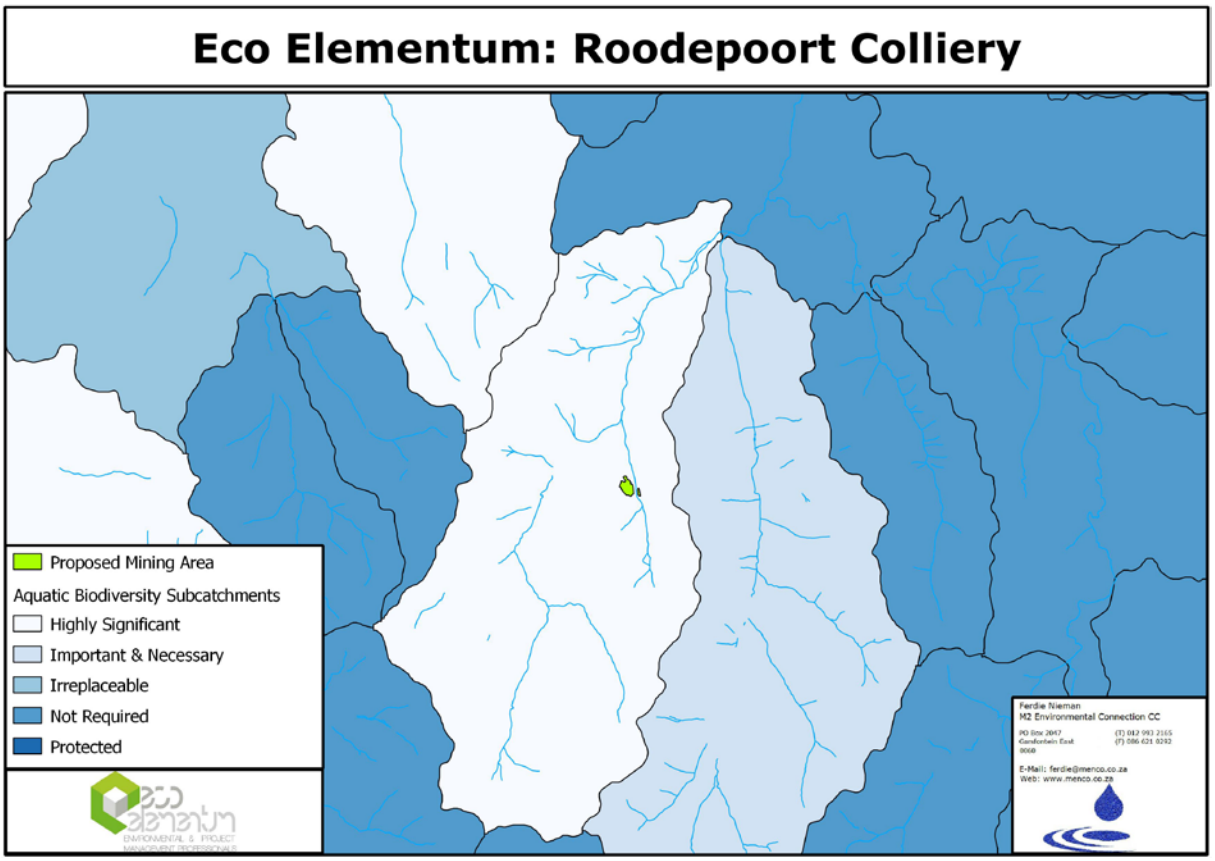

Figure 3-5: Terrestrial and Aquatic Biodiversity Assessment

3.4.3 Wetlands

According to SANBI BGIS Land Use Decision Support Tool website, no wetlands of national importance occur within the mining right area. However, the study area is located within close proximity to a regional wetland system referred to as the Pullenshope wetland system. As indicated in **Figure 3-5** there is a natural wetland system upstream of the proposed project area as well as human induced wetlands (unchannelled valley bottom) stemming from the central pivot irrigation located within the footprint of the proposed mining workings. **Table 3-6** indicates the preliminary rating of the wetlands is likely to provide given its particular hydro-geomorphic type.

Table 3-6: Preliminary rating the wetlands are likely to provide

Wetland	Generic Hydrological benefits provided by the wetlands							
Hydro-Geomorphic Type	Flood attenuation		Stream flow regulation	Erosion control	Sediment trapping	PO_4	NO_3	Toxicants[1]
Channelled Valley Bottom	Early wet season	Late wet Season						

	+	0	0	0	+	+	+	+
Unchanelled Valley Bottom	++	++	++	+	+	++	++	+

Note: [1]Toxicants are taken to include heavy metals and biocides
Rating: 0 Benefit unlikely to be provided to any significant extent
+ Benefit likely to be present at least to some degree
++ Benefit very likely to be present (and often supplied to a high level)

Present Ecological State

Despite several anthropogenic impacts on the wetlands, the current Present Ecological State (**Table 3-7**) for wetland unit 1 (representing the upper reaches of the Woestalleen Spruit wetland system) the health category is D, indicative of largely natural with few modifications. This rating entails an EIS sensitivity of high with an overall score of 2.2. Wetland unit 2 that was formed due to irrigation practices has an overall score of 0.8 representing a wetland system that has low EIS and a PES category E.

Table 3-7: WET-Health categories for describing the integrity of wetlands (Macfarlane *et al.* 2007)

Description	Health Category
Unmodified, natural.	A
Largely natural with few modifications. A slight change in ecosystem processes is discernable and a small loss of natural habitats and biota may have taken place.	B
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.	C
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	D
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	E
Modifications have reached a critical level and the ecosystem processes completely with an almost complete loss of natural habitat and biota.	F

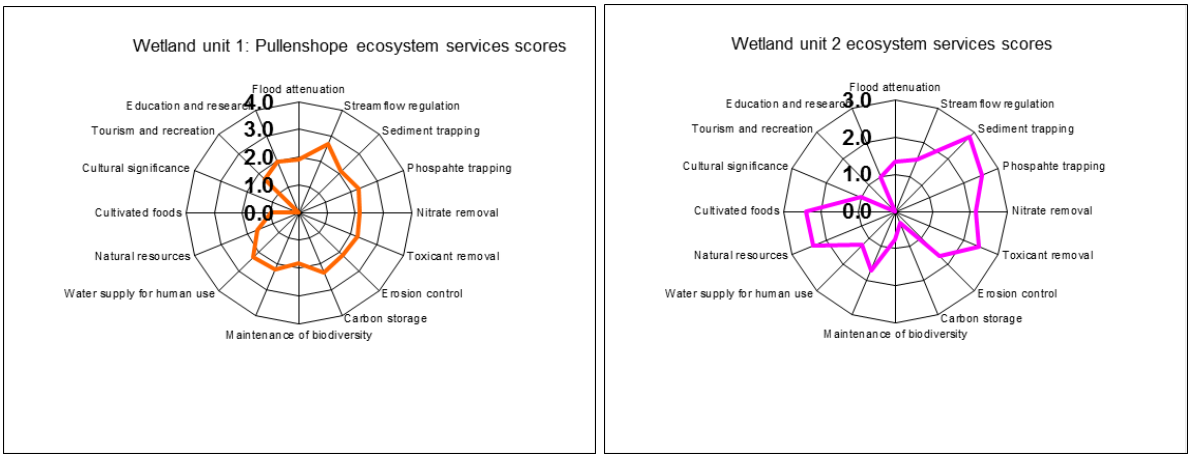

Figure 3-6: Wetland Ecosystem Services Scores

Ecological Importance and Sensitivity

The ecological importance of a wetland indicates the importance of the wetland in maintaining the ecological diversity and functioning on local and wider spatial scales. The sensitivity of a wetland indicates the system's ability to withstand disturbance and its capacity to recover from disturbance when it occurs (Department of Water Affairs and Forestry 1999) (refer **Table 3-8**).

Table 3-8: Ecological Importance and Sensitivity Categories (Department of Water Affairs and Forestry 1999)

Ecological Importance and Sensitivity Categories	Rating	Recommended Ecological Management Class
Very High Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water in major rivers	>3 and <=4	A
High Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers	>2 and <=3	B
Moderate Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water in major rivers	>1 and <=2	C
Low / Marginal Wetlands that is not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water in major rivers	>0 and <=1	D

Although wetland biodiversity had been artificially created, the vegetation still plays a role in moderating the quantity and quality of water in the downstream rivers. The overall EIS score for the project area is calculated as 0.8 (refer **Table 3-9**). The wetland system associated with the stream draining the property had largely lost the biodiversity component that is sensitive to flow and habitat modifications.

Table 3-9: EIS scores for wetlands in vicinity of project area

Channelled valley bottom wetland (Unit 1)	**Importance**	**Confidence**
Ecological importance & sensitivity	1.8	4.0
Hydro-functional importance	2.2	4.0
Carbon storage	3.0	4.0
Tourism and Recreation	2.8	3.0
Overall score	**2.2**	
Unchanelled valley bottom wetland (Unit 2)	**Importance**	**Confidence**
Ecological importance & sensitivity	1.0	2.8
Hydro-functional importance	1.0	2.8
Carbon storage	0.5	3.3
Tourism and Recreation	1.0	4.0
Overall score	**0.8**	

The wetland assessment indicated that there were small wetlands (**Figure 3-7**) on the proposed mining property but none within the immediate footprint of the proposed mine.

Kebrafields: Roodepoort Colliery is not situated close to a Wetland Freshwater Ecosystem Priority Area as depicted in the 2011 Atlas of Freshwater Ecosytem Priority Areas in South Africa. However, the surface water spatial layers of SANBI, (2010) reflect the presence perennial and non-perennial systems in the area. During the field survey it was found that the riparian vegetation in the adjacent wetland was still considered to be intact with few invasive or alien species.

No flora species of conservation concern was identified at any of the sites. However, there are three species that may occur within the area that would raise concern which include *Alepidea peduncularis*, *Hypoxis hemerocallidea* and *Anacampseros subnuda* subsp. *lubbersii*. *Alepidea peduncularis* and *Hypoxis hemerocallidea* that are classified by the IUCN as “DDT” and “Declining” respectively of which the latter is being overexploited as a traditional healing plant. The species *Anacampseros subnuda* subsp. *lubbersii* is classified by the IUCN as “Vulnerable” and is listed on CITES (Appendix 5 of Fauna and Flora Study, 2013) for all parts of the plant.

No species from the Threatened and Protected Species (ToPS) List, as part of the National Environmental Management: Biodiversity Act (Act 10 of 2004) is found in this area. Also, *A. peduncularis* and *A. subnuda* subsp. *lubbersii* are both endemic to South Africa. The remainder of the species found in the study area or that may possibly occur within the area are classified with a “Least Concern” status. Two exotic/alien species were identified, however, none of them are listed as Category Invader species as provided in the Conservation of Agricultural Resources Act (Act 43 of 1983). Also, ten species were indicated on the SABIF database on SANBI’s website as having medicinal value.

Please Note that these wetlands clearly fall outside the mining footprint of Kebrafield.

Also refer to Appendix 4 for the Wetland Delineation study conducted for the project area.

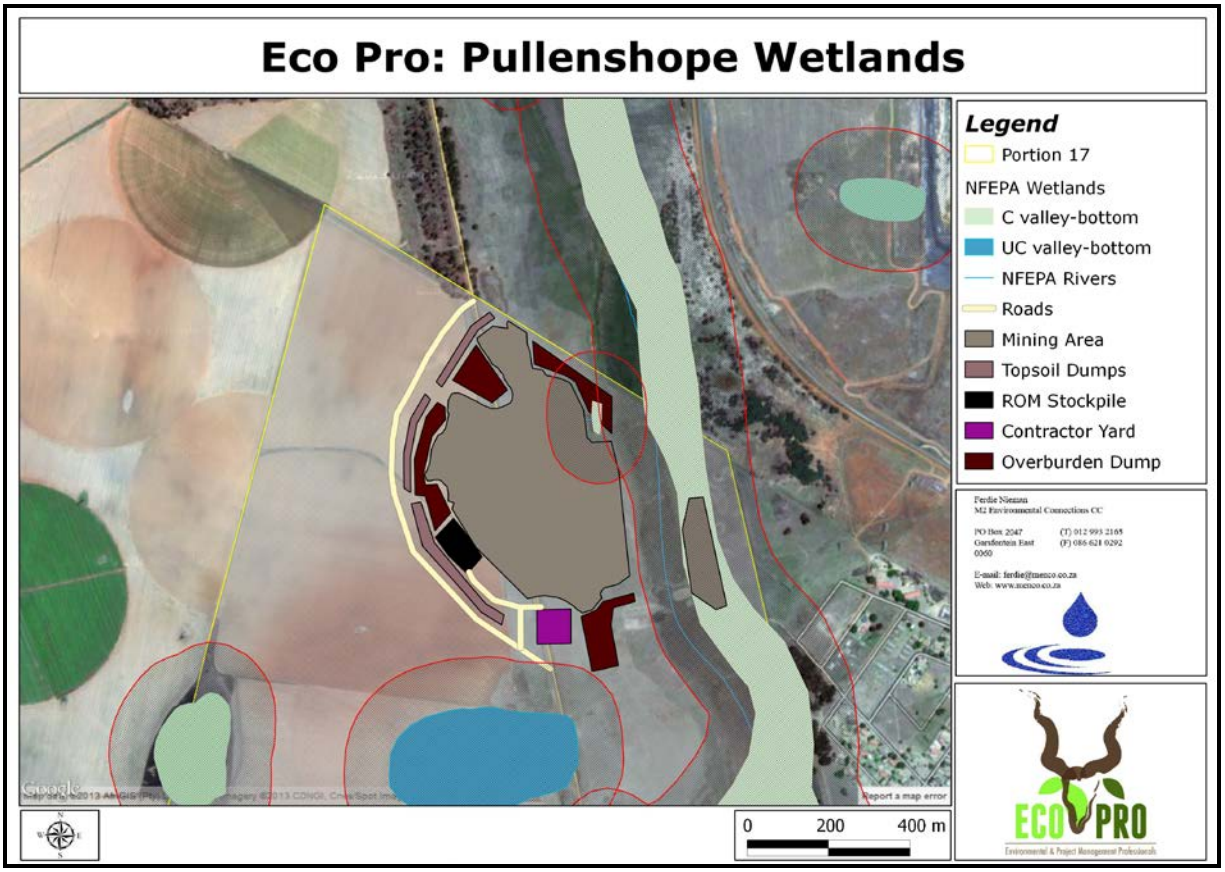

Figure 3-7: Delineation of wetlands with proposed buffer zones

3.5 SURFACE WATER

3.5.1 Water Management Area

The mining area is located in the B12B quaternary drainage area of the Klein Olifant River sub-management area of the Olifants Water Management Area (**Figure 3-9**). The mining area borders the B12D quaternary drainage area of the Upper Olifants River.

3.5.2 Surface Water Hydrology

Mean Annual Runoff (MAR)

The mean annual runoff (MAR) for the Klein Olifant River catchment as per the National Water Resource Strategy is provided as 73 million m^3/a. The total area of the B12B catchment is determined as 53.3 km^2 with the catchment area of the project site set at 13.5 km^2. The study area falls in an area where the MAR is 105.6 mm (refer **Figure 3-8)**.

The Surface Water Assessment is contained in Appendix 1. The flood line study for the project area is contained in Appendix 2.

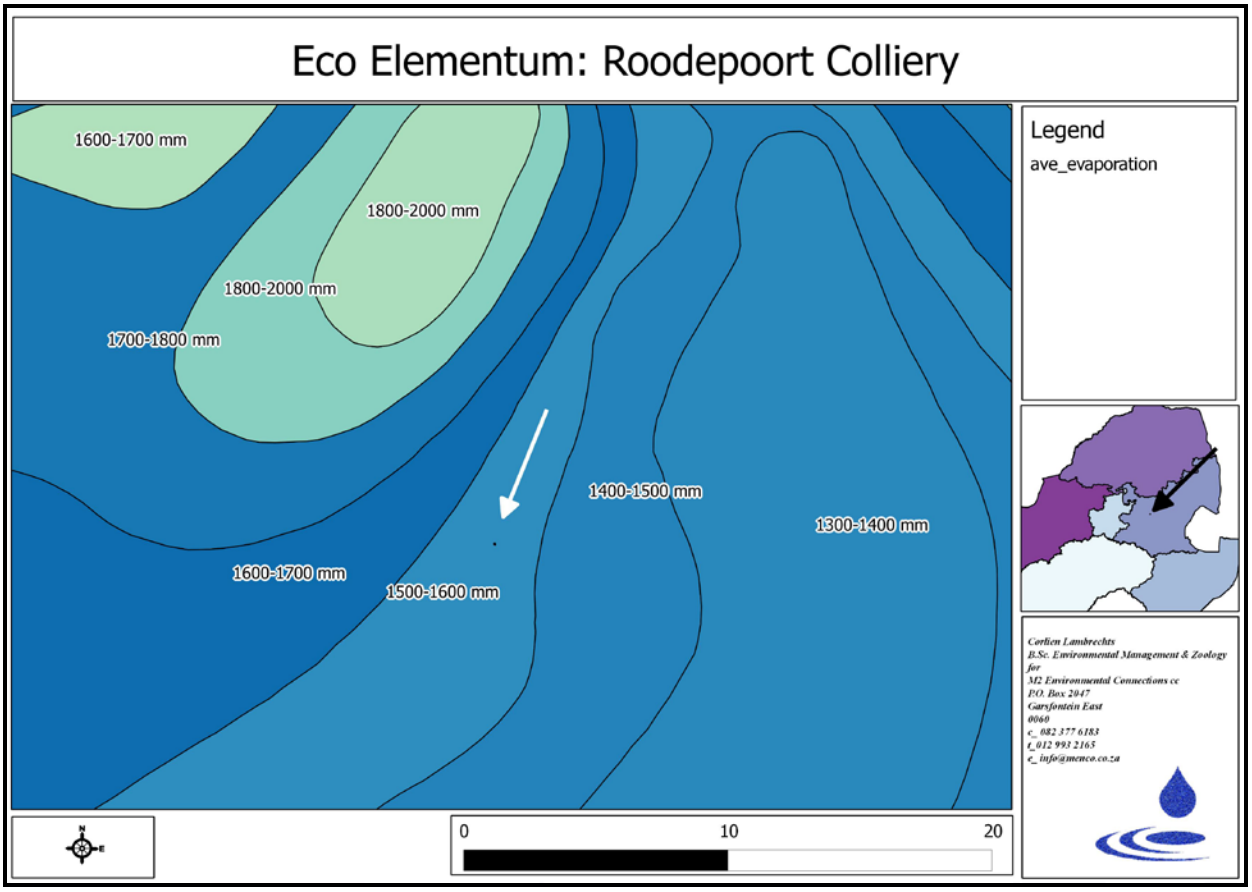

Figure 3-8: Mean Annual Evaporation (mm) for the study area and surrounds

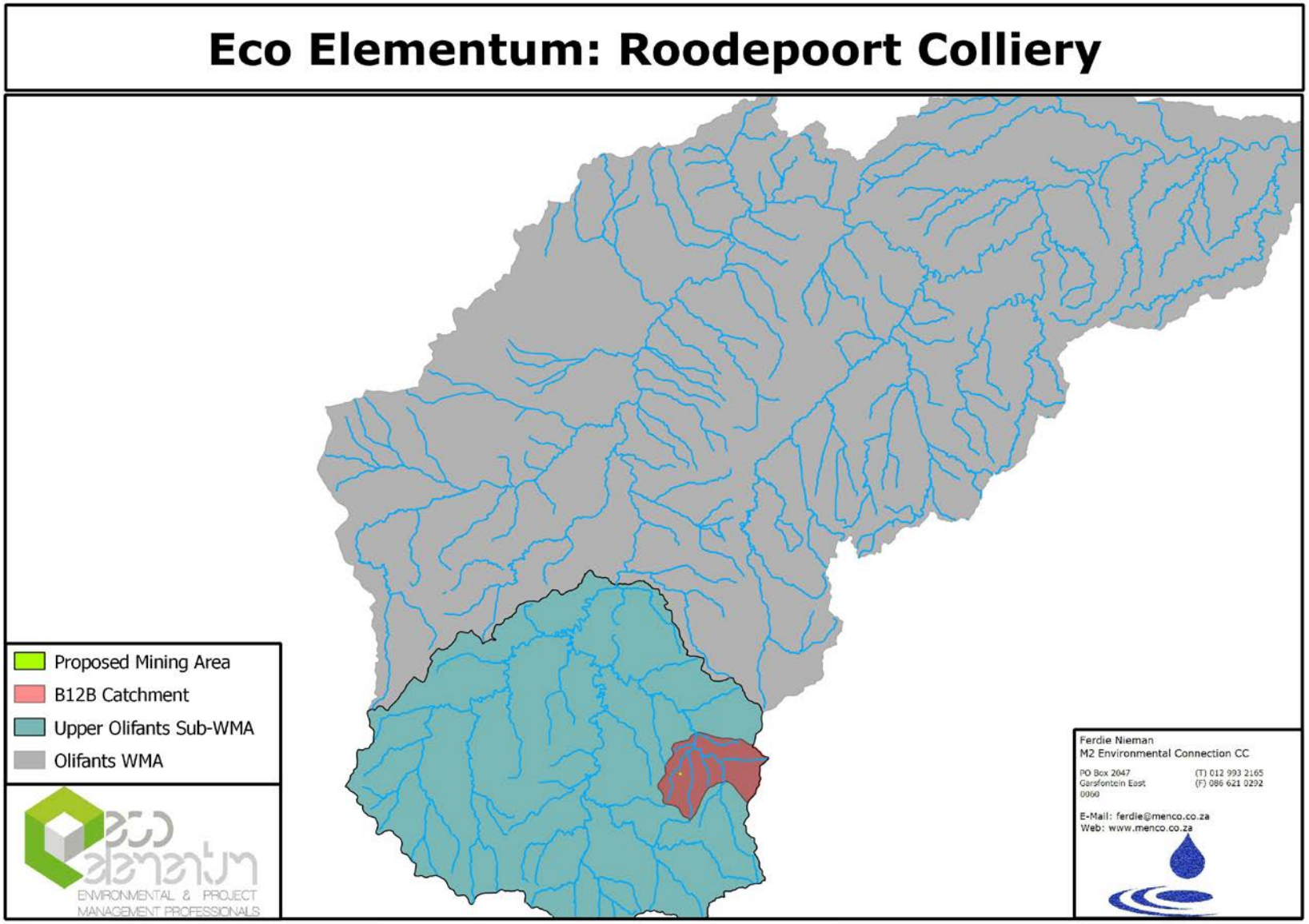

Figure 3-9: Overview of the Olifants River Water Management Area and Klein Olifants River basin

Flood peaks and volumes

The flood peaks and volumes of the proposed mining area have been calculated by means of the rationale method utilising UP Flood Model software. The flood peaks based on run-off for 24 hour floods are contained in **section 2.5** of the surface water study.

Drainage density of areas to be disturbed

The drainage density in the area is determined as being 0.68 km/km^2.

3.5.3 Surface Water Quality

Table 3-10 provides an indication of the background surface water quality for the site as taken during July 2013. This is representative of the dry season and should indicate possible variables of concern based on low base-flow conditions. **Figure 3-10** provides an indication of the location of the surface water monitoring points. The water quality within the proposed mining area is classified as *Moderate to Good*. A description of the water quality monitoring points is contained in **Table 7-2**.

Table 3-10: Background water quality results

Variable	Seep	Dam	KFBM3	KFBM2	KFBM4
pH	8.9	8.4	7.5	8.8	7.2
Electrical Conductivity as EC in mS/cm	284	79.8	77.2	78.8	57.7
Dissolved Oxygen as DO in mg/l	5.0	6.4	5.2	7.3	2.9
Total Dissolved Solids as TDS in mg/l	1914	530	518	528	374
Total hardness in $CaCO_3$ mg/l	430	262	274	260	169
Chloride as Cl in mg/l	193	36	34	40	34
Sulphate as SO_4 in mg/l	311	232	200	224	115
Nitrate as NO_3 in mg/l	0.6	<0.2	<0.2	<0.2	<0.2
Nitrite as NO_2 in mg/l	<0.1	<0.1	<0.1	<0.1	<0.1
Ortho-Phosphate as PO_4 in mg/l	<0.2	<0.2	<0.2	<0.2	<0.2
Sodium as Na in mg/l	547	49	50	47	47
Magnesium as Mg in mg/l	93	34	37	34	24
Potassium as K in mg/l	2.4	13.1	12.4	13.3	9.8
Aluminium as Al in mg/l	5.07	0.488	<0.100	<0.100	0.228
Iron as Fe in mg/l	3.5	0.522	0.924	0.102	76
Manganese as Mn in mg/l	0.082	0.200	0.044	0.025	3.07
Total Phosphorous as TP in mg/l	0.5	0.4	<0.2	0.2	2.7
Suspended Solids as SS in mg/l	197	75	17.2	3.6	324

It should be noted that the background values for pH at KFBM2, dam and seep are already indicative of alkaline conditions. This particular point represents the water quality stemming from upstream activities. Irrespective of abandoned coal mining and prospecting activities in the catchment, concentrations of Key Performance Indicators (KPI) such as TDS, SO_4 and sodium are extremely high.

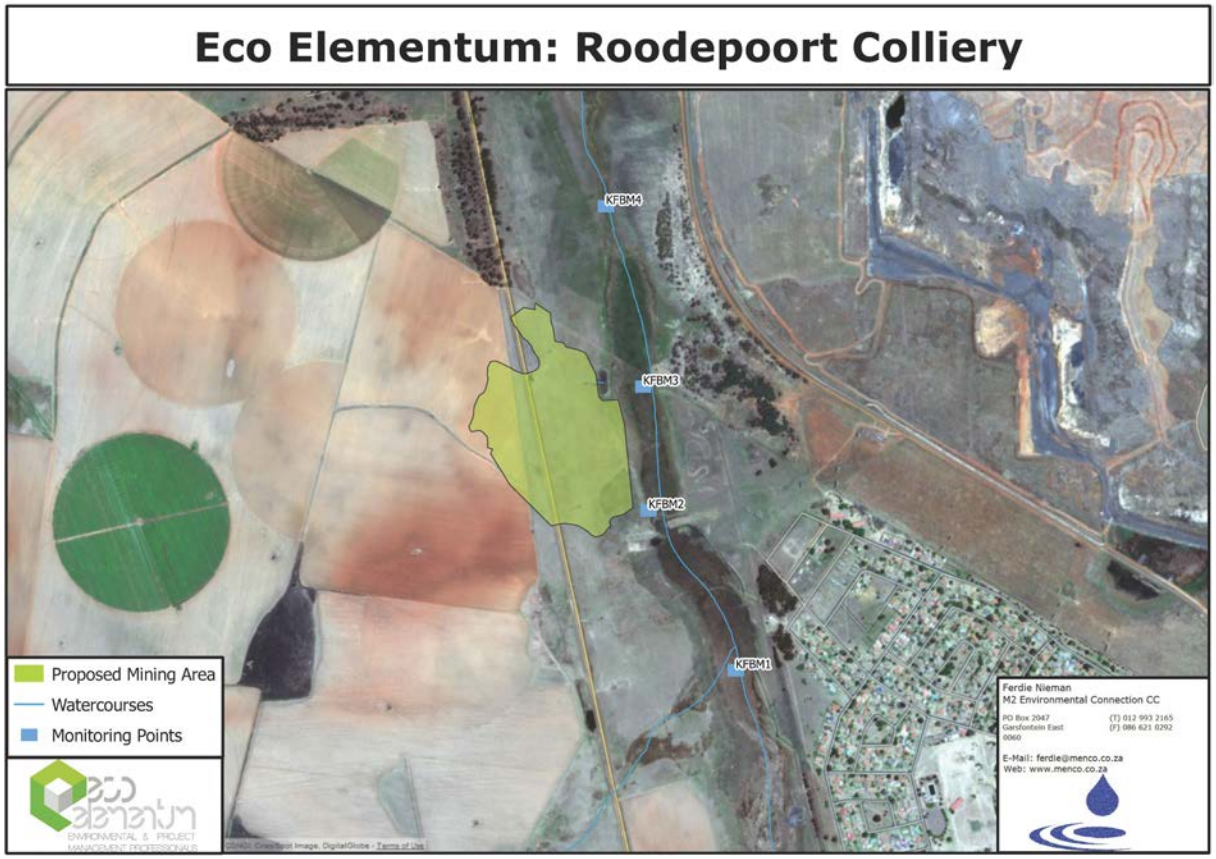

Figure 3-10: Surface water monitoring points

Once construction of the proposed coal mine commences, it would be important to monitor the water to ensure that pH values do not change more than 0.5 of a pH unit (Department of Water Affairs and Forestry 1996a), as changes in pH values may have severe consequences for biota. The total alkalinity concentration in the various streams monitored are low (< 8.258 mg/l) implying that the upper catchment has a low buffer capacity.

Although the water quality in the catchment is considered good, the Fe concentration (at KF03) already exceeds the Reserve limit of 0.3 mg/l and at all points are the aluminium concentration exceeding the limit of <0.02 mg/l.

3.5.4 Set Eco-classification (DWA/Reserve)

The ecological status of a river refers to its overall condition or health, i.e. the totality of the features and characteristics of the river and its riparian areas, which manifests in its ability to support a natural array of species. This ability relates directly to the capacity of the system to provide a variety of goods and services. The indices reported here refers to the area applicable to the license application as it falls in the upper reaches of the catchment, see also **Sections 4.7.2** and **4.7.3**.

- The In-stream Habitat Integrity is **good** primarily due to limiting impact of mining activity in the area. Water abstraction and mine dewatering has not altered the natural flow regime of the river.

- The Riparian Zone Habitat Integrity is also **good** because of insignificant flow and channel modifications due to mining activities. The Riparian Vegetation Integrity is **good** with moderate abundances of alien vegetation in the riparian zone. Increasing levels of development has resulted in vegetation removal.
- The Fish Assemblage Integrity is **good** – usually water quality problems originating from mines could create stress conditions for most fish species, sensitive species are lost due to the cumulative impacts of reduced water quality and flow modifications and obstructions.
- The Macro-invertebrate Integrity is **good** with water quality having no impact on invertebrate diversity and abundances and flow and habitat modifications contributing to high scores.
- Water Quality is **good** - flows have intermediate levels of nutrients and emerging signs of water quality problems.

The Ecological Importance and Sensitivity is **Very High** and the resource class for the X21F Class B (Largely in a natural state) with the Best AEMC as Class A. Further downstream the ecological state of the Elands River stabilizes at **good to fair**. This clearly demonstrates that agriculture and anthropogenic impacts have manifested in the catchment downstream of the proposed Kebra Fields.

3.5.5 Set Resource Class Objectives (DWA/Reserve)

There are currently no specific Receiving Water Quality Objectives for the Woestalleen Spruit. However, in such an instance, the Department of Water Affairs compiles objectives based on the downstream users once there is an application for a water use license in the area (during the reserve determination phase).

Interim Water Quality Objectives (**Table 3-11**) was compiled for the affected streams through a desk top study. The water in the stream is expected to be marginally impacted and the water quality objectives will therefore be within the ideal to acceptable range.

Table 3-11: Intermediate Water Quality Objectives for the affected streams

Variable	Unit	Ecological Reserve	Water Quality Reserve[1]
$MgSO_4$	mg/l	59	59
Na_2SO_4	mg/l	32	32
$MgCl_2$	mg/l	9	9
$CaCl_2$	mg/l	17	17
NaCl	mg/l	3	3
$CaSO_4$	mg/l	21	21
NH_3	mg/l N	0.007	0.007
Fe	mg/l	0.27	0.33
Mn	mg/l	0.37	<1.3
Cr^{3+}	mg/	<0.024	<0.34
Cr^{6+}	mg/l	<0.014	<0.02
Al	mg/l	<0.02	<0.150

[1] The more protective value between the Ecological Reserve and the Basic Human Needs Reserve to be selected.

Variable	Unit	Ecological Reserve	Water Quality Reserve[1]
Zn	mg/l	<0.0036	<0.036
Na	mg/l	10	<200
Mg	mg/l	14	<100
Cl	mg/l	7	<200
SO_4	mg/l	116	<400
Ca	mg/l	6	<80
PO_4	mg/l	0.04	0.04
TIN : P soluble ratio	mg/l	>29	>29
pH	-	6.5 – 8.0	6.5 – 8.0
DO	%	>80	>80

3.5.6 Surface Water User Survey

The area is known as a nature lover's paradise with premier fly-fishing destinations as well as several rare bird species within an area that is characterised by wild mountain ravines and streams. There are also several dams in the area as trout farming and tourism is one of the major economic activities in the area.

Water users that will be directly impacted by mining activities are agricultural uses (livestock watering and crop irrigation) and mining, with domestic uses (further downstream) not impossible due to the scarcity of potable water in the area. The aquatic environment is included by default during the reserve determination stage as a surface water user.

3.6 GROUNDWATER

3.6.1 Hydrogeology of the mining area

On a regional scale the hydrogeology consists of weathered and fractured aquifers of the Bushveld Igneous Complex, the Transvaal Supergroup and locally the Karoo Supergroup. Groundwater resources are widespread but limited with borehole yields generally <0.5 l/s. Groundwater occurrence is better developed along aquifers associated with the contact zones of the dolerite.

3.6.2 Groundwater Quality

The water quality in the area (**Table 3-12**) can generally be classified as Class I (recommended operational limit) according to the SANS Guidelines for Drinking Water in terms of the major cations and anions. Manganese was found at slightly elevated concentrations, Class II, in borehole BH3 and KGW3, as well as iron in BH3. Manganese and iron is naturally found at these concentrations in the coal-bearing Vryheid Formation, and none of them represent a health hazard as the negative effects are limited to a bitter taste and cosmetic effects like staining of equipment and laundry. None of the water samples contain elevated concentrations of sulphate or nitrate. No comment can be made on the temporal trends of the constituents. All the borehole samples analysed have TDS values lower than 1000mg/l, which is acceptable for water in contact with sedimentary rock formations of the Ecca Group.

Table 3-12: Results from the borehole at the homestead

Analysis result (mg/l)	Class I	Class II	SW1
Ca	150	300	0.96
Mg	70	100	0.64
Na	200	400	4.78
K	50	100	0.80
Mn	0.1	1	0.01
Fe	0.2	2	0.00
F	1	1.5	0.00
Nitrate as N	10	20	1.30
NO_3	44	88	5.76
Al	0.3	0.5	0.03
HCO_3	-	-	0.00
Cl	200	600	5.00
SO_4	400	600	6.00
TDS by sum	1000	2400	26.00
M-Alk ($CaCO_3$)	-	-	0.00
pH	5.0 - 9.5	4.0 - 10.0	6.17
EC (in mS/m)	150	370	3.03
Cat/An Bal. %	-	-	-3.79

3.6.3 Hydro-census

A hydrocensus for the project area was conducted during August 2013 at the points as illustrated in **Figure 3-11.** Hydrocensus field forms containing details of the owner and use are contained in the Geohydrological report as compiled by GPT (Pty) Ltd dated July 2011. The groundwater quality of all boreholes sampled during the hydrocensus is contained in **Table 3-13**.

Although an attempt was made to visit all boreholes in a 2km radius around the proposed mining area some boreholes could not be included due to unforeseen reasons such as accessibility and permission to enter upon property. However, a total of 8 boreholes and 2 surface water bodies were identified during the hydrocensus.

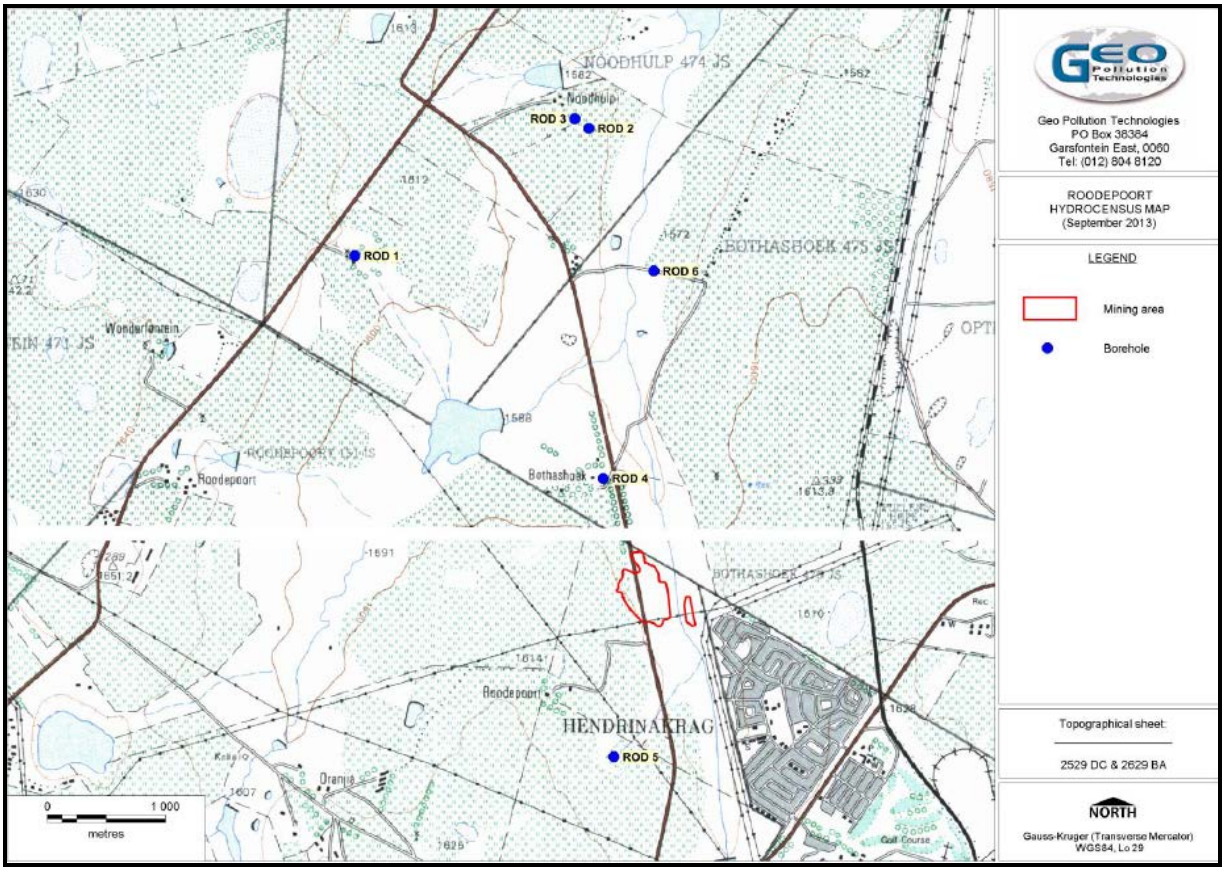

Figure 3-11: Hydro-census points identified

3.6.4 Depth of Water Tables

Groundwater levels, varying between 2.3m and 8.6m below ground level, were measured in the surrounding area during the survey. These values were determined from borehole data where the owner was available on site and where it was possible to gain access to the boreholes for precise measuring of water levels.

Usually a good relationship should hold between topography and static groundwater level. This relationship can be used to distinguish between boreholes with water levels at rest, and boreholes with anomalous groundwater levels due to disturbances such as pumping or local geohydrological heterogeneities. The relationship using the boreholes from the hydrocensus is shown **Figure 3-12** below and a good correlation can indeed be observed. This general relationship is useful to make a quick calculation of expected groundwater levels at selected elevations, or to calculate the depth of to the groundwater level (unsaturated zone):

Groundwater level = Elevation x 0.7281

Depth to the groundwater level = Elevation x (1 - 0.7281)

= Elevation x 0.02719

Table 3-13: Results of the Hydrocensus

Site Name	Y Coord	X Coord	Elevation	Static water level in m (mbgl)	Static water level in m (mamsl)	Collar height (m)	Use	Owner	Sampled
ROD 1	-25.97981	29.55531	1754	-	-	-	Domestic	Christo Schoeman	Yes
ROD 2	-25.97001	29.57496	1593	8.6	1584.25	0.15	Not used	Frik Snyman	No
ROD 3	-25.96928	29.57377	1595	-	-	-	Irrigation and domestic	Frik Snyman	Yes
ROD 4	-25.99672	29.57630	1597	8.03	1588.97	-	Not used	Unknown	Yes
ROD 5	-26.01796	29.57729	1611	2.5	1608.2	0.3	Cattle	CJ van Wyk	Yes
ROD 6	-25.98088	29.58049	1581	2.33	1578.37	0.3	Not used	Unknown	Yes

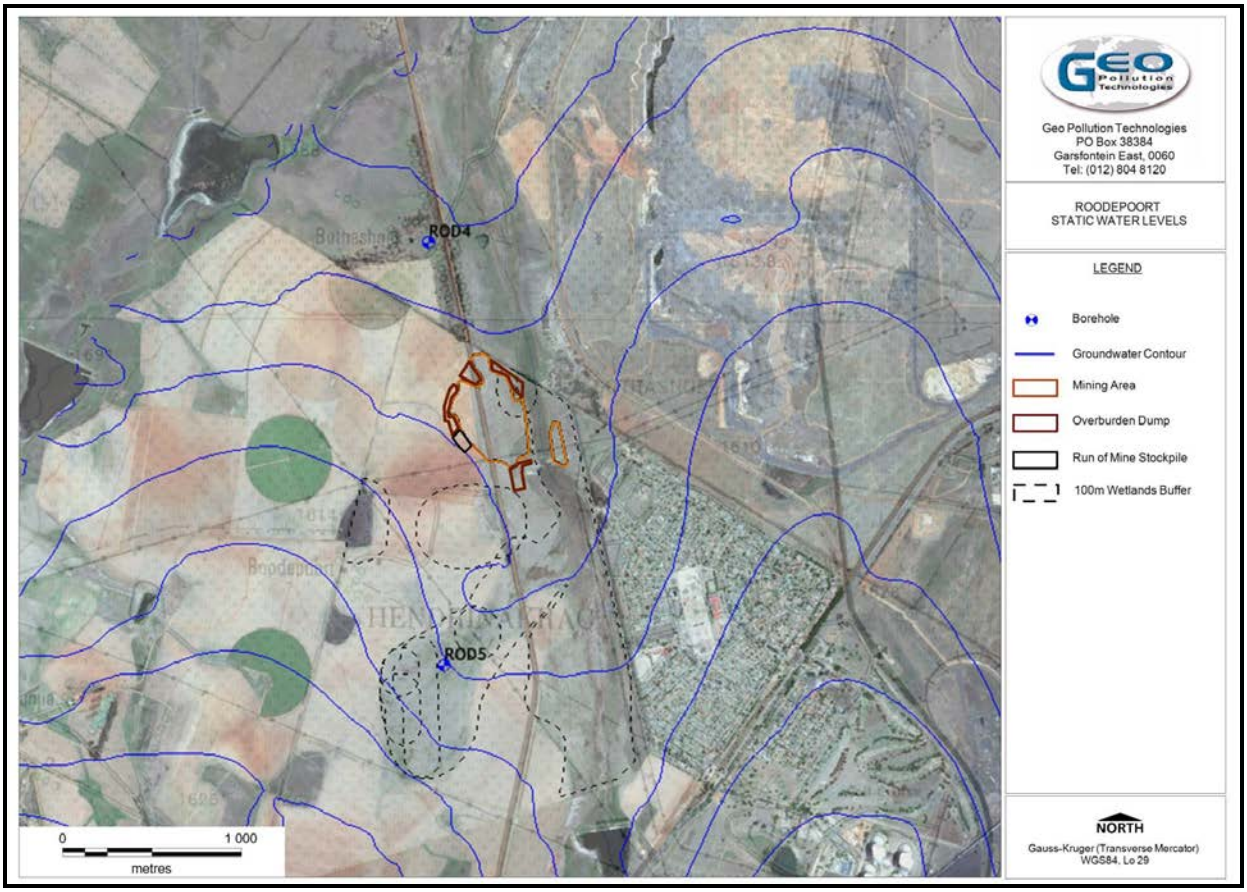

Figure 3-12: Pre-mining water contour levels at Kebrafield

This general relationship is useful to make a quick calculation of expected groundwater levels at selected elevations, or to calculate the depth of the groundwater level (unsaturated zone). However, due to the heterogeneity of the subsurface, these relationships should not be expected to hold everywhere under all circumstances, and deviations could thus be expected. The calibrated static water levels as modelled have been contoured and are displayed as **Figure 3-13**.

Groundwater flow direction should be perpendicular to these contours and inversely proportional to the distance between contours. Using this relationship, the inferred groundwater flow directions are depicted as below. As can be expected, the groundwater flow is mainly from topographical high to low areas, eventually draining to local streams.

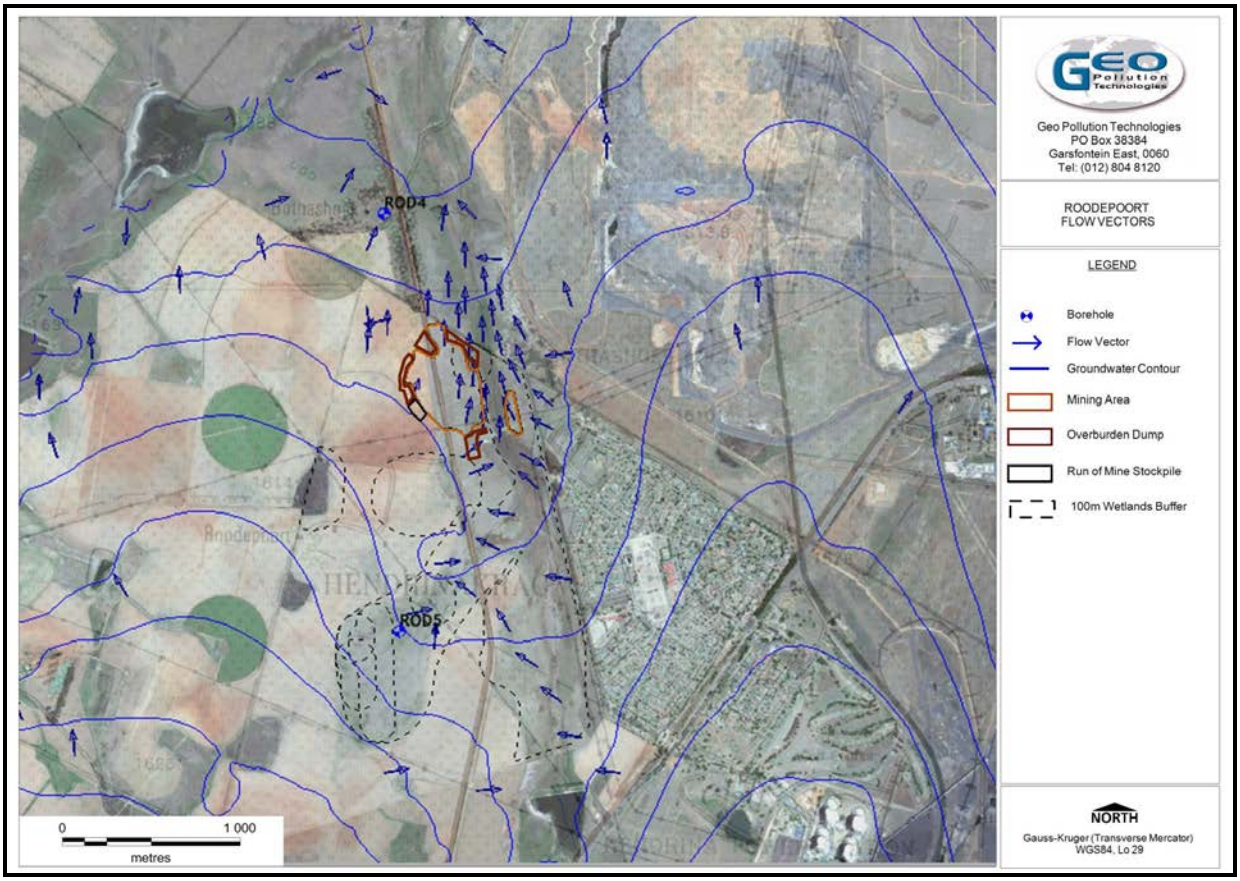

Figure 3-13: Groundwater flow direction at the study site

3.6.5 Aquifer characteristics

The hydrogeology of the area can be described in terms of the saturated and unsaturated zones. In the saturated zone, at least four aquifer types may be inferred from knowledge of the geology of the area. These are:

- A shallow aquifer formed in the weathered zone, perched on the fresh bedrock. Groundwater flow patterns usually follow the topography, often coming very close to surface in topographic lows, sometimes even forming natural springs.
- An intermediate aquifer formed by fracturing of the Karoo sediments. Most of the groundwater flow will be along the fracture zones that occur in the relatively competent host rock.
- Aquifers formed within the more permeable coal seams and sandstone layers. The margins of coal seams or plastic partings within coal seams are often associated with groundwater. The coal itself tends to act as an aquifer allowing the flow of groundwater at the margins.
- Aquifers associated with the contact zones of the dolerite intrusions. Although no dolerite was intersected during the exploration drilling of the opencast areas, this aquifer type is of regional importance. These conductive zones effectively interconnect the strata of the Ecca sediments both vertically and horizontally into a single, but highly heterogeneous and anisotropic unit on the scale of mining.

Although these aquifers vary considerably regarding geohydrological characteristics, they are seldom observed as isolated units. Usually they would be highly interconnected by means of fractures and intrusions. Groundwater will thus flow through the system by means of the path of least resistance in an intricate way that might include any of these components.

The unsaturated zone in the proposed mining area is in the order of between 0 and 9 meters thick (based on static groundwater levels measured in the existing boreholes and springs) and likely to consist of colluvial sediments at the top, underlain by residual sandstone/siltstone/mudstone of the Ecca Group that becomes less weathered with depth. Please refer to the geohydrological report by GPT (Pty) Ltd for more detail on the aquifer description.

3.6.6 Aquifer Classification

The aquifer is classified as a minor aquifer system. A Groundwater Quality Management Index of 4 was estimated for the study area from the ratings for the Aquifer System Management Classification. According to this estimate a **medium level groundwater protection** is required for the fractured aquifer.

3.6.7 Groundwater Reserve Determination

During September August 2008 the Chief Directorate: Resource Directed Measures has conducted a preliminary Reserve study for groundwater in quaternary catchment B12B to assist in the evaluation of water use license applications. The groundwater quality Reserve was determined from statistical analysis of data sets obtained from the catchment. The ambient groundwater quality in quaternary catchment B12B falls in Class ll of DWA water quality classification. Class ll represents water that is allowable for short term use or emergency use. The groundwater quality component used for the preliminary Reserve determination as based on data obtained from the National Groundwater Data Base of the Department of Water Affairs is contained in **Table 3-14**, **Table 3-15** and **Table 3-16**.

Table 3-14: Regional Groundwater quality

Chemical Parameter	Unit	Quaternary Catchment B12B		
		Minimum	Mean	Maximum
pH		6.2	7.6	8.8
Electrical Conductivity	mS/m	7.8	38	211
Calcium as Ca	mg/l	3	29	170
Magnesium as Mg	mg/l	1	18	62
Sodium as Na	mg/l	1	17	160
Total Alkalinity as $CaCO_3$	mg/l	13	118	385
Chloride as Cl	mg/l	1	21	360
Sulphate as SO_4	mg/l	2	21	322
Nitrate as NO_x-N	mg/l	0.1	0.1	50

Table 3-15: Groundwater Target Water Quality Ranges for B12B

Chemical Parameter	Target Water Quality Ranges		
	Class 0	Class I	Class II
pH	5 – 9.5	4.5 – 10	4 – 10.5
Electrical Conductivity	<70	70 – 150	150 – 370

Calcium as Ca	< 80	80 – 150	150 – 300
Magnesium as Mg	< 70	70 – 100	100 – 200
Sodium as Na	< 100	100 – 200	200 – 400
Chloride as Cl	< 100	100 – 200	200 – 600
Sulphate as SO_4	< 200	200 – 400	400 – 600
Nitrate as NO_x-N	< 6	6 – 10	10 – 20
Fluoride as F	< 0.7	0.7 – 1.0	1.0 – 1.5

Table 3-16: Groundwater Reserve for B12B

Parameter	Ambient Groundwater Quality[2]	Basic Human Needs Reserve[3]	Groundwater Quality Reserve[4]
Electrical Conductivity (mS/m)	38.8	< 150	41.8
Calcium (mg/l)	29	< 150	31.9
Magnesium (mg/l)	18	<100	19.8
Sodium (mg/l)	17	<200	18.7
Chloride (mg/l)	21	< 200	23.1
Sulphate (mg/l)	21	< 400	23.1
Nitrate (mg/l)	0.04	< 10	0.05
Fluoride (mg/l)	<0.7	< 1.5	1.50

3.7 SOCIO-ECONOMIC ENVIRONMENT

Information in this section was obtained from the IDP compiled during 2011 for the Steve Tshwete Local Municipality (TSLM).

3.7.1 Population density, growth and location

According to Stats (SA), the total population of the STLM amounts to 182,502 persons, however, the most recent census survey conducted during 2011 indicated that the population is approximately 229,839 as outlined below. The Municipality is estimating that the population grow at a rate of 4 % per year. The spatial distribution of the STLM is outlined in **Table 3-17**.

Table 3-17: Spatial population distribution of the Steve Tshwete Municipality

	Total population	Male	Female
Black African	169,048	88,888	80,160
Coloured	5,988	2,953	3,035
Indian/Asian	3,700	1,958	1,1742
White	50,191	24,992	25,199
Other	912	623	289
Total[5]	**229,839**	**119,414**	**110,425**

[2] Based on data obtained from National Groundwater Database (refer **Table 3-14**).

[3] Ref: *Quality of Domestic Water Supply, Volume 1: Assessment Guide*, 2nd edition, 1998.

[4] As per DWA Reserve dated 6 September 2009 with Reference 26/8/3/3/12

[5] Figures as provided in the Nkangala District Municipality IDP

3.7.2 Major economic activities and sources of employment

The main source of employment is the agriculture and mining sectors (26%). Other sectors that provide employment in the area are:

- Power Generation (5%);
- Private households (13%);
- Wholesale and retail (14%); and
- Work in community; social and personal services (11%).

Most people in the area are thus employed in the primary and secondary sectors, with very few people employed in the tertiary sector (only 2% as professionals and 3% as legislators; senior officials and managers).

Table 3-18: Employment status in region

Employment Status (2011)	No of Households	%
Employed	45,142	69.48
Unemployed	5,556	8.55
Discouraged work seeker	1,108	1.71
Not economically active	13,086	20.14
Age less than 15 years	79	0.12
TOTAL	**64,971**	**100**

A total of 100 full time people will be employed during the proposed activity, which will have a positive impact on the families of those 100 people. For example, for every 1 person employed it could indirectly impact on 10 other people by providing money and food.

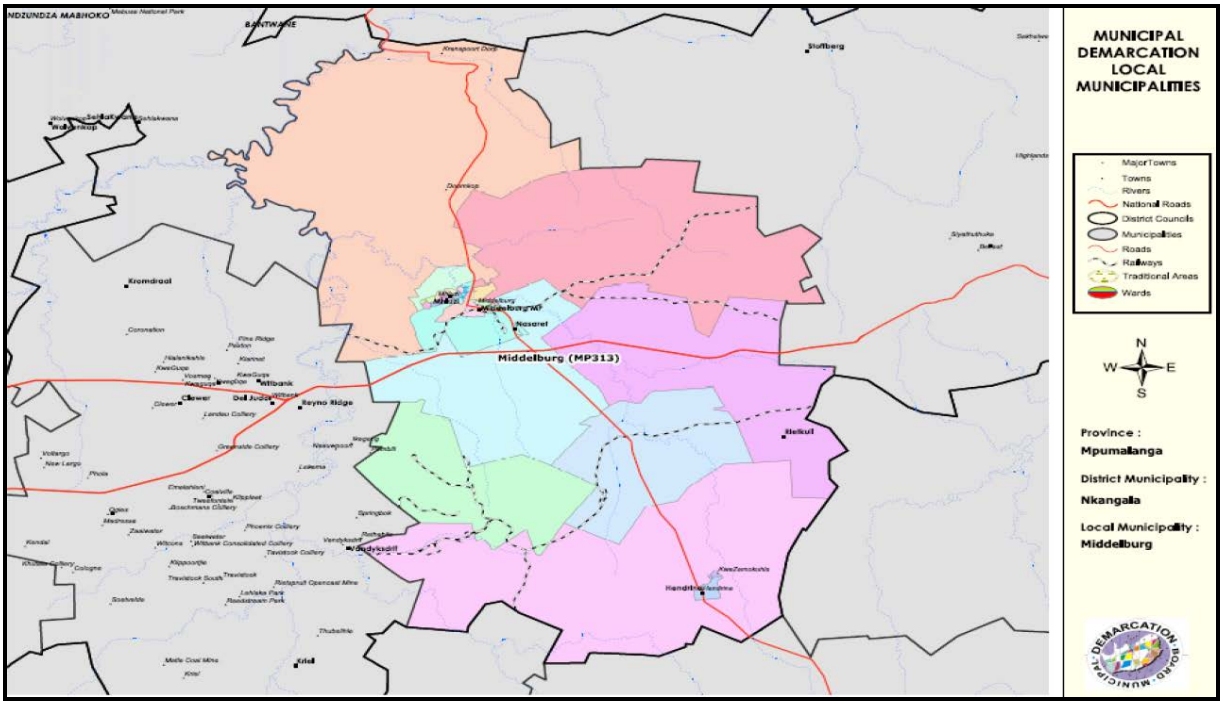

Figure 3-14: Spatial structure of the Steve Tshwete Local Municipality

3.7.3 Unemployment estimate for the area

Approximately 69% of STM population is economically active, while 8.5% are unemployed. An outline of the salary scale for the region is provided in **Table 3-19**.

Table 3-19: Salary scale of the Steve Tshwete Local Municipality

No of Household	Salary (R/month)
8,305	No Income
1,720	R 1 – R 4,800
2,727	R 4,801 – R 9,600
7,357	R 9,601 – R 19,600
10,465	R 19,601 – R 38,200
11,073	R 38,201 – R 76,400
9,295	R 76,401 – R 153,800
7,397	R 153,801 – R 307,600
4,579	R 307,601 – R 614, 400
1,463	R 614,401 – R 1,228,800
338	R 1,228,801 – R 2,457,801
251	>R2,457,601

Figure 3-14 provides for an overview of the spatial framework in which the Steve Tshwete Local Municipality operates as part of the Nkangala District Municipality. The Nkangala District Municipality covers a geographic area of 39,976 km^2 incorporating municipalities as depicted in **Figure 3-14.**

The Nkangala District Municipality inclusive of Middelburg, Witbank, Bethal, Ermelo and Hendrina has compiled an Integrated Development Plan with the main purpose of the IDP to be used as a decision support tool for the area with emphasis on:

- Description of the environmental attributes;
- Assessing the attributes in terms of relative sensitivity to development; and
- Guiding environmental decision making.

It is clear that job creation in the Steve Tshwete LM needs to be initiated. Mining will assist in dealing with the high unemployment as additional jobs will be created.

4. QUANTITATIVE RISK ASSESSMENT

4.1 SAFETY, HEALTH, ENVIRONMENT AND QUALITY POLICY

Kebrafield's Safety Health, Environmental and Quality (SHEQ) Policy will be implemented at the mining site and maintained by the SHEQ officer (and is available from the mine on request). Kebrafield (Pty) Ltd's SHEQ policy states the overall SHEQ objective by adhering to applicable and relevant legislation; indicates commitment to improve SHEQ performance and is signed by management. The SHEQ Policy is appropriate to the nature and scale of SHEQ risks and indicates commitment to continual improvement by periodical reviews. The SHEQ policy indicates where procedures can be found; is communicated to all employees, contractors and visitors; and is available to all Interested and Affected Parties.

Kebrafield (Pty) Ltd established and maintains a procedure for the on-going identification of hazards, the assessment of risks, and the implementation of necessary control measures for safety, health, the environment as well as quality. The hazard identification and risk assessment system identify hazards, assess risks and identify the nature of the hazard by indicating if it is Safety, Health, Environmental or Quality related. The calculated risks are classified as high, medium or low risks. Control measures are implemented to reduce residual risks. High risks are included in the objectives and targets and management plans to assign actions to reduce the residual risk. The high risks also form part of the companies SHEQ policy.

4.1.1 Health and Safety Policy

Kebrafield (Pty) Ltd is committed to the maintenance of a Healthy Working Environment. It recognizes the importance of ensuring a safe environment for people living within the environs of its operations, as well as for those persons who are not employees, but who are directly affected by the mining activities of the Company.

The Company acknowledges the importance of health and safety with regards to the future of the industry within which it operates, i.e. the production of coal from underground and surface sources, the beneficiation thereof and ultimately the sale of products produced.

4.1.2 Quality Policy

Kebrafield (Pty) Ltd was established and is operated with quality as a core value in its management philosophy. This philosophy is expressed through detailed planning and the selection of mining methods to target the highest quality raw materials (at the same time also reducing waste).

With the active participation of all employees, who are individually and collectively responsible for their performance, and through the commitment of continual improvement of the quality performance, Kebrafield (Pty) Ltd will incorporate Total Quality Management within their global strategy.

4.1.3 Environmental Policy

Kebrafield (Pty) Ltd recognises that immediate sustainability of its business is dependent on operating within the carrying capacity of the environment. Kebrafield (Pty) Ltd is committed to operating within this capacity and will set its business objectives and conduct its operations so that a balance is maintained between economic development, the needs of the business, the community and environmental conservation.

Kebrafield (Pty) Ltd is committed to preserve the environment in which they operate and undertakes:

- To manage the natural and physical environmental in a responsible manner
- To reduce non-renewable resources consumption to the minimum
- To comply with all applicable laws, regulations and standards
- To collaborate with the authorities to develop standards and practical guides aimed at protecting natural resources, and the environment
- To apply the principal of best available technology not entailing excessive cost; to keep abreast with new technology; to develop new technology to enable us to fulfil our environmental objectives.
- To provide appropriate environmental training
- To make all employees aware of the environmental impacts of their activities and the requirements of this policy. To motivate employees to take proper care of the environment
- To reduce waste generation and contamination of air, water and land to a minimum by applying the following waste management hierarchy: reduce at source, re-use, and re-cycle. To ensure that any waste, which is nonetheless generated, is disposed of in a way that does not damage or threaten the environment
- To prevent environmental emergencies. To implement and maintain a comprehensive contingency plan, to limit damage to a minimum when emergencies nevertheless occur
- To plan and carry out company related activities so as to keep disturbance of the land surface and natural environment to a minimum. To plan the positive and negative impacts, which the company has on the land under its control, so that when the operation closes, the overall effect, on balance is a positive one
- To prevent groundwater and surface water contamination to minimise the impact on the water body.
- To conserve water and promote water conservation strategies.
- To control emissions so as to avoid causing; damage to health, a nuisance, or long term damage to the atmosphere
- To ensure that environmental impact control is a vital component of all phases in the production process. To monitor key indicators so as to facilitate control of environmental performance
- To conduct thorough investigations where deviations or non-conformances occur and to implement the appropriate preventative and corrective actions
- To audit to assess the effectiveness of the environmental management systems and to assist

management in improving performance

- To undertake reviews to ensure compliance with this policy and the continual improvement of Kebrafield (Pty) Ltd environmental performance
- To actively involve the surrounding community in environmental control activities
- To inform Interested and Affected parties on the company's environmental performance

Kebrafield (Pty) Ltd accepts responsibility and accountability for fulfilling this policy. They will establish and maintain an effective environmental management system based on nationally accepted standards. In the event where no National Standard exists an internationally (such as ISO) accepted standard will be adopted.

4.2 OBJECTIVES AND STRATEGIES

An overarching water management strategy as contained in the Water for Growth and Development Framework states, "*Water can only support growth and development in the country without compromising the ecological sustainability of the resource*".

Kebrafield (Pty) Ltd established and maintains a documented procedure for the development of SHEQ objectives and management plans. Legal and other requirements, SHEQ hazards and risks, technical options, financial, operational and business requirements, as well as views of interested parties are taken into consideration when developing measurable SHEQ objectives in the company. The objectives are developed into a management system, because it indicates allocation of responsibilities, identifies how objectives will be met and the time frame set to achieve them. Objectives and programme(s) form part of the company's SHEQ Policy.

4.2.1 Environmental Management Objectives

Kebrafield (Pty) Ltd environmental objectives were compiled to ensure that identified impacts are either;

- Totally eliminated (such as design changes)
- Minimised
- Managed as not to impact on the environment

Environmental Management Objectives at the operational activities of Kebrafield (Pty) Ltd can be roughly divided into three categories, namely:

- Primary management objectives (long term)
- Secondary management objectives (short to medium term)
- Tertiary management objectives or site goals (short term)

Primary Management Objectives

Primary environmental management objectives are all based on the guidelines set by legislation, such as the National Water Act (1998), National Environmental Management Act (1998), Mineral and Petroleum Resources Development Act (2003) and the various other acts regulating the

environment.

Compliance to this legislation is set in policy and management principles on the site for the duration of the project (including planning, construction, operational, closure and post-closure phases).

The purpose of primary management objectives is therefore to comply with legislation (Acts, Regulations and other Government Notices). Primary management objectives are set to protect human health and safety at all costs.

Secondary Management Objectives

Secondary management objectives will be developed as part of the Integrated Water and Waste Management Plan, specifically focussing on the management of identified risks to prevent and minimise possible impacts on the environment.

Secondary management objectives therefore are site-specific, pro-active measures defined in the EMPR and the IWRMP that will prevent and/or minimise the impact on the environment.

Tertiary Management Objectives

Tertiary management objectives in this IWRMP will be defined as short term objectives set to attain a certain goal or aim. These objectives will be defined for specific required instances, where, due to the failure of primary or secondary objectives, an impact resulted.

An example would be a hydro-carbon spillage from the diesel bowser due to an unforeseen incident (accident). Though management objectives (primary and secondary) are in place, an accident may result in impact, which will require immediate mediation and management to minimise the impact. One typical management objective may be, “to limit the contamination to the smallest possible area”, or “to clean and mediate the impact area back to a natural state”.

Tertiary management objectives can at this stage not be defined, as in this IWWMP, it will only be required due to an extra-ordinary (unforeseen) event. Specific objectives will be defined if any such event occurs.

4.2.2 Management Strategies

Kebrafield (Pty) Ltd established and maintains various procedures to ensure that operational control in the company is up to standard. These procedures will be handled as per the Document Control system of Roodepoort Colliery detailing the general operational control procedure.

The system makes provision for various operating manuals such as the Standard Operating Procedures (SOP) as contained in section 5 of the IWWMP. All management strategies to be implemented at Kebrafield: Roodepoort Colliery will be aligned and coordinated with the Water Resource Management Strategy of DWA for the Olifants WMA.

Table 4-1

These operating systems and manuals are available from the mine on request.

All management strategies to be implemented at Kebrafield: Roodepoort Colliery will be aligned and coordinated with the Water Resource Management Strategy of DWA for the Olifants WMA.

Table 4-1: Standard Operating Procedures for Kebrafield

Document Control System Code	Description
KF-SOP/MIN-001	Pre-start inspection of mobile machine
KF-SOP/MIN -002	Testing brakes at the brake test ramp
KF-SOP/MIN -003	Park and immobilize surface mobile machinery
KF-SOP/MIN -004	Operating of an ADT
KF-SOP/MIN -005	Filling a mobile machine with diesel
KF-SOP/MIN -006	Operating a FEL
KF-SOP/MIN -007	Operating of a bulldozer
KF-SOP/MIN -008	Operating of a grader
KF-SOP/MIN -009	Operating of an excavator
KF-SOP/MIN -010	Operating of a TLB
KF-SOP/MIN -011	Lock-out procedure
STP - Standard Task Procedures	
KF-STP/MIN 001	Loading ADT with Material
KF-STP/MIN 002	Pre-start Checklist TMM's
KF-STP/MIN 003	Diesel Filling of Vehicles
KF-STP/MIN 004	Removal of Radiator cap
KF-STP/MIN 005	Lock out Procedure for Mobile Equipment
KF-STP/MIN 006[6]	Watering of haul roads
KF-STP/MIN 007	Grading of Haul roads
KF-STP/MIN 008	Loading Material with an Excavator
KF-STP/MIN 009	Correct use of PPE
KF-STP/MIN 010	Loading material with a FEL
Code of Practices	
KF-COP-01	COP for TMM
KF-COP-02	COP for Fitness to perform work
KF-COP-03	COP for Thermal Stress
KF-COP-04	COP for Noise
KF-COP-05	COP for Airborne Pollutants

[6] Standard Task Procedure for watering as a dust suppression activity subject to conditions of a water use authorization.

Document Control System Code	Description
General Task Procedures	
KF-GEN-01	Control of Hazardous Substances
KF-GEN-02	Personal Protective Equipment
KF-GEN-03	Contractors Control
KF-GEN-04	Access Control
KF-GEN-05	SHE Nominations and elections

Water Management Strategy

The water management strategy (hierarchy) adopted in the design of the mine layout is as follows:

- Minimise the extent to which water becomes contaminated
- Separate waters of different quality to maximize re-use potential
- Maximise the extent to which contaminated water is re-used by (if necessary) treating the water to a standard suitable for re-use
- Separate clean water and dirty water systems
- Design PCD to ensure Zero Effluent Policy

Waste Management Strategy

To reduce all waste to a minimum by applying the following waste management hierarchy:

- Reduce at source
- Re-use
- Re-cycle

To ensure that any waste, which is nonetheless generated, is disposed of in a way that does not damage or threaten the environment. This applies to the following waste types and activities, including contractors: recyclable waste, non-recyclable waste and hazardous waste.

4.3 KEY PERFORMANCE AREA AND INDICATORS

This process allows the project management team to identify significant environmental features that shall be addressed as a priority during the further operational, decommissioning and post closure phases of the project.

The process shall also take into account the cost and time of undertaking such analysis and the availability of reliable data. The process to identify significant environmental aspects associated with the project activities shall, where relevant consider the following:

- Releases to Water
- Emissions to Air
- Waste Management
- Contamination of Land
- Noise Control
- Use of Raw Materials and Natural Resources

- Local Environmental and Community Issues
- Visual Impact Control

Kebrafield (Pty) Ltd shall develop and implement procedures that will ensure that all the project activities are thoroughly addressed to make sure that project defined objectives are met. Specific project plans shall be available that identify and plan activities needed to achieve project objectives.

4.4 METHODOLOGY FOLLOWED FOR ENVIRONMENTAL IMPACT ASSESSMENT

An environmental risk assessment was completed on the potential impacts that the various water uses on site may have on the environment. Only impacts that have been ranked with a significant rate (or higher) had been further assessed.

4.4.1 Assessment Criteria

The criteria for the description and assessment of environmental impacts were drawn from the EIA Regulations, published by the Department of Environmental Affairs and Tourism (April 1998) in terms of the NEMA.

The level of detail as depicted in the EIA regulations was fine-tuned by assigning specific values to each impact. In order to establish a coherent framework within which all impacts could be objectively assessed, it was necessary to establish a rating system, which was applied consistently to all the criteria. For such purposes each aspect was assigned a value, ranging from one (1) to five (5), depending on its definition. This assessment is a relative evaluation within the context of all the activities and the other impacts within the framework of the project. An explanation of the impact assessment criteria is defined below. It is however of critical importance to note that impacts could be negative, or positive.

Extent	
Classification of the physical and spatial scale of the impact	
Footprint	The impacted area extends only as far as the activity, such as footprint occurring within the total site area.
Site	The impact could affect the whole, or a significant portion of the site.
Regional	The impact could affect the area including the neighbouring farms, the transport routes and the adjoining towns.
National	The impact could have an effect that expands throughout the country (South Africa).
International	Where the impact has international ramifications that extend beyond the boundaries of South Africa.
Duration	
The lifetime of the impact that is measured in relation to the lifetime of the proposed development.	
Short	The impact will either disappear with mitigation or will be mitigated through a natural process in a period shorter than that of the construction phase.

Short to Medium	The impact will be relevant through to the end of a construction phase (1.5 years)
Medium	The impact will last up to the end of the development phases, where after it will be entirely negated.
Long	The impact will continue or last for the entire operational lifetime i.e. exceed 30 years of the development, but will be mitigated by direct human action or by natural processes thereafter.
Permanent	This is the only class of impact, which will be non-transitory. Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact can be considered transient.
Intensity	
The intensity of the impact is considered by examining whether the impact is destructive or benign, whether it destroys the impacted environment, alters its functioning, or slightly alters the environment itself. The intensity is rated as	
Low	The impact alters the affected environment in such a way that the natural processes or functions are not affected.
Medium	The affected environment is altered, but functions and processes continue, albeit in a modified way.
High	Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.
Probability	
This describes the likelihood of the impacts actually occurring. The impact may occur for any length of time during the life cycle of the activity, and not at any given time. The classes are rated as follows:	
Improbable	The possibility of the impact occurring is none, due either to the circumstances, design or experience. The chance of this impact occurring is zero (0 %).
Possible	The possibility of the impact occurring is very low, due either to the circumstances, design or experience. The chances of this impact occurring is defined as 25 %.
Likely	There is a possibility that the impact will occur to the extent that provisions must therefore be made. The chances of this impact occurring is defined as 50 %.
Highly Likely	It is most likely that the impacts will occur at some stage of the development. Plans must be drawn up before carrying out the activity. The chances of this impact occurring is defined as 75 %.
Definite	The impact will take place regardless of any prevention plans, and only mitigation actions or contingency plans to contain the effect can be relied on. The chance of this impact occurring is defined as 100 %.

The status of the impacts and degree of confidence with respect to the assessment of the significance must be stated as follows:

- **Status of the impact** - A description as to whether the impact would be positive (a benefit), negative (a cost), or neutral
- **Degree of confidence in predictions** - The degree of confidence in the predictions, based on the availability of information and specialist knowledge

Other aspects to take into consideration in the specialist studies are:

- Impacts should be described both before and after the proposed mitigation and management measures have been implemented
- All impacts should be evaluated for the full-lifecycle of the proposed development, including construction, operation and decommissioning

- The impact evaluation should take into consideration the cumulative effects associated with this and other facilities which are either developed or in the process of being developed in the region
- The specialist studies must attempt to quantify the magnitude of potential impacts (direct and cumulative effects) and outline the rationale used. Where appropriate, national standards are to be used as a measure of the level of impact

4.4.2 Mitigation

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

Determination of Significance – Without Mitigation

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

No significance	The impact is not substantial and does not require any mitigation action.
Low	The impact is of little importance, but may require limited mitigation.
Medium	The impact is of importance and is therefore considered to have a negative impact. Mitigation is required to reduce the negative impacts to acceptable levels.
High	The impact is of major importance. Failure to mitigate, with the objective of reducing the impact to acceptable levels, could render the entire development option or entire project proposal unacceptable. Mitigation is therefore essential.

Determination of Significance – With Mitigation

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

No significance	The impact will be mitigated to the point where it is regarded as insubstantial.
Low	The impact will be mitigated to the point where it is of limited importance.
Low to Medium	The impact is of importance, however, through the implementation of the correct mitigation measures such potential impacts can be reduced to acceptable levels.
Medium	Notwithstanding the successful implementation of the mitigation measures, to reduce the negative impacts to acceptable levels, the negative impact will remain of significance. However, taken within the overall context of the project, the persistent impact does not constitute a fatal flaw.
Medium to High	The impact is of major importance but through the implementation of the correct mitigation measures, the negative impacts will be reduced to acceptable levels.

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

4.4.3 Assessment Weighting

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

Ranking, Weighting and Scaling

For each impact under scrutiny, a scaled weighting factor is attached to each respective impact. The purposes of assigning such weights serve to highlight those aspects considered the most critical to the various stakeholders and ensure that each specialist's element of bias is taken into account. The weighting factor also provides a means whereby the impact assessor can successfully deal with the complexities that exist between the different impacts and associated aspect criteria.

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

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

Mitigation Efficiency (ME)		Significance Following Mitigation (SFM)	
High	0,2	Low	0-19
Medium to High	0,4	Low to Medium	20-39
Medium	0,6	Medium	40-59
Low to Medium	0,8	Medium to High	60-79
Low	1,0	High	80-100

Identifying the Potential Impacts without Mitigation Measures (WOM)

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

Equation 1:

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

Identifying the Potential Impacts with Mitigation Measures (WM)

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

Mitigation Efficiency (ME)

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

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

Equation 2:

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

Or WM = WOM x ME

Significance Following Mitigation (SFM)

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

4.5 POSSIBLE IMPACTS ON THE WATER ENVIRONMENT

The environmental impacts were calculated as per the assessment criteria of **Section 4.4**. In general the mining activities at the project site may drive environmental change in the following manner:

- Changes in topography and surface drainage with the potential for increased soil erosion, long term compaction and reduced agricultural capacity
- Disturbance and disruption of the natural flow regime with potential surface and ground water pollution
- Changes in topsoil characteristics with increased acidity and salt content, development of nutrient deficiencies or imbalances, surface crustiness or desiccation, changes in vegetation cover and land use with the potential of atmospheric dust production and other pollution

Physical water impacts as identified that might occur include:

- The use of water for mining operations contributing towards an increased demand on the resource
- De-vegetation of the mining site resulting in erosion and increased silt and sediment load
- The creation of pollution control dams that could spill during extreme weather conditions resulting in pollution of the downstream water resource

- Erosion problems where soil, sediments and other associated contaminants are transported to streams, rivers and other water bodies, resulting in the alteration of the habitat and water quality
- Alteration of water courses contributing towards degradation of the natural systems
- Lowering of the floodplain groundwater and recharge to the wetland system(s)
- Terrestrial ecological changes associated with disturbed areas, e.g. alien invasive plant establishment, altered plant community species composition and loss of habitat for indigenous fauna and flora

The set of impacts that the mining may have on the aquatic environment will depend on:

- The type and scale of mining conducted
- The efficiency and effectiveness of any environmental management system that are deployed
- The sensitivity of the receiving environment (including the scarcity of water)

These various identified impacts can be described as:

- Direct physical disturbance impacts
- Primary and secondary pollution impacts
- Indirect impacts
- Long-term residual impacts

In addition the impacts could have cumulative and synergistic effects. This is specific applicable to the study area as any further coal mining in the area could lead to severe environmental consequences that will be difficult to mitigate. The extent of the remaining coal reserves are within the sensitive wetland areas.

The DWA has also identified the potential impacts caused by the exploration and surveying phase of small scale mining as indicated below. Adjacent to the proposed mining area is a sand quarry that may contribute towards the accumulative risk of environmental degradation.

Scale of impact	Activities	Potential Environmental Impact
Relatively small. However, the cumulative impacts at multiple sites within an area have the potential to drive environmental change, particularly from a larger regional perspective.	Surveys Vehicle tracks Vehicle and machinery fuel points Construction camp housing Construction camp sanitation systems Waste disposal (garbage)	Vegetation removal, damage and destruction Habitat disturbance due to noise / vibration Disturbance to wildlife and local resident Soil erosion along trenches and transects Dumping and waste Demand on local water resources Discharges or spillage of contaminants Contamination of local groundwater by exposed ores Restricted public access

4.6 SIGNIFICANCE OF POSSIBLE IMPACTS

The impact of the proposed mine on the hydrogeology of the area was determined through numerical modelling. Details of models can be found in the Geohydrological Report (see Appendix 7

of WULAR).

The construction phase is not expected to influence the groundwater levels. With the exception of lesser oil and diesel spills, there are also no activities expected that could impact on regional groundwater quality. Very little additional impacts are expected in the groundwater quality. It is expected that the current status quo will be maintained.

4.6.1 Effect of Water Abstraction on Groundwater Levels (Section 21(a) and 21(j))

During the operational phase, it is expected that the main impact on the groundwater environment will be de-watering of the surrounding aquifer. Water entering the mining areas will have to be pumped out to enable mining activities. This will cause a lowering in the groundwater table, in and adjacent to the mine.

The dewatering of the aquifer has been calculated for the colliery using the calibrated numerical model. A worst-case scenario has been modelled, assuming that the entire opencast would be dewatered. This is however unlikely to be the case, the actual draw-down may thus be less. However, as the recovery of groundwater is expected to be very slow, it could well be that the first boxcut in the opencast is still in early stages of recovery while the last is mined. Thus, the worst case scenario could also reflect the actual scenario.

Figure 4-1: Groundwater Drawdown during Mining – Opencasts

The calculated draw-down of the worst case scenario is depicted **Figure 4-1** below, as contours of drawdown for the opencast. It follows from this figure that:

- A maximum draw-down of 35 metres is predicted in places inside the opencasts areas, as can be expected.
- The total area of the cone of depression could extend about 1000 metres from the mining area (east and west of the proposed mine). However, at a radius of more than 800 metres, the effect on boreholes is expected to be marginal.

Some naturally occurring springs are found in the study area. With reference to **Figure 4-1**, it is evident that the dewatering of the mine may impact on the discharge of springs due to the drawdown of the piezometric level. These springs may contribute to the base flow of some stream (perennial or non-perennial). The spring found to the south of the mining area may be negatively impacted by the dewatering cone. The Dam located near ROD4 may be marginally impacted. These springs located on Portion 17 of farm Roodepoort appear to have the highest risk of being impacted by the dewatering cone. Nevertheless, the yield of springs used by private users should be determined during the commissioning phase. Monitoring of the springs is required to determine whether the mine may a significant impact on their yields.

The boreholes ROD4 and ROD5 found on Portion 17 of Roodepoort 151 IS are likely to be affected by the dewatering cone. There are no other privately owned boreholes in the potential affected area that might experience a decline in water levels of approximately 5 metres or more. The water levels in the surrounding boreholes should be monitored.

Despite the modelled predictions, it must again be stressed that structures of preferred groundwater flow have not been modelled. It is known by experience that dolerite intrusion will most likely transgress the area, but details are limited and not adequate to model this structure(s). If such a structure is dewatered through mining, any boreholes drilled into the structure might be seriously affected. These effects cannot be predicted with the current knowledge, and can only be established through continuous groundwater level monitoring.

It is also possible to estimate the inflow into the opencast from the numerical model. In the case of the model prepared for this project, the computed inflow to the colliery was calculated to be as tabled in **Table 4-2** below.

Table 4-2: Predicted inflow to the mining areas

Area (m^2)	Max Drawdown (m)	Cone of depression from edge of pit in m	Estimated Inflow m^3/day	Evaporation m^3/day
164,747	40	300	120	757.83

Evaporation has to be subtracted from these numbers, as wet material and open water could evaporate substantial amounts of water. Illustrative volumes are included in the table as if the evaporation will take place over the whole opencast, for comparative purposes. As the whole opencast will not be open at any one time, this is obviously an overestimate. Nevertheless, it is illustrative that evaporation can contribute considerably to the removal of groundwater seepage into the opencast, and it is not inconceivable that very little abstraction of groundwater might be needed during dry seasonal periods, if any. Furthermore, it should be realised that evaporation is a seasonal effect.

Direct recharge from rainfall will in turn add to these volumes. The amount of direct recharge will depend on the season as well as the details of the mining plans and storm water management.

The water make as calculated above are overestimations and probably reflect worst-case scenarios. The actual inflow will depend on the area being mined at any one moment in time. However, at the last box cut, the inflow from the backfilled portion of the opencast could be substantial and the above inflows can be approached.

Management	Extent	Duration	Intensity	Probability	Weighting Factor	Significance Rating
Unmanaged	Region	Long	Medium	Likely	High	Medium –High
	Mitigation Efficiency			**Significance after mitigation**		

Managed	Medium to High	Low – Medium

The significance of the impact on the change in groundwater level during the operational phase is considered Medium-High without mitigation and Low-Medium with mitigation.

Management	Extent	Duration	Intensity	Probability	Weighting Factor	Significance Rating
Unmanaged	Region	Long	Low	Likely	High	Medium
	Mitigation Efficiency			**Significance after mitigation**		
Managed	Low			Medium		

The significance of this impact on base flow of streams during the operational phase is considered Medium without mitigation and as the efficiency of mitigation of the impact is likely to be low, the significance is still medium with mitigation.

After closure, the water table will rise in the rehabilitated opencast to reinstate equilibrium with the surrounding groundwater systems. However, the mined areas will have a larger hydraulic conductivity compared to the pre-mining situation. The recharge over the rehabilitated areas is also likely to be higher than initially (~15%). This will result in a relative flattening of the groundwater table (groundwater flow gradient) over the extent of mining area, in contrast to the gradient that existed previously.

The end result of this will be a permanent lowering of the groundwater level in the higher topographical area and a rise in lower lying areas. It is predicted that the groundwater level will decline by about 20 metres in higher elevation (central) sections, and rise up to 6 metres in the lower sections (northern and southern extent of opencast area). The boreholes (BH10 and BH11) and spring (SW1) located on Portion 17 of Roodepoort 151 IS are likely to be permanently affected by the new equilibrium water level. The headwater of some of the non-perennial streams may also be affected by the change is water levels.

Management	Extent	Duration	Intensity	Probability	Weighting Factor	Significance Rating
Unmanaged	Region	Permanent	Medium	Highly Likely	High	Medium -High
	Mitigation Efficiency			**Significance after mitigation**		
Managed	Low to Medium			Medium –High		

The impact on the groundwater level during decommissioning and closure has a Medium-High significance rating without mitigation as well as with mitigation, as the efficiency of mitigation measures is likely to be low to medium.

Management	Extent	Duration	Intensity	Probability	Weighting Factor	Significance Rating
Unmanaged	Region	Permanent	Medium	Likely	High	Medium -High
	Mitigation Efficiency			**Significance after mitigation**		

Managed	Medium	Medium

During decommissioning and closure, the impact of mining activities on the base flow of streams is likely to be positive with a rating of Medium-High significance.

4.6.2 Effect on groundwater quality

The flow gradient in the aquifer will be directed towards the colliery during the operation of the mine, and very little groundwater pollution is thus expected from the opencast. Contaminants may seep from the pollution control dams, however they are assumed to be lined and would therefore initially have a minimal impact on the groundwater resource. Once the mine is operational, these dams can be included into the updated numerical model. The hards and softs stockpiles may act as contaminant sources if they contain sulphides conducive to ARD formation. The plant and ROM area are also potential sources. The contaminants emanating from these sources (hards, softs, ROM) are more likely to impact on the surface water through seepage than groundwater.

Once the normal groundwater flow conditions have been re-instated, polluted water can migrate away from the rehabilitated areas. Groundwater will flow away from the pit towards the streams. As some coal and discards will remain in the mine, this outflow will be contaminated as a result of acid or neutral mine drainage. Based on past experience, a starting concentration of sulphate of 2,000 mg/litre can be assumed as a worst case scenario.

Management	Extent	Duration	Intensity	Probability	Weighting Factor	Significance Rating
Unmanaged	Site	Long	Medium	Likely	Medium to High	Medium
	Mitigation Efficiency			**Significance after mitigation**		
Managed	Low to Medium			Medium		

The significance of the effects on water quality down gradient of the mining operations during the operational phase can be considered to be Medium without Mitigation and Medium with mitigation as the efficiency of mitigation measures is considered to be Low to Medium.

Management	Extent	Duration	Intensity	Probability	Weighting Factor	Significance Rating
Unmanaged	Foot-print	Long	Medium	Likely	Medium	Low-Medium
	Mitigation Efficiency			**Significance after mitigation**		
Managed	Medium			Low-Medium		

The significance of the impact of spills/leaks of oil, diesel and chemicals during the operational phase is considered to be Low-Medium without mitigation and Low-Medium with mitigation measures.

Management	Extent	Duration	Intensity	Probability	Weighting Factor	Significance Rating
Unmanaged	Foot-print	Long	Medium	Possible	Medium	Low-Medium
	Mitigation Efficiency			**Significance after mitigation**		
Managed	Medium			Low-Medium		

The significance of the impact of sewage related groundwater contamination during the operational phase is considered to be Low-Medium without mitigation and Low-Medium with mitigation.

The migration of contaminated water from the mining area in the long term was modelled in terms of the extent of the pollution plume 25, 50, 75 and 100 years after the colliery has been closed. Experience has shown that the plume stagnates after about 80-100 years, and no further movement after such time is expected.
The results of the modelling must be viewed with caution as a homogeneous aquifer has been assumed. Heterogeneities in the aquifer are unknown and the effect of this cannot be predicted. Furthermore, no chemical interaction of the sulphate with the minerals in the surrounding bedrock has been assumed. As there must be some interaction and retardation of the plume, it is hoped that this prediction will represent a worst-case scenario.

Within the limitations of the abovementioned assumptions, it can be estimated from these figures that:

- Movement of the plumes will be mostly downstream towards the stream to the east of the mining areas, as can be expected. However, the movement of the plume is predicted to be relatively slow due to the low hydraulic conductivity (assuming no preferential flow paths and nearby groundwater abstraction)
- The contaminant groundwater plume is likely to reach some of the non-perennial and perennial streams in the area
- After 25 years, the plume migrating to east may start impacting on the non-perennial stream draining the area
- Fifty years after mine closure, the plume migrates further and may start impacting on the Borehole ROD4
- At 75 years, the plume migrates further, with the south eastern non-perennial stream possibly being impacted on
- After 100 years the plume is likely to impact on the east to west flowing non-perennial stream found 570m south of the mine area. Only ROD4 and possibly ROD5 are likely to be affected by the contaminant plume.

No other currently used boreholes outside the proposed mine boundary are likely to be impacted by the groundwater contaminant plume. Provided no boreholes used for private purposes are drilled in the plume. At this stage (100 years) the plume is predicted to become stagnant as some chemical reaction will inevitably occur, thereby retarding and absorbing chemical substances in solution.

Management	Extent	Duration	Intensity	Probability	Weighting Factor	Significance Rating
Unmanaged	Region	Long	High	Highly Likely	High	High
	Mitigation Efficiency			**Significance after mitigation**		
Managed	Medium			Medium-High		

The impact on the groundwater quality down gradient of the mining operations due to plume movement is considered to be of High significance without mitigation and Medium-High with mitigation.

Management	Extent	Duration	Intensity	Probability	Weighting Factor	Significance Rating
Unmanaged	Footprint	Long	Medium	Possible	Medium	Low- Medium
	Mitigation Efficiency			**Significance after mitigation**		
Managed	Medium			Low- Medium		

The impact of the contaminants emanating from historic oil, diesel, chemical spills and facilities is considered to be Low-Medium significance without mitigation and Low-Medium with mitigation.

4.6.3 Alteration of Drainage Patterns – Section 21(c) and 21(i)

During the construction phase, the drainage lines of two small streams will be altered as clean water diversion channels are constructed to ensure that there is complete separation of clean and dirty storm water. It should be noted that no river diversions are planned or to be carried out. The altering of drainage lines are required in order to protect the wetlands from degradation stemming from mining activities. The diverted runoff will be allowed to flow to the nearest drainage line that it would normally enter without causing any negative on the bottom valley wetlands. The effect on stream flow will therefore be negligible. It should be noted that for the purpose of this impact assessment, the duration of the alteration is taken as medium term.

Management	Extent	Duration	Intensity	Probability	Weighting Factor	Significance Rating
Unmanaged	Region	Medium	Low-Medium	Definite	Medium	Medium
	Mitigation Efficiency			**Significance after mitigation**		
Managed	High			Low		

The impact on the drainage patterns is considered to be Medium without mitigation and Low with mitigation.

4.6.4 Waste Management Facilities – Section 21(g)

Water removed from the open pit will be pumped to two pollution control dams. Waste material from the mining activities will be disposed of on discard dumps. The water resource in the area has no buffer capacity (alkalinity) and is therefore susceptible to acidification. Spillage from the

pollution dams will be prevented as the dams will be build according to GN704 Regulations. They will be lined and will have minimum freeboards of 0.8 metres above full supply level. Waste material from the mining activities will be disposed of on discard dumps. There will be discard dumps for the hard overburden, soft material and for discard from the crushing and screening plant.

Management	Extent	Duration	Intensity	Probability	Weighting Factor	Significance Rating
Unmanaged	National	Medium	Medium	Highly Likely	Medium	Medium
	Mitigation Efficiency			**Significance after mitigation**		
Managed	High			Low		

The impact on the water quality due to possible pollution from the storm water system is considered to be Medium without mitigation and Low with mitigation.

Management	Extent	Duration	Intensity	Probability	Weighting Factor	Significance Rating
Unmanaged	National	Short to Medium	Medium	Highly Likely	Medium	Medium
	Mitigation Efficiency			**Significance after mitigation**		
Managed	High			Low - medium		

The impact on the water quality due to possible pollution from the waste residue sites is considered to be Medium without mitigation and Low - medium with mitigation.

4.6.5 Surface water quality

During the construction phase, soil exposure and concomitant runoff as well as dust may result in increased siltation of surface streams and wetlands. In addition, the increase of traffic, as well as the additional logistics (especially the storage of petroleum products) may result in hydrocarbon spillages. Hydrocarbon spillages will also emanates from the washing bay and the diesel storage tanks.

The exposure of waste material during the initial boxcut on the discard dumps to atmospheric conditions will accelerate the generation of Acid Mine Drainage. Although the coal waste material has a low sulphur content and potential to generate AMD, uncontrolled run-off will cause alleviated levels in TDS, SO_4, Na, Cl and EC with decrease in pH levels.

Metal concentrations such as Fe and Al in the water resource will also increase. Surface water quality will be at risk during all phases of the mine life cycle (Construction, Operation, Decommissioning and Closure).

Management	Extent	Duration	Intensity	Probability	Weighting Factor	Significance Rating
Unmanaged	Region	Short to Medium	Medium	Highly Likely	High	High

	Mitigation Efficiency	Significance after mitigation
Managed	Medium	Low - medium

The impact on the surface water quality is considered to be High without mitigation and Low - medium with mitigation.

4.6.6 Surface water levels

During the construction phase, the catchment yield (mean annual runoff) will be affected as construction activities within the footprint of the mining area could cause pollution. This water needs to be retained in a pollution control dam which will result in a decrease in storm water runoff. The location of the mine in the headwaters contributes towards low volumes of water and therefore insignificant impacts on catchment yield.

Management	Extent	Duration	Intensity	Probability	Weighting Factor	Significance Rating
Unmanaged	Region	Short	Low	Possible	Low	Low
	Mitigation Efficiency			Significance after mitigation		
Managed	Low			Low		

The impact on the surface water quality is considered to be Low without mitigation and Low with mitigation.

4.7 RISK TO THE ENVIRONMENT AND AQUATIC ENVIRONMENT

4.7.1 Mine Hazard Class

As Kebrafield (Pty) Ltd envisaged to operate a coal mining activity, the primary hazardous class is A. The mine is therefore subject to the compilation of an Integrated Water and Waste Management Plan as these mining activities are seen as having a significant potential to impact negatively on the environment.

4.7.2 Sensitivity of Water Resource

Please refer to **Section 1.6.8** for more information. Though, drainage region B12B has been classified as resource class Category C, and is in a largely moderate state with the Best AEMC determined as Category C. The Ecological Importance and Sensitivity of the applicable area is **high** as it falls in the upper reaches of the catchment and is virtually in a fairly natural condition.

4.7.3 Ecological Management Class

The Ecological Reserve Study for the B12B catchment by DWA (2007) indicates that the Woestalleen Spruit and Klein Olifants River is regarded a Class C implying to be in a fair state. The catchment is considered to have a high Ecological Important and Sensitivity rating due to the large

wetlands in the catchment.

4.8 RISK TO HUMAN HEALTH

It is often possible to describe the likely effects of specific water quality constituents on individual species or components of the system. However, the complex interrelationships between different components of aquatic ecosystems usually make it impossible to extrapolate these effects to the system as a whole. Despite uncertainties inherent in the approach used, protection of a few species within each trophic level is assumed to offer protection to all organisms.

It is important to follow a precautionary approach when setting water quality objectives on the basis of the water quality criteria. This implies that water quality objectives should not necessarily be set at a level which might adversely affect the resilience of aquatic ecosystems, since loss of this resilience might well limit options for future development of water resources.

In keeping with the goal of assuring the health and integrity of ecosystems, the different water quality criteria and objectives provided in these guidelines are typically used in the following ways:

- The Target Water Quality Range (TWQR) is a management objective that is used to specify the desired or ideal concentration range and/or water quality requirements for a particular constituent
- The Chronic Effect Value (CEV) is a criterion that is used, in certain special cases where the TWQR is exceeded. The setting of water quality requirements or objectives at the CEV protects aquatic ecosystems from acute toxicity effects. Examples of where it would be appropriate for water quality requirements for aquatic ecosystems to be set at the CEV would be:
  - Within the mixing zone of an effluent discharge
  - As interim water quality objectives in those situations where remediation is required, but water quality cannot immediately, or in one step, be restored to the TWQR
- The Acute Effect Value (AEV) is a criterion used to identify those cases requiring urgent management attention because the aquatic environment is threatened, even if the situation persists only for a brief period. The AEV may also be used to identify those cases in need of urgent mitigatory action. However, the AEV should not be used for setting water quality requirements for aquatic ecosystems

Due to the acid generating potential of the waste material it could also be expected that salinity will increase with significant increase in the SO_4 concentration. The lowering of pH will result in the mobilisation of metals. In general, activities at Kebrafield should result in the increase of variables such as iron, manganese and aluminium, mostly due to leaching of waste material in the opencast pit. The risks that these variables pose to other water users (including the aquatic environment) are discussed in the following sections.

4.8.1 Iron

Iron is the fourth most abundant element in the earth's crust and may be present in natural waters in varying quantities depending on the geology of the area and other chemical properties of the

water body. The two common states of iron in water are the reduced (ferrous, Fe^{2+}) and the oxidised (ferric, Fe^{3+}) states. Most iron in oxygenated waters occurs as ferric hydroxide in particulate and colloidal form and as complexes with organic, especially humic, compounds. Ferric salts are insoluble in oxygenated waters, and hence iron concentrations are usually low in the water column. In reducing waters, the ferrous form, which is more soluble, may persist and, in the absence of sulphide and carbonate anions, high concentrations of ferrous iron may be found.

The toxicity of iron depends on whether it is in the ferrous or ferric state, and in suspension or solution. Although iron has toxic properties at high concentrations, inhibiting various enzymes, it is not easily absorbed through the gastro-intestinal tract of vertebrates. On the basis of iron's limited toxicity and bio-availability, it is classified as a non-critical element. Iron is an essential micronutrient for all organisms, and is required in the enzymatic pathways of chlorophyll and protein synthesis, and in the respiratory enzymes of all organisms. It also forms a basic component of haeme-containing respiratory pigments (for example, haemoglobin), catalyses, cytochromes and peroxidases. Under certain conditions of restricted availability of iron, photosynthetic productivity may be limited. Iron at high concentrations can have various effects on aquatic ecosystems (**Table 4-3**), domestic use (**Table 4-4**), crop yield and quality (
Table 4-5**)**, clogging of irrigation equipment (**Table 4-6**) and the health of livestock (**Table 4-7**).

Table 4-3: Effect of iron on aquatic ecosystems

Target Water Quality Range (TWQR). Effect of Iron on aquatic ecosystems
The iron concentration should not be allowed to vary by more than 10% of the background dissolved iron concentration for a particular site or case, at a specific time.

Table 4-4: Effects of iron on domestic use

Target Water Quality Range Iron (mg/ℓ)	**Effects of iron on domestic use**
0 - 0.1	No taste, other aesthetic or health effects associated with consumption and use
0.1 – 0.3	Very slight effects on taste and marginal other aesthetic effects. Deposits in plumbing with associated problems may begin to occur. No health effects; the water is generally well tolerated
0.3 – 1.0	Adverse aesthetic effects (taste) gradually increase as do possible problems with plumbing. No health effects
1 – 10	Pronounced aesthetic effects (taste) along with problems with plumbing. Slight health effects expected in young children, and sensitive individuals
10 – 30	Severe aesthetic effects (taste) and effects on the plumbing (slimy coatings). Slight iron overload possible in some individuals. Chronic health effects in young children and sensitive individuals in the range 10 - 20 mg/ℓ , and occasional acute effects toward the upper end of this range
30 – 100	As above - Long-term health effects gradually increase
100 – 300	As above - Chronic health effects. Acute toxicity may begin to appear
300 – 3000	As above - Chronic and acute health effects. Accidental iron poisoning from water is rare
3000 – 30000	As above - Lethal toxicity occurs

Table 4-5: Effects of iron on crop yield and quality

Target Water	**Effects on Crop Yield and Quality**

Quality Range Iron (mg/ℓ)	
0 – 5	Not toxic to root uptake by plants in aerated soils. Range plant foliage damaged or blemished by iron deposits when wetted during irrigation
5 – 20	Maximum acceptable as concentration for fine textured neutral to alkaline soils
> 20	Exceeds the maximum acceptable concentration used by most international guidelines

Table 4-6: Effects of iron on the clogging of irrigation equipment

Concentration Range (mg/ℓ)	Effects on Clogging of Irrigation Equipment
0 – 0.2	Only minor problems encountered with clogging of drip irrigation systems
0.2 – 1.5	Moderate problems encountered with clogging of drip irrigation systems
> 1.5	Severe problems encountered with clogging of drip irrigation systems

Table 4-7: Effects of iron on the health of livestock

Concentration Range (mg/ℓ)	Effects on the Health of Livestock
0 – 10	No adverse effects
10 – 50	Adverse chronic effects such as liver and pancreas damage may occur, but, are unlikely if: - feed concentrations are normal, and - exposure is short term Could even be tolerated in the long term, depending on site-specific factors such as adequate intake of calcium, phosphorus and iron and water requirements
> 50	Adverse chronic and acute effects such as diarrhoea, vomiting, acidosis and respiratory failure and liver and pancreas damage respectively, may occur, although short-term exposure could be tolerated depending on site-specific factors such as adequate intake of phosphate and water requirements

4.8.2 Aluminium

Aluminium is the third most abundant element in the earth's crust. It occurs primarily as aluminosilicate minerals that are too insoluble to participate readily in bio-geochemical reactions. Aluminium is a strongly hydrolysing metal and is relatively insoluble in the neutral pH range. Under acidic (pH < 6.0) or alkaline (pH > 8.0) conditions, or in the presence of complexing ligands, elevated concentrations may be mobilised to the aquatic environment.

The solubility of aluminium in water is strongly pH dependent. Under acid conditions, it occurs as soluble, available and toxic hexahydrate (aqua) species. At intermediate pH values, it is partially soluble and probably occurs as hydroxy- and polyhydroxo- complexes. At alkaline pH values, aluminium is present as soluble, but biologically unavailable hydroxide complexes or as colloids and flocculants.

Aluminium is described as a non-critical element, although there is growing concern over the effects of elevated concentrations of aluminium in the environment, primarily that mobilized as a result of acid mine drainage and acid precipitation. Studies of the environmental chemistry and toxicity of aluminium provide a limited understanding of the processes regulating the aqueous concentration, speciation and bio-availability of this element. It should be noted that the toxicity of

aluminium depends on the chemical species involved.

It is clear that the aluminium toxicity is dependent on the species, the life stage of the organism, the concentration of calcium in water and the pH of the water. In acidic water the aluminium is generally more toxic with maximum toxicity occurring at pH 5.0 – 5.2.

In fish, the toxicity appears to be related to the interference with ionic and osmotic balance and with respiratory problems as a result of coagulation of mucus on gills. It may also interfere with the metabolism of calcium.

The target water quality for acid soluble aluminium in aquatic ecosystems area is indicated in **Table 4-8**. Aluminium at high concentrations can affect human health (**Table 4-9**), crop yield and quality (**Table 4-10**) and the health of livestock (**Table 4-11**).

Table 4-8: Target Water Quality for acid soluble aluminium in the aquatic environment

TWQR and Criteria – Aquatic Environment	Aluminium concentration (mg/ℓ)	
	pH < 6.5	pH > 6.5
Target Water Quality Range (TWQR)	5	10
Chronic Effect Value (CEV)	10	20
Acute Effect Value (AEV)	100	150

Table 4-9: Effects of Aluminium on human health

Target Water Quality Range Aluminium (mg/ℓ)	Effects
0 - 0.15	No acute or chronic health effects occur. Intake from water is <5 % of the total dietary intake of aluminium. Generally, no adverse aesthetic effects occur. Very slight discolouration of water may become apparent when iron or manganese is present in association with aluminium at the upper limit of the range
0.15 - 0.5	Intake from water may exceed 5% of the total dietary intake, but no effects on health are expected. Noticeable adverse aesthetic effects (colour) occur when aluminium is present in association with iron or manganese
> 0.5	Intake from water exceeds 5% of the total daily intake, but no acute health effects are expected except at very high concentrations. There may be long-term neurotoxic effects. This relationship has not been conclusively demonstrated. Severe aesthetic effects (discolouration) occur in the presence of iron or manganese

Table 4-10: Effects of Aluminium on Crop Yield and Quality

Target Water Quality Range Aluminium (mg/ℓ)	Effects
0 – 5	Several crops show aluminium toxicity at concentrations at Quality Range as low as 0.1 - 0.5 mg/ℓ in soil solution. Soils have the capacity to adsorb complex aluminium ions, thereby reducing their toxicity to plants
5 – 20	Maximum acceptable concentration for fine textured, neutral to alkaline soils
> 20	Acceptable for irrigation only over the short term on a site specific basis

Table 4-11: Effects of Aluminium on the Health of Livestock

Concentration Range (mg/ℓ)	Effects
0 – 5	No adverse effects
5 – 10	Adverse chronic effects, such as neurotoxicity, may occur but are unlikely if: - feed concentrations are normal - exposure is short term - adequate dietary intake of calcium and phosphorus Could even be tolerated in the long term, depending on site-specific factors, for example water requirements
> 10	Adverse chronic and acute effects, such as neurotoxicity, may occur although short-term exposure can be tolerated depending on site-specific factors, such as adequate calcium and phosphate intake and water requirements

4.9 ACCUMULATIVE RISK ASSESSMENT

When consider in isolation, many of the above-mentioned impacts may well be insignificant, however, when they occur simultaneously or in a haphazard way their significance may increase by an order of magnitude. The majority of water-related impacts are localised. Any further development of coal mines on the adjacent properties will result in a significant increase in cumulative impacts and will be felt over a greater area.

It is very important that surface and storm water management be addressed appropriately to prevent accumulation of water into the initial box cut. If this is not addressed the accumulative impact could be highly significant as uncontrolled run-off will cause degradation of the water resources as no buffer capacity is available to neutralise the potential acidic nature of the affected water.

5. COST-BENEFIT ANALYSIS

5.1 SELECTION OF COAL RESOURCE

For the purpose of this IWWMP, farm portion 17 of the farm Roodepoort 151 IS was considered due to the positive results obtained during prospecting with regards to the underlying mineral reserve; high grade coal. An initial desktop survey indicating the NFEPA wetlands were conducted as a pre-feasibility study and it was indicate that various wetland areas do transect this particular farm portion. The only position that was left for the proposed opencast mine was at the furthest northern edge on the farm. This area covers a mere 50-60ha of the total approximately 410ha farm portion. If viable the proponent would have wanted to mine the entire farm portion indicated in the image below, but as can be observed the wetlands do not allow for alternative layouts and this is the optimal layout for opencast operations. The hatched yellow polygon indicates the proposed opencast area as Alternative A while the orange polygon feature indicates alternative B. Both alternative A and B have been indicated in the figure below with 'text boxes'. A NFEPA wetland transects the area marked as alternative B and therefore it is not viable to mine this section unless a serious offset strategy is in place. The cost associated with off-set strategies will not be viable given the size of the reserve at 800 000 ton mineable reserve. Given both the fact that there is sensitive wetland habitat and the cost involved with offset strategies, alternative A is better than alternative B.

A complete survey was conducted during 2010 and the findings are tabulated in **Table 5-1**.

Table 5-1: Saleable coal in the project area

Roodepoort Tonnages	*In situ* Tons	No 1 Seam Geological loss	Minimum Loss	*In situ* Tons Mineable
Open Cast	1,361,770.85	15%	15%	1,106,379.44
No 2 Seam	615,011.62	-	-	788,453.53
No 4 Seam	775,163.92	20%	20%	484,104.91

5.1.1 No 2 Seam

The No 2 Seam width varies from 0 meters to 3.56 in width with an average width of 1.63 meters. The depth varies from outcrop to over 60 meters deep. The floor elevation is in general flat but dips steeply in areas suitable for underground mining. The samples taken revealed that this seam contains low phosphorus coal.

5.1.2 No 4 Seam

Insufficient data was available to conduct modelling to accurately quantify the coal resource. The sampled raw coal qualities indicated an average raw ash percentage of 23.5 with a raw CV of 23

MJ/kg. The yield for 27 CV (MJ/kg) is well below 50% making the coal unsuitable for beneficiation.

Considering the ecological sensitivity of the area, water stressed catchment with insufficient supply of water for coal beneficiation, site selection, containment as well as management of the coal slurry ponds it is clear that from an economic perspective that beneficiation of the No 4 Seam is not a viable mining option. The decision was based on the following criteria:

- Environmental risk and associated financial provision;
- Coal beneficiation will be required that is water use intensive;
- Water quality degradation and potential liabilities;
- Management of long-term environmental and residual impacts.

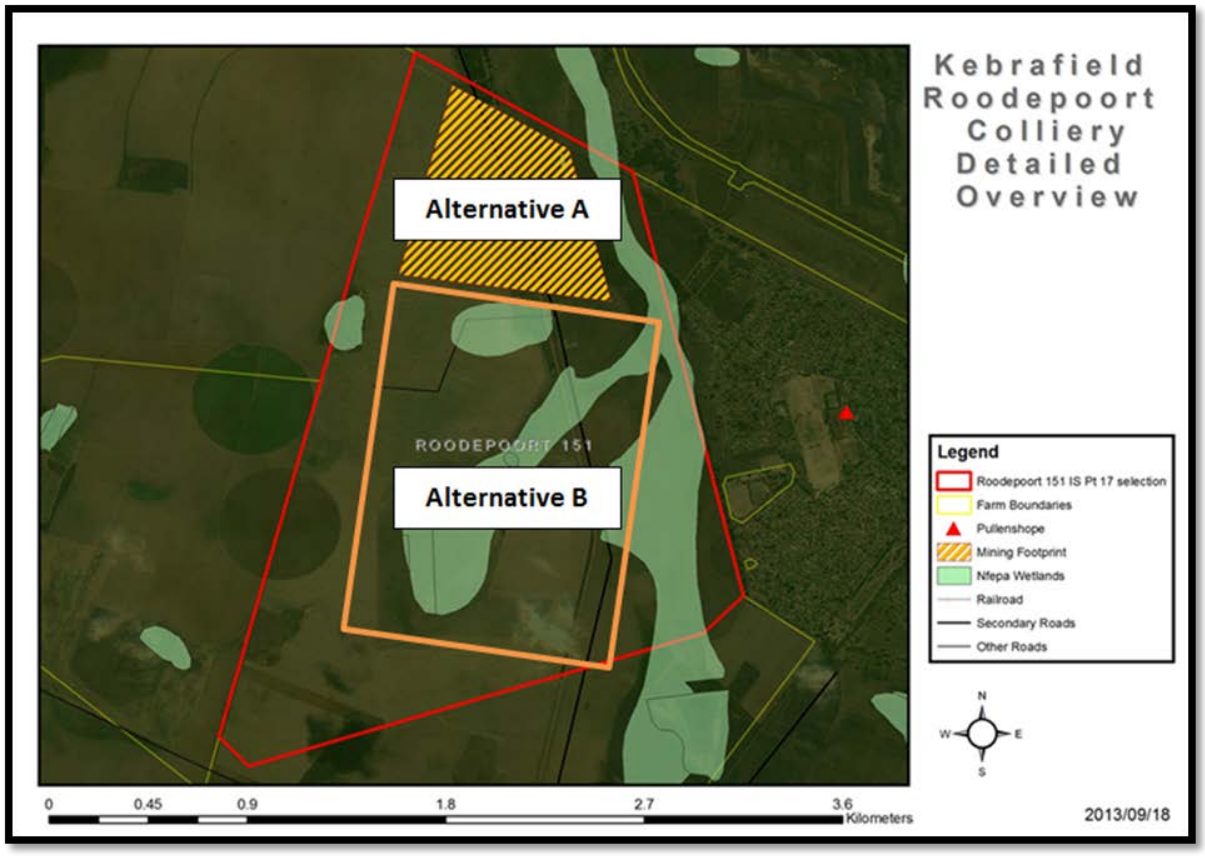

Figure 5-1: Considering the Alternatives

5.2 SELECTED MANAGEMENT OF IDENTIFIED RISKS

5.2.1 Deterioration in surface water quality

In compliance with the GN 704 Regulations, Kebrafield (Pty) Ltd will divert clean runoff from its mining surface infrastructure and collect dirty runoff from the existing box cuts, proposed shaft areas and washing area. It will ensure that its storm water collection facilities and dirty-water holding facilities are designed for the 1:50 year storm event and that erosion protection and appropriate energy dissipation structures will be provided at each discharge point. There will be no discharges of dirty water from the mining site unless there is an extreme storm event.

Kebrafield (Pty) Ltd will implement the surface water control measures outlined in this document as well as the relevant EMPRs and in accordance with the requirements of Regulation 704 and the corresponding DWAF M6.1 Operational Guideline.

Conditions that have been identified that may cause a spill event have been identified and rated in order of decreasing importance as follow:

- Failure by management to adhere to the operating protocol for the settling /pollution control dams
- The intersection of significantly more wet fractures by the mining operation that has been anticipated
- A prolonged general pump failure causing failure of the main sump pumps, pollution control dams or other pumps

5.3 FATAL FLAW ANALYSIS

The development of coal mining in an area that has raised several concerns and objections against mining needs to be subject to an inherent fatal flaw analysis. The protection of wetlands is in general an issue of grave concern that requires fastidious environmental and mine layout planning. The ranking criteria as illustrated in **Table 5-2** need to be considered prior to mine planning. The higher the ranking of the wetland, the more unlikely is the granting of environmental authorisations.

Table 5-2: Criteria for ranking of wetlands

Criterion	Rank
Wetlands that intersect with a Ramsar site	**1**
Wetlands within 500 m of a IUCN threatened frog point locality	**2**
Wetlands within 500 m of a threatened waterbird point locality	**2**
Wetlands (excluding dams) with the majority of its area within a sub-quaternary catchment that has sightings or breeding areas for threatened Wattled Cranes, Grey Crowned Cranes and Blue Cranes	**2**
Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands of exceptional biodiversity importance, with valid reasons documented	**2**
Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands that are good, intact examples from which to choose	**2**
Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands of biodiversity importance, but with no valid reasons documented	**3**
Wetlands (excluding dams) in A or B condition AND associated with more than three other wetlands (both riverine or non-riverine wetlands were assessed for this criterion)	**4**
Wetlands in C condition AND associated with more than three other wetlands (both riverine or non-riverine wetlands were assessed for this criterion)	**4**
Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing impacted Working for Wetland sites	**5**
Any other wetland (excluding dams)	**6**

The wetland system to be possibly impacted by Roodepoort Colliery could obtain a ranking equivalent of 4.

Table 5-3: Criteria used in the inherent fatal flaw analysis

Criteria	Relevance	Applicability to Kebrafield	Rating
Mining below 1:50 year flloodline	Eliminates wetlands, vleis, pans and floodplains where water pollution would result from mining	No mining to be conducted within the 1:50 year floodline of any identified water resource on the property.	Moderate
Areas in close proximity to significant water bodies	Water courses and dams in the area	Mine is located adjacent to the Pullenshope wetland system and a tributary of the Woestalleen Spruit.	Moderate
Unstable areas	Fault zones, seismic zones, dolomitic or karst areas, subsidence	Abandoned mining area located opposite of proposed development.	Low
Sensitive ecological and historical areas	Nature reserves and areas ecological, cultural and historical significance	Area with more than 30 graves dated early 1900	Moderate
Catchment areas for important water resources	All sites ultimately fall within catchment area, the size and sensitivity of the catchment may represent a fatal flaw	Proposed mine situated within quaternary drainage area B12B	Low
Areas characterised by flat gradients, shallow or emergent groundwater	Vleis, pans and springs where sufficient unsaturated zone separating the mining and ground water would not be possible	The Pullenshope wetlands situated towards the north and west of the mine but draining towards the B21D. This wetland system feeds the Klein Olifants system. The mine is situated in the B12B catchment	Low
Areas of groundwater recharges on account of topography and highly permeable soils	Protection of vleis, springs and water resources	No mining within wetlands. Mining within the 500 m buffer zone subject to WUL	Moderate
Mining on areas overlying important aquifers	Groundwater protection	Groundwater zone classed as a minor aquifer	Low
Adequate buffer zones not possible	Inclusion of buffer zones to protect water resources	Cone of depression will extend beyond buffer zone	Moderate
Development of areas in close proximity to land uses which are incompatible with mining	Development attract community resistance	Development short term activity with possible long term impact. Mining to be screened to reduce visual impact	Moderate to High
Mining in conflict with Local Development Objectives	Adherence to regional development and environmental initiatives and objections	Mining to impact on urban development in the short term	High

5.4 FINANCIAL PROVISIONING

Environmental management infrastructure that is required at the outset will be financed out of the project capital. On-going environmental management and rehabilitation as identified in this document and as set out in the SEMP will be funded from working costs during the life of the project.

The current environmental trust fund for Kebrafield is approximately R 2,500,000.00 consisting of

various trust funds and financial guarantees lodged with DMR. A complete breakdown of the financial provisioning for the mine is contained in the Mining Work Programme as well as the EIA/EMP for Kebrafield.

6. INTEGRATED ENVIRONMENTAL MANAGEMENT

A key consideration in the Integrated Environmental Management is the water planning and development processes. This planning process entails the consideration of various initiatives that is applicable to the catchment. The documentation considered for Kebrafield is contained in Table 6-1. Kebrafield consider the integration of catchment and water management strategies as an integral component of their water management plan as a key component to ensure compliance with catchment objectives and addressing the concerns of downstream water users.

Table 6-1: Planning processes considered

Water Planning Processes	Development Planning Processes
SADC Protocol Shared river agreements and processes	SADC RISP and RSAP Bi-national processes and agreements
Water for Growth and Development	NPC Vision 2025
Catchment Management Plan	Olifant Water Management Area Provincial Growth and Development Strategies: Nkangala Environmental Management Framework
Water Service Development Plan	Steve Tshwete WSDP, IDP

Environmental management for the project will fall under the General Manager. The various section foremen will assist with the day-to-day operations of the environmental function.

6.1 ENVIRONMENTAL MANAGEMENT PHILOSOPHY

The Environmental Policy of Kebrafield (Pty) Ltd is to provide a benchmark for its employees, customers and contractors to meet the highest standards and make every effort to conform to all legal requirements including all set key performance objectives.

The Management Philosophy is to continually improve the operations execution performances of their mining activities and to set objectives so as to reduce risks associated with these actions.

The Directors and the employees of Kebrafield (Pty) Ltd are committed to a safe, accident free working environment and will endeavour to show continual improvement in employee safety and health.

The company will make every effort to ensure that safety, health and environmental legislation and regulations are complied with, in the execution of project activities.

The project team will continually improve the quality of their actions to ensure that key performance objectives are met.

Kebrafield (Pty) Ltd is committed to the following Environmental Policies relating to reduction in environmental impacts:

- Prevention of pollution through proper planning and management systems;

- Management will provide the necessary resources to execute the Environmental Policy;
- Management will continuously review environmental impacts in order to minimise or prevent environmental degradation;
- Use emergency preparedness programme to implement risk mitigatory measures for identified impacts;
- Rehabilitate the mining site to a self-sustained and useable landform on final closure of operations; and
- Kebrafield: Roodepoort Colliery will be active in promoting the conservation of species and ecosystems in the interest of protecting the area's rich biodiversity.

6.2 ENVIRONMENTAL MANAGEMENT SYSTEMS

The integrated Safety, Health, Environment, Quality and Community (SHEQ) Management System is a set of interrelated or interacting elements and management processes, which are part of the overall management system to establish, implement, achieve, review and maintain the SHEQ policy and objectives. It collectively provides a systematic framework for ensuring that tasks are performed correctly, consistently and effectively to achieve a specified outcome and to drive continual improvement in Safety, Health, Environment and Community Performance and Quality Management Systems. It includes directing and controlling people and facilities with an arrangement of responsibilities, authorities and relationships with regard to SHEQ.

6.3 WATER USE AND MANAGEMENT OBJECTIVES

Table 6-2: Key issues considered in water resource protection

Key Issue	Criteria
Water Quality Management	Managing, monitoring and enforcing compliance with water quality standards will be high priority.
Protection of the Water Resource	Klein Olifant River resource inclusive of the wetland systems need to be protected. Adhere to specifications as contained in the ISP and EMF.
Classification System	Water management approach to ensure that eco region does not degrade below Class C
Reserve Determination	Compliance with DWA conditions
Resource Quality Objectives	Compliance with DWA conditions
Implementation of Regulatory Instruments	No mining to commence without issuance a water use authorisation
Waste Discharge Charge System	Polluter pays principle to be implemented with specific emphasis on AMD
Substandard quality of effluent discharge	Kebrafield will follow Zero Effluent Discharge Policy. No effluent will be allowed to be discharged in the natural environment.
Groundwater Management	Adherence to protection zoning.
Acid Mine Drainage (AMD)	Poses a complex problem and serious long term threat to water quality. Any potential AMD will be contained in HDPE lined PCDs. Points of possible decant identified and intervention measures to be implemented.
Land degradation and invasive alien plants	Implement Working for Water initiatives and eradicate invasive and alien plants.

6.3.1 Process Water Supply

The mine does not require any bulk water supply for mining purposes. Water supply for domestic purposes will be abstracted from the existing borehole. Water needed for dust suppression will be based on recycling and reuse of dirty contained within the enclosed water management system.

6.3.2 Potable Water Supply

Water for potable use will be abstracted from the borehole on portion 17 of the farm Roodepoort 151 IS. An estimated 120m^3/month (30 days) will be required. The requirement for potable water supply is based on 40 litres per person per day. The workforce was set at 100 employees.

6.3.3 Clean Water management facilities

Potable water will be stored in a tank for use by the office personnel. Clean water will be diverted around the mining areas.

6.3.4 Dirty Water Containment Systems

Water from the open pit areas will be pumped to two pollution control dams. Sediments will be allowed to settle out in the pollution control dams. Contaminated storm water will also be diverted to the pollution control dams.

6.3.5 Sewage Management Facilities

A septic tank system coupled with a French drain will be installed to cater for greywater stemming from the ablution facilities at the mine. The mine will also utilise potable chemical toilets to be erected in close proximity to the ablution facility. A contractor will be appointed to service the chemical toilets on a regular basis and to provide maintenance services to the septic tank system. The septic tank will be design to cater for a capacity of less than one (1) m^3/day.

6.3.6 Storm Water Management

Storm water management infrastructure that serves to separate clean and dirty water had been designed to comply with Regulation 704 of the National Water Act of 1998.

Clean and dirty water separation is achieved through a series of berms and canals that will be designed to function up to the 1:50 year time of concentration storm runoff and to not suffer any significant damage up to the 1:10 year event. The clean diversion canals will not be lined except where erosion is a significant problem. Clean storm water diversions will be discharged to surface water. Erosion protection and appropriate energy dissipation structures will be provided at each discharge point.

Dirty areas will be reduced to a minimum to minimise the quantity of dirty water that has to be collected and treated within the mining water circuit.
Storm water management infrastructure will be established to prevent suspended solids and other pollutants from the construction sites from entering watercourses. Good housekeeping will be

practised to reduce the pollution potential to a minimum.

Objective 1:

To minimize the pollution of surface water and maximize the clean runoff from the area

This policy will ensure the smallest possible detrimental impact on the surrounding surface water catchment.

Action:

A clean water diversion berm will be installed and maintained upstream of the mining sections. This storm water diversion berm will be able to cater for the runoff water from a 1:50 year 24-hour storm event.

All infrastructure to be installed will be in accordance with the specifications as laid out in Regulation 704 (4 June 1999) of the National Water Act, 1998 (Act No. 36 of 1998).

Objective 2:

To ensure that the surface water runoff from the mining site complies with RQO requirements as proposed in the water use authorisations to be issued in terms of the National Water Act, 1998 (Act No. 36 of 1998).

Action:

A surface water-monitoring programme will be maintained. Water quality monitoring is a mandatory requirement stipulated in the National Water Act, 1998 (Act 36 of 1998). Water samples will be taken on a monthly basis from the monitoring points (Figure 3-10) as proposed. The results generated at these points will be used to detect any possible impact on surface water from the mining area.

Sampling will be performed according to recognized procedures and approved laboratory analysing techniques will be followed. An accredited laboratory will perform the hydro-chemical analyses. The surface water samples will be tested as recommended in **Table 7-1**and **Table 7-2**.

There is no DWA water quality monitoring point directly downstream of the proposed mining areas. Results from the monitoring will be submitted to the Regional Director: Department of Water and Environmental Affairs (DWEA) located in Nelspruit on an annual basis. The results of the sampling will be compared to the South African Water Quality Guidelines.

6.3.7 Groundwater management

Objective 1:

To reduce the impact of the dewatering activity on groundwater levels

Action:

A drop (lowering) in groundwater level can be expected, but it is confined to no more than 800 metres around the mining area. As a drawdown of 5 metres and more is needed to seriously affect the yield of boreholes, limited negative quantity impact on any current private groundwater users (except for Roodepoort 151 IS portion 3) is predicted.

It is nevertheless important to monitor static groundwater levels on a quarterly basis in all boreholes within a zone of two kilometres surrounding the opencasts to ensure that any deviation of the groundwater flow from the idealised predictions is detected in time and can be reacted on appropriately. Preferred flow structures (dykes, sills, faults, etc.) have not been included in the model due to the unknown hydraulic characteristics, and these structures could alter the actual effects considerably.

If it can be proven that the mining operation is indeed affecting the quantity of groundwater available to certain users, the affected parties should be compensated. This may be done through the installation of additional boreholes for water supply purposes, or an alternative water supply. The headwaters of the non-perennial streams which may be impacted on do contribute to the base flow of the streams. However, any dewatering cone is unlikely to significantly impact on the base flow contribution of these streams to the larger rivers.

Objective 2:

Prevent contamination of ground water.

Action:

Although little or no groundwater contamination is expected during the operation of the mine, due to the cone of depression (flow gradient towards the opencast), it is nevertheless also recommended that groundwater quality be monitored on a quarterly basis as stipulated in section 3.6. The surface infrastructure may potentially pollute, therefore a monitoring system should be implemented which can assess their impact in addition to the other areas.

The numerical model should be updated during mining by using the measured water ingress, water levels and geophysics information to re-calibrate and refine the impact prediction. Pollution control dams should be lined to prevent ingress of contaminated seepage.

Concurrent rehabilitation should occur during mining to reduce the contact of water and air with any sulphides. The potential acid forming material should be placed at the bottom of the pit. The operating and rehabilitated opencasts should drain runoff away from the pit to reduce drainage into the pit. Install water collection and pumping systems within the pit capable of rapidly pumping water out in so minimising contact of water the geochemically reactive material.

Kinetic testing of the backfilled material should be conducted to aid in the prediction on geochemical conditions

Process water must be stored in a lined pollution control dam and the processing areas should be designed to prevent standing water. Clean and dirty water systems should remain separated.

6.3.8 Water use efficiency

The following measures and actions will ensure that water use efficiency is maximised:

- Measures will be put in place to prevent the spilling of water as the onsite tank is filled
- The chemical toilet does not make use of water
- The location and sizing of the storm water drain must ensure that contaminated water emanating from the disturbed area is contained for re-use.
- Dust suppression will only be in the designated areas within the dirty water system.

6.3.9 Operational Water Balance

A water balance for both the wet and the dry season for the mining area are presented in **Table** 6-3.

Table 6-3: Water balance for the proposed mining area

	Mining Area	
	South Dam	**North Dam**
Groundwater inflow (m^3/day)	120	120
Rainfall Dirty Area	625	572
Total In	**745**	**692**
Daily on site use	450	450
Daily evaporation	31	29
Netto Surplus	**264**	**213**

During the wet season, there will be an excess of water in the form of storm water. This water will have to be contained or alternative consumptive uses for the excess water during the wet seasons should be sought.

6.3.10 Environmental water balance

As water will be taken from the surface water resource, the surrounding surface water environment will be negatively affected and less water will be available to the downstream environment.

6.3.11 Emergency and Contingency Discharge

In case of an extreme rainfall event, the risk of spilling or overflow from the water pollution control dam to the wetland systems are considered extremely low. However, should this occur these incidents will be monitored and records will be kept.

6.4 SOLID WASTE MANAGEMENT

The types of domestic and industrial waste generated by the mine and associated disposal procedures/facilities are summarised in **Table 6-4.**

Table 6-4: Waste generated by the mine and management procedures

Items to be considered		**Intentions**
General	**Specific**	
Procedures	General	A waste management procedure will be developed and implemented. It covers the storage, handling and

Items to be considered		Intentions
General	**Specific**	
		transportation of waste.
	Classification	Wastes have been broadly classified in terms of the DWAF Minimum Requirements for Waste Disposal (DWAF, 1998).
	Waste minimization and recycling	Opportunities to minimize waste production has been identified and taken where possible. Where possible, waste is being recycled.
Waste disposal facilities	Collection points	Waste collection points have been established on site. Care is taken to ensure that there are sufficient collection points for each designated type of waste with adequate capacity and that these are serviced frequently.
	On site waste disposal facilities	At present there is no intention to develop waste disposal facilities on site; No waste disposal facility will be developed by the mine without the relevant permissions. These permissions include an environmental authorisation (from DEA) and a waste permit (from DEA) in terms of the National Environmental management: Waste Act, 2008.
	Offsite waste disposal facilities	Waste will be disposed of at appropriate permitted waste disposal facilities. These will vary depending on the waste.
Waste transport	Contractor	An approved subcontractor, working to local authority standards, will undertake the waste transport to remove domestic waste and sewage sludge (if necessary).
Disposal of different types of waste	Hazardous wastes	Hazardous industrial wastes are stored in specially marked bins or other storage areas (engineering workshops) before removal for either recycling such as for waste oils, which are sold to contractors or removed to hazardous waste disposal facilities to returned to the supplier. Contractors remove the hazardous waste such as PCB contaminated transformer lubricates from the site immediately after servicing. The frequency of disposal is as required.
	Non-hazardous waste	Domestic waste generated by the opencast area, crushing and screening plant & offices is collected daily from waste bins and collections points and transported by contractors to the Belfast Waste Disposal Site The solid industrial waste from the crushing and screening plant is collected by contractors from points of collection.
	Any soil polluted by a spill of chemicals	If remediation of the soil *in situ* is not possible, the soils will be classified as a waste in terms of the Minimum Requirements and will be disposed of at an appropriate permitted waste facility.
	Building rubble	Not applicable.
	Scrap metal	Care will be taken to ensure that scrap metal does not become polluted or mixed with any other waste (picks, bits, roof bolts, wire and cabling). The scrap metal will be collected in a designated area for scrap metal (scrap yard). It will be sold to scrap dealers.
	Oil	Oil will be collected in suitable containers at designated collection points. The collection points will be bunded and underlain by impervious materials to ensure that any spills are contained. Notices will be erected at each waste oil point giving instructions on the procedure for waste oil discharge and collection. An approved subcontractor will remove oil from site.

6.5 REHABILITATION AND MITIGATORY MEASURES

Rehabilitation of land disturbed by mining will be undertaken on an on-going basis throughout the life of the mine as soon as land becomes available for rehabilitation.

The following specific activities will take place during the decommissioning phase of the proposed opencast mining project:

- Removal of mine infrastructure
- Ripping of all infrastructure areas
- Filling of the final void and final shaping of the rehabilitated opencast pit
- Rehabilitation of all ROM/coal product stockpiling areas and haul/access roads
- Rehabilitation of the dirty water management facilities
- Seeding of ripped and rehabilitated areas
- Implementation of closure monitoring

The rehabilitation will be done in accordance with the plan as contained in **Figure 2-2**. The rehabilitation of the disturbed surface area was based on the following information and bulking factors:

Soft Materials:	1.05
Hard Material:	1.30
Total Void area:	15,874,343 m^3
Total Backfill Area:	15,843,588 m^3
Total Area to be rehabilitated:	759,555 m^2

After rehabilitation it is estimated that the topography of the area will drop with approximately with 4 cm and will be free-draining towards the Woestalleen Spruit catchment.

6.5.1 Integrated Closure Planning

Mining industry has historically not recognized that diversity of species is the key characteristic of natural ecosystem. The impacts on the biophysical environment caused by mining and minerals processing have frequently been associated with significant loss of biodiversity. These ecosystems form the basis of all ecosystem goods and services upon which sustainable livelihoods and food security depends (Limpitlaw *et al*, 2005). The state in which many collieries have been left are of great concern to many stakeholder with subsequent failure to support mining right application, specifically where it involves mining of coal. Today, with improved environmental legislation coal mining companies apply scientific methods in surface rehabilitation and take steps to mitigate future pollution from closed mine sites. Current best practice attempts to avoid negative impacts and, where necessary, to restore impacted environments. This is done by the mining sector to contribute significantly towards sustainable development in their respective regions. Kebrafield is committed to apply the integrated closure principles as part of rehabilitation for the mining right area on the farm Roodepoort.

The reactive nature of coal and its associated strata as well as the high level of surface disturbance result in potentially significant pollution problems which may persist for many years post mining. Methods exist to rehabilitate the surface and to ameliorate pollution, but the long-term success of the proposed interventions depends on the nature of post mining land uses.

6.5.2 Overview of closure practice

A key element in Integrated Closure planning entails a holistic approach towards the process. Such an approach to be followed by Kebrafield shall include the following criteria:

- Assessment of the economic viability of the plan inclusive of the funding required for post closure care and maintenance;
- Inclusion of the closure plan as part of the broader regional economic and development plan;
- Post-closure land capability targets and related land use options; and
- An avoidance of creating a culture of dependency in the local community

Post mining regeneration priorities applicable to Kebrafield as endorsed for the SADC in the light of the developmental context include the following:

- Restoration of land surface of sufficient quality to support pre-mining land use;
- Restoration of the ecological function of mined land and in the case of previously degraded land, the ecological function to be improved;
- Efficient alternative use of mine infrastructure should be encouraged where this can be economically justified. Where no economic alternative uses exist, mine infrastructure must be removed and the site rehabilitated to pre-mining condition;
- Minimization of current and potential future impacts on water quality and quantity is imperative;
- Job creation, education and stimulation of economic activity

Biophysical aspects of closure that are emphasized in the South African context include:

- Mine safety at the site
- Physical and chemical stability
- Ensuring that there is no future pollution

Table 6-5: Integrated Water Resource Management at Roodepoort Colliery

Impact	Source	Management
Wetland Management		
Changing the quantity and fluctuation properties of the watercourse	• Development within water resources e.g. mining footprint encroaches onto wetland area or riparian area, thereby diverting or impeding flow • Lack of adequate rehabilitation resulting in invasion by woody invasive plants • Vehicles driving in / through watercourses	• No activities should take place in the watercourses and associated buffer zone. Where the above is unavoidable, only a minor footprint and no access roads can be considered. This is subjected to authorization by means of a water use license. • Construction in and around watercourses must be restricted to the dryer winter months. • A temporary fence or demarcation must be erected around the works area to prevent access to sensitive environs. The works areas generally include the servitude, construction camps, areas where material is stored and the actual footprint of the mine • Prevent pedestrian and vehicular access into the wetland and buffer areas as well as riparian areas. • Consider the various methods of mining layout that will have the least impact on watercourses • Plan activities through watercourses to take place at pre-determined points such as where the wetland width (and thus area to be impacted) is the smallest • Access roads and bridges should span the wetland area, without impacting on the permanent or seasonal zones • Formalise access roads and make use of existing roads and tracks where feasible, rather than creating new routes through naturally vegetated areas. • Management of on-site water use and prevent stormwater or contaminated water directly entering the watercourse • Management of point discharges • Planning of mining site must include eventual rehabilitation / restoration of indigenous vegetative cover

Impact	Source	Management
		• Alien plant eradication and follow-up control activities prior to construction, to prevent spread into disturbed soils, as well as follow-up control during construction • The amount of vegetation removed should be limited to the least amount possible • Rehabilitation of damage/impacts that arise as a result of construction and mining operations must be implemented immediately upon completion of activities
Changing the amount of sediment entering water resource and associated change in turbidity	• Earthwork activities to construct mine layout. • Clearing of surface vegetation will expose the soils, which in rainy events would wash down into wetlands, causing sedimentation. In addition, indigenous vegetation communities are unlikely to colonise eroded soils successfully and seeds from proximate alien invasive trees can spread easily into these eroded soil. • Disturbance of soil surface • Disturbance of slopes through creation of roads and tracks • Changes in runoff characteristics • Erosion (head gully formation, bank destabilisation)	• Construction in and around watercourses must be restricted to the dryer winter months. • A temporary fence or demarcation must be erected around the works area to prevent water runoff and erosion of the disturbed or heaped soils into wetland areas. • Access roads and bridges should span the wetland area, without impacting on the permanent or seasonal zones. • Formalise access roads and make use of existing roads and tracks where feasible, rather than creating new routes through naturally vegetated areas. • Retain vegetation and soil in position for as long as possible, removing it immediately ahead of construction / earthworks in that area (DWAF, 2005). • A vegetation rehabilitation plan should be implemented. Grassland can be removed as sods and stored within transformed vegetation. The sods must preferably be removed during the winter months and be replanted by latest springtime. The sods should not be stacked on top of each other or within sensitive environs. Once construction is completed, these sods should be used to rehabilitate the disturbed areas from where they have been removed. In the absence of timely rainfall, the sods should be watered well after planting and at least twice more over the next 2 weeks.

Impact	Source	Management
		• Remove only the vegetation where essential for construction and do not allow any disturbance to the adjoining natural vegetation cover. • Rehabilitation plans must be submitted and approved for rehabilitation of damage areas during mining and that plan must be implemented immediately upon completion of mining. • Cordon off areas that are under rehabilitation as no-go areas using danger tape and steel droppers. If necessary, these areas should be fenced off to prevent vehicular, pedestrian and livestock access. • Ideally, the rehabilitated mining footprints, especially on slopes and along riparian and wetland areas, must be fenced to prevent livestock grazing and trampling. Once rehabilitation was observed to be successful during monitoring, the fenced may be removed (at least two years). • Negotiate with landowners to delay the reintroduction of livestock (where applicable) to all rehabilitation areas until an acceptable level of re-vegetation has been reached, especially against slopes. • During the construction and operational phases measures must be put in place to control the flow of excess water so that it does not impact on the surface vegetation. • Protect all areas susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the mining box-cut and work areas. • Runoff from roads must be managed to avoid erosion and pollution problems. • Implementation of best management practices • Source-directed controls • Buffer zones to trap sediments • Active rehabilitation
Alteration of water quality	• Runoff from road surfaces	• After construction, the land must be cleared of

Impact	Source	Management
	• Discharge of solvents, and other industrial chemicals	rubbish, surplus materials, and equipment, and all parts of the land shall be left in a condition as close as possible to that prior to use. • Ensure that maintenance work does not take place haphazardly, but, according to a fixed plan, from one area to the other. • Maintenance of mining vehicles • Control of waste discharges • Guidelines for implementing Clean Technologies • Maintenance of buffer zones to trap sediments with associated toxins and pollutants
Changing the physical structure within a water resource (habitat)	• Encroachment to achieve maximum commercial returns • Deposition of wind-blown sand • Loss of fringing vegetation and erosion • Alteration in natural fire regimes	• Other than approved and authorized structure, no other development or maintenance infrastructure is allowed within the delineated wetland and riparian areas or their associated buffer zones. • Demarcate the wetlands and riparian areas and buffer zones to limit disturbance, clearly mark these areas as no-go areas • Linear developments (e.g. roads) should span the watercourse • Weed control in buffer zone • Monitor rehabilitation and the occurrence of erosion twice during the rainy season for at least two years and take immediate corrective action where needed. • Monitor the establishment of alien invasive species within the areas affected by the construction and maintenance of the mining area and take immediate corrective action where invasive species are observed to establish.

6.5.3 Restoring Land Capability

Land capability is a decision to be made by society as degraded lands can potentially support fewer land uses. The type of land use may support a lower quality of rehabilitation such as from arable land to grazing. In this instance it should be noted that mono-specific grasslands and pastures are not able to sustain economic grazing systems. The sustainability of grasslands is largely dependent on the re-establishment of natural controls and a gradual removal of high intensity interventions. This can only be achieved during the post-mining rehabilitation period as it is practically impossible to re-establish natural control on grasslands during the operational phase.

In re-establishing of land capability, topsoil is a key resource that requires careful preservation and management.

Salt migration upwards through rehabilitated surfaces is a problem especially in discard dumps and areas where the soil cover is less than 200 mm. where soils are thicker, clay accumulation layers may occur where salts precipitate between 300 – 500 mm from surface. In this event salts will not migrate to the surface where it can impact re-vegetation. There is a need to understand the influence of soil depth on vegetation sustainability. Thick layers of compacted soils caused by machinery during the rehabilitation process are a factor to be addressed. Wet soils (moisture content > 10%) when moved are prone to compaction, especially red soils with clay content of less than 30%.

6.5.4 Latent Impacts

Discard Dumps

Sustainable rehabilitation of dumps is an enormous challenge faced by the mining sector. Dumps are not geologically stable landforms and therefore soil erosion is a critical factor to be addressed. Steep slopes (1:5) will become completely eroded within 50 years. Once the coal is exposed, oxidation, AMD and salt generation will kill off any vegetation cover. This would lead to further AMD generation, spontaneous combustion, increased permeability and groundwater pollution.

Subsidence

The problem of subsidence at mining is generally not well addressed. There is no underground mining at Roodeplaat Colliery and thus not applicable.

Generally in terms of underground board and pillar operations serious impacts will only manifest 100 – 120 years after initiation. This is due to aging that result in mass subsidence stemming from pillar runs and collapse of whole areas. Eventually all underground excavations will collapse over time and pillars will spall resulting in increased water ingress that eventually become polluted (AMD).

Subsidence will not cause any latent impact at Roodepoort Colliery and no liability is due.

Water

Water impacts stemming from closed mines are severe. In general mines that have ceased 20 or more years ago have not yet reached steady state where water starts to decant. The complexity of the mine's hydrology and geochemistry may result in decant running acidic at first and then change to neutral. Mines could also decant when only a portion of the main remains flooded and the effluent turns acidic or remains alkaline for an indefinite period. Geochemical reaction kinetics is very complex and based on the ABA results it could be determined whether serious water pollution problems may arise long after closure. Considering the decant situation at Roodepoort it appears that a steady state maybe reached with the water possibly emanating from the mine with characteristics not typical of AMD.

Legal

The legal situation of abandoned mines is not always very clear with uncertainty about the ownership of the surface and or mineral rights. Mining companies will therefore be hesitant to become involved in rehabilitation of abandoned mines as the concern is that they may end up with the environmental liability and responsibility that was not of their doing.

However, Kebrafield is not subject to legal matters pertaining to liability as there are no abandoned mining sites on the farm Roodepoort that may require rehabilitation.

6.5.5 Effective Mitigation Practices

Some old mines open pits have sufficient surface area to evaporate all water make and never decant. The consequence is that these mines have minimal impact on surface water quality. Open cast mines should be designed to achieve this objective.

In the case of Kebrafield the pollution control dams had been designed to intercept all water generated on the mine and will form an integral part of water management during rehabilitation and post closure.

Rehabilitated land cannot always be returned to a land capability equivalent to a pre-mining state. This can only be achieved by careful management of soil resources, promotion of biodiversity and management of latent risks post-closure. Implementation of management measures will not always achieve the desired output as poor post-closure land use practices could quickly degrade the rehabilitated surface. Therefore, government officials should become more involved with the stewardship of rehabilitated land.

6.5.6 Environmental Status Quo

Biodiversity

The disturbance and coalliferous contamination of former mined land in close proximity Pullenshope area (Optimum Colliery) on portion 17 of the farm Roodepoort 151 IS has resulted in environmental conditions that favour restricted and specialised habitats and species, in particular opencast and bare ground suitable for colonization by specialist lower plants such as wattle. Many

of these wetland habitats contain species of conservation value. These habitats have been given protection through SANBI or FEPA classification systems or local through designated structures and Local C-plans.

The biological composition and character of the majority of these habitats is in transition caused by agriculture, urban industrial (power generation) and mining activities relating to open cast coal mining. The primary aim of all management for biodiversity is to retain a representative mosaic of characteristic habitats and, at a minimum, sustain existing populations of rare and scarce species. In some cases, existing environmental factors, for example substrate chemistry and exposure, maintain these habitats and species, but the majority requires active management, usually grazing, to maintain their character and quality.

It is important that biodiversity conservation values and management regimes do not conflict with the overall conservation of the proposed development site. The cultural integrity and value of the area is now dependent upon the development of an integrated policy and management framework, based upon management at the landscape scale. Within this, if it is done well, there are significant opportunities to provide real and sustainable gains for agriculture and biodiversity, which will ensure the continuing quality of the site earmarked for mining development.

The proposed mining site contains some of the most polluted land in the immediate area. The responsibilities of the DMR together with DWA legislation controlling acceptable levels of salinity and heavy metals within watercourses or groundwater may result in pressure to tackle contamination pathways between mine waste disposal areas, mine drainage systems and hydrological systems which provide sources of drinking water for humans or animals, or which discharge into the natural wetland environment.

In order to prevent any possible degradation of the immediate environment mine water management will be critical (see section **6.5.8**). In order to restore the degraded wetlands (refer to **Figure 3-7**) an offset area will identified to rehabilitate impacted wetlands. A wetland rehabilitation plan will be compiled in accordance with the requirements of GN 1198 and 1199 of 18 December 2009 and submitted to the Department of Water Affairs for approval prior to implementation.

6.5.7 Risk Assessment

Risk is the threat that an event or action will adversely affect the ability to achieve objectives. In the case of the proposed Pullenshope Project, risks are present in the physical site itself and in the implementation of the Management Plan. The various regulators need to undertake a risk assessment of its own strategic and operational functions relating to the Nkangala EMF and Water Service Development Plan. Many of these risks have already been identified by the stakeholders and submitted to the Project Manager for assessment and possible intervention.

In order to assess the significance of all risks and to mitigate them it is necessary for an environmental risk assessment to be carried out using adopted procedures. Responsibility for risk assessment lies with individual owners and managers. The regulators will need to be proactive in encouraging the owners and managers of Kebrafield to undertake ongoing risk assessment and relate these to their own strategic and operational risk assessment. Risk management begins with identifying risks, evaluating their potential consequences and determining the most effective methods of managing or responding to them. Considering the complaints as lodged by Interested and Affected Parties this might include producing Action Plans for wetland rehabilitation, particularly those considered to have a high EIS rating.

The local regulators are encouraged to liaise with the SHE Officer of Kebrafield on integrating the proposed site into the existing forums and reporting mechanisms at the appropriate level, so that in the event of an incident the regulator is involved in decisions which may affect the universal value of eco-tourism in the region.

6.5.8 Principles for Water Management

Surface water management at Kebrafield must comply with the legal and regulatory conditions as depicted in the various environmental law specifications. The design, operation and closure of water management and pollution control facilities should be based on a holistic approach inclusive of the following criteria:

- Sustainability;
- Integrated water management principles and approaches;
- Optimisation of water use and the minimization of the potential impact from the coal mining operations in terms of water quality and quantity;
- Apply water management through the full life cycle of the mine;
- Emphasizes on process water during the operational phase of the mine;
- Water quality and quantity aspects;
- Integration of surface water and groundwater management.

Water management at Kebrafield will adopt a precautionary approach following anticipatory and conservative water management principles inclusive of:

a) All technical studies and design of water management facilities should be undertaken by suitable qualified and experienced personnel
b) Water management should take into account the “polluter pays principle”
c) Water management measures shall be designed and operated within the context of an overall closure plan. The design of water management measures should consider the impact of closure and whether this will compromise the closure objectives
d) Adequate financial provision need to be made during the mine life for water management measures to meet the closure objectives and beyond.

Concurrent rehabilitation shall take place during the operational phase in order to meet post mining topography requirements, minimize post closure water management requirements (free draining) and to ensure that water management principles are an integral component on rehabilitation and closure strategies.

Table 6-6: Management principles for rehabilitation and closure

Water Management Principle	Decision Criteria	Management
Surface water management must comply with the legal and regulatory conditions as depicted in the various environmental law specifications	Section 21 a, c, i, g and j	Compile IWULAR and IWWMP and obtain the relevant water use authorization
	GN 704 design criteria	Compile Civil Engineering Design report supported by A3 design drawings for: • PCD • Storm water system • Mining Infrastructure
	Exemption from GN 704 for placement of overburden in open pit for rehabilitation.	Submit motivational report to D:RPW and obtain approval
The design, operation and closure of water management and pollution control facilities should be based on a holistic approach	Water Balance	Compile Water Balance in accordance with BPG: G2.
	Waste characterization	Base liner design of PCD on the characteristics of the waste water
	Storage capacity	Ensure containment of 1:50 flood event plus o.8 m freeboard
	Minimise diffuse pollution	Ensure integrity of liner and implement monitoring system
Adopting of a precautionary approach following anticipatory and conservative water management principles	Execute the “No Go” option	Conduct CBA and determine the advantages and disadvantages relating to water management
	Sensitivity of environment renders mine project unsustainable	Ensure complete isolation of storm water system
All technical studies and design of water management facilities should be undertaken by suitable qualified and experienced personnel	Identified technical studies: • Geohydrology • Surface water • Wetlands	Qualified and experienced PSP’s appointed to conduct the required investigations.
	PCD design report and site selection	Qualified and experienced Civil Engineer appointed to conduct the required investigations.
Water management should take into account the “polluter pays principle”	Liability and responsibility for rehabilitation of abandoned mine workings	Commitment to rehabilitate the abandoned mine based on an approved Mine Rehabilitation and Closure Plan. Providing of sufficient Financial provisioning to remediate long-term residual impacts
	Replacement of wetlands destructed by mining operations	Commitment to replace any destructed wetland with artificial wetland. Compile wetland rehabilitation plan and submit for regulatory approval.
	Compensation of water users and replacement of polluted water sources	Identify potential sensitive users
Water management measures shall be designed and	Compliance with RQO’s	Monitoring system for surface and groundwater

Water Management Principle	Decision Criteria	Management
operated within the context of an overall closure plan. The design of water management measures should consider the impact of closure and whether this will compromise the closure objectives.	Adherence to the Eco-Classification for the Elands River	Conduct bi-annual aquatic biological studies and monitoring. Address potential impacts at source
Adequate financial provision need to be made during the mine life for water management measures to meet the closure objectives and beyond.	Adherence to DWA M-Policies on financial provisioning	Auditing and Reporting on financial provisioning
	Conduct internal and external audits in order to determine the extent of water management measures	Appoint specialist to rectify findings of audit reports
Concurrent rehabilitation shall take place during the operational phase in order to meet post mining topography requirements, minimize post closure water management requirements (free draining) and to ensure that water management principles are an integral component on rehabilitation and closure strategies.	Free draining rehabilitation to be conducted	Appoint Specialist to compile a comprehensive closure and rehabilitation plan
	Hydro-seeding to ensure stabilization of rehabilitated areas	Appoint service providers to conduct rehabilitation actions
	Minimise dirty water footprint and maximize clean water runoff (adherence BPG for mine management)	Appoint Civil Engineer to oversee construction of water management infrastructure.

6.6 SOIL AND LAND CAPABILITY MANAGEMENT

6.6.1 Soil management

Stripping and stockpiling of topsoil is a very high impact on the most valuable and less reparable natural resource in the world. The cumulative impact by opencast mining on soils in South Africa became devastating. Proper planning, management and precise execution of rehabilitation procedures are therefore compulsory. The ability to do proper rehabilitation depends on precise stripping and stockpiling of topsoil. Proper stripping and stockpiling is therefore the cornerstone of rehabilitation.

Generally the following management measures should be implemented:

- A stripping and stockpile plan based on the land capability report should be followed. Stripping of topsoil according to soil types and specified depths is compulsory. It is the only way to ensure that proper rehabilitation of high standards is possible and that post-mining land capability commitments are reached. Failure to do this will result in failure to restore soil potential, land capability and land use close to pre-mining conditions that implies deterioration of the most important natural resource that provides national food security
- The rehabilitation process consisting of the stripping, stockpiling and replacing actions should be monitored progressively by a competent third party
- Shaping of spoils to the original topography is compulsory. It will prevent water logging and subsidence to a large extent and will allow a continuation of the pre-mining natural surface

drainage pattern. Failure to comply with the closure plan might adversely affect the post-mining land capability and sustainability of rehabilitated land. Spoils should be placed during the mining process in such a way and position to reduce shaping and related cost

- Proper management of the total rehabilitation process starting at the planning phase up to supervision of the dozer operators is the key to successful rehabilitation and sustainable development.

The following measures are important during the construction and operational phase of the mine:

- The 100 m wetland buffer zone should be surveyed and staked at intervals of 50 m and all stockpiles should be located outside the buffer zone
- The boundaries of the soil types which can be stripped and stockpile together as shown in **Figure 6-1** should be surveyed and staked at 50 m intervals
- The four identified stockpile positions should be surveyed and staked
- The topsoil should be stripped based on soil potential and soil type at depths shown in **Figure 6-1** and stored as follows:
    - Red, well-drained soils of soil type **Hu** should be stored on the position indicated as stockpile 1A and 1B and yellow brown, well-drained soils of soil types **Cv1** and **Cv2** should be stored in positions indicated as stockpiles 2A and 2B.
    - The yellow arrows in Figure 6-1 show which patches of each soil type should be stored on which stockpile
- It is important to strip according to depths shown in **Figure 6-1**. Subsoil and soft overburden material stripped together with the topsoil layer reduces the quality and land capability of soils. Mixing of topsoil and subsoil has a dramatic adverse effect on soil physical properties and post-mining land capability
- Stockpiles or berms should by no means be contaminated with coal, discard or overburden material. Should the topsoil need to be stored as a berm the same principle should be applied and the red and yellow soil should be stored as 2 sections of the berm and should not be mixed

During the decommissioning phase, it is important to shape the spoil layer properly to a freely drained surface and as close to the original topography as possible. Proper shaping of the spoil layer is the second key to proper rehabilitation. Failing in stripping and stockpiling as well as shaping will definitely adversely affect the post-mining land capability even with other rehabilitation requirements at its best.

Post-mining land capability classes in terms of topsoil thickness replaced on top of the levelled spoil material are as follows:

- Arable: >900 mm (moderate to high agricultural potential)
- Arable: 600-900 mm (moderate agricultural potential)
- Grazing: 300-600 mm
- Wilderness: 100-300 mm
- Wetland: > 300 mm

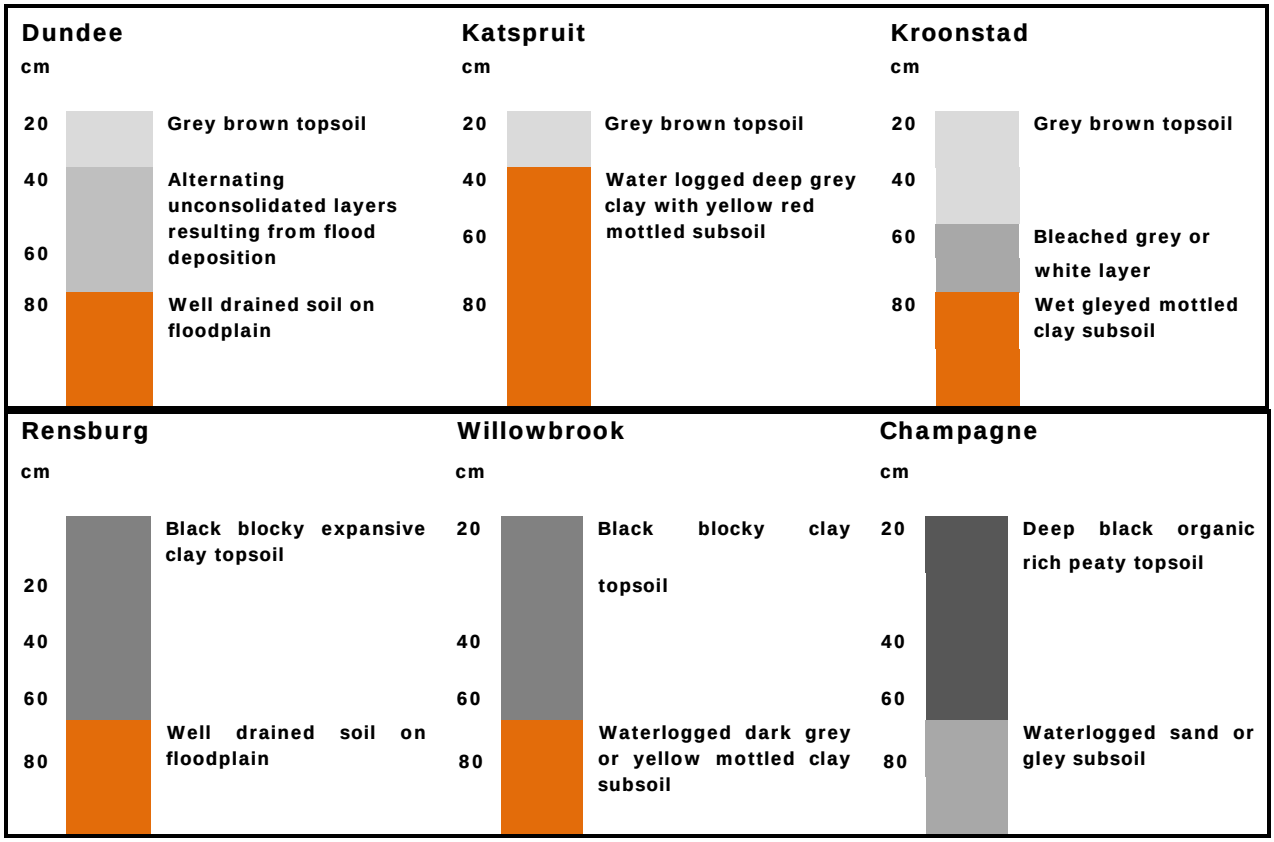

Figure 6-1: Wetland soil guide

6.6.2 Land Capability Management

The post mining topsoil thickness was determined by calculating the total stockpile volume divided by the original area which was stripped. This implies that e.g. the yellow brown soils of stockpile 2 which could have been stripped at more than 1 depth will be placed back at 1 average depth. The opencast area should be rehabilitated to the following post-mining proportions of land capability as indicated by **Table 6-7** which is the averages calculated from **Figure 6-1**.

Table 6-7: Post-mining rehabilitation depths per stockpile and proportions of post-mining land capability.

Soil volume per stockpile (m^3)	Replacing Soil depth (m)	Post mining area to be covered (ha)	Post mining percentage %	Pre-mining land capability	Post mining land capability class
280350	1.5	11.9	19.901	Arable	Arable
274500	1.5	11.7	19.483	Arable	Arable
178200	0.6	18.8	31.329	Arable + Grazing	Arable
265100	1.0	16.9	28.218	Arable	Arable
Unknown	Minimum 0.5m	0.63	1.070	Unknown – probably arable	Grazing
0	0	0	0		Wilderness
0		**60**	**100.00**		

The following precautions during the decommissioning phase will ensure that the rehabilitation process meets the EMPR commitments for closure purposes:

- The land capability class will be determined by the soil type and the thickness of the soil layer placed back on the spoil surface. The soils should be placed back in consolidated blocks with a pre-assigned land capability class and soil thickness for each block to prevent frequent varying depths which lead to small fragmented land capability units
- Topsoil should be dumped in sufficient quantities to allow a once-off levelling on top to prevent compaction in the lower soil profile which cannot be alleviated with normal agricultural equipment.
- Topsoil should not be spread over distances with dozers. Bowl scrapers may not be used
- Soils of stockpile 1A and 1B should be placed on the post-mining higher lying terrain units (crests and upper midslopes) and soils of stockpile 2A and 2B below that on lower lying terrain units (midslopes)

The soil fertility status of the rehabilitated land should be determined and soil amelioration should be take place accordingly before re-vegetation takes place. For the reason that the original soil profile will be disturbed and the chemical status will change, it is important to do intensive soil analysis after rehabilitation and fertilizer programs should be based on the soil chemical status after rehabilitation took place.

Fertilizer programs should consist of a pre-seeding lime and fertilizer application, an application during the seeding process as well as an annual maintenance application. Rehabilitation must be overseen by an appointed Environmental Control Officer.

7. MONITORING SYSTEMS

Water is typically the prime environmental medium that is affected by mining activities. Mining adversely affects the water quality and poses a potential significant risk to the area's water resources. The proposed mining could also substantially alter the hydrological and topographical characteristics of the mining footprint area. This would ultimately affect the mean surface runoff, soil moisture, evapo-transpiration and groundwater behaviour. Failure to manage impacts on regional water resources in an acceptable manner throughout Life of Mine and post-closure, will result in Kebra Fields finding it increasingly difficult to obtain community and government support for their existing projects. Consequently sound management practices to prevent and minimise water pollution are fundamental for coal mining operations to be sustainable. Therefore, in order to manage the mine properly monitoring is critical in order to take the correct management decisions. The following monitoring system is proposed to provide sound information on the effectiveness of protection measures.

7.1 WATER MONITORING

Water quality monitoring parameters as indicated below must be monitored on a monthly basis (**Table 7-1**) or in accordance with the frequency as specified in a water use authorisation.

Table 7-1: Water Quality Monitoring Parameters

Variable	Unit
pH	
Electrical Conductivity as EC	mS/m
Suspended Solids as SS	mg/l
Total Dissolved Solids as TDS	mg/l
Sulphate as SO_4	mg/l
Nitrate as NO_3	mg/l
Sodium as Na	mg/l
Chloride as Cl	mg/l
Calcium as Ca	mg/l
Potassium as K	mg/l
Magnesium as Mg	mg/l
Total hardness as $CaCO_3$	mg/l
Total alkalinity	mg/l
Fluoride as F	mg/l
Aluminium as Al	mg/l
Iron as Fe	mg/l
Manganese as Mn	mg/l

7.1.1 Surface Water Monitoring

There are several small surface drainage channels on the property. However, two main identified channels that drain the mining area could be regarded as perennial of nature and forms part of a channelled bottom valley wetland system. Due to the size and risk categorisation of the proposed

operations as well as the significant (high) risk of surface water pollution, surface water quality monitoring is proposed at points as indicated in **Table 7-2**. The surface water monitoring points as indicated in **Figure 7-1** were used to characterise the water resources in the project area.

Figure 7-1: Surface water monitoring points for Kebrafield Roodepoort Colliery

Table 7-2: Proposed surface water monitoring points

Sampling point	Coordinates	
	Longitude	Latitude
KFBM04: At bottom valley channelled wetland. Unnamed tributary to Woestalleen Spruit	25°59'56.98" S	29°34'52.06"E
KFBM03: Tributary of Woestalleen Spruit, direct opposite from proposed mining area	26° 0'14.90" S	29°34'56.62"E
KFBM02: Tributary of Woestalleen Spruit, overflow from dam	26° 0'26.33" S	29°34'56.64" E
Dam: Grab sample from dam on property	26° 0'34.83" S	29°35'2.80" E
KFBM01: Upstream of mining area and below second dam on property	26° 1'14.71" S	29°35'9.44" E

In addition, monitoring of the water quality in the pollution control dams will be done on a quarterly (October, January, April, July) basis and include the variables as specified in **Table 7-1**. The water quality will be representative of:

- Seepage/run off from the mining areas

- Seepage from waste rock dump
- Dewatering of the open pit
- Potential impacts from upstream land use activities

Proposed monitoring points as indicated in **Table 7-2** should be initiated during the operational phase of the mine. Once the mine moves towards decommissioning and closure, the monitoring programme will have to be updated and upgraded to cover the monitoring needs related to the specific closure objectives.

Due to the fact the Roodepoort Colliery mining area is located in the upper reaches of the Woestalleen Spruit catchment, no additional upstream monitoring points are anticipated. Upstream water quality at monitoring point KFBM1 is considered to be representative of water quality stemming from natural land use conditions.

Furthermore, the proposed colliery being situated below Hendrina Power Station and the Pullenshope Waste Water Treatment Works has two drainage areas that need to be covered by the monitoring programme. Mine drainage area 1 drains towards the Northern PCD and impacts will be determined at monitoring point KFBM04. Mine drainage area 2 drains towards the Southern PCD and potential impacts stemming from mining will be determined at monitoring point KFBM03. Monitoring point KFBM01 is directly upstream of the dam on the farm Roodepoort 151 IS. Monitoring point "Dam" was done to determine the background water quality of the water in the system. Should the mine start to decant, monitoring point KFBM02 will act as an early warning system. A proposed layout of the annual report to be submitted to DWA is presented in **Table 7-3**.

Table 7-3: Proposed layout of the annual report to DWA

Section	Title	Description
	Executive summary	
1	Introduction and scope of work	Why do report? Where info has been obtained from
2	Background and Brief	Overview of Project
2.1	Background of project	Where is mine located (brief)
2.2	Nature of Brief / Terms of Reference	Who was appointed and when to report: Responsible persons
3	Program Objectives and Work Program	
3.1	Program Objectives	Objective of report
3.2	Work Program / Scope of work	What does the report cover
3.3	Project team	Who is on the monitoring team
4	Overview of the mining / activity operation	Describe mining operations and give brief summary of expansions in the last year
5	Water use license application update	Mention any Exemptions or permits and brief overview of what has happened or where the licensing process is standing. Compliance audit
6	Environmental incidents	Brief summary of any environmental incidents for the year
7	Overview of the water environment and potential impacts from the mining operation (/plans/maps/regional setting and local use of water)	Describe water resources in and around mine lease area, describe the mining operation in relation to the potential of the infrastructure to impact on the water environment and downstream users

7.1	Catchment overview	Indicate which catchment is applicable + quaternary; Map indicating operations in relation to catchments
7.2	Surface water	Detail on surface water catchments
7.2.1	Rainfall and evaporation	Monthly recorded volumes and 24 hour rainfall events vs. return periods (1 in 5 etc.)
7.2.2	Surface water users	Outline of what the surface users use water for
7.2.3	Flow measurements (Continuous monitoring)	Report on any continuous water flow data
7.3	Groundwater	Detail on groundwater aquifers flow etc.
7.3.1	Aquifer types and characteristics	ID and Describe types affected
7.3.2	Groundwater users	Indicate if groundwater is used in the vicinity, if possible ID uses
7.3.3	Groundwater management plan	How will the mine prevent future water pollution
7.3.4	Groundwater dewatering	Describe any dewatering activities
7.4	Potential impacts from the mining infrastructure	Describe possible impacts
7.4.1	Potable water consumption	Compliance with allocated potable water
7.4.2	Re-use of water	Describe where and how re-used
7.5	Water and salt balance update	According to BPG G2
7.6	Water conservation and use efficiency	How is water conserved, and strategies to effectively use water / prevent losses
8	Water quality	Describe the water monitoring programme and gives an assessment of the surface and water quality data
8.1	Water monitoring programme	Objectives of monitoring, Brief description of monitoring plan, schedule, parameters, review, maps, sampling reconciliation (when was sample taken and when not) etc.
8.2	Surface water quality	Results, overview and discussion
8.3	Process water quality	Results, overview and discussion
8.4	Groundwater quality	Results, overview and discussion
9	Bio-monitoring	Results, overview and discussion
10	Regulation 704 compliance	Compliance audit
11	Management measures and actions implemented to minimize water quality impacts	Identify and discuss
12	Potable water use saving strategies	Identify and discuss
13	Water management commitments	Identify and discuss
14	Stakeholder and Governmental Departments	Summary of Issues raised relating to water and steps taken
15	Conclusions and Recommendation	Highlight non-compliance and rectifying measures implemented
16	Reference and Bibliography	
	Appendices	

7.1.2 Groundwater Monitoring

A groundwater monitoring system has to adhere to the criteria mentioned below. As a result the system should be developed accordingly.

Source, plume, impact and background monitoring

A groundwater monitoring network should contain monitoring positions which can assess the groundwater status at certain areas. The boreholes in **Figure 3-11** can be grouped according to

the following purposes:

- Source monitoring – monitoring boreholes are placed close to or in the source of contamination to evaluate the impact thereof on the groundwater chemistry
- Plume monitoring – monitoring boreholes are placed in the primary groundwater plume's migration path to evaluate the migration rates and chemical changes along the pathway
- Impact monitoring – monitoring of possible impacts of contaminated groundwater on sensitive ecosystems or other receptors. These monitoring points are also installed as early warning systems for contamination break-through at areas of concern
- Background monitoring – background groundwater quality is essential to evaluate the impact of a specific action/pollution source on the groundwater chemistry

System response monitoring network

Groundwater levels – the response of water levels to abstraction are monitored. Static water levels are also used to determine the flow direction and hydraulic gradient within an aquifer. Where possible all of the above mentioned borehole's water levels need to be recorded during each monitoring event.

Monitoring frequency

In the operational phase and closure phase, quarterly monitoring of groundwater quality and groundwater levels is recommended. Quality monitoring should take place before, after and during the wet season, i.e. during September and March. It is important to note that a groundwater-monitoring network should also be dynamic. This means that the network should be extended over time to accommodate the migration of potential contaminants through the aquifer as well as the expansion of infrastructure and/or addition of possible pollution sources.

Monitoring Parameters

The identification of the monitoring parameters is crucial and depends on the chemistry of possible pollution sources. They comprise a set of physical and/or chemical parameters (e.g. groundwater levels and predetermined organic and inorganic chemical constituents). Once a pollution indicator has been identified it can be used as a substitute to full analysis and therefore save costs. The use of pollution indicators should be validated on a regular basis in the different sample position. The parameters should be revised after each sampling event, some metals may be added to the analyses during the operational phase, especially if the pH drops.

Table 7-4: Ground water pollution indicators

Abbreviated analysis (pollution indicators)	
Physical Parameters:	Groundwater levels
Chemical Parameters:	
Field measurements:	pH, EC
Laboratory analyses:	Major anions and cations (Ca, Na, Cl, SO_4)
	Other parameters (EC)
Full analysis	
Physical Parameters:	Groundwater levels

Chemical Parameters:	Ca, Mg, Na, K, NO_3, Cl, SO_4, F, Fe, Mn, Al, Alkalinity
Field measurements:	pH, EC
Laboratory analyses:	Anions and cations (Ca, Mg, Na, K, NO_3, Cl, SO_4, F, Fe, Mn, Al, & Alkalinity)
	Other parameters (pH, EC, TDS)
	Petroleum hydrocarbon contaminants (where applicable, near workshops and petroleum handling facilities)
	Sewage related contaminants (E. coli, faecal coliforms) in borehole in proximity to septic tanks or sewage plants.

Monitoring Boreholes

Provisional positions for monitoring boreholes have been chosen taking existing boreholes and the predicted spread of pollution into account. The positions are depicted in **Figure 7-2** and **Table 7-5**.

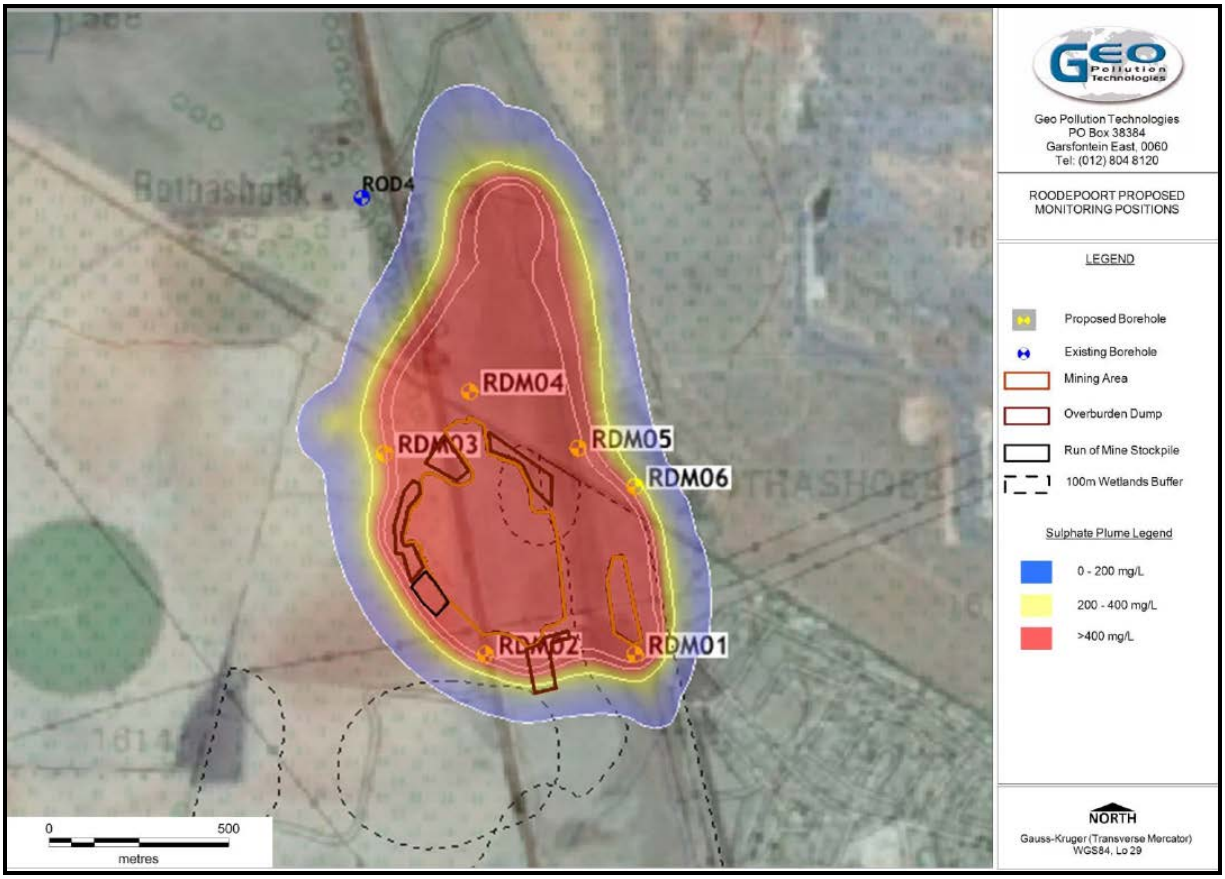

Figure 7-2: Proposed groundwater monitoring positions

However, there could be structures such as intrusive dykes and/or fractures and faults in the areas downstream of the opencasts. To ensure that monitoring boreholes correctly monitor such preferred groundwater flow structures, it is essential that the presence of these structures be determined by geophysical means. Both magnetic and electromagnetic geophysical traverses must be completed downstream of the opencasts and other potential pollution sources and boreholes sited by a qualified hydro-geologist before mining commence.

Table 7-5: Proposed monitoring boreholes

Borehole no.	X Coordinate	Y Coordinate	Monitoring Requirement
RDMO1	29.5839211	-26.00813933	Source and plume monitoring
RDMO2	29.57975849	-26.00823285	Source and plume monitoring
RDMO3	29.57688704	-26.00306219	Source and plume monitoring
RDMO4	29.57930092	-26.00155548	Source and plume monitoring
RDMO5	29.58232399	-26.00300201	Source and plume monitoring
RDMO6	29.58394288	-26.00395514	Source and plume monitoring

Groundwater sampling protocol

It is required that all boreholes be purged by pumping out at least two times the volume of the borehole before a sample is taken at the end of the pipe. This will ensure that no stratified water samples are taken, at the same time eliminating the possibility of measuring a borehole that was contaminated by surface activities.

7.1.3 Bio-monitoring

Bio-monitoring will be conducted on a bi-annual basis at the points KF01 – KF03 as proposed in **Table 7-2**. The bio-monitoring will assist in the determination of potential long term impacts on the receiving water environment.

7.2 DATA MANAGEMENT AND REPORTING

Document and data control forms an integral part of Kebrafield (Pty) Ltd's SHEQ System and is documented and maintained in an Excel Based Spread sheet. The procedure refers to document locations; how and when documents are reviewed and revised if necessary. The document and data control procedure specifies that documents must be approved for adequacy by authorized personnel and enforces that only current versions of relevant documents and data are available at all locations where essential.

Obsolete documents and data are removed from all points of issue and points of use or otherwise assured against unintended use; and archival documents and data that are retained for legal or knowledge preservation purposes or both, are suitably identified, to prevent unintended use.

7.3 WASTE MONITORING

7.3.1 Waste Rock

The volume of waste rock generated will be recorded weekly. In addition, the volume of waste rock used in rehabilitation will be monitored as it occurs.

7.4 ENVIRONMENTAL MANAGEMENT SYSTEM

Though Kebrafield (Pty) Ltd: Roodepoort Colliery is not ISO certified, they implement an approved SHEQ manual that is based on the following documents:

- ISO 9001 : 2000 : Section 4.2.1
- ISO 14001 : 1996 : Section 4.4.4
- OHSAS 18001 : 2007 : Section 4.4.4
- Mine Health and Safety Act 29 / 1996
- Occupational Health and Safety Act 85 / 1993

The SHEQ plan seeks to promote continuous improvement to the working conditions of activities. The ultimate goal for SHEQ improvement is the elimination of losses in all activities involving people, equipment, and material in addition to protecting the environment. Kebrafield (Pty) Ltd will

seek to effectively control all hazards and reduce the risk to all personnel to a zero incident level.

Kebrafield (Pty) Ltd established and maintains an emergency plan and documented procedure to identify the potential for, and responses to, incidents and emergency situations. The procedure describes preventing and mitigating any likely illness and injury that may be associated with Kebrafield (Pty) Ltd. The emergency preparedness and response plans and procedures will be reviewed as stated in the procedure, as well as after the occurrence of incidents or emergency situations. Periodic tests are carried out to test if the emergency preparedness response procedure and plan is adequate.

7.5 RECORDING OF INCIDENTS

The procedure for accidents, incidents, non-conformances and corrective and preventive action for Kebrafield (Pty) Ltd will be done in accordance with the prescribed legislation. The handling and investigation of accidents; incidents; non-conformances; taking action to mitigate any consequences arising from accidents, incidents or non-conformances; the initiation and completion of corrective and preventive actions; and confirmation of the effectiveness of corrective and preventive actions taken will be described criteria in the said procedure.

All proposed corrective and preventive actions are reviewed through the risk assessment process prior to implementation.

Any corrective or preventive action taken to eliminate the causes of actual and potential non-conformances is appropriate to the magnitude of problems and commensurate with the SHEQ risk encountered.

Any changes in the documented procedures resulting from corrective and preventive action are implemented and recorded.

7.6 ENVIRONMENTAL IMPACT REGISTER

Kebrafield (Pty) Ltd established and maintains a procedure for the identification, maintenance and disposition of SHEQ records, as well as the results of audits and reviews.

SHEQ records are:

- Legible, identifiable and traceable to the activities involved
- Stored and maintained in such a way that they are readily retrievable and protected against damage, deterioration or loss, as indicated in the relevant procedure

Retention times for all records are established and recorded in each procedure and records are maintained demonstrating conformance to the system and to the organization.

7.7 AUDITING AND REPORTING

A procedure to monitor and measure SHEQ performance on a regular basis will be established.

Both qualitative and quantitative measures appropriate to the needs of the organization are measured. Monitoring is done to determine the extent to which the organization's SHEQ objectives are met.

Pro-active measures of performance that monitor compliance with the SHEQ management programme are operational criteria, applicable legislation and regulatory requirements.

Accidents, ill health, incidents (including near-misses) and other historical evidence of deficient SHEQ performance forms part of reactive measures of performance monitoring.

Data are recorded and results of monitoring and measurement are used to facilitate subsequent corrective and preventive action analysis.

Monitoring equipment required for performance measurement and monitoring, as well as the calibration and maintenance activities thereof, is included in Kebrafield (Pty) Ltd's measurement and monitoring procedure.

Kebrafeld (Pty) Ltd established, implemented and maintains a procedure for periodically evaluating compliance with applicable legal requirements. The results of the periodic evaluations are kept as indicated in the section "Records" identified in each procedure.

Kebrafield (Pty) Ltd will also evaluate compliance with ISO 9001, ISO 14001 and OHSAS 18001 as described in the evaluation of compliance procedure.

Kebrafield (Pty) Ltd established and maintains an audit programme and a documented procedure for periodic SHEQ management system as well as legal audits to be carried out, in order to:

- Determine whether or not the OH&S management system:
  - Conforms to planned arrangements for OH&S management including the requirements of the OHSAS 18001 specification and legal requirements
  - Has been properly implemented and maintained
  - Is effective in meeting the organization's policy and objectives
- Review the results of previous audits
- Provide information on the results of audits to management

The following reports will be submitted to the indicated Provincial Government Departments:

- Rehabilitation plan: DMR, DWEA
- Annual water report: DWA
- Annual audit report: DMR and DWA

In addition to the above Kebrafield Pty (Ltd) will ensure continuing suitability, adequacy and effectiveness by establishing and maintaining a system to periodically review the companies SHEQ

system. All the necessary information is collected to allow management to evaluate and document this review. The management review shall address the possible need for changes to policy, objectives and other elements of the SHEQ management system, in the light of SHEQ management system audit results, changing circumstances and the commitment to continual improvement.

8. OPERATIONAL MANAGEMENT

8.1 ORGANIZATIONAL STRUCTURE

Roles, responsibilities and authorities of personnel of Kebrafield: Roodepoort Colliery are defined, documented and communicated through internal procedures. The top management of Kebrafield (Pty) Ltd is ultimately liable, responsible and indicates commitment to safety, health, environment, quality and the community.

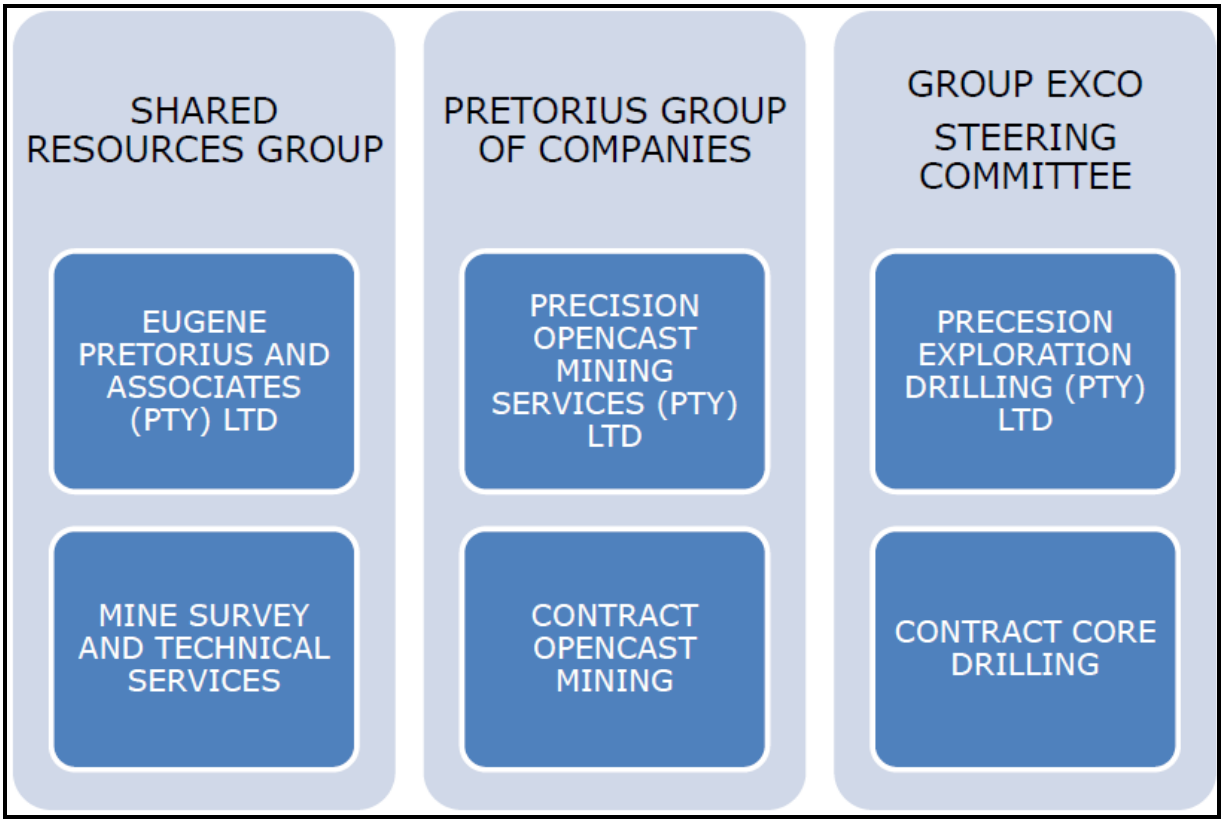

Figure 8-1: BEE and Kebrafield share distribution

Roles allocated to the different employees are indicated on the Kebrafield organogram. Employee responsibilities and authorities will be defined in each employee's job description.

Key management personnel that Kebrafield (Pty) Ltd will use at the project site are described below. Designations to change pending final appointments:

- Eugene Pretorius : Chief Executive Officer
- Schalk Burger : General Manager
- Owner Siweya : Human Resource Manager
- Mike Elliot : Operations Manager
- Dawie van Wyk : Mine Geologist

8.2 ENVIRONMENTAL MANAGEMENT: RESOURCES

Kebrafield (Pty) Ltd provided adequate resources, including the assignment of trained personnel for management, performance of work and verification of project activities including "Internal Audits".

8.2.1 Labour Complement

The steady-state permanent labour complement for the mining activities at Kebrafield is 100 employees and with the inclusion of six to be appointed professional service providers (PSPs) amounts to 106 jobs. The labour component required for the proposed Kebrafield is contained in **Table 8-1**.

Table 8-1: Proposed breakdown of employees for Roodepoort Colliery

Occupational Category	Number of Employees
Senior Management	4
Geologist and Mine Planner	2
Survey and assistant	2
Safety, Health and Environment	5
Sub-total: Skilled	***13***
Bulldozer Operators	4
Hydraulic Excavator operator	4
Articulated Dump Truck Operator	10
General Operators	34
Grader Operator	5
Water Bowser	4
Overburden Drill Operator	6
Drill Assistant	4
Blaster Assistant	6
Blasting technician	2
Relief (sick) and temporarily	8
Sub-total: Contract Mining Labour	***87***
TOTAL	**100**

8.3 AWARENESS AND TRAINING

The mine's documented procedure for competence, training and awareness emphasize the importance of conformance to the policy, procedures and the SHEQ system.

Roles and responsibilities are highlighted during training. The potential consequences if procedures are not followed, as well as consequences of work activities are also stressed during training.

Training and competency takes responsibility, ability and literacy; as well as risk into consideration.

8.3.1 Training needs

Training needs in the company is developed through the following:

- Employee input
- Management input
- The results of risk assessments and accident investigations

- Operating procedures and job descriptions

Training needs will include safety, health, environmental and quality related training. Personnel performing work affecting product quality shall be competent on the basis of appropriate education training, skills and experience. Personnel performing tasks that might have a significant environmental impact must be competent for the tasks to be performed.

All training needs will be evaluated at least annually to ensure that it is still adequate. This does not mean that training needs cannot change throughout the year. Incident investigations, changing job circumstances, risk assessments etc. can cause changes to the training needs at any time.

After training needs were identified, it will be included in the training matrix.

8.3.2 Training objectives

The companies' objective with regards to training will be handled as per the procedure "Skills Development" as contained in the Social and Labour Plan of Kebrafield.

Training will always form part of the companies SHEQ objectives.

8.3.3 SHEQ Related Courses

SHEQ related training courses will be internally handled by the Safety officer, or can be done through an outside company. Should a person receive "on the job" training, a training form must still be signed indicating the type of training received. The training matrix will be completed to identify SHEQ Training given to employees.

Training records and records of evaluation of effectiveness of training

All training records will be kept on the person's personal file for reference purposes. An electronic database - training matrix will be updated electronically to identify training done.

8.3.4 SHEQ Policy Training

All employees will receive training on an annual basis on the organizations health and safety policy through attending the company induction.

8.3.5 Training on roles and responsibilities

The individual roles and responsibilities with respect to SHEQ are included in the employees' job descriptions as well as appointment letters. Employees are requested to read through the said documents and only sign acceptance thereof after they agree with the roles and responsibilities. Job descriptions must indicate the necessary competence to perform the work.

8.3.6 Hazard Identification and Risk Control Training

Relevant employees will receive training on the Hazard Identification and Risk Control process

whereafter they will form part of the risk assessment team to identify hazards, risks and the control measures associated with their line of work. Employees will receive annual refresher training on all baseline risk assessments done within the company. Each standard task procedure will include the importance of following and conforming to control measures in the specific tasks to be done. The hazards include safety, health, environmental and quality related hazards in the workplace.

8.3.7 Emergency procedure training:

Each safe work procedure will specify the emergency procedure related to that specific task to be done. A standard emergency procedure is available and training will be given to all employees on such procedure.

8.4 COMMUNICATION

A communication, participation and consultation procedure to ensure pertinent SHEQ information is communicated to and from employees and other interested parties is established and maintained within the Kebrafield SHEQ system.

Kebrafield employees are involved in the development and review of policies and procedures to manage risks; consulted where there are any changes that affect workplace health and safety; represented on health and safety matters; and informed as to who is their employee OH&S representative(s) and specified management appointee.

Public involvement is an integral part of the EIA and the water use authorisation processes. A public participation process was organized in order to inform Interested and Affected parties (IAPs) about the current status of the Kebrafield (Pty) Ltd project. This provided them the opportunity to raise any relevant issues or concerns that they might have. More detail on the public participation process (PPP) followed is given in this section.

8.4.1 Identification of Stakeholders

The following groups of interested and affected parties were involved in the environmental assessment process:

- Landowners and non-landowners in the project area
- Non-governmental organisations and associations
- Community leaders
- Regulatory authorities

8.4.2 Public Liaison and Forum Participation

The public participation process was initiated with a Background Information Document (BID) posted / faxed to all identified Interested and Affected Parties (I&APs). The BID included an

invitation to the public meeting that was held on 30 March 2011.

8.4.3 Distribution of Information

The minutes of the public meeting were forwarded to all attendees. All verified information is available at the offices of Kebrafield (Pty) Ltd at Stonehill Office Park, Pretoria (Mr Mike Elliot) on request, and will also be available on the internet at http://www.menco.co.za.

8.4.4 Public Meeting

Public meetings were held on 1 November 2013 at 09:00, on site. The objective of the information sharing meeting with I&APs was to discuss the outcome of all specialist investigations conducted in support of the Mining Right Application.

8.4.5 Regulatory Authority Meeting

A regulatory authority meeting was held on 20 November 2013 in Bronkhorstspruit. The meeting was attended by representatives of the Regional Office dealing with the Olifants River Water Management Area.

8.4.6 Documents for Public Review

The accessibility and availability of all documents as described in this document is endorsed by the management of Kebrafield (Pty) Ltd.

The following documents are available for stakeholder review at Kebrafield (Pty) Ltd's offices, namely:

- All studies and documents produced as part of the WULA processes
- All previous reports compiled in terms of any legislation
- All proceedings of stakeholder participation
- The IWWMP for Kebrafield
- Revised EIA and EMP

The IWWMP is also available from the MENCO web page: http://www.menco.co.za.

9. CONCLUSION

This IWRMP is the culmination of the various specialist studies that formed part of the larger Environmental Management Programme Reports for Kebrafield (Pty) Ltd. Its purpose is not only to summarize the important sections of these baseline studies, but also to serve as the Technical Supporting Document for the Licence Application, while at the same time highlighting issues of concern as well as evaluating available data. Considering the objections as received from the various Interested and Affected Parties the following matters are identified as key concerns:

- Mining in the area not compatible with the EMF for Steve Tshwete LM
- Destruction/degradation of the Woestalleen Wetland system
- Accumulated ground and surface water pollution in the Klein Olifants River water management area

It is anticipated that a maximum 35 000 tons per month of soil, overburden and waste rock will be moved / screened. No coal washing will take place, only crushing and screening. The life of mine is expected to be 5 years.

Although the mining activities have potential negative effects on the surface water resource, the impacts are considered to have Low-Medium to Medium significance with mitigation. Storm water management measures will comply with GN704 regulations. Each open pit area will have clean storm water diversion to prevent water from entering the mining areas. In addition, dirty storm water from each mining site will be contained in a lined pollution control dam that will comply with GN704 regulations.

Several impacts had been identified that could influence the ambient groundwater quality of the area. The most significant impact is the formation of Acid Mine Drainage (AMD) and the potential for decanting to occur. Mitigations to prevent decanting of the opencasts include the reduction of the hydraulic conductivity of the opencast backfilled material, reduction of the rainfall recharge at the opencast, evaporating water from the final void in the pit, intercepting decant or redesigning the aerial extent of the opencast. With mitigation measures in place, the significance of the potential impacts on the ground water is considered to be Low.

The riparian wetlands within the footprint of the study area are considered a low significance. The wetlands in the wider study area are considered most sensitive with unique species composition and aquatic ecosystem functioning. It is not foreseen that Kebrafield will impact on the Pullenshope wetland systems. The mine will include as part of the rehabilitation plan the restoration of degraded wetlands caused by historic mining activities and invasion of alien plant species. Mining can only commence with the issuance of a water use license for the relevant water uses.

Very little waste will be produced on site. However, the following waste management hierarchy will

be applied: reduce at source, re-use, and re-cycle. Any waste generated will be disposed in an environmentally responsible manner. Therefore, the impact of waste is considered to be Low with mitigation.

It is important to follow the recommended management actions and to monitor the surface water resources, ground water, waste facilities and rehabilitation measures.

A final rehabilitation plan needs to be drawn up and will be implemented concurrently with closing of the open pits. Proper stripping, stockpiling and shaping of the spoil layer are important to ensure efficient rehabilitation to set post-mining land capability classes. Based on the moderate risks, as well as moderate environmental significance that the activities pose to the aquatic environment, it is recommended that the water uses applied for be approved prior to any mining activity to commence.

10. REFERENCES AND SPECIALIST STUDIES

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