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REPORT ON

DRAFT ENVIRONMENTAL IMPACT REPORT FOR THE NEW KOFFIEFONTEIN SLIMES DAM DEVELOPMENT

DESTEA Reference Nr: EMR/23(ii), 3, 15/14/11

NEAS Reference Nr: FSP/EIA/0000379/2014

Report No :13034-46-Rep-003-DEIR-Rev0

Submitted to:

Koffiefontein Mine JV
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Koffiefontein
9986

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February 2016 13034

YOUR COMMENT ON THE DRAFT ENVIRONMENTAL IMPACT ASSESSMENT REPORT

The Draft Environmental Impact Assessment Report (EIR) is available for comment from **Wednesday, 02 March 2016 to Friday, 15 April 2016**. This DEIR has been distributed to the authorities, and copies thereof are available at public places in the project area (see below).

List of public places where the Draft Environmental Impact Assessment Report is available:

VENUE	CONTACT DETAILS
Printed Copies	
Letsemeng Local Municipal Offices, 7 Groot Trek Street, Koffiefontein	Tel.: 053 205 9200
Koffiefontein Public Library, 29 Groot Trek Street, Koffiefontein	Tel.: 053 205 0147
Ditlhake Public Library, 429 Ttsane Street, Ditlhake, Koffiefontein	Tel.: 053 205 0383
Ethembeni Clinic, 100 Jacobsdal Road, Koffiefontein	Tel.: 053 205 0977
ELECTRONIC COPIES	
Zitholele Consulting Website	http://www.zitholele.co.za/eia-for-koffiefontein-slime-dam
Nicolene Venter	Available on CD on request via email Tel.: 011 207 2060 E-mail: publicprocess@zitholele.co.za

The DEIR is also available electronically from the Public Participation office or on the Zitholele website: http://www.zitholele.co.za/eia-for-koffiefontein-slime-dam, or the Koffiefontein Diamond Mine website http://www.petradiamonds.com (Koffiefontein Mine)

DUE DATE FOR COMMENT ON THE DEIR IS FRIDAY, 15 APRIL 2016

Send your comment to the Public Participation Office:

Nicolene Venter or Shandre Laven
Zitholele Consulting
PO Box 6002, Halfway House, 1685
Tel: (011) 207 2060 or Fax: 086 676 9950
Email: publicprocess@zitholele.co.za

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LIST OF ACROYNYMS

Acronym	Description
AQMP	Air Quality Management Plan
BC	Before Christ
BL	Block Caving
CA	Competent Authority
CI	Conservation Important
COMSA	Chamber of Mines South Africa
CPA	Communal Property Association
CRR	Comments and Responses Report
CTPA	Carats Per Annum
DCPT	Dynamic Cone Penetration Tests
DDT	Data Deficient – Taxonomically
DEA	Department of Environmental Affairs
DEIR	Draft Environmental Impact Report
DESTEA	Department of Economic, Small Business Development, Tourism and Environmental Affairs, Free State
DETEA	Department of Economic Development, Tourism and Environmental Affairs, Free State
DMS	Dense Media Separation
DMR	Department of Mineral Resources
DRDLR	Department of Rural Development and Land Reform
DSR	Draft Scoping Report
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
ECA	Environment Conservation Act
EIA	Environmental Impact Assessment
EIR	Environmental Impact Report
EMPr	Environmental Management Programme
FEIR	Final Environmental Impact report
FEPA	Freshwater Ecosystem Priority Areas
FRSF	Fine Residue Storage Facility
FSE	Federation for Sustainable Environment
FSR	Final Scoping Report
FY	Full Year
GDP	Gross Domestic Product
GNR	Government Notice Regulation
HDPE	High Density Polyethylene
I&APs	Interested and Affected Parties

Acronym	Description
IDP	Integrated Development Plan
IEM	Integrated Environmental Management
KMJV	Koffiefontein Mine Joint Venture
LETSEMENG LM	Letsemeng Local Municipality
LOM	Life of Mine
MPRDA	Mineral Petroleum Resources Development Act
NEM:AQA	National Environmental Management: Air Quality Act
NEM:WA	National Environmental Management: Waste Act
NEM:WAA	National Environmental Management: Waste Act Amendment
NEMA	National Environmental Management Act
NWA	National Water Act
PM_{10}	Particulate matter with an aerodynamic diameter of less than 10 µm
$PM_{2.5}$	Particulate matter with an aerodynamic diameter of less than 2.5 µm
PoS	Plan of Study
PPP	Public Participation Process
RWD	Return water dam
S&EIR	Scoping and Environmental Impact Reporting
SABS	South African Bureau of Standards
SACNASP	South African Council for Natural Scientific Professions
SAHRA	South African Heritage Resources Agency
SANBI	South African National Biodiversity Institute
SIA	Social Impact Assessment
SLC	Sub Level Cave
SMME	Small Medium Micro Enterprise Development
SOE	State Owned Entity
SR	Scoping Report
ToR	Terms of Reference
TSF	Tailings Storage Facilities
TSP	Total Suspended Particulate
WULA	Water Use Licence Application
XHARIEP DM	Xhariep District Municipality

1 INTRODUCTION

1.1 Project Background

The first known discovery of diamonds dates back to 4BC was made in Golconda Fort of Southern India. Perhaps one of the most famous stones from Golconda is the Blue Hope Diamond (Petra, 2015). The discovery of “The Star of South Africa” 83.5cts diamond in 1869 on the banks of the Orange River together with the first discovery of ‘kimberlite’ or ‘hard rock’ deposits (Petra Diamonds, 2015) marked the beginning of South Africa’s diamond rush. South Africa has since firmly established itself as a major contributor of diamonds ranking fourth in the production of diamonds worldwide. Furthermore, the South African mining industry is a key component of JSE accounting for 24.7% of the all-share index (COMSA, 2014), generating substantial revenue estimated at R330 billion and makes up 20% of all investment in the country (KPMG, 2013).

The mining sector in South Africa contributes 5% to the national Gross Domestic Product (GDP) and the mining activities within the Free State contribute 12.6% to the Provincial GDP (Stats SA, 2012). Specifically, within the Xhariep District Municipality mining generates less than 4% of jobs (Xhariep District Municipality IDP, 2014 – 2015). The diamond industry in the Free State was ignited after the founding of Jagersfontein mine where some of the first diamonds in South Africa were found. The Jagersfontein Mine was developed by De Beers in 1870’s and produced many of the world’s largest diamonds. The Excelsior, a 995.2 carat stone was the largest in the world for 12 years after it was found in 1893. Today Jagersfontein is the oldest and largest open mine in the South Africa and also a major tourism attraction (SA Tourism, 2015).

The project at hand is centred on providing additional infrastructure for the continued operation of the Koffiefontein Diamond Mine. The Koffiefontein Diamond Mine forms part of Petra Diamonds’ portfolio which includes four producing mines in South Africa, including the aforementioned. Petra Diamonds’ operations are focused on ‘hard rock’ kimberlite pipe orebodies, as opposed to alluvial deposits. Alluvial deposits refer to deposits of diamonds which have been removed from the primary kimberlite source by natural erosive action and eventually deposited in a new environment such as a river bed, an ocean floor or a shoreline. Conversely hard rock deposits are found at the primary source.

Koffiefontein Diamond Mine (KDM) is one of the largest kimberlite diamond mines in the world (mining technology.com; Oct 2015). Transport rider’s habit of stopping and making coffee at the location is said to have led to the name Koffiefontein (*coffee fountain, direct translated from Afrikaans*). So much so that upon entering the town tourists are welcomed by the vision of a suspended bronze kettle below the town name. In 1870, one of the transport riders picked up a diamond near the fountain. This prompted a diamond rush and by 1882 Koffiefontein had become a booming town with four mining companies (DCGTA, 2014).

Koffiefontein forms part of the diamond region, which is one of the priority development regions in the Free State Province. Koffiefontein Mine currently operates as an open cast and underground mining venture.

The total Koffiefontein Mine area amounts to 2817 ha of which 887 ha is utilised for mining and tailings storage and the rest (1930 ha) is a game farm. The study area includes the game farm, the Tailings Storage Facilities (TSF's) and the Return Water Dam (RWD) (Figure 2-1). Mining infrastructure on site includes open pits, underground mine infrastructure, plant infrastructure, waste rock dump, return water dam and slimes dams (West Dam, Middle Dam and East Dam). Currently mining activities include underground mining and open pit mining (Ebenhaezer Pit).

1.2 Context of this report

This Draft Environmental Impact Report (DEIR) is a key component of the Environmental Authorisation (EA) process for the proposed establishment of a Fine Residue Storage Facility (FRSF) at Koffiefontein Diamond Mine. This report addresses the requirements for the Impact Assessment Phase for the EIA as outlined in the NEMA regulations. The aim of this DEIR is to:

- Provide information to the authorities as well as Interested and Affected Parties (I&APs) on the proposed project;
- Undertake comparative analysis of alternatives;
- Investigate and describe the receiving environment;
- Identify potentially significant impacts and environmental risks associated with the proposed activities;
- Describe and implement an appropriate ranking methodology for impact assessment;
- Indicate how I&APs have, and are still, being afforded the opportunity to contribute to the project, verify that the issues they raised to date have been considered, and provide them with opportunity to comment on the findings of the impact assessment;
- Propose mitigation measures in order to minimise negative impacts and enhance positive impacts; and;
- Present the findings of the Impact Assessment Phase in a manner that facilitates decision-making by the relevant authorities.

1.3 Project Proponent

Petra Diamonds owns 74% of the Koffiefontein Diamond Mine and therefore has majority interest in the mine. The remaining 26% share of the Koffiefontein Diamond Mine is held by Re Teng Diamonds Pty Ltd. The partnership between Petra Diamonds and Re Teng Diamonds forms part of the Petra's initiative to conform to the Broad Based Black Economic Empowerment equity ownership requirements. Furthermore, the aforementioned partnership is formally referred to as the Koffiefontein Mine Joint Venture (KMJV). The Koffiefontein

Mine Joint Venture, under the mining right number: *FS 30/5/1/2/2/91MR C/2006/01/30/001*, anticipates increasing production from 50 375 ctpa in 2014 to approximately 100 000 ctpa by 2017[1], by which point the production will come from underground mining only. The Life of Mine (LOM) by will be extended by 20 years from the year 2017. The increased production is owed to the revised mining lay-out for the Sub Level Cave (SLC), which will accelerate access to fresh kimberlite ore. The proposed new FRSF falls within the mining property, adjacent to the existing slimes dam.

Development work on the underground tunnel infrastructure is underway, while ore-handling conveyor installations servicing the SLC are in the final stages of commissioning. The production has risen from about 35 000 carats per annum in 2013, to about 105 000 carats at present. Koffiefontein Diamond Mine currently holds an Mining Right for the existing mining operations, which includes the proposed development location for a new slime dam. The details of the project proponent / applicant is provided in Table 1-1.

Table 1-1: Details of Project Applicant

Project Applicant:	Koffiefontein Mine Joint Venture
Postal Address	P.O. Box 80, Koffiefontein, 9986
Project Manager:	Mr. Pieter Coetzee
Physical Address	Koffiefontein Mine
Postal Address	P.O. Box 80 Koffiefontein 9986
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Fax:	+27 53 733 0010
Cell phone:	+27 81 037 9428
E-mail address:	Pieter.Coetzee@petradiamonds.com

Table 1-2: Applicant Contact Person

Company:	Koffiefontein Mine Joint Venture
Environmental Specialist	Ester van der Westhuizen-Coetzer
Physical Address	Koffiefontein Mine
Postal Address	P.O. Box 80 Koffiefontein 9986
Telephone	+27 53 205 5354
Cell phone	+27 72 335 0273
Fax:	+27 53 205 5028
E-mail address	Ester.vanderWesthuizen-Coetzer@petradiamonds.com

1.4 Details of the Environmental Impact Assessment Practitioner

Zitholele Consulting Pty Ltd. (hereafter referred to as Zitholele) was appointed by the Koffiefontein Diamond Mine as the Environmental Assessment Practitioner (EAP) to carry

[1]www.petradiamonds.com

out the mandatory environmental legislative process that is required to obtain Environmental Authorisation (EA) in terms of the National Environmental Management Act 107 of 1998 (as amended). In keeping with the Regulation 28(1)(a) of the NEMA EIA Regulations 2010, an overview of the expertise and details of the key project team member who prepared this Draft Environmental Impact Report is provided in Part 1.4.2 of this report.

Table 1-3: Details of EAP

Name and Surname	Dr Mathys Vosloo
Highest Qualification	PhD (Zoology), Nelson Mandela Metropolitan University 2012
Professional registration	SACNASP (400136/12)
Company Represented	Zitholele Consulting (Pty) Ltd.
Physical Address	Building 1, Maxwell Office Park, Magwa Crescent West, Corner of Allandale Road & Maxwell Drive, Waterfall City, Midrand, 1685
Postal Address:	P O Box 6002, Halfway House, 1685
Telephone Number	011 207 2079
Fax Number	086 676 9950
E-mail address	mathysv@zitholele.co.za

1.4.1 Overview of Zitholele Consulting

Zitholele Consulting is an empowerment company formed to provide specialist consulting services primarily to the public sector in the fields of Water Engineering, Integrated Water Resource Management, Environmental and Waste Services, Communication (public participation and awareness creation) and Livelihoods and Economic Development.

Zitholele Consulting has no vested interest in the proposed project and hereby declares its independence as required by the EIA Regulations. The details of the EAP representative are listed below.

1.4.2 Expertise of Environmental Assessment Practitioner

Dr Mathys Vosloo graduated from the Nelson Mandela Metropolitan University with a PhD in Zoology in 2012. Over the past few years Mathys has been involved in a variety of projects and has undertaken environmental authorisations for projects ranging from new ash disposal facilities for power stations, the construction of roads, rehabilitation of dam wall infrastructure, development of low cost housing, and electricity generation and transmission projects of national strategic importance. Mathys has also been involved in the development of strategic environmental assessments and state of the environment reporting. He has developed numerous environmental management programmes during the course of his career. With more than 10 years in the environmental and scientific field, and more than 8 years in environmental consulting, Mathys has gained an advanced and holistic

understanding of environmental management in the built environment. A detailed CV of the Dr Mathys Vosloo is included in Appendix A to this report.

1.5 Department of Economic, Small business development, Tourism and Environmental Affairs Case officer contact details

The Provincial Department of Economic, Small business development, Tourism and Environmental Affairs (DESTEA) is the Competent Authority. The mandate and core business of the DESTEA is underpinned by the Constitution and all other relevant legislation and policies applicable to the government.

Table 1-4: Details of the DESTEA case officer

Name	Nonceba Balithe
Postal Address	Private Bag X 20801, Bloemfontein, 9300
Physical Address	Fountain Towers Building 1st Floor, Room 137 C/o Zastron & Markgraaf Street Bloemfontein
Telephone	051 400 4845/17
Fax	051 400 4842
E-mail	balithen@detea.fs.gov.za

1.6 KDM Reports considered

The following reports have been made available by the Koffiefontein Diamond Mine and have been considered as background supporting data for this EIA Process:

- Africa Geo-Environmental Services, 2013: Koffiefontein concept mine water study. Document Version 1.0 – Draft;
- Koffiefontein Diamond Mine, 2013: Water System explained Koffiefontein Diamond Mine.
- North West University, 2012: Avifaunal Survey of Petra Mines Koffiefontein, South Africa;
- North West University, 2013: Koffiefontein Mine JV Herpetological Survey;
- North-West University, 2011: Summer Assessment of the Avifauna of Petra Mines Koffiefontein, Western Free State, South Africa – Interim Project Report;
- North-West University, 2013: Winter and Summer Avifaunal Surveys of Petra Mines, Koffiefontein, South Africa;
- Rison Groundwater Consulting, 2011: Groundwater Quality Assessment, Koffiefontein Diamond Mine;
- Rison Groundwater Consulting, 2012: Hydrogeological Assessment at Koffiefontein Diamond Mine: Geophysics, Drilling, Aquifer Testing, Groundwater Flow And Hydrochemistry;
- Rison Groundwater Consulting, 2013: Dewatering Assessment at Koffiefontein Diamond Mine: Geophysics & Drilling at Ebenhaezer Open Pit; and
- Shangoni Management Services, 2011: Integrated Water and Waste Management Plan, Koffiefontein Empowerment Joint Venture.

2 PROJECT DESCRIPTION

2.1 Project Location

Koffiefontein is located in the Free State Province, 105 km SSE from Kimberley and approximately 138 km from Bloemfontein. Koffiefontein is situated in the Letsemeng Local Municipality (Letsemeng LM), which falls within the bounds of the Xhariep District Municipality (Xhariep DM). Letsemeng LM forms the western part of Xhariep District and borders the Northern and Western Cape Provinces, the former via Jacobsdal.

The Xhariep DM is renowned for diamond, salt and slate mining as well as irrigation farming along the Orange Riet Canal and Van der Kloof Dam. It comprises five towns connected by a tarred road via Koffiefontein. The R705 links Jacobsdal with Koffiefontein, while the R48 links Petrusburg, Koffiefontein and Luckhoff. The R704 links Koffiefontein, Fauriesmith and Jagersfontien, with the latter linked to Trompsburg by a dirt road. The N8 route traverses the area to the north and links Kimberley and Bloemfontein via Petrusburg. The Port Elizabeth railway line starts at Koffiefontein and connects at Springfontein with the Johannesburg/Cape Town railway line to continue in an easterly direction towards Port Elizabeth.

Koffiefontein serves as the municipal administrative seat within the Letsemeng LM. It is situated approximately 125 km northwest of Trompsburg and an estimated 146 km east of Bloemfontein. Koffiefontein is a major social and economic hub in the area and houses the main LM administrative centre, regional agricultural services centre, diamond mining operations, and regional social services centre.

The areas adjacent to the Koffiefontein Mine Operation are used primarily for residential and agricultural purposes. Residential areas in close proximity to the Koffiefontein Mine Operation are Koffiefontein town, Diamanthoogte, Ditlhake and Rooibult. Further infrastructure adjacent to the Koffiefontein Mine Operation is the airstrip and the municipal sewage treatment works with associated sewerage infrastructure.

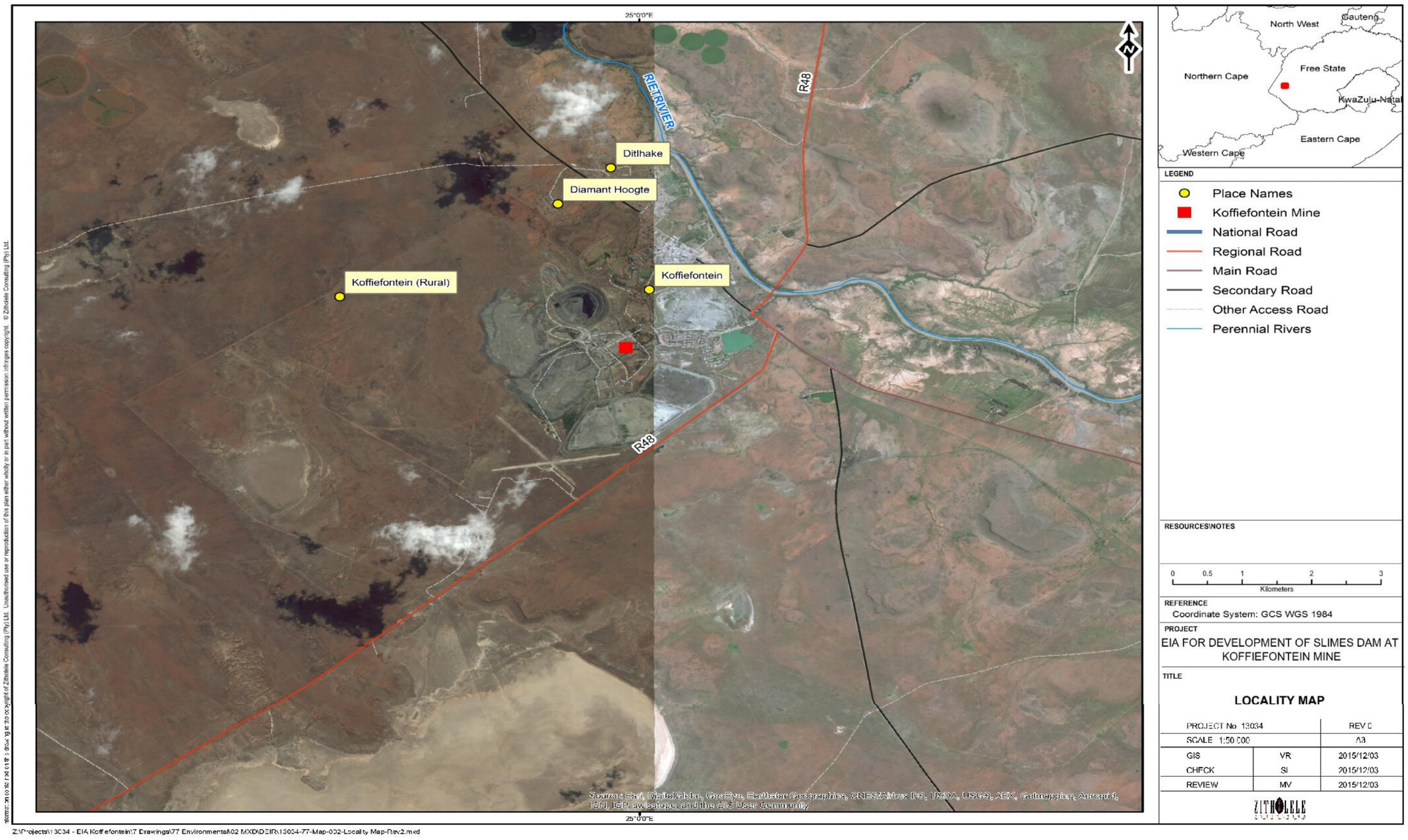


Figure 2-1: Overview of project location

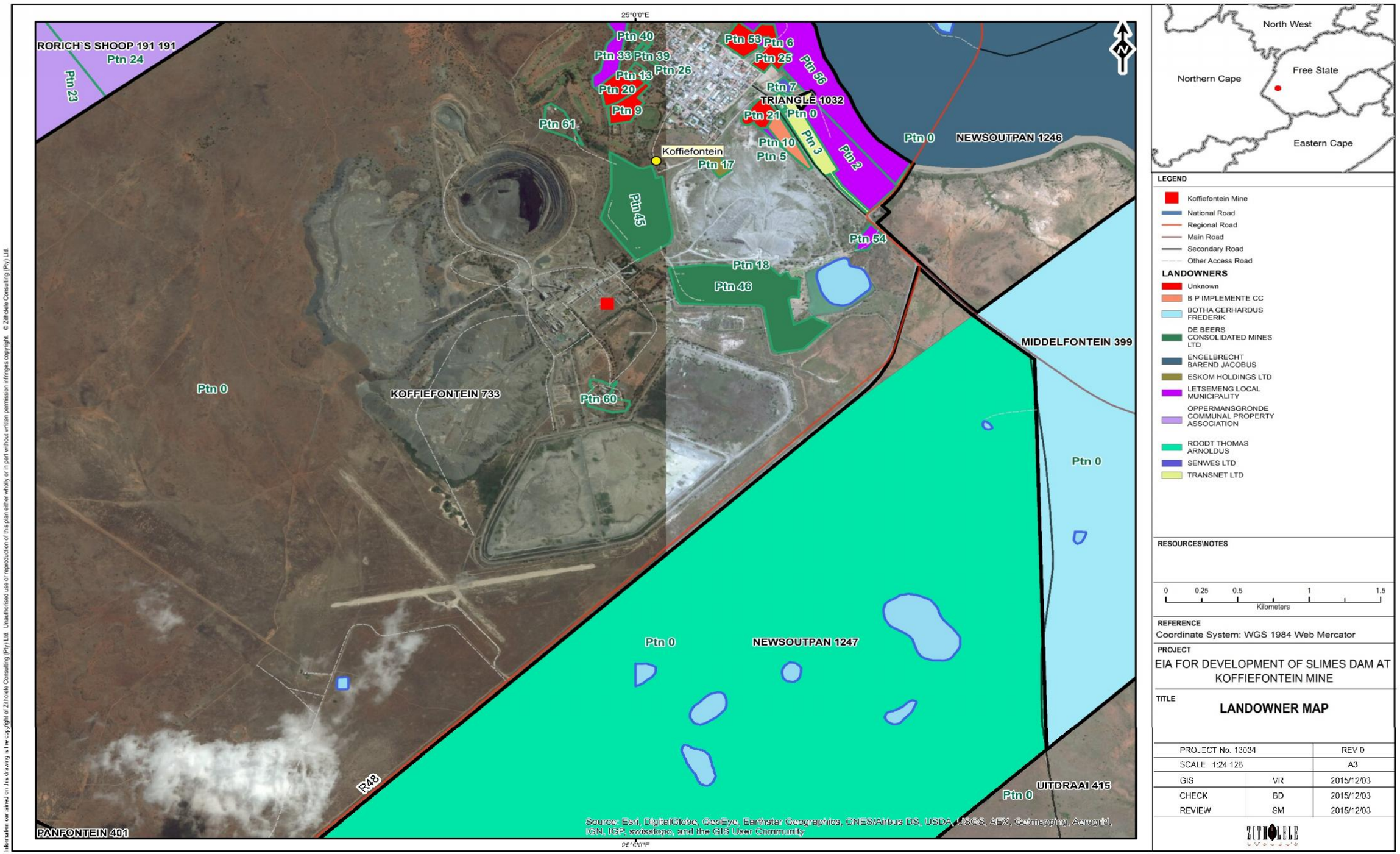


Figure 2-2: Land Owner map

Figure 2-3: Layout of the Koffiefontein Diamond Mine operations

2.2 Description of existing activities

2.2.1 Existing Services

Roads and transportation

Roads applicable to the Koffiefontein Diamond Mine include the R705 connecting Koffiefontein with the N12 to Kimberly and the R48 connecting Koffiefontein with the N8 to Bloemfontein or Kimberly. The R704 and R706 are located to the south-east of Koffiefontein. On-site roads consist of both tarred and gravel surfaces, maintained on a regular basis. Gravel roads are treated with a bitumen product to aid dust suppression.

Electricity

Eskom supplies electricity to Koffiefontein Diamond Mine and adjacent residential communities. Koffiefontein Diamond Mine is not responsible for any power generation.

Current Water supply

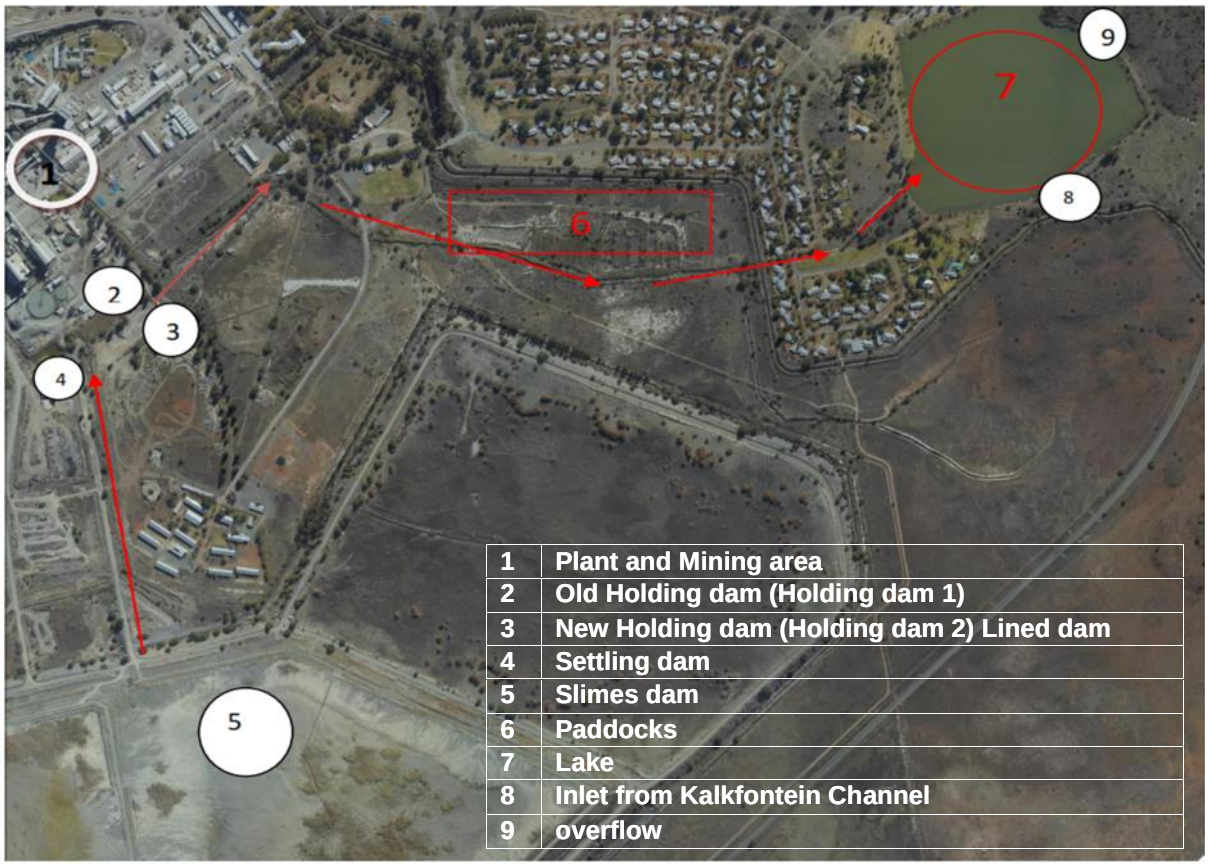
The source of domestic / potable water for Koffiefontein Diamond Mine is from the local municipal(Letsemeng LM and Xhariep DM) network. The local municipality receives water from the Kalkfontein water canal. For approximately four weeks of the year the local municipality uses raw water from the Mine Lake. The local municipality is responsible for managing the domestic water quality in terms of the domestic water quality requirements. [2]Groundwater is abstracted for; wildlife, livestock and domestic use use at Koffiefontein Diamond Mine (Rison Groundwater Consulting, 2015).

Make-up water for the mine process is obtained from the Mine Lake (raw water from the Kalkfontein water canal) (Figure 2-3). The use of make-up water is minimised by re-use of recovered mine affected water in a closed water system. No water is released into the environment at any given time, and thus complying with the domestic water quality requirements as stipulated by the Department of Water and Sanitation (DWS). However, the last point of release of effluent from the mine was into the lake area, which is currently used for recreational purposes as well as supplying water to the town of Koffiefontein for the three dry weeks in June when the Kalkfontein water Channel is being cleaned (Koffiefontein Diamond Mine[3], 2013).

Figure 2-4 below illustrates the current water system for Koffiefontein Diamond Mine (Koffiefontein Diamond Mine, 2013). Currently water from mining and plant operation (1) is

[2] Koffifontein Diamond Mine TSF Expansion Project EIA (Hydrology) 2015)
[3] Koffiefontein Diamond Mine, 2013: Water System explained Koffiefontein Diamond Mine

used in the plant for the process, and it is then pumped to the slimes dams (5). Water from the slimes dam flows in to the first settling dam which is situated at the foot of the slimes dam (5). Here it flows in the channel indicated by the red arrow from the slimes dam to either the settling dam (4) or the holding dam (2). From the holding dam the water is gravity fed to the mine lake area (7). Water from the lake is then used as make-up water if there is not enough water from underground to be used in the process. Fresh water in the dam is supplemented from Kalkfontein channel on a regular basis. Water from the lake can only overflow if the level of the lake is not managed with intake water from Kalkfontein.



1	Plant and Mining area
2	Old Holding dam (Holding dam 1)
3	New Holding dam (Holding dam 2) Lined dam
4	Settling dam
5	Slimes dam
6	Paddocks
7	Lake
8	Inlet from Kalkfontein Channel
9	overflow

Figure 2-4: Aerial photo of Water System Koffiefontein at Diamond Mine (Data Source: Koffiefontein Diamond Mine, 2013).

Future Water supply system

Area 3 as seen on Figure 2-4 is the new holding dam that has been lined with a polymer that is South African Bureau of Standards (SABS) approved to stop water from draining out of the dam. Area 6 is the old paddocks system from the early 1980's that has not been used since. The paddocks have been cleaned and excavated to the level of the channel. Sluice gates will be installed in the Mine-to-Lake Channel to stop water from running into the lake and divert the water to flow into the paddocks system where the water can settle. Water will be pump out of the paddocks with six inch pumps via a pipe line to the new holding dam (3) in the plant area where it will be used in the process again.

2.2.2 Existing mining operations infrastructure at KDM

The Koffiefontein Diamond Mine Operation consists of the following existing infrastructure:

- Access control and fencing;
- Service roads;
- Two shafts (Main rock shaft & decline shaft);
- Compressor rooms;
- Ore treatment plant;
- Overland pipe reticulation;
- Lighting infrastructure;
- Conveyor systems;
- Mine offices and change houses;
- Workshops and wash bay;
- An explosives magazine;
- Bulk storage facility for fuel and diesel;
- Salvage yard;
- Waste Storage Facilities for the temporary storage of hazardous and solid waste;
- Coarse tailings disposal facilities, ranging in size and footprint area, and waste rock dump;
- Two opencast pits which include Koffiefontein Pit (not operational) and Ebenhaezer Pit (Operational),

- Water Management Structures;
  - Mine lake,
  - Two (2) plant reservoir dams,
  - Settling Dam No1,
  - Plant Return Water Dam,
  - New Plant Return Water Dam,
  - Silt trap / paddocks,
  - Storm water reticulation systems,
  - Three slimes dams - Slimes Dam no 1 (West dam), Slimes Dam no 2 (Middle dam), and Slimes dam no 3 (East dam, desommissioned), and
  - Koffiefontein Diamond Mine sewage pipelines,
- An airstrip located on the mine property;
- A number of mine owned houses;
- Game farm with accommodation; and
- Recreational areas.

2.2.3 Infrastructure associated with the disposal of slimes

Existing slime dams

As is explained in Section 2.2.1 the existing slimes dams (West dam, Middle dam, and East dam) form part of a closed reticulation system (Figure 2-3).

Return Water Dam and Sediment Trap

Typically a Return Water Dam (RWD) and Sediment Trap are located downstream of a slimes dam as this allows for a gravity decant system (Figure 2-3). In some instances, the location of the RWD downstream of the slimes dam is not possible due to various reasons, including space shortage, and thus the RWD can be allocated upstream. The existing Return Water Dam (Figure 2-5) is lined with a polyseal geoliner minimising seepage into the groundwater.

An additional RWD with equal capacity of the existing one is proposed with its own pump set. It is may be required to combine the pump sets of the two RWD's to function as a duty / standby system. The suction and discharge pipeline will be combined, both attached to the pumps by means of a manifold.

The basin and main embankment will have an underdrainage system to manage possible leaks but also to reduce the uplift pressure below the liner. The dam will be filled by pumping from the pool of the TSF with a floating barge pump system. The dam is further decanted with two outlet pipes through the main embankment.

Figure 2-5: Existing Return Water Dam

2.2.4 Existing mining process

Mine residue in the form of fine tailings (slimes) is generated during the plant processes; a simplified diagram of the process is presented in Figure 2-6. After process usage the slimes affected water is pumped to the Slimes Storage Facilities.

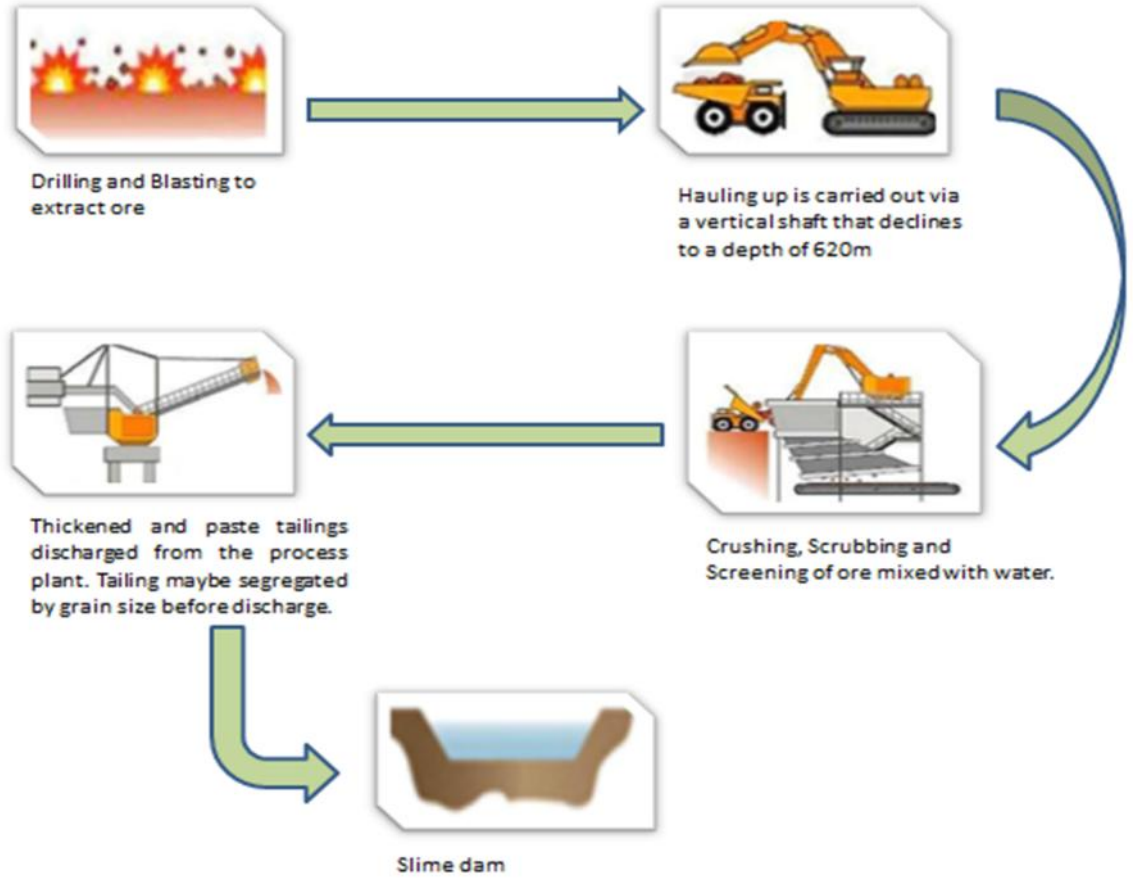


Figure 2-6: Schematic description of the process of diamond mining

Transporting ore to the processing plant

Access to underground operations is achieved through a roadway that descends down to the last level, or from the use of No. 2 Main rock shaft. In addition to the main shaft with a cage, the No. 2 Main Rock shaft is a decline shaft. The ore is extracted via the main shaft to the stockpile. Ore is uploaded onto the belts with trackless mobile machines. Ore from Ebenhaezer pit is transported with trucks to the stockpile. Material and equipment are transported on both public and private roads within the mine boundary.

Crushing/Scrubbing/Screening process

Physical, mechanical and chemical processes are used to extract the desired product from the mine ore and produce a waste stream known as fine tailings. This process of product extraction is never 100% efficient. Ore moves through the crushers to size the ore to a treatable size. After this the ore moves via conveyer belts to the scrubbers. This is a washing process. The ore moves from the scrubbers to the screening process.

Disposal of waste products

Slimes consist of ground rock and process effluents that are generated in a mine processing plant. The unrecoverable and uneconomic metals, minerals, organics and process water are discharged, normally as slurry, to a final storage area commonly known as a the Fine Residue Storage Facility (FRSF). Process waste water (fine tailings), is pumped to the slimes dam, from where the fine tailings (slimes) settle, and recovery water pumped back to Holding Dam No 2. Thereafter the recovered water is pumped to the Return Water Dams, prior to being reused in the plant process. Recirculation of process water only occurs after slimes settled out of suspension. An approximation of 80 % of process water is re-used. Water loss occurs through evaporation, and some seepage. Raw water is pumped from the Mine Lake for make-up water in the plant operation when required.

2.3 Description of proposed new infrastructure (FRSF)

The FRSF is a self-raise facility, raised under the operation of the mine. Slurry is deposited through spigots on the edge of the facility (see Figure 2-7).

The existing facility is 87 ha in footprint size, currently 23 m in height. Each paddock has a gravity penstock, draining supernatant to the solution trench around the perimeter of the facility and draining into the return water dam by the process plant.

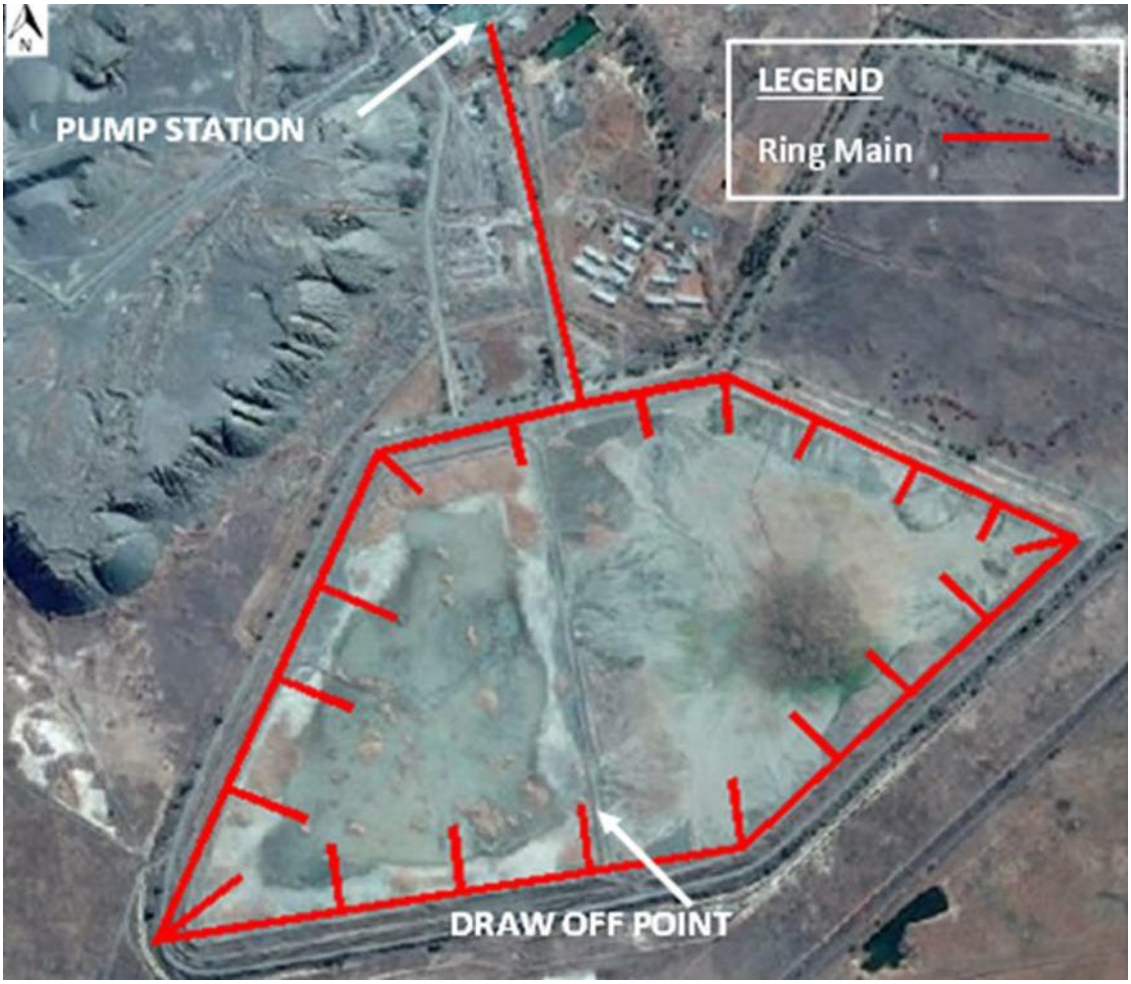


Figure 2-7: Schematic of the spigots

It is proposed that the existing facility will be extended in height to 40 m final height at elevation 1238.75 m, including 1 m of freeboard. This includes installing 2 elevated penstocks with elevated drains at the current elevation. This will improve strength gain within the material on the outer section of the embankment, reducing any potential pore pressure build up along the outer section of the FRSF and improving the existing components of the facility.

2.3.1 Pipes for the transportation of slimes to the slime dam

A piping system will be required to transport the slimes waste stream in the form of a slurry to the proposed disposal facility with cognisance of the 1:100 year flood line.

2.3.2 Infrastructure for transport of water

Services required for the transport and supply of water in the form of pipe lines, and associated infrastructure i.e. pumps, will be required to ensure re-use of water and pollution prevention. A network of pipelines will be installed primarily to transport water to and from

the return water dams, transport water for dust suppression and to transport water collected from the new slimes dam to the return water dam.

2.3.3 Access and maintenance roads to the slime dam

Access roads will be established, initially to allow for construction vehicles, but some of these roads may be retained post construction to allow for maintenance of the slime dam. An informal gravel access road may be constructed around the slimes dam facility. The width of the access road is however unlikely to exceed a width of six meters, and therefore falls below the 8 metres threshold defined in Activity 22 of Listing Notice 1 of 2010 (Government Notice No. R544). The proposed width of the access roads will exceed 8 meters. At the time of preparing this report no road reserves had been proclaimed. The impacts associated with the construction of the potential access roads have therefore not been assessed in this EIA Process.

2.3.4 Fencing and Access Control

It is envisaged that the access roads and the slime dam will be fenced off to limit access to the disposal facility, which is a key safety and security consideration.

2.4 Description of proposed Installation of a Mill

Forming part of this application is the proposed construction and operation of a new Autogenous Mill, so-called due to the self-grinding of the ore. The grinding of rock by the mill essentially entails placing larger rocks of ore in a cascading motion which in turn causes impact breakage of larger rocks and the compressive grinding of finer particles. The following principal steps form the process that is undertaken from collection of the material to disposal of the mill effluent at the existing slimes dam facility:

- Ore is received in the common collection bin ahead of the milling circuit. The ore is received from the stockpile of material mined at the Ebenheazer pit.
- Material is withdrawn from the collection bin at a controlled feed rate from the bunker and conveyed (existing conveyor) to a new conveyor feeding the milling circuit.
- An over band magnet removes any tramp iron ahead of the mill. The mill feed conveyor is fitted with a scale to meter for feed rate control and metallurgical accounting purposes;
- Mill dilution water is added (automated control system) to the feed of the mill.
- The mill discharge is screened on a double deck sizing screen. Spray water is added to the top and bottom decks of the screen to assist with the screening duty. No chemicals are added to the mill dilution water that is used throughout the process.

- The top deck oversize (+25mm) is conveyed and stockpiled while the bottom deck oversize fraction is conveyed to the existing Dense Media Separation (DMS) surge and feed circuit.
- Finally, the mill effluent (-1.5mm) is pumped to the existing slimes dam facility.

2.4.1 Process Considerations

The following process design considerations will be taken into account during the finalisation of the Koffiefontein mill concept:

a) Mill Design Parameters

Various mill design parameters are used to classify the milling characteristics of an ore body. It is worth noting that the mill parameter database for Kimberlites is not very extensive in comparison with other minerals such as platinum, gold and base metals. Given this, the mill design parameters for each ore type and ore body will be determined prior to conducting a detailed design.

b) Mill Configuration Alternatives

It is anticipated that one of the following configurations will be selected for the proposed mill:

- Open circuit autogenous Mill: The material goes through the mill once, no screening or treatment of the oversize; or
- Partially closed autogenous Mill: This includes the introduction of a pebble crusher (typically a cone). The oversize is crushed and the crushed material is recirculated back to the mill feed. The pebble crusher assists with liberation as well as increases the mill throughput. This particular configuration allows more flexibility in the configuration of the mill ports.

The amount of pebble porting as well as pebble port aperture needs to be verified as it has a significant influence on the throughput of the mill as well as the mass splits on the mill discharge. If the test work suggests that the material at Koffiefontein is competent and that the desired throughput may not be achieved, the option of installing a pebble crusher will be investigated.

2.5 Major activities to be undertaken during project execution

The major phases for the proposed project (including the EIA), prior to and after construction, are explained in, Table 2-1 below.

Table 2-1: Major phases of the project

NO	PHASE	ACTIVITY DETAILS
PRECONSTRUCTION PHASE		
1	Application and Scoping	The Scoping Phase, as its name implies, determines the scope of the project appropriately (i.e. alternatives, consultation requirements, extent of specialist studies, impact assessment methodology and approach, issues / concerns to be addressed, and reporting for decision-making). This is undertaken through an inclusive stakeholder engagement process, which allows for all sectors of society to be involved, including the proponent, the various spheres of government, the regulator, the immediately affected parties, interest groups or individuals, the consulting team, and the public at large. This phase of the project is structured and minimum requirements are regulated through legislation.
2	Environmental Impact Assessment	An EIA is being undertaken to ensure that all environmental, social and cultural impacts are identified. During this phase the specialist studies as identified during the Scoping Phase are undertaken, and issues / concerns identified are addressed. This phase of the project is also undertaken in consultation with all stakeholder groups as identified during the Scoping Phase. This phase of the project is a necessary precursor to obtaining EA from the CA, without which the project cannot proceed any further.
3	Approval from authorities.	
4	Appeal	Once authorities have issued their decision an opportunity to lodge an appeal against the decision will commence. During this phase both the proponent and other stakeholders have the opportunity to appeal the decisions, or conditions thereof within a prescribed timeframe.
5	Property acquisition (if required)	Purchase of property if the chosen site is not on existing Koffiefontein Diamond Mine property.
6	Structure foundation investigation	Investigations will be undertaken to ensure that the foundation specifications are in line with the underlying geology.
CONSTRUCTION PHASE		
7	Site establishment	The first stage of the construction phase is the establishment of contractors on site. This must be undertaken in line with the conditions of EA.
8	Structures	**Fencing** - Provide a safe and secured waste disposal area to restrict access and prevent injuries to wild animals.
		Formation and lining - Provide a ground formation/lining compacted to the required standard on which to build the slime dam.
		Drainage - Provide water drainage channels within the site.
9	Rehabilitate the construction area	The area where construction activities have taken place must be rehabilitated to minimise environmental degradation by following the Environmental Management Programme that is compiled in conjunction to the EIA.
OPERATIONAL PHASE		
10	Operations of the slime dam	Current operations to be continued onto the authorised disposal facility.

11	Rehabilitation and closure of existing slime dam.	The current and new slimes development shall be rehabilitated as required by legislation at the time of closure and rehabilitation.
DECOMMISSIONING AND CLOSURE PHASE		
12	Decommissioning of the slime dam and its infrastructure	Once the slime dam is no longer in use and is no longer required a decommissioning process may commence. Secondary processes such as transforming slime into building bricks may be commissioned where feasible.

3 NEED AND DESIRABILITY OF PROJECT

In keeping with the requirements of Regulation 28(1) of the NEMA EIA Regulations 2010 this document section is intended to provide an overview of the Need and Desirability of the proposed project. As explained in the Guideline on Need and Desirability (DEA[4], 2010) the application of Environmental Management Instruments including Environmental Management Frameworks, Spatial Development Tools (such as Spatial Development Frameworks) as well as Integrated Development Frameworks should be considered when determining the need and desirability of proposed project. Furthermore, in considering the need and desirability of the proposed project the strategic concept of the project along with the broader societal needs and public interest has been taken into account.

A number of questions formulated to guide the identification of the need and desirability of a proposed development are provided in the Guideline on Need and Desirability (DEA, 2010). The information provided in and Table 3-2 provides answers specific to the project at hand for each of the guiding questions contained in Section 5 of the Guideline on Need and Desirability (DEA, 2010).

Table 3-1: Assessment of the Need of the proposed Koffiefontein Mine slimes dam development

No.	Question	Description	Answer
1.	Is the land use (associated with the activity being applied for) considered within the timeframe intended by the existing approved Spatial Development Framework (SDF) agreed to by the relevant authority?	Koffiefontein forms part of the diamond region, which is one of the priority development regions in the Free State Province and has been identified in the Free State Province Spatial Development Framework completed in 2014. The current land use is diamond mining, therefore the slimes dam development is in line with existing development framework and current land use.	Yes
2.	Should the	Provincial strategic growth and development have been	Yes

[4] Department of Environmental Affairs (2010), Companion to the EIA Regulations 2010, Integrated Environmental Management Guideline Series 9, Department of Environmental Affairs, Pretoria

No.	Question	Description	Answer
	development, or if applicable, expansion of the town / area concerned in terms of this land use (associated with the activity being applied for) occur here at this point in time.	identified in the Free State Province Spatial Development Framework (2014) as an important goal to achieve. This goal is supported by a number of pillars, one of which deals with inclusive economic growth and sustainable job creation. The second driver for this pillar aims to minimise the impact of the declining mining sector and ensure that existing mining potential is harnessed. In order to achieve this the FSPSDF (2014) recommended that the mining sector be supported and allowed to extend the life of existing mines in the Free State and market new mining opportunities. The proposed activities being applied for on behalf of the Koffiefontein mine is one of these life of mine extension initiatives.	
3.	Does the community / area need the activity and the associated land use concerned (is it a societal priority)?	The mining sector in South Africa contributes 5% to its Gross Domestic Product (GDP) and the Free State's contributes 12.6% to its provincial GDP (Census, 2011) respectively. Mining also represents a major employer in the province. Diamond mining operations constitute one of the main social and economic functions of the Town of Koffiefontein, and also the Letsemeng Local Municipality and Xhariep District Municipality. The mine employs approximately 550 people, the majority of whom are resident in Koffiefontein or the nearby Ditlhake. The majority of the labour force is made up from the local community and neighbouring towns (KEJV IWWMP, 2011). The extension of the life of mine of the Koffiefontein Mine through the establishment of an additional slimes dam to receive the slimes waste stream during the extended operations will therefore ensure the sustained livelihood of the employees from the local communities, as well as local businesses that benefit from the spin-off from the diamond mine in the area. The Industrial Development Corporation (IDC), Petra Diamonds and Letsemeng Local Municipality have signed a Memorandum of Agreement on the establishment of an LED Forum. The Committee is responsible for the formulation of feasibility studies and business plans of two possible high impact local economic development projects, which are a brick making factory and crusher plant. These projects are aimed at boosting the local economy and sustaining the economy after mine closure in about 15 to 20 years. The municipality has also joined the discussions on the Social and Labour Plan of Petra Diamonds for 2012 – 2017 which also focuses on local economic development projects within the municipal jurisdiction (Letsemeng LM IDP, 2013).	Yes
4.	Are the necessary services with adequate capacity currently available or must additional capacity be created to cater for the development?	The proposed development activity constitutes a continuation of the existing mining operations therefore no new services is required by the Koffiefontein mine. A Water Use Licence Application is currently being undertaken to address additional water capacity that may be required.	Yes

No.	Question	Description	Answer
5.	Is this development provided for in the infrastructure planning of the municipality, and if not what will the implication be on the infrastructure planning of the municipality (priority and placement of services and opportunity costs)?	Koffiefontein forms part of the diamond region, which is one of the priority development regions in the Free State province and has been identified in the Free State Province Spatial Development Framework completed in 2014. Provincial strategic growth and development have been identified in the Free State Province Spatial Development Framework (2014) as an important goal to achieve. This goal is supported by a number of pillars, one of which deals with inclusive economic growth and sustainable job creation. The second driver for this pillar aims to minimise the impact of the declining mining sector and ensure that existing mining potential is harnessed. In order to achieve this the FSPSDF (2014) recommended that the mining sector be supported and allowed to extend the life of existing mines in the Free State and market new mining opportunities. The proposed activities being applied for on behalf of the Koffiefontein mine is one of these life of mine extension initiatives.	Yes
6.	Is this project part of a national programme to address an issue of national concern or importance?	Although the project is not directly mentioned as part of a national programme to address issues of national concern or importance, operation of the Koffiefontein mine contributes to a major part of the local economy through jobs and economic input into the local economy and infrastructure development, thus contributing to the eradication of poverty and provision of basic services.	No

Table 3-2: Assessment of the Desirability of the proposed Koffiefontein Mine slimes dam development

No.	Question	Description	Answer
1.	Is this development the best practicable environmental option for this land / site?	The expansion of the slimes dam will occur within the mine property which is already zoned for mining purposes. Given the proposed extension of the life of mine of the Koffiefontein mine, the proposed location of the slimes dam has taken into account the proximity of the town of Koffiefontein and communities on the urban edge. The proposed location of the slimes dam has also maximised the distance between the slimes dam and the local community through its placement on the west side of the Koffiefontein mine next to the existing slimes dams.	Yes

No.	Question	Description	Answer
2.	Would the approval of this application compromise the integrity of this existing approved and credible municipal IDP and SDF as agreed by the relevant authorities?	Koffiefontein forms part of the diamond region, which is one of the priority development regions in the Free State province and has been identified in the Free State Province Spatial Development Framework completed in 2014. The Free State Province Spatial Development Framework (2014) has also identified provincial strategic growth and development as an important goal to achieve. This goal is supported by a number of pillars, one of which deals with inclusive economic growth and sustainable job creation. The second driver for this pillar aims to minimise the impact of the declining mining sector and ensure that existing mining potential is harnessed. In order to achieve this the FSPSDF (2014) recommended that the mining sector be supported and allowed to extend the life of existing mines in the Free State and market new mining opportunities. The proposed activities being applied for on behalf of the Koffiefontein mine is one of these life of mine extension initiatives. This development is therefore 100% in line with the existing municipal IDP and SDF.	No
3.	Would the approval of this application compromise the integrity of the existing environmental management priorities for the area (e.g. as defined in EMFs), and if so, can it be justified in terms of sustainability considerations?	The Koffiefontein Diamond Mine falls within the earmarked mining area as identified within the FSPSDF (2014). This SDF identified protected areas, critical biodiversity areas and ecological support areas. The Koffiefontein mine does not fall within any of these environmental management priority areas.	No
4.	Do location factors favour the land use associated with the activity applied for at this place?	Koffiefontein forms part of the diamond region, which is one of the priority development regions in the Free State province and has been identified in the Free State Province Spatial Development Framework completed in 2014. The expansion of the slimes dam will occur within the mine property which is already zoned for mining purposes. The slimes dam is proposed for location on top of an existing slimes dam, thereby reducing environmental impact on a new footprint.	Yes
5.	How will the activity, and associated activities, applied for impact on sensitive natural or cultural areas (built and rural / natural environ-ment)?	The construction of the slimes dam may result in the loss of artificial wetland and associated ecosystem services. Refer to Chapter 9.3 – Surface Water Impacts.	
6.	How will the development impact on people's health and wellbeing?	The proposed project activities that will take place during Construction may result in nuisance impacts such as increased noise levels as well as dust.	

No.	Question	Description	Answer
7.	Will the proposed activity or the land use associated with the activity applied for, result in unacceptable opportunity costs?	Opportunity costs can be defined as the net benefit that would have been yielded by the next best alternative. For example, if farming is the next best alternative for a piece of land, then the foregone benefit of losing the farming option will be the opportunity cost of any other land use, or if not proceeding with the activity, then the foregone benefits of the proposed activity is the opportunity cost of not proceeding. A key part of considering opportunity costs is commonly to comparatively consider and assess the different alternatives in terms of the benefits and/or disadvantages associated with each alternative. The existing land use of the site on which the development of the slimes dam is proposed is already maximised to ensure high local and regional benefits. The next best alternative for the proposed land is likely to be agriculture. When compared to the proposed extension of life of mine the opportunity cost would be low. The site proposed for the slimes dam is already impacted upon by similar activities.	No
8.	Will the proposed land use result in unacceptable cumulative impacts?	A cumulative impact is defined in the National Environmental Management Act, 1998 (Act No. 107 of 1998) Environmental Impact Assessment Regulations (2010) as meaning “the impact of an activity that in itself may not be significant, but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area”. The proposed project will not result in unacceptable cumulative impacts. The most significant cumulative impacts will emanate from the anticipated Construction Phase Impacts on Surface Water Resources. The impacts on the wetlands during the construction phase may contribute cumulative to the existing wetland impacts associated with the surrounding land users. All reasonable measures will however be implemented to ensure that the anticipated wetland impacts are confined to the development footprint.	No

4 ENVIRONMENTAL LEGISLATION

This part of the Environmental Impact Report (EIR) is intended to provide a detailed account of all environmental legislation which may have bearing on the proposed project. Particular attention will be paid to the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). The NEMA (1998) is regarded as South Africa's Environmental Management Framework Act. An overview of sector specific environmental Acts which govern specific elements or project activities and the relevance on the proposed project will also be provided. In order to ensure that Environmental Management Best Practice Principles are adhered to, all guidelines which are relevant to the proposed project activities have also been taken into consideration during the preparation of this EIR. Determining the applicability of all environmental management legislation is fundamental in ensuring that all required Environmental Authorisations are applied for and facilitating compliance with the applicable provisions of these Acts.

4.1 The constitution of South Africa

The Constitution of the Republic of South Africa, 1996 (hereafter referred to as "the Constitution") is the supreme Law in South Africa. The Bill of Rights is included in Chapter 2 of the Constitution. The Environmental Right is set out Section 24 of the Constitution and states that –

Everyone has the right –

a) to an environment that is not harmful to their health or well-being; and
b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that –
   i. prevent pollution and ecological degradation;
   ii. promote conservation; and
   iii. secure ecologically sustainable development and use of natural resources,
   iv. while promoting justifiable economic and social development.

The National Environmental Management Act, 1998 (Act No. 107 of 1998) is the primary statute which gives effect to Section 24 of the Constitution. The Environmental Right contained in Section 24 of the Constitution also places responsibility on the Environmental Assessment Practitioner (EAP), Applicant and Competent Authority to ensure that this right is not infringed upon. The Sector Guidelines for Environmental Impact Assessment (2010) (Government Notice 654) describe a number of responsibilities which are placed on the EAP, Applicant and Competent Authority to ensure conformance with the statutory Environmental Right.

These responsibilities include:

- All parties to the EIA Process have a duty not to infringe other persons' rights in terms of Section 24 of the Constitution.

- The Applicant must ensure that while the development incorporates measures that prevent or control environmental pollution or degradation, it also maximises the positive environmental impacts.
- There must be an equitable balance between the rights of the applicant and the broader public. In this regard, the consideration of need and desirability is critical as it requires the strategic context of the development to be considered with the broader societal needs and public interest.
- The provisions of the Bill of Rights are binding on decision-makers.
- Decision-makers must ensure that their decisions are in keeping with the environmental right and promote an environment that is not harmful to health or well-being.

4.2 National Environmental Management Act, 1998 (Act No. 107 of 1998)

Environmental Management can be defined as the management of human interaction with the environment. Fuggle and Rabie (2009) defines Environmental Management as the regulation of the effects of peoples' activities, products and services on the environment. Although South Africa has a comprehensive array of environmental legislation and policies in place, these must be aligned with the provisions of the NEMA (1998), in particular the National Environmental Management Principles stipulated in Chapter 1 of the NEMA (1998). The Environmental Management Principles are centred on providing explicit guidance for co-operative and environmental governance on all matters relating to decision-making which will affect the environment, institutions that will promote co-operative governance and procedures for co-ordinating environmental functions exercised by organs of state and to provide for matters connected therewith.

Although the proposed project is primarily concerned with the development of a new slimes dam at Koffiefontein Mine, the project will require additional supporting infrastructure. The supporting infrastructure and project activities, in addition to the new slimes dam, fall within the ambit of the NEMA (1998). These project activities trigger activities listed in the Environmental Impact Assessment Regulations Listing Notice 1 (Government Notice R544) and Environmental Impact Assessment Regulations Listing Notice 2 (Government Notice R545) as amended, therefore requiring Environmental Authorisation before they may be implemented. The proposed activities prompt a full Scoping and Environmental Impact Reporting Process.

The NEMA (1998) is regarded as South Africa's framework legislation which is centred on facilitating the protection of the environment through the use of various tools to ensure integrated environmental management of activities. The listed activities which are associated with the proposed Koffiefontein slimes dam included activities that are defined in the NEMA (1998) EIA Listing Notice 1 (R.544) and Listing Notice 2 (R.545). As the proposed project triggers activities from Listing Notice 1 and 2 a full S&EIR process as defined in the EIA Regulations R.543 (2010) must be carried out. The table below provides a summary of the listed activities triggered by the proposed slimes dam project at Koffiefontein Mine.

Table 4-1: Applicable Listed Activities

No.	Project Activity	Listing Notice	Activity No.	Definition	Description of Listed Activity	Authorisation Requirement
1.	Construction of the slimes waste disposal facility and associated infrastructure	EIA Regulations Listing Notice 2 of 2010	15	Physical alteration of undeveloped, vacant or derelict land for residential, retail, commercial, industrial or institutional use where the total area to be transformed is 20 hectares or more.	The footprint of the feasible site alternatives which will be assessed in the EIA Phase include the following: • Alternative 1 – *Site 5 has a footprint of 70.22ha*; • Alternative 2 – *Modified Site 4 and Site 5 has a footprint of 118.16ha*; and • Alternative 3 – *Joining Site 4 and Site 5 to construct one large facility. The facility of the consolidated facility will be 118.16ha.*	As the footprint of the alternative sites exceed the 20ha threshold stipulated in Activity 15 of Listing Notice 2 and therefore require Environmental Authorisation.
2.	Construction of a storm water infrastructure and pipelines for the transportation of the slimes.	EIA Regulations Listing Notice 1 of 2010	9	The construction of facilities or infrastructure exceeding 1000 metres in length for the bulk transportation of water, sewage or storm water – i) With an internal diameter of 0.36 metres or more; or ii) With a peak throughput of 120 litres per second or more.	In the event where the slimes dam is constructed at Site 4 pipelines will be required to convey the slimes to the facility. The peak throughput of the pipeline will be 123 l/s with an internal diameter of 300 mm. It is anticipated that the distance from the pump station to the slimes dam will exceed 1000 metres.	The internal diameter, peak throughput and length of the pipeline trigger the thresholds provided for Activity 9 of Listing Notice 1 of 2010. The proposed pipeline therefore require Environmental Authorisation.

4.3 National Environmental Management: Waste Act, 2008 (Act 59 of 2008)

In order to regulate waste management activities and to ensure that they do not adversely impact on human health and the environment, the NEM:WA (2008) introduced the licensing of waste management activities. All waste management activities which are listed in Government Notice 921 (2013) in terms of the NEM:WA (2008) require licensing from the Competent Authority before these activities may proceed. Prior to the implementation of any waste management activity listed in Category A, of Government Notice 921 (2013), a Basic Assessment Process as set out in the Environmental Impact Assessment Regulation made under Section 24(5) of the NEMA (1998) must be carried out as part of the Waste Management License Application Process. However, prior to the implementation of any Waste Management Activities listed in Category B of Government Notice 921 (2013), a Scoping and Environmental Impact Reporting Process must be carried out as part of the Waste Management License Application Process.

In 2014 the National Environmental Management: Waste Amendment Act (Act 26 of 2014) was promulgated to include residue deposits and residue stockpiles as hazardous wastes from:

a) Mineral excavation;
b) Physical and chemical processing of metalliferous minerals;
c) Physical and chemical processing of non-metalliferous minerals;
d) Drilling operations.

Residue deposits means “any residue stockpiled remaining at the termination, cancellation or expiry of a prospecting right, mining right, mining permit, exploration right or production right” (NEMWAA, Act 26 of 2014). Residue stockpile is defined as “any debris, discard, tailings, slimes, screening, slurry, waste rock, foundry sand, mineral processing plant waste, ash or any other product derived from or incidental to a mining operation and which is stockpiled, stored or accumulated within the mining area for potential re-use, or which is disposed of, by the holder of a mining right, mining permit, or production right or old order right, including historic mines and dumps created before the implementation of this Act” (NEMWAA, Act 26 of 2014)

Owing to the nature and composition of the fine tailings from the diamond mining process, it is considered to be hazardous waste and as such also falls within the ambit of the NEMWAA and must conform to the provisions of the Act.

4.3.1 NEMWA: Regulations regarding the Planning and Management of Residue Stockpiles and Residue Deposits, 2015

Purpose of Regulations

In the course of the Scoping and Environmental Impact Reporting Process for the project at the hand, regulations concerning the management and planning of residue stockpiles and deposits came into effect under the National Environmental Management Waste Act 59 of 2008 (as amended). The aforementioned Regulations regarding the Planning and Management of Residue Stockpiles and Residue Deposits, 2015 (Notice 632) was published in the Government gazette 36020.

The Regulations regarding the Planning and Management of Residue Stockpiles and Residue Deposits, 2015 came into effect on 24 July 2015. Explicit provisions relating to the planning, management and reporting f residue stockpiles and residue deposits are included in Chapter 2 of Government Notice No. R 632 (2015). These include the following:

- The assessment of impacts and analyses of risks relating to the management of residue stockpiles and residue deposits;
- Characterisation of residue stockpiles and residue deposits;
- Classification of residue stockpiles and residue deposits;
- Investigation and the selection of site for residue stockpiling;
- Design of the residue stockpiles and residue deposits;
- Impact Management;
- Duties of the holder of right or permit;
- Monitoring and reporting system for residue stockpiles and residue deposits;
- Dust management and control; and
- Decommissioning, closure and post closure management of residue stockpiles and residue deposit.

Application of Regulations

The regulations provide the tools for and corresponds to the statutory provision relating to managing residue stockpiles and residue deposits in a prescribed manner as prescribed in Section 43A of the NEMWA (as amended by the National Environmental Management Laws Amendment Act 25 of 2014).

Implications of the Regulations on the planned activities

The transitional arrangments provided in the Regulations regarding the Planning and Management of Residue Stockpiles and Residue Deposits, 2015 fundamentally makes provision for activities which are carried out in in terms of Regulation 73 of the Mineral and Petroleum Resources Development Regulations, 2004 that can be done in terms of these regulations must be deemed to have been done in terms of these regulations (i.e

Regulations regarding the Planning and Management of Residue Stockpiles and Residue Deposits, 2015). Furthermore, management measures of residue stockpiles and residue deposits approved in terms of the Mineral and Petroleum Resources Development Regulations, 2004 must be regarded as having been approved in terms of the regulations regarding the Planning and Management of Residue Stockpiles and Residue Deposits, 2015.

In relation to the proposed project activities, the transitional arrangements provided in the Regulations regarding the Planning and Management of Residue Stockpiles and Residue Deposits, 2015 will have the following bearing on the proposed project activities:

- If the proposed project activities were, at the time of the coming into effect of these Regulations, included in an approved and updated Environmental Management Programme prepared in accordance with the MPRDA Mineral and Petroleum Resources Development Regulations 2004, the management of the Fine Residue Storage Facility will be deemed as having been approved in terms of these Regulations; and
- Anything which is done in terms of Regulation 73 of the MPRDA Mineral and Petroleum Resources Development Regukatiuns

4.4 National Environmental Management: Waste Amendment Act (Act no 26 of 2014)

The proposed new Koffiefontein Mine slimes dam triggers activities from both Category A and Category B listed in the NEM:WA (2009, as amended by GN R.633 of 24 July 2015): *List of Waste Management Activities that have, or are likely to have, a detrimental effect on the environment*. In accordance with the provisions stipulated in the Schedule no Waste Management Activity may be undertaken prior to the carrying out of the specified Environmental Authorisation Process as part of the Waste Management License Application Process. As the proposed project triggers activities from both Category A and B of Government Notice No.921 under the NEM:WAA (2014) an S&EIR Process as stipulated in the EIA Regulations (2010) made under Section 24(5) of the NEMA (1998) must be carried out. The S&EIR Process will serve to identify and assess the anticipated environmental consequences associated with the proposed project activities and to provide the CA with sufficient information to reach a decision with regards to granting or refusal of a Waste Management License.

The table below lists the activities of the NEMWAA (2014) that are triggered by the Koffiefontein slimes dam. The current EIA process does not include an application for a Waste Management License (WML) as there has been some controversy regarding the legislation and a decision was taken to proceed with the NEMA process without WML. In the interest of full disclosure, and in the case where the proponent proceeds with the WML Application Process, the Waste Management Activities as indicated in **Table 4-2** will apply.

Table 4-2: Waste Management Activities

No.	Category	Waste Management Activity		Project Activity	Description
1.	Category B	7	The disposal of any quantity of hazardous waste to land.	Disposal of tailings in the slimes dam	The diamond mine tailings are transported in slurry to the slimes dam facility. Waste classification will be undertaken to determine the hazard class of the tailings, which will inform the liner system that is to be used.
2.	Category B	10	The construction of a facility for a waste management activity listed in Category B of this Schedule (not in isolation to associated waste management activity).	Construction of the slimes dam	The tailings will be disposed of in slimes dam, which will specifically be constructed to receive the waste stream resulting from the processing of ore to extract diamonds.

4.5 Additional Legislative requirements

4.5.1 National Water Act (Act 36 of 1998)

The activities associated with the proposed Koffiefontein Mine new slimes dam project trigger a number Water Uses that are defined in Section 21 of the National Water Act, 1998 (Act No. 36 of 1998) (NWA). Accordingly, these Water Uses may not be undertaken without being granted a Water Use License from the DWS. In accordance with Sections 40 and 41 of the NWA (1998), a Water Use License Application Process will be carried out. The resultant documents from the WULA process will include completed WULA Forms as well as a Technical Report. These documents will be submitted to DWS for review and decision making. Although a joint PPP is followed for the WULA within the EIA Phase, these two EA processes constitute separate applications and submissions are made to the respective Competent Authorities. Koffiefontein Diamond Mine is in the process of applying for an appropriate Water Use License for water use activities associated with the development of a new slimes dam.

4.5.2 Other legislation

Table 4-3 below provides a summary of some of the other legislation that has been taken cognisance of within this EIA process for the development of the new Koffiefontein Mine slimes dam.

Table 4-3: List of additional applicable Environmental Legislation

Act	Applicable Section	Relevance on project
National Heritage Resources Act, 1999 (Act No. 25 of 1999)	Section 34: Structures	Structures which are older than 60 years may not be demolished without a permit issued by the relevant provincial Heritage Resources Authority. No structures older than 60 years were recorded in the Heritage Impact Study.
National Heritage Resources Act, 1999 (Act No. 25 of 1999)	Section 35: Archaeology, palaeontology and meteorites	The findings of the Heritage Impact Study indicated that the possibility of finding fossils of a specific assemblage zone either in outcrops or in bedrock on the site could not be ruled out. It is likely that the fossils may be present on the site and the probability of finding fossils during the excavation phase are high. Any archaeological or paleontological objects that are found on the site, must be reported to the provincial Heritage Resources Authority. The discovered archaeological or paleontological objects may not be removed from its original position and damaged, destroyed or altered prior to a permit being issued by the heritage resources authority.
National Heritage Resources Act, 1999 (Act No. 25 of 1999)	Section 36: Burial grounds and graves	Any graves that are discovered may not be destroyed, damaged, altered, exhumed or removed from its original position without a permit issued by SAHRA or a provincial heritage resources authority.
National Heritage Resources Act, 1999 (Act No. 25 of 1999)	Section 38(1)(c): Heritage Resource Management	As the proposed development area may exceed 5000 m^2, with the submission of the Heritage Impact Assessment to SAHRA, the responsible heritage resources authority has been notified of the project and provided with information relating to the project. Authorisation to proceed with the development is required from SAHRA.
Hazardous Substance Act, 1973 (Act No. 15 of 1973)	-	Provides for the definition, classification, use, operation, modification, disposal or dumping of hazardous substances.
National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)	• Section 53(1) • Section 53(2) • National list or ecosystems that are threatened and in need of protection (Government Notice 1002, published in Government Gazette 34809, 09 December 2011)	The development footprint falls within the Rand Highveld vegetation type which forms part of the greater Grassland Biome and is listed as Vulnerable Ecosystem. In accordance with Section 53(1) and 53(2) of the NEMBA (2004), any development that Involves loss of natural habitat in a listed ecosystem require Environmental Authorisation before such developments may proceed.

Act	Applicable Section	Relevance on project
National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004)	National Ambient Air Quality Standards, Government Notice 1210, Government Gazette 32816, 24 December 2009	The Air Quality standards published in Government Notice 1210 must be adhered to.
Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)	Section 6	Provisions included in the act regarding the implementation of control measures for alien and invasive plant species must be adhered to.
Occupational Health and Safety Act, 1993 (Act No. 85 of 1993)	Section 8	General duties of employers to their employees.
	Section 9	General duties of employers and self-employed persons to person other than their employees.
Local Municipality Integrated Development Plan Final Draft 2014/2015	Chapter 3	Reducing the impact of the declining mining sector and ensuring that existing mining potential is harnessed, is one of the drivers of the Free State Growth and Development Strategy.
Local Municipality By-laws	None	At the time of preparing this report and to the knowledge of the EAP no by-laws had been passed and enacted by the Letsemeng Local Municipal Council.

In order to ensure that a best practice approach was adopted for the EIA Process and to ensure that the EIR provides sufficient information require by the Competent Authority (CA) to reach a decision, the following guidelines have been considered in the compilation of this Environmental Impact Report:

- National Environmental Management Act, 1998 (Act 107 of 1998) Implementation Guidelines Sector Guidelines for Environmental Impact Assessment Regulations Government Notice 654 of 2010, published in Government Gazette 3333, dated 29 June 2010.
- National Environmental Management Act, 1998 (Act 107 of 1998) Publication of Need and Desirability Guideline in terms of the Environmental Impact Assessment Regulations, 2010, Government Notice 792 of 2012, Government Gazette 35746, dated 05 October 2012.
- Department of Water Affairs & Forestry, 1998. Waste Management Series. Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste.
- DEAT (2004) Cumulative Effects Assessment, Integrated Environmental Management, Information Series 7, Department of Environmental Affairs and Tourism (DEAT), Pretoria
- Department of Environmental Affairs, 2011. A user friendly guide to the National Environmental Management: Waste Act, 2008. South Africa. Pretoria.
- DEAT (2004) Criteria for determining Alternatives in EIA, Integrated Environmental Management, Information Series 11, Department of Environmental Affairs and Tourism (DEAT), Pretoria

5 ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

5.1 Scoping Phase

The S&EIR Process was initiated with the submission of the Application for Environmental Authorisation to the DESTEA. The DESTEA acknowledged receipt of the Application and issued a project reference number on 15 April 2014 (refer to **Appendix C4**). The acknowledgement of receipt of the Application for the proposed Koffiefontein Mine slimes dam Project marked the start of the Scoping Phase.

5.1.1 Scoping Process

In accordance with Regulations 26 – 29 of the EIA Regulations (2010) under the NEMA (1998) the following steps were undertaken during the Scoping Phase:

- A Public Notification Period was undertaken, aimed at announcing the proposed project to Interested and Affected Parties (I&APs) and providing I&APs with information relating to the proposed KDM Slimes Dam Development. A detailed account of the PPP is provided in **Chapter 5.3.5** of this document.
- Information relating to the potential environmental impacts which may result from the proposed project activities and the identification of reasonable and feasible alternatives of the proposed activity was collected. The Scoping Process also served to identify significant issues to be taken forward to the EIA Phase and eliminate the issues of very low significance. In accordance with Regulation 28 of the EIA Regulations (2010) under the NEMA (1998) this information was collated into a Final Scoping Report which also included Plan of Study for the subsequent EIA Phase.
- The Draft Scoping Report (DSR) was placed for a 40-day public review period, during which time I&APs and Commenting Authorities were provided with the opportunity to review the contents of the Scoping Report and supporting documentation. All comments that were received from I&APs, Commenting Authorities and stakeholders during the public review period were taken into account and collated into a Comments and Response Report (CRR). The CRR provided details of the comments that were received as well as the responses provided by the EAP.
- The final Scoping Report (FSR) was simultaneously submitted to the DESTEA and placed for a 30-day public review period. The DESTEA acknowledged receipt and submitted acceptance of the final Scoping Report and approval of the Plan of Study for EIA on 04 June 2015 (refer to **Appendix D**).

Following the approval of the Scoping Report by the DESTEA, the EIA Process as mapped out in the approved Plan of Study commenced.

5.2 EIA Phase

5.2.1 Environmental Impact Reporting Process

Following the approval of the Final Scoping Report and Plan of Study for EIA, the EIA phase commenced. Each of the steps as included in the Plan of Study for EIA have been, or will be undertaken during the EIA Phase. The primary objective of the EIA Phase is to investigate, assess and communicate the possible environmental impacts identified during the Scoping Phase, which are likely to transpire as a result of the project activities. Additional objectives of the EIA Phase include:

- Ensuring that all environmental considerations relating to the life-cycle are taken into account;
- Development of mitigation measures which are practical and effective in preventing the environmental impacts from transpiring or reducing the significance thereof;
- Facilitate informed decision-making by the Competent Authority.

To date, the EIA Phase has comprised the following overarching tasks:

- Completion of various specialist assessments;
- Undertaking the Impact Rating of potential impacts;
- Identifying implementable and effective mitigation measures to address potentially significant impacts;
- Undertaking of Public Participation activities within the EIA Phase;
- Preparing an EIR and EMPr in accordance with the Regulation 31 and 33 of the EIA Regulations (2010) under the NEMA (1998); and
- Placing the draft EIR for a 30-day public review period.

Once the comment period has ended and comments have been received from the public, key stakeholders and commenting authorities:

- The EIR and EMPr will be finalised;
- The CRR will be updated to include all comments received and provide responses to all comments; and
- The Final EIR and EMPr will be submitted to the Competent Authority for decision making.

5.2.2 Contents of the Environmental Impact Report

This Environmental Impact Report for the proposed new Koffiefontein Slimes Dam Project aims to conform to the requirements stipulated in Government Notice No. R543

(18 June 2010), Regulation 31(2) and have been structured as such. **Table 5-1** presents the document's structure, in terms of the aforementioned regulatory requirements. Based on the contents of this table it is evident that the EIR conforms to the regulatory requirements and provides sufficient information to facilitate the Competent Authority to reach an informed decision with regards to granting or refusal of Environmental Authorisation.

Table 5-1: EIR Document Roadmap

Document Roadmap		
Regulation 31(2) of the EIA Regulations (2010)	**Description**	**Section**
Regulation 31(2)(a)	A) Details of - I) the EAP who compiled the report; and II) the expertise of the EAP to carry out an environmental impact assessment;	1.4
Regulation 31(2)(b)	A detailed description of the proposed activity.	2
Regulation 31(2)(c)	A description of the property on which the activity is to be undertaken and the location of the activity on the property, or if it is— I) a linear activity, a description of the route of the activity; or II) an ocean-based activity, the coordinates where the activity is to be undertaken;	2.1
Regulation 31(2)(d)	A description of the environment that may be affected by the activity and the manner in which the physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed activity.	6
Regulation 31(2)(e)	Details of the public participation process conducted in terms of sub-regulation (1), including— I) steps undertaken in accordance with the plan of study; II) a list of persons, organisations and organs of state that were registered as interested and affected parties; III) a summary of comments received from, and a summary of issues raised by registered interested and affected parties, the date of receipt of these comments and the response of the EAP to those comments; and IV) copies of any representations and comments received from registered interested and affected parties;	5.3.5 Appendix L: Public Participation
Regulation 31(2)(f)	A description of the need and desirability of the proposed Activity.	3
Regulation 31(2)(g)	A description of identified potential alternatives to the proposed activity, including advantages and disadvantages that the proposed activity or alternatives may have on the environment and the community that may be affected by the activity.	8
Regulation 31(2)(h)	An indication of the methodology used in determining the significance of potential environmental impacts.	5.2.3
Regulation 31(2)(i)	A description and comparative assessment of all alternatives identified during the environmental impact assessment process.	8
Regulation 31(2)(j)	A summary of the findings and recommendations of any specialist report or report on a specialised process.	7
Regulation 31(2)(k)	A description of all environmental issues that were identified during the environmental impact assessment process, an assessment of the significance of each issue and an indication of the extent to which the issue could be addressed by the adoption of mitigation measures.	9
Regulation 31(2)(l)	An assessment of each identified potentially significant impact, including— I) cumulative impacts; II) the nature of the impact; III) the extent and duration of the impact; IV) the probability of the impact occurring; V) the degree to which the impact can be reversed; VI) the degree to which the impact may cause irreplaceable loss of resources; and VII) the degree to which the impact can be mitigated;	9
Regulation 31(2)(m)	A description of any assumptions, uncertainties and gaps in knowledge.	10

Document Roadmap		
Regulation 31(2) of the EIA Regulations (2010)	**Description**	**Section**
Regulation 31(2)(n)	A reasoned opinion as to whether the activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation;	11.2
Regulation 31(2)(o)	An environmental impact statement which contains - I) a summary of the key findings of the environmental impact assessment; and II) a comparative assessment of the positive and negative implications of the proposed activity and identified alternatives;	9.2.5
Regulation 31(2)(p)	A draft environmental management programme containing the aspects contemplated in Regulation 33.	APPENDIX M: Environmental Management Plan
Regulation 31(2)(q)	Copies of any specialist reports and reports on specialised processes complying with Regulation 32.	Appendix F: Air Quality Impact Study
		Appendix G: Groundwater Study
		Appendix H: Heritage Impact Study
		Appendix I: Ecology and Wetland Study
		Appendix J: Waste Classification Study
Regulation 31(2)(r)	Any specific information that may be required by the Competent Authority.	N/A
Regulation 31(2)(s)	Any other matters required in terms of sections 24(4)(a) and (b) of the Act.	N/A

5.2.3 Impact Assessment Methodology

The impacts will be ranked according to the methodology described below. This methodology is slightly different to the methodology provided in the FSR, as the new methodology makes better provision for “irreplaceable loss” and “reversibility” assessment. In order to ensure uniformity, a standard impact assessment methodology will be utilised so that a wide range of impacts can be compared with each other. The impact assessment methodology makes provision for the assessment of impacts against the following criteria, as discussed below.

The impacts will be ranked according to the methodology described below. Where possible, mitigation measures will be provided to manage impacts. In order to ensure uniformity, a standard impact assessment methodology will be utilised so that a wide range of impacts can be compared with each other. The impact assessment methodology makes provision for the assessment of impacts against the following criteria:

- Magnitude;
- Spatial scale (Extent);
- Temporal scale;
- Probability;
- Significance of impacts; and
- Degree of certainty.

A combined quantitative and qualitative methodology will be used to describe impacts for each of the aforementioned assessment criteria. A summary of each of the qualitative descriptors along with the equivalent quantitative rating scale for each of the aforementioned criteria is given in Table 5-2.

Table 5-2: Quantitative rating and equivalent descriptors for the impact assessment criteria

Rating	Magnitude	Extent Scale	Temporal Scale
1	VERY LOW	*Isolated sites / proposed site*	Incidental
2	LOW	*Study area*	Short-term
3	MODERATE	*Local*	Medium-term
4	HIGH	*Regional / Provincial*	Long-term
5	VERY HIGH	*Global / National*	Permanent

A more detailed description of each of the assessment criteria is given in the following sections.

5.2.4 Magnitude Assessment

Magnitude rating (importance) of the associated impacts embraces the notion of extent and magnitude, but does not always clearly define these since their importance in the rating scale is very relative. For example, the magnitude (i.e. the size) of area affected by atmospheric pollution may be extremely large (1 000 km^2) but the significance of this effect is dependent on the concentration or level of pollution. If the concentration is great, the significance of the impact would be HIGH or VERY HIGH, but if it is diluted it would be VERY LOW or LOW. Similarly, if 60 ha of a grassland type are destroyed the impact would be VERY HIGH if only 100 ha of that grassland type were known or remain. The impact would be VERY LOW if the grassland type was common. A more detailed description of the impact significance rating scale is given in Table 5-3 below.

Table 5-3: Description of the magnitude rating scale

Rating		Description
5	Very high	Of the highest order possible within the bounds of impacts which could occur. In the case of adverse impacts: there is no possible mitigation and/or remedial activity which could offset the impact. In the case of beneficial impacts, there is no real alternative to achieving this benefit.
4	High	Impact is of substantial order within the bounds of impacts, which could occur. In the case of adverse impacts: mitigation and/or remedial activity is feasible but difficult, expensive, time-consuming or some combination of these. In the case of beneficial impacts, other means of achieving this benefit are feasible but they are more difficult, expensive, time-consuming or some combination of these.
3	Moderate	Impact is real but not substantial in relation to other impacts, which might take effect within the bounds of those which could occur. In the case of adverse impacts: mitigation and/or remedial activity are both feasible and fairly easily possible. In the case of beneficial impacts: other means of achieving this benefit are about equal in time, cost, effort, etc.
2	Low	Impact is of a low order and therefore likely to have little real effect. In the case of adverse impacts: mitigation and/or remedial activity is either easily achieved or little will be required, or both. In the case of beneficial impacts, alternative means for achieving this benefit are likely to be easier, cheaper, more effective, less time consuming, or some combination of these.
1	Very low	Impact is negligible within the bounds of impacts which could occur. In the case of adverse impacts, almost no mitigation and/or remedial activity are needed, and any minor steps which might be needed are easy, cheap, and simple. In the case of beneficial impacts, alternative means are almost all likely to be better, in one or a number of ways, than this means of achieving the benefit. Three additional categories must also be used where relevant. They are in addition to the category represented on the scale, and if used, will replace the scale.
0	No impact	There is no impact at all - not even a very low impact on a party or system.

5.2.5 Spatial Scale

The spatial scale refers to the extent of the impact i.e. will the impact be felt at the local, regional, or global scale. The spatial assessment scale is described in more detail in Table 5-4.

Table 5-4: Description of the significance rating scale

Rating		Description
5	Global/National	The maximum extent of any impact.
4	Regional/Provincial	The spatial scale is moderate within the bounds of impacts possible, and will be felt at a regional scale (District Municipality to Provincial Level).
3	Local	The impact will affect an area up to 10 km from the proposed site.
2	Study Area	The impact will affect an area not exceeding the Koffiefontein Diamond mine property.
1	Isolated Sites / proposed site	The impact will affect an area no bigger than the slime dam.

5.2.6 Temporal Scale (Duration)

In order to accurately describe the impact it is necessary to understand the duration and persistence of an impact in the environment. The temporal scale is rated according to criteria set out in Table 5-5.

Table 5-5: Description of the temporal rating scale

Rating		Description
1	Incidental	The impact will be limited to isolated incidences that are expected to occur very sporadically.
2	Short-term	The environmental impact identified will operate for the duration of the construction phase or a period of less than 5 years, whichever is the greater.
3	Medium term	The environmental impact identified will operate for the duration of life of facility.
4	Long term	The environmental impact identified will operate beyond the life of operation.
5	Permanent	The environmental impact will be permanent.

5.2.7 Degree of Probability

Probability or likelihood of an impact occurring will be described as shown in Table 5-6 below.

Table 5-6: Description of the degree of probability of an impact occurring

Rating	Description
1	Practically impossible
2	Unlikely
3	Could happen
4	Very Likely
5	It's going to happen / has occurred

5.2.8 Degree of Certainty

As with all studies it is not possible to be 100% certain of all facts, and for this reason a standard "degree of certainty" scale is used as discussed in Table 5-7. The level of detail for specialist studies is determined according to the degree of certainty required for decision-making. The impacts are discussed in terms of affected parties or environmental components.

Table 5-7: Description of the degree of certainty rating scale

Rating	Description
Definite	More than 90% sure of a particular fact.
Probable	Between 70 and 90% sure of a particular fact, or of the likelihood of that impact occurring.
Possible	Between 40 and 70% sure of a particular fact or of the likelihood of an impact occurring.
Unsure	Less than 40% sure of a particular fact or the likelihood of an impact occurring.
Can't know	The consultant believes an assessment is not possible even with additional research.
Don't know	The consultant cannot, or is unwilling, to make an assessment given available information.

5.2.9 Quantitative Description of Impacts

To allow for impacts to be described in a quantitative manner in addition to the qualitative description given above, a rating scale of between 1 and 5 will be used for each of the assessment criteria. Thus the total value of the impact is described as the function of magnitude, spatial and temporal scale as described below:

$$\textbf{\textit{Impact Risk}} = \frac{(\text{Significance} + \textit{Spatial} + \text{Temporal})}{\mathbf{3}} \times \frac{\text{Probability}}{\mathbf{5}}$$

An example of how this rating scale is applied is shown below:

Table 5-8: Example of Rating Scale

Impact	Magnitude	Spatial Scale	Temporal Scale	Probability	Rating
	LOW	*Local*	Medium-term	*Could Happen*	
Impact to air	**1**	***1***	**1**	**2**	**0.2**

Note: The significance, spatial and temporal scales are added to give a total of 3, that is divided by 3 to give a criteria rating of 1. The probability (1) is divided by 5 to give a probability rating of 0,2. The criteria rating of 1.0 is then multiplied by the probability rating (0.2) to give the final rating of 0.2.

The impact risk is classified according to five classes as described in the table below.

Table 5-9: Impact Risk Classes

Rating	Impact Class	Description
0.1 – 1.0	**1**	**Very Low**
1.1 – 2.0	**2**	**Low**
2.1 – 3.0	**3**	**Moderate**
3.1 – 4.0	**4**	**High**
4.1 – 5.0	**5**	**Very High**

Therefore, with reference to the example used for air quality above, an impact rating of 0.2 will fall in the Impact Class 1, which will be considered to be a very low impact.

5.2.10 Cumulative Impacts

It is a requirement that the impact assessments take cognisance of cumulative impacts. In fulfilment of this requirement the impact assessment will take cognisance of any existing impact sustained by the operations, any mitigation measures already in place, any additional impact to environment through continued and proposed future activities, and the residual impact after mitigation measures.

It is important to note that cumulative impacts at the national or provincial level will not be considered in this assessment, as the total quantification of external companies on resources is not possible at the project level due to the lack of information and research documenting the effects of existing activities. Such cumulative impacts that may occur across industry boundaries can also only be effectively addressed at Provincial and National Government levels.

Using the criteria as described above an example of how the cumulative impact assessment will be done is shown below:

Table 5-10: Example of cumulative impact rating

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Initial / Existing Impact (I-IA)	**2**	**2**	**2**	*1*	0.4
Additional Impact (A-IA)	**1**	***2***	**1**	*1*	0.3
Cumulative Impact (C-IA)	**3**	***4***	**2**	*1*	0.6
Residual Impact after mitigation (R-IA)	**2**	***1***	**2**	*1*	0.3

As indicated in the example above the Additional Impact Assessment (A-IA) is the amount that the impact assessment for each criterion will increase. Thus if the initial impact will not increase, as shown for temporal scale in the example above the A-IA will be 0, however, where the impact will increase by two orders of magnitude from 2 to 4 as in the spatial scale the A-IA is 2. The Cumulative Impact Assessment (C-IA) is thus the sum of the Initial Impact Assessment (I-IA) and the A-IA for each of the assessment criteria.

In both cases the I-IA and A-IA are assessed without taking into account any form of mitigation measures. As such the C-IA is also a worst case scenario assessment where no mitigation measures have been implemented. Thus a Residual Impact Assessment (R-IA) is also made which takes into account the C-IA with mitigation measures. The latter is the most probable case scenario, and for the purpose of this report is considered to be the final state Impact Assessment.

5.2.11 Notation of Impacts

In order to make the report easier to read the following notation format is used to highlight the various components of the assessment:

- Magnitude- IN CAPITALS
- Temporal Scale – in underline
- Probability – in *italics and underlined*
- Degree of certainty - in **bold**
- Spatial Extent Scale – in *italics*

5.3 Environmental Impact Reporting phase

5.3.1 Environmental Impact Report

Once the Scoping Report and the Plan of Study for the EIA is accepted by the DESTEA, Zitholele Consulting will begin the Environmental Impact Report.

The Environmental Impact Report will include the activity description, site / area and corridor assessments, public participation, a description of the issues, assessment of the alternatives, emergency and response plan, the closure and rehabilitation plan. The specialist studies results will be summarised and integrated into the Environmental Impact Report.

5.3.2 Mitigation and Management Measures

The development of mitigation and management measures was undertaken throughout the course of the process, from the assessment of the first alternative to the selection of a preferred design. Mitigation measures, through the design review iterations and development of the preferred options, have been recorded. Specialist findings and reporting informed the development of mitigation measures. In addition, best practices were considered when identifying mitigation and management measures for potential impacts.

5.3.3 Environmental Management Programme

In accordance with Regulation 31(2)(p) of the EIA Regulations (2010) under the NEMA (1998) a draft EMPr conforming to the information requirement stipulated in Regulation 33 must be included in the EIR. All mitigation and management measures which emanated from the EIA Process as well as the specialist findings have been included in the EMPr. The EMPr therefore functions as an important management tool to ensure that these mitigation and management measures are implemented throughout all phases of the project life-cycle. The EMPr included in APPENDIX M: ENVIRONMENTAL MANAGEMENT PLAN of this EIR is furthermore also intended to ensure that adverse or reasonably avoidable adverse impacts associated with the Construction Phase, Operational Phase and Decommissioning

Phase of the proposed KPS Continuous Ash Disposal Facility project are prevented and that the positive benefits associated with the projects are enhanced.

5.3.4 Submission of Final EIR and Decision Making

Using the comments generated by the PPP the Draft EIR will be updated and finalised. All comments received will be added to the CRR and attached to the Final EIR as an appendix.

The Final EIR once updated with additional issues raised by I&APs may contain new information. The Final EIR will be submitted to the DESTEA for decision making, and will be distributed to those I&APs who specifically request a copy. I&APs will be notified of the availability of the report by letter, advertisements and e-mail.

5.3.5 Public Participation Process: Environmental Impact Assessment Phase

The purpose of the public participation process during the Impact Assessment Phase is to ensure that the DEIR and Draft Environmental Management Programme (EMPr) is made available to the public for review and comments. I&APs will be requested to comment on the findings of the EIA, including the measures that have been proposed to enhance positive impacts and reduce or avoid negative ones.

The DEIR (this report) includes the CRR (Version 3), which lists comments/concerns/issues raised and recommendations made with an indication of where the issue is dealt with in the technical evaluations (main Report, Specialist Study Reports or draft EMPr), and the relevant findings. Stakeholders will be notified of the availability of the DEIR and Draft EMPr for review and comments and will be afforded an opportunity to engage with the project team at the public meeting(s) to be held during the review period of the DEIR.

<u>Issues Raised during Scoping Phase and addressed in Impact Phase</u>

A well-defined Public Participation Process (PPP) is a process where the comments/concerns/issues and/or recommendations made by I&APs are considered and, where applicable, are addressed by the environmental specialist team. The following key issues were identified during the scoping phase and attended to in the impact phase:

Comment	Response in the DEIR
Various water related comments submitted by the DWS, Directorate: c & i. Key comments include:	
Recommended that a WULA should be obtained prior to commencement of activity.	Refer to Section 4.5.1 of this report.
Water Use Master Plan to be compiled.	Refer to Section 4.5.1 of this report.
Possible impact on the airstrip on KFDM property, especially in terms of dust, and the management thereof.	It is anticipated that the airstrip will be decommissioned.
SANBI recommended that the EAP visit their web portal for any possible biodiversity impacts and land use	The information provided on the SANBI portal were taken into account.

Comment	Response in the DEIR
planning.	
A waste classification study was recommended by DESTEA.	Waste Classification Study included as Appendix J of this report.

Availability of the DEIR and Draft EMPr

The DEIR and Draft EMPr will be made available for public review and comment from **Wednesday, 02 March 2016 to Friday, 15 April 2016**. All I&APs registered on the proposed project's database will be notified of the availability of the DEIR and Draft EMPr. The DEIR and Draft EMPr will be made available at the following public places. The documents will also be freely available in electronic format on Zitholele's website.

Table 5-11: List of public places where the DEIR and Draft EMPr are available for review

PRINTED COPIES	
Venue	**Contact Details**
Letsemeng Local Municipal Offices, 7 Groot Trek Street, Koffiefontein	Tel.: 053 205 9200
Koffiefontein Public Library, 29 Groot Trek Street, Koffiefontein	Tel.: 053 205 0147
Ditlhake Public Library, 429 Ttsane Street, Ditlhake, Koffiefontein	Tel.: 053 205 0383
Ethembeni Clinic, 100 Jacobsdal Road, Koffiefontein	Tel.: 053 205 0977
ELECTRONIC COPIES	
Zitholele Consulting Website	http://www.zitholele.co.za/eia-for-koffiefontein-slime-dam
Nicolene Venter / Bongani Dhlamini	Available on CD on request via: E-mail: publicprocess@zitholele.co.za Tel.: 011 207 2060

Invitation to Key Stakeholder Workshop and Public Meetings

Organs of State and representatives of various organisations i.e. Non-Government Organisations, Non-Profit Organisations, agriculture, etc will be invited to attend the key stakeholder workshop that is scheduled to take place on **Wednesday, 30 March 2016**. This workshop will allow the officials and/or representatives to hear one another's views and issues in context with their own, thus allowing for a more integrated approach to the proposed project's authorisation process.

Registered I&APs, including the key stakeholders mentioned above, will be invited to attend any one of the two public meetings scheduled to take place as follows:

Table 6-12: Public Meeting information

DATE	TIME	VENUE
Wednesday, 30 March 2016	14:00 – 16:00	Koffiefontein Golf Club, Du Preez Street, Koffiefontein
	18:00 – 20:00	Daniël Moopela Community Hall, Dithlake

The invitations will be extended as per registration on the project database i.e. those with e-mail addresses will receive their invitation per e-mail, those without an e-mail address but with a fax number, will receive their invitation per fax, and those without an e-mail address or fax number will receive their invitation by post.

Minutes of Meetings

The minutes of the key stakeholder workshop and public meetings will included as an Appendix in the FEIR, after it has been distributed to the attendees for verification.

Comments and Responses Report

All comments received during the review period of the DEIR and those raised at the key stakeholder workshop and public meetings will be updated in the Comments and Responses Report version 4, and will be included in the FEIR submission.Notification to I&APs of the submission of the FEIR

Once the FEIR and Draft EMPr are submitted to the Competent Authority (CA) (DESTEA), a letter will be sent to I&APs registered on the proposed project's database, indicating that the reports have been submitted. The notification will also indicate where the documents are available for review and comment, who their comments need to be submitted to and will outline the next steps in the EIA process.

Announcement of Environmental Authorisation

Once the DESTEA issues a decision, Zitholele Consulting, on behalf of Koffiefontein Diamond Mine, will, in writing and within 12 days of the date of the decision notify the registered I&APs of the decision. The DESTEA's reasoning, as set out in Environmental Authorisation, will be summarised in the notification letter. The DESTEA's letter and the Environmental Authorisation (EA) will be attached to the notice.

In addition to the notification to the registered I&APs, Zitholele Consulting, on behalf of Koffiefontein Diamond Mine, must, within 12 days of the date of the decision, place a notice in the same newspaper(s) used in the PP Process which are the Volksblad and the Free State Express. The notices will inform I&APs of the DESTEA's decision and describe where copies of the DESTEA's decision can be accessed. Any additional requirements set out by DESTEA in the EA will be included in both the I&AP notification letter and the advertisement. The opportunity for I&APs to lodge an appeal against the DESTEA's decision will be explained in the I&AP notification letter and the advertisement. A copy of the appeal process will be attached as an Appendix to the I&AP notification letter and the advertisement will indicate where a copy of the appeal process can be obtained. This notification process will comply with the EIA Regulations, 2010.

6 RECEIVING ENVIRONMENT

This section of the report presents an overview of the baseline environment within which the proposed project will be undertaken.

6.1 Climate

6.1.1 Data collection

Climate information was obtained from the Integrated Water and Waste Management Plan Assessment which was done by Shangoni Management Services[5] for the Koffiefontein Diamond Mine.

6.1.2 Regional Description

Mean daily maximum and minimum temperatures in the larger region for January and July, are approximately 37°C and -4°C, respectively. Overall mean annual temperature is approximately 16.5°C. Frost is frequent in winter (37 frost days per annum on average).

The monthly amount of rainfall measured at Kimberley between March 2014 and 2015 (data obtained from AccuWeather, 2015) is shown in Figure 6-1. During the 12-month period preceding March 2015 a total of 331mm rain was measured at Kimberley. This approximate rainfall data suggest that the Koffiefontein Study Region received an average amount of rainfall during the 12 months preceding our first visit. The approximate temperature data in shown in Figure 6-2 indicates that conditions were typically mild to warm during March 2015.

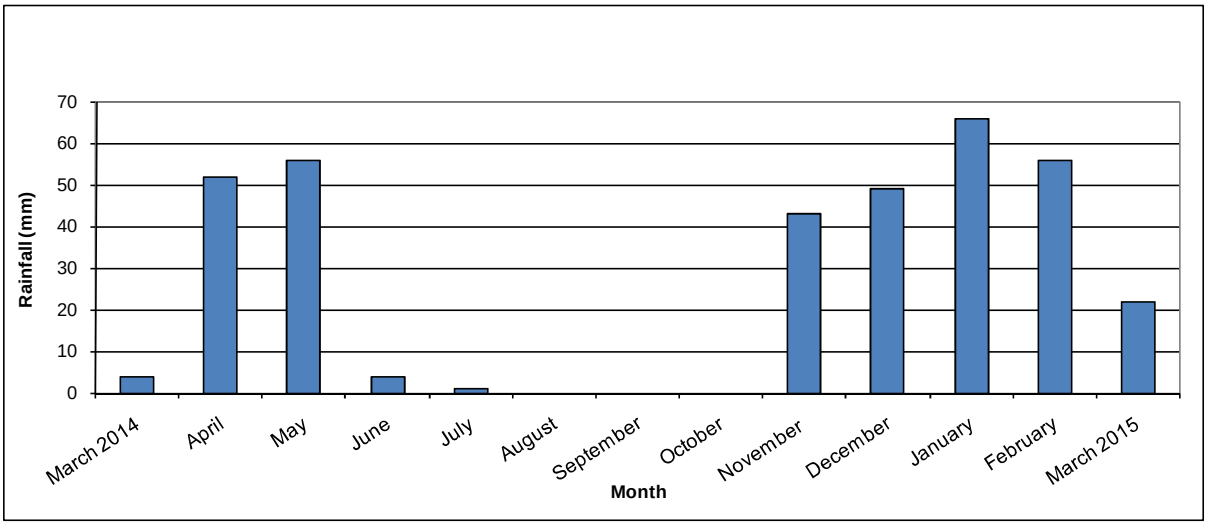


Figure 6-1: Measurements of monthly rainfall at Kimberley (AccuWeather 2015)

[5] Integrated Water and Waste Management Plan Volume I September 2011, Ref. no: KOFFIE/IWWMP/Sept 2011

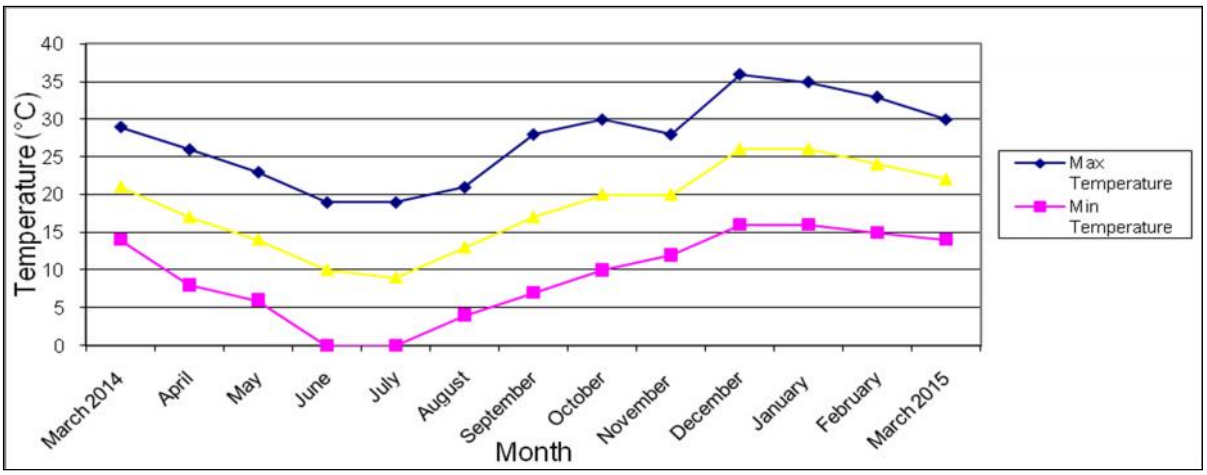


Figure 6-2: Measurements of air temperature at Kimberley (AccuWeather 2015)

6.2 Wind regime

Wind roses summarize the occurrence of winds at a specified location via representing their strength, direction and frequency. Calm conditions are defined as wind speeds of less than 1m/s which are Precipitation (mm) represented as a percentage of the total winds in the centre circle. Each directional branch on a wind rose represents wind originating from that specific cardinal direction (16 cardinal directions).

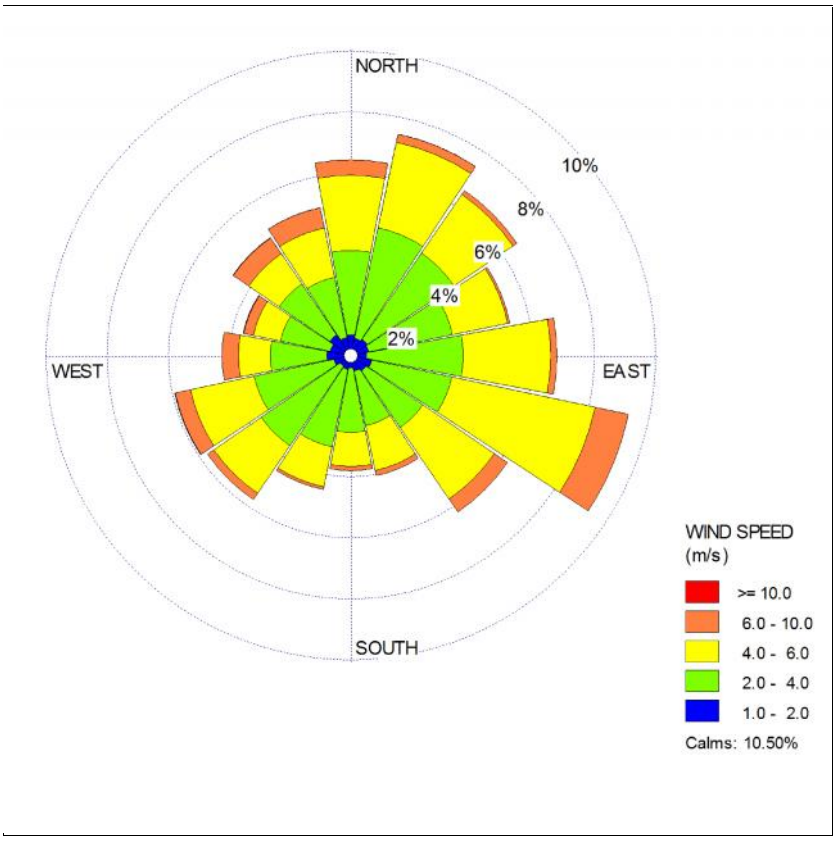


Figure 6-3: Modelled annual Koffiefontein wind rose for 2012-2014

Each cardinal branch is divided into segments of different colours which represent different wind speed classes. For the current wind roses, wind speed is represented on a scale from blue to red, with dark blue indicating low wind speeds (1 – 2 m/s) and red representing high wind speeds (in excess of 10 m/s). Winds at the Koffiefontein mine are expected to originate predominantly from the east-south-easterly sector, south-westerly sector and north-north-easterly sector. Wind speeds are moderate, with a low percentage (10.50%) of calm conditions (<1 m/s). Wind blows predominantly in a north easterly direction (refer to Figure 6-3). Wind speeds ranging between 6.0 – 10.0 m/s are prevalent in the study area.

6.3 Geology

6.3.1 Data Collection

The geological analysis was undertaken through the desktop evaluation using a Geographic Information System (GIS), as well as directly from existing specialist and other reports for Koffiefontein Diamond Mine.

6.3.2 Regional Description

The geology of the Free State Province is underlain by sedimentary rocks belonging to the Beaufort and Ecca Groups of the Karoo Supergroup. The sedimentary rocks conformably overlie the Collingham formation (Viljoen, 2005). Viljoen (2005) further mentioned that the lithology is composed of sandstone, blueish grey and dark grey to black shale and dark grey mudstone with interbedded siltstone[6], which have been intruded by dolerite sills and dykes. They are part of the vast Karoo basin that covers almost two-thirds of South Africa, and were deposited between 200 and 300 million years ago (CGS, 2014). These rocks are known to host major coal and clay deposits. The former generally occur as fairly thick, flat, shallow-lying coal seams. Of the country's 18 principal coalfields, two occur in the Free State Province, these being the Vereeniging-Sasolburg and Free State fields.

6.3.3 Study area

The complex internal geology of the kimberlite ore body, known as the Koffiefontein pipe, has contributed to the marginal nature of the mine. The key to this is the presence of a large zone dominated by down-rafted country rock Karoo-age shale, carbonaceous shale and dolerites (Figure 6-4). The deposit is hosted as kimberlite ore body within the Koffiefontein pipe. The pipe, together with several other kimberlite pipes and dykes, forms a cluster that intrudes Dwyka Shale's and Karoo Dolerites. It is characterised by carbonaceous and Karoo age shale's besides intercalated dolerite that overlies the granite gneiss basement (AGES, 2013).

[6] Viljoen, J.H.A., 2005: Tierberg Formation

A second pipe, extending 6 ha on the surface, lies adjacent to the Koffiefontein pipe. Known as Ebenhaezer pipe, it also hosts kimberlite ore body. Fifteen other pipes are known within a 30 km radius of the Koffiefontein mine (Rison Groundwater Consulting, 2012).

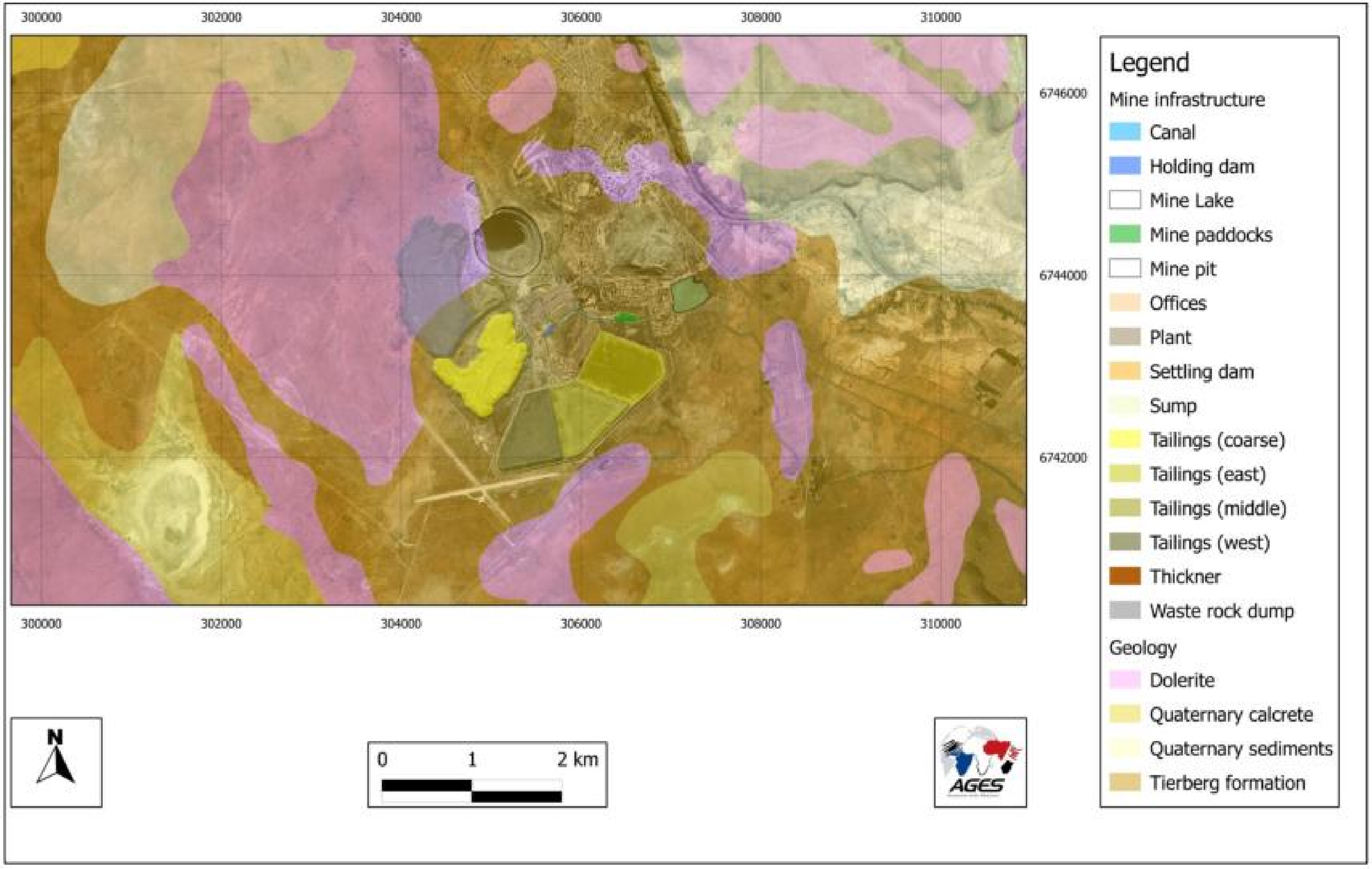


Figure 6-4: Simplified Geological Map of the Koffiefontein Mine area (map obtained AGES, 2013)

6.4 Soils and Land Capability

6.4.1 Data Collection

The Soils and Land capability analysis was undertaken through the desktop evaluation using a Geographic Information System (GIS) and relevant data sources. The soil data was taken from the Department of Water Affairs and Forestry.

6.4.2 Regional Description

Of the 10.6% of the country's land falling within the borders of the Free State Province, about 90 % of the land use is dedicated to agricultural purposes while 9.6% is used for the mining operations (Moeletsi & Walker, 2012[7]). Of the total land use, 57 % is used for stock farming, including beef and dairy cattle and sheep. Crops, which mainly occur on the grasslands of the Highveld, account for 33% of the land use and include maize, sorghum, wheat, groundnuts and sunflower crops. Only 1% of the land is set aside for conservation. The soils in the region are mostly derived from the geology of the region (as described above) and are mostly sandy soils.

6.4.3 Study area

The soil types found in the area of Koffiefontein Diamond Mine was obtained from AGIS Comprehensive Atlas, and the soils shows resemblance to the geology as mentioned above. Most common soil in the Koffiefontein area is red soils with high base status. Soils in close proximity to the study area consist of red, yellow and / or greyish soils with high base content and rock with limited soils. Soils which are further away from Koffiefontein Diamond Mine but still in the Free State Province are soils with minimal development, usually shallow, on hard or weathering rock, with or without intermittent diverse soils. Figure 6-5 below provides an illustration of the potential of the soils in the region, mostly suitable for extensive grazing, whether by livestock and game species as the soil depth excludes the possibility of intensive farming practices. Other areas maybe are used for residential purposes.

The overall grass species on the game farm section of the Koffiefontein Mine property indicates that there is a persistent medium grazing potential. Due to the high rainfall experienced in the previous months a lot of pioneer species was observed. The overall condition of the veld is very good for grazers (Van Deventer, 2011).

[7] Moeletsi, ME & Walker, S, 2012. Rainy season characteristics of the Free State Province of South Africa with reference to rain-fed maize production. Water SA [online]. 2012, vol.38, n.5, pp. 775-782. ISSN 1816-7950

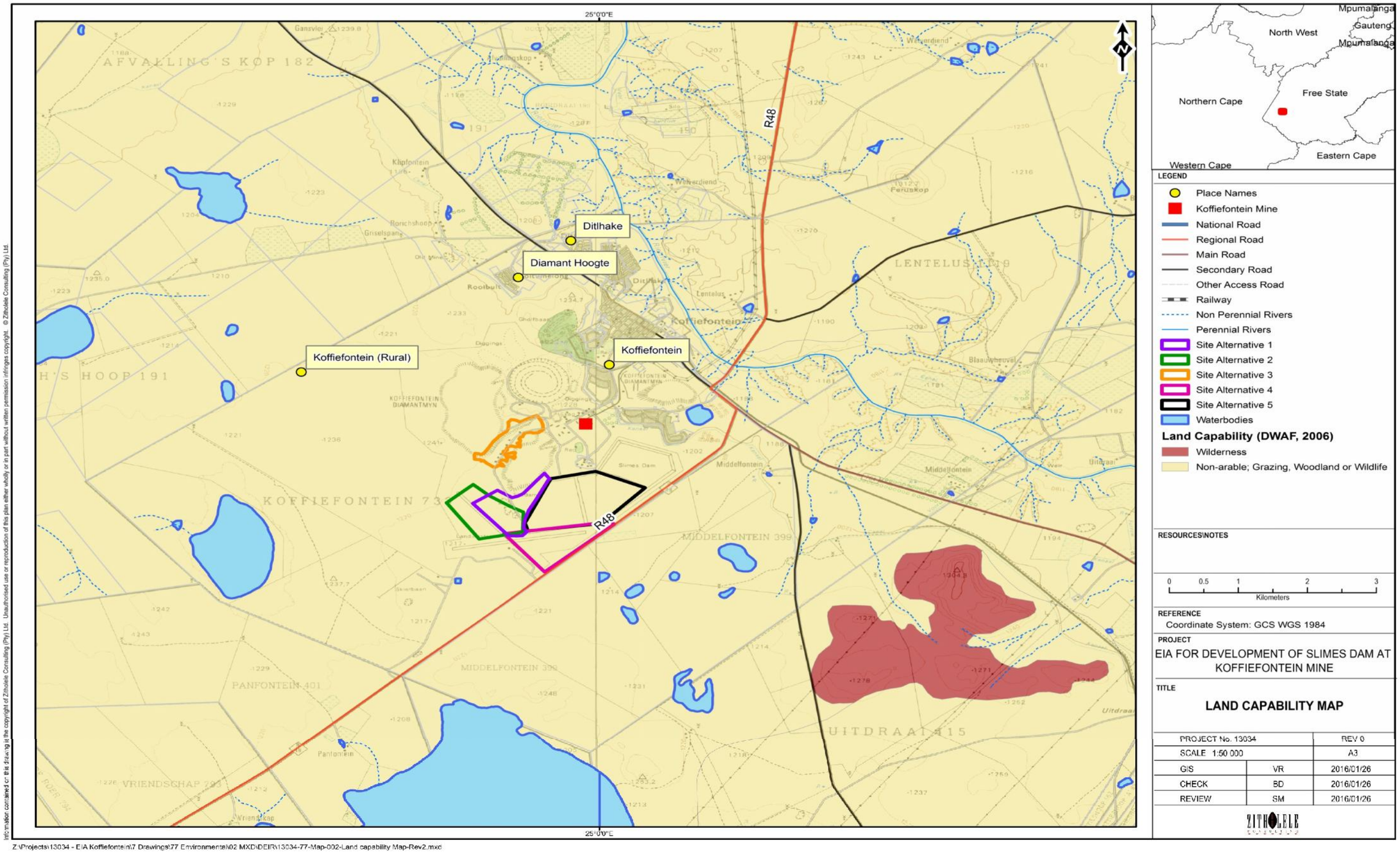


Figure 6-5: Land Capability of the study area

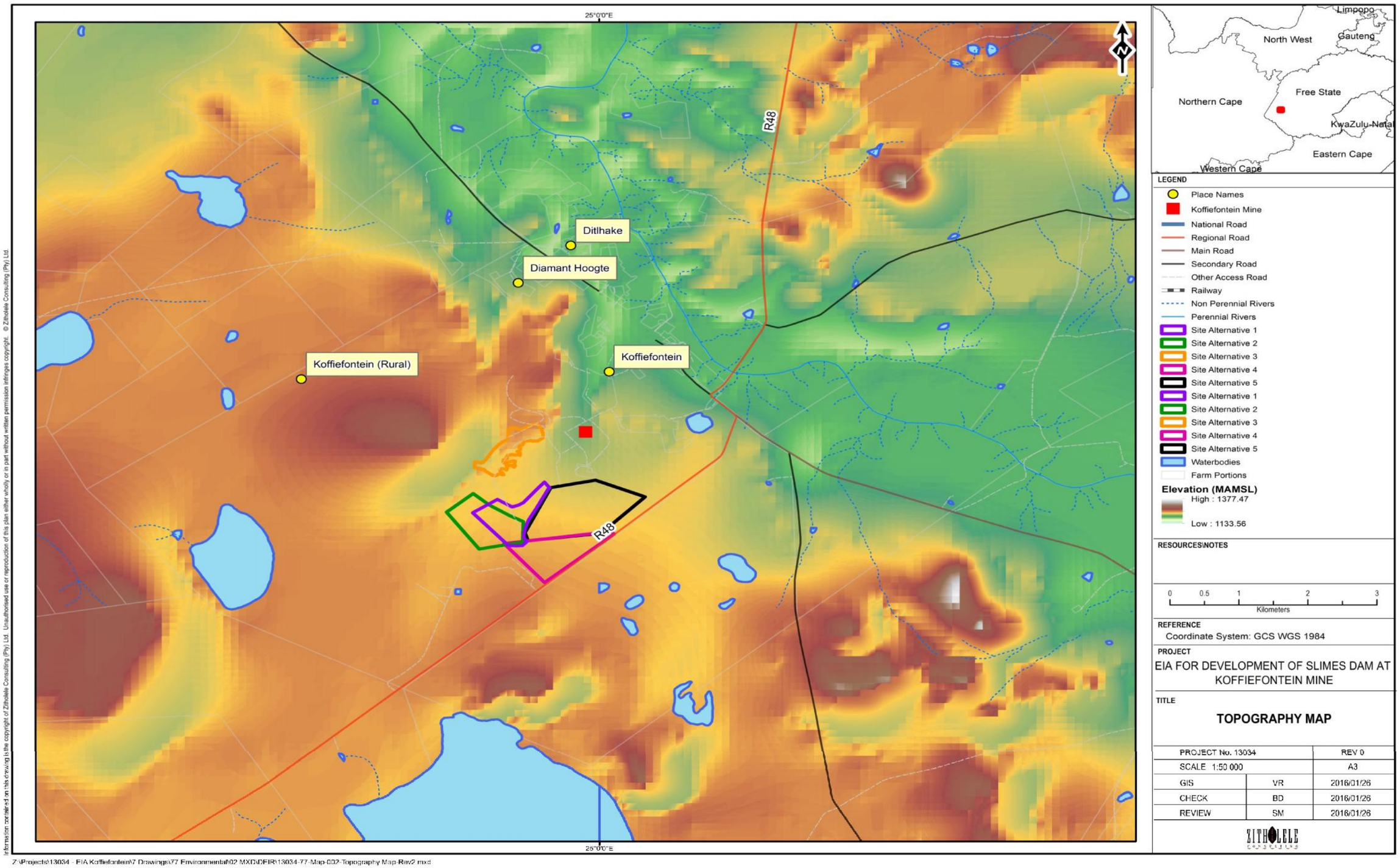


Figure 6-6: Topography of the study area

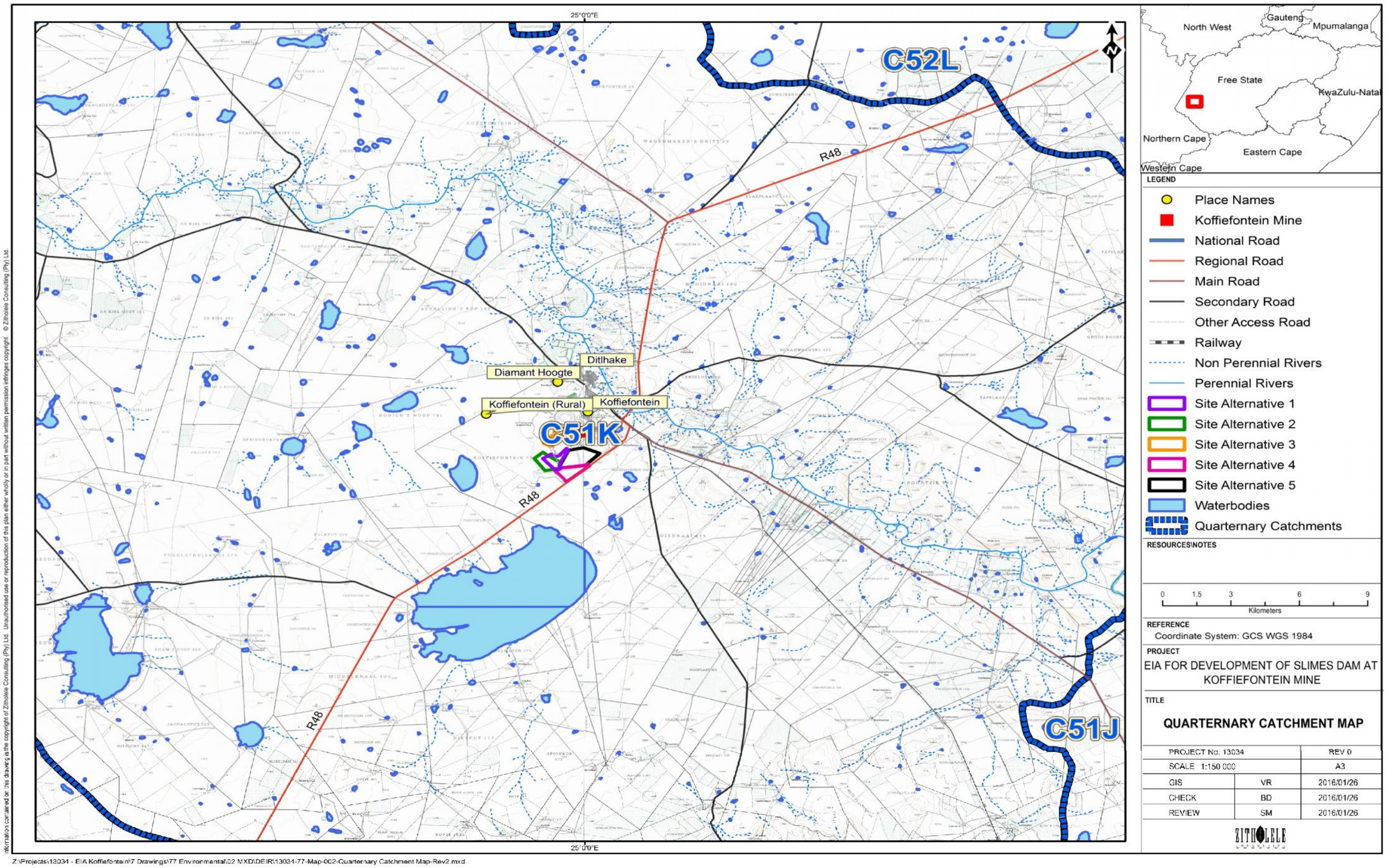


Figure 6-7: Water resources of the study area

6.5 Topography

6.5.1 Data Collection

The topography data was obtained from the Surveyor General's 1:50 000 toposheet data for the region, namely 2628 and 2629. Using the latest aerial photography of the area Zitholele Consulting was able to develop a digital elevation model of the region, showing also the ridges (Figure 6-6).

6.5.2 Regional Description

The topography of the region is a gently undulating to moderately undulating landscape of the Highveld plateau, dipping to the Riet River which flows to the North-East of the mine. Some small scattered wetlands and pans occur in the area, rocky outcrops and ridges also form part of significant landscape features in the area. The altitude ranges between 1050 to 1475 metres above mean sea level (mamsl). The mean annual runoff is approximately 3 mm/a (Rison Groundwater Consulting, 2014).

6.6 Surface and Groundwater Resources

6.6.1 Data Collection

Data and information on the water resources in the Koffiefontein area was obtained from the IWWMP produced for the Koffiefontein Diamond Mine (Shangoni, 2011), as well as the report titled: Rison groundwater consulting: Groundwater Quality Assessment: Koffiefontein Diamond Mine, Report No: RIS\110604, dated June 2011 and prepared by Rison Groundwater Consulting cc.

6.6.2 Regional Description

The Free State Department of Water and Sanitation is the responsible water authority, and the Kalkfontein Water Board supply potable water to the Mine. The Koffiefontein Diamond Mine is situated within the Upper Orange water management area. Koffiefontein Diamond Mine is situated in the Riet river primary catchment area and the C51K Tertiary Catchment Area. The mine is located on the western banks of the Riet River which flows in a north westerly direction. The mine is also located approximately 21 km northwest of Kalkfontein Dam.

Local catchment area that drains directly to and on the mining area of Koffiefontein Diamond Mine is 20 km^2. This catchment area is very flat with a 0.83 % slope. The catchment area was identified with a high permeable soil class and low runoff volume, therefore the 1:50 year flood runoff was estimated at 33 m^3/s.

Groundwater resources can be divided into two distinct aquifers, namely a shallow perched aquifer in the weathered zone followed by a deeper fractured hard rock aquifer. The fractured rock aquifer occurs as transmissive fractures in consolidated bedrock of either the Karoo sediments or the basement granite that underlies the Karoo sediments. A third, deeper aquifer in the underlying basement granite can also occur. Little information is however available for this aquifer, though it will also be a secondary fractured rock type.

It is further estimated that the long term recharge of the aquifers in the Koffiefontein area is estimated at between 3 and 5 % of the mean annual precipitation. Open pit mining usually causes a significant increase in aquifer recharge percentage. Surface water features like dams (tailings, slurry, process water, storm water, return water etc.) will also usually increase the recharge to the aquifer but compacted or concrete surfaces and roads will decrease the recharge.

6.6.3 Surface Water Resources

Wetlands

Within the study site itself only a number of artificial wetlands, created by seepage and runoff from the existing tailings facilities, were identified. A single ephemeral endorheic depression (pan) and what is referred to as a “cryptic” wetland was found within the immediate surrounds. In the broader area (over 1km from the study area) a number of larger pans, of National Importance, were identified, with the buffers of these systems extending over the study site. The southern artificial wetlands are located within the buffer of the Freshwater Ecosystem Priority Areas (FEPA) pans systems. The delineated artificial wetlands are located adjacent to and within the area earmarked for Site 1 and Site 4 respectively.

Pans

Depressions are defined as “a wetland or aquatic ecosystem with closed (or near closed) elevation contours, which increases in depth from the perimeter to a central area of greatest depth and within which water accumulates.” Due to the large number of depressions within the Dry Highveld Grassland Group 2 vegetation type, they are classified as Least Threatened. In terms of delineating the systems, it is the catchment of the depression that should be demarcated as sensitive. The available contour data was used to demarcate the pan, however due to the flat terrain the scale of the contours was not fine enough for an accurate delineation. The extent of the identified pan covers a segment of the area allocated for Site 1.

Cryptic Wetland

In addition to the ephemeral endorheic depression and artificial wetlands identified, there was also a “cryptic” wetland flat identified immediately to the south west of Site 2. This “cryptic” wetland occurs due to the presence suitable substrate that contains water for a

period of a few days. This occurs due to rain falling unevenly over time so that for a short period in time the rainfall will exceed evaporation, whilst for the rest of the time evaporation exceeds rainfall and the wetlands dry up. “Cryptic” wetlands cannot be reliably identified as wetlands during the dry season on the basis of standard wetland identification and delineation tools. It should be noted that as Site 2 was eliminated as a feasible option during the Site Screening Process, the impacts associated with constructing the slimes dam on the area earmarked for Site 2 will not be assessed.

6.6.4 Study area

Groundwater and surface water quality was investigated by Rison Groundwater Consulting. All samples were compared with Class 1 drinking water standards as defined in the South African Drinking Water Standard, SANS 241 of 2006. A technical report prepared by the company, Groundwater Complete, in March 2011 demonstrated a 77 % correlation between surface topography and groundwater elevation. Therefore groundwater flows from topographic high‘s towards topographic low‘s. In the region of the mine, groundwater migrates in a northerly direction which immediately implies that groundwater seeping from the tailings dam and rock dumps moves in the direction of the Koffiefontein pipe.

Rison Groundwater Consulting was contracted to investigate the origin of chloride-rich groundwater that enters the underground workings. The ingressing water is highly corrosive which has a negative effect on the mines underground steel infrastructure and machinery. For this investigation an extensive water sampling program was performed at Koffiefontein and the surrounds. Samples were collected at various ingress points underground as well as at various points on surface in an attempt to use hydrochemistry to link surface sources to underground ingress water. Results indicated that most of the surface and underground samples have a chemistry dominated by Ca – SO_4 – Na – Cl. Sulphate concentration certainly seems to be elevated and more prominent in surface water. It was concluded that seemingly the origin of the high chloride concentrations is at the tailings dam complex. This conclusion was purely based on the fact that the groundwater flow directions are from the tailings dam complex towards the mining area and the seepage water at the base of the tailings dam has elevated sulphate, sodium and chloride concentrations.

Hydrocensus data and user surveys undertaken by KLM Consulting also indicated that groundwater from boreholes surrounding the mining area is used mainly for domestic supply, livestock watering and irrigation of domestic and small vegetable gardens.

The Riet River is situated to the North East (less than 2km in distance) and is considered a FEPA system with a Class C: Moderately Modified Status. The Kalkfontein Dam on the Riet River provides water for the towns of Jacobsdal and Koffiefontein. There is also the presence of numerous ephemeral pans with a FEPA wetland cluster approximately 700m

south of the mine (refer to Figure 6-8).. The presence of any sensitive species will be confirmed by specialists during this EIA process.

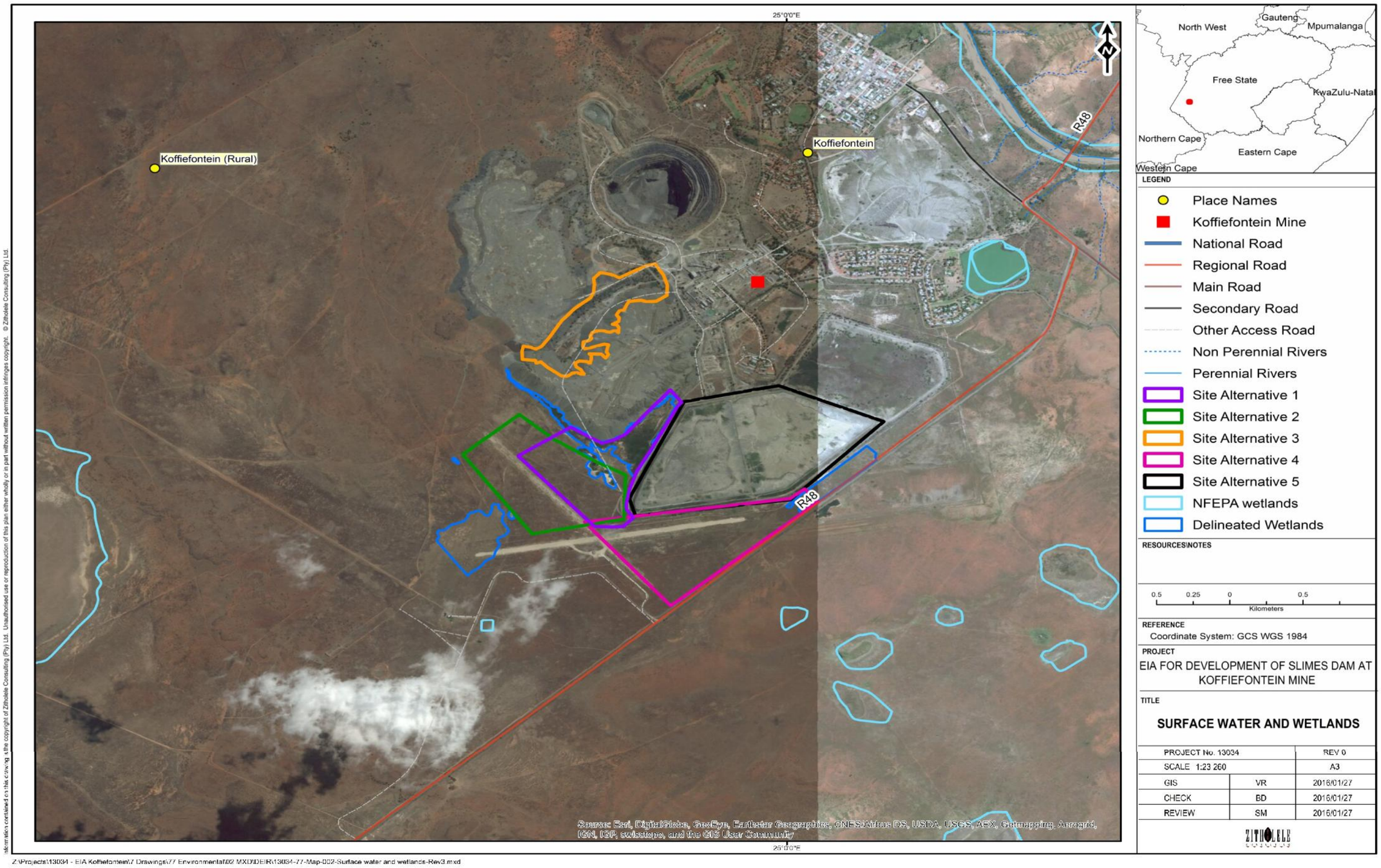


Figure 6-8: Map showing the wetlands including NFEPA wetlands and BGIS Data for the area

6.7 Terrestrial Biodiversity

6.7.1 Data Collection

A literature review of the faunal species that could occur in the area was conducted. Site descriptions of the vegetation at the Koffiefontein Mine was obtained from specialist studies and surveys undertaken for the Koffiefontein Mine property area. Site descriptions of the terrestrial biodiversity at the Koffiefontein Mine was obtained from:

- North-West University, 2013. Winter and Summer Avifaunal Surveys of Petra Mines, Koffiefontein, South Africa - June 2012/February 2013
- North-West University, 2013. Koffiefontein Mine JV herpetological survey – April 2013
- Vegetation survey for Koffiefontein Mine: An extensive vegetation survey for Koffiefontein mine and the adjacent game farm, prepared by Anja van Deventer and dated 2011.
- The following information was extracted from the document titled: “Koffiefontein Mine JV, Environmental Impact Assessment.” prepared by Petra Diamonds (Pty) Ltd, dated 2006.
- The field guide of Du Preez and Carruthers (2009) and the southern African frog atlas (Minter et al. 2004) were used to compile a species list of potential amphibian species that may occur at the Koffiefontein Mine conservation area.

6.7.2 Regional Description

The study area is located within the Nama Karoo Biome (Hoffman 1996), and more specifically, Northern Upper Karoo Vegetation (Mucina & Rutherford 2006). The Nama Karoo biome covers much of the central and western regions of the country. The dominant vegetation is a grassy, dwarf shrubland. Grasses tend to be more common in depressions and on sandy soils, and less abundant on clayey soils. Grazing rapidly increases the relative abundance of shrubs. Most of the grasses are of the C4 type1 and, like the shrubs, are deciduous in response to rainfall events. The biome is dominated by a steppe-type vegetation, comprising a mixture of shrubs, dwarf shrubs and annual and perennial grasses. The vegetation type of Koffiefontein is that of Besemkaree Koppies Shrubland.

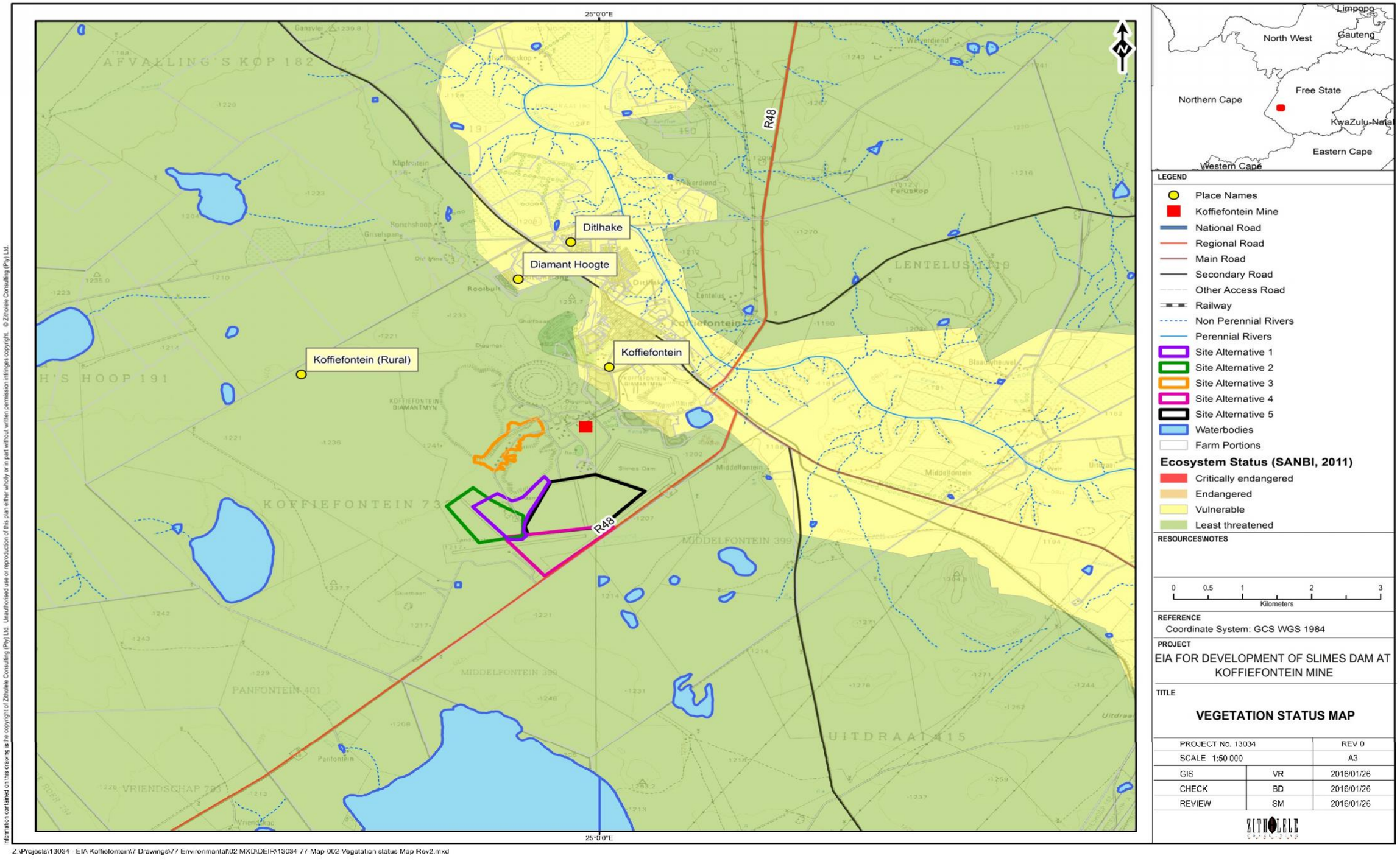


Figure 6-9: Vegetation status of the study area

The biome is associated with the moderate rainfall regions (250-450 mm per annum) and is suited to commercial sheep and goat production. The summer seasonality of the rainfall in the eastern parts of the biome means that there is often abundant grass production during the growing season. Graziers attempt to optimize production by sparing or resting grassy dwarf shrubland in the wet season. Herbivory by domestic livestock during the growing season has been shown to reduce grass cover and promote the growth of larger shrubs (species of *Rhus*, *Acacia* and *Euclea*) and dwarf shrubs. In the winter months, the dwarf shrubs maintain their crude protein at around 8 %, providing excellent forage. The nutrient-rich substrata provided by the mudstones, sandstones and dolerites mean that this production can be considered sustainable.

Frogs and toads in South Africa comprise almost 120 species and 33 genera from 9 families. Frogs occur throughout South Africa and their distribution is largely influenced by rainfall and temperature. The highest number of species is found in the eastern regions where high rainfall combines with warm year-round temperatures. The highest level of endimisity, however, occurs in the Fynbos biome (particularly the Cape Fold Mountains) of the Western Cape. While some species are widely dispersed in a variety of localities and climate regions, most species are fairly restricted in type of habitat resulting in limited ranges. Habitat loss is cited as the most pervasive threat for South African amphibians and has been listed as a possible threat to all threatened species (Harrison et al., 2001). Agricultural development, afforestation, invasive plants and urban development are the main drivers of herpetofauna habitat loss.

6.7.3 Study area

The general farm area towards the south and west of the Koffiefontein mining property are covered with mixed grass and Karoo scrub. There is a grass pan in this area which is heavily grazed. The perimeter of the pan is lined with tall grass which then gives way to grass/scrub land. The soil in this area is calcareous, but gives way to red sandy soil towards the north-eastern parts. This gradual transition in soil type towards the central parts of the property is characterised by the addition of scattered trees (mostly *Acacia tortilis*). The North-eastern section is characterised, in addition to grass/karoo scrub, with bolder-strewn ridges and dense stands of *Acacia tortilis*. Other trees in this area include *Rhus lancea*, *Rhus leptodictya*, *Ziziphus mucronata*, and the exotic *Schinus molle*. Termite mounds are plentiful throughout the whole area, and are used as perches by some birds.

The proposed slimes dam alternatives occur in areas with least threatened, but hardly protected, vegetation status.

Within the mining area, the active TSF resembles mudflats, with large “beach” areas where *Phragmites* reeds grow abundantly. The wall of the TSF is covered by Karoo scrub and grasses, indigenous trees such as *Rhus lancea*, *Acacia tortilis*, *Ziziphus mucronata*, *Rhus pyroides*, while exotics includes *Melia azedarach*, *Schinus molle*, *Pyracantha angustifolia*, *Opuntia* sp and Pampas grass, *Cortaderia selloana*. Where the wall meets the surrounding

area, there is a parallel trench which follows the circumference of the wall. This gives the impression of a drainage-line component and is wetter than the surrounding area. *Phragmites* reeds grow inside the trench. The TSF under rehabilitation resembles the active TSF, but is wholly covered with vegetation and is dry. Karoo scrub, grasses and indigenous trees such *Acacia tortilis*, *Rhus lancea*, *Rhus pyroides*, and exotics *Tamarix ramosissima* and *Opuntia* sp are all present.

Sedges and wetland related species found within the gamefarm section of the Koffiefontein Mine include *Cyprus* spp., *Schoenoplectus corymbosus* and *Typha capensis* (Van Deventer, 2011). Shrubs, succulents and other species include *Albuca Gladoilus* sp., *Alternanthera pungens* (Papierduweltjie), *Amaryllidaceae Scilla* sp., *Anacampseros lanigera* (Haaskos, Rare species), *Argyrolobium zanonii*, *Asclepias fruticosa* (Milkweed), *Asparagus Africana* (Katstert), *Asparagus suaveolens* (Groot katstert), *Berkheya barbata*, and *Brunsvigia radulosa*

A number of mammal species has been recorded in the Koffiefontein Mine area, with several other species expected to occur within the property. Several large to medium sized antelope species were encountered, e.g. Gemsbuck, Blue Wildebeest, Red Hartebeest, Zebra, Blesbuck, Springbuck and Eland. Their presence however is explained by the game farm, which approximately 1930 hectares in size that forms part of the Koffiefontein Mine property area.

With regards to herpetofauna, seven of the 12 possible amphibian species were found during at the Koffiefonein Mine property. These represent six families and include species that are primarily aquatic, semi-aquatic and semi-terrestrial. The species found included *Amietophrynus rangeri* (Raucous toad), *Amietia angolensis* (Common river frog), *Amietia fuscigula* (Cape river frog), *Cacosternum boettgeri* (Common caco), *Tomopterna cryptotis* (Tremelo sand frog), *Kassina senegalensis* (Bubbling kassina), and *Xenopus laevis* (African clawed frog). Distribution ranges is provided in Table 6-1.

Nine of the 37 possible reptile species were found within the Koffiefontein Mine property. These represent six families and subfamilies and include species that are primarily aquatic, semi-aquatic, terrestrial and arboreal. Species include *Stigmochelys pardalis* (Leopard tortoise), *Pelumodusa subrufa* (Marsh terrapin), *Psammophylax tritaeniatus* (Striped skaapsteker), *Trachylepis striata* (Eastern striped skink), *Trachylepis sulcata* (Western rock skink), *Pedioplanis lineoocellata* (Spotted sand lizard), *Varanus nilotikus* (Water monitor), *Cordylus polyzonus* (Karoo girdled lizard), and *Agama atra* (Southern rock agama).

Table 6-1: Distribution ranges of herpetofauna species found at the study site

Species	Distribution
Amietophrynus rangeri	Occurs in all provinces of South Africa, including Lesotho and Swaziland. This species is widespread, except for the Central Karoo region.
Amietia angolensis	This species is widely spread across southern Africa. It occurs mainly in the eastern half of South Africa, from the eastern border of the Western Cape Province, the eastern and southern Eastern Cape Province, the whole KwaZulu-Natal, Limpopo, Gauteng, Free State, North West Province and the Northern Cape Province.
Amietia fuscigula	Found at sea level in the Western and Eastern Cape provinces, but generally at higher elevations in the other provinces, but does not occur in Limpopo.
Cacosternum boettgeri	Wide distribution in southern Africa. It occurs widely in South Africa and occurs in all the provinces, except parts of the western Cape, Namaqualand, Mpumalanga escarpment and the Lesotho highlands.
Tomopterna cryptotis	Restricted to the central highlands of southern Africa. They are found in most of the Free State, North West, Gauteng, Limpopo, Mpumalanga, eastern Northern Cape and northern KwaZulu-Natal.
Kassina senegalensis	Common and widely distributed and is present in all the provinces except the Western Cape Province, the western part of the Eastern Cape Province and the central and western parts of the Northern Cape Province.
Xenopus laevis	Occurs widely in sub-Saharan Africa, and is present in all nine provinces of South Africa. They are absent in extreme arid areas, including parts of the Northern Cape Province. They are also absent in the low-lying parts of Limpopo and Mpumalanga.
Stigmochelys pardalis	Found throughout the savannahs of Africa, from Sudan to the southern Cape.
Pelumodusa subrufa	Most widely spread and most common terrapin in southern Africa. It occurs wherever suitable water bodies are present, but it is absent from the most arid parts of the Northern Cape Province, the southern half of Namibia and the south eastern parts of Botswana.
Psammophylax tritaeniatus	Found in open grass lands and savannah areas. The distribution of this species is From the Free State, through Gauteng and the Northern Provinces.
Trachylepis striata	Occurs in North Eastern Cape, through the former Transkei, Western KwaZulu-Natal, Free State, and the Northern Provinces.
Trachylepis sulcata	Occurs in Karroid areas of the Cape and adjacent Free State, through Namibia to South Angola.
Pedioplanis lineoocellata	Occurs in the Western half of South Africa, but is absent from regions with deep sand, e.g. deserts
Varanus nilotikus	Occurs in Sub Saharan Africa, from the Eastern Cape, KwaZulu-Natal, Free State, North West Province, Gauteng Province, Limpopo and the Mpumalanga Province.
Cordylus polyzonus	Range from the central and Western Cape into southern Free State and South Namibia.
Agama atra	Occurs in a variety of habitats, from semi-desert to fynbos, from sea-level to mountain tops.

6.8 Avifauna

6.8.1 Data collection

Avifauna surveys where undertaken at Petra's Koffiefontein mine by the School of Biological Sciences at North-West University since 2012. Winter and summer surveys were undertaken at six sampling strata in the farm area, and four areas in the mining section i.e. the active Tailings Storage Facilities (TSF), the outer wall of the TSF, the rehabilitated TSF, and the return dam used in the circulation of water used for mining operations (Figure 6-10).

The following reports were consulted:

- North-West University, 2013. Winter and Summer Avifaunal Surveys of Petra Mines, Koffiefontein, South Africa - June 2012/February 2013
- North-West University, 2012. Avifaunal Survey of Petra Mines Koffiefontein, South Africa - June 2012
- North-West University, 2012. Summer Assessment of the Avifauna of Petra Mines Koffiefontein, Western Free State, South Africa - Interim Project Report – January 2012

6.8.2 Regional description

The Karoo is home to a relatively rich avifaunal component with about 300 regularly recorded species and another hundred that occasionally or rarely occur (Harrison *et al.* 1997). It has been documented that land use changes in this area have not only altered avian species richness, but also mutualisms and plant-bird interactions. During the first Southern African Bird Atlas Project a total of 156 bird species where recorded in the quarter degree grid cell, 2925AC Koffiefontein (Harrison *et al.* 1997).

6.8.3 Study area

120 Bird species were collectively recorded within the Petra Mine Koffiefontein property area, with 90 species present during the winter, and 94 species during the summer survey. This includes all transects and incidental records for both seasons. Nineteen endemic, and twenty-four near-endemic species, were recorded. The near endemic Ludwig's Bustard (LB) was the only vulnerable species recorded during the winter survey, with the migrant Lesser Kestrel (LK) and the endemic Blue Crane (BC) recorded during the summer. Black Harrier (BH) and Blue Korhaan (BK) were two endemic, near-threatened, species recorded during the winter, and Secretarybird (SB) a breeding resident and near-threatened species was recorded both seasons. A total of nine migrant species were recorded in summer, with three of those species being breeding migrants. The Common Myna (COM) was the only introduced species recorded, and that during the summer survey.

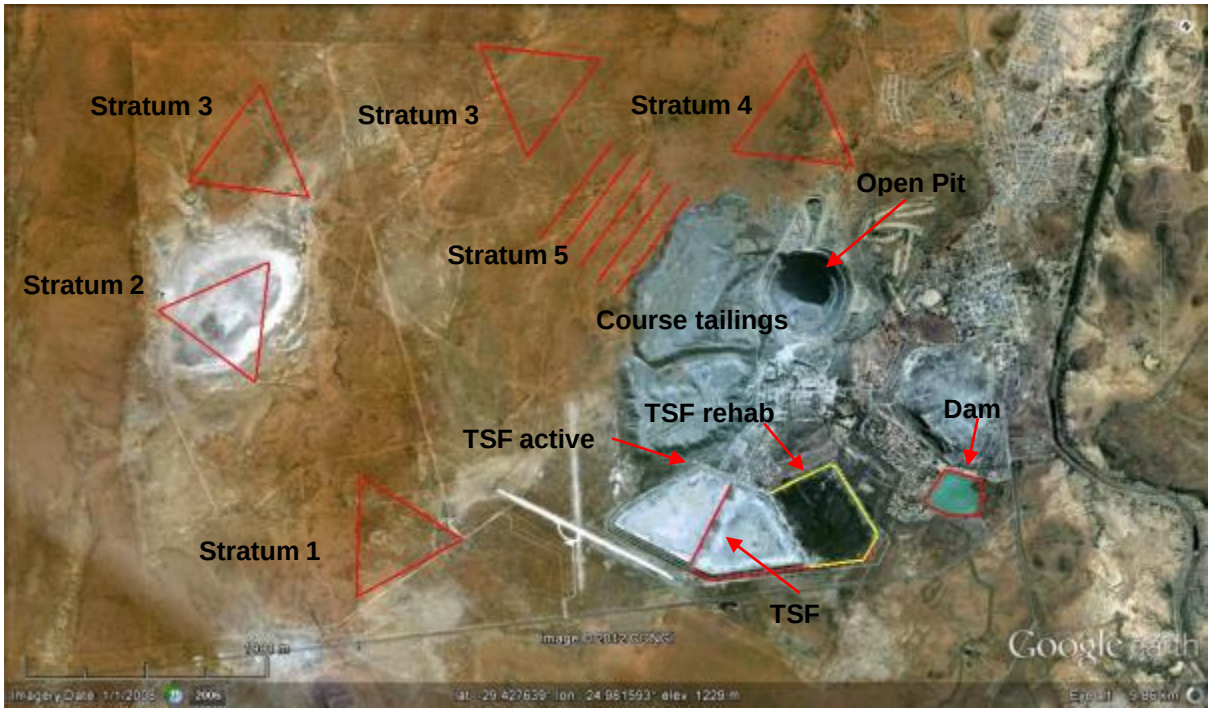


Figure 6-10: Petra Mine Koffiefontein indicating sampling strata

6.8.4 Findings

Findings suggest that Ant-eating Chat (AEC), African Pipit (AP), Northern Black Korhaan (NBK), Spike-heeled Lark (SHL), Karoo Scrub-Robin (KSR), Bokmakierie (B), Rufous-eared Warbler (REW), and Eastern Clapper Lark (ECL) could collectively serve as indicators of Karoo scrub/grassland which would help in assessing the degree to which rehabilitation of habitat in this particular area has occurred.

The relatively high summer density as well as the high species richness estimated on the Petra Mines Koffiefontein property area is probably a reflection of the great variety of habitat features to be found on the property area. In addition to the high species richness, the property also boasts a high incidence of endemic and near endemic birds.

Because of the low density of individual bird species in the area, no direct evidence could be obtained which would indicate negative impacts on birds on the farm area because of the proximity of mining operations.

6.8.5 Recommendations

Any planned expansion of the mine, whether infrastructure, TSF expansions or active mining, should not intrude into the woodland area (Stratum 4 and parts of Stratum 3 and 5 (see Figure 6-10). The woodland area covers only a small portion of the property, but contributes largely to the species richness. Also, it affords breeding opportunities to the resident pair of Secretary birds (near-threatened species).

6.9 Air quality

6.9.1 Data collection

Information relating to air quality was obtained from the draft Air Quality Management Plan produced for the Free State Province prepared by Zanokuhle Environmental Services.

6.9.2 Regional description

Air quality monitoring in the Free State is confined to a few local and district municipalities, and data is difficult to obtain. The Free State draft Air Quality Management Plan assessed data Mangaung Local Municipality (MLM), Sasolburg and Vaal Triangle networks. The MLM stations are situated in Bloemfontein while the DEAT and Sasolburg networks represent an area within the Vaal priority area, Fezile Dabi District Municipality. The MLM has four ambient monitoring station within the Bloemfontein Central Business District (CBD) that monitors meteorological parameters, Sulphur Dioxide (SO_2), Particulate Matter <=10µm (PM_{10}) and Particulate Matter <=2.5µm ($PM_{2.5}$). The Sasolburg network comprises four continuous monitoring stations while the Vaal Triangle Priority Area (DEAT) network has only one station that falls within the Free State.

The sources of airborne particulate matter in the Free State include:

- Agricultural activities which result in wind-blown soil dust that occur from bare fields, especially in dry periods,
- Vehicles, unpaved roads and construction,
- Mining including quarries,
- Domestic fuel burning,
- Industries including power plants and to lesser extent natural sources.

6.9.3 Study area

No site specific air quality data could be found to assess the air quality baseline conditions associated with the Letsemeng LM, the town of Koffiefontein or the Koffiefontein Diamond Mine. Windblown dust and particulate matter has been identified as a source of air pollution associated with slimes dams and tailings storage facilities. An air quality assessment was undertaken to assess potential impacts associated with the KDM and recommended mitigation measures that will be affective in minimising identified air quality impacts.

6.10 Socio-Economic Profile

The following social information was extracted from the Integrated Development Plan 2014-15 for the Xhariep District Municipality. The IDP and most recent review for the Letsemeng Local Municipality had been evaluated – together with other relevant data sources – to determine inter alia the following pertaining to environmental matters:

- Education Profile;
- Health Profile;
- Socio-Grant per population group
- Types of dwelling per population enumerated;
- Economic Active population.

6.10.1 Education Profile

Definition

Functional literacy is defined as the number of persons aged 20 and above that has completed grade 7. For an investigation on no schooling and limited schooling (grade 5) global insight utilized population with age 15 and above in their count of no schooling and limited education (Grade 5), as this is the legal school-leaving age.

Indicator

Grade 12 pass rate:

- Ten year target: 80%
- Twenty year target: 90%

An investigation of level of education identified the following specific geographic areas (district and local municipalities) with highest need, indicated in relation with Xhariep District Municipality and its local municipalities.

The number of persons aged 20 and above that has completed grade 7 in Xhariep in 2010 was 68 887, representing a percentage of 58.33% of residents and had less in number in relation with other district and metro municipalities of the province.

Locally, Kopanong topped the other three local municipalities (Letsemeng, Mohokare and Naledi) with total number of functional literate people of 26 017 (61.29 % of LM residents). Letsemeng was the second highest with 18 683 (55.42 %), followed by Mohokare with 13 323 (55.07 %) and Naledi with 10 863 (61.22 %) functional literate people.

Accounting for people with no schooling and limited education, the district had 14 707 (10.81%) people aged 15 or more with no schooling and 22 523 (16.56%) people with limited education in 2010. It had less number in relation with other district and metro municipalities with people that have no schooling and limited education (Table 6-2).

Table 6-2: Number of pupils per schooling category per LM (Data Source: Xhariep District Municipality, Integrated Development Plan 2014-15)

Local Municipality	Letsemeng	Kopanong	Mohokare	Naledi	Total
Pre-school including day care; crèche; Grade R and Pre-Grade	91	122	149	87	**450**

Local Municipality	Letsemeng	Kopanong	Mohokare	Naledi	Total
R in an ECD centre					
Ordinary school including Grade R learners who attend a formal school; Grade 1-12 learners & learners in special class	8847	12013	9372	7208	**37440**
Special school	25	42	17	63	**147**
Further Education and Training College FET	92	127	82	46	**347**
Other College	30	64	15	17	**127**
Higher Educational Institution University/University of Technology	147	289	184	98	**719**
Adult Basic Education and Training Centre ABET Centre	150	190	114	177	**631**
Literacy classes e.g. KhaRiGude; SANLI	63	36	33	61	**193**

6.10.2 Health profile

The Letsemeng has the second highest number of clinics operating in the municipality, however no hospitals are located within the boundaries of the LM (Table 6-3). Residents have to travel to Jagersfontein, Trompsburg, Smithfield or Zastron to access hospital services.

Table 6-3: Health profile of local municipalities in the Xhariep District Municipality (Data Source: Xhariep District Municipality, Integrated Development Plan 2014-15)

Local Municipality	Letsemeng	Kopanong	Mohokare	Naledi
Fixed Clinics	5	10	4	4
Mobile Clinics (weekly range)	6	6	6	
Vehicles	13 + 5 subsidised	11 + 8 subsidised	21 + 11 subsidised	
Ambulances	4	9	6	
Commuter Services	2	3	4	
Radio-graphic Services	1 X-Ray, I Sonar	2 X-ray, 1 Radiographer, 1 Supplementary Radiographer, 1 Community service Radiographer	2 X – Rays, 1 Community Service Radiographer	
District Hospitals (laundry, mortuary & theatre services)	0	Diamond hospital (Jagersfontein) - 32 bed; Trompsburg District Hospital - 300 beds	Stoffer Coetzee Hospital (Smithfield) - 23 beds; Embekweni Hospital (Zastron) - 25 beds	
Community Health care	1	1	0	

6.10.3 Social grant profile

Letsemeng LM has the second lowest overall grant and aid dependants in the Xhariep DM, while Kopanong has the highest number of grant and aid dependants in the Xhariep DM (Table 6-4).

Table 6-4: Social grant profile per population group (Data Source: Xhariep District Municipality, Integrated Development Plan 2014-15)

Municipality	Type of grant	Black	Coloured	Indian	White
Letsemeng Local Municipality	Old age pension	1 227	715	-	168
	Disability grant	1 763	589	-	84
	Child support grant	4 418	1 293	-	-
	Care dependency grant	-	150	-	-
	Foster care grant	20	-	-	-
	Grant in aid	155	-	-	-
	Social relief	-	-	-	-
	Multiple social grants	-	125	-	-
	Total grants / aid	**7583**	**2872**	**0**	**252**
Kopanong Local Municipality	Old age pension	3 322	392	-	534
	Disability grant	2 624	850	-	-
	Child support grant	6 027	1 551	-	-
	Care dependency grant	168	-	-	-
	Foster care grant	55	-	-	-
	Grant in aid	227	99	-	-
	Social relief	107	-	-	-
	Multiple social grants	-	-	-	-
	Total grants / aid	**12530**	**2892**	**0**	**534**
Mohokare Local Municipality	Old age pension	2 282	91	-	136
	Disability grant	1 376	-	-	-
	Child support grant	7 841	225	-	-
	Care dependency grant	226	-	-	-
	Foster care grant	32	-	-	-
	Grant in aid	162	-	-	-
	Social relief	-	-	-	-
	Multiple social grants	68	-	-	-
	Total grants / aid	**11987**	**316**	**0**	**136**
Naledi Local Municipality	Old age pension	1 785	37	-	23
	Disability grant	756	54	-	49
	Child support grant	4 121	66	-	-
	Care dependency grant	46	-	-	20
	Foster care grant	23	-	-	-
	Grant in aid	43	-	-	-
	Total grants / aid	**6774**	**157**	**0**	**92**

6.10.4 Housing conditions

The Letsemeng LM has the second lowest number of formal dwellings within the municipality (Table 6-5), but shows the highest number of informal dwellings still being occupied. This clearly indicates the need for the development of formalised dwellings in the Letsemeng LM.

Table 6-5: Types of dwelling per population

Type of dwellings	FS161: Letsemeng	FS162: Kopanong	FS163: Mohokare	FS164: Naledi
House or brick/concrete block structure on a separate stand or yard or on a farm	9016	13904	9027	6309
Traditional dwelling/hut/structure made of traditional materials	17	57	74	34
Flat or apartment in a block of flats	63	80	62	35
Cluster house in complex	12	11	5	42
Townhouse (semi-detached house in a complex)	36	31	1	9
Semi-detached house	76	20	97	106
House/flat/room in backyard	133	197	103	15
Room/flat let on a property or larger dwelling/servants quarters/granny flat	22	51	55	10
Total: Formal dwellings	**9375**	**14351**	**9424**	**6560**
Informal dwelling (shack; in backyard)	634	475	838	662
Informal dwelling (shack; not in backyard; e.g. in an informal/squatter settlement or on a farm)	1179	739	483	436
Caravan/tent	5	6	9	-
Total: Informal dwellings	**1818**	**1220**	**1330**	**1098**

6.10.5 Economically Active population

Definition

Economically active population is defined as the number of people that are able and willing to work from the age of 15 up to and including 64 years. It includes both employed and unemployed persons. In this regard, the official definition of Economically active population is utilized in that persons who consider themselves unemployed, but did not recently take active steps to find employment are not considered part of the economically active population. The economically active population is measured at the place of residence and thus represents the number of economically active persons residing within a specific region.

Table 6-6: Economically Active Population per Local Municipality

Local Municipality	Number	Percentage (%)
Kopanong	19472	29.54
Letsemeng	16639	30.53
Mohokare	12110	32.63
Naledi	8067	27.38

Letsemeng LM shows the second highest number of economically active persons when compared to the other LMs in the Xhariep DM.

6.10.6 Unemployment

According to the Letsemeng Local Municipality IDP, 2012-2013, 9 510 of the people are in formal employment in the Letsemeng Local Municipality, the remaining 27 563 need to be brought into the mainstream of the development and economy of the area. The balance of the population which is 27 563 derives their livelihoods from the informal sector including pensions, disability grants as well as seasonal work. The number of unemployment has most absolutely decreased during the past 11 years according to census statistics. The unemployment figures pose a mammoth challenge to Letsemeng Local Municipality which enforces upon us the need to develop more social support programmes and job creation initiatives that will reduce the unemployment rate significantly. The other endeavour will be to create a business enabling environment in the area to attract more private investors to the area to bring more sustainable economic growth to the municipal area. Self-employment initiatives and SMME development programmes will increase through the Local Economic Development Unit of Letsemeng Municipality, which has put a budget aside for Local Economic Development projects.

7 SUMMARY OF SPECIALIST STUDIES AND PROCESSES

7.1 Introduction

In terms of Chapter 5 of the NEMA EIA regulations, EIA means the process of collecting, organising, analysing, interpreting and communicating information that is relevant to the consideration of the application. This includes an assessment of the nature, extent, duration, probability and significance of the identified potential environmental, social and cultural impacts of the proposed development as well as the cumulative impacts thereof. Mitigatory measures for each significant impact are to be determined. Alternative land uses or developments, their impacts and their cumulative impacts will also be considered and compared with those of the proposed development.

7.2 Terms of Reference (ToR) for Specialist Studies

Based on the available data, the issues raised by stakeholders and the sensitivities identified the following specialist studies will be conducted in the EIA phase:

- Slime Waste Classification;
- Facility Design (conceptual design);
- Terrestrial Ecology Assessment (Fauna and Flora);
- Heritage Impact Assessment;
- Geotechnical Assessment;
- Air Quality Assessment; and
- Groundwater assessment.

The findings of these studies is reflected in the EIA Report. The proposed Terms of Reference (ToR) for each of these specialist investigations is indicated below.

7.2.1 ToR: Slime Waste Classification

The process to extract diamonds from the mined ore produces among other fine tailings as a waste stream. The extraction process employed slurries the fine tailings when it comes out of the plant and deposited on it in the slimes dam facility. The scope of work includes the following activities:

- Classification of the slimes dam tailings;
- Waste sample chemical analyses by a (South African Norms and Standards) SANAS accredited laboratory;
- Total chemical composition analysis for inorganic and organic compounds;
- Waste classification report with recommendations on the type of landfill barrier system, etc.
- The waste classification will have significant input towards the preferred alternative for waste disposal as well as the conceptual design of the required disposal facilities.

7.2.2 ToR: Slime Dam Design and Operating Manual

A design engineer were appointed to undertake the conceptual design of the slime dam. The scope of work will include:

- Site visit of the project area;
- Commission and oversee the Topographical Survey of the site;
- Identification of applicable standards, legislation and guidelines which would constitute project adherence / compliance requirements;
- Generate conceptual layout alternative drawings for each of the three site alternatives;
- Compile design drawings for the preferred slime dam alternative for the 15 year life of the site to the design standard required for a waste management licence application;
- Undertake liner design for the slimes dam;
- Submit and present drawings to DESTEA and DWS for review and make any alternations required;
- Include any mitigation measures prescribed by specialist into the design;
- Investigate optimisation strategies to minimise the development footprint; and
- Review and amend current site operating manual to be relevant for the new site.

7.2.3 ToR: Topographic Survey (for concept design)

A specialist surveyor undertook a topographic survey. The scope included:

- Survey of the site at 0.5 meter contours;
- Identify all features and structures within the surveyed area;
- Produce 0.5 m contours and high-resolution aerial photography of the study area; and
- Submit the information in an electronic CAD format.

7.2.4 ToR: Terrestrial Ecology

An ecological investigation was conducted on the alternative sites and their associated infrastructure. The objectives of this study included the following:

- Review existing ecological information available;
- Identification of applicable standards, legislation and guidelines which would constitute project adherence / compliance requirements;
- Conduct a site visit during the summer seasons to determine the general ecological state of the proposed site, determine the occurrence of any red data and/or vulnerable species, or any sensitive species requiring special attention;
- Compile a detailed description of the baseline environment;
- Provide a ranking assessment of the suitability of the proposed sites;
- Identify significant impacts that may cause detrimental impact to the environment;
- Undertake a comparative assessment of the various alternatives;

- Provide mitigation measures to prevent and/or mitigate any environmental impacts that may occur due to the proposed project;
- Advise on the legislated or best practice buffer zones around sensitive environments; and
- Compile an ecological report, indicating findings, preferred site recommendations and maps indicating sensitive and/or no-go areas.

7.2.5 ToR: Heritage Impact Assessment

A Heritage Impact Assessment was conducted to comply with Section 38 of the National Heritage Resources Act (No 25 of 1999). Specific objectives of this study was to:

- Undertake a desktop assessment (consulting heritage data banks and appropriate literature);
- Identify applicable standards, legislation and guidelines which would constitute project adherence / compliance requirements;
- Undertake a site visit of the project area;
- Determine whether any of the types and ranges of heritage resources as outlined in Section 3 of the Act (No 25 of 1999) do occur in the project area;
- Determine what the nature, the extent and the significance of these remains are;
- Determine whether any heritage resources (including graves) were going to be affected by the development of the project;
- Identify possible archaeological, paleontological, cultural and historical sites within the study area;
- Identify the potential impacts of construction and operation of the proposed development on such resources, with and without mitigation;
- Offer an opinion on a preferred site in terms of this specialist field;
- Provide mitigation measures to ameliorate any negative impacts on areas of heritage significance; and
- Advise on the legislated or best practice buffer zones around sensitive environments.

7.2.6 ToR: Geotechnical assessment

The Phase 2: geotechnical assessment was undertaken on each of the alternatives. The objectives of the study included:

- Review existing available geological, drilling and geotechnical information;
- Identify applicable standards, legislation and guidelines which would constitute project adherence / compliance requirements;
- Conducted a site visit to verify available aerial photographs and investigated the depth and properties of regolith by excavations and soil sampling;
- Approximately 10 test pits were excavated on the each site to characterise land forms or terrain units and anomalies identified during the API. Samples of representative soils were taken to the laboratory testing;

- Dynamic Cone Penetration Tests (DCPT) was carried out at the site of each test pit to determine the variation in in-situ stiffness over the upper 1m of the profile;
- Soil samples from the test pits were tested for soil, classification, compaction characteristics and strength/stiffness properties;
- Identified and assessed significance of potential geotechnical constraints to the proposed development;
- Proposed mitigation measures that could reduce or eliminate the identified constraints; and
- Advised on the legislated buffer zones around sensitive environments.

A geotechnical report was compiled highlighting the findings of the study.

7.2.7 ToR: Air Quality Assessment

The Air Quality Assessment included a Baseline Characterisation and an Impact Assessment. Specific objectives of this study were to:

- Provide a detailed literature review of the available information.
- Carry out a desktop literature review and gether available information in relation to the air quality;
- Describe the material characteristics of the slime material;
- Identify expected air emissions sources;
- Identify applicable air quality standards, legislation and guidelines which would constitute project adherence / compliance requirements;
- Analyse site-specific meteorological data at the proposed site, using the MM5 model meteorological data, supplemented by dispersion modelling (using AERMOD modelling code), covering the construction, commissioning, operating and decommissioning phases of the proposed project;
- The methodology and findings of the site screening exercise based on air quality criteria, findings were consolidated into the motivation of the preferred project site and recommendations for forwarding the preferred site into the EIA phase.
- Provided professional opinion in regards to:
    - Incorporation of air quality criteria into the Environmental Impact Report (EIR) and Environmental Management Plan (EMP) documents;
    - Management interventions to control and/or mitigate the identified project air quality impacts; and
    - Advised on the legislated buffer zones around sensitive environments.

7.2.8 ToR: Groundwater Assessment

A Groundwater Assessment Study was for the proposed project. The objectives of this study included the following:

- Provide a detailed literature review of the available information.

- Identify applicable standards, legislation and guidelines which would constitute project adherence / compliance requirements;
- Undertake a site visit and conduct a hydrocensus;
- Carry out groundwater sampling and for laboratory analyses;
- Undertake a gap analyses of existing groundwater monitoring network;
- Develop an initial groundwater conceptual model;
- Review geochemical data;
- Update existing groundwater numerical model for impact and risk assessment;
- Identify and assess significance of potential groundwater impacts resulting from the proposed development;
- Propose mitigation measures that could reduce or eliminate the identified impacts;
- Advise on the legislated or best practice buffer zones around sensitive environments; and

7.2.9 Environmental Management Programme

An Environmental Management Programme (EMPr), in the context of the Regulations, is a tool that takes a project from a high level consideration of issues down to detailed workable mitigation measures that can be implemented in a cohesive and controlled manner. The objectives of an EMPr are to minimise disturbance to the environment, present mitigation measures for identified impacts, maximise potential environmental benefits, assign responsibility for actions to ensure that the pre-determined aims are met, and to act as a “cradle to grave” document. The EMPr was drafted according to the findings in the Scoping Report and Draft EIR.

7.2.10 Public Participation during the EIA Phase

The purpose of public participation during the Impact Assessment Phase is to present the findings of the EIA phase and to avail the Draft EIR to the public for comments. I&APs will be afforded an opportunity to verify that their issues have been considered either by the EIA specialist studies, or elsewhere. Also, I&APs will comment on the findings of the Draft EIR, including the measures that have been proposed to enhance positive impacts and reduce or avoid negative ones. Once the review is completed, the authority may decide to request additional information on matters that may not be clear from the report, authorise the application with certain conditions to be complied with by the applicant or reject the application. An EA reflecting the decision of the authority as well as any conditions that may apply will be issued to the applicant, which will be communicated to all I&APs during the final phase of Public Participation.

I&APs will be advised in good time of the availability of these reports, how to obtain them, and the dates and venues of public and other meetings where the contents of the reports will be presented for comment.

The public participation process for the EIA involve the following proposed steps:

- Announcement of the availability and public review of the Draft EIR;
- Host a Key Stakeholder Workshop and two public meetings when a summary of the environmental findings as documented in the Draft EIR and mitigations measures as proposed in the Draft EMPr will be presented;
- Announcement of the availability of the Final EIR; and
- Notification of the authorities' decision with regard to EA

Below information is provided about each step.

Announcing the availability of the Draft EIR and the EMPr

A letter will be circulated to all registered I&APs on the project database, informing them in terms of progress made with the study and that the Draft EIR and EMPr are available for comment. The report will be distributed to public places and also presented at a stakeholder meeting. Advertisements will be placed in the same newspapers used in the scoping phase to announce the public review period of the Draft EIR.

Public review of Draft EIR and Draft EMPr

The EIA Guidelines specify that stakeholders must have the opportunity to verify that their issues have been captured and assessed before the EIA Report will be approved. The findings of the specialist assessment will be integrated into the Draft EIR. The report will be written in a way accessible to stakeholders in terms of language level and general coherence. The Draft EIR will have a comprehensive project description, motivation and alternatives being considered and also the findings of the assessment and recommended mitigation measures. It will further include the Comments and Responses Report (CRR), which will list every issue raised with an indication of where the issue was dealt with in the EIR. The findings of the assessment and recommended mitigation measures will also be incorporated into the EIR.

As part of the process to review the Draft EIR and Draft EMPr, a stakeholder workshop and two public meetings will be arranged to afford stakeholders the opportunity to obtain first-hand information from the project team members and also to discuss their issues and concerns. Contributions at this meeting will be considered in the Final EIR.

Announcing the availability of the Final EIR and EMPr

A letter will be circulated to all registered I&APs, informing them in terms of progress made with the study and that the Final EIR and EMPr are available for comment. The reports will be distributed to the same public places (See Section 5 with the venues) as the previous reports for I&APs to review.

Progress feedback

After comments from I&APs have been incorporated, all stakeholders on the database will receive a letter to report on the status of the process, to thank those who commented to date and to inform them that the Final EIR and EMPr have been submitted to the lead authority for consideration. I&APs will be advised on the next steps in the process.

Announce Competent Authority's decision

Registered I&APs will be notified by letter of the Environmental Authorisation issued, including the reason for the Competent Authority's decision and the appeal process. An advertisement will be placed in the same newspapers which were used during the scoping and impact assessment phases.

8 ALTERNATIVE ASSESSMENT

The alternatives were selected based on identified site constraints and sensitivities and through professional experience and consultation with project stakeholders (steering team), interested and affected parties, including the key stakeholders and indigenous communities. The site selection workshop was conducted on 9 April 2015. The proposed project falls within area zoned for mining, thus environmental impacts identified pose a lesser risk. Koffiefontein Diamond Mine wholly owns the farms that surround the mine, and discussion with Koffiefontein Diamond Mine indicated that no other sites were considered as alternatives other than those at close proximity and owned by the mine. During the site screening workshop, the technical team focused on the following criteria:

- Engineering feasibility;
- Environmental and social sensitivities; and
- Financial / Cost Implications.

The screening workshop was conducted on the five potential sites to eliminate options that did not meet the general requirements. None of the five sites, as stand-alone options, could accommodate the total fines volume expected over the 20 year LOM, of 9 Mt and 15 Mt respectively. Four additional options were then added during the site screening workshop. These additional options were combinations of mine's existing FRSF (Option 5) and one of the other stand-alone sites. **Table 8-1: Site Options**

Site	Description
Option 1	Located approximately 1.3 km south west of the plant, between the tailings storage facility (TSF) and existing FRSF.
Option 2	Located 1.6 km south west of the plant and west of the existing TSF and existing FRSF.
Option 3	Located approximately 0.5 km west of the plant, flanked by the mines TSF's.
Option 4	This site is 2 km from the plant, south of the existing FRSF and adjacent to the R48 road and located on the eastern section of the air strip
Option 5	This option is the raise of the existing FRSF to a higher elevation than currently planned and designed for. The facility is located 1 km south west of the plant.
Option 6	Modified Option 1 + 5
Option 7	Modified Option 2 + 5
Option 8	Modified Option 3 + 5
Option 9	Modified Option 4 + 5

The site screening workshop resulted in options 1, 3, 6 and 8 being eliminated as potential options going forward with the design. The remaining options (namely options 2,4,5,7 and 9) were then taken forward to the Site Selection workshop. Subsequent to the site screening, another option was added; Option 10 is the joining of site 4 to site 5 to construct one large facility. Option 10, modified option 4/5 combined into one facility, was also brought forward to the Site Selection workshop. Details of the site screening process are detailed in technical memorandum "Koffiefontein Mine Fine Residue Facility Site Screening Assessment. 18 February 2015" attached in the appendices.

8.1 Site selection workshop

The site selection workshop was conducted on 9th April 2015. Both engineering and environmental personnel from ZC / Golder participated in the workshop. The aim of the process was to identify the best and next best options to take forward into the conceptual design.

8.1.1 Storage capacity calculations

Scoping level designs were finalised for each option brought forward from the site screening workshop. The capacity analyses and preliminary bill of quantities were extracted from the designs completed for each option. The capacity analyses were completed for deposition rates of 32 700 tpm and 62 400 tpm, giving total volumes, over the 20 year LOM, of 9 Mt and 15 Mt respectively. Table 8-2 below shows the results of the capacity analysis checking if each of the capacity conditions were met by the site options. **An option was considered flawed if it did not meet the capacity requirements for the lower or upper bound capacity limits.**

Table 8-2 below shows the results of the capacity analysis checking if each of the capacity conditions were met by the site options. An option was considered flawed if it did not meet the capacity requirements for the lower or upper bound capacity limits. Figure 8-1 shows developable areas used during the site screening workshop.

The site selection for the FRSF involved a two-step approach including:

- Complete a site screening study of the site options identified to eliminate the sites that do not comply with the general requirements;
- Site selection workshop to identify the preferred and the second best sites based on the remaining sites from the screening process. This will involve a site ranking and rating to identify the most likely socially and environmentally acceptable sites and also the technical or engineering assessment and suitability of each site.

A site screening workshop was conducted on the five potential sites to eliminate options that did not meet the general requirements. None of the five sites, as stand-alone options, could accommodate the total fines volume expected over the life of the mine (total volume taken as 62 400 tpm over 20 LOM). Four additional options were then added during the site screening workshop. These additional options were combinations of mine's existing FRSF (Option 5) and one of the other stand-alone sites.

Table 8-1: Site Options

Site	Description
Option 1	Located approximately 1.3 km south west of the plant, between the tailings storage facility (TSF) and existing FRSF.

Site	Description
Option 2	Located 1.6 km south west of the plant and west of the existing TSF and existing FRSF.
Option 3	Located approximately 0.5 km west of the plant, flanked by the mines TSF's.
Option 4	This site is 2 km from the plant, south of the existing FRSF and adjacent to the R48 road and located on the eastern section of the air strip
Option 5	This option is the raise of the existing FRSF to a higher elevation than currently planned and designed for. The facility is located 1 km south west of the plant.
Option 6	Modified Option 1 + 5
Option 7	Modified Option 2 + 5
Option 8	Modified Option 3 + 5
Option 9	Modified Option 4 + 5

The site screening workshop resulted in options 1, 3, 6 and 8 being eliminated as potential options going forward with the design. The remaining options (namely options 2,4,5,7 and 9) were then taken forward to the Site Selection workshop. Subsequent to the site screening, another option was added; Option 10 is the joining of site 4 to site 5 to construct one large facility. Option 10, modified option 4/5 combined into one facility, was also brought forward to the Site Selection workshop. Details of the site screening process are detailed in technical memorandum "Koffiefontein Mine Fine Residue Facility Site Screening Assessment. 18 February 2015" attached in the appendices.

8.2 Site selection workshop

The site selection workshop was conducted on 9th April 2015. Both engineering and environmental personnel from ZC / Golder participated in the workshop. The aim of the process was to identify the best and next best options to take forward into the conceptual design.

8.2.1 Storage capacity calculations

Scoping level designs were finalised for each option brought forward from the site screening workshop. The capacity analyses and preliminary bill of quantities were extracted from the designs completed for each option. The capacity analyses were completed for deposition rates of 32 700 tpm and 62 400 tpm, giving total volumes, over the 20 year LOM, of 9 Mt and 15 Mt respectively. Table 8-2 below shows the results of the capacity analysis checking if each of the capacity conditions were met by the site options. **An option was considered flawed if it did not meet the capacity requirements for the lower or upper bound capacity limits.**

Table 8-2: Capacity analysis and planning for FRSF site selection

Site Option	Lower Bound Capacity (9 Mt)	Upper Bound Capacity (15 Mt)	Flawed / Not Flawed
2	Yes	No	Flawed for upper bound

Site Option	Lower Bound Capacity (9 Mt)	Upper Bound Capacity (15 Mt)	Flawed / Not Flawed
			capacity
4	No	No	Fatal Flawed
5	Yes	Yes	Not Flawed
7	Yes	No	Flawed for upper bound capacity
9	Yes	Yes	Not Flawed
10	Yes	Yes	Not Flawed

Only options 5, 9 and 10 have adequate capacity to accommodate both the lower and upper bound capacity requirements, with deposition on the facilities below or at the 1 m/yr rate restriction. However this does not rule out the possibility of a combination of sites to meet the capacity requirements.

8.3 Site selection criteria

The key criteria for the site selection workshop were:

- Engineering criteria
- Environmental criteria (H&S/ Social)
- Financial criteria

The sub-criteria for each of the key aspects stated above were based on the sub-criteria used in the site screening process. Some changes were made to the sub-criteria to update it to a site selection level Table 8-3 below, shows a summary of the sub-criteria used in the Site Screening.

Table 8-3: Sub-criteria used in site selection workshop

	Engineering	Environmental	Financial
Sub-criteria	Stormwater management impact	Risk of impacting on groundwater	Capital cost estimate (Capex)
	Airspace achieved within the rate of rise limitations	Impact on surface water	Operating Costs (Opex)
	Decant system (Number to operate and maintain)	Rehabilitation and closure requirements	Closure costs
	Decant system (Availability of stand-by systems for continued operations)	Licensing and regulatory requirements (ease of)	
	Expansion potential	Zone of influence (potential failure)	
	Distance from the plant	Zone of influence	

	Engineering	Environmental	Financial
		(Air quality)	
	Hazard rating of failure / zone of influence	Ecology and sensitive areas – proximity to conservation area	
	Infrastructure upgrade	Impact on heritage sites (Grave sites)	
	Phasing potential		
	Founding conditions		
	Availability of borrow materials (starter wall)		
	Ease of construction		
	Ease of operation (Freeboard, flexibility, etc)		
	Slope stability risk		
	Availability of borrow materials		
	Impact on water balance		

The following changes were made to the Environmental sub-criteria:

- Removal of 'water conservation' – Deemed unnecessary, already fully assessed at site screening level.
- Inclusion of 'rehabilitation' under 'closure requirements' – rehabilitation of the facility at closure was an important aspect to consider environmentally.
- Inclusion of 'Impact on heritage sites (Gravesites)'- The heritage report requested by the environmental team stated the possibility of grave sites positioned south of the NE-SW aligned runway, within the footprint area of Option 4.

The final sub-criteria of 'Environmental' for the Site Selection workshop are shown Table 8-4 below.

Table 8-4: Environmental sub-criteria for Site Selection

Environmental and Social sub-criteria	Weighting
Risk of Impacting on groundwater	10.0%
Impact on surface water	10.0%
Rehabilitation & Closure requirements	10.0%
Licensing and regulatory requirements (Ease)	15.0%
Zone of influence (potential failure)	15.0%

Environmental and Social sub-criteria	Weighting
Zone of influence (Air Quality)	10.0%
Ecology and Sensitive areas - Proximity to conservation area	15.0%
Impact on heritage sites (Gravesites)	15.0%

The following changes were made to the Engineering sub-criteria:

- Inclusion of 'Stormwater Management Impact' – This was relevant to the operation of the facility at the different options.
- 'Storage Capacity' was changed to 'Airspace achieved within rate of rise limitations' – this addressed the storage capacity of the options brought forward within the limits of practical and safe operation of a facility.
- Inclusion of 'Decant system (number to operate and maintain)'- This addressed expenses and ease of operation associated with the operation of multiple penstocks.
- Inclusion of 'Decant system (Availability of stand-by systems for continued operation)'- This addressed the safety aspect associated with multiple penstocks at one facility.
- Inclusion of 'Expansion potential' – Addressed the ease with which any of the options could be expanded to accommodate additional material volume.
- 'Additional infrastructure requirements' were changed to 'infrastructure upgrades' – addressing the associated infrastructure improvements required by each option.
- 'Availability of borrow materials (for embankment construction and liner system)' was split into two sub-criteria, weighted differently; namely, 'Availability of borrow materials (starter wall)' and 'Availability of barrier system borrow materials'.
- Inclusion of 'Phasing potential'- addressed the safety aspects of a facility with more than one deposition location (e.g. if it has more than one cell) as well as the operational considerations associated with this.
- 'Ease of operation' was changed to 'Ease of operation (freeboard, flexibility)' – The mine itself will be operating the facility. This sub-criterion addressed the ease with which freeboard problems could be addressed as well as the flexibility of deposition, of each of the options.

The final sub-criteria of 'Engineering' for the Site Selection workshop are shown in **Error! Reference source not found.** below.

Table 8-5: Engineering sub-criteria for Site Selection

Engineering Sub-criteria	Weighting
Stormwater management impact	5.0%
Airspace achieved within the rate of rise limitations	10.0%
Decant system (Number to operate and maintain	2.5%
Decant system (Availability of stand-by systems for continued operations)	7.5%
Expansion potential	7.5%
Distance from the plant	5.0%
Hazard rating of failure/zone of influence	7.5%
Infrastructure upgrade	5.0%
Phasing potential	5.0%
Founding conditions	2.5%
Availability of borrow materials (starter wall)	5.0%
Ease of construction	5.0%
Ease of Operation(Freeboard, Flexibility)	5.0%
Slope stability risk	15.0%
Availability of barrier system borrow materials	7.5%
Impact on water balance	5.0%

Subsequent to the site screening workshop and the scoping level designs conducted on the options brought forward, it was generally expected that Option 5 and Option 10 would be the best and next best options respectively, coming out of the site selection process. This was not the case as Option 10 consistently ranked 3rd or 4th when considering all the key criteria mainly because of the grave sites identified on the potion where site 4 is located. Table 8-6 below shows the outcome of the site selection workshop.

Table 8-6: Option rankings from Site Selection Workshop

Option	Ranking

Option	Ranking
Option 2	2
Option 4	6
Option 5	1
Option 7	4
Option 9	5
Option 10	3

Option 5 (Site 5), raising of the existing FRSF to a final height of 40 m **was selected as the most preferred site**. Although Option 2 is ranked second, when comparing it with Option 10 and considering engineering and financial aspects only, Option 10 is preferable. Option 2 cannot accommodate a deposition rate of 62 400 tpm over the 20 year LOM, unlike Option 10 which; Option 10 has a lower capital cost than Option 2. The Environmental aspect then is the criteria limiting Option 10 to 3rd place. Considering this, it was recommended that despite its ranking Option 10 also be brought forward into the Conceptual Design phase as an additional option for the mine to consider, provided the location of the graves on the option 4 footprint can be identified and confirmed.

Table 8-7: Capacity analysis and planning for FRSF site selection

Site Option	Lower Bound Capacity (9 Mt)	Upper Bound Capacity (15 Mt)	Flawed / Not Flawed
2	Yes	No	Flawed for upper bound capacity
4	No	No	Fatal Flawed
5	Yes	Yes	Not Flawed
7	Yes	No	Flawed for upper bound capacity
9	Yes	Yes	Not Flawed
10	Yes	Yes	Not Flawed

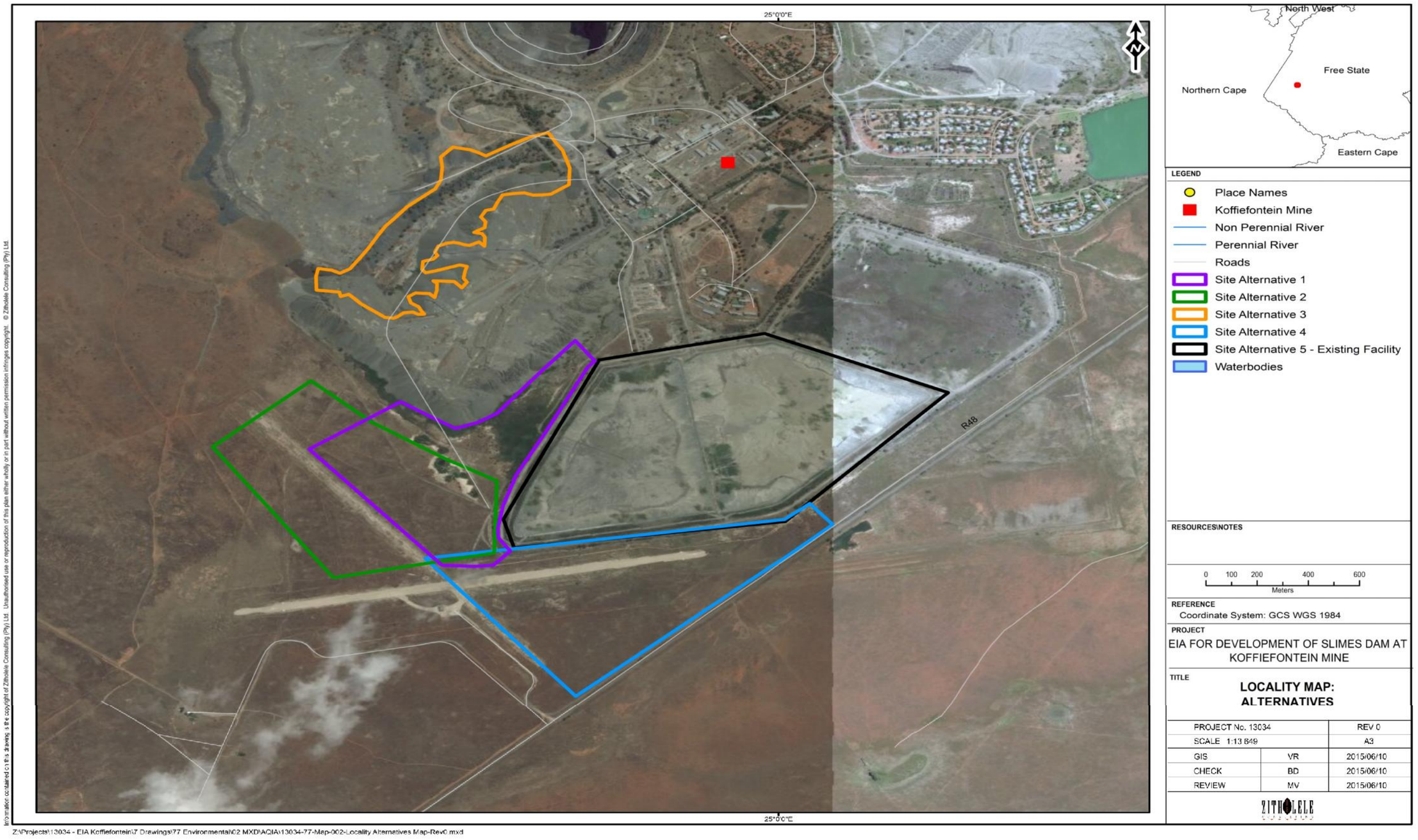


Figure 8-1: Potential developable areas

Subsequent to the site screening workshop and the scoping level designs conducted on the options brought forward, option 1, 3, 6 and 8 were eliminated, as potential options, however option 5 and Option 2 rose as the best and next best options respectively, coming out of the site selection process. **Table 8-8** below shows the outcome of the site selection workshop.

Table 8-8: Option rankings from Site Selection Workshop

Option	Ranking
Option 5	1
Option 2	2
Option 10	3
Option 7	4
Option 9	5
Option 4	6

This DEIR includes but is not limited to the acceptable alternatives carried forward through into the EIA phase. Alternatives that will be further identified will be carefully assessed. This chapter provides an overview of the alternatives assessment process, the alternatives assessed, and the set of preferred alternatives that are carried into the EIA phase. the recommended method to

8.4 Fine Residue Storage Facility alternative

The optimal goal in building a fine residue storage facility and associated infrastructure (such as conveyors, canals, pipelines and return water dams) is to effectively minimise the negative environmental and social impacts whilst ensuring safety, reliability, and cost savings for the utility.

The waste classification of the is performed according to the requirements of the National Environmental Management: Waste Amendment Act (26 of 2014) (NEM: WAA), in terms of the “Waste Classification and Management Regulations” (GN R. 634 and 635 of 2013), based on the understanding that these regulations will be applied by the Department of Water and Sanitation in consideration of a Water Use License for the waste disposal facilities.

To ensure that defensible alternatives are identified and considered, a structured approach was utilised. Initially, the project team determined the need and motivation for the proposed project (NEMA, 1998). The discussion then identified all the potential solutions that can result in the need being met; some alternatives were dropped during the screening process.

8.5 Design and Layout for disposal facility

The FRSF is 87 ha in footprint size, currently 23 m in height. Each paddock has a gravity penstock, draining supernatant to the solution trench around the perimeter of the facility and draining into the return water dam by the process plant. The facility will be extended in height to 40 m final height at elevation 1238.75 m, including 1 m of freeboard. This includes installing 2 elevated penstocks, with elevated drains at the current elevation to improve strength gain within the material on the outer section of the embankment, reducing any potential pore pressure build up along the outer section of the FRSF and improving the existing components of the facility. Table 8-9 shows the summary of the design criteria specific to the FRSF.

Table 8-9: Summary design criteria for FRSF

Item	Description	Value	Units
1.	Type of storage facility	Ring-dyke self-raise dam	-
2.	Footprint	87	ha
3.	FRSF safety classification	High Hazard	-
4.	Fine residue output	37 500 / 63 400	tpm
6.	Particle specific gravity	2.34	-
7.	Average in-situ dry density	1.2	t/m^3
8.	Beach slope	0.5%	-
9.	Deposition method	Spigot deposition	-
10.	Freeboard	0.8	m
11.	Acceptable rate of rise	1	m/yr
12.	Residue classification	Type 3 waste	-
13.	Decant system	Gravity elevated penstocks	-
14.	Design storm	1 in 50 year 24 hr storm	-

The fine residue has been classified as Type 3 waste due to the total concentrations of barium, cobalt, copper, nickel and fluoride and the leach concentrations of nickel (for detailed waste classification report, please refer to APPENDIX J: WASTE CLASSIFICATION STUDY). The implications of the classification mean a Class C Liner is required to line the FRSF.

There are four different ways fof disposing fine residue, namely; filtered, paste, thickened, and conventional disposal, as described below:

- Filtered tailing disposal: Tailing materials are dewatered to a >85% solids by weight (defined as weight of solids divided by weight of solids plus weight of water) using filters aided by a vacuum or confining pressure. The materials are transported by conveyor or trucked to deposal areas where they are handled by earthmoving equipment.
- Paste disposal: Produced in specialised paste thickeners, or ultra-high-density thickeners and transported by positive displacement pumps, paste is best used for

backfill of void, where transport and placement is aided by gravity. Paste is generally discharged with 70-85% solids by weight. Here the tailings are dewatered to a point where they do not have a critical flow velocity when pumped, do not segregate as they deposit.

- Thickened tailing disposal: Tailing materials are 'thickened' through the use of high-density or deep-cone thickeners to about 65-72% solids by weight. This creates a structurally stable tailing that can be deposited at an impoundment site with little segregation and releases very small amounts of reclaim water.
- Conventional tailing disposal: Tailing materials are dewatered in conventional thickeners to about 30-55% by weight and transported as a slurry to the repository. Tailing particles typically segregate during deposition and the deposits release significant amounts of water for recovery in reclaim water ponds. Conventional disposal involves the use of dams, embankments or surface impoundments and may use spigoting for deposition.

8.6 Feasible Alternative

The Scoping Phase is regarded as a crucial part of the EIA process with regards to shaping the nature and extent of the subsequent EIA process. The input required from the required participants, during and subsequent to the Scoping Phase, ensured that, the issues covered were not limited and often at odds with the objectives of the EIA Process. It is therefore important to take note of the following:

- Following the conclusion of the Scoping Phase, further project planning emanated in the development of a number of additional Site Alternatives and / options;
- Although environmental considerations were taken into account in the development of Site Alternatives the capacity analysis and planning for FRSF site selection rendered the following options as Feasible Site Alternatives (see Table 8-10):
  - Option 5 (Site Alternative 5);
  - Option 9 (Modified Site 4 & Site 5); and
  - Option 10 (joining of Site 4 to Site 5 to construct one large facility).
- The raising of the existing FRSF is the Preferred Site Alternative.

Table 8-10: Naming of feasible alternatives taken forward to EIA Phase

Option	Site Alternative	Description	Preferred Alternative
Option 5	Site 5	Raising of the existing FRSF.	✓
Option 9	Modified Site 4 & Site 5	Option 10 is to utilise the existing FRSF as well as to construct an additional FRSF. Site 4 to Site 5 will not be joined.	
Option 10	Site 4 & Site 5	Option 10 is the joining of Site 4 to Site 5 to construct one large facility.	

8.7 Proceeding with the project

Proceeding with the project entails open pit mining and production of diamond ore, as described from Section 2 on the mine processes. Proceeding with the project would have both positive and negative effects on the biophysical and socio-economic environment. Most biophysical effects would be restricted to the project site, while socio-economic effects would likely extend from local to national level. The design of the project and the assessment of alternatives are focused on ensuring that all significant adverse effects of the project can be reduced or avoided entirely through good design, mitigation measures, compensation and or both.

8.8 "No-Go" Development alternative

If the sitewas not developed, i.e. the No-Go Option were implemented, the site would remain as it is at present. The decision of not proceeding with the project is the benchmark against which the consequences of implementing the project can be measured. Comparison of the advantages and disadvantages of proceeding with the project as opposed to the "No-Go" alternative provides the basis for selecting the preferred alternative. This comparison ensures that a decision to proceed with the project would not result in substantial negative effects that could negate the obvious positive effects of economic development. The vacant and highly disturbed site (see Figure 8-2 below) will remain in its current state, with no immediate or direct benefits to the society.

Figure 8-2: Wilting grass/Disturbed site

9 IMPACT ASSESSMENT RATING

The identification and assessment of environmental impacts which are likely to emanate from the project activities, undoubtedly forms the crux of Environmental Impact Assessment. It is therefore that the information provided in this chapter has been meticulously put together to allow the Competent Authority to make an informed decision regarding the granting of Environmental Authority, based on the anticipated environmental impacts and without seeking further advice. Furthermore, the "*comprehensive treatment of mitigation measures, will only be possible if all significant impacts have been correctly identified*" (Lee *et al*., 1999). As is evident by the Impact Assessment Methodology that is described in **Section 5.2.3**, a systematic approach has been adopted to assess the identified environmental impacts.

Consideration has not been given to events and impacts arising from non-standard operational conditions. To ensure that emphasis remains on the anticipated environmental impacts which may result from the planned project activities which require Environmental Authorisation, each impact is linked to the corresponding project activity. It is important therefore to bear in mind that it is the impacts that are associated with the planned project activities and which triggers the Listed Activities that should take prominence as opposed to generic environmental impacts.

9.1 Planning Phase

The activities which forms part of the Planning Phase will not result in any noteworthy impacts on the receiving environment. Furthermore the nature of the activities (e.g. Specialist Studies and Engagement with I&APs) to be carried out during the S&EIR Process is non-invasive. It is therefore unlikely that any environmental impacts will result from the activities associated with the Planning Phase.

9.2 Construction Phase: Slurry Pipeline

The existing slimes dam is fed from a 300 mm diameter High Density Polyethylene (HDPE) and Stainless Steel pipe. The HDPE pipe runs underground from the pump station until it reaches the toe of the slimes. A perpendicular (90 degree) bend is then introduced and the underground HDPE pipe transitions into an above ground Stainless Steel pipe. It is assumed that the same approach will be adopted for the proposed pipeline which will extend from the pump station to Site 4. Where the proposed slimes dam is constructed alongside the existing slimes dam, which will be raised to a higher elevation, a pipeline will be extended from the existing slimes dam to the additional adjacent proposed slimes dam on Site 4. However in keeping with the precautionary principle, the impacts which may arise if a new pipeline is laid from the pump station to the proposed / new slimes dam are presented in the subsequent document sections.

The installation of the pipeline (i.e. pipeline construction) will mainly entail trenching and site clearing. The impacts on the receiving environment that may result from the required pipeline construction activities must therefore be identified and assessed. The environmental aspects relating to the pipeline construction activities include the removal of soil from the trenches as well as the temporary storage of the overburden. Excavating the trenches will entail removing large volumes of soil overburden.

9.2.1 Heritage Resources

The findings of the Heritage Impact Study indicated the possibility of the occurrence of a number of heritage resources. Evidence of graves and paleontological features were identified, whilst remnants of historical farmland and archaeological artefacts were identified within the study area.

Two sites with clusters of finished stone tools dating to the Late Stone Age were identified within the proposed study area. The farming components which were identified include feeding troughs, livestock enclosures, fences and paths. None of these aforementioned farming components are deemed as being of historical importance (G&A Heritage, 2015:39). During the field investigations the stone mounds identified was originally thought to be the result of rock clearing for the construction of the airfield. After the information recovered from the archival study indicated the possibility of graves within the area the prospect of these rock mounds being possible gravesites was postulated (G&A Heritage, 2015:36). The possibility of gravesites within the proposed development footprint can therefore not be disregarded.

Damage caused to or the loss of palaeontological, archaeological and heritage resources is often irreversible and cannot be remedied easily. Taking the aforementioned into account the duration, extent and potential intensity of the impact remains the same pre- and post-mitigation. The causal factor which influences the significance rating is therefore rather the likelihood of the impact transpiring.

Table 9-1: Assessment of Impacts on Heritage Resources - Prior to mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
Excavating the trench may expose and damage underlying heritage resources, in particular unmarked graves. Furthermore, in the case where stone tools are not removed prior to the commencement of the trenching, these may be damaged or lost.	HIGH	*Study Area*	Permanent	*Could Happen*	Low	Probable	2
	4	2	5	3	**2.2**		

The implementation of mitigation measures which are intended to prevent the impact from transpiring, reduces the likelihood of any damage to archaeological artefacts or disturbance

to graves. Without the implementation of any mitigation measures the impacts on heritage resources, resulting from the pipeline construction, is rated as Low (refer to Table 9-1). The extent of the impact will be confined to the *Study Area.* Any damage caused to heritage resources will be Permanent.

Table 9-2: Assessment of Impacts on Heritage Resources - Post Mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
Excavating the trench may expose and damage underlying heritage resources, in particular unmarked graves. Furthermore in the case where stone tools are not removed prior to the commencement of the trenching, these may be damaged or lost.	HIGH	*Study Area*	Permanent	*Unlikely*	Low	Possible	2
	4	2	5	2	**1.4**		

In the case where mitigation measures are implemented, thereby reducing the likelihood of the impact to *Unlikely*, the impact rated as a Low significance impact. The mitigation measures which are proposed to prevent the anticipated impacts from occurring are provided in Table 9-3.

Table 9-3: Summary of impacts on Heritage Resources - Pipeline Construction

Environmental Attribute	Environmental Aspect	Environmental Impact	Rating before mitigation	Rating after mitigation	Mitigation Hierarchy	Mitigation Measures
Heritage Resources	Trenching	Damaging stone tools.	Low	Low	Prevention	It is recommended that a local institute such as the McGregor Museum be allowed to do surface collection of the stone tools prior to the commencement of construction.
Heritage Resources	Trenching	Disturbance and damaging of graves.	Low	Low	Prevention	• It is recommended that a heritage practitioner monitor the possible burial sites during the excavation process; • Indicators of unmarked sub-surface sites including ash deposits, bone concentrations, ceramic fragments and stone concentrations of any formal nature; • In the case were any remains are found on site that is potentially human remains, the South African Police Service must be informed thereof. Furthermore all work must cease until such time the SAPS has concluded their investigation; and • No graves may be destroyed, damaged, altered, exhumed or removed from its original position until a permit to do so has been issued by South African Heritage Resources Agency.

9.2.2 Air Quality

All vegetation within the width of the demarcated trench will be removed thereby exposing the soil surface. These conditions are conducive for dust generation which will adversely impact on the air quality due to increased nuisance dust and increased Particulate Matter (PM) levels.

Dust Generation

Excavating the trenches will entail removing large volumes of soil overburden and temporarily stockpiling the overburden will also contribute to increased nuisance dust and PM levels. Daily dust emissions will vary according to the level of activity, the type of operation and the meteorological conditions (Golder Associates, 2015:23).

Vehicular Gaseous Emissions

In the case where the trenches are dug mechanically, the movement construction vehicles are likely to cause an increase in the entrainment of dust (including PM and Total Suspended Particulate (TSP)) on unpaved roads. These emissions are likely to be short lived and largely restricted to the construction site (Golder Associates, 2015:23).

An increase in Nitrogen dioxide (NO_2), Sulphur dioxide (SO_2), TSP, $PM_{2.5}$ and PM_{10} levels are anticipated to occur as a result of the increase in heavy vehicle movement associated with the construction activities. Vehicle emissions are likely to result in primary and secondary pollutants. Primary pollutants are those emitted directly to the atmosphere as exhaust emissions whereas, secondary pollutants are formed in the atmosphere as a result of atmospheric chemical reactions, such as hydrolysis, oxidation, or photochemical reactions.

Table 9-4: Assessment of Air Quality Impacts - Prior to mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
The increased dust, PM levels and gaseous emissions will adversely impact on the ambient air quality of the immediate environment.	MODERATE	*Study Area*	Short Term	*Very Likely*	Low	Probable	2
	3	2	2	4	1.8		

Table 9-5: Assessment of Air Quality Impacts – Post Mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
The increased dust, PM levels and gaseous emissions will adversely impact on the ambient air quality of the immediate environment.	MODERATE	*Study Area*	Short Term	*Could Happen*	Low	Probable	2
	3	*2*	2	3	1.4		

The air quality impacts described above will only transpire for the duration of the Construction Phase and is therefore Short Term. Furthermore, the effects thereof will remain within the development *Study Area.* Although the impact is *Very Likely* to occur, the implementation of mitigation measures can reduce likelihood thereof. The significance rating of the reduced ambient air quality is rated as Low prior to, and subsequent to the implementation of mitigation measures.

Table 9-6: Summary of impacts on Air Quality Impact - Pipeline Construction

Environmental Attribute	Environmental Aspect	Environmental Impact	Rating before mitigation	Rating after mitigation	Mitigation Hierarchy	Mitigation Measures
Air Quality	Bare Soil Surfaces	Degeneration of the ambient air quality due to increased TSP and PM_{10} levels from land clearing, ground excavation and materials handling activities	Low	Low	Reduction	• Contractors should take preventative measures to minimise complaints regarding dust nuisances (e.g. screening, dust control, timing, pre-notification of I&APs); • Drop height reduction during materials handling activities; • Wet suppression during materials handling activities; • Load wet suppression of materials transported by road (i.e. load spraying) or load covering with tarpaulins to reduce fugitive dust generation; • Wind speed reduction through sheltering (where possible).
	Vehicular Gaseous Emissions	Degeneration of the ambient air quality due to increased TSP and PM levels from the entrainment of dust on unpaved roads.	Low	Low	Reduction	• Wet suppression on all construction access roads; • Rigorous speed control and the institution of traffic calming measures to reduce vehicle entrainment. A recommended maximum speed of 20 km/h to be set on all unpaved roads and 35 km/h on paved roads; • Avoidance of dust track-on onto neighbouring paved roads; and • Wind speed reduction through sheltering (where possible).

Environmental Attribute	Environmental Aspect	Environmental Impact	Rating before mitigation	Rating after mitigation	Mitigation Hierarchy	Mitigation Measures
	Vehicular Gaseous Emissions	Degeneration of the ambient air quality due to increased NO_2, SO_2 and $PM_{2.5}$, Carbon monoxide, Volatile organic compounds, PM levels from primary and secondary vehicle emissions.	Low	Low	Reduction	• All construction vehicles and other equipment should be maintained and serviced regularly to ensure that exhaust particulate emissions are kept to a minimum; • Parking construction vehicles off travelled roadways; and • Encouraging the receipt of materials during non-peak traffic hours to avoid traffic build-up.

9.2.3 Flora

It is assumed that the alignment of the pipeline will extend through operational area of the mine (built-up area) which is largely disturbed by the existing mining activities. The trenching activities required for the installation of the pipeline will nonetheless result in a loss of vegetation cover. Although it is evident that vegetation was cleared for the historical slimes dams, the affected areas have recovered to a large extent to form new habitats (NSS, 2015:80). Although the loss of vegetation is considered an adverse impact, the significance of the impact is augmented in the case where species of Conservation Importance (CI) such as the *Nananthus vittatus* is found within the earmarked development area In addition to presence of *Nananthus vittatus, Myrothamnus flabellifolius* (resurrection plant) species were also identified during the fieldwork. The latter is regarded as a Data Deficient – Taxonomically (DDT) species, and is found in the rocky outcrops just north of the site (not within the boundaries of the slimes dam site alternatives). Furthermore *Myrothamnus flabellifolius* (resurrection plant) which is regarded as a CI species in terms of the Nature Conservation Ordinance, 12 of 1983 were also identified.

Table 9-7: Assessment of impacts on vegetation – Prior to Mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
Loss of CI and other species specimens, habitats and ecosystem services.	HIGH	*Study Area*	Long Term	*Very Likely*	Moderate	Probable	3
	4	*2*	4	4	2.7		

The magnitude of the loss of CI and other species specimens is considered is considered to be a HIGH Magnitude impact which is *Very Likely* to occur. The impact is rated as a Moderate significance impact prior to the implementation of mitigation measures (refer to Table 9-7).

Table 9-8: Assessment of impacts on vegetation – Post Mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
Loss of CI and other species specimens, habitats and ecosystem services.	HIGH	*Study Area*	Long Term	*Could Happen*	Low	Probable	2
	4	*2*	4	3	2.0		

Table 9-9: Summary of impacts on vegetation - Pipeline Construction

Environmental Attribute	Environmental Aspect	Environmental Impact	Rating before mitigation	Rating after mitigation	Mitigation Hierarchy	Mitigation Measures
Vegetation	Trenching	Loss of CI and other species specimens, habitats and ecosystem services.	Moderate	Low	Reduction	• The proponent is required by law to remove Category 1 species, therefore an alien and invasive plan needs to be compiled and implemented; • Daily wetting of exposed surfaces during earth works to control dust; • Erosion Management Plan to be compiled and implemented. Measures that could be assessed include: • Placing biodegradable sand bags around stockpiles, construction footprint etc. As the topography is flat these are recommended as opposed to berms. • Rehabilitation of areas disturbed outside of the slimes dam footprint; • Rehabilitation of existing impacts, for example removal of berms, infill and re-vegetation of borrow pits (Only locally indigenous and weed-free flora should be used for re-vegetation of disturbed areas); • During earthworks a faunal specialist should be on hand for any species that will require translocation during the construction phase; and • Construction crews should be informed about the importance of biodiversity through an induction process. Awareness of potentially harmful animals such as snakes should also be raised. The appointed Environmental Control Officer on site should be trained to handle snakes

9.2.4 Terrestrial Ecology

An estimated third of potentially occurring mammal, bird, reptile and butterfly species, and almost two thirds of potentially occurring frog species, were recorded in the Study Area. *Termitaria* in the locally predominant karooid scrub habitat represent an important resource for fauna including CI species such as the observed Lesser Dwarf Shrew, and the potentially occurring Black-footed Cat and Aurora Snake.

Aardvark burrows also provide important refuge for numerous fauna. Rocky outcrops provide important habitat for reptiles, whereas most frog species were recorded at wetlands (both natural and artificial). Blue Korhaans were encountered at the nearby large pan which, when inundated, could provide habitat for other CI bird species such as the Greater Flamingo and Caspian Tern. Various other CI bird species, e.g. Ludwig's Bustard, Secretary bird and Kori Bustard, could forage in the area. Anticipated impacts on Terrestrial Ecology include habitat loss (foraging and breeding area) for threatened species such as the identified Blue Korhaan (refer to **Table 9-10**).

Increased traffic, machinery and human activity, especially during construction, will likely cause increased faunal disturbance and roadkill (displacement of species such as the Blue Korhaan), dust and erosion, proliferation of alien flora and thus, degradation of habitats and ecosystem services.

Table 9-10: Assessment of impacts on fauna – Prior to Mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
Habitat loss (foraging and breeding area) for threatened species such as the identified Blue Korhaan.	HIGH	*Study Area*	Long Term	*Very Likely*	Moderate	Probable	3
	4	2	4	4	2.7		

The implementation of the proposed mitigation measures relating to restricting construction activities to the demarcated work area, will not eliminate the source or receptor of the impact, but can reduce the extent of the impact. Without the implementation of mitigation measures the impact is rated as being of Moderate significance (see Table 9-12).

Table 9-11: Assessment of impacts on fauna – Post Mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
Habitat loss (foraging and breeding area) for Threatened species	HIGH	*Isolated Sites*	Long Term	*Could Happen*	Low	Probable	2

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
such as the identified Blue Korhaan	4	1	4	3	1.8		

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Table 9-12: Summary of impacts on fauna - Pipeline Construction

Environmental Attribute	Environmental Aspect	Environmental Impact	Rating before mitigation	Rating after mitigation	Mitigation Hierarchy	Mitigation Measures
Terrestrial Ecology	Trenching	Habitat loss (foraging and breeding area) for Threatened species such as the identified Blue Korhaan	Moderate	Low	Reduction	• Petra Diamonds' Environmental Officer (EO) to be on site regularly and to monitor progress and implementation of mitigation measures; • Petra Diamonds is required by law to remove Category 1 species, therefore an alien and invasive plan needs to be compiled and implemented; • Daily wetting of exposed surfaces during earth works to control dust; • Erosion Management Plan to be compiled and measures that could be assessed include placing biodegradable sand bags around stockpiles, construction footprint etc. As the topography is flat these are recommended as opposed to berms; • Rehabilitation of areas disturbed outside of the slimes dam footprint, for example borrow pits; • Rehabilitation of existing impacts, for example removal of berms, infill and re-vegetation of borrow pits (Only locally indigenous and weed-free flora should be used for re-vegetation of disturbed areas); • During earthworks a faunal specialist should be on hand for any species that will require translocation during the construction phase; and • Construction crews should be informed about the importance of biodiversity through an induction process. Awareness of potentially harmful animals such as snakes should also be raised. The appointed EO on site should be trained to handle snakes.

9.2.5 Groundwater

Open trenches provide conditions conducive for ponding and local groundwater mounding (i.e. elevation of groundwater table) in the case where surface runoff accumulates in the trenches. Potential hydrogeological impacts associated with the proposed project includes local groundwater mounding and pollution of the underlying aquifer. Furthermore, significant hydrocarbon spills from stationary plant or stored materials may result in the contamination of subsurface water resources. The groundwater levels are generally shallow (average of 9.6 m below ground level) (Risson, 2015:45) and is therefore susceptible to contamination from surface sources. The shallow groundwater levels increase the risk of groundwater contamination in the event of a significant hydrocarbon spill. Although it is unlikely, the contamination will spread beyond the boundaries of the Koffiefontein Mine, groundwater contamination is generally regarded as an irreversible impact (Berkowitz *et.al*., 2014:457).

Table 9-13: Assessment of groundwater impacts – Prior to Mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
Local groundwater mounding and pollution of the underlying aquifer	VERY HIGH	*Study Area*	Long Term	**Could Happen**	Moderate	Possible	3
	5	2	4	3	2.2		

Table 9-14: Assessment of groundwater impacts – Post Mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
Local groundwater mounding and pollution of the underlying aquifer	VERY HIGH	*Study Area*	Long Term	**Unlikely**	Low	Possible	2
	5	2	4	2	1.5		

The anticipated groundwater impacts is rated as being of Moderate Significance. Although once the impact has transpired the extent of the contamination cannot be contained, it will generally be limited to the *Study Area* vicinity of the Koffiefontein Mine (Risson, 2015:41). The implementation of mitigation measures will reduce the degree of probability of the impact to unlikely (see Table 9-14).

Table 9-15: Summary of impacts on groundwater - Pipeline Construction

Environmental Attribute	Environmental Aspect	Environmental Impact	Rating before mitigation	Rating after mitigation	Mitigation Hierarchy	Mitigation Measures
Groundwater	Trenching	Local groundwater mounding and pollution of the underlying aquifer	Moderate	Low	Prevention	• Maintenance of equipment and vehicles will be performed in such a manner so as to avoid any environmental contamination (e.g. use of drip trays). • No washing of plant may occur on the construction site. • Drip trays will be provided for the stationary plant and for the "parked" plant. • All vehicles and equipment will be kept in good working order and serviced regularly. • Leaking equipment will be repaired immediately or removed from the site. • Suitable storage and disposal of hydraulic fluids and other vehicle oils.

9.2.6 Noise

Noise will be generated by the movement of construction vehicles and to a lesser extent by construction activities. Noise generated during the Construction Phase will be less noticeable over other background noise already experienced in the area (i.e. Operational Activities of the mine).

Anticipated elevated sound pressure levels resulting from construction activities will probably going to be of a Low negative significance (prior to mitigation), affecting the study area in extent, and acting in the short term. The impact is very likely to occur. The impact risk class remains Low with the implementation of mitigation measures.

Table 9-16: Assessment of noise impacts - Prior to mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
Elevated noise levels caused by construction activities.	LOW	*Study Area*	Short Term	**Going to happen**	Low	Definite	2
	2	2	2	5	2		

Table 9-17: Assessment of noise impacts – Post Mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
Elevated noise levels caused by construction activities.	LOW	*Site*	Short Term	**Going to happen**	Low	Definite	2
	2	1	2	5	1.7		

Table 9-18: Summary of impacts on groundwater - Pipeline Construction

Environmental Attribute	Environmental Aspect	Environmental Impact	Rating before mitigation	Rating after mitigation	Mitigation Hierarchy	Mitigation Measures
Ambient Noise Levels	Pipeline Construction Activities	Elevated noise levels caused by construction activities.	Low	Low	Reduction	• No amplified music will be permitted on site and in construction camps; • All noise levels must be controlled at the source; • If the noise levels at the boundaries of the site exceed 7 dB above ambient levels, the local health authorities must be informed; • All onsite workers must be provided with the necessary ear protection gear; • I&APs must be informed of the excessive noise factors; • Local municipal by-laws specific to noise must be adhered to; • The SANS10103 (2008) should be applied to provides a guidance for determining the community's response to the increase in the general ambient noise level caused by the Construction Phase; • Amplified noise such as sirens and announcements limited to restricted hours other than cases of emergency; • Ensure that employees and staff conduct themselves in an acceptable manner while on site, both during work hours and after hours; and • Respond to community complaints with regard to noise generation, taking reasonable action to ameliorate the impact. Where complaints cannot be addressed to the satisfaction of all parties, the Contractor will, upon instruction by the Project Manager, provide an independent and registered Noise Monitor to undertake a survey of the noise output levels.

9.2.7 Visual

The earthworks and activities that will be undertaken during the Construction Phase will be add on to the existing visual disturbance / presence of the Koffiefontein Diamond Mine. Although the construction activities are expected to contrast marginally with the surrounding landscape, a moderate change in the key views defining the landscape characteristics is expected. The combined weighted project impact to the existing visual environment (prior to mitigation) will definitely be of a MODERATE negative significance affecting the local area.

Table 9-19: Assessment of visual impacts – Prior to Mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
The earthworks and construction activities associated with the installation of the pipeline will cause a visual disturbance.	MODERATE	*Study Area*	Short Term	**Going to happen**	Moderate	Definite	3
	3	2	2	5	2.3		

The visual impacts associated with the earthworks and required impacts will only occur for the duration of the Construction Phase and will therefore be short term. The impact risk class is thus MODERATE (refer to Table 9-19).

Table 9-20: Assessment of visual impacts – Post Mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
The earthworks and construction activities associated with the installation of the pipeline will cause a visual disturbance.	MODERATE	*Site*	Short Term	**Going to happen**	Low	Definite	2
	3	1	2	5	2		

Table 9-21: Summary of visual impacts - Pipeline Construction

Environmental Attribute	Environmental Aspect	Environmental Impact	Rating before mitigation	Rating after mitigation	Mitigation Hierarchy	Mitigation Measures
Visual Character	Pipeline Construction Activities	The earthworks and construction activities associated with the installation of the pipeline will cause a visual disturbance.	Moderate	Low	Reduction	• The movement of construction vehicles and workers must as far as reasonably possible be restricted to the immediate site and access roads; • As far as reasonably possible construction activities should be confined to daylight hours. In the event where construction activities cannot be confined to daylight hours all Interested and Affected Parties should be notified of the extended working hours, which will be approved by the ECO and project manager, and provided with the reason for the extended working hours, at least 24 hours beforehand; • It must be ensured that rubble, litter and construction rubble are collected and appropriately stored until the collection and disposal thereof at an appropriate registered landfill site; and • Appropriately site the construction camp as well as other storage areas and consider screening through the erection of shade cloth.

9.3 Construction Phase: Environmental Impact Assessment - Construction of Slimes Dam

9.3.1 Terrestrial Ecology

Anticipated impacts from excavating, levelling, compacting and dumping material may result in the following:

- Destruction and displacement of fossorial fauna, specifically herpetofauna;
- Excessive dust;
- Erosion and sedimentation;
- Proliferation of alien flora; and
- Creation of artificial wetlands in areas of excavation.

All of the above will result in edge effects such as vegetation structural changes, changes in faunal population dynamics.

9.3.2 Vegetation

Site preparation activities will include the clearing of all vegetation within the demarcated footprint of the slimes dam will result in a loss of indigenous vegetation. The bare soil surface provides conditions which are conducive for the encroachment of alien invasive vegetation. As indicated above the proliferation of alien flora will inevitable result in vegetation structural change. Alien species, especially invasive species, are a major threat to the ecological functioning of natural systems and to the productive use of land. These plants can have the following negative impacts on our natural systems (NSS, 2015:45):

- A loss of biodiversity and ecosystem resilience as alien species out-compete indigenous flora and in doing so reduce complex ecosystems to mono-cultures therefore destroying habitats for both plant and animals;
- Through increased evaporative transpiration rates ‘alien thickets’, reduce the amount of groundwater thus reducing the volume of water entering our river systems;
- Alien invasive species dry out wetlands and riparian areas thereby increasing the potential for erosion in these areas;
- The loss of potentially productive land, and the loss of grazing potential and livestock production;
- Poisoning of humans and livestock;
- An increase in the cost of fire protection and damage in wildfires due to alien invasive stands being denser than natural vegetation and the wood more resinous, creating hotter fires; and

- An increased level of erosion, following fires in heavily invaded areas, as well as the siltation of dams.

A single TSP listed CI species was recorded within the demarcated area for Site Alternative 1. The species is considered DDT and is known as *Nananthus vittatus*. During a Site Screening Process, which only took place after the Scoping Phase had been concluded, it was determined that Site 1 did not meet the technical requirements and was eliminated as a possible site alternative. The likelihood of *Nananthus vittatus* being found within the boundaries of the remaining site alternatives is therefore considered negligible.

Table 9-22: Assessment of impacts on Flora – Prior to Mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
Loss of indigenous vegetation and creating conditions conducive for the establishment of alien invasive species.	MODERATE	*Study Area*	Long Term	**Going to happen**	Moderate	Probable	4
	3	2	4	5	3.0		

Owing to the largely undisturbed state of the area earmarked for Site 4 as well as the potential impacts on the nearby wetland FEPAs such as increased sedimentation and proliferation of unwanted flora, the magnitude of the anticipated impact is rated as Moderate. Although the phased removal of vegetation intended to ensure that vegetation cover is retained for as long as possible, ultimately the footprint of the slimes dam will cover the entire earmarked area. The impact is therefore considered a Long Term impact. The impacts on vegetation is rated as a Moderate significance impact prior to mitigation.

Table 9-23: Assessment of impacts on Flora – Post Mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
Loss of indigenous vegetation and creating conditions conducive for the establishment of alien invasive species.	MODERATE	*Site*	Long Term	**Going to happen**	Moderate	Probable	3
	3	1	4	5	2.7		

The implementation of mitigation measures will largely ensure that vegetation is only removed in the area earmarked for the slimes dam. Post – mitigation the anticipated impact on vegetation is rated as a Moderate significance impact.

Table 9-24: Summary of flora impacts – Construction of Slimes Dam

Environmental Attribute	Environmental Aspect	Environmental Impact	Rating before mitigation	Rating after mitigation	Mitigation Hierarchy	Mitigation Measures
Flora	Site Clearing required for construction of slimes dam	Loss of indigenous vegetation and establishment of alien invasive species.	Moderate	Moderate	Reduction	• The proponent is required by law to remove Category 1 species, therefore an alien and invasive plan needs to be compiled and implemented; • Daily wetting of exposed surfaces during earth works to control dust; • Erosion Management Plan to be compiled and implemented. Measures that could be assessed include: - Placing biodegradable sand bags around stockpiles, construction footprint etc. As the topography is flat these are recommended as opposed to berms. • Rehabilitation of areas disturbed outside of the slimes dam footprint; • Rehabilitation of existing impacts, for example removal of berms, infill and re-vegetation of borrow pits (Only locally indigenous and weed-free flora should be used for re-vegetation of disturbed areas); • During earthworks a faunal specialist should be on hand for any species that will require translocation during the construction phase; and • Construction crews should be informed about the importance of biodiversity through an induction process. Awareness of potentially harmful animals such as snakes should also be raised. The appointed Environmental Control Officer on site should be trained to handle snakes.

9.3.3 Heritage

A small cluster of Late Stone Age artefacts was found in a small area alongside Site 4. The tools consist mainly of small microlithic scrapers and some blade remnants. The area where the tools were found is around 8 metres by 5 metres in size. The scatter does not contain any cares or discarded flakes, suggesting that this was not a production site, but rather the result of alluvial settlement deposit.

Table 9-25: Assessment of impacts on Heritage Resources – Prior to Mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
Loss and / or damage of Late Stone Age artefacts	HIGH	*Site*	Permanent	**Very Likely**	Moderate	Probable	3
	4	1	5	4	2.7		

Although the artefacts were found outside the area earmarked for Site 4, the movement of construction vehicles and activities associated with construction to and from the site can result in a loss and damaging of the artefacts. Land surface disturbance associated with infrastructure construction could potentially be steered away from the area where the artefacts were found furthermore the artefacts can be removed from site, to be stored at a museum. Taking the aforementioned factors into account, the implementation of mitigation measures can reduce the Degree of Probability to **unlikely**, thereby reducing the significance rating post-mitigation to Low.

Table 9-26: Assessment of impacts on Heritage Resources – Post Mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
Loss and / or damage of Late Stone Age artefacts	HIGH	*Site*	Permanent	**Could Happen**	Low	Probable	3
	4	1	5	3	2.0		

9.3.4 Surface Water Resources

Anticipated impacts on Surface Water Resources

The presence of pans within the moisture stressed environment of the study area means that these wetlands are key providers ('hotspots') of ecosystem services, including water and food supply. The Millennium Ecosystem Assessment (2005) and the United Nations Environment Programme's Global Deserts Outlook both highlighted that in moisture stressed environments such as the study area wetland ecosystem services are unbalanced and may provide the only supply of fundamental water and food resources. The concern with pans is that they perform few of the functions normally associated with wetlands and could therefore be seen as less important systems, which is not the case. In addition to the provision of water, these depressions provide a unique habitat in terms of biodiversity maintenance, precipitation of minerals and the distribution of accumulated salts and nutrients during the dry months

The activities associated with the construction of the slimes dam will entail ground excavations, levelling, deposition and compacting. These wetlands were created by run-off and seepage from the existing tailings facilities. Within the immediate surrounds one small ephemeral depression (pan) was identified as well as a "cryptic" temporary wetland system. The main function of these temporary/ephemeral systems is the supply of water for short periods following rainfall events. The aforementioned construction activities, if taken place with the delineated wetland areas, may ultimately result in the following impacts, particularly relating to Site 4:

- Disturbance within the 1 kilometre buffer around the southern wetland FEPAs;
- Destruction of habitat with Moderate, Low, and Low-None significance;
- Loss of artificial wetlands emanating from seepage and run-off from the existing tailings; and
- Habitat loss with specific reference to foraging areas for Threatened species such as the identified Blue Korhaan.

Table 9-27: Assessment of impacts on Surface Water Resources – Prior to Mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
Loss of artificial wetland and associated ecosystem services.	MODERATE	*Study Area*	Permanent	**It's going to happen**	High	Probable	4
	3	2	5	5	3.3		

In the case where the slimes dam is constructed within the delineated wetlands, the application of mitigation measures will be aimed at reducing the extent of the impact as opposed to preventing the impact from transpiring.

The impacts associated with surface water resources is rated as a HIGH magnitude, the effects of which are likely to be Permanent prior to mitigation (refer to Table 9-27). The implementation of mitigation measures such as demarcating and restrict anthropogenic disturbances to the construction area, will reduce the spatial scale of the impact to the footprint of the proposed slimes dam (i.e. Site) thereby reducing the significance rating of the impact to Moderate (refer to Table 9-28).

Table 9-28: Assessment of impacts on Surface Water Resources – Post Mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
Loss of artificial wetland and associated ecosystem services.	HIGH	*Site*	Permanent	**Very Likely**	Moderate	Probable	3
	4	1	5	4	2.7		

Table 9-29: Summary of surface water impacts – Construction of Slimes Dam

Environmental Attribute	Environmental Aspect	Environmental Impact	Rating before mitigation	Rating after mitigation	Mitigation Hierarchy	Mitigation Measures
Surface Water Resources	Activities associated with the construction of the slimes dam will entail ground excavations, levelling, deposition and compacting	Loss of artificial wetland and associated ecosystem services.	High	Moderate	Reduction	• Stockpile what remains of topsoil in the southern section (not covered historically by slimes) to retain viability of the seed bank; • Investigate the NFEPA status assigned to the pans to the south as this will affect the integrity of the buffer; • Petra Diamonds EO to be on site regularly and to monitor progress and implementation of mitigation measures; • Vegetation should preferably be cleared during winter, when many fauna are less active or have migrated; • It is recommended that a walk down of the site be conducted by herpetologist, to intensively search for and oversee the relocation of reptiles and amphibians within the proposed footprint area; • Demarcate and restrict anthropogenic disturbances to the construction area; • Where possible in the removal process, species such as geophytes should be collected and stored for future rehabilitative efforts around the mine in a nursery. Grass seeds can also be collected and stored and used during operation in a number or rehabilitation exercises, such as dam wall coverage; and • Construction crews should be informed about the importance of biodiversity through an induction process. Awareness of potentially harmful animals such as snakes should also be raised. The appointed EO on site should be trained to handle snakes

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The impacts on the wetlands during the construction phase may contribute cumulative to the existing wetland impacts associated with the surrounding land users. All reasonable measures will however be implemented to ensure that the anticipated wetland impacts are confined to the development footprint.

9.3.5 Groundwater

Groundwater mounding is evident at the existing slimes by shallow water levels recorded at monitoring boreholes. Furthermore, groundwater quality data from the existing slimes dam indicate the influence of contamination from mining activities, particularly elevated Sulphate (SO4), Calcium (Ca), Chlorine (Cl), Sodium (Na) and Magnesium (Mg) (Rison, 2015:45). This is due to Acid Rock Drainage processes in surface contaminant sources which give rise to saline seepage that may infiltrate to the groundwater. The highest groundwater SO4 concentrations of approximately 3 900 mg/l are measured at the existing slimes dam.

Taking the aforementioned into account the excavation activities required for the construction of the slimes dam may breach shallow perched aquifer. In addition, significant spills of hazardous substances that will be used during the construction phase solvents and hydrocarbons introduces an environmental risk. Spills which may occur during the storage, handling, and use of such dangerous chemicals could infiltrate shallow aquifers leading to groundwater contamination.

The contamination of groundwater resources (i.e. aquifers) will be confined to the *Study Area.* The contamination of groundwater resources will be a permanent impact and is regarded as a HIGH significance impact (prior to mitigation).

Table 9-30: Assessment of groundwater resources impacts – Prior to mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
Contamination of groundwater resources.	HIGH	*Study Area*	Permanent	**Could Happen**	Moderate	Probable	3
	4	2	5	3	2.2		

Table 9-31: Summary of groundwater impacts – Groundwater Resources

Environmental Attribute	Environmental Aspect	Environmental Impact	Rating before mitigation	Rating after mitigation	Mitigation Hierarchy	Mitigation Measures
Groundwater Resources	Excavation activities required for the construction of the slimes dam may breach shallow perched aquifer. Significant spills of hazardous substances that will be used during the construction phase solvents and hydrocarbons introduces an environmental risk.	Contamination of groundwater resources.	Moderate	Low	Prevention	**Storage and handling of hazardous substances** • All hazardous substances must be stored in secure, safe and weatherproof facilities, underlain by a bunded concrete slab to protect against soil and water pollution. The bunded area must be able to contain 110% of the total volume of the stored hazardous substance; • In the event of a significant hazardous substance spillage or leakage, the ECO must Investigate the incident and prepare a report which documents the following information: • Environmental Aspect associated with the incident; - The manner in which the incident happened; - Indicate whether any preventative measures were not implemented; - Determine the reason why the incident occurred; - Required and appropriate rehabilitation and remediation measures; - Indicate whether the actions which resulted in the incident were aligned with the applicable Method Statements; - The type of work, process or equipment involved; and - Recommendations to avoid future such incidents and/or occurrences. • Any accidental spills must be cleaned immediately, treating the spilled material using absorbent material. Spill kits must be kept on site to use in the event of a hazardous substance spillage; and • All cleaning of equipment, batching plants, trucks and flushing of mixers will not result in pollution, with all contaminated wash water entering the waste water collection. Contaminated water may therefore not be discharged to the environment.

Table 9-32: Assessment of groundwater resources impacts – Post mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
Contamination of groundwater resources.	HIGH	*Study Area*	Permanent	**Unlikely**	Low	Probable	2
	4	2	5	2	1.5		

9.3.6 Visual Impacts

The earthworks and activities that will be undertaken during the Construction Phase will add to the existing visual impacts associated with the operational mine. It is anticipated that the movement of construction vehicles to and from the site as well as the construction activities will be visible, especially taking into account the proximity of the site alternatives to Road R48.

Table 9-33: Assessment of visual impacts – Prior to Mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
The earthworks and construction activities associated with the construction of the slimes dam will cause a visual disturbance.	MODERATE	*Study Area*	Short Term	**Going to happen**	Moderate	Definite	3
	3	2	2	5	2.3		

The visual impacts associated with the earthworks and required impacts will only occur for the duration of the Construction Phase and will therefore be short term. The impact risk class is thus Moderate (refer to Table 9-33). The implementation of mitigation measures will reduce the significance of the impact to Low (refer to Table 9-34).

Table 9-34: Assessment of visual impacts – Post Mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
The earthworks and construction activities associated with the construction of the slimes dam	MODERATE	*Site*	Short Term	**Going to happen**	Low	Definite	2

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
will cause a visual disturbance.	3	1	2	5	2.0		

Cumulative Impacts – Visual

Taking into account the existing visual disturbance associated with the operational Koffiefontein Diamond mine along with the surrounding land uses, the construction activities will add to the cumulative negative effect on the visual quality of the landscape.

Table 9-35: Cumulative Impact - Visual

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Initial / Existing Impact (I-IA)	**3**	**3**	**4**	*4*	2.7
Additional Impact (A-IA)	**4**	***3***	***5***	*5*	4.0
Cumulative Impact (C-IA)	**7**	***6***	***9***	*9*	13.14
Residual Impact after mitigation (R-IA)	**4**	***3***	***4***	*5*	3.7

Table 9-36: Summary of visual impacts – Construction of Slimes Dam

Environmental Attribute	Environmental Aspect	Environmental Impact	Rating before mitigation	Rating after mitigation	Mitigation Hierarchy	Mitigation Measures
Visual Character	The earthworks and construction activities associated with the construction of the slimes dam will cause a visual disturbance.	Visual disturbance	Moderate	Low	Reduce	• Dust suppression techniques should be in place at all times; • Rehabilitate / restore exposed areas as soon as possible after construction activities are complete; • Stockpiles may not exceed a height of 1.5 meters, thereby reducing the visibility of the stockpiles beyond the demarcated stock area. Where practical stockpiles should also be located in areas which are not in the line of sight of surrounding land users; • The movement of construction vehicles and workers must as far as reasonably possible be restricted to the immediate site and access roads; and • As far as reasonably possible construction activities should be confined to daylight hours. In the event where construction activities cannot be confined to daylight hours all Interested and Affected Parties should be notified of the extended working hours, which will be approved by the Environmental Control Officer and project manager, and provided with the reason for the extended working hours, at least 24 hours beforehand.

9.3.7 Soil and Land Capability

Excavations and surface preparation activities could possibly alter the soil profile and capability of the land to support other land uses. All exposed areas will be prone to erosion as well as compaction.

Table 9-37: Assessment of Soil and Land Capability Impacts – Prior to Mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
Exposed surfaces will be eroded and compacted.	HIGH	*Study Area*	Permanent	**Going to happen**	High	Definite	3
	4	2	5	5	3.7		

Although the significance rating of the soil and land capability remains HIGH, regardless of the implementation of mitigation measures the extent of the impact can be reduced to only the development footprint (i.e. *Isolated Sites*).

Table 9-38: Assessment of Soil and Land Capability Impacts – Post Mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
Exposed surfaces will be eroded and compacted.	HIGH	*Isolated Sites*	Permanent	**Very Likely**	Moderate	Definite	3
	4	1	5	4	2.6		

Table 9-39: Summary of Soil and Land Capability Impacts – Construction of Slimes Dam

Environmental Attribute	Environmental Aspect	Environmental Impact	Rating before mitigation	Rating after mitigation	Mitigation Hierarchy	Mitigation Measures
Soil and Land Capability	Excavations and the movement of construction vehicles to and from the site.	Exposed surfaces will be eroded and compacted.	High	Moderate	Reduction	Management and mitigation measures relating to the removal, storage and maintenance of topsoil includes the following: • Prior to the commencement of the construction activities the topsoil layer must be removed and be stockpiled separately from overburden (subsoil and rocky material). In the absence of a recognizable topsoil layer, strip the upper most 300mm of soil; • Co-ordinate works to limit unnecessarily prolonged exposure of stripped areas and stockpiles. Vegetation cover must be retained for as long as possible; • Stripping of the topsoil must not be carries out when wet; • Topsoil must be stored in a demarcated area; • Stockpile topsoil stripped from different sites separately, as reapplication during rehabilitation must preferably be site specific; • Do not mix topsoil obtained from different sites; • Topsoil is to be handled twice only – once to strip and stockpile, and once to replace and level; • Ensure that all topsoil is stored in such a way and in such a place that it will not cause the damming up of water, erosion gullies, or wash away itself. • Stockpiled material may not exceed a height of 1.5 meters; • Protect topsoil stockpiles from erosion; • Exotic / invasive plants and broad leaf weeds that emerge on topsoil stockpiles removed by hand; • If topsoil is to be stockpiled for extended periods, especially during the wet season, stockpiles may be re-vegetated with indigenous grasses and covered with a protective material such as hessian mats; and • Ensure that topsoil is at no time buried, mixed with spoil (excavated subsoil), rubble or building material, or subjected to compaction or contamination by vehicles or machinery. This will render the topsoil unsuitable for use during rehabilitation.

9.4 Operational Phase

9.4.1 Groundwater

Assessment of groundwater impacts

The numerical groundwater model was used to assess the impact of tailings deposition on the groundwater quality. The life of the TSF was assumed to be 50 years. The model output was in terms of percentage of the starting source term concentration. Time intervals of 5, 10, 25 and 50 years were simulated with a lining and without a lining. The model shows that the plume development is minimal but that which does occur, moves towards the open pit and generally does not leave the mine site, except for a portion of the plume that migrates in a south-westerly direction.

Table 9-40: Operational Phase Groundwater Impact Assessment – Prior to mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
Decrease in groundwater quality	HIGH	*Study Area*	Permanent	**Could Happen**	Moderate	Possible	3
	4	2	5	3	2.2		

Construction of a cut-off trench reduces migration of the plume in a south-westerly direction. Decrease in groundwater quality during deposition of the tailings material is expected to be of low significance subsequent to the implementation of mitigation measures.

Table 9-41: Operational Phase Groundwater Impact Assessment – Post Mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
Decrease in groundwater quality	HIGH	*Study Area*	Permanent	**Unlikely**	Low	Possible	2
	4	2	5	2	1.5		

Cumulative Impact Assessment – Groundwater Resoruces

During the depositional process soluble components in the tailings material is mobilised in seepage to the underlying aquifer. Similarly, the process water used to deposit the tailings is elevated in dissolved salts relative to natural groundwater. Seepage of this process water through the tailings footprint could contaminate local groundwater.

Table 9-42: Cumulative Impact Assessment - Groundwater

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Initial / Existing Impact (I-IA)	**3**	**3**	**3**	*3*	1.8
Additional Impact (A-IA)	**4**	***3***	***3***	*4*	2.7
Cumulative Impact (C-IA)	**7**	***6***	***6***	*7*	8.9
Residual Impact after mitigation (R-IA)	**3**	***3***	***4***	*4*	2.7

9.4.2 Terrestrial Ecology

The poor operation and maintenance of the new slimes dam could lead to:

- Further erosion and sedimentation,
- Further surface and groundwater contamination and potential impacts on the NFEPAs south of the site,
- Creation of new artificial wetland habitats, and
- Edge effects altering vegetation structure such as the proliferation of alien or other unwanted flora.

Table 9-43: Operational Impacts on Terrestrial Ecology – Prior to mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
Impacts on Terrestrial Ecology	HIGH	*Study Area*	Permanent	**Very Likely**	Moderate	Possible	3
	4	2	5	4	2.9		

Table 9-44: Operational Impacts on Terrestrial Ecology – Post mitigation

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class

Nature	Magnitude	Spatial	Temporal	Degree of probability	Rating	Degree of Certainty	Impact Class
Impacts on Terrestrial Ecology	HIGH	*Study Area*	Permanent	**Could Happen**	Moderate	Possible	3
	4	2	5	3	2.2		

Many of these impacts are evident in the Study Area where historical practices (e.g. slimes dam containing no lining, toe drains etc.) were adopted and no corrective management measures implemented. These impacts are most extensive where Site Alternative 4 is located and, therefore, for this alternatives, the existing impact risk was rated as High.

9.5 Decommissioning Phase

Closure and decommissioning is only anticipated at the end of the LOM. It is probable that the activities associated with decommissioning the proposed infrastructure may trigger activities listed in the NEMA EIA Regulations 2014. In such case the required Environmental Authorisation Process as stipulated by the legislation at the time of closure and decommissioning must be carried out before such activities are carried out. It is proposed by the EAP that a thorough Screening Exercise be done to determine whether Environmental Authorisation will be required.

9.6 Consideration of Dam Failure

A study (Risk Profile for the Proposed Brick Making Quarry on the Eastern Slimes Dam of Koffiefontein Mine, 2015) was carried out to determine the risk profile associated with the reclamation of the tailings material from the decommissioned Eastern slimes dam, adjacent slimes dam, western and central paddocks, if such activity is approved and becomes operational.

As part of the study a Dam Break Analysis was carried out to evaluate and map out areas that would be inundated should a dam break failure of the east compartment of the FRSF occur, due to the proposed brick making activities planned for the east compartment. The dam break analysis determines the probability of inundation at any point downstream of the FRSF and determining the distance of the flowslide of the fine residue material in the event that the FRSF should fail and analyses the potential impact zone from the slimes travelling downstream, more specifically the potential impacts on the village located downstream of the compartment and any other infrastructure.

9.6.1 Risk Assessment

The only activity to be carried out on the FRSF's east compartment is winning the slimes with an excavator. The rest of activities will be completed off the compartment. This reduces the risk of any liquefaction that could occur on the slimes due to the vibration and wave action caused by activities on the slimes, regardless of the behaviour of the slimes, with regards to the critical state line of the slimes. None of the proposed brick activities pose any high risk tothe stability of the FRSF embankments.We have assumed that the remaining brick making activities will be set up in close proximity of the east compartment for ease of operation and access. It is suggested that these activities and associated infrastructure be set up away from the north east embankments of both the central and east compartment, to minimise the risk of inundation of people and equipment in the case of a failure.

9.6.2 Dam Break Failure Modes

Inclusions

Two failure mechanisms for the dam break failure of FRSF embankments were analysed, including:

- A slip failure of the containment embankment of FRSF caused by pore water build-up in a weak layer of tailings within the bottom layer of the central compartment;
- An overtopping of the containment embankment following an extreme rainfall event, with minimal freeboard available; and
- Potential liquefaction caused by vibratory wave action from plant working on top of both compartments.

Exclusions

The following impacts of a failure have not been assessed as part of the study:

- Environmental assessment resulting from the flow of slimes to the areas downstream of the FRSF;
- The loss of company image due to the failure to contain the tailings material; and
- Assessment of liquefaction potential of the slimes contained in the FRSF.

9.6.3 Results of Study

The results showed the following:

- For a 250 m wide breach of the central compartments' north-eastern embankment of the FRSF, the inundation probability of a point 332 m from the embankment is 97%, reducing to 50% inundation probability of a point at a distance of 670 m away;

- For a 500 m wide breach of the north-eastern embankment of the FRSF, the inundation probability of a point 332 m from the embankment is 82%, reducing to 40% inundation probability of a point at a distance of 670 m;

The flowslide distances and probabilities as per the calculations for the 250 m and 500 m wide breaches of the north east embankment of the central compartment, respectively. It is evident that the calculated failure modes and flowslide distances will inundate the east ompartment and not extend to the village, for all the calculated scenarios. The impact of this flowslide can trigger a breach of the north east embankment of the eastern paddock and similar failure modes may then inundate the village. A wider bridge could be anticipated but the topography determined the flowslide path and direction.

For a 250 m wide breach of the eastern compartments' north-eastern embankment of the FRSF, the inundation probability of a point 140 m from the embankment is 97%, reducing to 50% inundation probability of a point at a distance of 401 m away. For a 500 m wide breach of the north-eastern embankment of the FRSF, the inundation probability of a point 140 m from the embankment is 82%, reducing to 40% inundation probability of a point at a distance of 401 m.

9.6.4 Recommediations emanating from the Risk Profiling

The following mitigation measures prior to and during the proposed operations in order to ensure the integrity of the slopes of the existing FRSF are recommended:

- The perimeter berm to the Eastern Slimes Dam be buttressed or flattened to increase the factor of safety to greater than 1:5. If the berm is flattened, a minimum of 5 m wide crest of the original compacted embankment must be maintained;
- Quarry operations should not encroach to within 20m of the toe-line of the Central Slimes Dam with cut embankment slopes of not steeper than 1:5;

The following measures, to minimise the potential of a dam break occurring and also minimising the impacts of a dam break of the central and eastern compartments embankments making sure that minimal activities occur on the eastern compartment except winning of the slimes, are recommended:.

- Ensuring that minimal activities occur on the eastern compartment except winning of the slimes;
- Ensuring that the east compartment starter walls are not mined out during the winning of the slimes;
- Installing piezometers to measure the phreatic surface on the central compartments northeast embankment;
- Determine the in-situ tailings material properties stored in the central compartment;

- Construction of diverting berm/wall across the village to divert and contain some of the slimes, should a breach on the east compartment embankment occur. The berm should be positioned and designed by a professional engineer; and
- Reclamation contractor to include a water management plan in his operational plan.

10 KNOWLEDGE GAPS AND LIMITATIONS

This information provided in this chapter of the EIA Report serves to conform to Regulation 31(m) of the NEMA EIA Regulations 2010, which stipulates that “a description of any assumptions, uncertainties and gaps in knowledge” must be provided in the EIA Report. Therefore, the information that is documented below is intended to highlight any difficulties that were encountered in acquiring, compiling and analysing information related to the proposed project activities and which may have a bearing on the reliability of impact predictions. Furthermore, the information presented in this chapter, specifically with regards to limitations and uncertainties, is intended to provide the Competent Authority with sufficient information to make an informed decision with regards to granting Environmental Authorisation.

Information used to populate the Environmental Impact Report have been obtained from various sources. Information relating to the project description and therefore planned project activities was received from the applicant and formed the basis of the study. A number of specialist studies were also identified during the Scoping Phase and was carried out during the subsequent Environmental Impact Assessment Phase. The project information obtained from the proponent as well as the findings made during the Scoping Phase served to guide these specialist studies. The specialist studies also furthermore served to provide more information relating to impact of the proposed project activities on various environmental elements. Included in the findings of each of the specialist studies were certain assumptions on which the study was based as well as knowledge gaps. The subsequent sections will provide an overview of the various knowledge gaps and limitations to the studies that were identified.

10.1 Impact Assessment

Specialist investigations were only carried out in response to the proactive identification of environmental anticipated impacts which are more likely to be of high significance. Therefore, specialist input with regards to identifying and assessing impacts were limited to the Specialist Studies which were carried out for this project. The assessment of the remaining impacts was therefore largely drawn from the EAPs experience and knowledge gained from similar projects for which EA Processes were followed.

10.2 Scope of Work

Although the EAP appreciated all efforts towards advancing Integrated Environmental Assessment, emphasis is drawn to the fact that the information provided in this EIA Report is intended to provide the CA with sufficient information relating only to the project activities that trigger activities which are listed in the NEMA EIA Regulations 2010, Listing Notice 1 and Listing Notice 2. Following the conclusion of the Scoping Phase, it became apparent that the activities associate with the mill falls under the ambit of the National Environmental Management: Waste Act 59 of 2008. Taking the aforementioned into account, the

environmental aspects and impacts associated with the installation of the new mill were not assessed as part of this Application. In the case where the proponent decides to undertake any activities which fall under the NEMWA and the regulations thereunder, a separate Environmental Authorisation Process will be required.

10.3 Specialist Studies

Assumptions and limitations pertaining to each specialist study is provided below. All information provided by Koffiefontein Diamond Mine was correct and valid at the time of compiling this report.

10.3.1 Heritage

The following assumptions and limitations are noted in the Heritage Impact Study Report:

- It is assumed that the SAHRIS database is correct;
- It is assumed that the information supplied by Petra Diamonds and Zitholele Environmental is correct; and
- A large heap of stones was noted from the south of the airstrip, the heap was believed to be rocks pilled during airstrip construction, whilst it is also most likely that it could be a mass grave. It is expected that several other burial grounds could be found in and around the existing mine. Although these sites are in most likelihood not burial sites, the occurrence of such sites is so common that the area will have to be monitored during construction to ensure that no further damage is suffered to burial sites in this area.

10.3.2 Ecology

It is important to note that the absence of species on site does not conclude that the species is not present at the site. Reasons for not finding certain species during the March 2015 visit may be due to:

- The small, fragmented nature of the site and disturbances from past agricultural activities on site;
- The short duration of fieldwork and the timing of the fieldwork in the latter part of summer. A second visit is proposed for early summer (2015/2016 season);
- Some plant species, which are small, have short flowering times, rare or otherwise difficult to detect may not have been detected even though they were potentially present on site;
- The three site alternatives were relatively homogeneous in nature making it difficult to assess using vegetation sampling methods such as Braun-Blanquet cover-abundance scale. They had also been affected historically through the construction and removal of a slimes dam;

- A number of the grasses and shrubs contained no flowerheads or even fruiting bodies. The veld showed signs of moving towards winter dormancy;
- As an alternative to other vegetation cover methods (such as the Domin method), the Braun-Blanquet cover-abundance scale was used to analyze vegetation. It is reported that the Braun-Blanquet method requires only one third to one fifth the field time required to other similar methods (Wikum & Shanholtzer, 1978). Furthermore, cover-abundance ratings are better suited than density values to elucidate graphically species-environment relationships. For extensive surveys this method provides sufficiently accurate baseline data to allow environmental impact assessment as required by regulatory agencies. However, there are a couple of problems that have been detected with such sampling methods (Hurford & Schneider, 2007). These are as follows:
    - It can be seen as subjective and dependent upon the experience and knowledge of the vegetation type by the surveyor. The cover estimate may vary from observer to observer.
    - There also may be a problem when the cover estimate is very close to two different classes (on the border so to speak) and then it is for the observer to decide which class it should be allocated to. In Hurford & Schneider's (2007) experience, in marginal situations, where the cover of a species is close to a boundary between two classes, the chance of two observers allocating the species to the same cover class is no better than 50:50. However, when comparing to other sampling methods such as Domin, Braun-Blanquet scale is better adapted for monitoring (less cover classes and fewer boundaries).

10.3.3 Waste Classification

The following assumption pertaining the Waste Classification Study was noted in the report:

- Approximately 2 kg of the slimes generated at the Koffiefontein Mine was provided to EnviroSim for the classification assessment. This sample is understood to have been collected from the saturated slimes material as it is being deposited onto the tailings storage facility.

10.3.4 Groundwater Assessment

The following assumption pertaining the Groundwater Study was noted:

- The characterisation is based on available information, supplemented by a hydrocensus and limited test-pumping programme that was previously undertaken; and
- With regards to the groundwater flow rates, assumptions include a homogeneous and isotropic aquifer i.e. same aquifer parameters throughout the aquifer in all directions.

11 ENVIRONMENTAL IMPACT STATEMENT

The Environmental Impact Statement provides an account of the key findings of the Environmental Impact Assessment Process. Based on the significance ratings assigned to the anticipated environmental impacts, it is evident from the ratings that have been given to the that the major concerns with regards to the proposed Project include impacts on flora and Surface Water Resources.

11.1 Key Findings of Impact Assessment

The results of the impact assessment showed that the most significant impacts on the receiving environment would include impacts on flora as well as the anticipated impacts on Surface Water Resources during the Construction Phase of the project lifecycle.

The implementation of the proposed mitigation measures will however reduce the significance of the anticipated environmental impacts. Mitigation measures which have been proposed in the various specialist studies that were undertaken for the proposed project have also been included. The findings of the Impact Assessment showed that the proposed project will not lead to unacceptable environmental costs.

11.2 Proposed conditions for Environmental Authorisation

Taking into account the outcome of the Scoping and Environmental Impact Reporting Process, and in particular the EIA Phase, it is proposed that the Competent Authority include the following conditions, intended to ensure that the Best Practicable Environmental Option for all proposed activities associated with the proposed project is implemented:

- All feasible mitigation measures included in the specialist studies carried out for the proposed project are implemented during the project lifecycle;
- Owing to the uncertainty surrounding the prescense of graves within the proposed development area it is recommended that, prior to the commencement of the Construction Phase, graves test excavations be done, provided that the required permits have been issued. Any comments / recommendations made by SAHRA concerning the matter should also be taken into account.
- The EMPr must be implemented fully at all stages of the proposed project life cycle.

12 CONCLUSION AND WAY FORWARD

The Koffiefontein Mine Joint Venture (KMJV) appointed Zitholele Consulting to undertake the EIA application for the proposed new slimes dam development at the Koffiefontein Diamond Mine. This Scoping study was undertaken with the aim of identifying potential aspects of concern (both positive and negative) on the biophysical environment and identifying issues, concerns and queries from I&APs. This DEIR documents the process followed, the findings and recommendations of the Scoping study, and the proposed Plan of Study for the EIA Phase to follow.

Subsequent to the conclusion of the public review period of the DEIR, all comments received from Interested and Affected Parties (I&APs) on the DEIR and all supporting documented will be considered and addressed. Where required the comments received will be incorporated in the Final Environmental Impact Report (FEIR). The FEIR will be simulataneously placed for the public review and submitted to the DESTEA for review and consideration. All registered I&APs will be notified of the availability of the FEIR. In keeping with the Regulation 10 of the NEMA EIA Regulations 2010, all registered I&APs will be notified of the decision made by the DESTEA in writing, within 12 days of the date of the decision on the application.

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Appendix A: Curriculum Vitae of EAP

Appendix B: Application Form for Environmental Authorisation

Appendix C: Acceptance of Application for Environmental Authorisation Form

Appendix D: Acceptance of Final Scoping Report

Appendix E: Declaration of Interest Forms

Appendix F: Air Quality Impact Study

Appendix G: Groundwater Study

Appendix H: Heritage Impact Study

Appendix I: Ecology and Wetland Study

Appendix J: Waste Classification Study

Appendix K: Conceptual Design Report

Appendix L: Public Participation

Appendix M: Environmental Management Plan