capability classes, high potential arable land, medium potential arable land, high potential grazing/low to medium potential arable land, low to medium potential grazing land/drainage complex, low potential grazing land/drainage complex and wetland/drainage line. High potential arable land was dominant.

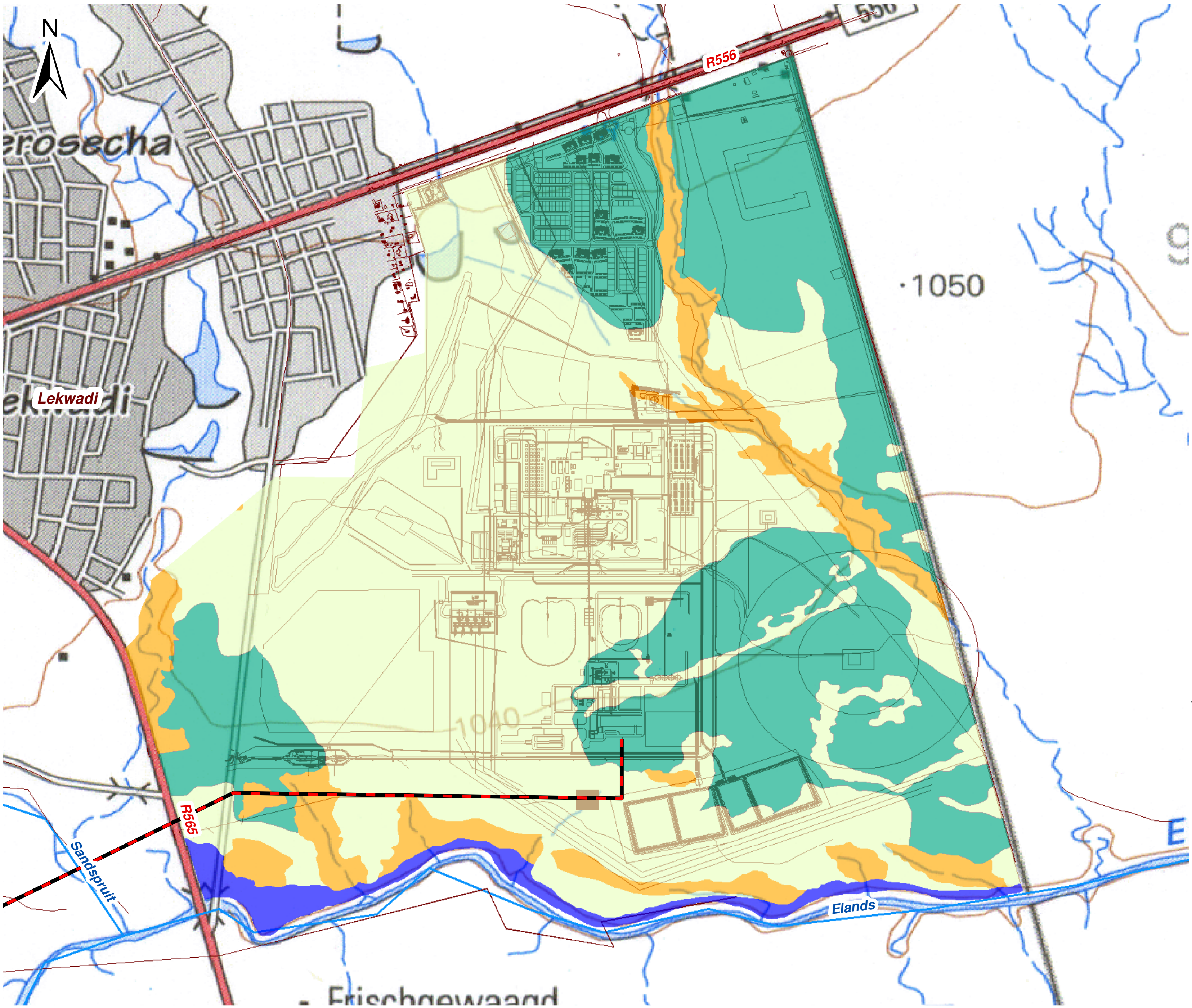
<u>Irrigation potential</u>

Three classes of irrigation potential were identified along the pipeline route:

- Class 1. Highly suitable for irrigation, few or no limitations and preconditions. Topography is flat, soils are well drained, of moderate permeability and deep, medium textured with a high water holding capacity.
- Class 3. Low suitability with moderately severe limitations, imperfect or somewhat excessively drained soils, slow or rapid permeability or shallow soils.
- Class 4. Not suitable for irrigation under most conditions with severe limitations.

With reference to Figure 7-8, the high potential arable land had soils suited to dry-land crop production and fell into Class 1. The medium potential arable land had soils suited to dry-land crop production and fell into Class 3. The high potential grazing/low to medium potential arable land had soils suited to dry-land crop production and fell into Class 4. The remaining areas along the pipeline route were not suitable for crop production as they fell within drainage complexes, the Eland River and/or a wetland system.

For the plant and TSF areas, Sd1 (Shortlands) and Oa1 (Oakleaf) were considered to have high irrigation potential (Figure 7-6 and Figure 7-7).



Legend

Mine Layout

Proposed Pipeline

Land Capability

Arable

Grazing

Riparian

Wilderness

Data Source: Rehab Green CC (2007)

Kilometers

0 0.4 0.8

Scale: 1:18 000 @ A4

SA Grid WGS84

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Figure 7.6

Land Capability in the Plant Area

SLR

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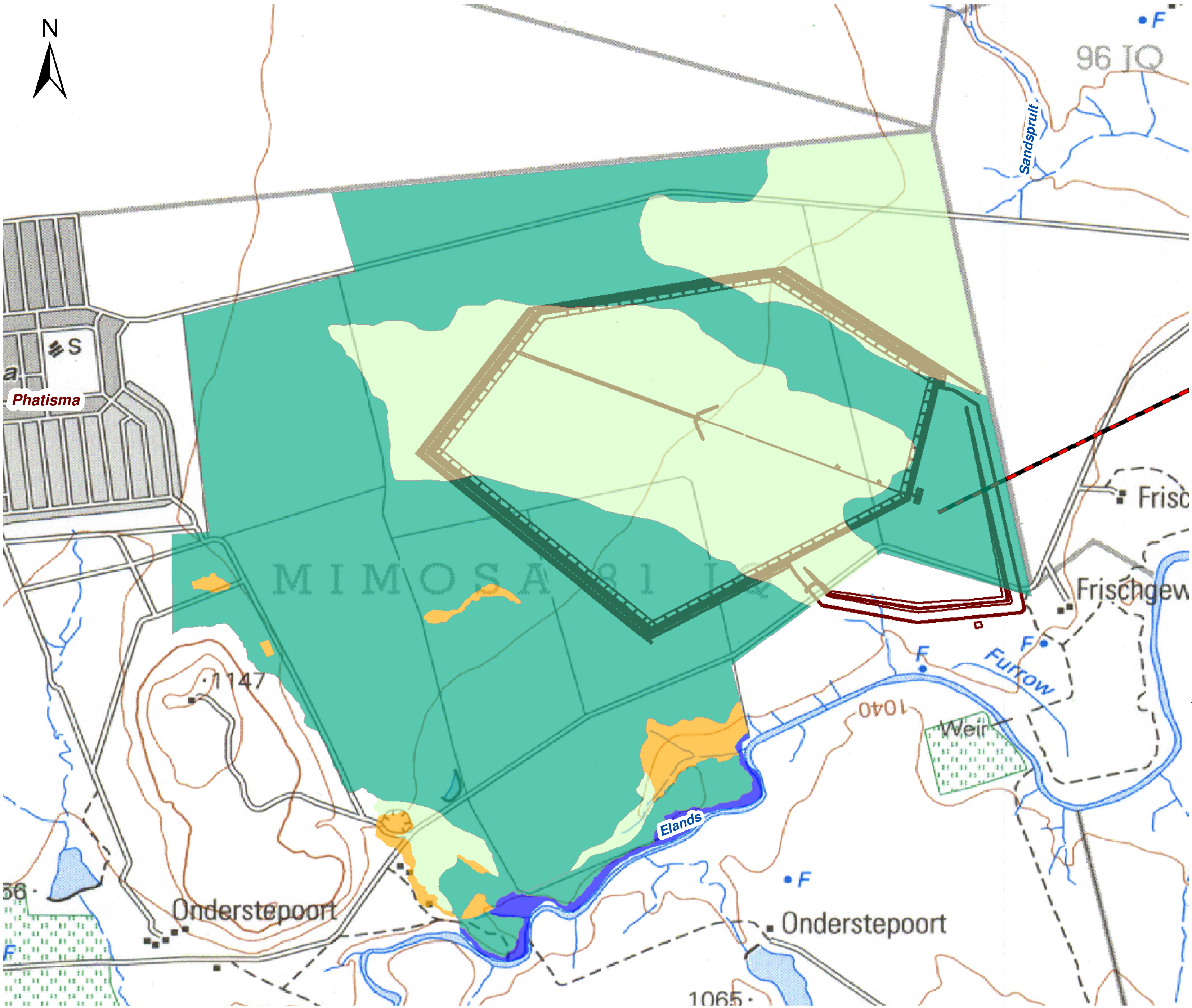
March 2016



Legend

Mine Layout

Proposed Pipeline

Land Capability

Arable

Grazing

Riparian

Wilderness

Data Source: Rehab Green CC (2007)

Kilometers

0 0.5 1

Scale: 1:24 000 @ A4

SA Grid WGS84

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Figure 7.7

Land Capability in the TSF Area

SLR

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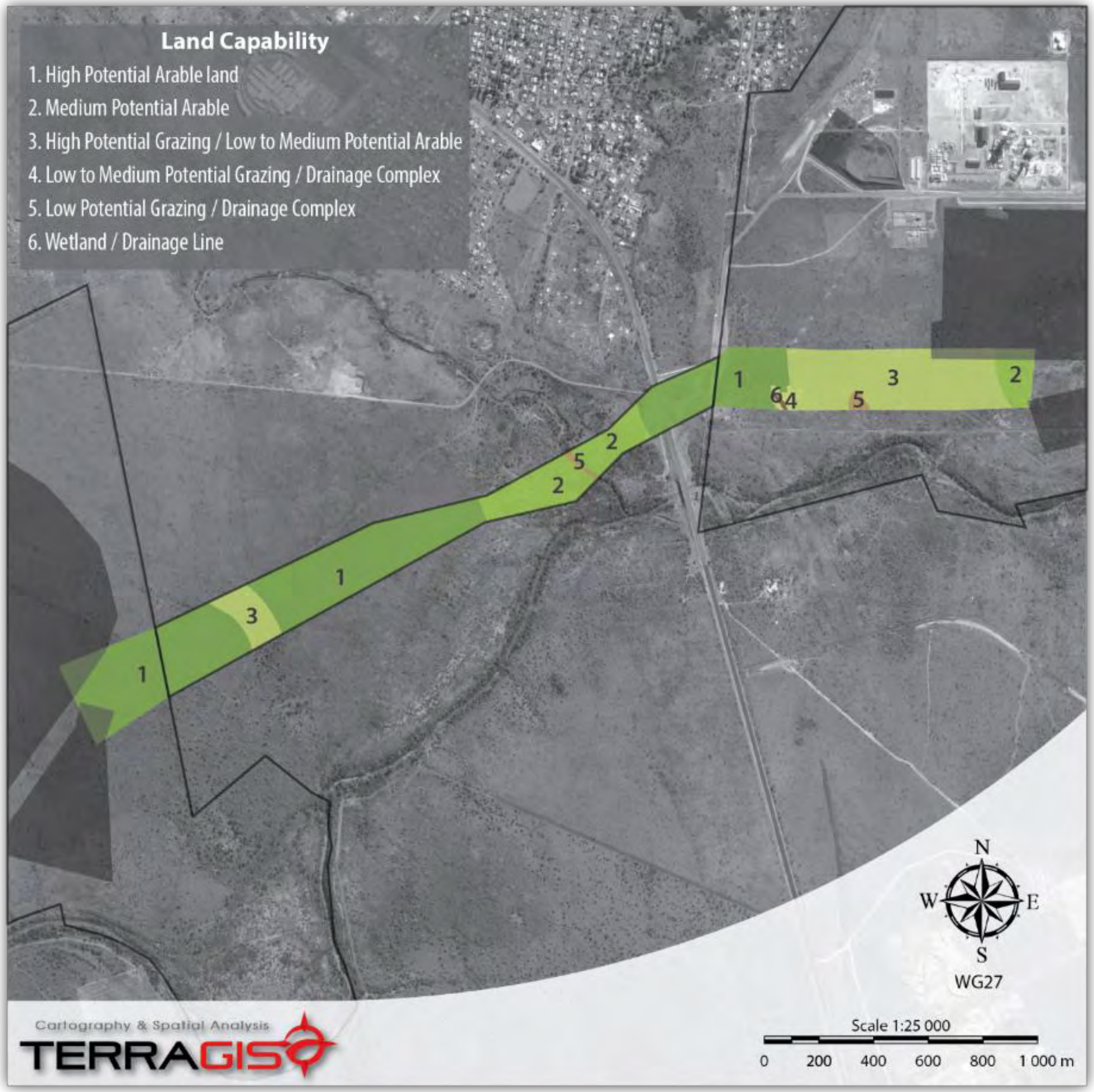
710.23001.00006 | March 2016



Land Capability
1. High Potential Arable land
2. Medium Potential Arable
3. High Potential Grazing / Low to Medium Potential Arable
4. Low to Medium Potential Grazing / Drainage Complex
5. Low Potential Grazing / Drainage Complex
6. Wetland / Drainage Line
N
W
E
S
WG27
Scale 1:25 000
0
200
400
600
800
1 000 m
Cartography & Spatial Analysis
TERRAGIS

CONCLUSION

The study area comprises a range of soil types with varying land capabilities. High potential arable land, drainage lines and wetland soils prone to erosion are considered by the specialists to be sensitive soil resources; these occur along the majority of the pipeline route, the eastern edge of the PCDs, and the southern edge of the Phase 1a mine housing. A re-alignment of a section of the pipeline near the plant area has been suggested by the specialist to avoid sensitive drainage areas. This has been taken into consideration in the final route alignment. Moving the other section of the pipeline won't have significant differences as similar soils are expected to be found. The soils on site also have high arable, grazing and irrigation potential, therefore increases in the overall footprint of the mine need to be carefully planned. Soils disturbed by the project will require appropriate management measures during construction and operation to minimise the loss of soil resources through pollution and physical disturbance including erosion, soil compaction and stripping.

7.4.1.5 Biodiversity

INTRODUCTION AND LINK TO ANTICIPATED IMPACT

In the broadest sense, biodiversity provides value for ecosystem functionality, aesthetic, spiritual, cultural, and recreational reasons. The known value of biodiversity and ecosystems is as follows:

- soil formation and fertility maintenance
- primary production through photosynthesis, as the supportive foundation for all life
- provision of food and fuel
- provision of shelter and building materials
- regulation of water flows and water quality
- regulation and purification of atmospheric gases
- moderation of climate and weather
- control of pests and diseases
- maintenance of genetic resources.

The establishment of additional mining-related infrastructure and support facilities have the potential to result in the loss of vegetation, habitat and related ecosystem functionality through physical disturbance and/or contamination of soil, air and/or water resources.

As a baseline, this section provides an outline of the type of vegetation occurring in the project area and the status of the vegetation and highlights the occurrence of sensitive ecological environments including sensitive/endangered species (if present) that require protection and/or additional mitigation should they be disturbed. Some habitat has been removed/disturbed in the process of establishing the approved operations and the related surface infrastructure

DATA SOURCES

Information in this section is sourced from the approved EIA and EMP (TWP, 2008) (where relevant) and the following studies:

- Aquatic ecological assessment: Scientific Aquatic Services (2015) - Appendix M
- Vegetation assessment: De Castro and Brits (2016a) - Appendix K
- Watercourse assessment: De Castro and Brits (2016b) - Appendix I
- Faunal assessment: De Castro and Brits (2016c) - Appendix L

The specialist studies specified above covered areas applicable to both the approved and proposed project footprints. The information presented in the specialist report reflects a combination (in undisturbed areas) of the pre-mining state of the biodiversity in 2007 and in disturbed areas, the transformation that has occurred as a result of the mine development. According to the specialist, when comparing the vegetation findings of the two studies, there are correlations between the identified vegetation types with some differences (aside from name categories). For the purposes of this report, the more recent 2016 specialist findings have been used to inform the baseline. Further detail on the methodologies used is provided in the specialist reports.

RESULTS – NATIONAL GUIDELINES

Importance of the project area according to National Guidelines

The Mining and Biodiversity Guideline

According to the Mining and Biodiversity Guideline (DEA et al, 2013), the plant and shaft project area falls within the highest and high biodiversity categories and the TSF site falls within the high biodiversity category (Figure 7-9). This is described below:

- Highest biodiversity areas are generally areas with critically endangered ecosystems, critical biodiversity areas (CBAs), river and wetland freshwater ecosystem priority areas (FEPAs) and 1 km buffer zone around these areas, and RAMSAR sites. The implication for mining projects is that environmental assessments should focus on confirming the presence and significance of the biodiversity features and to provide site-specific basis on which to apply the mitigation hierarchy to inform regulatory decision making.
- High biodiversity areas generally comprise protected area buffer zones, transfrontier conservation areas, other identified areas from provincial spatial biodiversity plans, high water yield areas. The implication for mining projects is that environmental assessment should include an assessment of the optimum, sustainable land use and determine the impacts on biodiversity.

National Environmental Management: Biodiversity Act

The National Environmental Management: Biodiversity Act (No. 10 of 2004) (NEMBA) provides for listing of threatened or protected ecosystems. Threatened ecosystems are listed in order to reduce the rate of ecosystem and species extinction by preventing further degradation and loss of structure, function and composition of threatened ecosystems. The purpose of listing protected ecosystems is primarily to conserve sites of exceptionally high conservation value. For the project area, approximately 45% of the land cover is

Marikana Thornveld (De Castro and Brits, 2016a) which is classified as vulnerable (Figure 7-10 and Figure 7-11).

National Protected Area Expansion Strategy

A National Protected Area Expansion Strategy (NPAES) has been developed by the South African National Botanical Institute (SANBI) and aims to achieve cost effective protected area expansion for ecological sustainability and adaptation to climate change. The NPAES sets targets for protected area expansion, provides maps of the most important areas for protected area expansion, and makes recommendations on mechanisms for protected area expansion. According to the NPAES database, the project area does not fall within an area earmarked for expansion of a National Protected Area.

Freshwater Ecosystem Priority Areas Project

The National Freshwater Ecosystem Priority Areas Project (NFEPA) was developed by SANBI, DWA and other stakeholders and organisations. This project was aimed at identifying strategic spatial priority areas for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. There are two wetlands indicated on the NFEPA wetland dataset to be within the project area. These are located near the Mine Housing Phase 1 but do not overlap with the infrastructure footprint. The wetland study confirmed that these wetlands are artificial wetlands in the form of dams and there are no other FEPA wetlands present within the project footprint (De Castro and Brits, 2016b; Figure 7-12).

Critical Biodiversity Areas (CBAs)

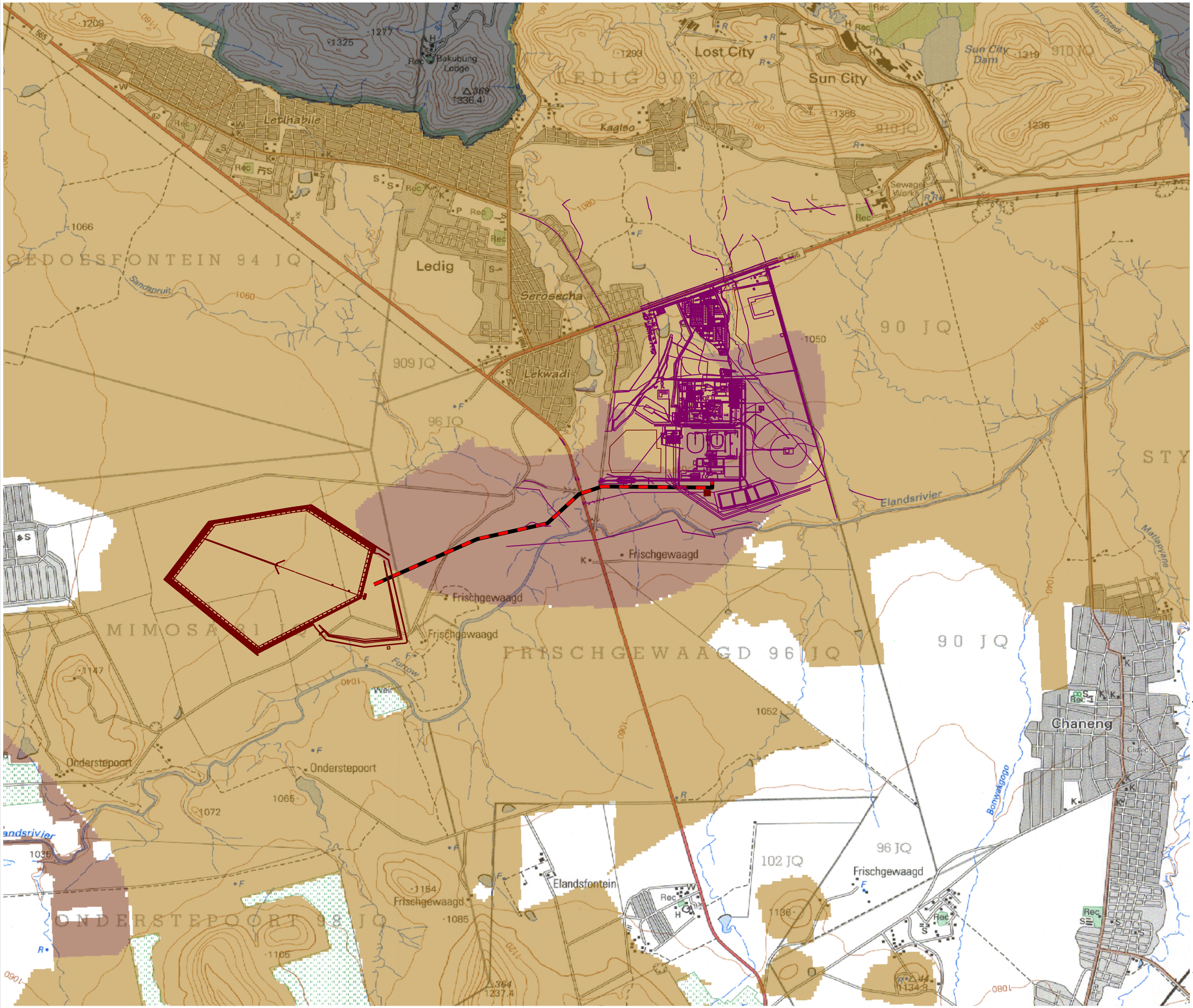
The North-West Province published a biodiversity conservation assessment report in 2009, which includes a list of CBAs. These areas are terrestrial and aquatic features that are critical for retaining biodiversity and supporting continued ecosystem functioning and services. The North West Biodiversity Sector Plan (NWBSP) 2015 has recently been completed which provides updated information on CBAs and Ecological Support Areas (ESAs). The NWBSP is not yet available on the SANBI or BGIS websites but a copy of the NWBSP and shapefiles for the CBAs was obtained by the vegetation specialist from the North West Department of Rural, Environment and Agricultural Development for this project (De Castro and Brits, 2016a).

The NWBSP showed that the majority of the project area falls within CBA 2 with small areas falling within ESA1 and ESA2 and small areas mapped as No Natural Habitat Remaining (Figure 7-13). The vegetation specialist indicated that based on the available GIS information for the NWBSP, the principal criteria for allocating CBA 2 status to the habitats of the study area is that the habitats are regarded as 'Natural Corridor Linkage' and 'Natural Protected Area Buffer' (within 5km of the Pilanesberg National Park) areas. The small area of ESA1 in Mimosa is based on the 'Natural Corridor Linkage' criteria and the small area of ESA2 in Mimosa is based on the 'Natural Corridor Linkage' criteria (De Castro and Brits, 2016a). Appendix K, the vegetation impact assessment provides a description of the land management objectives for each of these categories, extracted from Table 12 of the NWBSP 2015.

It should be noted that the vegetation specialist indicated that the NWBSP mapping for the study area is not accurate as CBA2 includes large areas of secondary vegetation of historically cultivated areas or permanently transformed areas (i.e. mine shaft complex and associated infrastructure). Approximately 42.9% of the area mapped as CBA2 within the study area comprises transformed habitats with secondary vegetation or no vegetation. The CBA and ESA land management

National Biodiversity Assessment

The National Biodiversity Assessment (NBA) conducted in 2011 was led by the SANBI in partnership with the Department of Environmental Affairs and a range of other organisations. The study provides an assessment of South Africa's biodiversity and ecosystems. This assessment also provides a summary of biodiversity priority areas that have been identified through systematic plans at national, provincial and local levels. The project area is not located within a formally or informally protected area in terms of this assessment, though the project area (and approved mine) falls within the 'Natural Protected Area Buffer' by being within 5 km of the protected Pilanesberg National Park (De Castro and Brits, 2016a).



Legend

Mine Layout

Proposed Pipeline

Mineguide Category

A. Legally Protected - Mining Prohibited

B. Highest Biodiversity Importance - Highest Risk for Mining

C. High Biodiversity Importance - High Risk to Mining

Data Source:
South African National Biodiversity Institute (SANBI) 2012

Kilometers

0 1.5 3

Scale: 1:60 000 @ A4

SA Grid WGS84

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Figure 7.9

National Mining Biodiversity Priority Areas

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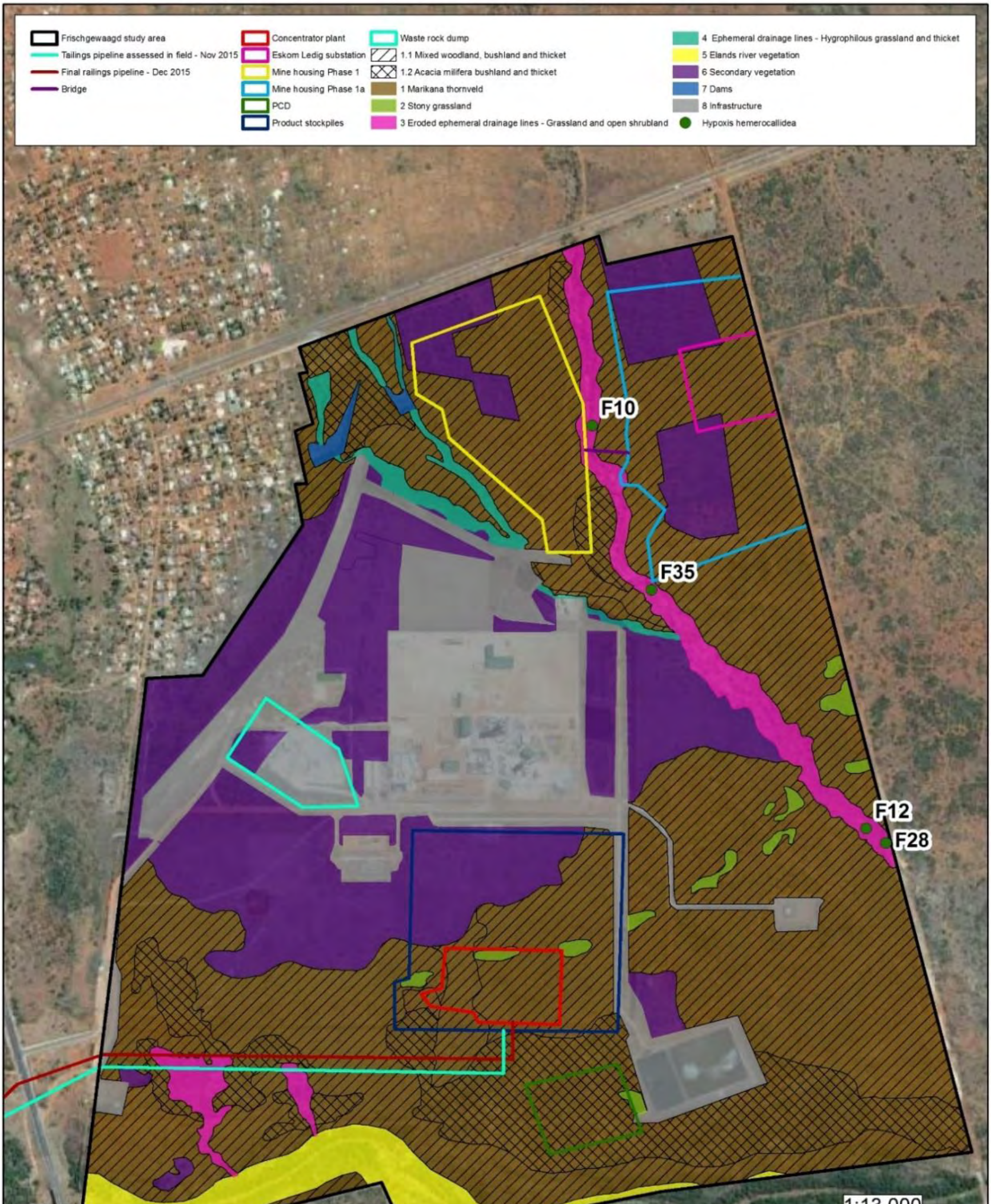
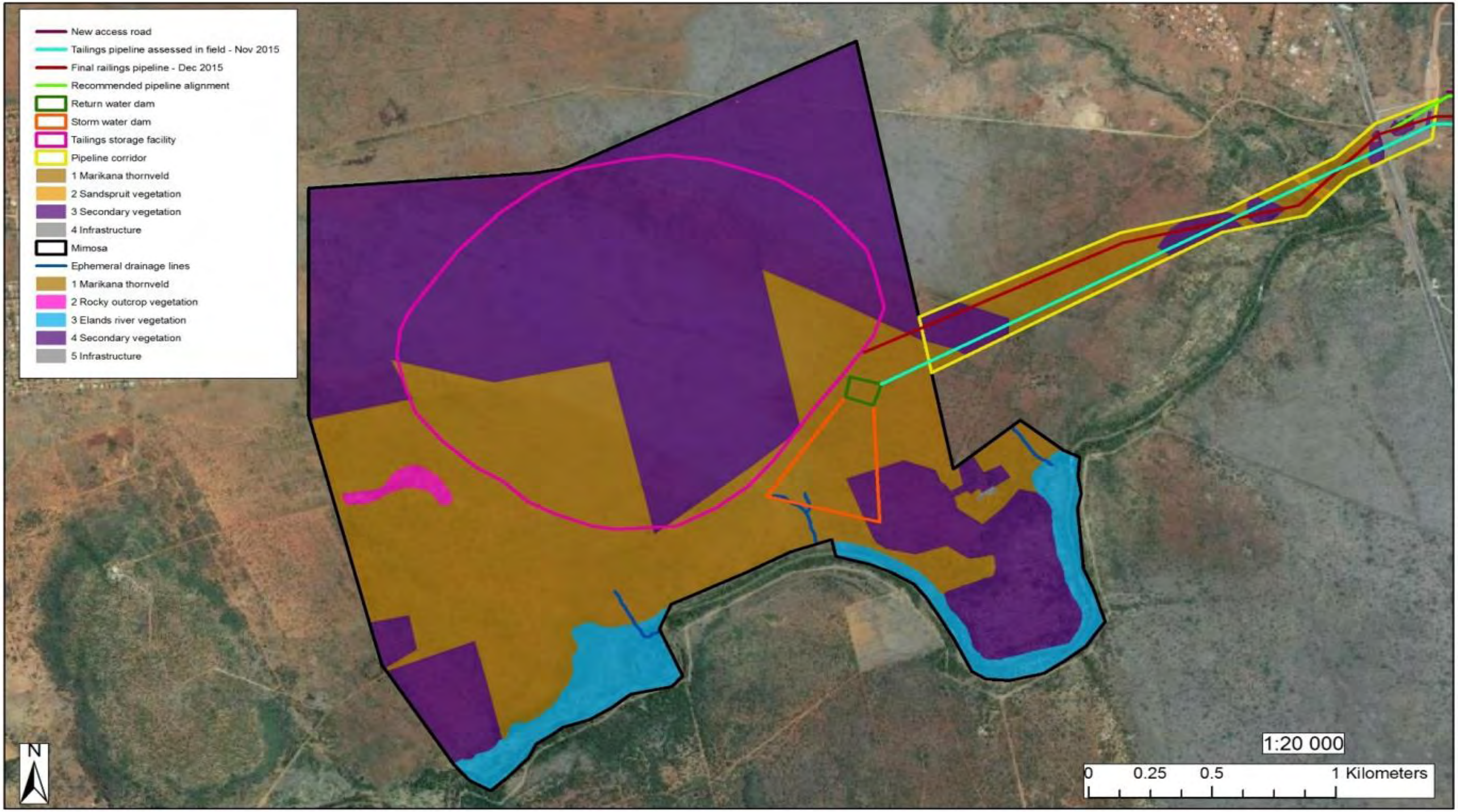


Vegetation map for Frischgewaagd

January 2016
Created by:

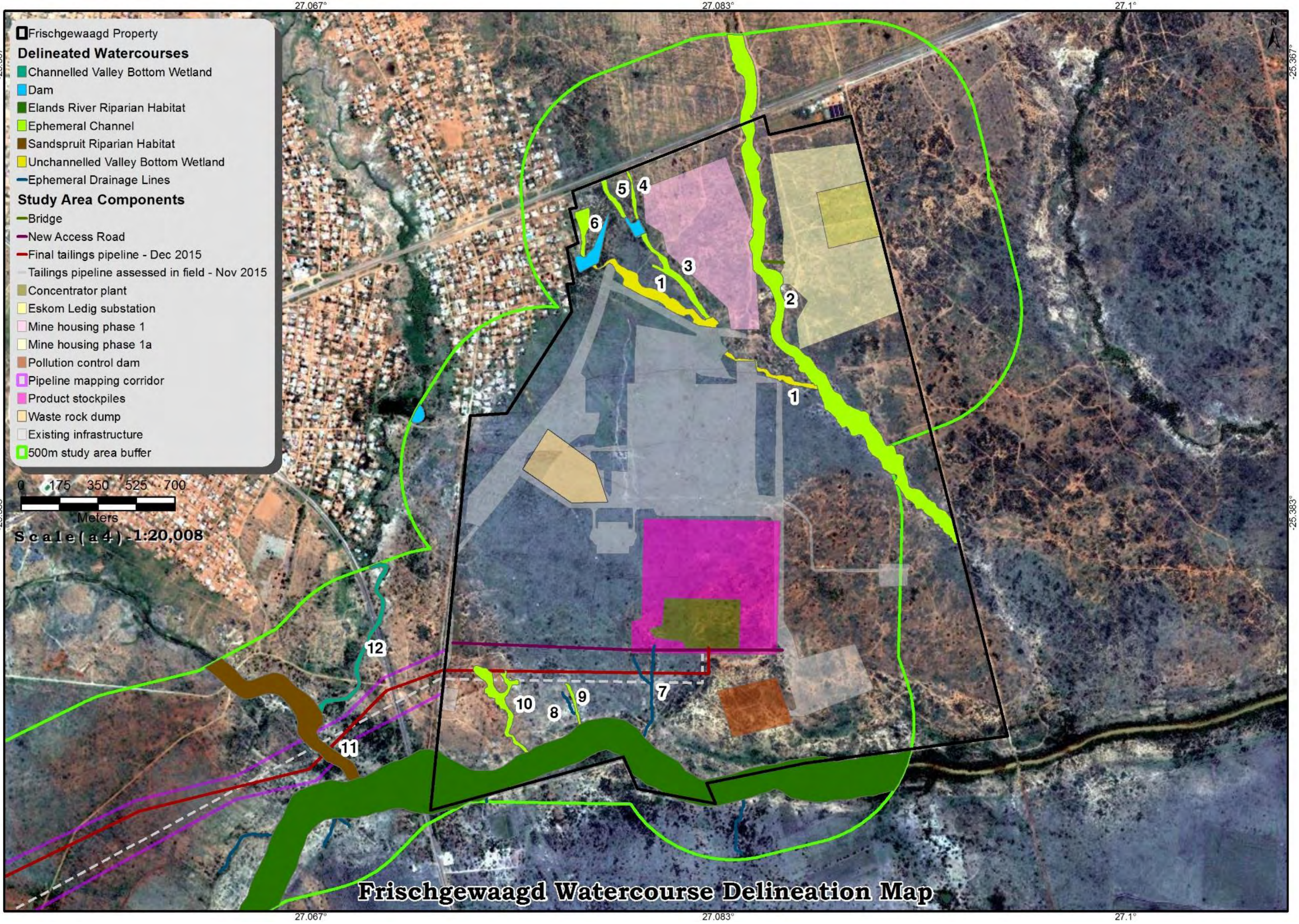
DE CASTRO & BRITS ECOLOGICAL CONSULTANTS



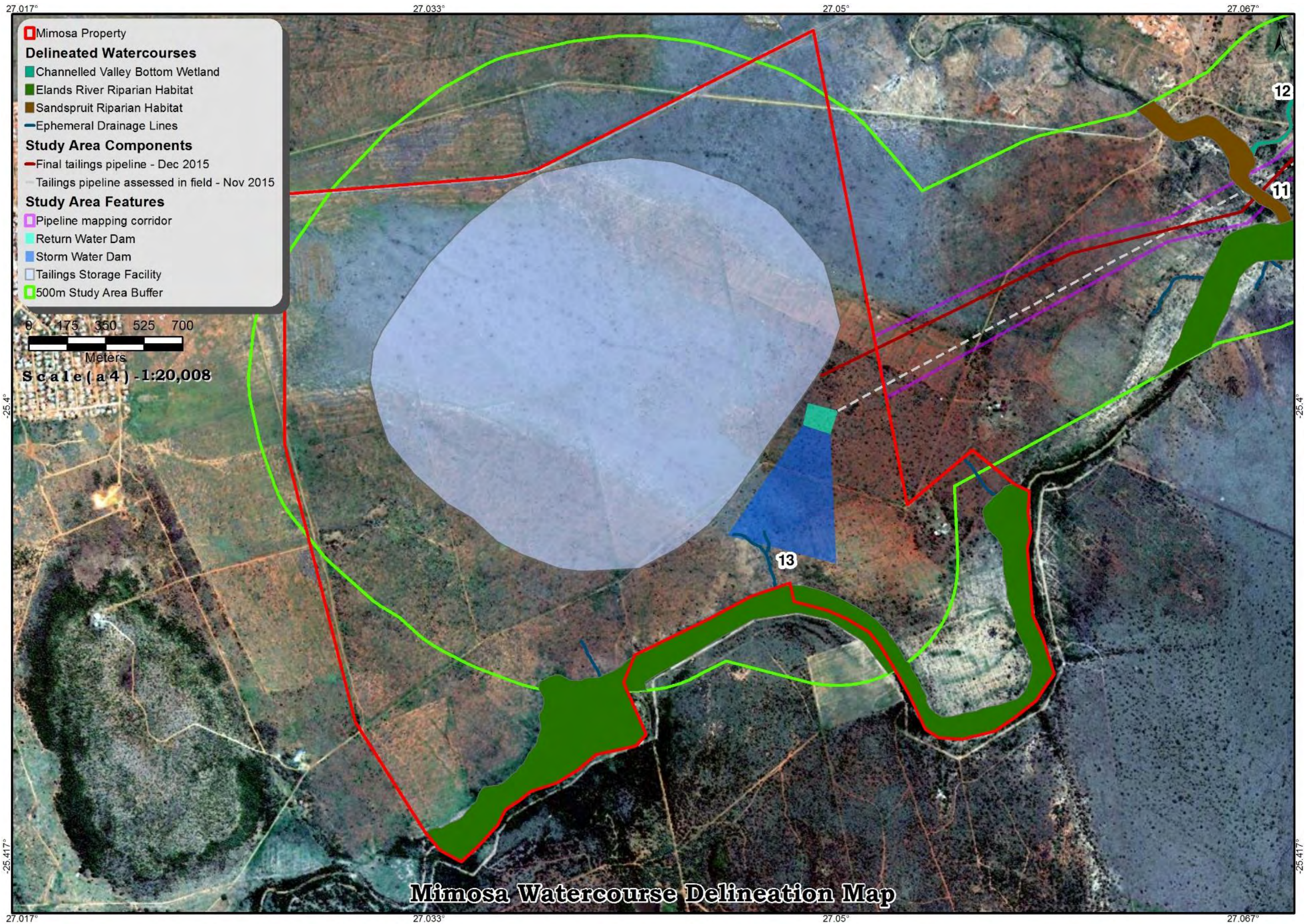
Vegetation map with proposed infrastructure for Mimosa and the Pipeline corridor

January 2016
Created by:

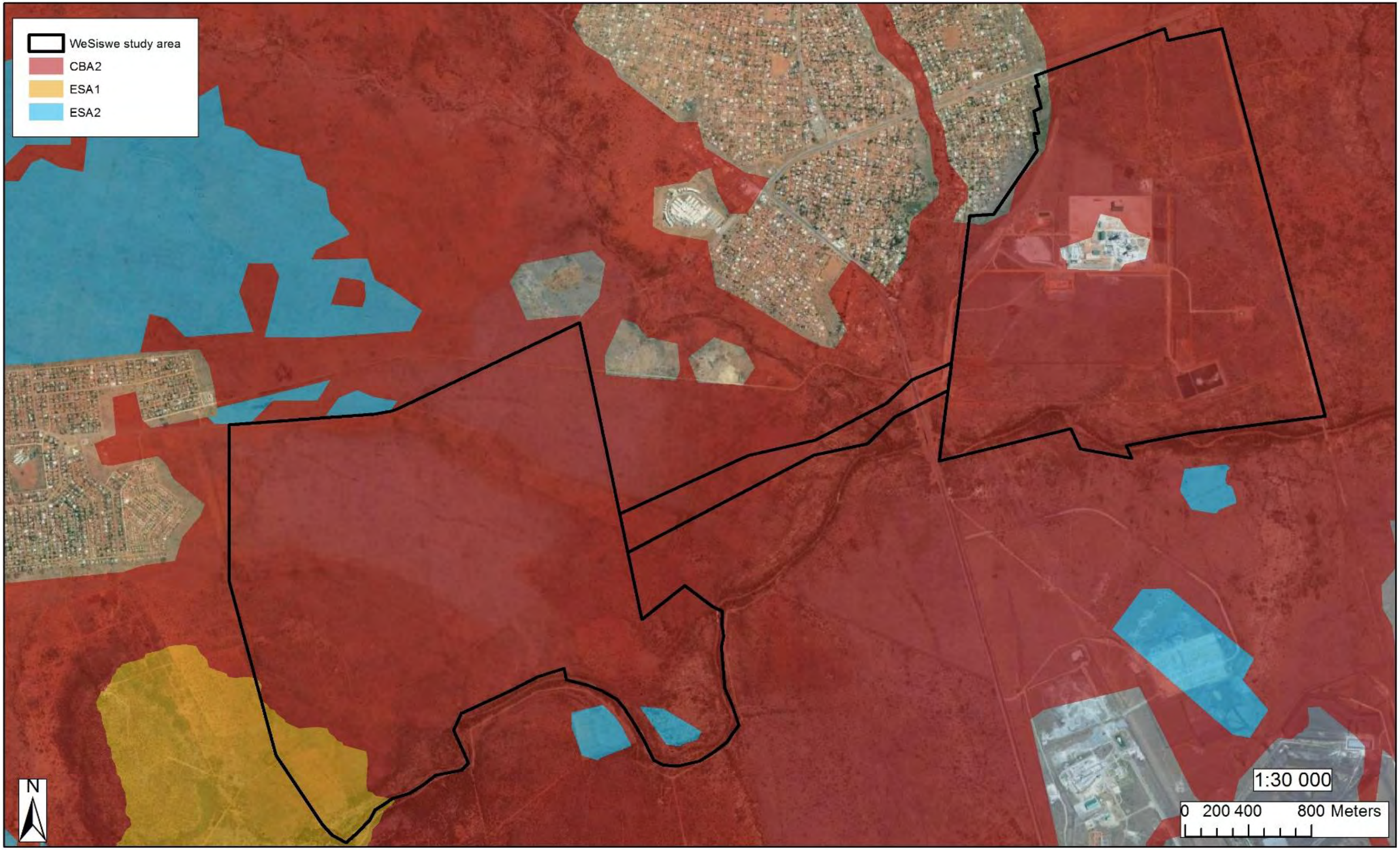
DE CASTRO & BRITS ECOLOGICAL CONSULTANTS



Frischgewaagd Property
Delineated Watercourses
Channelled Valley Bottom Wetland
Dam
Elands River Riparian Habitat
Ephemeral Channel
Sandspruit Riparian Habitat
Unchannelled Valley Bottom Wetland
Ephemeral Drainage Lines
Study Area Components
Bridge
New Access Road
Final tailings pipeline - Dec 2015
Tailings pipeline assessed in field - Nov 2015
Concentrator plant
Eskom Ledig substation
Mine housing phase 1
Mine housing phase 1a
Pollution control dam
Pipeline mapping corridor
Product stockpiles
Waste rock dump
Existing infrastructure
500m study area buffer
0 175 350 525 700
Meters
Scale(a4)-1:20,008
27.067°
27.083°
27.1°
-25.367°
-25.383°
N
1
2
3
4
5
6
7
8
9
10
11
12
Frischgewaagd Watercourse Delineation Map



27.017°
27.033°
27.05°
27.067°
-25.4°
-25.417°
Mimosa Property
Delineated Watercourses
Channelled Valley Bottom Wetland
Elands River Riparian Habitat
Sandspruit Riparian Habitat
Ephemeral Drainage Lines
Study Area Components
Final tailings pipeline - Dec 2015
Tailings pipeline assessed in field - Nov 2015
Study Area Features
Pipeline mapping corridor
Return Water Dam
Storm Water Dam
Tailings Storage Facility
500m Study Area Buffer
0 175 350 525 700
Meters
Scale(a4) - 1:20,008
12
11
13
Mimosa Watercourse Delineation Map



NWBSP 2015 Biodiversity classification for the Wesizwe study area

January 2016
Created by:

DE CASTRO & BRITS
ECOLOGICAL CONSULTANTS

RESULTS - NATURAL VEGETATION

Veld-type classification and conservation importance

The project area falls within the Central Bushveld Bioregion of the Savanna Biome. The NWBSP (2015) provides revised mapping of the national vegetation types (Mucina and Rutherford, 2006) within the North West Province. According to this revised mapping, six vegetation types occur within 3 km of the study area and four vegetation types occur within the study area, indicating that the study area is situated within a zone of transition. Although, according to the revised mapping, most of the study area is mapped as Zeerust Thornveld, with areas of Western Sandy Bushveld, Moot Plains Bushveld and Marikana Thornveld, the vegetation specialist is of the opinion that the study area conforms far more closely to the Mucina and Rutherford (2006) description of Marikana Thornveld in terms of species composition and dominance and therefore the vegetation type for the majority of the project area is regarded as Marikana Thornveld. The only other vegetation type identified within the project area is Gold Reef Mountain Bushveld, which is present near the western boundary of the farm Mimosa (De Castro and Brits, 2016a). These two vegetation types are described below.

Marikana Thornveld: This unit occurs across the North West province and northern part of Gauteng to the north of the Magaliesburg from Pretoria westwards. It has been categorised as Vulnerable, and less than 1% is statutorily conserved. This vegetation unit has been significantly transformed through cultivation and to a lesser extent residential and industrial development (De Castro and Brits, 2016a).

Gold Reef Mountain Bushveld: This unit is largely confined to rocky quartzitic ridges of the Magaliesburg and the parallel ridge to the south, and occurs in the North-West, Gauteng, Free State and Mpumalanga Provinces. It is categorised as least threatened and approximately 22% of this vegetation type is statutorily conserved mainly in the Magaliesburg Nature area and in smaller proportions in the Rustenburg, Wonderboom and Suikerbosrand Nature Reserves. There has been some transformation of this unit, which is attributed to cultivation and urbanization, though approximately 84% remains untransformed.

Vegetation based habitat zones

Nine vegetation/habitat zones were mapped within the mine area by Golder (2007). These included:

- Acacia mellifera Thicket
- Dichrostachys thicket
- Hillslope vegetation
- Open bushveld
- Riparian thicket
- Riparian woodland
- Rocky outcrop
- Secondary vegetation
- Wetland

For the 2016 study, De Castro and Brits (2016a) categorised the vegetation types as follows:

Frischgewaagd area:

- Marikana Thornveld
- Mixed Woodland and Thicket
- Acacia mellifera Bushland and Thicket
- Stony Grassland
- Ephemeral drainage lines - hygrophilous Grassland and Thicket
- Eroded ephemeral drainage lines - Grassland and Open Shrubland
- Secondary vegetation
- Elands River vegetation
- Dams

Mimosa:

- Marikana Thornveld - Mixed Thicket Bushland and Woodland
- Rocky outcrop vegetation
- Elands River vegetation
- Secondary vegetation
- Pipeline corridor:
- Marikana Thornveld
- Sandspruit vegetation
- Secondary vegetation

Descriptions of the habitat types as described in the 2016 vegetation study (Figure 7-10 and Figure 7-11) are provided below in Table 7.9, Table 7.10 and Table 7.11. The botanical biodiversity conservation value and sensitivity for each habitat is also provided.

TABLE 7.9 HABITAT TYPES IDENTIFIED AT THE PLANT AREA (DE CASTRO AND BRITS, 2016A)

Unit No.	Vegetation / land cover unit	Description	Conservation value and sensitivity	Species associated with vegetation / land cover unity Alien species are indicated by an asterisk.
1	Marikana Thornveld	Untransformed woody communities representative of the Marikana Thornveld vegetation type. Occurs mostly on deep red-brown to brown clay loam to sandy clay loam soils smaller areas on situated on black clay soils that have not been historically ploughed Two major plant communities occur within this unit, namely Mixed Thicket, Short/Low Woodland and Bushland on a variety of soil forms listed above (unit 1.1) and a less extensive community of Acacia mellifera Thicket and Bushland on soils of the Valsrivier form (unit 1.2)	High	See unit 1.1 and unit 1.2
1.1	Mixed Woodland & Thicket - on red clay loam soils	Thicket, Short/Low Woodland and Bushland communities of red-brown clay loam soils. Dominated by Searsia lancea, Zizphus mucronata and Acacia spp		Common trees include *Acacia caffra, Acacia robusta, Acacia karoo, Acacia tortilis, Searsia lancea* and *Ziziphus mucronata.* Dominant shrubs include *Acacia caffra* and *Acacia karoo*. Common shrubs include *Acacia erubescens, Carissa bispinosa, Diospyros lycioides, Grewia flava, Acacia tortilis, Searsia lancea* and *Searsia pyroides*. The dominant grasses are *Themeda triandra* and *Cymbopogon pospischilii*. Common grasses include *Aristida canescens, Aristida congesta subsp. barbicollis, Enneapogon scoparius, Eragrostis rigidior, Eragrostis trichophora, Eragrostis superba, Melinis repens, Panicum coloratum* and *Panicum maximum*. Common forbs and geoxylic suffrutices include *Aptosimum procumbens*, *Barleria macrostegia, Commelina africana, Crabaea angustifolia, Geigeria burkei, Felicia muricata, Hermannia depressa, Hibiscus pusillus, Vernonia oligicephala* and *Ziziphus zeyheriana.* The low shrub *Asparagus suaveolens* and the succulent *Aloe davyana* are also common.

Unit No.	Vegetation / land cover unit	Description	Conservation value and sensitivity	Species associated with vegetation / land cover unity Alien species are indicated by an asterisk.
1.2	Acacia mellifera Bushland and Thicket	Dense Acacia mellifera Thicket and Bushland and Acacia mellifera, Acacia tortilis and Tarchonanthus parvicapitulatus communities on red-brown clay to grey brown soils in southern parts of study area.		Common trees include *Acacia mellifera, Acacia karoo* and *Acacia tortilis*. The dominant shrub is Acacia mellifera, which usually constitutes the vast majority of woody cover. Common shrubs include *Diospyros lyciodes, Grewia flava, Gymnosporia buxifolia, Carissa bispinosa, Lycium cinereum* and *Tarchonathus parvicapitulatus*. Dominant grasses include *Panicum coloratum, Eragrostis chloromelas, Eragrostis curvula* and *Heteropogon contortus*. Common grasses include *Sporobolus fimbriatus, Aristida congesta subsp. barbicollis, Aristida congesta subsp. congesta, Digitaria eriantha, Eragrostis trichophora* and *Melinis repens.* Common forbs include *Blepharis integrifolia, Commelina africana, Corchorus aspleniifolius, Evolvulus alsinoides, Justicia betonica, Merremia plamata, Ruelliopsis setosa* and *Seddera capensis*. The low shrub *Asparagus suaveolens* and the succulent *Aloe davyana* are also common.
2	Stony Grassland	Grassland and Low Open Shrubland on red-brown, soils of the Shortlands form with alluvial pebbles scattered on surface. South-eastern parts of the study area.	High	The dominant grasses are *Trachypogon spicatus*, *Elionurus muticus* and *Schizachyrium sanguineum.* Common grasses include *Anthephora pubescens, Aristida canescens*, *Bewsia biflora, Brachiaria nigropedata, Diheteropogon amplectans, Enneapogon scoparius, Heteropogon contortus, Loudetia flavida* and *Urelytrum agropyroides*. Common forbs and low shrubs include *Aptosimum procumbens, Bulbostylis hispidula, Cyanotis speciosa, Dicoma anomala, Gnidia caffra, Ipomoea bathycolpos, Rhynchosia minima, Rotheca cf. hirsuta, Sida chrysantha, Silene sp., Triumfetta sonderi, Vernonia oligocephala* and *Ruellia patula*. This unit contains habitat that is considered suitable for one of the 'plant species of conservation' concern recorded or potentially occurring in the vicinity of the study area namely *Boophone disticha* (Declining).
3	Eroded ephemeral drainage lines - Grassland and Open Shrubland	Grassland and Shrubland along incised ephemeral drainage lines, with occasional, scattered trees. Includes small ephemeral drainage lines with shallowly incised channels surrounded by, stable eroded areas with exposed calcrete and rounded (probably alluvial) stones vegetated by Grassland and Shrubland in the southern parts of the study area, as well as a deeply incised larger ephemeral drainage line running from North to South through the north-eastern parts of the study area. No hygrophilous vegetation is present along the small southern drainage lines, but hygrophilous grassland is present along the active channel of the larger drainage	High	The central channel of the larger northern stream has distinct, narrow band of marginal vegetation. The vegetation can be described as marginal hygrophilous grassland with scattered riparian large shrubs and small trees, *Searsia lancea* is common. Other riparian shrubs and small trees include *Acacia karoo, Searsia pyroides* and *Ziziphus mucronata*. The dominant grasses include *Imperata cylindrica* and *Botriochloa insculpta*. Common to sub-dominant grasses include *Botriochloa bladhii, Eragrostis capensis, Hyparrhenia dregeana, Hyparrhenia filipendula, Hyparrhenia hirtaand* and *Themeda triandra.* Common forbs include *Berkheya radula, Cephalaria zeyheriana, Haplocarhpa lyrata, Lobelia thermalis, Nidorella resediifolia, Salvia runcinata* and *Vigna vexillata*. Small trees which occur scattered on the naturally eroded areas associated with these drainage lines include *Acacia karoo, Acacia mellifera, Maerua angolensis, Olea europaea subsp. africana* and *Searsia lancea*. Common shrubs include *Acacia mellifera, Dodonaea viscosa var. angustifolia, Euclea undulata, Grewia flava, Searsia lancea* and *Tarconanthus parvicapitulatus*.

Unit No.	Vegetation / land cover unit	Description	Conservation value and sensitivity	Species associated with vegetation / land cover unity Alien species are indicated by an asterisk.
		line in the north. These areas are characterised by various soils at different section along the drainage lines, including soils of the Oakley form, Valsrivier form, Shortlands form and Arcadia form.		The vegetation of the naturally eroded areas associated with the two smaller southern drainage lines and the lower reaches of the larger northern drainage line is Short Closed Grassland. The dominant grass is Aristida canescens and Trachypogon spicatus is sub-dominant. Common grasses include *Cymbopogon pospischilii, Diheteropogon spicatus, Enneapogon scoparius, Fingerhuthia africana, Melinis repens, Schmidtia pappophoroides* and *Schizachyrium sanguineum*. Common forbs include Ruelliopsis setosa, Bulbostylis hispidula, Chascanum cf. hederaceum, Dicoma anomala, Euphorbia davyi, Geigeria burkei, Indigofera heterotricha, Kohautia virgata, Oldenlandia cf. herbacea, Polygala krumaniana, and *Ptycholobium plicatum.*
4	Ephemeral drainage lines - hygrophilous Grassland and Thicket	Hygrophilous Grassland, Open Shrubland and Thicket of an indistinct ephemeral drainage line system in the north-western parts of the study area. The upper reaches of this drainage line comprise a series of small discontinuous swales, and the lower reaches a more distinctly incised channel. Periodically the upper reaches of this drainage line flood broad floodplains which may be over 50m wide. Most of the widely flooded areas are on black vertic clays.	High	Along the northern tributary of this drainage system dominant grasses include Botriochloa insculpta and Aristida bipartita. Common to locally dominant grasses include *Dicanthium annulatum, Ischaemum afrum, Botricochloa bladhii* and *Cynodon dactylon*. The margins of these swales and the periodically inundated soils adjacent to these swales are vegetated by Short Thicket. Dominant trees are *Searsia lancea* and *Acacia karoo*. Common trees include *Acacia tortilis* and *Ziziphus mucronata*. Dominant shrubs are *Acacia tortilis* and *Acacia karoo.* Common shrubs include *Acacia karoo, Aspargus laricinus, Searsia pyroides and Dichrostachys cinerea. Common grasses include Panicum maximum, Botriochloa insculpta* and *Sporobolus nitens*. Along the southern tributary of the drainage system common shrubs include *Acacia tortilis*, *Acacia karoo* and *Asparagus laricinus*. The dominant grasses are *Aristida bipartita* and *Dicanthium annulatum*. Common grasses include *Ischaemum afrum*, *Botriochloa insculpta*, *Brachiaria eruciformis* and *Eragrostis cf. micrantha*. The facultative hydrophytic geophyte *Crinum lugardiae* is abundant along the southern tributary (wetland) of this unit.
5	Elands River vegetation	Vegetation of the macro-channel bank and periodic floodplain of the Elands River. Includes marginal vegetation of the macro-channel bed vegetation, riparian Closed Woodland and Forest, and Low Bushland to Short Thicket of upper parts of macro-channel bank. The soils of this unit comprise deep, sandy loam to loam, alluvial soils of the Oakleaf form	High	The macro-channel bed comprises vegetation comprises dense reed beds of the megagraminoid Phragmites mauritianus, interspersed with herbaceous plant communities dominated by hygrophytic grasses and sedges, which include many alien weeds. Common small trees and shrubs include *Gomphostigma virgatum, Nicotiana glauca*, Salix mucronata, Searsia lancea, Eucalyptus camaldulensis** and *Sesbania punicea**. Common to dominant grasses, sedges and rushes include *Agrostis lachnantha, Cynodon dactylon, Echinochloa colona, Eragrostis rotifer, Hemarthria altissima, Imperata cylindrica, Paspalum dilatatum*, Paspalum distichum, Bulbostylis sp., Sporobolus fimbriatus, Cyperus fastigiatus, Cyperus marginatus, Cyperus eragrostis*, Cyperus sexangularis* and *Typha capensis.*

Unit No.	Vegetation / land cover unit	Description	Conservation value and sensitivity	Species associated with vegetation / land cover unity Alien species are indicated by an asterisk.
				Common forbs include *Aster squamatus*, Juncus excertus, Ludwigia adscendens subsp. diffusa, Persicaria lapatifolia*, Persicaria senegalensis, Pulicaria scabra, Schkhuria pinnata*, Verbena bonariensis** and *Xanthium strumarium*.* On the lower macro-channel banks the dominant trees are *Acacia karoo, Combretum erythrophyllum* and *Searsia lancea*. Common trees include *Celtis africana, Melia azedarach*, Morus alba*, Searsia pyroides* and *Ziziphus mucronata.* The alien invasive trees include *Eucalyptus camaldulensis** and *Populus x canescens** are localised but together with *Melia azedarach** and *Morus alba** pose a significant threat of habitat transformation in this riparian woodland. Common shrubs include *Diospyros lyciodes, Gymnosporia buxifolia, Searsia pyroides* and *Ziziphus mucronata*. Dominants in the herbaceous layer include the grasses *Panicum maximum* and *Setaria megaphylla* and the forb *Hypoestes forskaolii.* Common grasses include *Cynodon dactylon, Ehrharta erecta* and *Urochloa mossambicensis*. Common forbs include *Ambrosia crataegifolia, Asparagus virgatus, Malvastrum coromandelianum** and *Pavonia burchellii*. The climber *Clematis brachiata* is common. On the upper parts of macro-channel bank common trees include *Acacia karoo, Melia azedarach*, Searsia lancea* and *Ziziphus mucronata*. Dominant shrubs include *Asparagus laricinus*, *Grewia flava, Diospyros lyciodes, Ziziphus mucronata.* Common shrubs include *Acacia tortilis, Gymnosporia buxifolia, Lycium cinereum* and *Tarchonanthus parvicapitulatus*. The dominant grasses include *Digitaria eriantha, Cynodon dactylon* and *Eragrostis rigidior.*
6	Secondary vegetation	Secondary vegetation of historically cultivated areas, borrow pits and scoured soils. Includes mostly secondary Bushland and Shrubland with smaller areas of secondary Thicket and patches of secondary Grassland on recently disturbed sites. Includes almost all areas on black turf soils classified as Arcadia as well as areas of red-brown soils of the Oakleef and Vlasrivier forms. Vegetation structure varies greatly in accordance with soil type, time elapsed since disturbance and the nature and duration of disturbance.	Moderate	On recently disturbed black clay soils the dominant grass is *Aristida bipartita*, and *Sorghum versicolor*, *Brachiaria eruciformis and Setaria sphacelata* are sub-dominant. Common forbs are *Zinnia peruviana**, *Bidens bipinnata** and *Schkhuria pinnata**. A low density of *Acacia mellifera* and *Acacia tortilis* saplings is present. In areas where succession has progressed further, the only common small tree is *Acacia tortilis.* The dominant shrub is also *Acacia tortilis* and common shrubs include *Acacia karoo*, *Asparagus laricinus, Diospyros lyciodes* and *Ziziphus mucronata*. The dominant grasses are *Aristida bipartita* and *Ischaemum afrum*, and common grasses include *Cymbopogon pospischilii*, *Eragrostis chloromelas* and *Brachiaria eruciformis*. On red-brown sandy clay loams (Oakleaf form) the dominant shrubs are *Acacia tortilis*

Unit No.	Vegetation / land cover unit	Description	Conservation value and sensitivity	Species associated with vegetation / land cover unity Alien species are indicated by an asterisk.
				and *Dichrostachys cinerea*, and *Grewia flava is common*. The dominant grass is *Hyparrhenia filipendula* and common grasses include *Heteropogon contortus, Eragrostis superba, Eragrostis rigidior* and *Melinis repens*.
7	Dams	This unit comprises two old earth-walled farm dams built on ephemeral drainage lines and these dams therefore represent secondary drainage line habitat. Depending on the state of inundation, the floor of the full supply level either comprises bare, dry clays or is vegetated by stands of indigenous hygrophytic grasses and indigenous and alien forbs which often occur in disturbed areas.	Low	Dominant grasses are *Echinochloa colona* and *Cynodon dactylon.* Common grasses include *Botriochloa insculptpta, Dicanthium annulatum, Setaria sphacelata* and *Urochloa mossambicensis*. Common weedy forbs include *Ambrosia artemisiifolia**, *Aster squamatus*, Denekia capensis, Indigastrum parviflorum, Nidorella resedifolia, Persicaria senegalensis* and *Xanthium strumarium**. The alien biannual shrub **Sesbania bispinosa var. bispinosa* is common.
8	Infrastructure	The infrastructure comprising this unit was constructed mostly on soils of the Arcadia form. This unit comprises the mine shaft complex, discard dumps, steel water reservoirs, lined pollution control dams and linear infrastructure such as roads, canals and berms. The habitats of these areas have been completely transformed and the natural vegetation cleared.	Negligible	None

TABLE 7.10: HABITAT TYPES IDENTIFIED AT THE TSF AREA (DE CASTRO AND BRITS, 2016A)

Unit No.	Vegetation / land cover unit	Description	Conservation value and sensitivity	Species associated with vegetation / land cover unity Alien species are indicated by an asterisk.
1	Marikana Thornveld - Mixed Thicket Bushland and Woodland on red clay loam soils	Untransformed Thicket, Bushland and Woodland communities representative of Clay Thorn Bushveld. Mostly Short/Low Thicket and Bushland communities, with smaller areas of Closed Woodland, on red-brown clay loam soils. Dominated by Searsia lancea, Zizphus mucronata and Acacia spp. Unit also includes three small (longest 300m), indistinct 1st order ephemeral drainage lines near the Elands River.	High	Common trees include *Acacia caffra, Acacia karoo, Acacia tortilis, Searsia lancea* and *Ziziphus mucronata*. Dominant shrubs include *Acacia caffra* and *Acacia karoo*. Common shrubs include *Acacia erubescens, Grewia flava, Acacia tortilis, Searsia lancea* and *Searsia pyroides*. The dominant grasses are *Cymbopogon pospischilii*, *Heteropogon contortus* and *Themeda triandra*. Common grasses include *Aristida congesta subsp. barbicollis*, *Eragrostis chloromelas, Eragrostis superba, Eragrostis rigidior, Eragrostis trichophora, Eragrostis superba, Melinis repens, Panicum coloratum, Panicum maximum, Panicum coloratum, Setaria sphacelata* and *Tragus racemosa.* Common forbs include *Aptosimum procumbens, Barleria macrostegia, Commelina africana, Corchorus aspleniifolius, Crabaea angustifolia, Hermannia depressa, Hibiscus*

Unit No.	Vegetation / land cover unit	Description	Conservation value and sensitivity	Species associated with vegetation / land cover unity Alien species are indicated by an asterisk.
				pusillus, Indigofera circinnata, Nidorella resediifolia, Ptycholobium plicatum and Ziziphus zeyheriana. The low shrub Asparagus suaveolens and the succulents Aloe davyana and *Aloe transvaalensis* are also common. The vegetation of the three small ephemeral drainage lines near the Elands River is very similar to the surrounding terrestrial vegetation but does display some differences. Common trees are *Acacia karoo, Olea europaea subsp. africana and Ziziphus mucronata*. The dominant shrub is *Acacia karoo*. Common shrubs include *Asparagus laricinus, Acacia erubescens, Combretum hereroense, Diospyros lycioides, Grewia flava, Gymnosporia buxifolia, Searsia pyroides, Tarchonanthus parvicapitulatus* and *Ziziphus mucronata*. Dominant grasses in the indistinct central channels include *Botriochloa insculpta* and *Setaria sphacelata*. Common grasses include *Cymbopogon pospischilii, Hyperthelia dissoluta, Ischaemum afrum* and *Themeda triandra*. Drimia sanguinea (Near Threatened), *Hypoxis hemerocallidea* (Declining) and a protected species *Sclerocarya birrea* were also recorded.
2	Rocky outcrop vegetation	This unit is entirely restricted to single low, linear rock (quartzite) outcrop situated near the western boundary of the section. The soils are shallow, reddish brown sandy clay loam soils of the Mispah soil form. The vegetation of this unit can be described as Open Shrubland which grades to Short Bushland and smaller patches of Short Thicket.	High	Common trees include *Acacia caffra, Acacia tortilis, Boscia albitrunca, Dombeya rotundifolia, Sclerocarya birrea, Searsia lancea, Strychnos pungens* and *Ziziphus mucronata*. The tree aloe, *Aloe marlothii*, is also common. The dominant shrub is *Acacia caffra*. Common shrubs include *Ehretia rigida, Elephantorrhiza burkei, Indigofera melanadenia subsp. melanadenia, Lannea discolor, Pavetta zeyheri, Searsia lancea, Searsia leptodictya, Vangueria infausta* and *Ximenia caffra*. Dominant grasses are *Schizachyrium jeffreysii, Loudetia flavida* and *Diheteropogon amplectans.* Common grasses include *Andropogon schirensis, Aristida congesta subsp. barbicollis Melinis repens, Trachypogon spicatus, Bewsia biflora, Elionurus muticus, Melinis repens, Themeda triandra, Trachypogon spicatus* and *Tricholaena monachne*. Common forbs include *Acalypha petiolaris, Bulbostylis hispidula, Chaetacanthus costatus, Chascanum cf. hederaceum, Dicoma anomala, Gnidia caffra, Ipomoea bathycolpos* and *Jamesbrittenia burkeana*. The succulent Aloe davyana and the woody climber/scrambler *Ancylobotrys capensis* are also common. The invasive large succulents *Cereus jamacuru** and *Agave Americana** are well established and pose a risk of significant habitat transformation within this unit. This unit contains habitat that is considered suitable for one of the ‘plant species of conservation’ concern recorded or potentially occurring in the vicinity of the study area, namely *Boophone disticha* (Declining).
3	Elands River vegetation	This unit comprises the vegetation of the	High	The macro-channel bed vegetation comprises dense reed beds of the megagraminoid

Unit No.	Vegetation / land cover unit	Description	Conservation value and sensitivity	Species associated with vegetation / land cover unity Alien species are indicated by an asterisk.
		Elands River macro-channel, including the active-channel banks, macro-channel bed and macro-channel banks, as well as a large floodplain of approximately 15ha directly downstream of the western boundary and a smaller floodplain with a floodplain lake on the eastern boundary. The soils of the vast majority of this unit comprise deep, sandy loam to loam, alluvial soils of the Oakleaf form, but small areas of sandy clay loam soils of the Valsrivier form occur on the upper edge of the floodplain		*Phragmites mauritianus*, interspersed with herbaceous plant communities dominated by hygrophytic grasses and sedges, which include many alien weeds. Frequent flooding by fact flowing waters largely precludes the establishment of mature trees other than rheophytes (e.g. *Salix mucronata*), but small trees and shrubs occur scattered on the macro-channel bed. Common small trees and shrubs include *Gomphostigma virgatum, Nicotiana glauca*, Salix mucronata, Searsia lancea, Eucalyptus camaldulensis** and *Sesbania punicea**. Common to dominant grasses, sedges and rushes include *Agrostis lachnantha, Cynodon dactylon, Echinochloa colona, Eragrostis rotifer, Hemarthria altissima, Imperata cylindrica, Paspalum dilatatum*, Paspalum distichum, Bulbostylis sp., Sporobolus fimbriatus, Cyperus fastigiatus, Cyperus marginatus, Cyperus eragrostis*, Cyperus sexangularis* and *Typha capensis*. Common forbs include *Aster squamatus*, Juncus excertus, Ludwigia adscendens subsp. diffusa, Persicaria lapatifolia*, Persicaria senegalensis, Pulicaria scabra, Schkhuria pinnata*, Verbena bonariensis** and Xanthium strumarium*. On the lower macro-channel the dominant trees are *Acacia karoo, Combretum erythrophyllum and Searsia lancea. Common trees include Celtis africana, Melia azedarach*, Morus alba*, Searsia pyroides* and *Ziziphus mucronata*. Common shrubs include *Diospyros lyciodes, Gymnosporia buxifolia, Searsia pyroides* and *Ziziphus mucronata*. Dominants in the herbaceous layer include the grasses *Panicum maximum* and *Setaria megaphylla* and the forb *Hypoestes forskaolii.* Common grasses include *Cynodon dactylon, Ehrharta erecta* and *Urochloa mossambicensis.* Common forbs include *Ambrosia crataegifolia, Asparagus virgatus, Malvastrum coromandelianum** and *Pavonia burchellii*. The climber *Clematis brachiata* is common. Patches of Tall Forest on the seldom activated upper parts of the macro-channel also have *Olea europaea subsp. africana* as a common tree, *Acalypha glabrata var. pilosior* as a common shrub, and a higher species richness in the herbaceous layer. The alien invasive trees *Eucalyptus camaldulensis** and *Populus x canescens** are localised but together with widespread *Melia azedarach** and *Morus alba** pose a significant threat of habitat transformation in this riparian woodland. There is also the alien invasive woody climber *Dolichandra unguis-cati**. On the upper parts of macro-channel common trees include *Acacia karoo, Melia azedarach*, Searsia lancea* and *Ziziphus mucronata*. Dominant shrubs include *Asparagus laricinus, Grewia flava, Diospyros lyciodes, Ziziphus mucronata.* Common shrubs include *Acacia tortilis, Gymnosporia buxifolia, Lycium cinereum* and

Unit No.	Vegetation / land cover unit	Description	Conservation value and sensitivity	Species associated with vegetation / land cover unity Alien species are indicated by an asterisk.
				Tarchonanthus parvicapitulatus. The dominant grasses include *Digitaria eriantha, Cynodon dactylon* and *Eragrostis rigidior.* On the floodplains the only common tree is *Acacia karoo*. The dominant shrub is *Grewia flava*. Common shrubs include *Acacia karoo, Asparagus laricinus, Dichrostachys cinerea, Diospyros lycioides, Grewia bicolor, Gymnosporia buxifolia, Tarconanthus parvicapitulatus and Ziziphus mucronata. Dominant grasses include Botriochloa insculpta, Digitaria eriantha, Tragus racemosa* and *Urochloa mossambicenis*. *Cenchrus ciliaris* is a localised dominant. Common grasses include *Aristida cf. adscensionis, Aristida bipartita, Botriochloa radicans, Panicum coloratum, Panicum maximum* and *Heteropogon contortus*. Forb diversity is low. Common forbs include *Corchorus aspleniifolius, Talinum caffrum, Indigastrum parviflorum, Ledebouria sp., Nidorella resediifolia* and *Cullen tomentosum*. The low shrub *Asparagus suaveolens* is common as are the climbers *Asapagus cf. setaceus* and *Cyphostemma sulcatum*.
4	Secondary vegetation	This unit comprises vegetation of historically cultivated areas and scoured soils. It includes mostly secondary Bushland and Shrubland with a few small patches of secondary Thicket in areas where succession is more advanced. It covers the majority of the northern half of the study area as well as several patches in the south-eastern and south-western parts of the study area along the Elands River. It includes almost all areas on black turf soils classified as Arcadia as well as areas of red-brown soils of various soil forms. Vegetation structure and species composition varies greatly in accordance with soil type, time elapsed since disturbance and the nature and duration of the disturbance.	Moderate	In secondary Tall Closed Shrubland to Low Closed Bushland on red-brown sandy clay loams and clay loam soils common trees include *Acacia karoo, Acacia tortilis* and *Ziziphus mucronata*. The dominant shrub is *Acacia tortilis*. Common shrubs include *Acacia karoo, Acacia mellifera and Ziziphus mucronata*. The dominant grasses are *Aristida congesta subsp. barbicollis, Eragrostis rigidior* and *Urochloa mossambicensis*. Common grasses include *Cynodon dactylon, Eragrostis curvula, Eragrostis trichophora, Heteropogon contortus, Panicum maximum* and *Tragus racemosa*. Common forbs include *Berkheya carilinopsis subsp. magalismontanum, Boerhavia diffusa*, Corchorus aspleniifolius, Gomphrena celosiodes*, Indigofera circinnata. Indigofera melanadenia subsp. malacostachys, Kyphocarpha angustifolia, Nidorella resediifolia, Osteospermum muricatum, Pentarrhinum insipidum* and *Solanum eleagnifolium*.* In secondary In Tall Open Shrubland communities on heavy black clay soils, the vegetation is dominated by grasses. The only common small tree is *Acacia tortilis*, though small *Acacia karoo* trees are present in places. Common shrubs include *Acacia tortilis*, *Asparagus laricinus, Dichrostachys cinerea* and *Ziziphus mucronata. and Diospyros lycioide*s and common shrubs include *Acacia karoo*, *Asparagus laricinus, Diospyros lyciodes* and *Ziziphus mucronata*. The dominant grasses are Aristida bipartita, *Eragrostis chloromelas* and *Ischaemum afrum*, and common grasses include *Brachiaria eruciformis*, *Cymbopogon pospischilii*, *Setaria incrassate* and Themeda triandra. Common forbs include *Acalypha indica, Convolvulus sagittatus, Corchorus*

Unit No.	Vegetation / land cover unit	Description	Conservation value and sensitivity	Species associated with vegetation / land cover unity Alien species are indicated by an asterisk.
				aspleniifolius, Elephantorrhiza elephantina (geoxylic suffrutex), Jamesbrittenia aurantiaca, Kouhautia virgate, Nidorella resediifolia, Rhynchosia minima and *Schkhuuria pinnata*.*
5	Infrastructure	Farm homesteads and guard huts.	Negligible	None

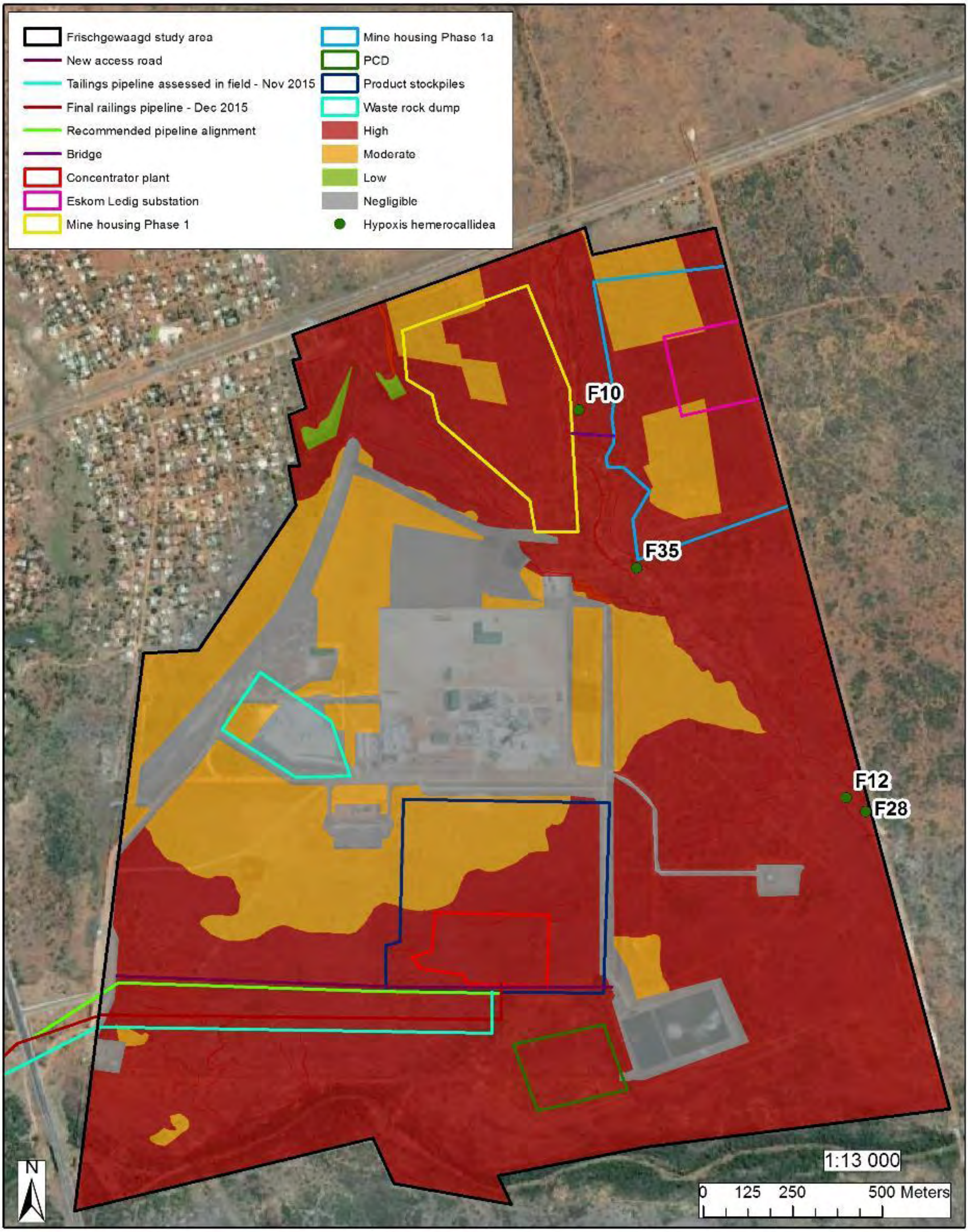
TABLE 7.11: HABITAT TYPES IDENTIFIED ALONG THE PIPELINE CORRIDOR (DE CASTRO AND BRITS, 2016A)

Unit No.	Vegetation / land cover unit	Description	Conservation value and sensitivity	Species associated with vegetation / land cover unity Alien species are indicated by an asterisk.
1	Marikana Thornveld	Refer to the descriptions provided in Table 7.9 and Table 7.10		
2	Sandspruit vegetation	This unit comprises the vegetation of the Sandspruit River macro-channel, including the macro-channel bed, active-channel banks (marginal zone) and the macro-channel banks. The Sandspruit is a weakly perennial stream. The soils of this unit comprise a mixture of sandy clay loam soils of the Oakleaf, Valsrivier and Mispah forms. The vegetation of this unit falls within a communal grazing area situated between Mimosa and Frischgewaagd, and is overgrazed and subjected to extensive cutting of trees for fuel and construction material.	High	Common shrubs at the exposed macro-channel bed include the rheophytes *Gomphostigma virgatum, Salix mucronata, and Sesbania punicea*.* Dominant grasses and rushes include *Cynodon dactylon* and *Juncus excertus*. Common grasses and sedges include *Agrostis lachnantha, Hemarthria altissima, Paspalum distichum, Cyperus eragrostis** and *Cyperus sexangularis*. Common forbs include *Aster squamatus*, Lobelia thermalis, Pulicaria scabra* and *Xanthium strumarium*.* On the lower macro-channel banks common small trees are *Salix mucronata* and *Morus alba*.* The dominant shrub is *Searsia lancea.* Common shrubs include *Conyza scabrida*, *Gymnosporia buxifolia, Salix mucronata* and *Sesbania punicea*.* The dominant species in the herbaceous layer are the sedge *Cyperus sexangularis* and the grass *Cynodon dactylon*. Common grasses include *Paspalum dilatatum*, Hemarthria altissima, Botriochloa* insculpta and *Sporobolus fimbriatus*. Common forbs include *Juncus excertus, Pulicaria scabra and Ranunculus multifidus*, *Verbena officinalis*. On the upper macro-channel banks, the dominant trees are *Searsia lancea* and *Acacia karoo*. Common trees include *Morus alba*, Olea europaea subsp. africana, Ziziphus mucronata*. The dominant shrubs are *Acacia karoo* and *Gymnosporia buxifolia*. Common shrubs include *Asparagus laricinus, Grewia flava, Searsia pyroides, Searsia lancea* and *Tarchonanthus parvipunctulatus*. The dominant species in the herbaceous layer is the grass *Panicum maximum*. Common forbs include *Hypoestes forskaolii* and *Pavonia burchellii.* Young plants of the alien invasive succulent *Agave americana** are locally abundant

Unit No.	Vegetation / land cover unit	Description	Conservation value and sensitivity	Species associated with vegetation / land cover unity Alien species are indicated by an asterisk.
				along the macro-channel banks.
3	Secondary vegetation	Refer to the descriptions provided in Table 7.9 and Table 7.10		
4	Infrastructure	Tar road, dog kennels for the mine and access roads	Negligible	None

Biodiversity Sensitive Habitats at Bakubung Mine

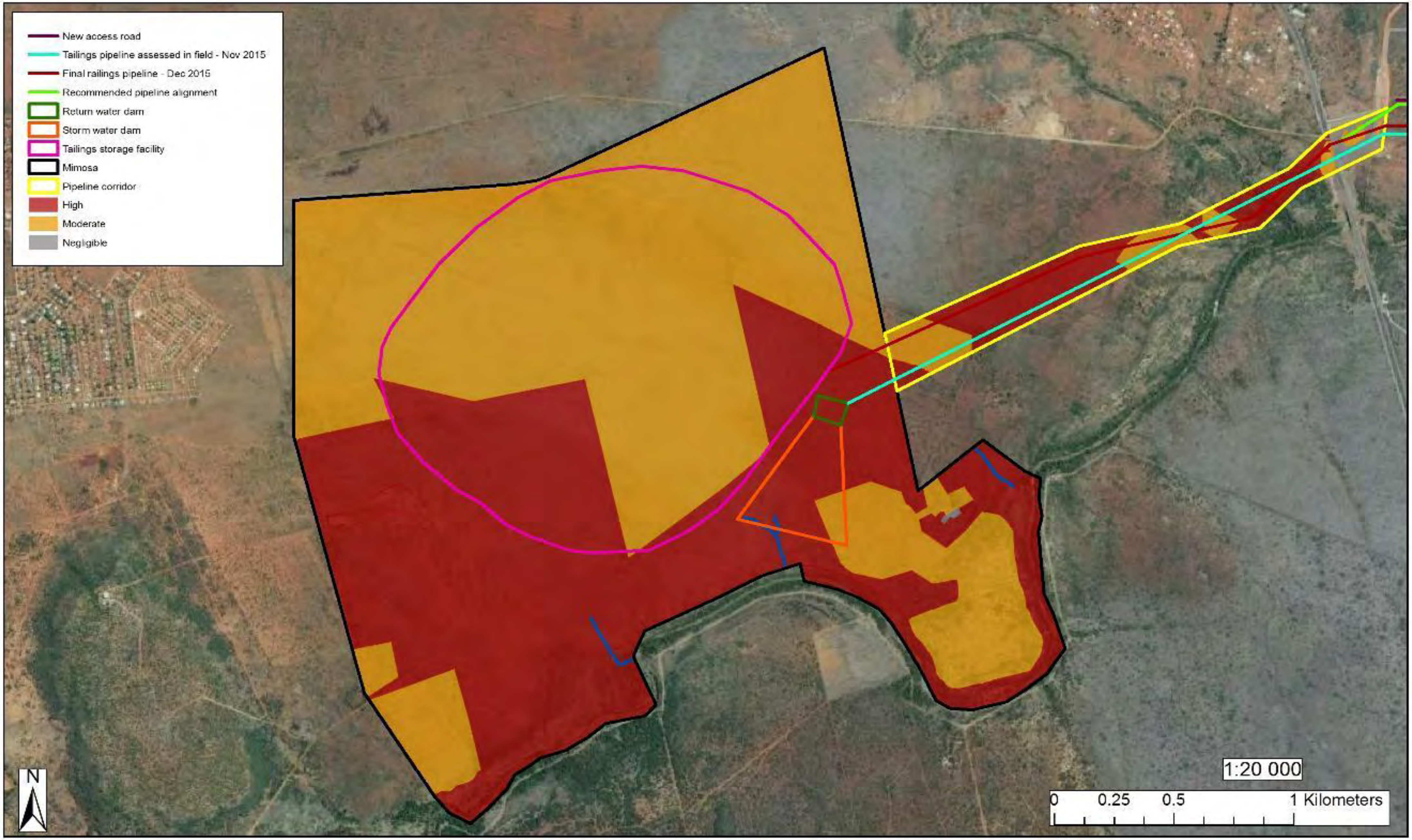
Areas of high, moderate, low and negligible botanical biodiversity sensitivity were mapped by the specialist (Figure 7-14 and Figure 7-15). All areas falling within Marikana Thornveld, the stony grasslands, watercourses, riparian areas and rocky outcrop were classified as having high sensitivity. All areas of secondary vegetation were classified as moderate. Areas with infrastructure had no sensitivity and the two dams were classified as having low sensitivity as described in Table 7.9, Table 7.10 and Table 7.11.



Senisitivity map with proposed infrastructure for Frischgewaagd

January 2016
Created by:

DE CASTRO & BRITS ECOLOGICAL CONSULTANTS



Sensitivity map with proposed infrastructure for Mimosa and the Pipeline corridor

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Protected Tree Species and Species of conservation concern

Two protected species in terms of the National Forests Act (NFA; No. 84 of 1998) were recorded within the study area. These include *Boscia albitrunca* and *Sclerocarya birrea subsp*. *Africana*. A permit must be obtained from DAFF before these species may be removed from site.

The Pretoria Computer Information Systems lists of historically recorded species of conservation concern included nine plant species of conservation concern. Two additional species were also considered; Stenostelma umbelluliferum because it occurs in the eastern parts of the North West province in habitats similar to those found in the project area and was included as a potentially occurring species and Hypoxis hemerocallidea (Declining) because it was identified on site during the survey.

Table 7.12 provides the probability of occurrence of the 11 species discussed above. Only one of the eleven species listed has thus far been recorded within the study area. This species was recorded at four sites within Frischgewaagd. Hypoxis hemerocallidea is not a threatened species as defined by the IUCN criteria, but is categorised as Declining in the latest Red List of South African Plants.

TABLE 7.12: SPECIES OF CONSERVATION CONCERN AND THEIR PROBABILITY OF OCCURRENCE (DE CASTRO AND BRITS, 2016A).

Species	Conservation Status Category*	Habitat	Probability of occurrence	
			Frischgewaagd	Mimosa
Frithia pulchra	Rare	Coarse, shallow, quartzitic soils on sandstones.	Low	Low
Boophone disticha	Declining	Dry grassland and woodland, particularly in rocky areas.	Low	Medium
Stenostelma umbelluliferum	Near Threatened	Deep black turf in open woodland mainly in the vicinity of drainage lines.	Medium	Low
Ilex mitis var. mitis	Declining	Along rivers and streams in forests and thickets, sometimes in the open. Found from sea level to inland mountain slopes.	Low	Low
Aloe peglerae	Endangered	Grassland, in shallow, gravely quartzitic soils on rocky, north-facing slopes or summits of ridges.	Negligible	Negligible
Adromischus umbraticola subsp. umbraticola	Near Threatened	South-facing rock crevices on ridges, restricted to Gold Reef Mountain Bushveld in the northern parts of its range, and Andesite Mountain Bushveld in the south	Negligible	Negligible
Gunnera perpensa	Declining	In marshy, cold or cool, continually moist localities, mainly along upland streambanks. From coast to 2400m.	Negligible	Negligible
Drimia sanguinea	Near Threatened	Open veld and scrubby woodland in a variety of soil types.	Medium	Medium
Hypoxis hemerocallidea	Declining	Grassland and mixed woodland, including secondary grassland of historically cultivated soils. Usually in moist situations.	Recorded	High
Rapanea melanophloeos	Declining	Coastal, swamp and mountain forest, on forest margins and in bushclumps, often in damp areas from coast to mountains.	Negligible	Negligible
Prunus africana	Vulnerable	Evergreen forests near the coast,	Negligible	Negligible

Species	Conservation Status Category*	Habitat	Probability of occurrence	
			Frischgewaagd	Mimosa
		inland mistbelt forests and afromontaone forests up to 2100m.		

Medicinal species

Two medicinal plants could occur on site and are species of conservation concern. The Declining medicinal plant Hypoxis hemerocallidea was recorded on site and Boophone disticha has a moderate probability of occurring as described above. Boophone disticha is not under any immediate threat of extinction, and has been categorised as Declining as it is a popular and fairly heavily utilised medicinal plant. It is long-lived and slow growing, and thus there are concerns that the long-term over-utilisation of wild plants will lead to a decline in many of the sub-populations of this species.

Alien and Invasive Species

Scattered alien and invasive plant species are located throughout the project area. The most important species in terms of habitat transformation that were recorded on site include, Agave americana. Cereus jamacuru, Dolichandra anguis-cati, Eucalyptus camaldulensis, Melia zedarach, Morus alba, Nicotiana glauca, Opuntia ficus-indica, Populus x canescens and Sesbania punicea These species pose a significant threat to the indigenous vegetation of the study area and its immediate surrounds and should be controlled as a matter of urgency. This list does not include all the species identified, for a full list refer to the vegetation study (Appendix K).

RESULTS - TERRESTRIAL ANIMAL LIFE

Commonly occurring faunal species

While the study area is generally untransformed, large portions to the west and south are intensively settled or mined and the specialist is of the opinion that the fauna of the site is as a consequence lacking. However, the Pilanesberg National Park, is situated a 2 km north of the site and contains large numbers of vertebrate fauna, including many Red Data listed species (De Castro and Brits, 2016c).

Mammals

The savanna biome is a region with high diversity of mammals, a low number of endemics and a high number of Red Data species.

Much of the area surrounding the project area has been transformed and extensively disturbed through mining, agriculture and urban spread. This habitat transformation, together with elevated human presence and impacts such as disturbance and hunting, has negatively impacted on large mammal occurrence, particularly ungulates and predators. As a result, mammals remaining in the study area are mostly small, cryptic and often nocturnal species that are adapted to live in close proximity to transformed ecosystems such as cultivated fields or urban developments (De Castro and

Brits, 2016b). Ten mammal species were confirmed to occur within the development footprint, one being a species of conservation concern, the Serval (*Leptailurus serval*). All the remaining species located during fieldwork are common and widespread mammals of the savanna and grassland biomes of South Africa and include herbivores such as Steenbok (*Raphicerus campestris*), Grey Duiker (*Sylvicapra grimmia*), Springhare (*Pedetes capensis*) and Scrub Hare (*Lepus saxatilis*) and carnivores such as Caracal (*Caracal caracal*), Black-backed Jackal (*Canis mesomelas*) and Water Mongoose (*Atilax paludinosus*) (De Castro and Brits, 2016c).

Twenty three conservation-important mammal species potential occur within the general vicinity of the project area; Table 7.13 provides the likelihood of their occurrence. Of the 23 species, 21 are Red Data species and five are protected under NEMBA. No mammals potentially occurring within the study area are endemic to South Africa (De Castro and Brits, 2016c).

TABLE 7.13: POTENTIALLY OCCURRING MAMMALS IN THE PROJECT AREA (DE CASTRO AND BRITS, 2016C).

Species	Scientific Name	Red Data	Protected	Likelihood
African Clawless Otter	*Aonyx capensis*	NT*		Moderate
Southern African Hedgehog	*Atelerix frontalis*	NT		Moderate
Reddish-grey Musk Shrew	*Crocidura cyanea*	DD		Moderate
Swamp Musk Shrew	*Crocidura mariquensis*	DD		Moderate
Tiny Musk Shrew	*Crocidura fuscomurina*	DD		Moderate
Lesser Red Musk Shrew	*Crocidura hirta*	DD		Moderate
Peters' Musk Shrew	*Crocidura silacea*	DD		Moderate
Short-snouted Elephant-shrew	*Elephantulus brachyrhynchus*	DD		Moderate
Black-footed Cat	*Felis nigripes*		NEMBA (PR)	Low
Spotted-necked Otter	*Hydrictis maculicollis*	NT		Moderate
Single-striped Grass-Mouse	*Lemniscomys rosalia*	DD		Moderate
Serval	*Leptailurus serval*	NT	NEMBA (PR)	Confirmed
Honey Badger	*Mellivora capensis*	NT		Moderate
Forest Shrew	*Myosorex varius*	DD		Moderate
Brown Hyaena	*Hyaena brunnea*	NT	NEMBA (PR)	Moderate
Rusty Bat	*Pipistrellus rusticus*	NT		Moderate
African Weasel	*Poecilogale albinucha*	DD		Moderate
Ground Pangolin	*Smutsia temminckii*	VU	NEMBA (VU)	Low
Least Dwarf Shrew	*Suncus infinitesimus*	DD		Moderate
Greater Dwarf Shrew	*Suncus lixus*	DD		Moderate
Lesser Dwarf Shrew	*Suncus varilla*	DD		Moderate
Cape Fox	*Vulpes chama*		NEMBA (PR)	Low
Bushveld Gerbil	*Tatera leucogaster*	DD		Moderate

* = IUCN classification; DD = Data Deficient; NT = Near-threatened; EN = Endangered; VU = Vulnerable

<u>Birds</u>

The savanna regions of South Africa support the highest diversity of bird species but also the lowest number of endemics.

The quarter-degree grid 2527AC, within which the project area is located, has had a high total of 365 bird species recorded so far in the ongoing second South African Bird Atlas (SABAP2). This is primarily due to high observer coverage in the Pilanesberg National Park, which is located within this grid (De Castro and Brits, 2016c). One-hundred and twelve bird species have been confirmed to occur in the project area (Table 7.14).

TABLE 7.14: BIRD SPECIES CONFIRMED TO OCCUR IN THE PROJECT AREA (DE CASTRO AND BRITS, 2016C)

Common Name	Scientific name
Common Myna	*Acridotheres tristis*
Egyptian Goose *	*Alopochen aegyptiacus*
Thick-billed Weaver	*Amblyospiza albifrons*
Red-billed Teal *	*Anas erythrorhyncha*
African Darter	*Anhinga rufa*
African Pipit	*Anthus cinnamomeus*
Little Swift	*Apus affinis*
White-rumped Swift	*Apus caffer*
Black-headed Heron	*Ardea melanocephala*
Marsh Owl	*Asio capensis*
Chinspot Batis	*Batis molitor*
Marico Flycatcher	*Bradornis mariquensis*
Cattle Egret	*Bubulcus ibis*
Steppe Buzzard	*Buteo vulpinus*
Barred Wren-Warbler	*Calamonastes fasciolatus*
Sabota Lark	*Calendulauda sabota*
Fiery-necked Nightjar	*Caprimulgus pectoralis*
Familiar Chat	*Cercomela familiaris*
White-browed Scrub-Robin	*Cercotrichas leucophrys*
Kalahari Scrub-Robin	*Cercotrichas paena*
Dideric Cuckoo	*Chrysococcyx caprius*
Klaas's Cuckoo	*Chrysococcyx klaas*
Marico Sunbird	*Cinnyris mariquensis*
White-bellied Sunbird	*Cinnyris talatala*
Desert Cisticola	*Cisticola aridulus*
Rattling Cisticola	*Cisticola chiniana*
Neddicky	*Cisticola fulvicapilla*
Zitting Cisticola	*Cisticola juncidis*
Great Spotted Cuckoo	*Clamator glandarius*
Jacobin Cuckoo	*Clamator jacobinus*
White-backed Mousebird	*Colius colius*
Speckled Mousebird	*Colius striatus*
Speckled Pigeon	*Columba guinea*
Pied Crow	*Corvus albus*
Grey Go-away-bird	*Corythaixoides concolor*
Black-throated Canary	*Crithagra atrogularis*
Yellow Canary	*Crithagra flaviventris*
Yellow-fronted Canary	*Crithagra mozambica*
Black Cuckoo	*Cuculus clamosus*
African Palm-Swift	*Cypsiurus parvus*
Fulvous Duck *	*Dendrocygna bicolor*
Crested Francolin	*Dendroperdix sephaena*
Fork-tailed Drongo	*Dicrurus adsimilis*
Black-shouldered Kite	*Elanus caeruleus*
Golden-breasted Bunting	*Emberiza flaviventris*
Cinnamon-breasted Bunting	*Emberiza tahapisi*

Common Name	Scientific name
Chestnut-backed Sparrowlark	*Eremopterix leucotis*
Common Waxbill	*Estrilda astrild*
Yellow-crowned Bishop	*Euplectes afer*
White-winged Widowbird	*Euplectes albonotatus*
Southern Red Bishop	*Euplectes orix*
Red-knobbed Coot *	*Fulica cristata*
Violet-eared Waxbill	*Granatina granatina*
Woodland Kingfisher	*Halcyon senegalensis*
Wahlberg's Eagle	*Hieraaetus wahlbergi*
Lesser Striped-Swallow	*Hirundo abyssinica*
White-throated Swallow *	*Hirundo albigularis*
Greater Striped-Swallow	*Hirundo cucullata*
Rock Martin	*Hirundo fuligula*
Barn Swallow	*Hirundo rustica*
Red-breasted Swallow	*Hirundo semirufa*
Red-billed Firefinch	*Lagonosticta senegala*
Cape Glossy Starling	*Lamprotornis nitens*
Crimson-breasted Shrike	*Laniarius atrococcineus*
Southern Boubou	*Laniarius ferrugineus*
Common Fiscal	*Lanius collaris*
Red-backed Shrike	*Lanius collurio*
Lesser Grey Shrike	*Lanius minor*
Red-crested Korhaan	*Lophotis ruficrista*
Black-collared Barbet	*Lybius torquatus*
Pale-chanting Goshawk	*Melierax canorus*
European Bee-eater	*Merops apiaster*
Little Bee-eater	*Merops pusillus*
Rufous-naped Lark	*Mirafra africana*
Cape Wagtail	*Motacilla capensis*
Spotted Flycatcher	*Muscicapa striata*
Southern Pochard *	*Netta erythrophthalma*
Helmeted Guineafowl	*Numida meleagris*
Namaqua Dove	*Oena capensis*
Red-winged Starling	*Onychognathus morio*
Black-headed Oriole	*Oriolus larvatus*
African Quailfinch	*Ortygospiza atricollis*
Chestnut-vented Tit-Babbler	*Parisoma subcaeruleum*
Southern Greyheaded Sparrow	*Passer diffusus*
House Sparrow	*Passer domesticus*
Cape Sparrow	*Passer melanurus*
White-browed Sparrow-Weaver	*Plocepasser mahali*
Southern Masked-Weaver	*Ploceus velatus*
Black-chested Prinia	*Prinia flavicans*
Tawny-flanked Prinia	*Prinia subflava*
Swainson's Spurfowl	*Pternistis swainsonii*
Dark-capped Bulbul	*Pycnonotus tricolor*
Green-winged Pytilia	*Pytilia melba*
Red-billed Quelea	*Quelea quelea*
Scaly-feathered Finch	*Sporopipes squamifrons*
Cape Turtle Dove	*Streptopelia capicola*
Red-eyed Dove	*Streptopelia semitorquata*
Laughing Dove	*Streptopelia senegalensis*
Common Whitethroat	*Sylvia communis*
Long-billed Crombec	*Sylvietta rufescens*
Little Grebe *	*Tachybaptus ruficollis*
Brown-crowned Tchagra	*Tchagra australis*
African Grey Hornbill	*Tockus nasutus*

Common Name	Scientific name
Acacia Pied Barbet	*Tricholaema leucomelas*
Blue Waxbill	*Uraeginthus angolensis*
Red-faced Mousebird	*Urocolius indicus*
Blacksmith Lapwing *	*Vanellus armatus*
Crowned Lapwing	*Vanellus coronatus*
Pin-tailed Whydah	*Vidua macroura*
Long-tailed Paradise-Whydah	*Vidua paradisaea*
Shaft-tailed Whydah	*Vidua regia*
Cape White-eye	*Zosterops virens*

* = Recorded from adjacent habitat in 2015

The Pilanesberg National Park is considered an Important Bird Area and supports a number of threatened large raptors such as White-backed and Cape Vultures, Secretarybird, Verreaux's, Tawny and Martial Eagles, Bateleur and African Marsh Harrier. Additional wetland birds include White-backed Night Heron and African Finfoot. All of these birds are scarce outside protected areas in South Africa and no breeding habitat is present within the project area. No species of conservation concern were located during fieldwork, though Black Stork was confirmed on an adjacent property in May 2015 during another survey. An additional 22 Red Data species have been recorded from other pentads (unit of measurement - five minutes of latitude by five minutes of longitude, squares with sides of roughly 9 km) within 2527AC. Of the potentially occurring Red Data species, six have a moderate chance of occurring within the study area (Table 7.15) (De Castro and Brits, 2016c).

TABLE 7.15: POTENTIALLY OCCURRING BIRDS IN THE PROJECT AREA (DE CASTRO AND BRITS, 2016C).

Species	Scientific Name	Red Data	Protected	Likelihood
Half-collared Kingfisher	*Alcedo semitorquata*	NT		Moderate
Kori Bustard	*Ardeotis kori*	NT	NEMBA (PR)	Low
Pallid Harrier	*Circus macrourus*	NT		Low
Abdim's Stork	*Ciconia abdimii*	NT		Moderate
African Marsh-Harrier	*Circus ranivorus*	EN		Low
Black-winged Pratincole	*Glareola nordmanni*	NT		Low
Black Stork	*Ciconia nigra*	VU		Moderate
European Roller	*Coracias garrulus*	NT		Moderate
Lanner Falcon	*Falco biarmicus*	VU		Moderate
White-backed Vulture	*Gyps africanus*	EN	NEMBA (EN)	Low
Cape Vulture	*Gyps coprotheres*	EN	NEMBA (EN)	Low
Marabou Stork	*Leptoptilos crumeniferus*	NT		Low
Yellow-billed Stork	*Mycteria ibis*	EN		Low
Pink-backed Pelican	*Pelecanus rufescens*	VU		Low
Lesser Flamingo	*Phoenicopterus minor*	NT		Low
Greater Flamingo	*Phoenicopterus ruber*	NT		Low
Verreaux's Eagle	*Aquila verreauxii*	VU		Low
Martial Eagle	*Polemaetus bellicosus*	EN	NEMBA (EN)	Low
Secretarybird	*Sagittarius serpentarius*	VU		Low
Yellow-throated Sandgrouse	*Pterocles gutturalis*	NT		Moderate
Greater Painted-Snipe	*Rostratula benghalensis*	VU		Low
Bateleur	*Terathopius ecaudatus*	EN	NEMBA (EN)	Low
Lappet-faced Vulture	*Torgos tracheliotus*	EN	NEMBA (EN)	Low
African Grass Owl	*Tyto capensis*	VU		Low
Tawny Eagle	*Aquila rapax*	EN	NEMBA (EN)	Low
Bateleur	*Terathopius ecaudatus*	VU	NEMBA (EN)	Low

* = IUCN classification; DD = Data Deficient; NT = Near-threatened; EN = Endangered; VU = Vulnerable

Reptiles and amphibians

Four reptile and four frog species are confirmed to occur in the study area, all being common and widespread in the savanna biome in South Africa and not species of conservation-concern. The North West Province does not have high numbers of threatened or near threatened reptiles, and no Red Data reptile species potentially occur. The only additional frog species of conservation concern that potentially occurs in the study area is the Giant Bullfrog (Pyxicephalus adspersus) which has been assessed as Near Threatened and is protected under the NEMBA. There are no seasonal pan-wetlands in the study area which could provide suitable breeding sites for the Giant Bullfrog and its presence within the study area is unlikely (De Castro and Brits, 2016c).

TABLE 7.16: REPTILES AND AMPHIBIANS RECORDED ON SITE (DE CASTRO AND BRITS, 2016C)

Common name	Scientific name
Reptiles	
Puffadder	*Bitis arietans*
Mozambique Spitting Cobra	*Naja mossambica*
Striped Skink	*Trachylepis striata*
Variable Skink	*Trachylepis varia*
Amphibians	
Common River Frog	*Amietia angolensis*
Gutteral Toad	*Amietophrynus gutteralis*
Raucous Toad	*Amietophrynus rangeri*
African Bullfrog	*Pyxicephalis edulis*

Invertebrates

A total of 72 arthropods were recorded during the site investigations for the approved EIA and EMP; 37 species of Lepidoptera and 35 species of other arthropods. The specialist indicated that the dry summer and degradation and low floristic diversity of the area could play a part in low arthropod diversity. Five lepidoptera identified have medium conservation status, these include False Swift (*Borbo fallax*), Barber's Acraea (*Acraea (Acraea) Barberi*), Purple Gem (*Chloroselas mazoensis*), Darker Commodore (*Junonia antelope*) and Ragged Skipper (*Caprona pillaana*). A potentially occurring red data species (low probability) is the Rossouw's Copper (*Aloeides rossouw*) which is Vulnerable. A list of the species identified is included in Table 7.17. All of the species recorded during the survey were common savanna species and are not restricted in terms of habitat or distribution (Golder, 2007).

TABLE 7.17: ARTHROPOD SPECIES RECORDED ON SITE (GOLDER, 2007)

Order	**Scientific Name**
Isoptera	*Trinervitermes*
Isoptera	*Amitermis hastatus*
Mantodea	*Harpagomantis tricolor*
Mantodea	*Sphodromantis gastrica*
Dermaptera	*Labidura riparia*
Orthoptera	*Hetrodes pupus*
Orthoptera	*Phaneroptera*

Order	Scientific Name
Orthoptera	*Gryllus bimaculatus*
Orthoptera	*Hoplolopha*
Orthoptera	*Phymateus morbillosus*
Orthoptera	*Acrida acuminata*
Orthoptera	*Locustana pardalina*
Hemiptera	*Etrichodia crux*
Hemiptera	*Mirperus faculus*
Hemiptera	*Scantius fosteri*
Hemiptera	*Nemia costalis*
Coleoptera	*Passalidius fortipes*
Coleoptera	*Acanthoscelis ruficornis*
Coleoptera	*Melyris*
Coleoptera	*Psammodes striatus*
Coleoptera	*Stenocara dentata*
Diptera	*Tabanus taeniatus*
Diptera	*Exoprosopa*
Diptera	*Chrysomya chloropyga*
Diptera	*Chrysomya albiceps*
Hymenoptera	*Apis mellifera*
Hymenoptera	*Tetraponera*
Hymenoptera	*Messor capensis*
Hymenoptera	*Camponotus fulvopilosus*
Scorpiones	
Araneae	
	Centipede
	Millipede
Lepidoptera	*Bunaea alcinoe*
Lepidoptera	*Delta hottentottum*
Lepidoptera	*Axiocerses tjoane tjoane*
Lepidoptera	*Aloeides Molomo molomo*
Lepidoptera	*Danaus (Anosia) chrysippus aegyptius*
Lepidoptera	*Hyalites (Auracraea) rahira rahira*
Lepidoptera	*Iolaus (Stugeta) bowkeri tearei*
Lepidoptera	*Acraea (Acraea) anemosa*
Lepidoptera	*Acraea (Stephenia) aglaonice*
Lepidoptera	*Ypthima impure paupera*
Lepidoptera	*Physcaeneura panda*
Lepidoptera	*Melanitis leda helena*
Lepidoptera	*Tirumala petiverana*
Lepidoptera	*Hyalites (Hyalites) encedon encedon*
Lepidoptera	*Junonia ceryne ceryne*
Lepidoptera	*Lachnocnema durbani*
Lepidoptera	*Hypolimnas misippus*
Lepidoptera	*Hamanumida daedalus*
Lepidoptera	*Leucochitonea levubu*
Lepidoptera	*Metisella willemi*
Lepidoptera	*Gegenes niso niso*
Lepidoptera	*Gegenes pumilio gambica*
Lepidoptera	*Pelopidas thrax inconspicua*
Lepidoptera	*Parosmodes morantii morantii*
Lepidoptera	*Kedestes macomo*
Lepidoptera	*Spialia dromus*
Lepidoptera	*Spialia colotes transvaaliae*
Lepidoptera	*Kedestes lepenula*
Lepidoptera	*Zizeeria knysna*
Lepidoptera	*Eurema (Eurema) brigitta brigitta*
Lepidoptera	*Azanus moriqua*

Order	Scientific Name
Lepidoptera	*Catopsilia florella*
Lepidoptera	*Azanus ubaldus*
Lepidoptera	*Azanus jesous jesous*
Lepidoptera	*Borbo fallax*
Lepidoptera	*Acraea (Acraea) barberi*
Lepidoptera	*Chloroselas mazoensis*
Lepidoptera	*Junonia antilope*
Lepidoptera	*Caprona pillaana*

RESULTS - AQUATIC ECOLOGY

The project area is located within the Crocodile (West) and Marico Water Management Area (WMA) and Eland Sub Water Management Area (sub WMA), which falls within Quaternary Catchment A22F. The portion of Quaternary Catchment A22F located where the project area is located increasingly being transformed by urban and mining development, although the upper margins of the catchment located within the Pilanesberg Nature Reserve is more natural.

The site survey confirmed the presence of different watercourse types within the study area, (Figure 7-16) (De Castro and Brits, 2016b). These include:

- 1 Unchannelled valley bottom wetland
- 1 Channelled valley bottom wetland
- 7 Ephemeral Channels (these are clearly defined drainage lines)
- 3 Ephemeral drainage lines (these are poorly defined drainage lines)
- 3 Dams
- Riparian habitat along the Sandspruit, including the active channel
- Riparian habitat along the Elands River, including the active channel

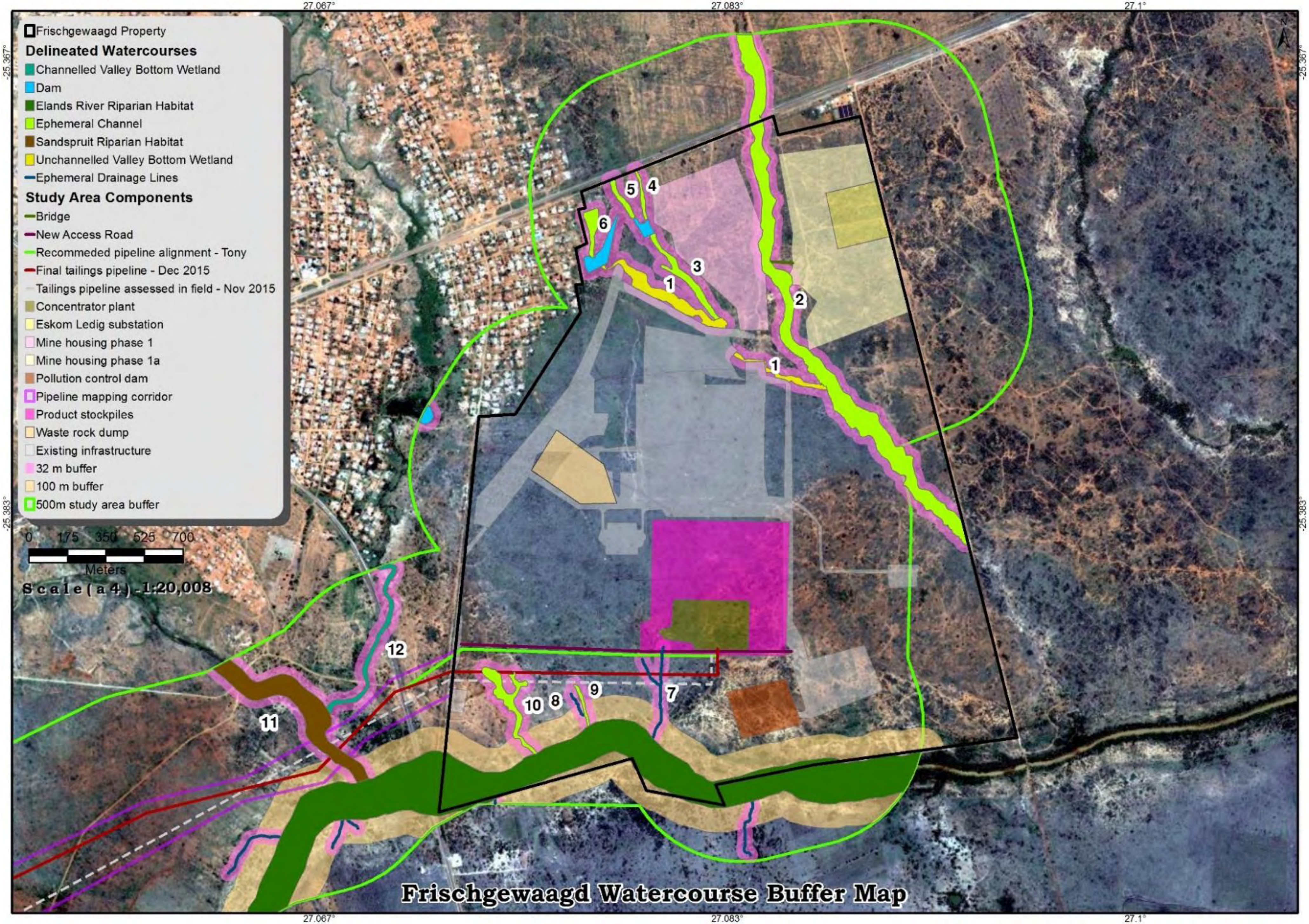
The present ecological state (PES) and the ecological importance and sensitivity (EIS) of each delineated watercourse are presented in Table 7.18.

TABLE 7.18: WATERCOURSES DELINEATED WITHIN THE PROJECT AREA (DE CASTRO AND BRITS, 2016B)

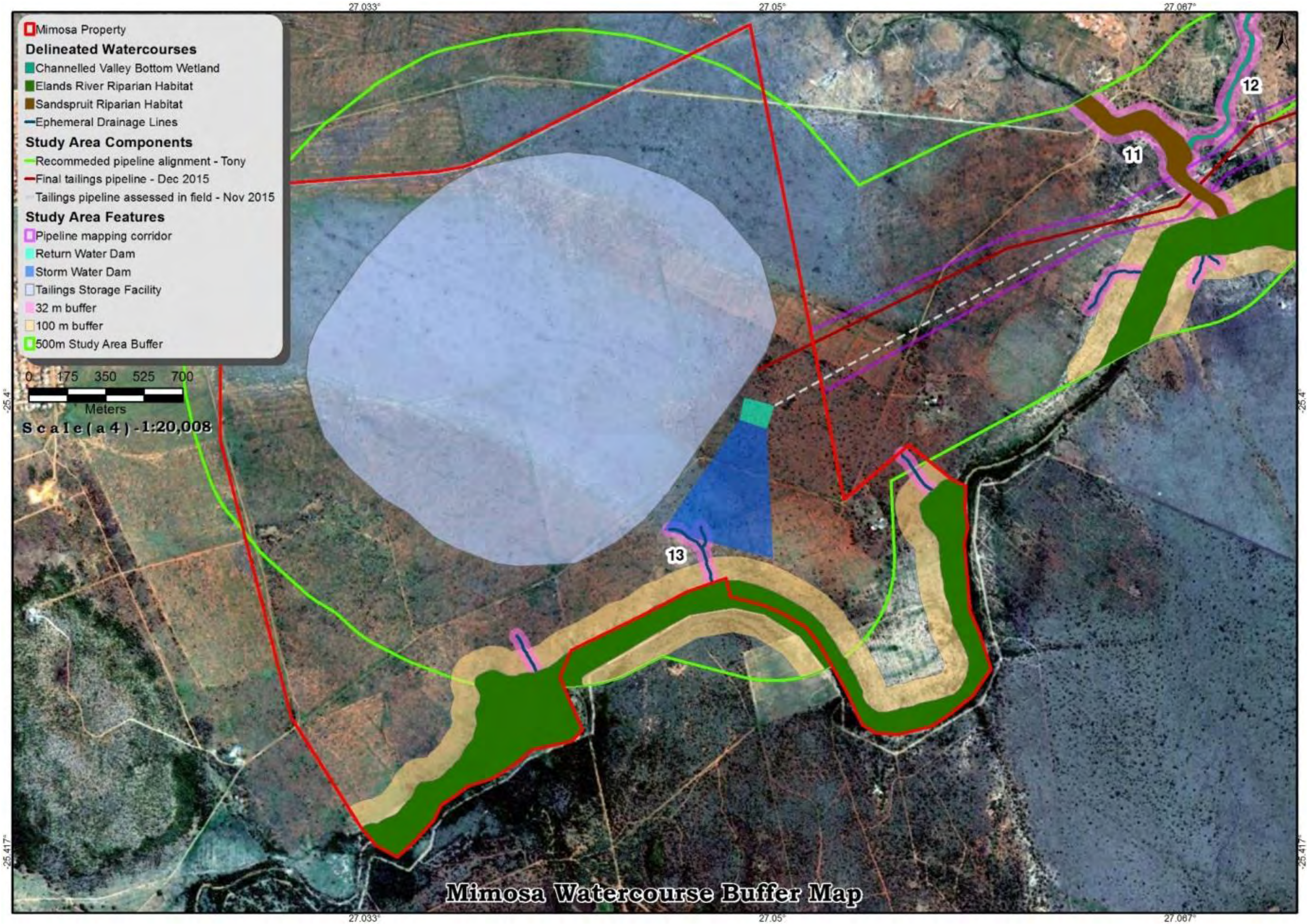
Watercourse Number	Watercourse Type	Present Ecological state*	Ecological importance and sensitivity
1	Unchannelled valley bottom wetland	D	High
2	Ephemeral channel	C	High / Very High
3	Ephemeral channel	B	High
4	Ephemeral channel	C	High
5	Ephemeral channel	C	High
7	Ephemeral drainage line	B	High
8	Ephemeral drainage line	B	High
9	Ephemeral channel	B	High
10	Ephemeral channel	B	High
11	Sandspruit River and riparian habitat	C	Moderate
12	Channelled valley bottom wetland	C	Moderate / High
13	Ephemeral drainage line	B	High

* Category B is largely natural, Category C is moderately modified and Category D is largely modified

SAS (2015) indicated that the Sandspruit and unnamed tributary of the Elands River had a PES Category C and a moderate EIS.



27.067°
27.083°
27.1°
-25.367°
-25.383°
Frischgewaagd Property
Delineated Watercourses
Channelled Valley Bottom Wetland
Dam
Elands River Riparian Habitat
Ephemeral Channel
Sandspruit Riparian Habitat
Unchannelled Valley Bottom Wetland
Ephemeral Drainage Lines
Study Area Components
Bridge
New Access Road
Recommeded pipeline alignment - Tony
Final tailings pipeline - Dec 2015
Tailings pipeline assessed in field - Nov 2015
Concentrator plant
Eskom Ledig substation
Mine housing phase 1
Mine housing phase 1a
Pollution control dam
Pipeline mapping corridor
Product stockpiles
Waste rock dump
Existing infrastructure
32 m buffer
100 m buffer
500m study area buffer
0 175 350 525 700
Meters
Scale (a4) - 1:20,008
1
2
3
4
5
6
7
8
9
10
11
12
Frischgewaagd Watercourse Buffer Map


27.033°
27.05°
27.067°
Mimosa Property
Delineated Watercourses
Channelled Valley Bottom Wetland
Elands River Riparian Habitat
Sandspruit Riparian Habitat
Ephemeral Drainage Lines
Study Area Components
Recommeded pipeline alignment - Tony
Final tailings pipeline - Dec 2015
Tailings pipeline assessed in field - Nov 2015
Study Area Features
Pipeline mapping corridor
Return Water Dam
Storm Water Dam
Tailings Storage Facility
32 m buffer
100 m buffer
500m Study Area Buffer
0 175 350 525 700
Meters
Scale(a4) - 1:20,008
-25.4°
-25.417°
11
12
13
Mimosa Watercourse Buffer Map

River health

The Sandspruit and unnamed tributary of the Elands River are considered by the specialist as systems of reduced Ecological Importance and Sensitivity due to limited provision of refugia and limited support for the aquatic ecology of the area. However, the systems are important for the provision of services to the terrestrial fauna of the area and have a fair importance from a socio-cultural point of view (SAS, 2015).

The large instream impacts to the Sandspruit are from flow modification and water quality modification. The moderate impacts include water abstraction, bed modification and channel modification. The largest riparian zone impacts included bank erosion, indigenous vegetation removal, flow modification and water abstraction. The Sandspruit was found to be moderately modified. The habitat conditions at the sites sampled were regarded as inadequate for supporting a diverse and sensitive aquatic macro-invertebrate community due to lack of strong flowing water and the absence of marginal vegetation (SAS, 2015).

The unnamed tributary of the Elands River has also been impacted. Instream, large impacts are from flow modification and water quality modification. Moderate impacts include water abstraction, bed modification and channel modification. In the riparian zone the impacts include bank erosion, indigenous vegetation removal and water abstraction. The unnamed tributary of the Elands River was found to be moderately modified. Habitat conditions upstream were regarded as inadequate for supporting a diverse and sensitive aquatic macro-invertebrate community due to sedimentation from a collapsed road crossing further upstream. The downstream habitat was considered to be adequate for supporting a diverse and sensitive aquatic macro-invertebrate community (SAS, 2015).

Aquatic macroinvertebrates

Monitoring of macro-invertebrates is useful as they are good indicators of localised conditions over the short-term. Benthic macro-invertebrates (bottom dwellers) are an important part of monitoring the health of an aquatic ecosystem as they are relatively sedentary and enable the detection of localised disturbances. The South African Scoring System, Version 5 (SASS5), was used to provide an indication of the quality of the aquatic environment at four sites sampled. The aquatic macro-invertebrates (to family level) recorded in terms of SASS5 are in Table 7.19 and the location of the sites sampled is in Figure 7-17.

Bak2 is downstream from Bak1 and Bak4 is downstream of Bak3, therefore any impact on the aquatic resources as a result of the proposed tailings pipeline will be evident at Bak2 and Bak4.

TABLE 7.19: AQUATIC MACRO-INVERTEBRATES (SAS, 2015)

Order	Family
Ephemeroptera	*Caenidae*
Annelida	*Oligochaeta*

Order	Family
Ephemeroptera	*Baetidae*
Ephemeroptera	*Caenidae*
Diptera	*Ceratopogonidae*
Diptera	*Chironomidae*
Diptera	*Culicidae*
Diptera	*Simuliidae*
Diptera	*Muscidae*
Pelecypoda	*Sphaeriidae*
Coleoptera	*Dytiscidae*
Coleoptera	*Gyrinidae*
Coleoptera	*Hydrophilidae*
Odonata	*Corduliidae*
Odonata	*Libellulidae*
Odonata	*Coenagrio nidae*
Hemiptera	*Veliidae*
Hemiptera	*Corixidae*

Following the SASS5 scoring, the biotic integrity of the sites can be classified as follows (the location of points is in Figure 7-17) (SAS, 2015):

- BAK5, an ephemeral pan, was dry at the time of the sampling;
- The aquatic macro-invertebrate community integrity of the Sandspruit at both the Bak1 and Bak2 sites was considered to be seriously impaired (Class E);
- The aquatic macro-invertebrate community integrity of the unnamed tributary was considered as critically impaired (Class F) at the upstream Bak3 site and as seriously impaired (Class E) at the downstream Bak4 site.

Diatoms

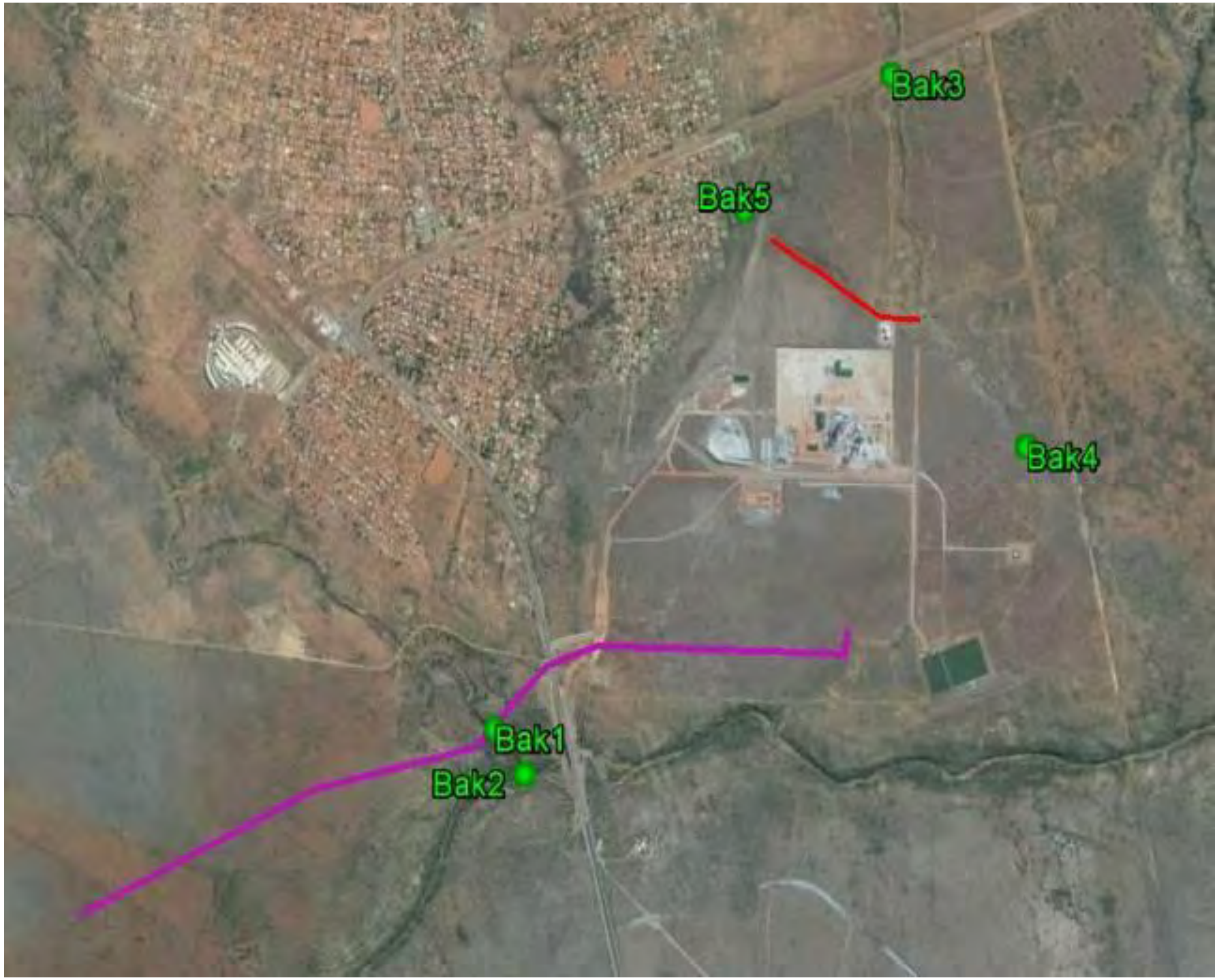
Diatoms are useful in providing an overall picture of the trends that are occurring in an aquatic system as they provide a rapid response to specific physico-chemical conditions in water and are often the first indication of change. The presence or absence of indicator taxa can be used to detect specific changes in environmental conditions such as eutrophication, organic enrichment, salinisation and changes in pH. The sampling in the Sandspruit found high values of pollution tolerant diatoms, indicative of artificial inputs of organic material. The upstream site of the unnamed tributary of the Elands River also found a high number of pollution tolerant diatoms, while the downstream site has a low percentage. This indicates that organic pollution is entering the unnamed tributary at the upper reaches of the system. This is likely due to the locality of the sampling site being close to the R556 and downstream of a rural settlement (SAS, 2015).

Ichthyofauna

While invertebrate communities are good indicators of localised conditions in a river over the short-term, fish, which are relatively long lived, mobile and feed on lower trophic levels, are good indicators of long-term influences and general habitat conditions (SAS, 2015). The approved EIA and EMP indicated that 16 indigenous fish species are expected to occur in the Elands River; eight are of low conservation importance, seven have medium conservation importance and one has high conservation importance. From sampling conducted in 2007 nine were recorded in the sample area. The species identified had low and medium conservation importance, the species of medium conservation importance included the Papermouth (*Barbus matozzi*) and the River sardine (*Mesobola brevianalis*) (Table 7.20).

TABLE 7.20: EXPECTED FISH ASSEMBLAGES FOR THE ELANDS RIVER (GOLDER, 2007)

Scientific Name	Common Name	Conservation Status	Recorded / Expected
Labeobarbus marequensis	Largescale yellowfish	Medium	Expected
Barbus mattozi	Papermouth	Medium	Recorded
Barbus paludinosus	Straightfin barb	Low	Recorded
Barbus trimaculatus	Threespot barb	Low	Recorded
Barbus unitaeniatus	Longbeard barb	Low	Recorded
Labeo cylindricus	Redeye labeo	Medium	Expected
Labeo molybdinus	Leaden labeo	Medium	Expected
Mesobola brevianalis	River sardine	Medium	Expected
Chiloglanis pretoriae	Shortspine suckermouth	High	Expected
Synodontis zambezensis	Brown squeaker	Medium	Expected
Clarias gariepinus	Sharptooth catfish	Low	Recorded
Oreochromis mossambicus	Mozambique tilapia	Low	Recorded
Pseudocrenilabrus philander	Southern mouthbrooder	Low	Recorded
Tilapia rendalli	Redbreast tilapia	Low	Expected
Tilapia sparrmanii	Banded tilapia	Low	Recorded
Schilbe intermedius	Silver catfish	Medium	Expected


Bak3
Bak5
Bak4
Bak1
Bak2

CONCLUSION

The project area falls mainly within the Marikana Thornveld which is classified as Vulnerable and thus an important vegetation type that requires careful consideration when developing mining projects. The probability of species of conservation concern occurring in the project area overall is moderate for floral and faunal species with three species having been confirmed on site in the current survey (one mammal and two plant species). For mammals and fish, there is a moderate likelihood, for plant there is a low to moderate likelihood, for birds, amphibian and arthropods it is mainly low. The approved mine and project area falls entirely within a CBA2 (in terms of the 2015 NWBSP) which has a management objective to maintain it in a natural or near natural state that maximises the retention of biodiversity pattern and ecological process. Important in this area are the natural corridor linkages and natural protected area buffer of the Pilanesberg National Park. It is important to note that these national guidelines and assessments were published after the mine was approved in 2009.

Areas of high, moderate and low botanical biodiversity sensitivity were mapped by the specialist. Some project footprints fall within areas of high botanical biodiversity sensitivity. Some areas have been transformed by agricultural and mining activities (both on the project sites and in the surrounding areas). The river systems have also shown some deterioration and further deterioration should be minimised. There are however aquatic systems that are still considered to be in a natural state and a large portion of the undeveloped area is the Marikana Thornveld. Thus, there are aquatic and terrestrial habitats that still exist within the project area which are suitable for fauna and flora species, including some Red Data and protected species.

7.4.1.6 Hydrology

INTRODUCTION AND LINK TO ANTICIPATED IMPACT

Surface water resources include rivers, drainage lines, paths of preferential flow of storm water runoff as well as the channelling and/or collection of water on the surface such as dams. Mining projects have the potential to alter the drainage of surface water flow across a site and/or result in the contamination of the surface water resources through the placement of infrastructure and seepage and/or spillage of substances, non-mineralised and mineralised wastes.

Key to understanding the hydrology of the site is understanding the climatic conditions of the site (see Section 7.4.1.3) and topographical features (see Section 7.4.1.1). As a baseline, this section identifies hydrological catchments that could be affected by the project and the status of surface water features in the mining area.

DATA SOURCES

The information for this section was sourced from the approved mine EIA and housing BAR, the annual surface water monitoring report (SLR, 2015a), the September 2015 and December 2015 quarterly reports (SLR, 2015b and 2015c) (the Elands River was dry during the most recent quarterly and monthly sampling), the aquatic biomonitoring report (SAS, 2015b), the social impact assessment (Desai, 2016; Appendix P) and the wetland assessment report (De Castro and Brits, 2016d).

RESULTS

<u>Surface Drainage</u>

The project area is located within the Crocodile (West) and Marico Water Management Area and is located in Eland Sub Water Management Area, which falls within Quaternary Catchment A22F (De Castro and Brits, 2016d). The project area is located along the Elands River which is a tributary of the Crocodile River and forms part of the Limpopo River primary drainage system. The project area falls within the Bushveld-Basin Aquatic Ecoregion (SAS, 2015b).

There are various water courses and drainage lines within and around the project area. There are three main river reaches which includes the Elands River, an unnamed tributary of the Elands River and the Sandspruit. The Elands River flows south of the project area, is the receiving water body and flows into the Vaalkop Dam. The unnamed tributary of the Elands River flows through Frischgewaagd between Phase 1 and Phase 1a of the Gabonewe Estate mine housing. The Sandspruit flows to the west of the R565 and is between the TSF and plant/shaft area. The watercourses present within the project area are shown in Figure 7-12 (De Castro and Brits, 2016b).

An unchannelled valley bottom wetland is present to the north of the shaft complex and is bisected by a noise berm that has been constructed between the mine housing and the plant area. A channelled valley bottom wetland is east of and connected to the Sandspruit just north of the TSF/return water pipeline route. Clearly defined ephemeral channels are located to the west of the Phase 1 Gabonewe Estate mine housing and south of the TSF pipeline route on the Farm Frischgewaagd linking to the Elands River. Poorly defined ephemeral drainage lines feeding into the Elands River are present south of the TSF pipeline route on the Farm Frischgewaagd and south of the return water dam. There are also two artificial wetlands in the form of dams located west of the Phase 1 Gabonewe Estate mine housing area (De Castro and Brits, 2016b).

Mean Annual Runoff

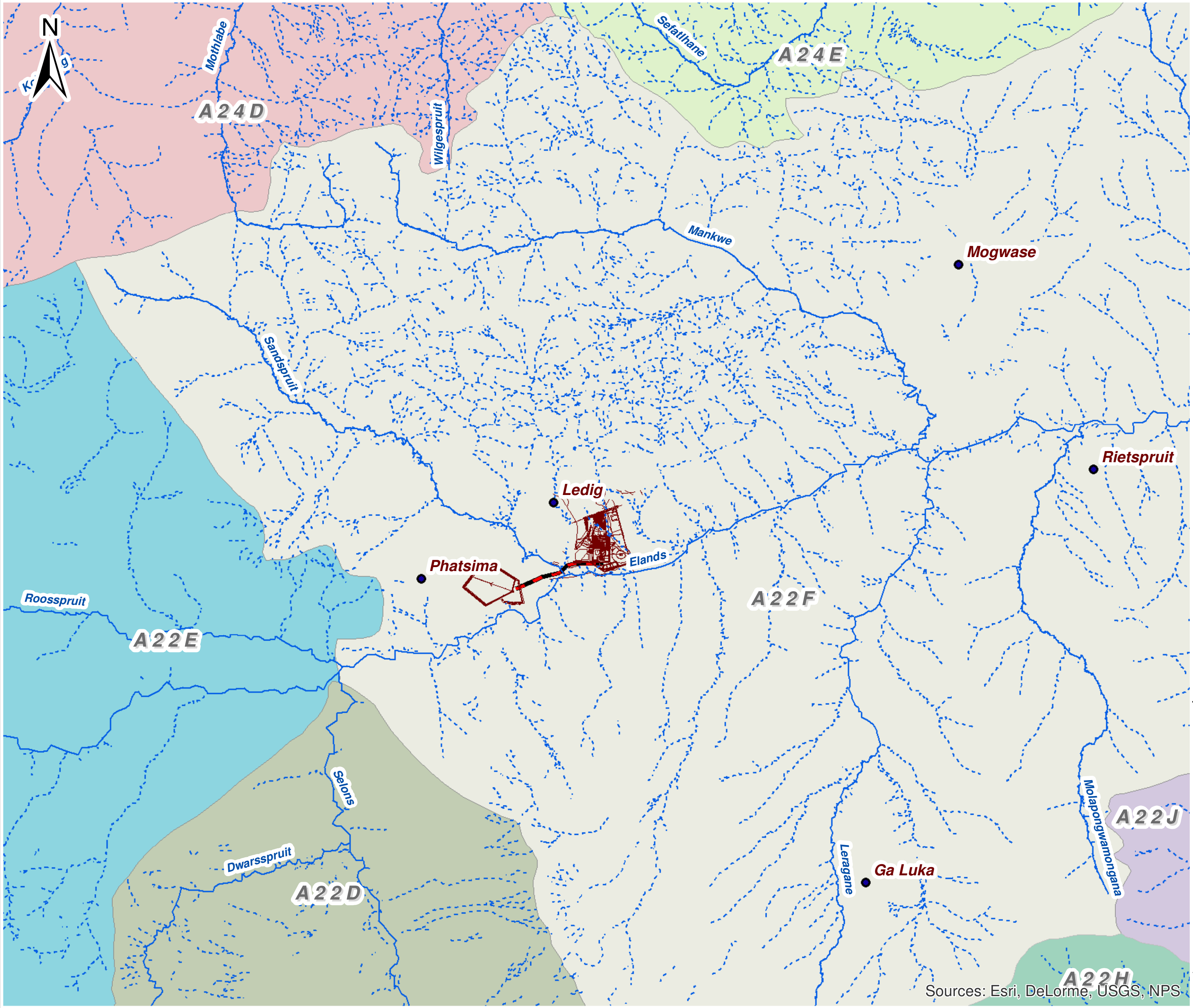
The upslope sub-catchment referred to as Part of A22F North has been subdivided into five drainage areas corresponding to the drainage lines draining from or past the farms Frischgewaagd and Mimosa Figure 7-18). The sub-catchments of concern are the Sandspruit (I), Matlhogaabone (II), an unnamed north drainage line (III), the part of A22F south of the site (IV) and the Phatsima/Mimosa area (V). The sub-catchment area totals approximately 303 km^2 (TWP, 2008).

The annual runoff expected from the Elands basin area is 10 to 20 mm. The Mean Annual Runoff (MAR) is the long-term average river flow derived from the relevant catchment under virgin conditions, i.e. in its pristine state prior to any changes brought about by anthropogenic land-use (TWP, 2008).

The total MAR in the catchment upstream of the project area is 54 million cubic meters (mcm) with A22F contributing 4.8 million cubic meters (8.9% of the total MAR). The approved mine and proposed project lies within sub-catchments that contribute approximately 1.8 % of MAR (i.e. II + III + V) for the Elands upstream of the site (Table 7.21). The Elands upstream of the site contributes approximately 48 % of MAR of the total Elands Catchment (TWP, 2008).

TABLE 7.21: MEAN ANNUAL RUNOFF FOR RELEVANT SUB-CATCHMENT AREAS NEAR THE PROJECT AREA (PRISTINE CONDITIONS) (TWP, 2008)

Sub-Catchment	Sub-Catchment Area (km^2)	MAR (106 m^3)	MAR % of Total
I	172	2.75	56.7
II	28	0.45	9.3
III	11	0.18	3.7
IV	70	1.12	23.1
V	22	0.35	7.2
Total for Sub-Catchments	**303**	**4.85**	**100**



Legend

Mine Layout

Perennial Rivers

Non-Perennial Rivers

Quatenary Catchments

A22D

A22E

A22F

A22H

A22J

A24D

A24E

Kilometers

0 5 10

Scale: 1:236 000 @ A4

SA Grid WGS84

BAKUBUNG PLATINUM MINE (PTY) LTD

Figure 7.18

Catchments

SLR Consulting (Africa) (Pty) Ltd
P O Box 1596,Cramerview, 2060, South Africa
Tel: +27 (11) 467-0945 Fax: +27 (11) 467-0978

710.23001.00006	March 2016

Normal dry weather flow

The normal dry weather flow for perennial streams is regarded as the average monthly flow that is expected during the three driest months. The three driest months include June, July and August.

The sub-catchments areas (I, II, III, IV and V) contribute to normal dry weather flow at a rate totalling approximately 108 l/hour or 2.6 m^3 per day. These drainage lines which are ephemeral in nature are dry during most of the dry months as the available volume of runoff is virtually zero during these periods. The normal dry weather flows in the sub-catchment areas are shown in Table 7.22. Note that the average expected flow is a long-term average and for arid areas such as Elands, the variance could also be large (TWP, 2008).

TABLE 7.22: NORMAL DRY WEATHER FLOW FOR THE RELEVANT SUB-CATCHMENT AREAS NEAR THE PROJECT AREA (PRISTINE CONDITIONS) (TWP, 2008)

Sub-Catchment	Jun (million cubic meters (mcm))	Jul (mcm)	Aug (mcm)	Average (mcm)	Average (l/hour)
I	0.055	0.044	0.036	0.045	61
II	0.009	0.007	0.006	0.007	10
III	0.004	0.003	0.002	0.003	4
IV	0.022	0.018	0.015	0.018	25
V	0.007	0.006	0.005	0.006	8
Total	0.097	0.078	0.063	0.079	108

Flood Peaks and volumes

Flood peaks for the 1:20, 1:50, 1:100 and 1:200 year storm events were calculated for the Elands River. Various methods were used to calculate the peak floods, these included the Franco Rodier method, the Standard Design Flood method and the Unit Graph (UG) method. The UG method of calculation was considered to be applicable in this case. The peak flow rates are summarised below in Table 7.23.

TABLE 7.23: FLOOD PEAK ESTIMATES FOR THE ELANDS RIVER ACCORDING TO THE UG METHOD (TWP, 2008)

Return Period	1:20	1:50	1:100	1:200
UG (m3/s)	520	800	980	1 150
Flood volume (106 m3)	35.5	54.6	66.9	78.5

Floodlines

Floodlines were determined for the project area as part of the mine EIA and housing BAR. Input data included the 1:100 flood peak, flood plain slopes, vegetation and general roughness of the river and overbanks areas.

Disturbance of drainage systems

The portion of Quaternary Catchment A22F located around the project area is increasingly being transformed by urban and mining development, although the upper margins of the catchment located within the Pilanesberg National Park is more natural (TWP, 2008).

At desktop level, the project area was found to be deteriorated from what be expected. The large instream impacts to the Sandspruit are from flow modification and water quality modification. The moderate impacts include water abstraction, bed modification and channel modification. The largest riparian zone impacts included bank erosion, indigenous vegetation removal, flow modification and water abstraction. The Sandspruit was found to be moderately modified (SAS, 2015b).

The unnamed tributary of the Elands River has also been impacted. Instream, large impacts are from flow modification and water quality modification. Moderate impacts include water abstraction, bed modification and channel modification. In the riparian zone the impacts include bank erosion, indigenous vegetation removal and water abstraction. The unnamed tributary of the Elands River was found to be moderately modified (SAS, 2015b).

Ongoing aquatic biomonitoring in the project area has indicated that the Elands River has also been moderately modified from anthropogenic activities within the larger project area (SAS, 2015a).

Water Quality

The pre-mining water quality was determined through 11 surface water sampling points along the Elands River.

Monthly surface water monitoring has been taking place since 2010 at BPM, with a more detailed set of parameters assessed every quarter.

Surface water monitoring takes place at the evaporation dam (SW4) on site and along three of the original sampling points in the Elands River:

- Upstream: Elands River, south of the proposed TSF area, upstream of tributary from the south on Onderstepoort 98 JQ (SW1)
- Midstream: Elands River intersection with the R565, downstream of the confluence of the Sandspruit on Frischgewaagd 96 JQ (SW2); and
- Downstream: Elands River downstream of proposed shaft and plant area along the intersection of the river with the communal boundary between Frischgewaagd 96 JQ and Styldrift 90 JQ (SW3).

During the winter months there is no water flow in the Elands River thus sampling occurs sporadically mainly during the rainy season.

The pre-mining water quality is shown in Table 7.24. The three monitoring points included in the monthly surface water monitoring programme along the Elands River are indicated as SW1, SW2 and SW3. The results were compared to SANS 241:2011 water quality guidelines. Exceedances for Class II (maximum allowable) are bold and exceedances for Class II (limits exceeded) are shaded grey.

The following parameters exceeded one or more of the guideline values: aluminium (Class II limits exceeded), fluoride (Class II limits exceeded), iron (Class II maximum allowable), manganese (Class II maximum allowable) and turbidity (Class II limits exceeded). Possible reasons for the elevated parameters were not indicated. There were no traces of faecal coliforms in the samples analysed.

TABLE 7.24: PRE-MINING SURFACE WATER QUALITY (FEBRUARY, 2008) (TWP, 2008)

Variable	S1	S3	S4 (SW1)	S6	S7	S8	S9 (SW2)	S10 (SW3)	S12	S13	S15	Class I (Rec. Ops. Limit)	Class II (Max. allow.)	Class II Limits Exceeded
% Ion Difference	9.24	9.8	10.17	9.95	7.79	6.79	8.34	8.7	8.85	8.75	8.78			
Aluminium (mg/l)	0.06	1.03	0.97	0.24	0.04	0.03	2.34	2.42	1.88	2.31	2.55	0 - 0.3	0.3 - 0.5	> 0.5
Ammonia (mg/l) as N	<0.01	<0.01	0.014	<0.01	0.103	0.036	<0.01	0.047	0.057	0.018	0.042	0 - 1.0	1.0 - 2.0	> 2.0
Arsenic (mg/l)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0 - 0.01	0.01 - 0.05	> 0.05
Boron (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Ca Hardness (mg/l)	44.9	26	22.6	28.9	68.9	110	50.2	43.4	43.4	39.7	42.7			NS
Cadmium (mg/l)	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0 - 0.005	0.005 - 0.01	> 0.01
Calcium (mg/l)	18	10.4	9.04	11.6	27.6	43.9	20.1	17.4	17.4	15.9	17.1	0 - 150	150 - 300	> 300
Chloride (mg/l)	7.03	5.45	6.68	5.93	15.5	28.6	12	10.2	8.24	6.72	7.64	0 - 200	200 - 300	> 300
Chromium (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0 - 0.1	0.1 - 0.5	> 0.5
Copper (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0 - 1	1.0 - 2.0	> 2.0
Corrosion Ratio	7.3	7.76	8.55	8	5.82	5.86	6.61	6.24	6.06	6.18	6.46			
EC (mS/m)	17.3	13.8	13.3	12.8	36.4	59.6	27.1	22.7	21	20.3	20.8	0 - 150	150 - 370	> 370
Fluoride (mg/l)	0.12	0.12	0.1	0.11	1.16	1.64	0.89	0.92	0.88	0.73	0.74	0 - 1.0	1.0 - 1.5	> 1.5
Hexavalent Chromium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0 - 0.01	0 - 0.01	> 0.01
Iron (mg/l)	0.08	1.23	1.41	0.25	0.05	0.01	1.85	1.84	1.35	1.79	2.11	0 - 0.2	0.2 - 2.0	> 2.0
Lead (mg/l)	0.03	0.03	0.03	0.03	0.04	0.03	0.03	0.04	0.03	0.03	0.04	0 - 0.02	0.02 - 0.05	> 0.05
Magnesium (mg/l)	13.4	9.76	10.5	9.44	18.6	28.5	14.5	11.6	10.5	10.9	11.6	0 - 70	70 - 100	> 100
Manganese (mg/l)	0.07	<0.01	<0.01	<0.01	0.06	0.01	0.02	0.057	0.23	0.053	0.102	0 - 0.1	0.1 - 1.0	> 1.0
Mercury (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0 - 0.001	0.001 - 0.005	> 0.005
Mg Hardness (mg/l)	55.2	40.2	43.4	38.9	76.6	117	59.7	47.8	43.2	44.9	47.8			
Nickel (mg/l)	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0 - 0.15	0.15 - 0.35	> 0.35
Nitrate (mg/l) as N	0.49	0.47	0.16	0.17	0.48	0.92	0.97	0.75	0.47	0.36	0.54	0 - 10	10.0 - 20.0	> 20
Ortho Phosphate (mg/l) as P	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
pH	7.51	7.64	7.4	7.43	7.85	8.01	7.81	7.77	7.69	7.85	7.74	5.0 - 9.5	4.0 - 10.0	< 4 or > 10
Potassium (mg/l)	3.04	3.8	3.41	3.39	1.08	1.03	4.09	4.66	4.89	4.33	4.75	0 - 50	50- 100	> 100

Variable	S1	S3	S4 (SW1)	S6	S7	S8	S9 (SW2)	S10 (SW3)	S12	S13	S15	Class I (Rec. Ops. Limit)	Class II (Max. allow.)	Class II Limits Exceeded
Ryznar Index	0.54	0.63	0.76	0.69	0.33	0.31	0.39	0.41	0.37	0.32	0.37			
Selenium (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0 - 0.02	0.02 - 0.05	> 0.05
Silicon (mg/l)	9.04	9.69	6.78	8.95	12.2	14.9	11.8	6.5	7.14	18.3	8.13			
Sodium (mg/l)	7.61	8.99	9.41	6.83	23.8	46.1	18.9	13.5	11.8	10.7	10.5	0 - 200	200 - 400	> 400
Sodium Absorption Ratio	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01			
Sulphate (mg/l)	35.4	35.7	42.5	36.2	21.9	19.1	28.6	21.7	19.4	20.1	24	0 - 400	400 - 600	> 600
Suspended Solids (mg/l)	10	66	189	12	32	806	39	23	30	6	21			
T.Alk. as CaCO3 (mg/l)	70.5	53.8	53.9	51.7	168	295	126	97.7	89	90.9	92.7			
TDS (mg/l)	126	107	114	102	212	349	179	142	127	125	134	0 - 1 000	1 000 - 2 400	> 2 400
TDS to EC Ratio	0.33	0.48	0.5	0.36	0.85	1.33	0.78	0.61	0.55	0.5	0.48			
Total Chlorine mg Cl2/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0 - 200	200 - 600	> 600
Total Hardness (mg/l)	100	66.2	65.9	67.8	146	227	110	91.2	86.7	84.6	90.5			
Turbidity NTU	185	340	377	232	205	1273	120	97.1	87.1	77	84.9	0 - 1	1.0 - 5.0	> 5
Vanadium (mg/l)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0 - 0.2	0.2 - 0.5	> 0.5
Zinc (mg/l)	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0 - 5.0	5.0 - 10.0	> 10.0

The water quality from the surface water monitoring programme has been compared to the previous monitoring events as well as the following guidelines (SLR, 2015):

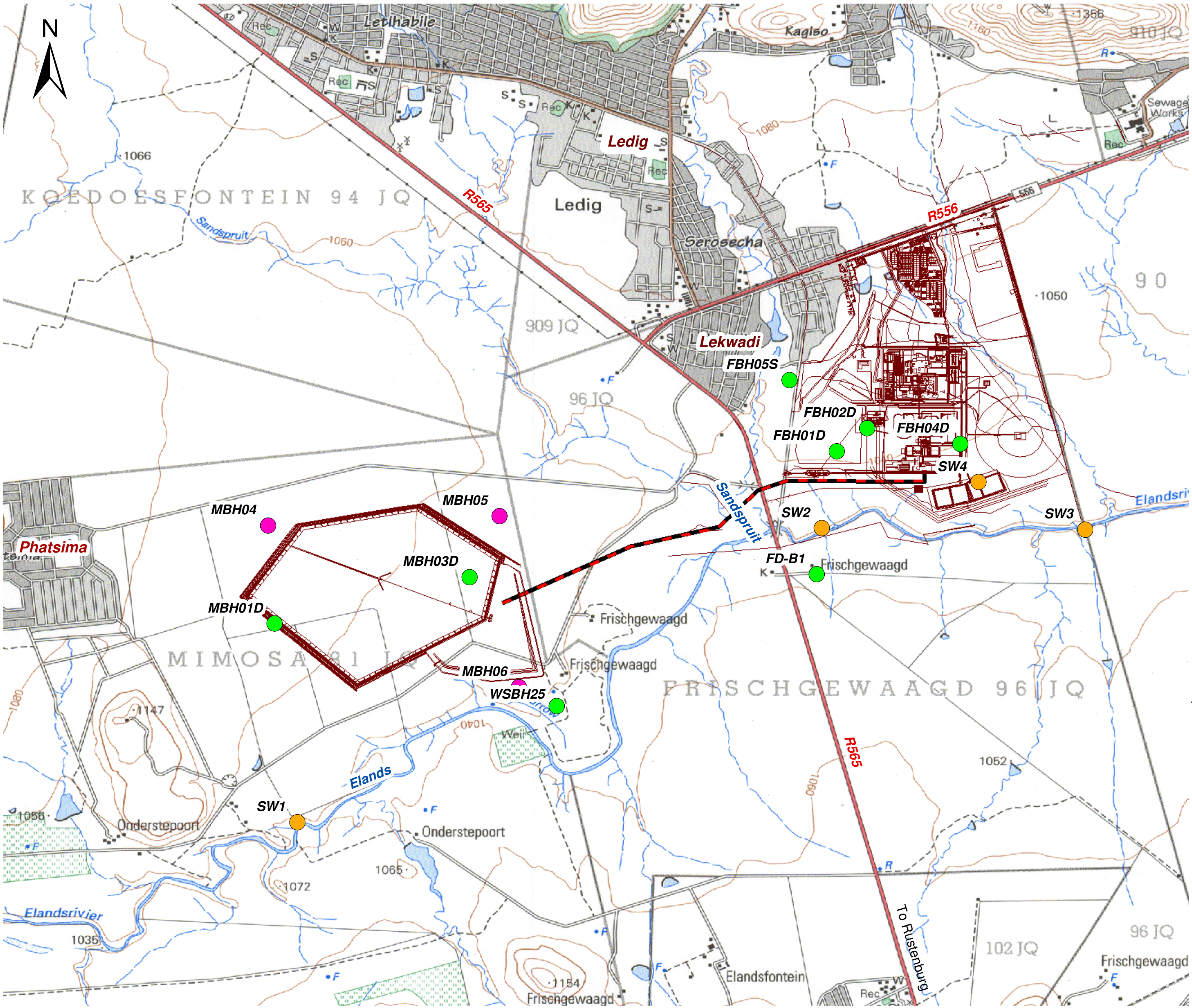
- South African National Standard for Drinking water (SANS 241:2011 and SANS 241: 2015 (for December 2015 data))
- South African DWAF Water Quality Guidelines for Livestock Watering

The most recent quarterly surface water sampling in the Elands River only took place in September and December 2014 as the river was dry during the quarterly winter monitoring runs (SLR, 2015a). Sampling locations are shown in Figure 7-19. The most recent quarterly monitoring for SW4 (evaporation dam) took place in September 2015 (SLR, 2015b) and December 2015 (SLR, 2016a). Review of the available data showed the following:

- The EC recorded from SW1, SW2 and SW3 was low, ranging from 22.4 mS/m (SW3, December 2014) to 81.8 mS/m (SW1, December 2014). The EC recorded in SW4 (December 2015) remained low (≤46.7 mS/m). Concentrations are consistent with previous monthly monitoring events.
- The TDS concentrations recorded in the river samples were low, averaging between 158 mg/l (SW3) and 432 mg/l (SW1). The concentration recorded in SW4 for December was 256 mg/l remaining low. Concentrations are consistent with previous monitoring events.
- Concentrations of nitrate identified in the pre-mining water quality data as being of concern were all below DWAF limits for Livestock Watering in the Elands River.
- Nitrate concentrations at SW4 continued the previous year’s trend of being elevated above the SANS 241: 2011 standard up to December 2014. This was compared to 0.8 mg/l in December 2013. Nitrate levels decreased substantially to 1.5 mg/l in December 2015. It was indicated that it is unclear if birds which frequent the dam are contributing to nitrate contamination. It is likely that ammonium nitrate fuel oil (ANFO) explosive residue collected from the dirty water containment area runoff is the source of contamination.
- E.coli counts per 100 ml were elevated above the SANS 241: 2011 standard on at least one occasion during the 2014/2015 annual monitoring period at the following surface water monitoring points:
  - SW1; 4 & 15 /100 ml (September and December 2014)
  - SW2; 25 & 490 /100 ml (September and December 2014)
  - SW3; 120 /100 ml (December 2014)
  - SW4; 100 & 2 /100 ml (December 2014 and March 2015)
- E. coli contamination within the Elands River is likely due to the use of the river for livestock watering. E. coli contamination within the evaporation dam (SW4) was indicated to be likely due to birds which frequent the pond.
- Aluminium concentrations exceeded the SANS 241: 2011 standard of 300 µg/l at SW2 and SW3 in December 2014 and for SW4 in September 2015 and December 2015. No spillages at BPM have been reported during the December 2014 period. Aluminium concentrations are likely due to

the high sediment loads present within the Elands River, however due to the ephemeral nature of the Elands River it is difficult to determine trends.

- Trace amounts of Iron and Manganese were detected in the Elands River in December 2014 at SW2 and SW3. This represents an aesthetic impact on water quality in terms of the SANS 241: 2011 guidelines. Elevated levels of Iron that exceeded the SANS 241: 2015 standard were found in SW4 in December 2015.



Legend

- Main Roads
- Secondary Roads
- Other Access Roads
- Power Line
- Rivers and Streams
- 20m Contour Lines
- Cultivated Areas
- Built-up Areas
- Mine Layout
- Proposed Pipeline

Sampling Points

- Groundwater
- Surface Water
- Newly Drilled Groundwater

Kilometers

0 1 2

Scale: 1:48 000 @ A4

SA Grid WGS84

BAKUBUNG PLATINUM MINE (PTY) LTD

Figure 7.19

SW and GW Sampling Points

SLR

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710.23001.00006

March 2016

Surface Water Use

There are various water users for the Elands sub-area of the Crocodile (West) Water Management Area, which include mainly agricultural irrigation, followed by mining, industrial (urban) and industrial (non-urban) purposes (TWP, 2008). The approved EIA and EMP also indicated that around the project area cattle drinking from the Elands River and fishing were observed. Observations on site in December 2015 (Desai, 2016) confirmed that there is still cattle grazing on site and fishing taking place in the river.

CONCLUSION

There are a number of surface water systems within the mine and project area including the Elands River, a tributary of the Elands River, the Sandpsruit and various ephemeral drainage lines, channels and wetlands. Use of the water from these systems has been observed on site. The water systems are deteriorated from what would be expected at desktop level and the systems have been modified through water abstraction, bed and channel modification, bank erosion and vegetation removal among others.

The pre-mining water quality showed elevated concentration of certain parameters. The water quality monitoring shows that the water quality has remained consistent for most parameters when compared to pre-mining water quality. There were instances of elevated E. Coli counts found at the sampling sites, which is likely from livestock and avifauna.

The facilities that part of this project will influence surface water runoff on the site, which in turn will influence the storm water management system on site. The proximity of project components to drainage lines needs careful consideration in the assessment of impacts and design of mitigation measures.

7.4.1.7 Geohydrology

INTRODUCTION AND LINK TO ANTICIPATED IMPACT

Groundwater is a valuable resource and is defined as water that is located beneath the ground surface in rock pore spaces and in the fractures of lithologic formations. Understanding the geology of the area (see Section 7.4.1.2) provides a basis from which to understand the occurrence of groundwater resources. Project related activities have the potential to contaminate groundwater and result in a reduction of groundwater resources available to both the environment and third party users.

As a baseline, this section provides an understanding of the groundwater conditions (quality, quantity and use) and the potential for changes in groundwater as a result of project-related activities in the mining area.

DATA SOURCES

The information for this section was sourced from the approved EIA, BAR and EMPs, the annual ground water monitoring report (SLR, 2015a), the most recent quarterly (SLR, 2016a) and monthly (SLR, 2016b) groundwater monitoring reports and the groundwater modelling report (DTM, 2016, Appendix H).

RESULTS

Aquifer Classification

As discussed in the geology baseline, the area under investigation is underlain by the Rustenburg Layered Suite of the Bushveld Complex. Numerous faults and north-south striking dykes cut through and across the area. Groundwater occurs in secondary aquifers and is mainly associated with deeply weathered and fractured mafic rocks. This characteristic, in association with north-south striking dykes that cut through and across the norite, has formed groundwater compartments (TWP, 2008).

Two aquifers have been identified, an upper weathered aquifer and a lower fractured aquifer.

- Upper weathered aquifer: The weathered aquifer extends to a depth of 10 metres below ground level (mbgl). The weathered material forms due to vertical infiltration of recharging rainfall into the anorthosites/norites. The weathered aquifer was found to be partially saturated to unsaturated. This can be attributed to the fact that evaporation in the area is greater than rainfall for all months of the year resulting in a marked moisture deficit. Hence little or no recharge occurs (DTM, 2016).
- Lower fractured aquifer: The competent anorthosite/norite/gabbro-norites are subjected to fracturing associated with tectonic movements, and layering of the rock suites. The primary porosity does not allow significant groundwater flow, except where the porosity has been increased by formation of secondary structures. Groundwater flow in the fractured aquifer is mostly associated with these secondary fracture zones, provided that they are open and have not been filled with secondary mineralization (DTM, 2016).

The approved EIA and EMP indicated that the average yield in the area was approximately 1.7 l/s (6120 l/hour). These yields are based on blow yields and it was assumed that the actual yields would be much less. A realistic average yield for the area was indicated to be approximately 1-1.5 l/s.

The permeability tests conducted within the footprint of the TSF found that groundwater movement in the clayey turf was regarded as “slow” (TWP, 2008), with recharging water being retarded by the lower permeability of the overlaying clay material (DTM, 2016), with permeability being 0.08m/day (TWP, 2008). Rainwater and surface run-off will thus have a slow infiltration rate into the saturated turf (TWP, 2008).

The aquifer system in the project area was classified according to “A South African Aquifer System Management Classification (1995)”. Following a hydrocensus and according to the abovementioned system, the aquifer system was classified as a minor aquifer system. Minor aquifer systems can have fractured or potentially fractured rocks which do not have a high permeability, or other formations of variable permeability. Aquifer extent may be limited and water quality may be variable. While these aquifers seldom produce large quantities of water they are important for local supplies and in supplying base flow for rivers. The aquifer was found to be important for supplying base flow to the Elands River (TWP, 2008).

Groundwater Recharge

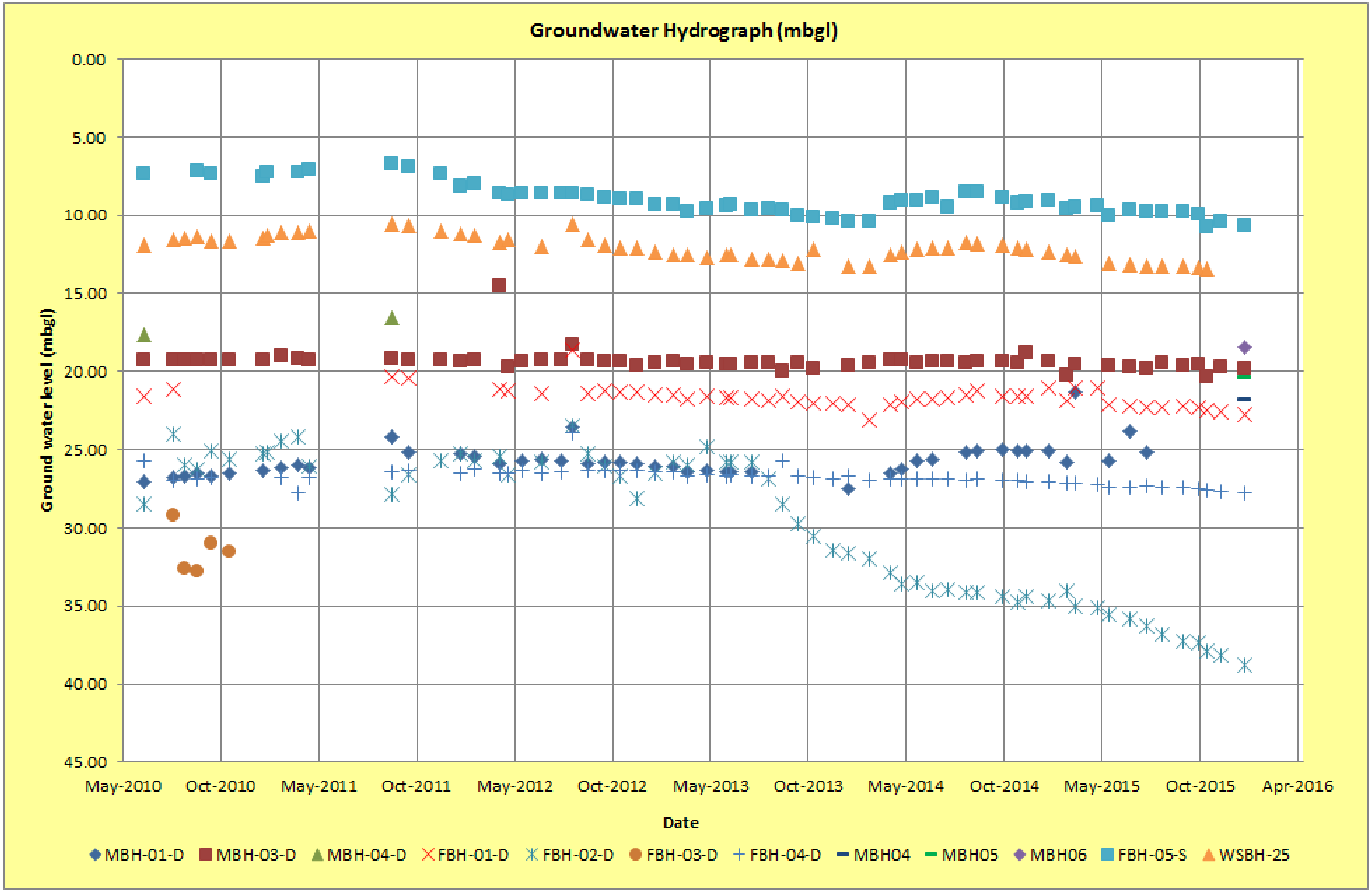
With evaporation being greater than rainfall in the area, there is a marked moisture deficit, thus little or no recharge to the aquifer occurs (DTM, 2016). Rainfall recharge is the only water source for groundwater recharge in the project area, with it being specified between 3% and 5% of the average annual precipitation. Natural drainage canals were seen as near surface groundwater sinks. The Elands River is a gaining river, receiving groundwater from the adjacent aquifer systems. Groundwater (especially the shallow aquifer systems) will therefore flow towards the river where it either daylights as springs or is recovered through evapotranspiration by vegetation (TWP, 2008).

Groundwater Flow, Levels and Use

The regional groundwater flow is closely related to the topography, and groundwater flows from higher lying ground in the north towards lower lying areas in the south and towards watercourses, which occur in lower lying areas. Of major importance for groundwater flow in the area is the presence of a relatively impermeable interface between the upper shallow weathered aquifer and the deeper, fractured aquifer. This semi- to impermeable interface prevents rapid vertical drainage of the shallow aquifer on a regional scale, thus permitting lateral groundwater flow in the shallow aquifer driven by groundwater gradients related to local topography.

The groundwater contours follow the surface topography, indicating that the groundwater flow is from high ground towards the Elands River. Groundwater will generally flow from north to south towards the Elands River (TWP, 2008).

The approved EIA and EMP indicated that the majority of the groundwater levels were between 20 to 30 mbgl. The results from groundwater monitoring suggest that groundwater levels generally range between 8.48 mbgl and 35.81 mbgl with groundwater flow towards the Elands River (SLR, 2015b). A hydrograph showing the changes in groundwater levels since 2010 (when on site groundwater monitoring started) is shown in Figure 7-20.

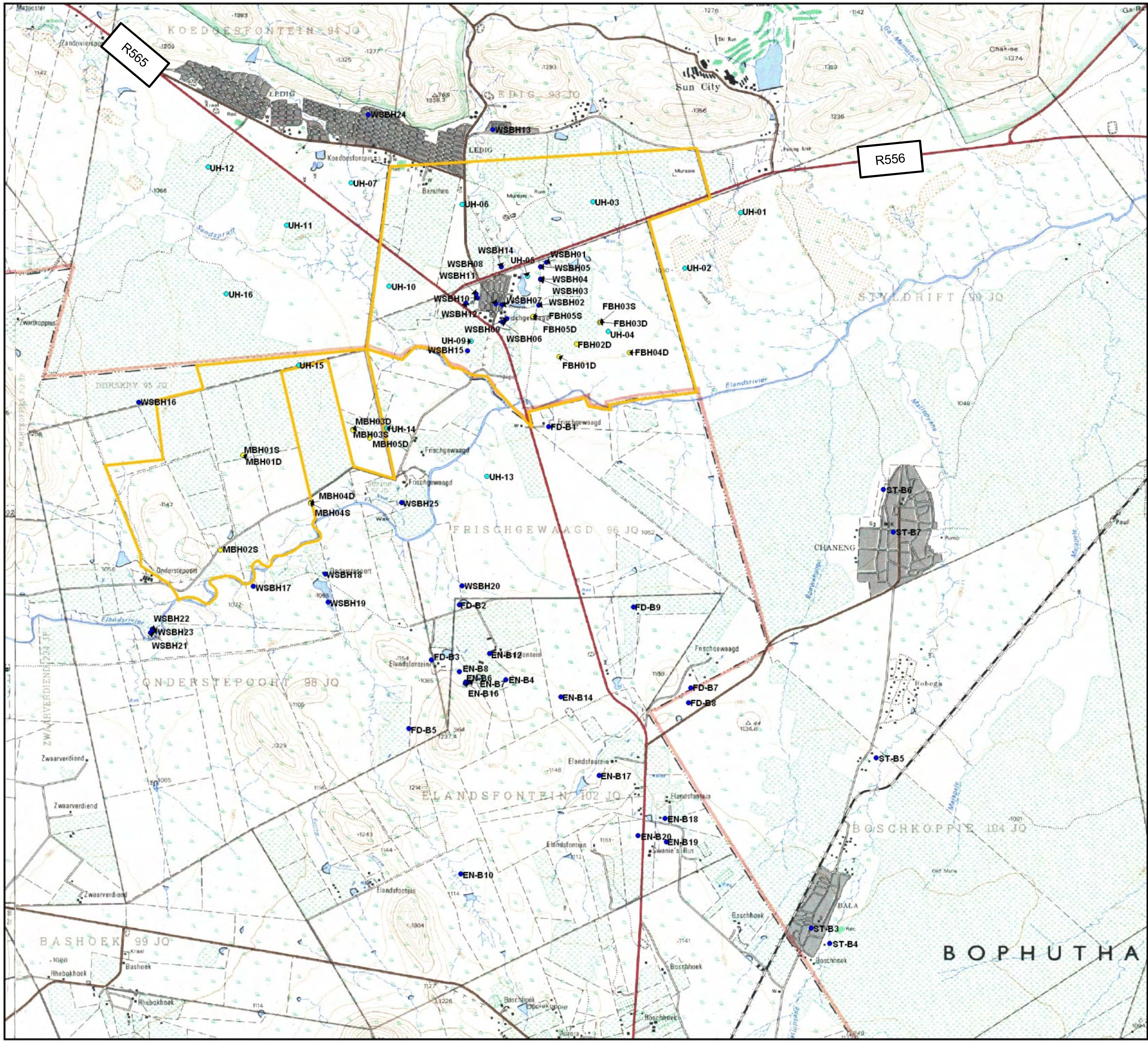

Groundwater Hydrograph (mbgl)
Ground water level (mbgl)
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
45.00
May-2010
Oct-2010
May-2011
Oct-2011
May-2012
Oct-2012
May-2013
Oct-2013
May-2014
Oct-2014
May-2015
Oct-2015
Apr-2016
Date
MBH-01-D
MBH-03-D
MBH-04-D
FBH-01-D
FBH-02-D
FBH-03-D
FBH-04-D
MBH04
MBH05
MBH06
FBH-05-S
WSBH-25

The figure shows that there are fluctuations with groundwater over time around the site. The water level in borehole FBH02D has been falling over time. FBH02D is located south of the waste rock dump, east of the Concentrator Complex; the decrease in water levels may be as a result of mine operations.

Groundwater in the area is used for domestic, agriculture and irrigation purposes (SLR, 2016b). A map showing the boreholes that were identified in the 2008 EIA and EMP is contained in Figure 7-21 Figure 7-22. It should be noted that some of these may no longer exist and new ones may have been developed since the previous EIA.

BH nr.	Latitude/Longitude		Address	Owner	Tel nr.	Date drilled	Depth (m)	Collar height	Waterlevel (mbgl)	Date measured	Waterlevel (mbgl)	Date measured	Equipment	Yield (l/s)	Waterstrikes	User application
WSBH01	25.37354	27.07414	Kagiso Section 1	Municipality		1981	Unknown	0.00	~	9/7/2007			Hand pump	No info	No info	Domestic
WSBH02	25.37947	27.07296	Kagiso Section 1, Stand 2788	Mr Malebo	0736334295	1991	Unknown	0.00	~	9/7/2007			Hand pump	No info	No info	Domestic & Irrigation
WSBH03	25.37593	27.07326	Kagiso Section 1, Stand 2766	Me J. M. Moalusi	0836850106	1989	Unknown	0.33	~	9/7/2007			Hand pump	No info	No info	Domestic
WSBH04	25.37583	27.07328	Kagiso Section 1, Stand 2773	Me J. A. Ramotshudi	0764719970	Not Known	Unknown	0.40	~	9/7/2007			Hand pump	No info	No info	Domestic
WSBH05	25.37411	27.0733	Kagiso Section 1, Stand 2768	Me M. Masimo	0722674297	Not Known	Unknown	0.21	5.25	9/7/2007			Submersible	No info	No info	Domestic & Irrigation
WSBH06	25.38178	27.06792	Kagiso Section 1	Municipality	~	Not Known	Unknown	0.10	3.84	9/7/2007			Hand pump	No info	No info	None
WSBH07	25.3794	27.06786	Lekwadi Section, Stand 2425	Mr A. P. Mthembu	0787085422	28/07/1983	Unknown	0.26	7.30	9/7/2007			Submersible	No info	No info	Domestic
WSBH08	25.37936	27.06698	Lekwadi Section, Stand 2429	Me J. B. Motshoane	0834969112	1997	Unknown	0.25	8.05	9/7/2007			Submersible	No info	No info	None
WSBH09	25.38137	27.06849	Lekwadi Section	Municipality	~	Not Known	Unknown	0.20	4.44	9/7/2007			Hand pump	No info	No info	Domestic
WSBH10	25.37853	27.0644	Lekwadi Section, Stand 2138	Me M. V. Mbanjwa	0726611682	1989	Unknown	0.15	~	9/7/2007			Submersible	No info	No info	Domestic
WSBH11	25.37794	27.06423	Lekwadi Section, Stand 2063	Me J. Tlapu	0145510754	1984	72	0.13	~	9/7/2007			Mono pump	No info	No info	Domestic
WSBH12	25.37921	27.06283	Lekwadi Section, Stand 2050	Mr S. M. Gaborone	0826872267	1990	Unknown	0.17	~	9/7/2007			Mono pump	No info	No info	Domestic
WSBH13	25.35495	27.06662	Bagatleng Section , Stand 2834	Mr M. T. Nkosi	0724521593	30 years ago	Unknown	0.17	7.90	10/7/2007			Submersible	No info	No info	Domestic & Irrigation
WSBH14	25.37408	27.06784	Bagatleng Section , Stand 2465	Mr T. Dmoeti	0836952512	Not Known	Unknown	0.35	7.70	10/7/2007			Submersible	No info	No info	Domestic
WSBH15	25.38588	27.06298	Casablanca Sect, Stand TKK00181	Mr Masisi	0735334862	Dec-06	30	0.12	10.30	10/7/2007			Submersible	0.8	No info	Domestic
WSBH16	25.39315	27.01692	Phatsima Village	Municipality	~	Not Known	Unknown	0.06	31.29	11/7/2007			None	No info	No info	Domestic
WSBH17	25.41888	27.03298	Onderstepoort	Mr J. C. Grobbelaar	~	Not Known	50	0.06	12.00	11/7/2007			None	No info	No info	None
WSBH18	25.41721	27.04314	Onderstepoort	Mr J. C. Grobbelaar	~	Not Known	50	0.24	25.41	11/7/2007			Wind mill	No info	No info	None
WSBH19	25.42112	27.04349	Onderstepoort	Mr J. C. Grobbelaar	~	Not Known	50	0.13	~	11/7/2007			Mono pump	No info	No info	Domestic & Agricultural
WSBH20	25.41882	27.06227	Frischgewaagd	Mr J. C. Grobbelaar	~	Not Known	Unknown	0.22	32.35	11/7/2007			None	No info	No info	None
WSBH21	25.42541	27.01866	Phatsima Village	Municipality	~	Not Known	Unknown	0.58	9.42	11/7/2007			None	No info	No info	None
WSBH22	25.42491	27.01883	Phatsima Village	Municipality	~	Not Known	Unknown	0.25	11.06	11/7/2007			None	No info	No info	None
WSBH23	25.42511	27.01897	Phatsima Village	Municipality	~	Not Known	Unknown	0.79	10.51	11/7/2007			None	No info	No info	None
WSBH24	25.3528	27.0491	Ledig Section 3, Stand 1247	Me P. M. Tekela	0732442215	1985	54	0.20	17.02	11/7/2007			Submersible	No info	No info	Domestic
WSBH25	25.40709	27.05377	Frischgewaagd	No info	~	Not Known	Unknown	0.24	12.41	11/7/2007			None	No info	No info	None
UH-01	25.36652	27.10137	Styldrift	Anglo Platinum	~	7/7/2007	130	~	15.02	24/07/2007			None	7.5	22, 67	Seismic survey (destroyed?)
UH-02	25.3743	27.09349	Styldrift	Anglo Platinum	~	8/7/2007	100	~	14.34	24/07/2007			None	7.5	25	Seismic survey (destroyed?)
UH-03	25.36498	27.0806	Ledig	Anglo Platinum	~	5/7/2007	64	~	18.96	24/07/2007			None	0.4	31	Seismic survey (destroyed?)
UH-04	25.38315	27.08278	Frischgewaagd	Anglo Platinum	~	9/7/2007	90	~	11.03	23/07/2007			None	Dry	~	Seismic survey (destroyed?)
UH-05	25.37543	27.07146	Frischgewaagd	Anglo Platinum	~	12/7/2007	100	~	1.43	24/07/2007			None	0.6	25	Seismic survey (destroyed?)
UH-06	25.36536	27.06224	Ledig	Anglo Platinum	~	10/7/2007	110	~	8.16	24/07/2007			None	3.8	40	Seismic survey (destroyed?)
UH-07	25.36234	27.0467	Koedoesfontein	Anglo Platinum	~	17/7/2007	100	~	10.33	23/07/2007			None	5	28	Seismic survey (destroyed?)
UH-09	25.38452	27.06354	Frischgewaagd	Anglo Platinum	~	11/7/2007	100	~	10.01	23/07/2007			None	12.5	18	Seismic survey (destroyed?)
UH-10	25.3768	27.05201	Ledig	Anglo Platinum	~	7/7/2007	100	~	10.78	23/07/2007			None	6.2	18, 55	Seismic survey (destroyed?)
UH-11	25.36831	27.03767	Koedoesfontein	Anglo Platinum	~	7/6/2007	100	~	16.57	23/07/2007			None	Dry	~	Seismic survey (destroyed?)
UH-12	25.36015	27.02667	Koedoesfontein	Anglo Platinum	~	7/6/2007	85	~	26.09	23/07/2007			None	Dry	~	Seismic survey (destroyed?)
UH-13	25.40344	27.06572	Frischgewaagd	Anglo Platinum	~	13/7/2007	100	~	24.30	24/07/2007			None	0.6	59	Seismic survey (destroyed?)
UH-14	25.39671	27.05168	Onderstepoort	Anglo Platinum	~	11/7/2007	95	~	21.71	24/07/2007			None	Dry	~	Seismic survey (destroyed?)
UH-15	25.38789	27.03936	Onderstepoort	Anglo Platinum	~	3/7/2007	100	~	18.00	24/07/2007			None	1.2	67	Seismic survey (destroyed?)
UH-16	25.37788	27.0292	Koedoesfontein	Anglo Platinum	~	4/7/2007	75	~	23.01	24/07/2007			None	0.2	41	Seismic survey (destroyed?)
FBH01D	25.38671	27.07588	Frischgewaagd	Wesizwe Platinum	~	11/7/2007	72	0.66	21.63	15/08/2007	21.77	4/3/2008	None	0.5	26, 61	Monitoring
FBH02D	25.38494	27.0783	Frischgewaagd	Wesizwe Platinum	~	10/7/2007	72	0.74	29.42	15/08/2007	22.81	4/3/2008	None	Dry	~	Monitoring
FBH03D	25.38187	27.08158	Frischgewaagd	Wesizwe Platinum	~	10/7/2007	60	0.86	29.29	15/08/2007	25.33	4/3/2008	None	Dry	~	Monitoring
FBH03S	25.38188	27.0817	Frischgewaagd	Wesizwe Platinum	~	10/7/2007	12	0.83	Dry	15/08/2007	Dry	4/3/2008	None	Dry	~	Monitoring
FBH04D	25.38612	27.08576	Frischgewaagd	Wesizwe Platinum	~	10/7/2007	60	0.69	26.68	15/08/2007	26.91	4/3/2008	None	0.01	33	Monitoring
FBH05D	25.38105	27.07224	Frischgewaagd	Wesizwe Platinum	~	9/7/2007	60	0.65	8.88	14/08/2007	8.12	4/3/2008	None	0.01	34	Monitoring
FBH05S	25.38104	27.07218	Frischgewaagd	Wesizwe Platinum	~	9/7/2007	12	0.40	9.40	14/08/2007	8.69	4/3/2008	None	Dry	~	Monitoring
MBH01D	25.40057	27.03158	Mimosa	Wesizwe Platinum	~	9/7/2007	60	0.72	27.72	14/08/2007	28.09	4/3/2008	None	0.2	51	Monitoring
MBH01S	25.40048	27.03153	Mimosa	Wesizwe Platinum	~	9/7/2007	12	0.82	Dry	14/08/2007	Dry	4/3/2008	None	Dry	~	Monitoring
MBH02S	25.41379	27.02837	Mimosa	Wesizwe Platinum	~	13/7/2007	43	0.77	23.70	14/08/2007	23.82	4/3/2008	None	0.1	25-35	Monitoring
MBH03D	25.39688	27.04694	Mimosa	Wesizwe Platinum	~	11/7/2007	60	0.60	19.22	14/08/2007	19.28	4/3/2008	None	Dry	~	Monitoring
MBH03S	25.39699	27.04699	Mimosa	Wesizwe Platinum	~	12/7/2007	12	0.44	Dry	14/08/2007	Dry	4/3/2008	None	Dry	~	Monitoring
MBH04D	25.40718	27.04103	Mimosa	Wesizwe Platinum	~	12/7/2007	60	0.70	18.58	14/08/2007	18.09	4/3/2008	None	5	23, 32	Monitoring
MBH04S	25.40723	27.041	Mimosa	Wesizwe Platinum	~	12/7/2007	12	0.73	Dry	14/08/2007	Dry	4/3/2008	None	Dry	~	Monitoring
MBH05D	25.39805	27.0493	Mimosa	Wesizwe Platinum	~	13/7/2007	44		Dry	14/08/2007	Dry	4/3/2008	None	Dry	~	Monitoring
EN-B4	25.43204	27.06845	Sundown Ranch	L Coetzer	083 633 4905	No info	85	0.12	55.20	10/7/2007			Submersible	0.17	No info	Domestic
EN-B6	25.43229	27.06278	Sundown Ranch	L Coetzer	083 633 4905	No info	100	0.90	51.60	10/7/2007			Submersible	0.42	No info	Domestic
EN-B7	25.43231	27.06330	Sundown Ranch	L Coetzer	083 633 4905	No info	96	0.30	53.37	10/7/2007			Submersible	0.10	No info	Domestic
EN-B8	25.43077	27.06190	Sundown Ranch	L Coetzer	083 633 4905	No info	86	0.15	65.18	10/7/2007			Submersible	0.13	No info	Domestic
EN-B10	25.45928	27.06215	Sundown Ranch	L Coetzer	083 633 4905	No info	100	0.46	43.37	10/7/2007			Submersible	0.31	No info	Domestic

BH nr.	Latitude/Longitude		Address	Owner	Tel nr.	Date drilled	Depth (m)	Collar height	Waterlevel (mbgl)	Date measured	Waterlevel (mbgl)	Date measured	Equipment	Yield (l/s)	Waterstrikes	User application
EN-B12	25.42832	27.06614	Sundown Ranch	L Coetzer	083 633 4905	No info	100	0.11	45.92	10/7/2007			Submersible	0.12	No info	Domestic
EN-B14	25.43437	27.07611	Sundown Ranch	L Coetzer	083 633 4905	No info	100	0.29	54.47	10/7/2007			Submersible	1.66	No info	Domestic
EN-B16	25.43251	27.06266	Sundown Ranch	L Coetzer	083 633 4905	No info	100	0.47	54.06	10/7/2007			Submersible	1.11	No info	Domestic & Agricultural
EN-B17	25.44540	27.08155	Sherwood house	G Du Plessis	072 450 4541	No info	65	0.28	32.91	11/7/2007			None	No info	No info	None
EN-B18	25.45153	27.09073	Elandsfontein	S Palmer	072 777 1104	No info	55	0.08	37.05	11/7/2007			Submersible	2.78	No info	Domestic & Agricultural
EN-B19	25.45485	27.09093	Elandsfontein	S Palmer	072 777 1104	No info	78	0.22	37.42	11/7/2007			None	2.78	No info	None
EN-B20	25.45395	27.08686	Elandsfontein	S Palmer	072 777 1104	No info	60	0.21	34.45	12/7/2007			None	2.22	No info	None
WN-B1	25.35412	27.17532	Haartbeesspruit	Sauva Englezakis	076 845 5544	No info	0	0.11	5.92	11/7/2007			Mono pump	0.23	No info	Domestic & Agricultural
FD-B1	25.39650	27.07441	Frischgewaagd	Andre van Vuuren	073 721 4265	No info	25	0.48	9.63	10/7/2007			Mono pump	0.14	No info	Domestic & Agricultural
FD-B2	25.42147	27.06195	Frischgewaagd	Wiitkrans Trust	082 922 1579	No info	80	0.22	32.57	11/7/2007			None	0.63	No info	None
FD-B3	25.42923	27.05800	Frischgewaagd	Wiitkrans Trust	082 922 1579	No info	100	0.30	42.40	11/7/2007			None	0.25	No info	None
FD-B5	25.43876	27.05483	Frischgewaagd	Wiitkrans Trust	082 922 1579	No info	130	0.26	51.76	11/7/2007			Submersible	0.19	No info	Domestic & Agricultural
FD-B7	25.43312	27.09435	Frischgewaagd	J J Stols	072 988 6863	No info	73	0.21	17.44	10/7/2007			None	0.83	No info	None
FD-B8	25.43515	27.09402	Frischgewaagd	J J Stols	014-573 3327	No info	40	0.31	20.24	10/7/2007			Submersible	0.83	No info	Domestic & Agricultural
FD-B9	25.42178	27.08632	Sundown Ranch	L Coetzer	083 633 4905	No info	44	0.49	21.92	11/7/2007			None	No info	No info	None
ST-B2	25.46773	27.71113	Rasimone Village	MRS S MORAKE	~	No info	0	0.27	4.77	11/7/2007			Submersible	0.42	No info	Domestic & Irrigation
ST-B3	25.46690	27.11123	Rasimone Village	MRS M THBEDI	073 508 0656	No info	0	0.07	8.71	11/7/2007			Submersible	0.42	No info	Domestic & Agricultural
ST-B4	25.46898	27.11381	Rasimone Village	BAFOKENG PROPETY	~	No info	0	0.00	4.14	11/7/2007			None	No info	No info	None
ST-B5	25.44294	27.12029	Boschkoppie	No info	~	No info	0	0.00	13.15	11/7/2007			None	No info	No info	None
ST-B6	25.40526	27.12133	Chaneng Village, Plot B683	MRS R M MAGOBE	083 997 6112	No info	0	0.00	12.23	11/7/2007			Powerhead	0.01	No info	Domestic & Agricultural
ST-B7	25.41127	27.12271	Chaneng Village	MR L TEEKE	082 951 2772	No info	40	0.13	16.64	11/7/2007			Submersible	0.01	No info	Domestic & Agricultural



Project:
WESIZWE PLATINUM LIMITED:
GEOHYDROLOGICAL EVALUATION

TWP-ES

Map:

PLAN 12:
GROUNDWATER BOREHOLE LOCATIONS

Legend:

- UH Boreholes
- Hydrocensus Boreholes
- Newly drilled Boreholes
- Mining Rights Area

N W E S

Africon

0 1 2 3
Kilometers

Scale: 1:50,000

Date: 2007/11/08

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Groundwater Quality

For the pre-mining groundwater quality, chemical results were compared with the SANS Drinking Water Standards (SANS 241:2006). The majority of boreholes showed a Ca-Mg-HCO3 signature indicating recently recharged or recharging water. The pre-mining groundwater quality in the area was generally good with most of the water samples fit for human consumption (SLR, 2015b). Class I is the recommended operational limit and Class II is the maximum allowable concentration for short term use only. The results are shown in Table 7.25. Elevated levels above Class I are shown in bold.

Of the 26 boreholes sampled, 16 fell into Class I. Information on elevated concentrations and pollution indicators normally associated with platinum mining is indicated below (TWP, 2008):

- Nitrate: Nitrate concentrations exceeding the Class i concentration of 10 mg/l were present in 3 boreholes. These boreholes were all located within 40 m of a pit latrine, which is a potential source of nitrate pollution.
- Fluoride: Fluorides were high in 6 boreholes, exceeding the Class I concentration of 1 mg/l. The study indicated that high fluoride occurrences in the Pilanesberg area and the Rustenburg Layered Suite as confirmed by McCaffrey (1993) and Barnard (2000). According to McCaffrey (1993) the fluoride can be associated with the Red Foyaite in the Pilanesberg Complex and high values are encountered on the margins of the Pilanesberg, at or near the contact with the country rocks.
- Iron: Iron concentrations in 3 boreholes exceeded the Class I limit of 0.2 mg/l. The concentrations in 2 of the boreholes would only have aesthetic (taste) effects but no health effects. The concentration in the third borehole could have had slight health effects in children and sensitive individuals and pronounced aesthetic effects.
- Magnesium: The magnesium concentration in 1 borehole exceeded the Class I limit of 70 mg/l. The magnesium gives water a slight bitter taste and diarrhoea may occur in sensitive users.
- Electrical Conductivity: Electrical conductivity is an indicator of the total amount of dissolved solids in water, and thus serves as a useful indicator of groundwater pollution. The electrical conductivity of all the samples was low compared to the Class I drinking water standard of 150 mS/m.
- pH: The normal pH range of groundwater tends to be between 6 and 8, depending on the specific soil and rock composition through which it has percolated. All of the samples fell within this range and had a pH of greater than 7. The water had an alkaline character that is typical of water present in the occurring geology in the area.
- Sulphate: All the samples had sulphate concentrations that were within the Class 1 drinking water standards of 400mg/l.

The approved EIA and EMP indicated that as part of the social survey that was conducted in August 2007 in Ledig, Phatsima, and Mahobieskraal, more than 95% of respondents indicated that they had access to in-yard pit latrines. The reliance on pit latrines could result in a high potential for groundwater contamination in the area.

TABLE 7.25: BASELINE GROUNDWATER QUALITY (TWP, 2008)

Borehole	pH	EC	TDS	Ca	Na	Mg	K	P-Alk	Si	M-Alk	CO3	HCO3	Cl	SO4	NO3-N	F	Fe	Mn	NH3-N	As	B	Cr	Cu	PO4	U	IBE
FBH01D	8.25	75	346	43.2	79.7	37.7	1.6	0.3	25.8	390.3	3.85	468.23	20.0	20.9	0.3	0.5	0.03	0.01	1.00	0.001	0.028	0.001	0.001	0.40	0.004	-3.41
FBH02D	8.80	34	182	4.7	75.2	3.0	1.4	0.3	20.2	148.2	4.97	170.32	7.2	9.1	0.1	0.7	1.96	0.04	1.00	0.001	0.054	0.012	0.005	0.40	0.003	-5.86
FBH03D	9.33	31	204	5.0	55.0	1.4	2.2	0.3	14.8	38.6	3.77	38.13	46.4	25.8	0.1	1.6	0.60	0.01	1.00	0.002	0.066	0.005	0.001	0.40	0.000	-12.21
FBH04D	8.18	71	356	39.8	51.8	41.8	2.5	0.3	22.7	309.3	2.60	371.96	46.5	10.6	0.1	0.6	0.03	0.09	1.00	0.001	0.028	0.001	0.001	0.40	0.005	-3.69
FBH05D	8.12	96	522	46.6	46.9	64.3	4.3	0.3	11.9	336.5	2.47	405.43	99.3	62.0	3.9	0.5	0.03	0.09	13.60	0.001	0.027	0.001	0.001	0.40	0.000	-0.79
FBH05S	8.12	97	566	51.1	59.8	63.4	3.2	0.3	2.5	373.0	2.74	449.41	82.7	66.4	0.1	0.7	0.40	0.40	1.00	0.001	0.048	0.001	0.001	0.40	0.000	1.59
MBH01D	8.02	82	516	65.6	29.9	65.8	2.5	0.3	35.2	460.6	2.69	556.39	4.6	1.5	2.4	0.1	0.01	0.00	1.00	0.004	0.018	0.002	0.002	0.40	0.002	-2.38
MBH02S	8.21	53	312	34.8	16.2	44.0	0.9	0.3	3.4	248.8	2.24	298.88	10.9	36.7	0.1	0.2	0.05	0.30	1.00	0.001	0.044	0.001	0.001	0.40	0.000	5.42
MBH03D	8.11	82	504	66.0	34.2	61.0	2.0	0.3	33.9	433.9	3.11	522.95	15.7	7.8	7.9	0.1	0.02	0.10	1.00	0.002	0.019	0.001	0.002	0.40	0.002	-2.62
MBH04D	8.07	86	500	78.1	26.2	64.4	2.2	0.3	34.8	480.1	3.15	579.25	4.8	2.2	3.7	0.1	0.02	0.01	1.00	0.003	0.020	0.001	0.001	0.40	0.003	-2.52
WSBH01	8.50	85	642	83.1	55.1	59.1	3.6	7.8	25.0	369.3	6.39	437.35	105.9	61.1	0.1	0.7	0.03	0.20	1.00	0.005	0.013	0.001	0.001	0.90	0.001	-4.23
WSBH05	8.29	107	810	93.0	57.9	62.9	1.2	0.3	34.7	268.2	2.90	321.20	160.6	62.0	8.1	0.2	0.03	0.03	1.00	0.003	0.066	0.001	0.001	0.40	0.001	-3.85
WSBH07	7.88	62	426	50.9	55.5	29.7	3.4	0.3	33.4	165.0	0.70	199.83	68.8	21.9	11.8	1.6	0.03	0.03	1.00	0.002	0.012	0.002	0.002	1.40	0.007	-6.33
WSBH09	8.37	74	538	59.4	49.7	37.5	3.6	0.3	31.9	180.1	2.33	214.84	81.7	34.9	11.4	1.1	0.03	0.03	1.00	0.002	0.012	0.001	0.069	0.40	0.004	-5.00
WSBH11	7.97	64	356	55.3	48.7	27.1	3.8	0.3	33.1	168.8	0.88	204.09	58.8	20.7	10.2	1.2	0.03	0.03	1.00	0.002	0.013	0.001	0.027	0.40	0.005	-5.63
WSBH13	7.83	67	448	49.1	75.4	9.6	2.9	0.3	38.9	111.7	0.42	135.37	100.9	6.8	1.7	2.1	0.10	0.03	1.00	0.002	0.033	0.001	0.001	0.40	0.001	-15.55
WSBH14	8.43	86	574	51.8	77.8	42.8	4.4	0.3	32.2	267.1	3.95	317.66	84.4	44.9	4.5	1.7	0.03	0.03	1.00	0.002	0.009	0.001	0.001	0.40	0.009	-4.31
WSBH15	7.66	72	452	63.1	46.6	32.2	4.4	0.3	34.7	204.0	0.52	247.79	55.6	13.0	9.7	1.0	0.03	0.03	1.00	0.001	0.011	0.001	0.001	0.40	0.008	-3.15
WSBH16	8.13	80	518	62.2	47.7	43.7	1.1	0.3	12.3	344.6	2.59	415.07	62.9	55.0	0.5	0.1	0.03	0.03	1.00	0.001	0.012	0.001	0.001	0.40	0.005	-4.26
WSBH19	7.97	47	316	51.1	14.5	38.1	1.4	0.3	28.3	271.0	1.41	327.69	1.3	4.8	0.2	0.1	0.03	0.03	1.00	0.003	0.010	0.001	0.001	0.40	0.000	-2.60
WSBH20	7.46	95	670	80.4	22.5	88.5	3.3	0.3	40.0	598.4	0.97	728.06	18.6	18.5	0.1	0.1	0.10	0.20	1.00	0.003	0.033	0.001	0.001	0.40	0.004	-5.23
WSBH24	8.18	37	258	16.5	65.4	4.9	2.6	0.3	36.3	102.0	0.86	122.60	17.9	8.9	9.0	0.5	0.03	0.03	1.00	0.001	0.012	0.003	0.001	0.40	0.002	-15.41
UH03	8.14	63	384	38.2	82.1	16.3	5.1	0.3	25.1	233.2	1.79	280.78	49.8	22.3	2.7	1.9	0.03	0.03	1.00	0.003	0.056	0.001	0.001	3.70	0.002	-6.71
UH10	8.03	52	296	39.8	82.4	17.4	5.0	0.3	24.6	212.9	1.27	257.08	27.0	12.1	2.7	0.9	0.01	0.01	1.00	0.002	0.053	0.001	0.001	1.60	0.005	-3.85
UH13	8.06	88	522	36.4	118.0	19.3	13.4	0.3	8.0	189.9	1.22	229.13	126.9	74.5	1.7	0.8	0.03	0.12	1.00	0.001	0.038	0.001	0.001	0.40	0.001	-0.07
UH15	8.00	77	472	59.4	36.8	51.8	2.7	0.3	29.7	435.0	2.43	525.70	24.1	11.5	0.6	0.1	0.01	0.01	4.75	0.002	0.110	0.001	0.001	1.90	0.001	-6.12

Groundwater monitoring has been conducted since 2010. Since construction has begun there have been fluctuations above the pre-mining baseline; iron and Manganese which have been identified on numerous occasions to be above the SANS 241: 2011 standards. This was attributed to rusting of borehole casings, rather than mine activities. The locations of the monitoring points are shown in Figure 7-19

The most recent quarterly groundwater monitoring which was compared to the SANS 241: 2015 standards indicated the following:

- Electrical conductivity in all boreholes was low and remained below the SANS 241: 2015 Drinking Water Standard. The lowest average EC value (56.7 mS/m) was recorded on the eastern side of the mine (FBH02D) whilst the highest EC average was 105mS/m (FBH05) on the western side of the mine. Concentrations are consistent with previous monitoring events.
- Total dissolved solids within all boreholes are low, ranging between 345mg/l at FBH02D and 568mg/l at FBH05S. Concentrations are consistent with previous monitoring events.
- Iron and manganese were reported above the SANS 241: 2015 drinking water standard in borehole FBH05S. Although concentrations have fluctuated in this borehole it is generally consistent with previous monitoring events.
- Arsenic has been recorded in five of the boreholes during the December 2015 monitoring. Concentrations have been recorded in other recent monitoring, however not typical in groundwater for the area. Further sampling will identify trends.
- Concentrations of sulphate, nitrate, and fluoride, acknowledged in baseline quality data (TWP, 2008) as a concern, were all below SANS 241: 2015 drinking water standard for the December 2015 monitoring period.

CONCLUSION

Two groundwater aquifers occur in the area. These are an upper weathered aquifer and a lower fractured aquifer. Of major importance for groundwater flow in the area is that the semi- to impermeable interface between the upper shallow weathered aquifer and the deeper, fractured aquifer prevents rapid vertical drainage of the shallow aquifer on a regional scale, thus permitting lateral groundwater flow in the shallow aquifer driven by groundwater gradients related to local topography

Pre-mining quality monitoring shows elevated concentrations of nitrate (likely linked to pit latrines), fluoride (linked to geology), iron and manganese. Iron and manganese have remained elevated, but nitrate and fluoride have decreased to be below SANS 241: 2015 drinking water standards.

The groundwater level near the Shaft Complex has been declining over time. Groundwater is one of the sources of water for agriculture, domestic use and irrigation purposes. The project components will need to be appropriately designed and implemented to avoid a reduction in groundwater through potential contamination.

7.4.1.8 Air Quality

INTRODUCTION AND LINK TO ANTICIPATED IMPACT

Existing sources of emissions in the region and the characterisation of existing ambient pollution concentrations is fundamental to the assessment of cumulative air impacts. A change in ambient air quality can result in a range of impacts which in turn may cause a disturbance and/or health impacts to nearby receptors. Potential receptor sites areas of tourism including Sun City, the Bakubung Bush Lodge, the Pilanesberg National Park, animals and plants, residential areas including Phatsima, Ledig and Chaneng as well as the future Gabonewe Estate. There are also farming areas, including the properties spanning between the plant and TSF areas which is used as a grazing area.

The climatic conditions at the site will influence the potential for air dispersion (see Section 7.4.1.3). This section provides a baseline description of the ambient air quality, potential air receptors and emissions sources associated with the project.

DATA SOURCES

The information for this section was sourced from the Air Quality Impact Assessment (AQIA) conducted by Airshed Planning Professionals (Airshed, 2016; Appendix R) for the proposed project. Air quality data were identified through the review of available studies, available monitoring data from the mine and the specialist's knowledge of the project area.

RESULTS

<u>Ambient air quality within the region</u>

Current land uses within the vicinity of the project area are farming, residential and tourism. There is also shaft sinking currently occurring on site which involves blasting and deposition of waste rock on site. These land-uses contribute to baseline pollutant concentrations via the following sources:

- Miscellaneous fugitive dust sources including vehicle entrainment on roads and wind-blown dust from open areas: Fugitive dust emissions can occur as a result of vehicle entrained dust from local paved and unpaved roads, and wind erosion from open or sparsely vegetated areas. The extent of particulate emissions from the main roads is dependent on the number of vehicles using the roads and the silt loading on the roadways.
- Gaseous and particulate emissions from vehicle exhaust emissions: Air pollution from vehicle emissions can be grouped into primary and secondary pollutants. Primary pollutants are those emitted directly into the atmosphere, and secondary, those pollutants formed in the atmosphere as a result of chemical reactions, such as hydrolysis, oxidation, or photochemical reactions. The significant primary pollutants emitted by vehicles include CO_2, CO, hydrocarbons (HCs), SO_2, NOx, DPM and Pb. Secondary pollutants include: NO_2, photochemical oxidants (e.g. O3), HCs,

sulphur acid, sulphates, nitric acid, nitric acid and nitrate aerosols. Vehicle tailpipe emissions are localised sources and unlikely to impact far-field.

- Gaseous and particulate emissions from household fuel burning: There are three main categories of energy use within the residential sector, these are traditional (consisting of wood, dung and bagasse), transitional (consisting of coal, paraffin and liquefied petroleum gas), and modern (consisting of electricity (increasingly this includes the use of renewable energy)).
- Gaseous and particulate emissions from biomass burning (e.g. wild fires): Biomass burning includes the burning of evergreen and deciduous forests, woodlands, grasslands, and agricultural lands. Within the project vicinity wild fires may therefore represent a source of combustion-related emissions. Biomass burning is an incomplete combustion process, with CO, methane and NO_2 gases being emitted. In addition to the impact of biomass burning within the vicinity of the project, long-range transported emissions from this source can further be expected to impact on the air quality. It is impossible to control this source of atmospheric pollution loading. However, it should be noted as part of the background or baseline condition before considering the impacts of other local sources.

<u>Baseline air pollutant conditions</u>

The main air pollutants of concern associated with project activities are PM_{10}, NO_2 and SO_2. These pollutants pose a potential health risk to the surrounding communities. Dustfall (total suspended particulates (TSP)) is of concern due to its nuisance effects. Baseline conditions are presented below.

<u>Dustfall monitoring around the Mine</u>

Dustfall is an indicator of the amount of dust generated over a period of time (measured per day as per South African National Standards (SANS)). Dust deposition rates were evaluated based on the National Dust Control Regulations (NDCR) promulgated in November 2013, providing a residential limit of 600 mg/m²/day and a non-residential limit of 1 200 mg/m²/day, neither to be exceeded more than twice within a year or two sequential months.

Average annual dustfall rates for the period January 2011 to August 2015 were obtained for 16 points sampled around the project area. The monthly dustfall rates were generally below the relevant legislation thresholds with the exception of eight exceedances. Seven of the exceedances occurred in 2012 and one in 2014 at various locations. Dustfall rates were exceeded at the Lekwadi Section (which falls under the residential limit) three times in one year and also over two sequential months. None of the other sampled areas had more than one exceedance or sequential month exceedances. Refer to Figure 7-23 for the dustfall bucket locations

PM_{10} Monitoring around the Mine

Daily PM_{10} results from the particulate monitor were analysed for the period 27 July 2012 to 30 June 2015. The 24-hour national ambient air quality standards (NAAQS) limit value for PM_{10} of 75 µg/m³ was not exceeded over the sampling period. Refer to Figure 7-23 for the PM_{10} sampler location.

SO_2 and NO_2 Monitoring around the Mine

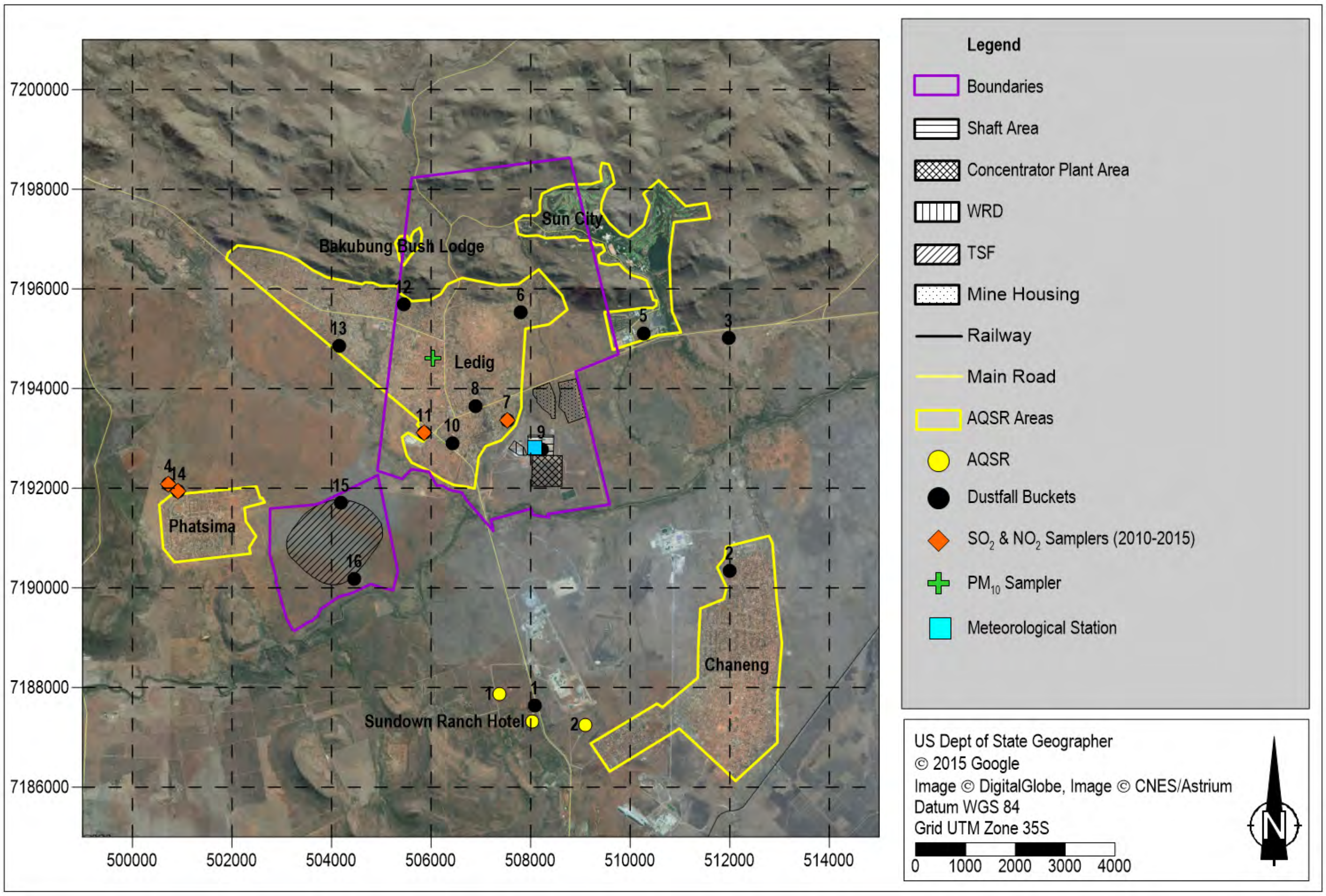
SO_2 and NO_2 sampling data was available for the period October 2010 to August 2015. There were no exceedances of the 1-year or 24-hour average NAAQS for SO_2 of 50 µg/m³ and 125 µg/m3 at any of the sites or NO_2 for 1-year average NAAQS of 40 µg/m³ at any of the sites. Extrapolated hourly concentrations were exceeded for two sites in January 2011 for SO2 and all sites during the sampling period for NO_2. However, this may be linked to the sampling methodology used, where samples are collected on a monthly basis rather than a bi-weekly basis which might skew the data. Refer to Figure 7-23 for the SO_2 and NO_2 sampler locations.

Potential air receptors

Potential air receptors around the project site include areas of tourism including Sun City, the Bakubung Bush Lodge, the Pilanesberg National Park, Sundown Ranch Hotel, animals and plants, residential areas including Phatsima, Ledig and Chaneng as well as the future Gabonewe Estate. There are also farming areas, including the properties spanning between the plant and TSF areas which is used as a grazing area.

CONCLUSION

The project falls within an area close to various potentially sensitive receptors including residential, tourism and farming areas and the proposed housing facilities for mine employees. The monitoring taken place to date indicates that there are some air pollution exceedances around the project site. The proposed project will present additional sources of pollutants that may influence existing pollutant concentrations. The proposed activities should therefore be carefully designed and managed to ensure that contributions from the proposed project remain within acceptable limits.



Bakubung Mine
Current Air Quality Monitoring Network
Dustfall Buckets, PM_{10}, SO_2 and NO_2 Samplers and Weather Station

AIRSHED PLANNING PROFESSIONALS

7.4.1.9 Noise

INTRODUCTION AND LINK TO ANTICIPATED IMPACT

Activities associated with a project have the potential to cause an increase in ambient noise levels in and around the site. This may cause a disturbance to nearby receptors. Potential receptor sites include the surrounding land owners/land users such as Bakubung Bush Lodge and Sun City, settlements including Phatsima, Ledig and Chaneng and schools/creches in the Lekwadi, Letlhabile and Serosecha sectors of Ledig. As a baseline, this section provides an understanding of existing conditions in the area from which to measure changes as a result of project-related noise.

DATA SOURCES

The information for this section was sourced from the approved EIA and BAR and the updated noise impact assessment (NIA) conducted for the project (Jongens Keet Associates (JKA), 2016; Appendix N).

RESULTS

Noise surveys

The measured noise levels (LAIeq equivalent noise level – 'average') around the mine area are in Table 7.26 and the noise climate adjacent to the main roads (Ldn Day-night equivalent) is in Table 7.27. The location of the sampling points is illustrated in Figure 7-24

TABLE 7.26: MEASURED NOISE LEVELS IN THE BPM STUDY AREA (JKA, 2016)

Site No	Location Description	Measured Sound Pressure Level (dBA) LAIeq	
		Daytime Period	Evening Period
1	At the Bakubung Mine entrance.	52.8	45.3
2	On the central southern portion of the Bakubung Mine property just north of the Elands River at borehole WF18	50.0	-
3	In the south eastern sector of Ledig Village (Kagiso Ext 2 sector)	49.7	-
4	In the north eastern sector of Ledig Village (Kagiso Ext 2 sector)	50.7	54.0
5	Eastern boundary of the Bakubung Mine property approximately 1.2 km south of R556	44.8	-
6	In the north western sector of Chaneng Village	45.7	50.4
7	In the north western sector of Ledig Village (Lekwadi sector) at a school in the south eastern quadrant of the R565 and R556 intersection	61.2	-
8	In the south eastern sector of Ledig Village (Lekwadi sector)	47.5	-
9	In the north western sector of Reagile informal settlement	55.3	-
10	In the south eastern sector of Phatsima Village	46.8	47.4
11	Along the southern boundary of Melani Game Ranch on access road and approximately 1.8 km west of R565	51.7	44.1
12	At the Sundown Ranch Hotel, east of the parking lot.	52.9	54.1

Site No	Location Description	Measured Sound Pressure Level (dBA) LAIeq	
		Daytime Period	Evening Period
	Approximately 90 m west of R565		
13	North of Elands River, 1.6 km south east of Phatsima Village, 5 km west of R565	48.8	-

TABLE 7.27: EXISTING NOISE CLIMATE ADJACENT TO THE MAIN ROADS NEAR THE BAKUBUNG MINE (JKA, 2016)

Offset (m)	Ldn at 25	Ldn at 50	Ldn at 100	Ldn at 250	Ldn at 500	Ldn at 1000	Ldn at 1500	Ldn at 2000	Ldn at 2500	Ldn at 3000	Ldn at 4000
R565N	61.7	58.7	55.5	51.1	47.3	42.8	39.7	37.5	35.6	34.2	31.7
R565S	66.1	63.1	59.9	55.5	51.7	47.2	44.1	41.9	40	38.6	36.1
R556	65	62	58.8	54.4	50.6	46.1	43	40.8	38.9	37.5	35
Phatsima	57.9	54.9	51.7	47.3	43.5	39	35.9	33.7	31.8	30.4	27.9

Following from the noise sampling, the main sources of noise in the area are from:

- Traffic on the R565, the R556 and Phatsima Road;
- The Pilanesberg Airport;
- Construction work at the Bakubung Mine; and
- Styldrift and Maseve Mines.

The existing noise climate alongside the main roads is degraded with regard to suburban residential living. Residences in some areas are negatively impacted from traffic noise (particularly at night) for up to the following distances from these roads:

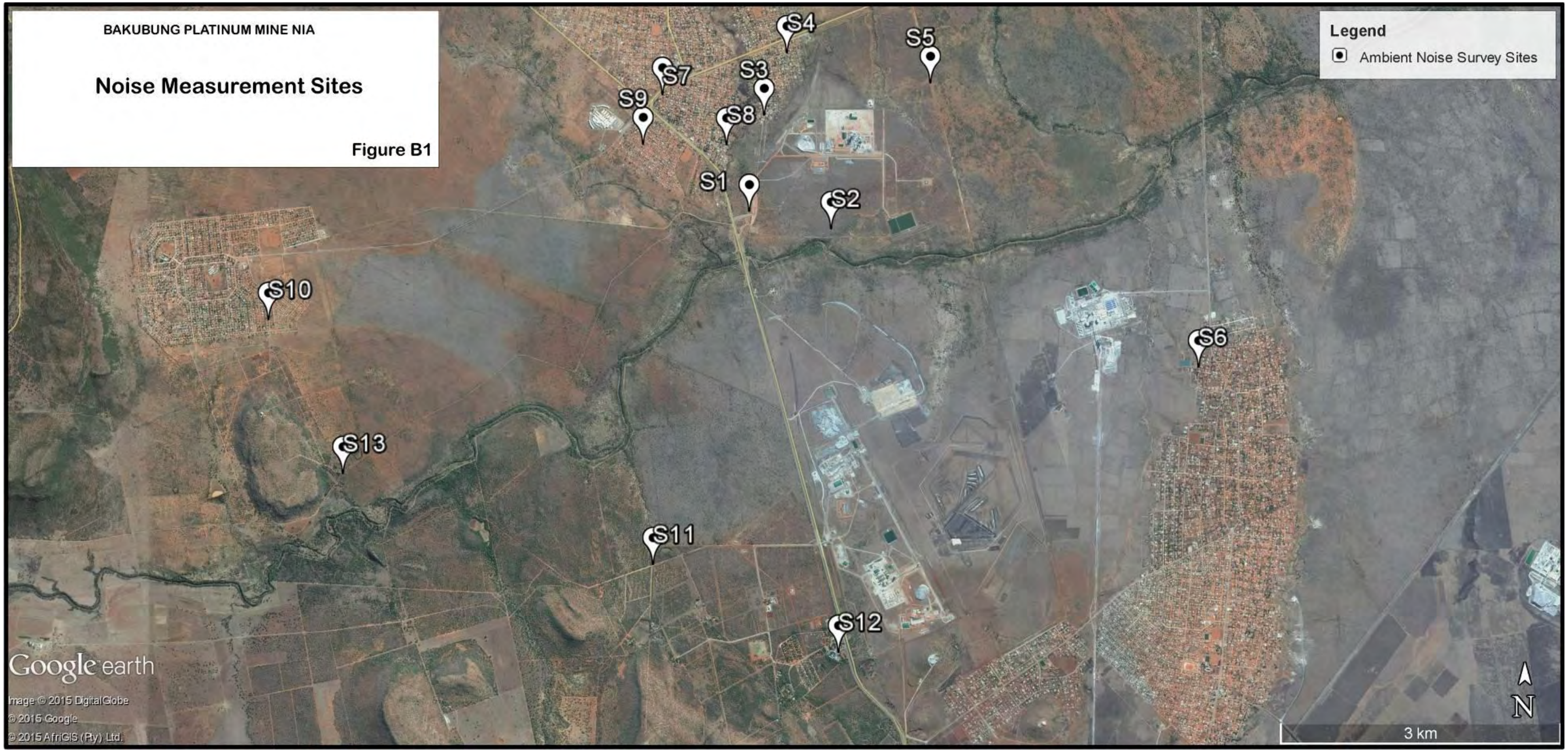
- The R565 (North of R556) - 300 metres.
- The R565 (South of R556) - 550 metres.
- The R556 (East of R565) - 550 metres.
- Phatsima Road - 140 metres.

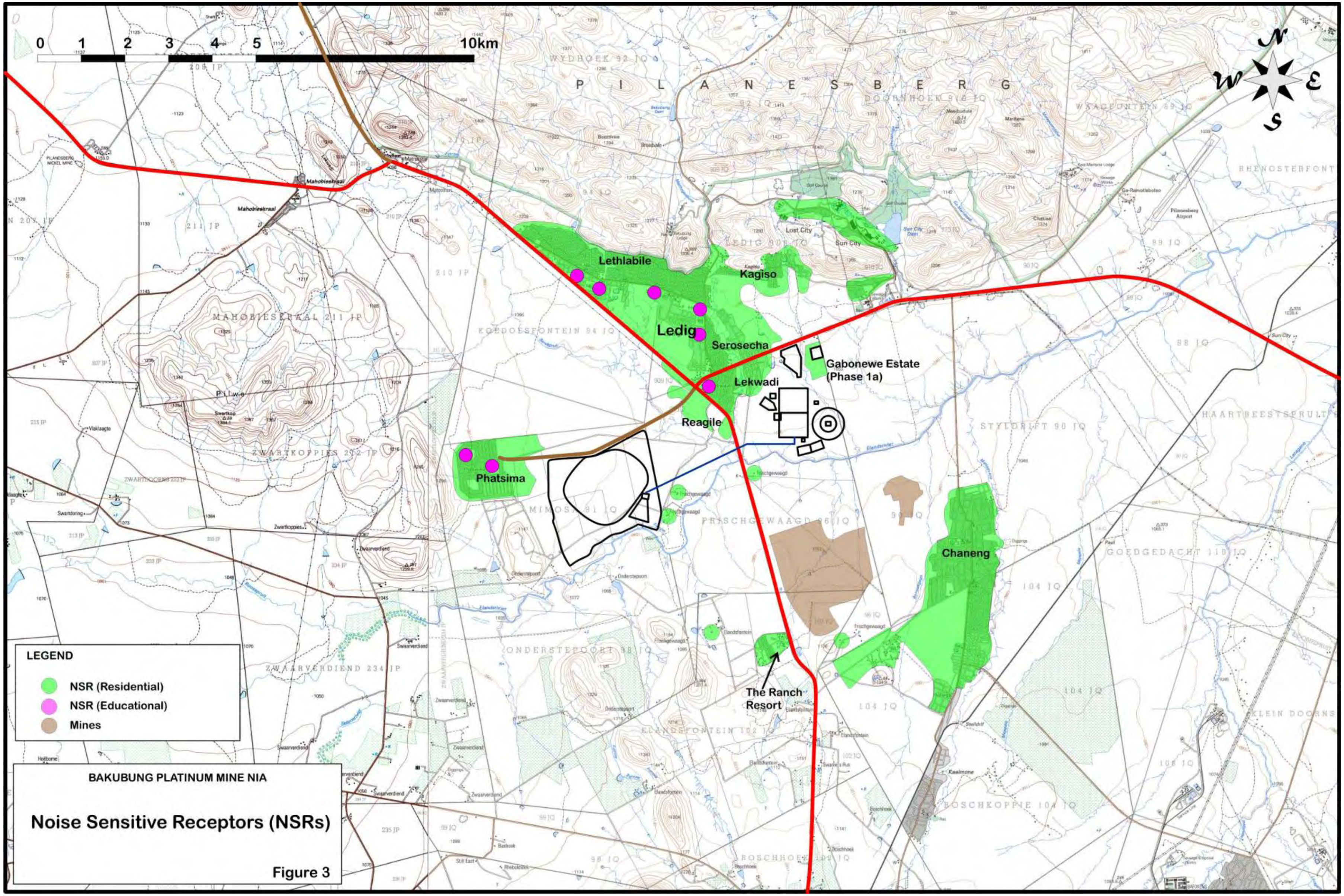
SANS 10103 indicates ambient noise level should not exceed 50 dBA for daytime periods and 40 dBA for night-time periods. The residual (existing background) noise levels are relatively low (quiet) in the areas of Ledig Village that are not close to and are relatively shielded from the main roads. Daytime ambient conditions range from about 45dBA to 62dBA. Evening conditions range from about 44dBA to 54dBA. Similar conditions occur in Phatsima Village and in the Reagile informal settlement.

In general the residual noise levels in the undeveloped areas south and south-east of Lekwadi and Kagiso (east of Road R565) and areas to the south of Phatsima and Reagile (west of Road R565) are low (very quiet). The noise levels are typically representative of a rural farming area, namely where the average daytime noise levels do not exceed 45dBA and the night-time levels do not exceed 35dBA. Actual night-time noise levels fall to 30dBA and less. The noise levels at the school in the south-eastern quadrant of the intersection of Roads R556 and R565 are significantly higher than those desirable for educational facilities which should not exceed 50dBA (outdoor) and 40 dB (indoor) and which were measured at an average of 61.2dB.

Potential noise sensitive receptors

The noise sensitive receptors around the project area are shown in Figure 7-25.


BAKUBUNG PLATINUM MINE NIA
Noise Measurement Sites
Figure B1
Legend
Ambient Noise Survey Sites
S1
S2
S3
S4
S5
S6
S7
S8
S9
S10
S11
S12
S13
Google earth
Image © 2015 DigitalGlobe
© 2015 Google
© 2015 AfriGIS (Pty) Ltd.
3 km
N


0 1 2 3 4 5 10km
P I L A N E S B E R G
Lethlabile
Kagiso
Ledig
Serosecha
Gabonewe Estate
(Phase 1a)
Lekwadi
Reagile
Phatsima
Chaneng
The Ranch
Resort
LEGEND
NSR (Residential)
NSR (Educational)
Mines
BAKUBUNG PLATINUM MINE NIA
Noise Sensitive Receptors (NSRs)
Figure 3

CONCLUSION

The proposed project has the potential to contribute to disturbing noise levels within and surrounding the project area. It is however important to note that activities associated with surrounding land uses (Maseve and Styldrift mines and the Pilanesberg airport) including traffic along the R565, R556 and Phatsima Road contribute to the existing noise climate. Construction activities at BPM are also indicated by the specialist to contribute to ambient noise levels. Any further increase in ambient noise levels may influence nearby potential noise receptors. Careful planning should therefore be taken into consideration for the proposed project in order to minimise increasing disturbing noise levels.

7.4.1.10 Visual aspects

INTRODUCTION AND LINK TO ANTICIPATED IMPACT

Mining related activities have the potential to alter the landscape character of a site and surrounding area through the establishment of both temporary and permanent infrastructure. As a baseline, this section provides an understanding of the visual aspects (such as landscape character, sense of place, scenic quality, and sensitive views) of the area against which to measure potential change as a result of project infrastructure and activities.

DATA SOURCES

For the approved mine EIA, a specialist study was conducted by MetroGIS (Pty) Ltd (2007). This information has been updated by SLR for the purposes of this study.

RESULTS

<u>Landscape character</u>

The topography of the Frischgewaagd and Mimosa areas is generally flat with moderate slopes leading down to the Elands River in the southern parts. The area is characterised by semi-industrial mining-related activities, agriculture and conservation.

The natural environment within and around the mining right area has been extensively disturbed by past and current mining and agricultural activities. As such, mining activities and specifically residue facilities have become an integral part of the landscape's topographical features and character.

The landscape around the project area (within 5 km of the project area was assessed) includes mountains and ridges, river channels and undulating slopes. The major topographical feature is the Pilanesberg Mountain Range. The foothills lie approximately 1.3 km north of the plant area. The Elands River which flows south of the project area is approximately 50 m from the Frischgewaagd property border and an unnamed tributary of the Elands River flows on the eastern edge of the plant and between the Phase 1 and Phase 1a housing areas. There are various ephemeral drainage lines and channels and wetlands around the project area.

The area is characterised by transformed secondary vegetation and natural vegetation. Prior to the commencement of mining operations and fencing of the future TSF area, the areas where there is secondary vegetation experienced heavy grazing and browsing by domestic livestock and were frequently burnt which impacted the landscape characteristics. Heavy grazing and cultivation has also taken place within the ephemeral drainage line catchments (De Castro and Brits, 2016a)

Sense of place

The BPM is located within a ‘mining belt’ with various mines being located south east of the project area, east of the R565. To the north, the Pilanesberg Mountain Range dominates the skyline at an approximate height of 160 m from base to top. Isolated ridges between 80 m and 100 m occur to the south and to the east. There are also residential features in the landscape.

The fact that the project components will take place within the current BPM operations and the existence of the immediately surrounding mining activities, gives the area where project-related infrastructure is located a relatively weak sense of place (when the viewer is within the ‘mining belt’). The TSF area is further west than the ‘mining belt’ with it being west of the R565. However, seen in context with the site contained by distant hills and ridges and the Pilanesberg Mountain Range which ‘soften’ the harsh nature of the mining activities (when the viewer views the area from outside the ‘mining belt’), the larger area has a stronger sense of place.

Scenic quality / Visual resource value

The scenic quality is linked to the type of landscapes that occur within an area. The landscape quality of the study area can be divided into the following distinct categories in the local context:

- The mountains and ridges have a very high visual quality due to the steep slopes and isolated ridges that dominate the skyline.
- The river channels were rated have a high visual quality due to moderate steep slopes and trees.
- The visual quality of the undulating slopes has a medium visual quality.
- The vegetation, although mostly degraded and overgrazed, provides a visual buffer for the current landscape and is has a medium visual quality.
- The surrounding communities and industrial developments are progressively expanding and their presence decreases the overall visual quality of the area.
- Apart from the human activities, the remainder of the area is mainly covered by vegetation. These areas have moderate to steep slopes and are covered with trees in varying densities therefore giving them a visual quality rating of high
- The visual quality of the area varies between low to very high due to the diversity of land use activities. Although the visual quality of the surrounding communities is low, the views of mountains and surrounding open space creates a sense of peace. Views of site to the south and east were noted. The visual quality of the mining and associated industries on the periphery of

the project area was rated as low due to the distance from the site and the screening effects of buildings and trees. The specialist gave an average rating of medium for visual quality of the area.

Visual receptors

When viewed from the perspective of tourists and farmers within the area, mining activities could be associated with a sense of disenchantment. People who benefit from the mine and proposed project (employees, contractors, service providers etc.) may not experience this disenchantment but rather see the mine with a sense of excitement and anticipation. While some residents may see the benefit of the mine, the specialist allocated a high sensitivity as the possibility of high visual receptors within the community needed to be taken into account. Phatsima, Chaneng and Ledig were considered to be receptors with high sensitivity. The R565 and R556 are the main access roads to Sun City and are frequently travelled by tourists; these roads and Sun City are considered to have very high sensitivity. The sensitive viewers are a combination of tourists and land owners / land users on surrounding farms.

CONCLUSION

The landscape character and quality of the visual resource has been altered by various land uses including mining operations at and around BPM. Views from residential areas as well as tourism areas have been altered since the establishment of the approved mine in 2010 and will alter as the approved infrastructure development progresses. Further disturbance by the addition of the project components needs to be minimised through appropriate design and implementation of mitigation measures.

7.4.1.11 Heritage/cultural and paleontological resources

INTRODUCTION AND LINK TO ANTICIPATED IMPACT

Various natural and cultural assets collectively form the heritage. Heritage resources (cultural resources) include all human-made phenomena and intangible products that are the result of the human mind. Natural, technological or industrial features may also be part of heritage resources, as places that have made an outstanding contribution to the cultures, traditions and lifestyles of the people or groups of people of South Africa.

Mining related activities have the potential to disturb both the ground surface (through establishment of infrastructure) as well as soils and rock layers below the surface (through excavations for foundations). In this regard, heritage and palaeontological resources could be disturbed or destroyed. As a baseline, this section identifies the presence of heritage and palaeontological resources and their conservation significance.

DATA SOURCES

Information in this section was sourced from the heritage study conducted by PGS (2016; Appendix Q). A paleontological desktop study was conducted by PGS. A desktop assessment was considered adequate for this study.

RESULTS - HERITAGE

Heritage resources identified in the study area, including approved mine areas, are summarised in Table 7.28. The most important heritage resources discovered in the area were cemeteries, graves and stone cairns which might be graves according to the specialist.

Of relevance to the project components are MHC003, MHC005, MHC018, MHC019, MHC020, MHC021, MHC025, MHC026 and MHC027. Their location in relation to project components is provided in Table 7.28.

Of the identified sites, the identified graves, possible graves and cemeteries have a high significance level as graves and burial grounds have high levels of emotional, religious and historical significance. Graves and burial grounds fall under various legislative protections, depending on factors such as where the graves are located as well as their age. These sites will require careful consideration and particular mitigation to ensure the dignity of the remains are kept intact.

As part of the approved project, permits were received for the destruction/mitigation of two sites. These sites have been included below for completeness (MHC002 and MHC004).

TABLE 7.28: HERITAGE RESOURCES IDENTIFIED AT BAKUBUNG MINE (PGS, 2016)

Site	Disturbed by approved activities	Disturbed by new project components	Study footprint location	Description	Significance Level
Iron /Middle Iron Age /Early Stone Age					
MHC001	No	No	-	Iron Age site comprising an open scatter of slag and undecorated ceramics.	Low/Medium
MHC003	Yes	No	Explosives magazine	Iron Age site comprising lower grinders, hut dagga (with pole impressions) as well as ceramics.	Medium
MHC005	Yes	No	Security office	Iron Age site comprising a low concentration of undecorated ceramics.	Low
MHC012	No	No	-	Iron Age site comprising upper grinding stones as well as decorated and undecorated ceramics.	Medium
MHC013	No	No	-	Iron Age site comprising decorated and undecorated ceramics as well as upper grinding stones and hut dagga.	Medium

Site	Disturbed by approved activities	Disturbed by new project components	Study footprint location	Description	Significance Level
MHC015	No	No	-	Iron Age site comprising five circular hut structures with verandas associated with a grain bin foundation and two cooking huts. All structures from the site are marked by a single row of upright stones. Associated cultural material includes hut dagga remains and undecorated ceramics.	Medium
MHC019	No	Yes	Phase 1a housing	Iron Age site comprising a low concentration of undecorated ceramics.	Low
MHC020	No	Yes	Phase 1a housing	Iron Age site comprising decorated and undecorated ceramics, upper and lower grinding stones and hut dagga.	Medium
MHC022	No	No	-	Iron Age site comprising undecorated ceramics and a broken lower grinding stone.	Low
MHC023	No	No	-	Iron Age site comprising undecorated ceramics and a broken lower grinding stone.	Low
MHC010	No	No	-	Possible Iron Age site comprising a circular hut foundation structure associated with what appears to be a grain bin structure. Undecorated ceramics were also identified.	Medium
MHC002	Yes	No	Explosives magazine	Middle Iron Age site comprising lower grinders, hut dagga (with pole impressions), Madikwe type pottery and Early Stone Age lithics.	Medium
MHC004	Yes	Yes (changes within an approved footprint)	Concentrator area	Possible Middle Iron Age site comprising two possible grain bin stands and a low concentration of undecorated ceramics.	Low
MHC006	No	No	-	Middle Iron Age site comprising lower grinders, hut dagga (with pole impressions) as well as decorated (Madikwe) and undecorated ceramics.	Medium
MHC008	No	No	-	Middle Iron Age site comprising lower grinders, slag, a possible midden as well as decorated (Madikwe) and undecorated ceramics.	Medium
MHC018	No	Yes	Eskom/Ledig Substation	Middle Iron Age site comprising decorated (Madikwe) and undecorated ceramics, lower grinding stones and hut dagga.	Medium
MHC011	No	No	-	Possible Late Iron Age site comprising a low concentration of undecorated ceramics as well as several disturbed stone circles.	Low

Site	Disturbed by approved activities	Disturbed by new project components	Study footprint location	Description	Significance Level
Historic/recent site					
MHC009	No	No	-	Historic to Recent site comprising four rectangular stone foundation structures and one circular hut. A lower grinding stone and undecorated ceramics were also identified.	Medium
MHC027(B)	No	Yes	Return water dam	Rectangular structure which may have been a reservoir.	Low
Graves and cemeteries					
MHC007	No	No	-	Three stone cairns are located here which may be graves.	High
MHC014	No	No	-	The site comprises a single stone cairn, which might be a grave.	High
MHC016	No	No	-	The site comprises three stone cairns, which might be a grave.	High
MHC017	No	No	-	Modern cemetery consisting of approximately 90 graves was identified here.	High
MHC021	Yes	No	Phase 1 housing	The site comprises a single stone cairn, which might be a grave (this has been fenced off).	Medium
MHC024	No	No	-	An extensive modern cemetery was identified here.	High
MHC025	No	Yes	TSF pipeline route	Two possible graves, with no cultural material or formal headstones present.	Medium/High
MHC026	No	Yes	Return water dam	Three possible graves, with no cultural material or formal headstones present. However, a broken lower grinding stone was observed on the eastern end of one of the possible graves.	Medium/High
MHC027(A)	No	Yes	Return water dam	Two rectangular foundation structures of stone and brick were identified here. An associated glass bottle dates the site to the recent past (possibly the 1960s). The possibility exists for stillborn babies to be buried in unmarked graves in association with the structures.	Medium/High
MHC027(C)	No	Yes	Return water dam	A rectangular structure was identified here. Several glass fragments associated with the structure dates it to the recent past. The possibility exists for stillborn babies to be buried in unmarked graves in association with the structure.	Medium/High

Site	Disturbed by approved activities	Disturbed by new project components	Study footprint location	Description	Significance Level
MHC027(D)	No	Yes	Return water dam	A rectangular stone foundation structure was identified here. Several glass fragments associated with the structure dates it to the recent past. The possibility exists for stillborn babies to be buried in unmarked graves in association with the structure.	Medium/High
MHC027(E)	No	Yes	Return water dam	Three possible graves, with no cultural material or formal headstones present.	Medium/High
MHC027(F)	No	Yes	Return water dam	A rectangular stone foundation structure was identified here. The possibility exists for stillborn babies to be buried in unmarked graves in association with the structure.	Medium/High
MHC027(G)	No	Yes	Return water dam	A rectangular stone foundation structure was identified here. The possibility exists for stillborn babies to be buried in unmarked graves in association with the structure.	Medium/High

RESULTS – PALAEONTOLOGICAL RESOURCES

The study area was found to be within a grey area on the Palaeontological Sensitivity Map of South Africa indicating that the area has no significant/zero palaeontological significance. Therefore, no desktop study was required.

Conclusion

Heritage resources of high significance have been identified within the study area and will be affected by approved and new infrastructure.

Resources of medium/high significance (graves and cemeteries) occur within the return dam area, the TSF pipeline route and the Phase 1 housing area (fenced off). These sites are important in terms of emotional, religious and historical significance and are protected by national legislation. Any disturbance of these sites requires the necessary permits and further assessment work.

Although no paleontological resources are expected within the study area, these resources are protected by national legislation and must be reported to the South African Heritage Resources Agency (SAHRA) should they be identified on-site.

7.4.1.12 Road and Traffic Conditions

INTRODUCTION AND LINK TO ANTICIPATED IMPACT

Traffic from mining developments has the potential to affect the capacity of existing road networks as well as result in noise, air quality and public road safety issues. This section provides an overview of the current road network, conditions and road use. Understanding the layout, use and conditions of transport systems relevant to the proposed project site provides a basis for understanding a change as a result of project contributions.

DATA SOURCES

The information for this section was sourced from the traffic impact assessment conducted by WSP Group Africa (Pty) Ltd (WSP 2016; Appendix O). A separate traffic impact assessment (TIA) was conducted for the Gabonewe Estate housing (Mott MacDonald, 2014 and 2015 (2015 was an addendum to 2014)). The WSP assessment took this assessment into consideration as part of their reporting.

The study comprised sourcing relevant data from a site inspection of the existing road network, traffic counts, calculations and reference to relevant traffic impact assessment guideline documents.

RESULTS

The Bakubung Mine is located south of the R556 on both sides of the R565. Access to the mine is and will remain approximately 1.5km south of the intersection of the R565 and R556. Currently access to the TSF is approximately 1.5km south of the mine access to the west of the R565 (Figure 7-26)

The access to the mine has already been constructed as a T-junction with priority stop control on the access road. Short turning lanes have been provided for both left and right turn movements into the mine. A short acceleration lane has also been provided for vehicles exiting the mine in the southbound direction.

A schematic diagram of the existing intersection and number of lanes for each road is shown below in Figure 7-27. The Gabonewe TIA suggested that the road be upgraded to add an additional approach lane to the north-eastern approach, separating the through and right turning movements (shown in red in Figure 7-28). The speed limit of the R556 varies between 60km/h and 120km/h along the section east of its intersection with the R565. The speed limit at the intersection is indicated as 60km/h.

The average traffic volumes conducted along the R565 are shown in Table 7.29. Peak-hour traffic counts (AM – 06:00-07:00 and PM – 17:00-18:00), between Ledig and the mine access are shown in

Table 7.30. The peak-hour traffic flow at the relevant intersections shows a general increase in traffic volumes during the evening (PM) peak period. An annual growth rate of 3% was assumed for background traffic.

TABLE 7.29: AVERAGE TRAFFIC VOLUMES ALONG THE R565 (WSP, 2016)

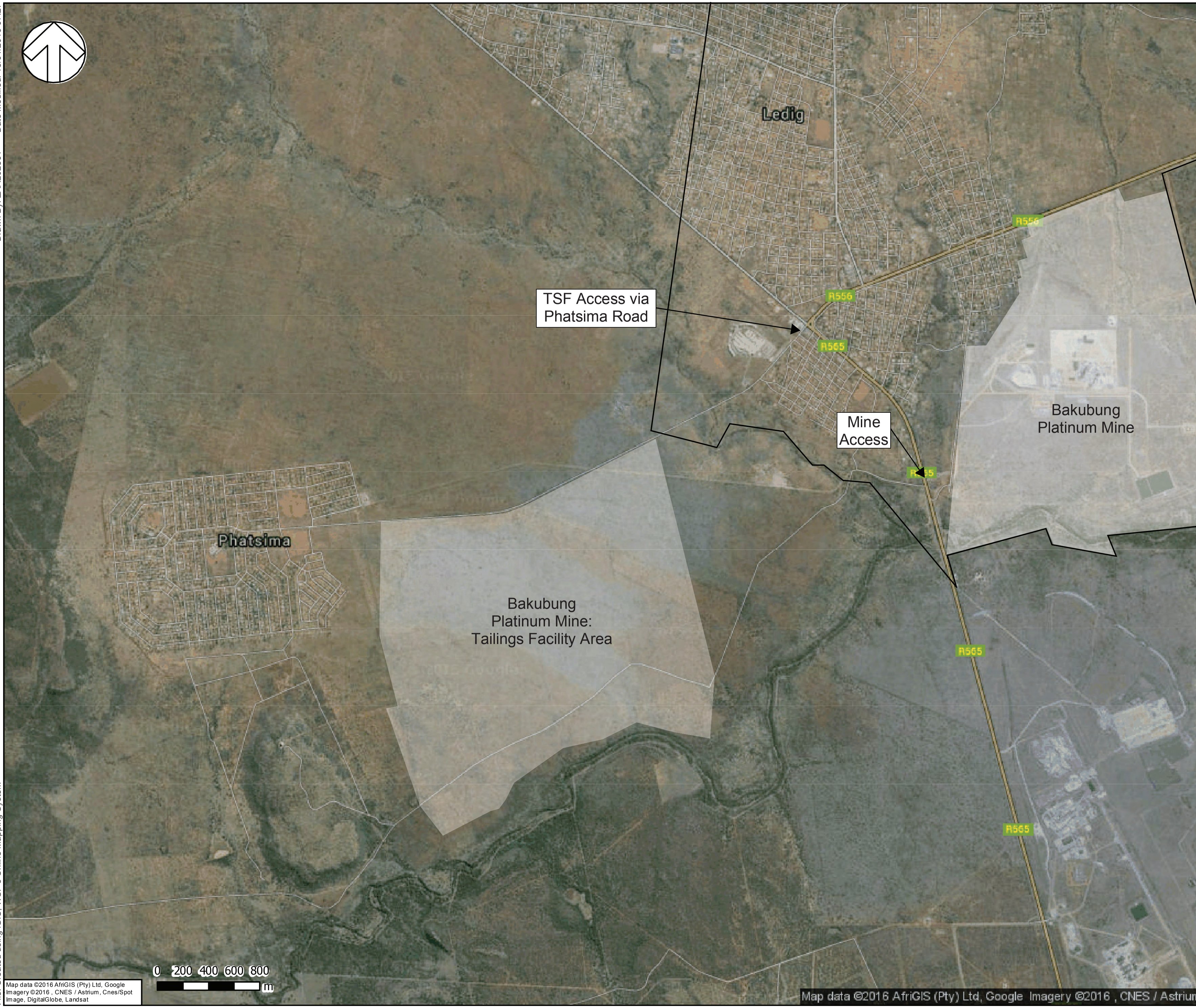
Vehicle Classification	Northbound	South Bound	Both Direction
Light	3521	3349	6870
Heavy	319	469	785
All	3837	3718	7654

TABLE 7.30: PEAK TRAFFIC VOLUMES FOR THE 565 AND ACCESS INTERSECTION AND THE R565 AND R556 INTERSECTION (WSP, 2016)

Intersection	AM peak		PM peak	
	Time interval	Number of vehicles	Time interval	Number of vehicles
R565 and Access	06:00 – 07:00	569	17:00 – 18:00	714
R565 and R556	06:00 – 07:00	680	17:00 – 18:00	896

The TIA indicated that the level of service (LOS) of the existing road network for AM peak hours ranged between reasonably free flow (LOS B) and approaching unstable flow (LOS D). For the PM peak hours the level of service ranged between reasonably free flow to unstable flow (LOS E) (LOS E was for two of the turning lanes). LOS A represents the best operating conditions and LOS F represents the worst. With the proposed project, the LOS levels for the two turning lanes that are currently LOS E, become LOS F which is forced/breakdown of flow. The LOS during peak hours can be decreased with the introduction of a roundabout improving the LOS to LOS A and LOS B.
It should be noted that the LOS of the roads will be LOS F even without the mine, though the mine will contribute to the lowered LOS.

In terms of road condition, both the R556 and the R565 appear to be generally in a good condition and evidence of maintenance measures were observed, especially along the R556.



WSP | PARSONS BRINCKERHOFF

TITLE:

Bakubung Platinum Mine

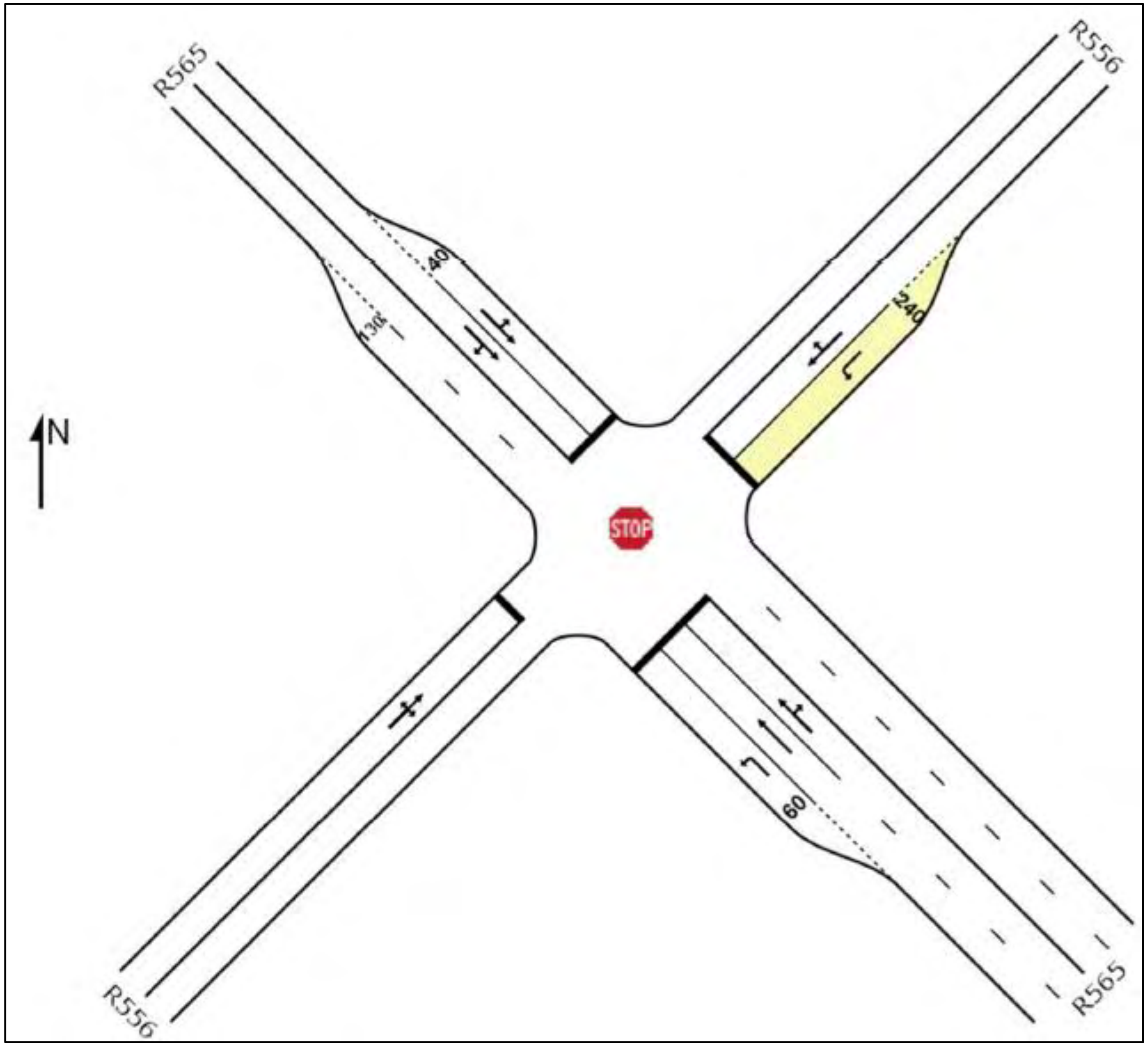
FIGURE No:

Map 1 - Locality Plan

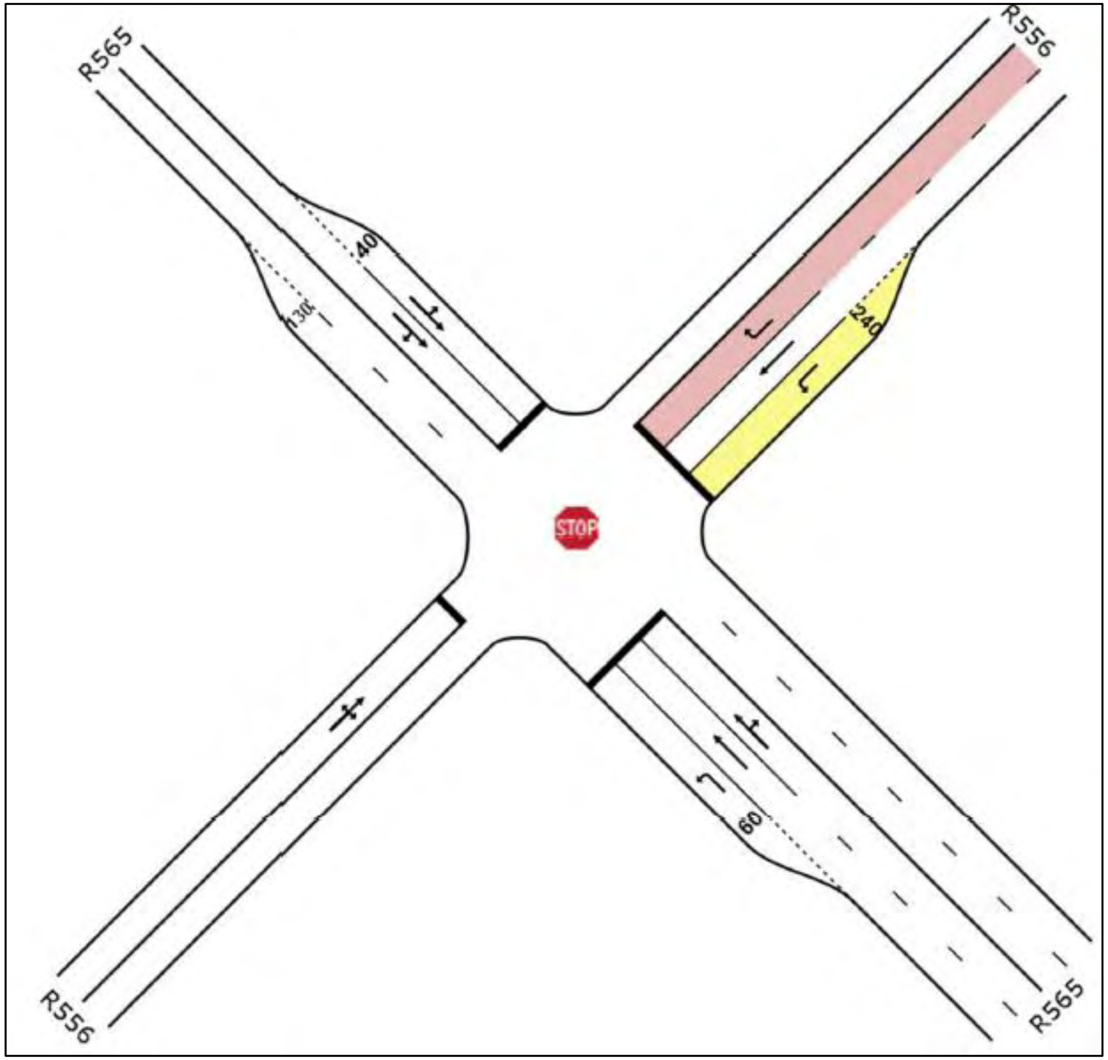
Date Modified: 18/01/2016 07:27

Drawn By: ZAAL02864

File: Created using iGIS, WSP's Online Mapping System



R565
R556
N
40
130
240
STOP
60
R556
R565


R565
R556
40
130
240
STOP
60
R556
R565

CONCLUSION

With the current traffic volumes and level of service, improvements to the road network need to be considered for the proposed project. The Gabonewe TIA recommended that the intersection be upgraded to add an additional approach lane to the north-eastern approach, separating the through and right turning movements. There is a further recommendation to convert the intersection into a roundabout improving the LOS of the intersection.

7.4.1.13 Socio-economic

INTRODUCTION AND LINK TO ANTICIPATED IMPACT

Mines have the potential to result in both positive and negative socio-economic impacts. The positive impacts are usually economic in nature with mines contributing directly towards employment, procurement, skills development and taxes on a local, regional and national scale. In addition, mines indirectly contribute to economic growth in the local and regional economies because the increase in the number of income earning people has a multiplying effect on the trade of other goods and services in other sectors.

The negative impacts can be both social and economic in nature. In this regard, mines can cause:
Influx of people seeking job opportunities which can lead to increased pressure on basic infrastructure and services (housing, health, sanitation and education), informal settlement development, increased crime, introduction of diseases and disruption to the existing social structures within communities
A change to not only pre-existing land uses, but also the associated social structure and meaning associated with these land uses and way of life. This is particularly relevant in the closure phase when the economic support provided by mines ends, the natural resources that were available to the pre-mining society are reduced, and the social structure that has been transformed to deal with the threats and opportunities associated with mining finds it difficult to readapt.

DATA SOURCES

The information for this section was sourced from the socio-economic impact assessment that was conducted for this project by Kerryn Desai (2016; Appendix P) and the approved EIA and BAR.

RESULTS

Governance

There is a dual system of governance in the Province, the political and traditional structure of governance. The project area falls within the jurisdiction of the Rustenburg and Moses Kotane local municipalities (RLM and MKLM respectively) of the Bojanala District Municipality (BDM). The TSF area falls within the RLM and the Plant area falls within the MKLM. The people living in the project area, most specifically Ledig, are the Bakubung-Ba-Ratheo. The leadership structure of the Bakubung-Ba-Ratheo consists of the Royal Family, Heads of Clans and the Traditional Council.

Population

In 2011 the population of the BDM was 1 507 505 with a growth rate of ~2.4% per annum. The RLM has the largest population in the district with approximately 46% of the district's population, with the MKLM having approximately 21%.

The population density is highest in RLM with 161 persons/km^2, with MKLM having only 42 persons/km^2. The lower density in MKLM can be attributed to the area being predominantly rural in nature with land primarily being managed via communal land tenure, with 92% of the settlements being located on tribal/ traditional land. In RLM only 30% are located on tribal land with 68% of settlements being located in urban areas.

The Project area has a young population, with RLM having the higher working-age population between 15 and 64 (Table 7.31).

TABLE 7.31: AGE COMPOSITION OF THE PROJECT AREA

Age	BDM	MKLM	RLM
0-14	26%	29%	24%
15-64	68%	63%	73%
65+	5%	8%	3%

The dominant language in the MKLM is Setswana followed by isiZulu, isiXhosa and English. In the RLM the dominant language is Setswana followed by Afrikaans, isiXhosa and Tsonga.

Basic services

Health

Health care services are available at a community level as well as in the local municipality centres i.e. Madikwe and Rustenburg. The Provincial hospital is located in the capital, Mahikeng. There are local clinics also available located in Ledig and Phatsima and despite the low standards and lack of adequate resources, approximately 70% (of respondents of a 2007 survey) make use of the local clinics with only 6% going to the provincial hospital.

Infrastructure and services

Households in the BDM seem to lack access to most basic infrastructure, most notably water and flush toilets. Table 7.32 below shows household access to basic infrastructure and services for the BDM, MKLM and RLM.

TABLE 7.32: HOUSEHOLD ACCESS TO BASIC INFRASTRUCTURE AND SERVICES

Services / Infrastructure	BDM	MKLM	RLM
Formal housing	69%	78%	69%
Water inside dwelling and < 200m from house	79%	81%	84%
No access to piped water	8%	7%	6%
Electricity for lighting	84%	83%	91%
Flush toilets	33%	12%	53%
Weekly refuse removal	49%	81%	70%

The 2008 SIA indicated that in the local communities, nearly 6% of households in Phatsima have access to water inside their homes and the remaining 94% had access to water in their yards. In Ledig, nearly 6% of the households have no access to water, approximately 58% have water available in their yards, approximately 23% have taps in their homes and approximately 10% have both hot and cold taps in their homes. In Ledig, half the households reported that water supply is unreliable and generally problematic, while nearly 85% reported that the quality is good.

In the local areas, 11% of respondents had flush toilets; the majority of households have pit latrines. In Ledig, 87% of households use pit latrines.

Electricity is used for cooking, lighting and heating. Paraffin, gas, wood and candles are used as alternate fuel sources. In Ledig, nearly all households (approximately 96%) make use of electricity for cooking. Electricity supply is considered to be poor by over 50% of the population.

<u>Education</u>

Between 2006 and 2010 the level of education and literacy increased in the BDM with the functional literacy rate being approximately 74% in 2010. Approximately half of the adult population in the BDM have completed some secondary schooling, including grade 12. The RLM has the highest functional literacy in the DBM (78%) and generally has higher levels of education than the MKLM. In RLM, approximately 67% of the population have some secondary education and/ or have completed Grade 12, compared to 62% in MKLM. Only 9% and 5% of the population have completed a higher education in the RLM and MKLM respectively. The differences in literacy rates of the two Local Municipalities may be attributed to their respective levels of urbanisation and employment opportunities.

<u>Economic profile</u>

Sector services

In 2013 the regional gross domestic product (GDP) of the North West Province (NWP) equated to over 5% of the national economy. The GDP growth rate for the province was lower at 1.6% when compared to the national growth rate of 1.9%.

The major provincial export products are gold, diamonds, platinum and other metals and minerals, machinery and equipment. Mining is a primary sector driving the economy contributing over 30% to the economy in 2010. NWP's mining contributed approximately 16% to the mining GDP in South Africa. The Province contributes 50% of the world's platinum, as well as gold, diamonds, chrome, vanadium, granite, slate, limestone, dimension stone, nickel, silica, manganese, fluorspar, zinc and andulasite. Therefore, the economic, social and physical characteristics of the greater project area, which includes the BDM, are largely determined by the dominant mining sector.

The project area is located in the Bushveld Complex which is one of the most heavily mineralised areas in the world, with the largest platinum producing mines in the world. In 2011, the 95 mines in the NWP accounted for 25% of the provincial employment. Following mining, community services, trade, finance and transport were the next most economically dominant sectors, which were boosted by mining sector activities. While not necessarily being the highest revenue contributors, agriculture, manufacturing, tourism, services and green economy also play an important role in the local economy.

Employment levels

The unemployment rate in the NWP in 2013 was 26% with the national rate being 25.5%.

There are high levels of unemployment in the areas surrounding the project site. In the BDM the unemployment rate is approximately 31%, 38% in MKLM, and 26% in RLM. Youth unemployment is higher at 39% in BDM and 47% and 35% in MKLM and RLM, respectively. At community level, the communities of Ledig and Phatsima offer few employment opportunities. A skills audit conducted by BPM in 2006 found that 42% of Ledig's economically active population are unemployed.

Sector employment

The 2012-2017 IDP (2006) indicated that at district level the largest employer is the mining sector accounting for 43% followed by trade at 15.4%, community services at 13.6% and manufacturing at 6.1%. Of the employed population, males are the most dominant with 97% and only 3% being females, with the exception of people employed in private households and community sector jobs.

At a community level, in Ledig and Phatsima, the tourism and hospitality industry is the primary employer (approximately 43%); Sun City provides approximately 80% of all hospitality industry and tourism jobs in the communities. Construction and mining are the next largest sources of employment at 9% and 8%, respectively.

CONCLUSION

When considering the socio-economic environment the statistical data reflects a community where there is unemployment, pressure on basic infrastructure and services and pressure on delivery of basic services. The project has the potential to impact on these either positively or negatively although the amended activities will not be as significant as the approved mine. The aim of any project should be to enhance these positives and minimise the potential negatives.

7.4.1.14 Current land uses

INTRODUCTION AND LINK TO ANTICIPATED IMPACT

Mining projects have the potential to influence current land uses both on the site (through loss) and in the surrounding areas (through direct or secondary positive and/or negative impacts). As a baseline, this section outlines pre-mining land uses, land tenure including surface and prospecting/mining rights (both on the site and in the surrounding area), describes the land uses on site and in the surrounding area, and identifies third party service infrastructure. This section provides the context within which potential impacts on land uses and existing economic activity will be felt.

DATA SOURCES

The information for this section was sourced from approved EIA and EMP as well as specialist studies including the social impact assessment (Desai, 2016) and the heritage impact assessment (PGS, 2016).

RESULTS – SURFACE RIGHTS

Properties within the mining rights area are owned by the mine and a number of individuals/entities (Table 7.33). The project components will be located within the existing mining rights area. For project areas where there will be project infrastructure, the property is owned by either Wesizwe (TSF area) or the *Bakubung-Ba-Ratheo Tribe* (Plant and pipeline area). BPM has a lease for the plant area owned by the *Bakubung-Ba-Ratheo* Tribe and has permission to utilise the area where the pipeline is to be located.

TABLE 7.33: SURFACE RIGHTS OF PROPERTIES AFFECTED BY THE PROPOSED PROJECT

Note: This table does not represent all interested and/or affected parties (IAPs) registered on the IAP database but gives an indication of land ownership within the mining rights area.

Farm Name	Farm Portion Number	Owner	Title Deed Number
Frischgewaagd 96 JQ	R/E Portion 1	Jacobus Paulus Voessee	D/T4996/1906
	Portion 3	RSA President in Trust for Bakubung Tribe	D/T36887/64
	Portion 4	RSA President in Trust for Bakubung Tribe	D/T362/84
	Portion 11	RSA President in Trust for Bakubung Tribe	D/T362/84
Ledig 909 JQ	Consolidated farm Ledig (Comprising the former Portions 1, 2, 3, 4, 5, & 6)	RSA President in Trust for Bakubung Tribe	D/T94/1981
	Portion 3	RSA National Government	D/T41635/04
	Portion 4	RSA National Government	D/T41635/04
	Portion 6	Provincial Government of North West Province	D/T41636/04
	Portion 7	RSA National Government	D/T41637/04
Mimosa 81 JQ	Portion of the Remainder	Wesizwe Platinum Limited	D/T161187/03

RESULTS - RIGHT TO MINE

Bakubung Minerals (Pty) Ltd hold the mineral rights. In terms of the mineral right, two reefs will be mined for Platinum Group Elements - platinum, palladium, rhodium and gold, with copper and nickel as by-products. The current project caters to also include waste rock as aggregate into the mineral right as it may potentially be crushed and sold.

RESULTS – LAND USES

Prior to BPM, land use in the area was a mixture of predominantly grazing (non-commercial cattle farming), industrial/commercial (hydroponics farming and a glass recycling plant), residential, cemeteries and sporting grounds. Communal grazing land is a scarcity in this area already, due to the surrounding land owners using their farms for other activities like township development, mining, game farming, etc. (TWP, 2008). The surrounding area also included mining, tourism, horticulture (on private property for private consumption), livestock (on private property or communal lands for personal consumption), and limited commercial and industrial developments (TWP, 2008). Similar land uses still take place adjacent to the mine infrastructure and activity areas. These are discussed further below.

Residential, agricultural and tourism

Residential land use i.e. formal, informal and farmsteads is one of the main land uses near the mine. Communities and community structures include:

- Private land owners/residents
- Ledig Village
- Phatsima Village
- Chaneng Village
- Reagile informal settlement
- Surrounding grazing areas (including Mimosa where BPM is allowing grazing on their property until such time that the TSF is constructed).

Areas of tourism interest include:

- Sun City
- The Pilanesberg National Park

Mining/Industry

Locally there are several mining and mining related activities occurring in the surrounding areas, these include, but are not limited to:

- Platinum Group Metals' and Wesizwe's Maseve Mine, 1.7 km south of BPM
- Royal Bafokeng Platinum's and Anglo Platinum's Styldrift Mine, 1.6 km south east of BPM
- Glencore Xstrata/Merafe Boshoek Smelter, 10 km south of BPM
- Royal Bafokeng Platinum's and Anglo Platinum's Bafokeng Rasimone Platinum Mine, 7.3 km south of BPM
- Impala's Platinum's Shafts
    - Shaft 6, 12.9 south east of BPM
    - Shaft 8, 11.4 km south east of BPM
    - Shaft 12N, 9.9 km south east of BPM
    - Shaft 20, 7.5 south east

Secondary support services/facilities

Infrastructure present in the area is directly linked to the type of land uses occurring in the area as described above. Support infrastructure and facilities identified in the area include:

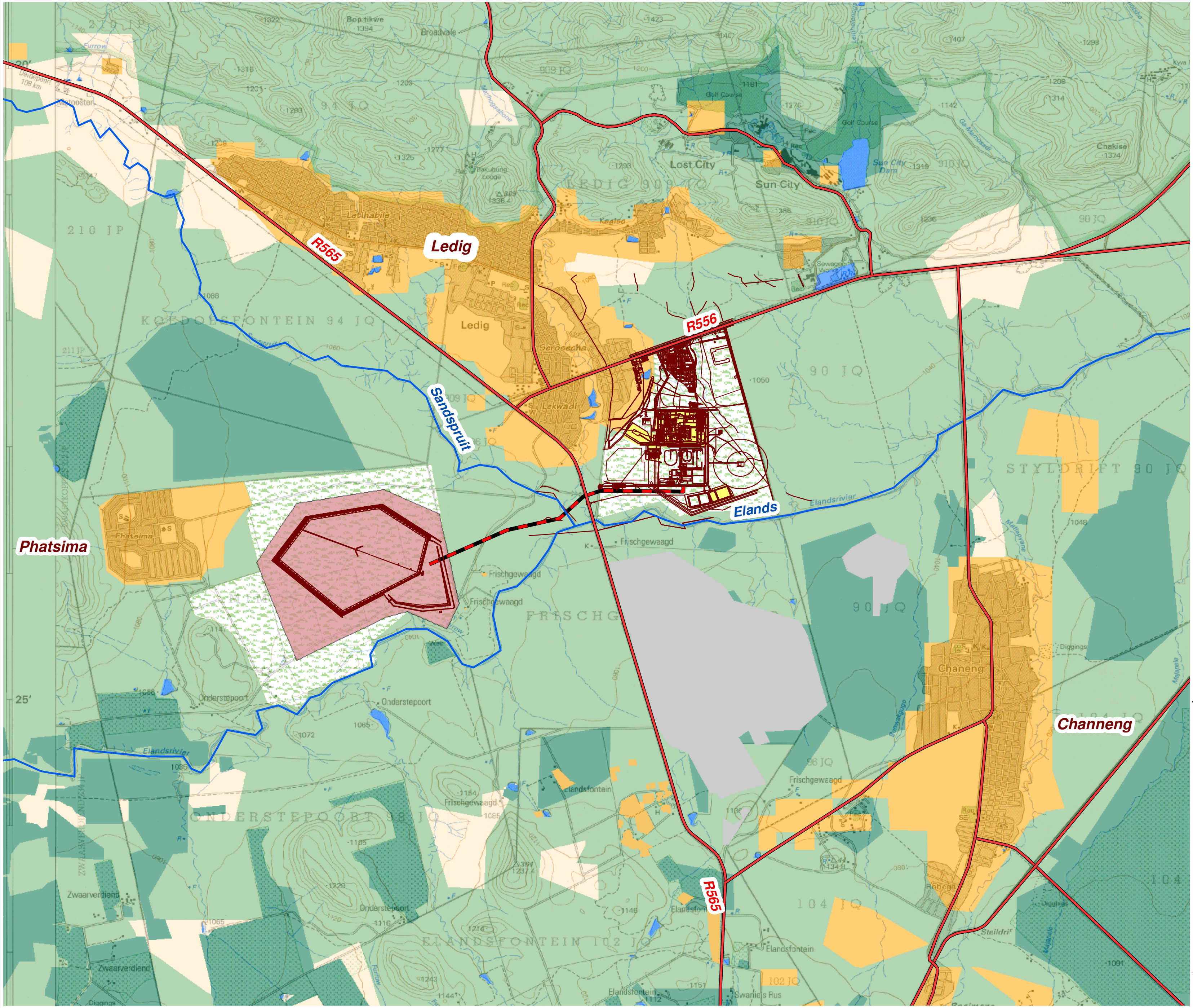
- Road network: A network of roads exists in and around BPM, these include:
- R556 – the road linking Ledig to Sun City linking to the N4 at Moddersspruit
- R565 – the road linking Ledig to Rustenburg

- Railway: There is a railway network passing near Chaneng running in a north east – south west direction
- Villages: Within the towns and villages, there are varying degrees of infrastructure and service provision e.g. schools, clinics, businesses.
- Airport: The Pilanesberg airport is 8.9 km north east of the BPM.
- Power supply and communication: Two 88kV power lines and associated ESKOM servitude supply the mine. Powerlines also cross over the south western corner of the plant area crossing over the R565 running south east / north west towards Ledig. Powerline and telephone lines service the residential and tourism areas in the surrounding area.
- Cemeteries: Two modern cemeteries are located around the project area. One is located west of the existing soil noise berm on Frischgewaagd and the other is located on Mimosa north west of the proposed TSF, neither of these fall within project footprints. Additional possible cemeteries may also exist around the project area (PGS, 2016; refer to the Heritage baseline in Section 7.4.1.11)

CONCLUSION

Through the development of the approved mine, land within the mining footprint has started to change from being predominantly grazing, to mining. The TSF area is still being used for grazing until such time that the TSF is constructed. While much of the plant area still needs to be developed that area is no longer available for grazing or alternative land uses.

Land surrounding BPM is mostly used for mining operations, residential, grazing and tourism. Land within the project footprints ranges from developed, to agricultural which has a combination of secondary or transformed vegetation and natural vegetation. The residential areas surrounding the mine include villages of varying scales including clinics and schools. There is the potential for these land uses to be impacted to varying degrees by changes to the mine's approved infrastructure and operations. As some of these land uses contribute to the economy of the region together with mineral-related activities, care should be taken when planning the project to limit impacts on these land uses. Third party service infrastructure does exist and care needs to be taken to avoid and/or manage these appropriately.



Legend

- Roads
- Rivers
- Mine Layout
- Proposed Pipeline

Land Use

- Already Developed Mining Infrastructure
- Mining/Industry
- Grazing Earmarked for Mining Purposes
- Built-Up /Residential Areas
- Cultivation
- Grazing Land
- Natural and Secondary Vegetation
- Waterbodies
- Degraded Land

Data Source:
South African National Biodiversity Institute (SANBI) 2012, Specialist Input and Satellite Imagery

Kilometers
0 2 4

Scale: 1:60 000 @ A4

SA Grid WGS84

BAKUBUNG PLATINUM MINE (PTY) LTD

Figure 7.29

Land Use

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7.5 ENVIRONMENTAL IMPACTS AND RISKS OF THE ALTERNATIVES

This section provides a list of potential impacts on environmental and socio-economic aspects that have been identified in respect of each of the main project actions / activities and processes as described in the initial site layout. A discussion of the negative and positive impacts of the project alternatives is provided in Section 7-1 and Section 7.7. The ratings for consequence, probability and significance of each of the impacts in the **unmitigated scenario** (which assumes that no consideration is given to the prevention or reduction of environmental and social impacts) are also provided in the table below in accordance with the new DMR report template.

TABLE 7.34: LIST OF IMPACTS IDENTIFIED FOR THE PROPOSED PROJECT INCLUDING ALTERNATIVES

The assessment ratings provided in this table are for the unmitigated scenario only which assumes that no consideration is given to the prevention or reduction of environmental and social impacts. Alternative 2 is the re-aligning infrastructure, however this represents a mitigation scenario and thus ratings are kept the same for both Alternative 1 and 2 for the unmitigated scenario.

Potential impact	Activity	Alternative	Project phases	Consequence			Probability	Significance	Degree to which impact		
				Severity	Duration	Spatial scale			Can be reversed	Causes irreplaceable loss of resources	Can be avoided/ Managed/ Mitigated
Additional mineral resource	Waste rock management	1 & 2	Construction Operation Decommissioning Closure	L	M	H	M	M	Fully	Possible	Can be fully managed/mitigated
Hazardous excavations, surface subsidence and infrastructure that can be harmful to people and animals	Site preparation Civil works Earthworks Waste rock management Mining and mining related activities Tailings management Demolition Rehabilitation Maintenance and aftercare	1 & 2	Construction Operation Decommissioning Closure	H	H	M	H	H	Fully (plant and pipeline areas) No (TSF)	Possible	Can be managed/mitigated to acceptable levels
Loss of soil resources and land capability through contamination	Site preparation Earthworks Waste rock management Transport systems Tailings management Housing Process and storm water management Sewage sludge management Demolition Rehabilitation Maintenance and aftercare	1 & 2	Construction Operation Decommissioning Closure	H	H	H	H	H	No	Definite	Can be avoided and managed/mitigated to acceptable levels

Potential impact	Activity	Alternative	Project phases	Consequence			Probability	Significance	Degree to which impact		
				Severity	Duration	Spatial scale			Can be reversed	Causes irreplaceable loss of resources	Can be avoided/ Managed/ Mitigated
Loss of soil resources and land capability through physical disturbance	Site preparation Earthworks Waste rock management Transport systems Tailings management Housing Demolition Rehabilitation Maintenance and aftercare	1 & 2	Construction Operation Decommissioning Closure	H	H	M	H	H	Partially	Unlikely	Can be managed/mitigated to acceptable levels
Physical destruction of biodiversity	Site preparation Civil works Earthworks Tailings management Waste rock management Transport systems Housing Process and storm water management Sewage sludge management Site/contract management Demolition Rehabilitation Maintenance and aftercare	1 & 2	Construction Operation Decommissioning Closure	H	H	M	H	H	Partially	Definite (vegetation/ habitat type) Potential (other aspects)	Can be managed/mitigated to acceptable levels
General disturbance of biodiversity	Site preparation Civil works Earthworks Tailings management Waste rock management Transport systems Housing Process and storm water management	1 & 2	Construction Operation Decommissioning Closure	H	H	M	H	H	Partially	Unlikely	Can be managed/mitigated to acceptable levels

Potential impact	Activity	Alternative	Project phases	Consequence			Probability	Significance	Degree to which impact		
				Severity	Duration	Spatial scale			Can be reversed	Causes irreplaceable loss of resources	Can be avoided/ Managed/ Mitigated
	Sewage sludge management Site/contract management Demolition Rehabilitation Maintenance and aftercare										
Contamination of surface water resources	Site preparation Civil works Earthworks Transport systems Mining and mining related activities Waste rock management Tailings management Process and storm water management Site support services General and hazardous waste management Sewage sludge management Site support services Demolition Rehabilitation Maintenance and aftercare	1 & 2	Construction Operation Decommissioning Closure	H	H	M	H	H	No	Possible	Can be managed/mitigated to acceptable levels
Alteration of surface water drainage patterns	Site preparation Civil works Earthworks Transport systems Waste rock management Tailings management Process and storm water management Demolition	1 & 2	Construction Operation Decommissioning Closure	H	H	M	H	H	No (TSF) Partially (plant and pipeline areas)	Possible	Can be managed/mitigated to acceptable levels

Potential impact	Activity	Alternative	Project phases	Consequence			Probability	Significance	Degree to which impact		
				Severity	Duration	Spatial scale			Can be reversed	Causes irreplaceable loss of resources	Can be avoided/ Managed/ Mitigated
	Rehabilitation Maintenance and aftercare										
Contamination of groundwater resources	Site preparation Civil works Earthworks Transport systems Waste rock management Tailings management General and hazardous waste management Site support services Process and storm water management Demolition Rehabilitation Maintenance and aftercare	1 & 2	Construction Operation Decommissioning Closure	H	H	M	H	H	No	Possible	Can be managed/mitigated to acceptable levels
Air pollution	Site preparation Civil works Earthworks Mining and mining related activities Waste rock management Mineral processing operations Tailings management Power Supply and Use Site support services Transport systems Housing Demolition Rehabilitation Maintenance and aftercare	1 & 2	Construction Operations Decommissioning Closure	H	H	M	M	H	No	Possible	Can be managed/mitigated to acceptable levels

Potential impact	Activity	Alternative	Project phases	Consequence			Probability	Significance	Degree to which impact		
				Severity	Duration	Spatial scale			Can be reversed	Causes irreplaceable loss of resources	Can be avoided/ Managed/ Mitigated
Noise pollution	Site preparation Earthworks Civil works Tailings management Waste rock management Transport systems Mineral processing operations Mining and mining related activities Demolition Rehabilitation	1 & 2	Construction Operation Decommissioning	M	M	M	H	M	Fully	Unlikely	Can be managed/mitigated to acceptable levels
Road disturbance and traffic safety	Transport system	1 & 2	Construction Operation Decommissioning Closure	M	M	M	H	M	Fully	Unlikely	Can be mitigated to improve the service level
Negative visual impacts	Site preparation Civil works Earthworks Mining and mining related activities Waste rock management Mineral processing operations Tailings management Housing Demolition Maintenance and aftercare of final land forms and rehabilitated areas	1 & 2	Construction Operation Decommissioning Closure	H	H	M	H	H	Partially (TSF) Fully (plant and pipeline areas)	Unlikely	Can be managed/mitigated to acceptable levels
Loss of heritage, cultural and paleontological resources	Site preparation Earthworks Transport systems Housing	1 & 2	Construction Operation Decommissioning	H	H	M	H	H	No	Possible	Can be managed/mitigated to acceptable levels

Potential impact	Activity	Alternative	Project phases	Consequence			Probability	Significance	Degree to which impact		
				Severity	Duration	Spatial scale			Can be reversed	Causes irreplaceable loss of resources	Can be avoided/ Managed/ Mitigated
	Site/contract management Tailings management Demolition Rehabilitation										
Economic impact	Site preparation Civil works Earthworks Mining and mining related activities Waste rock management Mineral processing operations Tailings management Power Supply and Use Water supply and use Process and storm water management Transport systems General and hazardous waste management Sewage sludge management Site support services Housing Site/contract management Demolition Rehabilitation Maintenance and aftercare	1 & 2	Construction Operations Decommissioning Closure	M - H+	M	H	H+	H+	Fully	Possible	Can be managed/mitigated to acceptable levels
Inward migration impacts	Site preparation Civil works Earthworks Mining and mining related activities Waste rock management	1 & 2	Construction Operations Decommissioning Closure	H	H	H	M	H	Fully	Possible	Can be managed/mitigated to acceptable levels

Potential impact	Activity	Alternative	Project phases	Consequence			Probability	Significance	Degree to which impact		
				Severity	Duration	Spatial scale			Can be reversed	Causes irreplaceable loss of resources	Can be avoided/ Managed/ Mitigated
	Mineral processing operations Tailings management Power Supply and Use Water supply and use Process and storm water management Transport systems General and hazardous waste management Sewage sludge management Site support services Housing Site/contract management										
Change in land use	Construction of project components Operation of the mine Decommissioning of project components Final land forms	1 & 2	Construction Operations Decommissioning Closure	H	H	M	H	H	Partially	Possible	Can be managed/mitigated to acceptable levels

7.6 METHODOLOGY USED IN DETERMINING THE SIGNIFICANCE OF ENVIRONMENTAL IMPACTS

The method for the assessment of environmental issues is set out in the Table 7.35 below. Part A in Table 7.35 below provides a list of criteria that can be selected in order to rank the severity, duration and spatial scale of an impact. The consequence of the impact is determined by combining the selected criteria ratings allocated for severity, spatial scale and duration in part B of Table 7.35. The significance of the impact is determined in Part C of Table 7.35 whereby the consequence determined in part B is combined with the probability of the impact occurring. The interpretation of the impact significance is given in Part D.

This assessment methodology enables the assessment of environmental issues including: cumulative impacts, the severity of impacts (including the nature of impacts and the degree to which impacts may cause irreplaceable loss of resources), the extent of the impacts, the duration and reversibility of impacts, the probability of the impact occurring, and the degree to which the impacts can be mitigated. This assessment method was used to assess impacts associated with all project alternatives.

TABLE 7.35: CRITERIA FOR ASSESSING IMPACTS

PART A: DEFINITION AND CRITERIA*		
Definition of SIGNIFICANCE		**Significance = consequence x probability**
Definition of CONSEQUENCE		**Consequence is a function of severity, spatial extent and duration**
Criteria for ranking of the SEVERITY of environmental impacts	**H**	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	L+	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	M+	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	H+	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
Criteria for ranking the DURATION of impacts	**L**	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
Criteria for ranking the SPATIAL SCALE of impacts	**L**	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national
PART B: DETERMINING CONSEQUENCE		

SEVERITY = L

DURATION	Long term	**H**	**Medium**	**Medium**	**Medium**
	Medium term	**M**	**Low**	**Low**	**Medium**
	Short term	**L**	**Low**	**Low**	**Medium**

SEVERITY = M					
DURATION	Long term	**H**	Medium	**High**	**High**
	Medium term	**M**	Medium	Medium	**High**
	Short term	**L**	**Low**	Medium	Medium
SEVERITY = H					
DURATION	Long term	**H**	**High**	**High**	**High**
	Medium term	**M**	**Medium**	Medium	**High**
	Short term	**L**	**Medium**	Medium	**High**
			L	**M**	**H**
			Localised Within site boundary Site	Fairly widespread Beyond site boundary Local	Widespread Far beyond site boundary Regional/ national
			SPATIAL SCALE		
PART C: DETERMINING SIGNIFICANCE					
PROBABILITY (of exposure to impacts)	Definite/ Continuous	**H**	Medium	Medium	**High**
	Possible/ frequent	**M**	Medium	Medium	**High**
	Unlikely/ seldom	**L**	**Low**	**Low**	Medium
			L	**M**	**H**
			CONSEQUENCE		

PART D: INTERPRETATION OF SIGNIFICANCE	
Significance	**Decision guideline**
High	It would influence the decision regardless of any possible mitigation.
Medium	It should have an influence on the decision unless it is mitigated.
Low	It will not have an influence on the decision.

***H = high, M= medium and L= low and + denotes a positive impact.**

7.7 POSITIVE AND NEGATIVE IMPACTS IN TERMS OF SITE LAYOUT ALTERNATIVES

Following the assessment of the original site layout, alternative site layouts were suggested by the biodiversity specialists. This includes:

- Modify TSF footprint so as to maximise the surface area comprising Secondary vegetation and minimise the extent of Marikana Thornveld within the footprint.
  - The final layout of the TSF has a footprint that covers less Marikana Thornveld and more secondary vegetation than the footprint assessed by the specialist. This recommendation from the specialist is thus already catered for with the final TSF layout. Therefore, this aspect does not need to be assessed further as the recommendation is met.
- Re-aligning the Frischgewaagd section of the tailings and return water pipeline alignment along the recently constructed access road and reduce the width of the construction servitude in untransformed habitats.
- Shifting the product stockpiles – this was referring to the Concentrator Complex area.

  - The area where the watercourses and the Concentrator Complex overlap is the approved Concentrator Complex footprint which is not changing. The product stockpiles will be placed in the northern section of the Concentrator Complex and not overlapping with the ephemeral drainage line. This recommendation from the specialist is thus already catered for with the final positioning of the product stockpiles. Therefore this aspect does not need to be assessed further as the recommendation is met.
- Modify the return water dam footprint by shifting it to the north and west so that it is situated outside of the recommended buffer zone for the biological corridor along the Elands River and so as to avoid overlap between watercourses, as well as the 32 m and 100 m buffers as far as possible.
- Modify PCD footprint by shifting it approximately 50 m to the north-west so as avoid a small patch of 'Stony grassland' and situate it outside of the recommended buffer zone for the biological corridor along the Elands River.
- Modify Phase 1 Mine housing footprint to so as to avoid overlap between watercourses, as well as the 32 m and 100 m buffers as far as possible.
  - The final layout of the Phase 1 Mine housing is slightly further north than the layout in the wetland specialist's assessment. The Phase 1 Mine housing is thus not overlapping with the watercourse. Therefore, this aspect does not need to be assessed further as the recommendation is met.
- Modify Phase 1a Mine housing footprint to so as to avoid overlap between watercourses, as well as the 32 m and 100 m buffers as far as possible.
- Modify the solar plant layout to reduce the extent of infrastructure in the high biodiversity conservation value and status areas: Mixed Woodland/Thicket and *Acacia mellifera* Bushland/ Thicket.

PCD and return water dam alternative consideration

- Shifting the return water dam is not feasible as the position of the dam is located at the lowest topographical point to ensure appropriate collection of potential seepage from the TSF and has been optimised for engineering purposes. The applicant has indicated that the TSF location has also already been shifted as far as possible to the west to be further away from the Phatsima community to decrease the noise and air pollution impacts. Therefore, Option 1 is the only feasible option. This alternative has therefore not been considered further.
- The PCD layout is within a footprint that was already approved for a dirty water containment area and thus there is no new impact. The PCD is located at the lowest topographical point to ensure appropriate collection of dirty water from the shaft and concentrator complex areas and has been optimised for engineering purposes. In addition, there are existing powerlines north and west of the approved location of the PCD restricting any significant movement. This alternative has therefore not been considered further.

A basic alternative selection matrix was compiled in order to provide a discussion in terms of the advantages and disadvantages of the site layout options. Table 7.36 presents the results of the related high level selection matrix process. The ranking system is a simple two score relative ranking system. For each criterion, a score of one is allocated to the best option and a score of two to the worst. The option with the lowest total score is the preferred option. Option 1 is the original layout and Option 2 is the suggested alternatives as provided by the biodiversity specialists. The tailings and return water pipeline, the Phase 1a housing and the solar plant have been assessed separately.

TABLE 7.36: POSITIVE AND NEGATIVE IMPACTS ASSOCIATED WITH SITE LAYOUT ALTERNATIVES

Criteria	Relative ranking		Advantages and disadvantages
	Option 1	Option 2	
Biodiversity (terrestrial and aquatic fauna, flora)	2	1	**Pipeline:** The pipeline route in Option 1 is located in Marikana Thornveld and crosses over rocky outcrop vegetation. The pipeline route in Option 2 also falls within Marikana Thornveld but does not cross over rocky outcrop vegetation. The vegetation specialist highlighted that this option will be along a recently constructed access route and will thus decrease the width of the construction servitude in untransformed habitats. The rocky outcrop is entirely restricted to a single outcrop and is considered to have high botanical diversity. The pipeline route in Option 1 is also located within the 32 m buffer of an ephemeral channel and an ephemeral drainage line thus the associated habitat. Neither route option avoids the ephemeral drainage line but Option 2 moves the pipeline outside of this buffer area of the ephemeral channel. Based on the above, Option 2 is preferred.
Heritage resources	1	2	**Pipeline:** When considering Option 2 for the pipeline route, a heritage site of low significance was identified near the access road route in 2007 but during the 2015 site assessment, there was no evidence of the site observed. The reason for this is unknown. The original extent of this site was no possible to judge in 2007.The site included dense scatter of undecorated ceramics, a lack of visible archaeological deposit and little evidence for Iron Age settlement. The heritage specialist indicated that this site is of low heritage significance and following mitigation it can be destroyed. No additional identified heritage resources are expected to be affected by the proposed pipeline route alternative. Since the extent of the heritage resource identified in 2007 was not known, it would be conservative to assume there could be a larger extent than observed; the Option 1 for the pipeline route is therefore preferred. However, since this site can be destroyed Option 2 is not considered undesirable.
Soils and land capability	2	1	**Pipeline:** Along the pipeline route in Option 1, Sepane soil was identified. The Sepane soil covering less than 0.1 ha was within a wetland system and is not suitable for crop production, but is considered to have high sensitivity. Option 2 for the pipeline, shifts the pipeline away from the Sepane soil. Route option 2 is therefore the preferred option. Based on the above, Option 2 is preferred.
Ground water regime and impacts on downstream users	1	1	**Pipeline:** Both site layout options are underlain by two aquifers, an upper weathered aquifer and a lower fractured aquifer. The proposed minor shifts of Option 2 are unlikely to change groundwater regimes. It follows that there are no disadvantages or advantages with either site option when compared together.
Proximity to surface water resources	2	1	**Pipeline**: The pipeline route in Option 1 is also located within the 32 m buffer of an ephemeral channel and an ephemeral drainage line. Neither route option avoids the ephemeral drainage line but Option 2 moves the pipeline outside of this buffer area of the ephemeral channel.

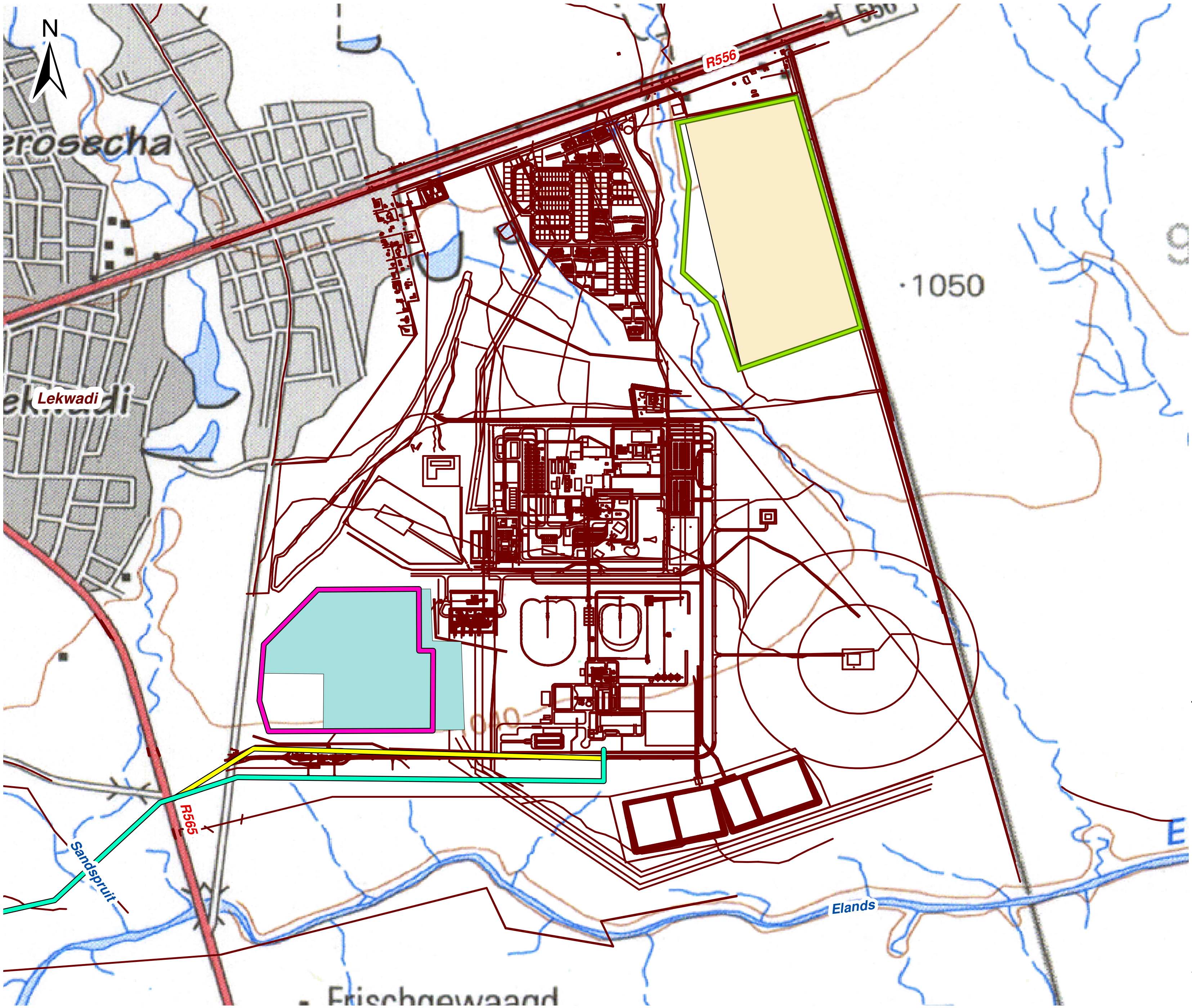
Criteria	Relative ranking		Advantages and disadvantages
	Option 1	Option 2	
			Based on the above, Option 2 is preferred.
Visual impact	1	1	**Pipeline:** For both site layout options, the proposed footprints are surrounded by existing mining operations and are within approved project footprints. In addition, Option 2 layouts are within 100 m of Option 1 layouts and thus are not expected to have differing visual impact. It follows that in the context of existing surrounding mining operations both site layout options are not expected to materially influence existing negative visual impacts. It follows that there are no disadvantages or advantages with either site option when compared together.
Proximity to residential areas	1	1	**Pipeline:** For both options, the external sensitive receptors are the same. There are no disadvantages or advantages with either site option when compared together.
Change in land use	1	1	**Pipeline:** For both site layout options, land use will be changed from agricultural to mining. In addition to this, the land uses surrounding the proposed project area are the same for both site layout options. There are no disadvantages or advantages with either site option when compared together.
Economic impact	1	1	**Pipeline:** The proposed project will contribute towards local, regional and national economies through wages, taxes and profits regardless of the site layout options. No disadvantages or advantages with either site option when compared together
Inward migration	1	1	**Pipeline:** The proposed project can lead to an influx of job seekers that will place pressure on existing services regardless of the site layout options, as this is the nature of mining. No disadvantages or advantages with either site option when compared together.
Total pipeline	**13**	**11**	**Infrastructure layout option 2 is preferred**

Criteria	Relative ranking		Advantages and disadvantages
	Option 1	Option 2	
Biodiversity (terrestrial and aquatic fauna, flora)	2	1	**Phase 1a housing:** The Phase 1a footprint in Option 1 overlaps with watercourse buffer zones, and thus the associated riparian biodiversity. The housing footprint Option 2 will shift the footprint out of these buffer zones and thus reducing overlap with associated watercourse habitats. Based on the above, Option 2 is preferred.
Heritage resources	1	1	**Phase 1a housing:** Modifications to the housing footprint (Phase 1a) will not change the impact the current layout is having on the identified heritage resources present and these resources will still be impacted. There are no disadvantages or advantages with either site option when compared together.
Soils and land capability	2	1	**Phase 1a housing:**

Criteria	Relative ranking		Advantages and disadvantages
	Option 1	**Option 2**	
			Option 2 will shift infrastructure outside of watercourse buffer areas and thus outside of areas that the 2007 soil report indicated to be eroded which was considered as sensitive according to the specialist. Shifting the infrastructure can decrease the chance of further degradation. Based on the above, Option 2 is preferred
Ground water regime and impacts on downstream users	1	1	**Phase 1a housing:** Both site layout options are underlain by two aquifers, an upper weathered aquifer and a lower fractured aquifer. The proposed minor shifts of Option 2 are unlikely to change groundwater regimes. It follows that there are no disadvantages or advantages with either site option when compared together.
Proximity to surface water resources	2	1	**Phase 1a housing:** The Phase 1a footprint in Option 1 overlaps with watercourse buffer zones. The housing footprint Option 2 will shift the footprint out of these buffer zones and thus reducing overlap with watercourse habitats. Based on the above, Option 2 is preferred.
Visual impact	1	1	**Phase 1a housing:** For both site layout options, the proposed footprints are surrounded by existing mining operations and are within approved project footprints. In addition, Option 2 layouts are within 100 m of Option 1 layouts and thus are not expected to have differing visual impact. It follows that in the context of existing surrounding mining operations both site layout options are not expected to materially influence existing negative visual impacts. It follows that there are no disadvantages or advantages with either site option when compared together.
Proximity to residential areas	1	1	**Phase 1a housing:** For both options, the external sensitive receptors are the same. It follows that there are no disadvantages or advantages with either site option when compared together.
Change in land use	1	1	**Phase 1a housing:** For both site layout options, land use will be changed from agricultural to mining. In addition to this, the land uses surrounding the proposed project area are the same for both site layout options. There are no disadvantages or advantages with either site option when compared together.
Economic impact	1	1	**Phase 1a housing:** The proposed project will contribute towards local, regional and national economies through wages, taxes and profits regardless of the site layout options. No disadvantages or advantages with either site option when compared together
Inward migration	1	1	**Phase 1a housing:** The proposed project can lead to an influx of job seekers that will place pressure on existing services regardless of the site layout options, as this is the nature of mining. No disadvantages or advantages with either site option when compared together.
Total Phase 1a housing	**13**	**10**	**Infrastructure layout option 2 is preferred**

Criteria	Relative ranking		Advantages and disadvantages
	Option 1	**Option 2**	

Criteria	Relative ranking		Advantages and disadvantages
	Option 1	Option 2	
Biodiversity (terrestrial and aquatic fauna, flora)	2	1	**Solar Plant:** Option 1 will cover approximately 12 ha of secondary vegetation and 9.5 ha of vegetation units that have high biodiversity conservation value and sensitivity. Option 2 will cover 14.7 ha of secondary vegetation and 6.8 ha of vegetation units that have high biodiversity conservation value and sensitivity. Based on the above, Option 2 is preferred.
Heritage resources	1	1	**Solar Plant:** No additional identified heritage sites will be impacted by the solar plant positioning. It follows that there are no disadvantages or advantages with either site option when compared together.
Soils and land capability	1	1	**Solar Plant:** The same soils will be impacted by the Option 1 and Option 2 of the solar plant and neither of these soils were indicated to have high sensitivity. It follows that there are no disadvantages or advantages with either site option when compared together.
Ground water regime and impacts on downstream users	1	1	**Solar Plant:** Both site layout options are underlain by two aquifers, an upper weathered aquifer and a lower fractured aquifer. The proposed changes are unlikely to change groundwater regimes. It follows that there are no disadvantages or advantages with either site option when compared together.
Proximity to surface water resources	1	1	**Solar Plant:** There are no delineated watercourses within the solar plant footprint. It follows that there are no disadvantages or advantages with either site option when compared together.
Visual impact	1	1	**Solar Plant:** For both site layout options, the proposed footprints are surrounded by existing mining operations and are within approved project footprints. It follows that there are no disadvantages or advantages with either site option when compared together.
Proximity to residential areas	1	1	**Solar Plant:** For both options, the external sensitive receptors are the same. It follows that there are no disadvantages or advantages with either site option when compared together.
Change in land use	1	1	**Solar Plant:** For both site layout options, land use will be changed from agricultural to mining. The land uses surrounding the proposed project area are the same for both site layout options. It follows that there are no disadvantages or advantages with either site option when compared together.
Economic impact	1	1	**Solar Plant:** The proposed project will contribute towards local, regional and national economies through wages, taxes and profits regardless of the site layout options. No disadvantages or advantages with either site option when compared together.
Inward migration	1	1	**Solar Plant:** The proposed project can lead to an influx of job seekers that will place pressure on existing services regardless of the site layout options, as this is the nature of mining. No disadvantages or advantages with either site option when compared together.
Total Phase 1a housing	**11**	**10**	**Infrastructure layout option 2 is preferred**



Legend

Mine Layout

Alternatives

Pipeline - Option 1

Pipeline - Option 2 (Preferred Option)

Mine Housing - Option 1

Mine Housing - Option 2 (preferred Option)

Solar Plant - Option 1

Solar Plant Option 2 (preferred Option)

Data Source: Rehab Green CC (2007)

Kilometers

0 0.4 0.8

Scale: 1:18 000 @ A4

SA Grid WGS84

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Figure 7.30

Site Layout Alternatives

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7.8 POSSIBLE MITIGATION MEASURES THAT COULD BE APPLIED AND THE LEVEL OF RESIDUAL RISK

Section 7.3, provides a summary of issues and concerns raised by IAPs as part of the proposed project. This section outlines possible mitigation measures or alternatives that are available to accommodate or address issues and concerns raised by IAPs where relevant. In addition to this, this section will also provide an assessment of the impact or risks associated with the identified possible mitigation measures or alternatives. The full comments are contained in Appendix E and this table only highlights the issue raised in the comments received.

TABLE 7.37: POSSIBLE MITIGATION MEASURES AND ANTICIPATED LEVEL OF RESIDUAL RISK

<table>
<tr><th rowspan="2">Issue and concern raised</th><th rowspan="2">Possible mitigation measure or alternative to address issue</th><th colspan="2">Impact significance of the possible mitigation measure or alternative before and after mitigation (Section 9)</th></tr>
<tr><th>Unmitigated</th><th>Mitigated</th></tr>
<tr><td>Concerned about proximity of the proposed infrastructure to the Elands River and proposed mitigation. Interested in information on understanding monitoring plans for surface and groundwater.</td><td rowspan="5">The studies found that the tailings material is considered to be non-acid forming. There could be other water pollution impacts which will be mitigated through:
• Continuing the surface and groundwater monitoring programme on site including additional groundwater monitoring around the TSF site
• Through management of dirty water by containing it in polluted water facilities.
• Through the effective implementation of a liner below the TSF, return water dam and PCDs.
• Clean and dirty storm water are to be kept separated through implementation of a storm water management plan.
• Spills are to be cleaned timeously
• Regular inspections of infrastructure
• Hazardous substances, chemicals, fuels, oil and grease are to be stored and handled on impermeable surfaces</td><td rowspan="5">High</td><td rowspan="5">Medium</td></tr>
<tr><td>Concerned about project polluting water.</td></tr>
<tr><td>Youth must not be affected by pollution</td></tr>
<tr><td>Water must not be polluted by mining activities.</td></tr>
<tr><td>Concerned about the TSF being constructed close to their location as it will contain acid water.</td></tr>
<tr><td>Concerned about additional noise from the crusher moved above ground.</td><td>The incremental noise of the project components was assessed to not significantly increase form what was previously assessed.</td><td>Medium</td><td>Medium</td></tr>
</table>

Issue and concern raised	Possible mitigation measure or alternative to address issue	Impact significance of the possible mitigation measure or alternative before and after mitigation (Section 9)	
	Mitigation to minimise noise impacts include: • Keeping noisy activities to reasonable working hours during the day and early evening • Keeping equipment and vehicles in good repair • Incorporating acoustic designs to minimise noise levels • Monitor noise	(The mitigated significance is unchanged from the approved project)	
Concerned about the TSF being constructed close to their location and the sand drying up and causing dust which has health impacts.	• Continuation of the existing monitoring programme • Erosion control measures to be implemented on the TSF to minimise • Dust suppression to be implemented on exposed areas, roads, material handling and drilling points • Concurrent rehabilitation of the TSF • Soil stockpiles are to be wetted • Vehicle speeds are to be controlled to reduce dust entrainment • Trees to be planted around the TSF to break laminar wind flow • Site inspections are to take place to monitor areas where dust can be problematic	High	Medium (TSP and PM10) Low- High (PM2.5)
Concerned about dust at the mine affecting the community and plants.			
Concerned about the cumulative impacts of air quality in the area.			
The TSF is susceptible to wind entrainment and can lead to environmental impacts especially for sensitive receptors downwind.			
Dust during construction must be controlled effectively.			
Animals in the game reserve must not be affected by dust.			
Youth must not be affected by pollution			
Employment should be given as far as possible to local skilled, semi-skilled and unskilled labour force.	• Local products and services to be maximised and used where possible. • Create a database of employable community members. • Fair and equitable recruitment opportunities to all with equivalent qualification. • Contracts to specify the preferential use of local labour from Phatsima and Ledig as far as possible • Identify candidates from the local communities for apprenticeships and on the job training programs. • Implementing SLP project which include projects identified in IDPs relating to infrastructure, road improvements • Periodic communication and feedback to be undertaken to the community in respect of the progress of the Project and the implementation. • Focus on employing local labour as far as possible	High Positive	High Positive
Wondering how the community will benefit from the project.			
Hoping there will be employment and improvement of the local economy.			
Employment opportunities in Phatsima.			
How will we know about project happening/			
What kind of jobs will be available?			
Looking for work.			
Will preference be given to Phatsima since the project is located near Phatsima inhabitants?			
Want the community members to be included			

Issue and concern raised	Possible mitigation measure or alternative to address issue	Impact significance of the possible mitigation measure or alternative before and after mitigation (Section 9)	
to mitigate socio-economic impacts.			
Hoping for change in the community by providing employment and reducing crime and poverty.			
Query on internships and learnerships			
Improvement of local economy, schools being built, improvement to roads			
Concerned about lives being endangered by the project Concerned about community health and safety.	Projects of this nature can bring about an influx of people looking for employment, this brings within it associated social ills. Management of some of the issues linked to safety and health will include: • Through the *Bakubung-Ba-Ratheo* Non-Mining Economic Development Trust and the *Bakubung-Ba-Ratheo* Economic Development Unit and BPM's corporate social investment program investigate opportunities to improve local health care. • Work closely with the *Bakubung-Ba-Ratheo* to minimise establishment of informal settlements • Educate employees and contractor employees about promoting good health practices, and inform them about other communicable diseases, and the prevention of the spread thereof. • Identify opportunities to improve the health of the community. • Link with relevant forums/organisations on issues of community safety and provision of emergency response services.	High	Medium
Concerned about graves being destroyed.	A heritage study was conducted to identify graves present on site that might be impacted by the project. Impacted graves identified will be relocated and not destroyed. A procedure will be followed for the relocation of graves which includes: • A detailed social consultation process, at least 60 days in length, comprising the attempted identification of the next-of-kin so as to obtain their consent for the relocation of the graves. • Bilingual site notices indicating the intent of the relocation. • Bilingual newspaper notices indicating the intent of the relocation. • Permit applications to the legally required authorities, including (but certainly not restricted to) the South African Heritage Resources Agency. • An exhumation process that keeps the dignity of the remains and family intact. • An exhumation process that will safeguard the legal rights of the families as well as that of the development company. • The process must be done by a reputable company well versed in the mitigation of graves.	High	Medium

Issue and concern raised	Possible mitigation measure or alternative to address issue	Impact significance of the possible mitigation measure or alternative before and after mitigation (Section 9)	
Concerned about blasting impacts.	There will be no blasting activities as part of this project for the additional/changed infrastructure on site.	Not applicable to this project's components	Not applicable to this project's components
The land has been degraded and does not know what the final state of the environment will be and the physical extent of the impact. No negative impacts must be experienced The environment needs to be protected as the current state of the environment is not good.	• Minimisation of degradation to the environment during the life of the project will be through managing hazardous excavations and structures, disturbance of biodiversity, surface and groundwater quality and quantity, dust generation, increase in traffic, noise pollution, visual and negative socio-economic impacts. Following the cessation of the project, infrastructure that is not to be retained is to be demolished and the area is to be rehabilitated. The final land form is to be returned to its pre-mining state as far as possible of grazing and wilderness where appropriate.	High	Medium to Low (during operations) Low (Closure)

7.9 MOTIVATION WHERE NO ALTERNATIVE SITES WERE CONSIDERED

Not applicable.

7.10 STATEMENT MOTIVATING THE PREFERRED ALTERNATIVE

With reference to Section 7.1 and Section 10, site layout alternatives were considered as part of the proposed project. A motivation describing the preferred alternatives is provided below.

7.10.1 SITE LAYOUT ALTERNATIVES

With reference to Section 10, layout alternatives were proposed by specialists to avoid sensitive areas including vegetation units and watercourses. The alternative layouts represent a part of the mitigated scenarios for the biodiversity and soil impact assessments contained in Appendix F. Following a site selection assessment, alternative layouts were preferred for some infrastructure, whereas shifting other infrastructure was not feasible. For the site alternatives the following was concluded:

- Modify TSF footprint so as to maximise the surface area comprising Secondary vegetation and minimise the extent of Marikana Thornveld within the footprint.
    - The final layout of the TSF has a footprint that covers less Marikana Thornveld and more secondary vegetation than the footprint assessed by the specialist. This recommendation from the specialist is thus already catered for with the final TSF layout. Therefore, this aspect does not need to be assessed further as the recommendation is met.
- Shifting the product stockpiles – this was referring to the Concentrator Complex area.
    - The area where the watercourses and the Concentrator Complex overlap is the approved Concentrator Complex footprint which is not changing. The product stockpiles will be placed in the northern section of the Concentrator Complex and not overlapping with the ephemeral drainage line. This recommendation from the specialist is thus already catered for with the final positioning of the product stockpiles. Therefore this aspect does not need to be assessed further as the recommendation is met.
- Modify Phase 1 Mine housing footprint to so as to avoid overlap between watercourses, as well as the 32m and 100m buffers as far as possible.
    - The final layout of the Phase 1 Mine housing is slightly further north than the layout in the wetland specialist's assessment. The Phase 1 Mine housing is thus not overlapping with the watercourse. Therefore this aspect does not need to be assessed further as the recommendation is met.
- Re-aligning the Frischgewaagd section of the tailings and return water pipeline alignment along the recently constructed access road.

- Modifying Phase 1a Mine housing footprint to avoid overlap between watercourses, as well as the 32 m and 100 m buffers as far as possible.
- Modify the solar plant layout to reduce the extent of infrastructure areas of high biodiversity conservation value and status: Mixed Woodland/Thicket and *Acacia mellifera* Bushland/ Thicket.
- Shifting the return water dam: This is not feasible as the position of the dam is located at the lowest topographical point to ensure appropriate collection of potential seepage from the TSF and has been optimised for engineering purposes. The applicant has indicated that the TSF location has also already been shifted as far as possible to the east to be further away from the Phatsima community to decrease the noise and air pollution impacts. Therefore, Option 1 is the only feasible option. This alternative has therefore not been considered further
- Shifting the PCD layout: The PCD layout is within a footprint that was already approved for a dirty water containment area and thus there is no new impact. The PCD is located at the lowest topographical point to ensure appropriate collection of dirty water from the shaft and concentrator complex areas and has been optimised for engineering purposes. In addition, there are existing powerlines north and west of the approved location of the PCD restricting any significant movement. This alternative has therefore not been considered further.

It should be noted that the preferred site alternative came about from the impact assessment conducted for this project; therefore the impact assessment contained below is based on Layout Option 1 with Layout Option 2 representing a part of the mitigated scenario.

8 FULL DESCRIPTION OF THE PROCESS UNDERTAKEN TO IDENTIFY, ASSESS AND RANK THE IMPACTS AND RISKS THE ACTIVITY WILL IMPOSE ON THE PREFERRED SITE THROUGH THE LIFE OF THE ACTIVITY

8.1 DESCRIPTION OF THE PROCESS UNDERTAKEN TO IDENTIFY IMPACTS

Environmental and socio-economic impacts associated with the proposed project were identified through site visits, undertaken by SLR and specialists (where relevant), the social scan, consideration of the project description, site layout and specialist studies.

Potential environmental and socio-economic impacts identified were outlined in the background information document that was distributed to IAPs and regulatory authorities (Section 7.2.1) for consideration. In addition to this, potential identified environmental and socio-economic impacts were discussed at the public and regulatory authorities meetings (Section 7.2.4). The feedback received from IAPs and regulatory authorities also provided input into the identification of environmental and socio-economic impacts.

8.2 DESCRIPTION OF THE PROCESS UNDERTAKEN TO ASSESS AND RANK THE IMPACTS AND RISKS

A description of the assessment methodology used to assess the severity of identified impacts including the nature of impacts and the degree to which impacts may cause irreplaceable loss of resources is provided in Section 7.6. In addition to this, the assessment methodology also assesses the extent of the impacts, the duration and reversibility of impacts, the probability of the impact occurring, and the degree to which the impacts can be mitigated.

8.3 A DESCRIPTION OF THE ENVIRONMENTAL IMPACTS AND RISKS IDENTIFIED DURING THE ENVIRONMENTAL ASSESSMENT PROCESS

This section below (Table 8.1) provides a description of the impacts on environmental and socio-economic aspects in respect of each of the main project actions / activities and processes that will be assessed in Appendix F and summarised in Section 9.

TABLE 8.1: LIST OF POTENTIAL IMPACTS AS THEY RELATE TO PROJECT ACTIONS / ACTIVITIES / PROCESSES

Main activity/process	Impacts (unmitigated)
Site preparation	Hazardous excavations, surface subsidence and infrastructure that can be harmful to people and animals Loss of soil resources and land capability through contamination Loss of soil resources and land capability through physical disturbance Physical destruction of biodiversity

Main activity/process	Impacts (unmitigated)
	General disturbance of biodiversity Contamination of surface water resources Alteration of surface water drainage patterns Contamination of groundwater resources Air pollution Noise Pollution Negative visual impacts Loss of heritage, cultural and paleontological resources Economic impact Inward migration impacts Change in land use
Civil works	Hazardous excavations, surface subsidence and infrastructure that can be harmful to people and animals Physical destruction of biodiversity General disturbance of biodiversity Contamination of surface water resources Alteration of surface water drainage patterns Contamination of groundwater resources Air pollution Noise Pollution Road disturbance and traffic safety Negative visual impacts Loss of heritage, cultural and paleontological resources Economic impact Inward migration impacts Change in land use
Earthworks	Hazardous excavations, surface subsidence and infrastructure that can be harmful to people and animals Loss of soil resources and land capability through contamination Loss of soil resources and land capability through physical disturbance Physical destruction of biodiversity General disturbance of biodiversity Contamination of surface water resources Alteration of surface water drainage patterns Contamination of groundwater resources Air pollution Noise pollution Negative visual impacts Loss of heritage, cultural and paleontological resources Economic impact Inward migration impacts Change in land use
Mining and mining related activities	Hazardous excavations, surface subsidence and infrastructure that can be harmful to people and animals Contamination of surface water resources Air pollution Noise pollution Negative visual impacts Economic impact Inward migration impacts Change in land use
Waste rock management	Additional mineral resource Hazardous excavations, surface subsidence and infrastructure that can be harmful to people and animals Loss of soil resources and land capability through contamination Loss of soil resources and land capability through physical disturbance Physical destruction of biodiversity

Main activity/process	Impacts (unmitigated)
	General disturbance of biodiversity Contamination of surface water resources Alteration of surface water drainage patterns Contamination of groundwater resources Air pollution Noise pollution Negative visual impacts Economic impact Inward migration impacts Change in land use
Mineral processing operations	Air pollution Noise pollution Negative visual impacts Economic impact Inward migration impacts Change in land use
Tailings management	Hazardous excavations, surface subsidence and infrastructure that can be harmful to people and animals Loss of soil resources and land capability through contamination Loss of soil resources and land capability through physical disturbance Physical destruction of biodiversity General disturbance of biodiversity Contamination of surface water resources Alteration of surface water drainage patterns Contamination of groundwater resources Air pollution Noise pollution Negative visual impacts Loss of heritage, cultural and paleontological resources Economic impact Inward migration impacts Change in land use
Power Supply and Use	Air pollution Economic impact Inward migration impacts Change in land use
Water supply and use	Economic impact Inward migration impacts Change in land use
Process and storm water management	Loss of soil resources and land capability through contamination Physical destruction of biodiversity General disturbance of biodiversity Contamination of surface water resources Alteration of surface water drainage patterns Contamination of groundwater resources Economic impact Inward migration impacts Change in land use
Transport systems	Road disturbance and traffic safety Change in land use
General and hazardous waste management	Contamination of surface water resources Contamination of groundwater resources Inward migration impacts Economic impact Change in land use
Sewage sludge management	Loss of soil resources and land capability through contamination

Main activity/process	Impacts (unmitigated)
	Physical destruction of biodiversity General disturbance of biodiversity Contamination of surface water resources Economic impact Inward migration impacts Change in land use
Site support services	Contamination of surface water resources Contamination of groundwater resources Economic impact Inward migration impacts Change in land use
Housing	Loss of soil resources and land capability through contamination Loss of soil resources and land capability through physical disturbance Physical destruction of biodiversity General disturbance of biodiversity Air pollution Negative visual impacts Loss of heritage, cultural and paleontological resources Economic impact Inward migration impacts Change in land use
Site/contract management	Physical destruction of biodiversity General disturbance of biodiversity Loss of heritage, cultural and paleontological resources Economic impact Inward migration impacts Change in land use
Demolition	Hazardous excavations, surface subsidence and infrastructure that can be harmful to people and animals Loss of soil resources and land capability through contamination Loss of soil resources and land capability through physical disturbance Physical destruction of biodiversity General disturbance of biodiversity Contamination of surface water resources Alteration of surface water drainage patterns Contamination of groundwater resources Air pollution Noise pollution Negative visual impacts Loss of heritage, cultural and paleontological resources Economic impact Inward migration impacts Change in land use
Rehabilitation	Hazardous excavations, surface subsidence and infrastructure that can be harmful to people and animals Loss of soil resources and land capability through contamination Loss of soil resources and land capability through physical disturbance Physical destruction of biodiversity General disturbance of biodiversity Contamination of surface water resources Alteration of surface water drainage patterns Contamination of groundwater resources Air pollution Noise pollution Negative visual impacts Loss of heritage, cultural and paleontological resources Economic impact

Main activity/process	Impacts (unmitigated)
	Inward migration impacts Change in land use
Maintenance and aftercare	Hazardous excavations, surface subsidence and infrastructure that can be harmful to people and animals Loss of soil resources and land capability through contamination Loss of soil resources and land capability through physical disturbance Physical destruction of biodiversity General disturbance of biodiversity Contamination of surface water resources Alteration of surface water drainage patterns Contamination of groundwater resources Air pollution Noise pollution Negative visual impacts Loss of heritage, cultural and paleontological resources Economic impact Inward migration impacts Change in land use

8.4 ASSESSMENT OF THE SIGNIFICANCE OF EACH IMPACT AND RISK AND AN INDICATION OF THE EXTENT OF TO WHICH THE ISSUE AND RISK CAN BE AVOIDED OR ADDRESSED BY THE ADOPTION OF MITIGATION MEASURES

The assessment of the significance of the impacts identified for the proposed project area are included in Appendix F and summarised in Section 9. The extent to which the identified impacts can be avoided or addressed by the adoption of mitigation measures is included in Section 9.

9 ASSESSMENT OF EACH IDENTIFIED POTENTIALLY SIGNIFICANT IMPACT AND RISK

As stipulated by the DMR template a summary of the assessment of the environmental and socio-economic impacts associated with the proposed project is provided in Table 9.1 below. A full description of the assessment is included in Appendix F. All identified impacts are considered in a cumulative manner such that the current baseline conditions on site and in the surrounding area are discussed and assessed together.

TABLE 9.1: ASSESSMENT OF SIGNIFICANT IMPACTS AND RISKS

L = Low, M= Medium, H = High, + = positive impact

Activity	Potential impact	Aspects affected	Phase	Significance (unmitigated)	Mitigation type	Significance (mitigated)	Extent to which the impact can be avoided or addressed through the implementation of management measures
Waste rock management	Inclusion of additional mineral resources	Geology	Construction Operation Decommissioning Closure	M	• Manage through sale of all available aggregate waste rock	H+	Can be fully managed/mitigated
Site preparation Civil works Earthworks Waste rock management Mining and mining related activities Tailings management Demolition Rehabilitation Maintenance and aftercare	Hazardous excavations infrastructure and surface subsidence	Topography	Construction Operation Decommissioning Closure	H	• Control through access control • Control through management and monitoring • Control through rehabilitation • Remedy through emergency response procedure (Section 31.2.2) • Control and remedy through training	M (Plant area) M-H (TSF area)	Can be managed/mitigated to acceptable levels
Site preparation Earthworks Waste rock management Transport systems Housing Tailings management Demolition Rehabilitation Maintenance and aftercare	Loss of soil resources and land capability through physical disturbance	Soils and land capability	Construction Operation Decommissioning Closure	H	• Manage through the implementation of soil conservation management plan and waste management plan • Control through rehabilitation • Control through limiting project footprint • Control through erosion control measures	M-H	Can be managed/mitigated to acceptable levels
Site preparation Earthworks Waste rock management Transport systems Tailings management Housing	Loss of soil resources and land capability through pollution	Soils and land capability	Construction Operation Decommissioning Closure	H	• Manage through the implementation of soil conservation management plan and waste management plan • Control through rehabilitation • Remedy through emergency response procedure (Section 31.2.2)	L M-H (pipeline)	Can be managed/mitigated to acceptable levels

Activity	Potential impact	Aspects affected	Phase	Significance (unmitigated)	Mitigation type	Significance (mitigated)	Extent to which the impact can be avoided or addressed through the implementation of management measures
Process and storm water management Sewage sludge management Demolition Rehabilitation Maintenance and aftercare					• Control and remedy through training		
Site preparation Civil works Earthworks Tailings management Waste rock management Transport systems Housing Process and storm water management Sewage sludge management Site/contract management Demolition Rehabilitation Maintenance and aftercare	Physical destruction of biodiversity	Biodiversity	Construction Operation Decommissioning Closure	H	• Modify through placement of infrastructure • Control through species relocation and an invasive species management plan • Remedy through conservation and rehabilitation measures • Control through monitoring and inspections • Control through limiting disturbance	M- H (habitat / vegetation type) M (other biodiversity aspects)	Can be managed/mitigated to acceptable levels
Site preparation Civil works Earthworks Tailings management Waste rock management Transport systems Housing Process and storm water management Sewage sludge	General disturbance of biodiversity	Biodiversity	Construction Operation Decommissioning Closure	H	• Can be controlled through pollution management • Can be controlled through implementation of procedures, management plans and personnel training • Can be managed through an invasive species management plan	M	Can be managed/mitigated to acceptable levels

Activity	Potential impact	Aspects affected	Phase	Significance (unmitigated)	Mitigation type	Significance (mitigated)	Extent to which the impact can be avoided or addressed through the implementation of management measures
management Site/contract management Demolition Rehabilitation Maintenance and aftercare							
Site preparation Civil works Earthworks Transport systems Mining and mining related activities Waste rock management Tailings management Process and storm water management General and hazardous waste management Sewage sludge management Site support services Demolition Rehabilitation Maintenance and aftercare	Contamination of surface water resources	Surface water	Construction Operation Decommissioning Closure	H	• Control through storm water management and design • Remedy through emergency response procedure (Section 31.2.2)	L	Can be managed/mitigated to acceptable levels
Site preparation Civil works Earthworks Transport systems Waste rock management Tailings management Process and storm water management Demolition	Alteration of natural drainage patterns		Construction Operation Decommissioning Closure	H	• Control through appropriate design / re-alignment • Control through the separation of dirty and clean water	M	Can be managed/mitigated to acceptable levels

Activity	Potential impact	Aspects affected	Phase	Significance (unmitigated)	Mitigation type	Significance (mitigated)	Extent to which the impact can be avoided or addressed through the implementation of management measures
Rehabilitation Maintenance and aftercare							
Site preparation Civil works Earthworks Transport systems Mining and mining related activities Waste rock management Tailings management Process and storm water management General and hazardous waste management Sewage sludge management Site support services Demolition Rehabilitation Maintenance and aftercare	Contamination of groundwater resources	Groundwater	Construction Operation Decommissioning Closure	H	• Control through monitoring • Remedy through emergency response procedure (Section 31.2.2)	L	Can be managed/mitigated to acceptable levels
Site preparation Civil works Earthworks Mining and mining related activities Waste rock management Mineral processing operations Tailings management Power Supply and Use Transport systems Housing	Air pollution	Air	Construction Operation Decommissioning Closure	H	• Control through implementation of dust control measures • Monitor through the continuation of the monitoring programme	M (PM10 & Dustfall) L-H (PM2.5)	Can be managed/mitigated to acceptable levels

Activity	Potential impact	Aspects affected	Phase	Significance (unmitigated)	Mitigation type	Significance (mitigated)	Extent to which the impact can be avoided or addressed through the implementation of management measures
Demolition Rehabilitation Maintenance and aftercare							
Site preparation Earthworks Civil works Waste rock management Tailings Management Transport systems Demolition Rehabilitation Waste rock management Mineral processing operations Mining and mining related activities	Noise pollution	Noise	Construction Operation Decommissioning	M	• Control through noise control measures and monitoring (if required)	M	Can be managed/mitigated to acceptable levels
Transport systems	Road disturbance and traffic safety	Traffic	Construction Operation Decommissioning Closure	M	• Modify through the introduction of a roundabout and converting a lane into turning lane only. • Control through appropriate design • Management through the implementation of traffic safety programme • Remedy through emergency response procedure (Section 31.2.2)	H+	Can be mitigated to improve the service level
Site preparation Civil works Earthworks Mining and mining related activities Waste rock management Mineral processing operations	Negative visual views	Visual	Construction Operation Decommissioning Closure	H	• Control through visual controls and concurrent rehabilitation	M	Can be managed/mitigated to acceptable levels

Activity	Potential impact	Aspects affected	Phase	Significance (unmitigated)	Mitigation type	Significance (mitigated)	Extent to which the impact can be avoided or addressed through the implementation of management measures
Tailings management Housing Demolition Maintenance and aftercare of final land forms and rehabilitated areas							
Site preparation Earthworks Transport systems Housing Site/contract management Tailings management Demolition Rehabilitation	Loss of heritage, cultural and palaeontological resources	Heritage/ cultural and palaeontological resources	Construction Operation Decommissioning	H	• Control through relocation of graves • Avoid through data collection • Control through additional site assessments prior to development • Remedy through emergency response procedure (Section 31.2.2)	L-M	Can be managed/mitigated to acceptable levels
Site preparation Civil works Earthworks Mining and mining related activities Waste rock management Mineral processing operations Tailings management Power Supply and Use Water supply and use Process and storm water management Transport systems General and hazardous waste management Sewage sludge management Site support services	Economic impact	Socio-economic	Construction Operation Decommissioning Closure	H+	• Control through procurement programme and bursary and skills development programme	H+	Can be managed/mitigated to acceptable levels

Activity	Potential impact	Aspects affected	Phase	Significance (unmitigated)	Mitigation type	Significance (mitigated)	Extent to which the impact can be avoided or addressed through the implementation of management measures
Housing Site/contract management Demolition Rehabilitation Maintenance and aftercare							
Site preparation Civil works Earthworks Mining and mining related activities Waste rock management Mineral processing operations Tailings management Power Supply and Use Water supply and use Process and storm water management Transport systems General and hazardous waste management Sewage sludge management Site support services Housing Site/contract management Demolition Rehabilitation Maintenance and aftercare	Inward migration and associated social ills		Construction Operation Decommissioning Closure	H	• Control through health policy, monitoring the development of informal settlements • Remedy through emergency response procedure (Section 31.2.2)	M	Can be managed/mitigated to acceptable levels
Construction of project components Operation of the mine Decommissioning of project	Loss or changes to existing land use	Land use	Construction Operation Decommissioning	H	Control through closure planning Manage through implementation of mitigation measures for environmental and social impacts	M-L L (at closure)	Can be managed/mitigated to acceptable levels

Activity	**Potential impact**	**Aspects affected**	**Phase**	**Significance (unmitigated)**	**Mitigation type**	**Significance (mitigated)**	**Extent to which the impact can be avoided or addressed through the implementation of management measures**
components Final land forms			Closure				

10 SUMMARY OF SPECIALIST REPORT FINDINGS

The relevant specialist studies that were undertaken as part of the proposed project including the recommendations made by the specialist are summarised in Table 10.1 below. The relevant specialist reports have been attached in the appendices to this EIA and EMP report.

TABLE 10.1: SUMMARY OF SPECIALIST REPORTS

Studies undertaken	Recommendations of specialists	Specialist recommendations that have been included in the EIA report (mark with an x)	Reference to applicable section in this report
Soil, land use and land capability	• Place pipeline in areas already transformed or where transformation will occur owing to road construction etc. • Avoid vehicle slippage and rutting. • Place pipeline away from the drainage lines on the farm Frischgewaagd, especially where the Sepane soil form occurs. • Construct in dry season. • If soil erosion has occurred, an erosion control plan entailing hard (i.e. gabion construction) and/or soft (i.e. breaking surface water flow velocities) should be designed by a competent person. • Soil horizons to be stripped separately. • Soil horizons to be stockpiled separately. • C-horizon material to be backfilled first followed by B- and A-horizon material. • Maintain pipeline in order to avoid spillage. • If spillage occurs, the spill must be contained with swales and berms, after the leakage has been repaired the spilled material should be removed and pollution plume should be determined by a soil chemist and hydrologist and geohydrologist. • A remediation plan must be compiled by the soil chemist and hydrologist following a spill event.	X	Section 28 and Section 31
Heritage/ cultural and palaeontological resources	**Possible Graves:** • A detailed social consultation process, at least 60 days in length, comprising the attempted identification of the next-of-kin so as to obtain their consent for the relocation of the graves. • Bilingual site notices (in the most appropriate languages) indicating the intent of the relocation. • Bilingual newspaper notices indicating the intent of the relocation. • Identified graves and cemeteries (including those confirmed to be graves from the procedure followed for possible graves): • Permit applications to the legally required authorities, including (but certainly not restricted to) the South African Heritage Resources Agency. • An exhumation process that keeps the dignity of the remains and family intact. • An exhumation process that will safeguard the legal rights of the families as well as that of the development company. • The process must be done by a reputable company well versed in the mitigation of graves. **Iron Age sites** *For MCH002, MCH003, MCH004, MHC018, MCH020*: • Shovel pit test to determine depth and integrity of archaeological deposit of site and for	X	Section 28

Studies undertaken	Recommendations of specialists	Specialist recommendations that have been included in the EIA report (mark with an x)	Reference to applicable section in this report
	sites with ceramics also to collect more diagnostic ceramics (MHC018 and MHC020) to positively establish group identity. • Test pit excavations will be aimed at identifying structures. • Based on the findings further assessment of the site might be required. • Before destruction of the site, a destruction permit must be applied for (for sites that require destruction permits) and received from the South African Heritage Resources Agency. • This work can only be undertaken by a suitably qualified and experienced archaeologist. • This work may only be undertaken after permits had been received from the South African Heritage Resources Agency allowing such mitigation measures to be undertaken. *For MHC005:* • If the site is impacted upon, an archaeologist must monitor the site during construction to mitigate accidental finds. • Before destruction of the site, a destruction permit must be applied for and received from the South African Heritage Resources Agency. • This work can only be undertaken by a suitably qualified and experienced archaeologist. *MHC019:* • An archaeologist must monitor the site during construction to mitigate accidental finds. This work can only be undertaken by a suitably qualified and experienced archaeologist. **Early Stone Age:** • An Early Stone Age specialist must assess the study area in particular the pebble layers that contain artefacts. New dating techniques could be used here.		
Traffic	• The intersection of the R556 & R565 should be converted to a 2-lane roundabout as already recommended in the 2008 traffic study. • The roundabout should have a minimum island diameter of 15m and two circulating lanes. The geometric details of the roundabout are however subject to detail design; the limitations of the design vehicle; and restrictions on site.* • Further investigation should be undertaken to determine the remaining pavement capacity of the transport route and to establish the upgrading and maintenance requirements if any. These further investigations should not be a requirement for receiving authorisation but can be included as part of the construction phase.	X *The recommendation for the construction of a traffic roundabout at the intersection ~1.6 km from the mine access road is one that cannot be fulfilled by BPM exclusively as the road does not fall within BPM's jurisdiction. The commitment provided in the EMP incorporates consideration of this.	Section 28
Groundwater Modelling	**Construction Phase**	X	Section 28

Studies undertaken	Recommendations of specialists	Specialist recommendations that have been included in the EIA report (mark with an x)	Reference to applicable section in this report
	• Excess water that accumulates during the construction phase will be dealt with as part of the construction phase water balance; • All unwanted water accumulating in the excavations will be used or discharged into pollution control dams; and • Clean runoff will be diverted around the total TSF complex. • **Operational Phase** • All excess water must be managed as part of operational phase water balance. Return water from the TSF must be used as much as possible; • All water coming to the TSF must be treated as polluted. Where water is not returned to the plant area, disposal must take place in the correct polluted water facility; • As the TSF will be lined, seepage of potential contaminants to the groundwater system will be significantly reduced • The sustainability of the lining must be continuously checked through continuous monitoring of groundwater quality and levels for any type of impact; • Groundwater quality and levels should be continuously monitored for any type of impact; and • If required, a groundwater abstraction scheme should be implemented around the TSF to capture polluted ground water, and to prevent the migration of polluted water away from the site. **Decommissioning Phase** • During the decommissioning phase, final rehabilitation of the TSF will take place. All measures put in place during the operational phase will be extended through the decommissioning phase to closure. The long term groundwater closure objective is to prevent any migration of polluted water from the TSF. **Monitoring** • Groundwater monitoring has to continue during all phases of the TSF operation to identify the impact on the groundwater resources over time, so effective measures can be taken at an early stage before serious damage to the environment occurs. • In total nine monitoring points are recommended for the proposed groundwater monitoring program (four shallow, four deep and one by the Elands River).		
Aquatic Ecology Assessment	• Any damage to the drainage lines necessary to complete the work must be limited in extent; • Tie-in points at riverbanks (i.e. where infrastructure is placed into the ground) must be suitably safeguarded with gabion cut-off walls to prevent erosion. • Permit only essential construction personnel within 32m of the riparian habitat, if	X	

Studies undertaken	Recommendations of specialists	Specialist recommendations that have been included in the EIA report (mark with an x)	Reference to applicable section in this report
	absolutely necessary that they enter the buffer zone; • All areas should be monitored for erosion and incision. Specific mention is made of sedimentation of riparian areas; • To prevent the erosion of topsoils, management measures to minimise erosion should include installation of berms, silt traps, hessian curtains at erodible areas and storm water diversion away from areas susceptible to erosion; • Sheet runoff from access roads should be slowed down by the strategic placement of berms; • All soils compacted as a result of activities falling outside of project footprint areas should be ripped and profiled; • Rehabilitate all drainage line and riparian habitat areas if required, in order to ensure that the ecology of these areas is re-instated during all phases; • Edge effects of activities including erosion and alien/weed control need to be strictly managed in these areas; • Alien and invasive vegetation control should take place throughout all phases of the development; • All reseeding activities must be undertaken at the end of the dry season to ensure optimal conditions for germination and rapid vegetation establishment; • Implement effective waste management in order to prevent construction related waste from entering the drainage line and riparian environments; • It must be ensured that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage; • No camp fires should be permitted in or near the riparian area; • During the operational phase of the tailings pipeline, ensure that operational and maintenance related activities are kept strictly within the development footprint; • Regular monitoring of the tailings pipeline is recommended during the operational phase to prevent potential spills/leakages; • All spills/leakages by the tailings pipeline should be immediately cleaned up and treated accordingly; • All development footprint areas and areas affected by closure and decommissioning of the tailings pipeline should remain as small as possible and should not encroach onto surrounding riparian areas and their associated buffer zones; • Upon closure and decommissioning, reseeding with indigenous grasses should be implemented in all affected areas; • On-going aquatic ecological monitoring must take place on a 6 monthly basis by an SA RHP Accredited assessor during both the construction and operational phases; • Post closure aquatic ecological monitoring is recommended to ensure that no impact on the aquatic resources in the area takes place after decommissioning and closure has taken place;		

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	• Since the downstream sites in both the Sandspruit and unnamed tributary of the Elands River displayed higher SASS scores this spatial trend should not show a deterioration in the future once the proposed development takes place and this trend should be considered a Key Performance Indicator for the project throughout the life of the infrastructure.		
Faunal Assessment	• Additional surveys to be performed if expansion of infrastructure is planned in the future. • Apply sound veld management principles to ensure maximum biodiversity. This would include sound fire management and grazing techniques. Refer to mitigation measures in the Flora and Vegetation Report; • Construction teams to be housed off-site to reduce human presence on site; • Fence off surrounding untransformed vegetation (applicable to all footprints except the pipeline); • Limit damage and access to riparian vegetation during bridge construction; • Limit transformation only to development footprints; • Maintain untransformed vegetation in a natural state; • Mine infrastructure to be adequately rehabilitated after mining ceases. This includes stockpiles, tailings, rock dumps etc.; • Monthly perimeter inspections to assess state of fence and determine if it is being breached by poachers; • Report and monitor species of conservation-concern and implementing a monitoring programme.		
Floral Assessment	• Avoid placement of any infrastructure footprints within the buffer zones for the biological corridors recommended in the vegetation report (Appendix 12 of Appendix K). • Botanical research and conservation institutions (e.g. SANBI and universities), should also be afforded an opportunity to search the footprint for species that are of research or horticultural interest, prior to commencement of development. • Conduct additional, brief floristic surveys, focused on searching for Drimia sanguinea, Stentonstelma umbelluliferum, *Boophone disticha* and *Hypoxis hemerocallidea* within the final development footprints prior to construction. Surveys should be conducted in late October to early November and in January. The brief floristic surveys should focus on searching those parts of the proposed infrastructure footprints containing potentially suitable habitat for Drimia sanguinea. These surveys will also contribute towards confirming the absence of other 'species of conservation concern' within the study area. • Develop and implement a rehabilitation plant for the tailings pipeline construction servitude. The principal objectives of the plan should be the optimal reintroduction of stripped topsoil and the establishment of indigenous seral plant communities through the natural process of secondary succession. • Develop and implement a veld management plan for the study area, which emphasises the use of sustainable grazing and controlled fires to ensure optimal vegetation condition	X	Section 28

Studies undertaken	Recommendations of specialists	Specialist recommendations that have been included in the EIA report (mark with an x)	Reference to applicable section in this report
	and biodiversity levels in areas of Marikana Thornveld and spatially restricted untransformed vegetation units not destroyed by the project. • Develop and implement an alien plant control programme for the study area, with emphasis on areas surrounding infrastructure footprints. • If herbaceous Protected plant species that are readily transplantable are found (e.g. many geophytes), viable populations of such species can also be translocated to transformed (including rehabilitation areas) or untransformed areas within the study area which provide potentially suitable habitats, but such translocations will have to be carried out in a manner that ensures that no ecological degradation of the host habitat occurs, and will have to be evaluated by a botanist for each species and each potential translocation area. Alternatively such species should be rescued and placed in a nursery or donated to a research institute (e.g. SANBI and universities), rather than simply being destroyed upon receipt of a permit. • Illegal medicinal plant harvesting should be discouraged through control of access to untransformed habitats and vegetation within the study area. • Implement pollution control measures recommended in the soil, geotechnical and hydrological specialist reports for the project. • In the event of any Declining (sensu Raimondo et al., 2009) plant species being recorded within approved development footprints in future, permission for their removal or destruction should be obtained from the provincial Directorate of Biodiversity Management. Where feasible, viable populations of such species should be translocated to degraded or untransformed areas within the study area which provide potentially suitable habitats, but such translocations will have to be carried out in a way that ensures no ecological degradation of the host habitat occurs, and will have to be evaluated by a botanist for each species and each potential translocation area. • In the event of any threatened (i.e. Critically Endangered, Endangered and Vulnerable) or Near Threatened plant species being recorded within the study area or proposed development footprints in future, appropriate in situ and/or ex situ conservation measures should be developed in consultation with the North-West Province Directorate of Biodiversity Management. • Limit transformation only to development footprints. • Modify infrastructure footprints so as to reduce the area of spatially restricted vegetation units and Marikana Thornveld within the footprints wherever possible. Realigned footprints should be placed within the 'Secondary vegetation' unit in as far as possible. • Modify PCD footprint by shifting it approximately 50m to the north-west so as avoid a small patch of 'Stony grassland' and situate it outside of the recommended buffer zone for the biological corridor along the Elands River.* • Modify the return water dam footprint by shifting it to the north and west so that it is situated outside of the recommended buffer zone for the biological corridor along the		

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	Elands River.* • Modify TSF footprint so as to maximise the surface area comprising Secondary vegetation and minimise the extent of Marikana Thornveld within the footprint. • Realign the Frischgewaagd section of the 'final tailings pipeline alignment' along the recently constructed access road and reduce the width of the construction servitude in untransformed habitats. • The 'final' Tailings Pipeline alignment was not surveyed in the field during the current study and was assessed only at a desktop level. The final Tailings Pipeline alignment should be searched for Protected plant species prior to the commencement of construction. • The damaging or destruction of any plant species Protected in terms of the National Forest Act or the Biodiversity Act should be avoided wherever possible, and a permit for the destruction of any such protected plant must be obtained from the provincial Directorate of Biodiversity Management prior to development. • A thorough survey for plant 'species of conservation concern' and Protected plant species within the proposed Solar Plant footprint should be conducted prior to any development of the footprint. This survey should focus on searching for Drimia sanguinea, Stentonstelma umbelluliferum, Boophone disticha and Hypoxis hemerocallidea within the final development footprints prior to construction, and should be conducted in late October to early November and in January. • The proposed Solar plant footprint should be modified so as reduce the extent of vegetation units with High biodiversity conservation value and sensitivity (Units 1.1 and 1.2) contained within the footprint. The attached mapping indicates the recommended realignment of the proposed footprint, which would result in the new footprint alignment including only 6.8ha of Unit 1.1, no area of Unit 1.2 and 14.7ha of Unit 6. Transformed habitats would therefore comprise 68.4% of the recommended footprint and the percentage of transformed habitat included within the final footprint could be further increased by shifting the eastern boundary of the footprint further to the east	*The recommendation to shift the PCDs and the return water dam is not feasible. Further details are contained in Section 7.7 for further details.	
Wetland Assessment	• A remediation plan must be compiled by a soil chemist and hydrologist after a spill event. • A watercourse rehabilitation plan should be developed during the latter part of the construction process to help address remnant impacts that were not successfully mitigated. Note that rehabilitation works in a watercourse will require a Water Use License. It is therefore recommended that rehabilitation needs and flexibility are considered as part of the WULA. • A well designed and implemented storm water management system will be required to attenuate flood peak events within the property and thereby prevent erosion and sediment impacts in watercourses. • Buffer zones are not walk away solutions and need to be maintained during the operational phase of the project in order to be effective. This includes the maintenance of	X	

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	a well vegetated grass cover that is free of aliens and erosion features. Any aliens and/or erosion features observed within the buffer zone need to be addressed in order to ensure buffer functioning. • Delineated watercourses and buffers should be treated as sensitive no-go areas as far as possible. No unauthorized access is allowed in these features. • Develop and implement a site specific alien control plan during the latter half of the construction phase based on the evaluation of weed species present within watercourses located within or in close proximity to infrastructure features. Alien species in remaining areas of the properties should also be addressed as part of the alien control plan. • The proposed alien control plan should include a monitoring phase to evaluate successes achieved. Timing of treatments are essential, as control for most alien plant species can only be done during the growing season. • Dewatering that may be required during excavation activities should not be released directly into watercourses. • Discharged storm water must be released in a controlled manner in a diffuse flow pattern across a buffered vegetation strip and be accompanied by energy dissipating interventions to prevent erosion damage. • Storm water release impacts can be addressed in two main ways: The first is to make use of preventative construction techniques (source controls), such as to limit the amount of impervious material near watercourses as far as possible, and to demarcate setbacks from watercourses in the form of a buffer zone with a natural vegetation cover. • Structural control measures such as treatment techniques or naturally vegetated detention basins could be used to improve storm water quality. • Other structural control measures include grass swales, infiltration trenches and basins, wet ponds, and constructed wetlands to intercept and partially treat storm water before it is released. A combination of source controls and structural controls can result in an integrated solution, which is likely to provide the best benefits. • Ensure that geotechnical and geohydrological mitigation measures are in place around the proposed tailings storage facility to prevent seepage into nearby watercourses. • Ensure that the return water dam, tailings storage facility and product stockpiles are constructed and operated according to specifications, in order to help reduce the likelihood of structure failure, which can result in disastrous water quality impacts in downstream watercourses over a short space of time. • If spillage occurs, the spill must be contained with swales and berms after the leakage has been repaired, the spilled material should be removed and pollution plume should be determined a soil chemist and hydrologist. • Implement sediment control structures upslope of watercourses, in between stockpiles and construction activities that may act as sources of sediment. • A portion of the tailings pipeline will have to be moved north to avoid overlap with the		

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	100m buffer. • Maintain the pipeline in a good working order with regular checks and inspections to help reduce the risk of spillage events. • Maintain sediment control structures in a functional manner during the entire construction phase. • Modify infrastructure footprints so as to avoid overlap between watercourses, as well as the 32m and 100m buffers as far as possible. This pertains specifically to changes to the two Mine housings phases (Phases 1a and 1), the product stockpiles, and return water* dam. • No new access roads may be created through watercourses along the pipeline alignment. All new tracks and roads that intersect delineated watercourses and the 32m buffer will have to receive environmental approval before they can be constructed. • No refueling of heavy motorised vehicles (HMVs) or other vehicles, stockpiling of material or the positioning of portable toilets should be allowed within any of the watercourses or their associated buffer zones. • Overlap between the tailings pipeline and the Sandspruit River is unavoidable, but a restricted servitude width should be used, while no construction activities should occur within the instream and riparian habitat along the macro channel. Plinths can be located within the 32m buffer, but not within delineated riparian habitat. • Repair erosion damage within watercourse through the use of either soft or hard rehabilitation interventions. Hard interventions, such as gabion drop inlets and other features, will require design by an engineer with rehabilitation experience. Soft rehabilitation interventions include rehabilitation interventions that do not consists of rock and concrete, examples include earth berms, revegetation with indigenous species and biojute fabrics. Note also that rehabilitation works in watercourses require a WUL. • Stockpiles should be protected from erosion during the wet season to prevent sedimentation in watercourses. • Storm water outflows should not be allowed to enter directly into watercourses, but need to be attenuated before they are released into watercourses. • Interventions and mechanisms in the storm water management system can include measures to facilitate a higher percentage of infiltration and reduce runoff volumes and velocities, without concentrating their outflows as far as practically possible. • The alignment of the tailings pipeline along the new access road can also serve as a maintenance road for the pipeline, which will remove the need for a new access road along the pipeline alignment. • The damaging or destruction of any plant species Protected in terms of the National Forest Act or the Biodiversity Act should be avoided wherever possible, and a permit for the destruction of any such protected plant must be obtained from the provincial Directorate of Biodiversity Management prior to development.	*The recommendation to shift the return water dam is not feasible. Further details are contained in Section 7.7 for further details.	

Studies undertaken	Recommendations of specialists	Specialist recommendations that have been included in the EIA report (mark with an x)	Reference to applicable section in this report
	• The proposed bridge can remain at its current location as an access road through Ephemeral channel 2 that connects the two housing phases appears to be unavoidable. The bridge will have to be modified to prevent further habitat loss due to expected anthropogenic erosion damage. • The proposed bridge crossing through Ephemeral channel 2 should contain culverts across the length of the crossing and armouring on the downstream channel banks and bed to avoid further channel incision and channel bank scour during high flow events. Pipes are not recommended as they can become easily blocked with alluvial material, which can lead to further scour damage in the watercourse. • The proposed tailings pipeline should move further to the north along the new access road in order to avoid overlap with Ephemeral channels 9 and 10, as well as Ephemeral drainage line 8. Overlap with Ephemeral drainage line 7 appears to be unavoidable, but the servitude width should be minimised as far as practical during the construction process. The pipeline should be spanned across the watercourse with plinths, which will need to be located outside of Ephemeral drainage line 7. • The storm water management plan needs to give special consideration to buffer zones in order to prevent erosion impacts and the creation of channelised flows at discharge points, which would largely negate the benefits of any buffers present. • Environmental control officers should ensure that signage to identify watercourses and their buffers are kept in place and remain well visible during the construction process and that no unauthorised access occurs. Toolbox talks should address the importance and sensitivity of wetlands and other watercourses.		
Air Quality	**Construction** • Land clearing activities such as bulldozing and scraping of road and blasting • Water sprays at area to be cleared. • Moist topsoil will reduce the potential for dust generation when tipped onto stockpiles. • Ensure travel distance between clearing area and topsoil piles to be at a minimum. **Road construction activities such as road grading** • Water sprays at area to be graded. • Freshly graded areas to be kept to a minimum. • During construction operations monthly dustfall rates should not exceed 600 mg/m²/day at residential dustfall bucket locations and 1 200 mg/m²/day at non-residential dustfall bucket locations. *Wind erosion from exposed areas* • Ensure exposed areas remain moist through regular water spraying during dry, windy periods.	X	Section 28

Studies undertaken	Recommendations of specialists	Specialist recommendations that have been included in the EIA report (mark with an x)	Reference to applicable section in this report
	• Monthly dustfall rates should not exceed 600 mg/m²/day at residential dustfall bucket locations and 1 200 mg/m²/day at non-residential dustfall bucket locations. *Operations* • Ventilation shafts (underground mining emissions) • It is recommended that a mitigation measure of water sprays on underground roads resulting in 75% CE. • Shorter haul routes would reduce emissions. • It is recommended that a mitigation measure of water sprays at underground materials handling points resulting in 50% CE. • It is recommended that a mitigation measure of water sprays at underground drilling resulting in 70% CE. • Vehicle exhausts – vehicle inspection and maintenance programs. • Monthly dustfall rates should not exceed 600 mg/m²/day(a) at residential dustfall bucket locations and 1 200 mg/m²/day(b) at non-residential dustfall bucket locations. *Vehicle activity on unpaved roads* • A minimum mitigation measure of water sprays resulting in 75% CE. • Shorter haul routes would reduce emissions. • Speed limits on all the BM roads. • Vehicle exhausts – vehicle inspection and maintenance programs. • Monthly dustfall rates should not exceed 600 mg/m²/day(a) at residential dustfall bucket locations and 1 200 mg/m²/day(b) at non-residential dustfall bucket locations. *Vehicle activity on paved roads* • Shorter haul routes would reduce emissions. • Speed limits on all the BM roads. • Vehicle exhausts – vehicle inspection and maintenance programs. • Monthly dustfall rates should not exceed 600 mg/m²/day(a) at residential dustfall bucket locations and 1 200 mg/m²/day(b) at non-residential dustfall bucket locations. *Materials handling* • A minimum mitigation measure of water sprays resulting in 50% CE. • Monthly dustfall rates should not exceed 600 mg/m²/day(a) at residential dustfall bucket locations and 1 200 mg/m²/day(b) at non-residential dustfall bucket locations. *Crushing and screening*		

Studies undertaken	Recommendations of specialists	Specialist recommendations that have been included in the EIA report (mark with an x)	Reference to applicable section in this report
	• A minimum mitigation measure of enclosure with fabric filters resulting in 83% CE. • Monthly dustfall rates should not exceed 600 mg/m²/day(a) at residential dustfall bucket locations and 1 200 mg/m²/day(b) at non-residential dustfall bucket locations. *Wind erosion* • Keep active TSF and WRD surfaces to a minimum. • Monthly dustfall rates should not exceed 600 mg/m²/day(a) at residential dustfall bucket locations and 1 200 mg/m²/day(b) at non-residential dustfall bucket locations. ***General*** • Monthly dustfall rates should not exceed 600 mg/m²/day(a) at residential dustfall bucket locations and 1 200 mg/m²/day(b) at non-residential dustfall bucket locations. • PM2.5 and PM10 ambient samplers with no exceedances of the selected criteria. • SO2 and NO2 ambient samplers with no exceedances of the selected criteria. **Closure** *Wind erosion from exposed areas* • Demolition of infrastructure to have water sprays where a lot of vehicle activity is required. • Ensure site is restored to pre-mining conditions. **Record keeping and reporting** • Site inspections and progress reporting be undertaken at regular intervals (at least quarterly) during operations, with annual environmental audits being conducted. • Results from site inspections and off-site monitoring efforts should be combined to determine progress against source- and receptor-based performance indicators. Progress should be reported to all interested and affected parties, including authorities and persons affected by pollution. • Corrective action or the implementation of contingency measures must be proposed to the stakeholder forum in the event that progress towards targets is indicated by the quarterly/annual reviews to be unsatisfactory. • Stakeholder forums at specific intervals should be held for information dissemination and consultation		
Noise	**Pre-construction**: • Local residents are to be notified of any potentially noisy field survey works or other works during the planning and design phase and these activities are to be undertaken at reasonable times of the day. These works should not take place at night or on weekends. • During this phase, consideration must be given to the noise mitigation measures required	X	Section 28

Studies undertaken	Recommendations of specialists	Specialist recommendations that have been included in the EIA report (mark with an x)	Reference to applicable section in this report
	during the construction phase that should be included in the tender document specifications and the design. **Construction:** • Construction site yards, concrete batching plants, asphalt batching plants, construction worker camps (accommodation) and other noisy fixed facilities should be located well away from noise sensitive areas adjacent to the development site. • All construction vehicles and equipment are to be kept in good repair. • Noisy construction activities are to be contained to reasonable hours during the day and early evening. • The temporary ventilation system for the shaft construction should incorporate all the applicable noise mitigation measures. • With regard to unavoidable very noisy construction activities in the vicinity of noise sensitive areas, the contractor should liaise with local residents on how best to minimise impact. • In general operations should meet the noise standard requirements of the Occupational Health and Safety Act (Act No 85 of 1993). • Construction staff working in areas where the 8-hour ambient noise levels exceed 75dBA should wear ear protection equipment. **Operational:** • The following noise mitigation measures, which will need to be considered where appropriate, are indicators of what needs to be done to reduce or control the noise generated by the proposed operations: • The designs of the proposed plant are to incorporate all the necessary acoustic design aspects required in order that the overall generated noise level from the new installation does not exceed a maximum equivalent continuous day/night rating level (LRdn), namely a noise level of 70dBA (just inside the property projection plane, namely the property boundary) as specified for industrial districts in SANS 10103. • Notwithstanding this provision, the design is also to take into account the maximum allowable equivalent continuous day and night rating levels of the potentially impacted sites outside the mine property. Where the noise level at such an external site is presently lower than the maximum allowed, the maximum for that land use zoning shall not be exceeded. Where the noise level at the external site is presently at or exceeds the maximum, the existing level shall not be increased by more than indicated as acceptable in SANS 10103. Note that the induced ambient noise levels in the residential areas of Ledig Village should ideally not exceed 50dBA during the day and 40dBA at night. • The latest technology incorporating maximum noise mitigation measures for the shaft complex and concentrator plant components should be designed into the system.		

Studies undertaken	Recommendations of specialists	Specialist recommendations that have been included in the EIA report (mark with an x)	Reference to applicable section in this report
	• The design process is to consider, inter alia, the following aspects: • The position and orientation of buildings on the site. • The design of the buildings to minimise the transmission of noise from the inside to the outdoors. • The insulation of particularly noisy plant. • Specifically measures need to be taken for the two types of equipment, which are responsible for the highest noise levels from the shaft complex, namely the compressor house and the mine ventilation system (upcast vent fans): • The compressors should be fitted with effective silencers and the walls and roof of the compressor house should be constructed of a sufficiently dense material so as to achieve at least a 20dBA reduction (insertion loss) between the indoor noise and that transmitted to the outside of the building. Ventilation openings, if required, should be placed on the side of the building facing away from the noise sensitive areas. • The mine ventilation system should preferably use centrifugal fans rather than radial fans. The upcast vent fan outlets should be oriented slightly upwards and to the south-east away from Ledig Village, and if possible the enclosure of the surface infrastructure in an insulated building should also be considered. • Irrespective of the aforementioned mitigation measures that need to be taken at the sources of the noise, earth berms (noise attenuation barriers) should also be constructed: • Along the eastern perimeter of Ledig Village. • North of mine along the southern perimeter of the planned Gabonewe Estate (mine housing). • The design of the pump stations at the planned tailings dam is to incorporate all the necessary acoustic design aspects required in order that the induced ambient noise levels in the residential areas of Phatsima Village and Reagile informal settlement shall not exceed 50dBA during the day and 40dBA at night. • It should be noted that any mitigation measures taken at the development site will limit the impacts in the specific areas designed for, and will not necessarily contribute to improving the degraded noise climates in adjacent areas where there is already a problem from another source(s). **General recommendations** • The National Noise Control Regulations and SANS 10103 should be used as the main guidelines for addressing the potential noise impact on this project. • Various measures to reduce the potential noise impact from the planned mine are possible, and the mitigation measures indicated need to be considered. • The noise mitigation measures will need to be designed and/or checked by an acoustical engineer in order to optimise the design parameters and ensure that the cost/benefit of the measure is optimised.		

Studies undertaken	Recommendations of specialists	Specialist recommendations that have been included in the EIA report (mark with an x)	Reference to applicable section in this report
	• At commissioning of the mine, the noise footprint of the new shaft complex, the concentrator plant and the tailings dam area should be established by measurement in accordance with the relevant standards, namely SANS ISO 8297:1994 and SANS 10103. The character of the noise (qualitative aspect) should also be checked to ascertain whether there is any nuisance factor associated with the operation.		
Socio-economic	• Implement all Planning/ Design Phase and Construction Phase mitigation measures as outlined in the April 2008 EMP, Section 13.14.1. • A grievance/ complaints register should be compiled and implemented in which all community and Interested and Affected Parties (IAP) complaints are recorded and addressed. • Periodic communication (annual at a minimum) and feedback should be undertaken to the community and IAPs in respect of the progress of the Project and the implementation of the EIA management plans. • Implement all mitigation measures as outlined in the April 2008 EMP, Section 13.14.2. • Review all commitments outlined in the SLP and EMP, update to ensure that there is an increased benefit directed towards Phatsima. This should include meaningful interventions that promote long-term investment and expenditure in the community. • All directly affected communities will be considered for corporate social investment initiatives. BPM to clearly define beneficiaries (notably Ledig and Phatsima). Specific initiative should be defined for these communities. • BPM will continue to support the Bakubung-Ba-Ratheo Non-Mining Economic Development Trust and Bakubung-Ba-Ratheo Economic Development Unit (EDU) sustainable development initiatives and monitor their effectiveness. • All IAPs should be informed of the commencement of the decommissioning phase and the date of mine closure on a regular basis. • BPM must ensure that rehabilitation has taken place correctly, as stated in Section 13.17 of the SLP and according to legislation and the final end land users' requirements. • In order to ensure that no additional pressure is added to the existing infrastructure and services, BPM must continue to implement all mitigation measures as outlined in the April 2008 EMP, Sections 13.14.2, and 13.14.4. • Worker accommodation (construction and operation phases) must comply with the standards of international best practice; i.e. Workers Accommodation Processes and Standards: A Guidance Note by IFC and EBRD (2009). • Implement all mitigation measures as specified in the relevant 2016 specialist inputs, namely: o noise impact assessment; o air quality impact assessment; o traffic impact assessment; and o visual impact assessment in the EIA.	X	Section 28

Studies undertaken	Recommendations of specialists	Specialist recommendations that have been included in the EIA report (mark with an x)	Reference to applicable section in this report
	• A grievance/complaints register should be compiled and implemented in which all community and IAP complaints are recorded and addressed. • Periodic communication (annual at a minimum) and feedback should be undertaken to the affected communities and stakeholders in respect of the activities that will generate nuisance factors. **Construction staff, plant and equipment:** • All construction staff will agree to a Code of Conduct (CoC) that outlines protocols and standards for working on the affected land. The CoC should address the following: o respect for local residents; o respect for existing livelihood activities and the environment; o no hunting, snaring or unauthorised taking of any property belonging to someone else; o compliance with the Traffic Management Plan and all associated regulations; o unambiguous disciplinary measures for not adhering to the Code of Conduct. • Community members / affected land users will be able to lodge grievances with BPM using the existing grievance procedure. In the event that the grievance is not addressed or closed out properly, there should be an avenue through which the matter is escalated to a higher level of authority within BPM. • BPM and the Bakubung-Ba-Ratheo Traditional Authority will discuss appropriate mitigation measures including methods and procedures to minimise the disruption to land use patterns and livelihood activities. This will include, fencing off the construction site to ensure that community members and livestock do not get injured due to construction activities and providing access points (both during construction and during operations and maintenance) across, over or under the pipeline to ensure unhindered movement for pedestrian and livestock as well as a clear and simple claim mechanism in the event of proven damage to property by the contractor. • Compliance with relevant mitigation measures as outlined in the noise, air quality, and heritage assessments. **Pipeline crossings:** • Identify and confirm all affected land uses and land user groups with input from the Bakubung-Ba-Ratheo Traditional Authority. • Consider all possible measures to enable convenient and safe pedestrian and livestock crossing of the construction site and the pipeline, post construction. These may include providing overpasses and underpasses at regular intervals or in designated locations along the pipeline route. • Together with the Bakubung-Ba-Ratheo Traditional Authority and affected land user groups identify practical and cost-effective engineering solution to cross the construction site and the pipelines.		

Studies undertaken	Recommendations of specialists	Specialist recommendations that have been included in the EIA report (mark with an x)	Reference to applicable section in this report
	• The pipelines should not be fenced during operations as this will completely prevent all pedestrian and livestock from crossing. **If required:** • Hold discussions with the Traditional Authority to confirm that they are in agreement that all livelihoods activities can proceed unhindered. Should they raise concerns, these should be defined and investigated, suitable mitigation should be agreed. • Update BPM's "Grazing Compensation Assessment Procedure". Implement as and when required. • A practical and cost effective yet fair agreement should be reached between all parties. Possible mitigation measures may therefore include the construction of overpasses and underpasses at designated locations along the pipeline route or pursuing other options as detailed in the procedure[1]. • Mitigation measures should be approached in accordance with the principles of the International Finance Corporation's Performance Standard 5 on Land Acquisition and Involuntary Resettlement (IFC PS5, 2012), namely to achieve fair compensation that will not leave affected parties worse off than their position pre-project intervention. • implement all mitigation measures as outlined in the Environmental Impact Assessment and Environmental Management Program for BPM and Associated Infrastructure, April 2008. [1]Should the pipeline prohibit livestock movement to the extent that livelihoods are compromised, BPM should enhance/ extend the Bakubung-Ba-Ratheo Farming Project to provide opportunities for the affected people.		

11 ENVIRONMENTAL IMPACT STATEMENT

11.1.1 SUMMARY OF KEY FINDINGS OF THE EIA

This section provides a summary of the findings of identified and assessed potential impacts on the receiving environment in both the unmitigated and mitigated scenarios, including cumulative impacts. A summary of the potential impacts (as per Section 9), associated with the original layout (as per Section 7), in the unmitigated and mitigated scenarios for all project phases is included in Table 11.1 below. The alternatives suggested by the specialists would partly be represented by the mitigated scenario.

TABLE 11.1: SUMMARY OF POTENTIAL IMPACTS

Section	Potential impact	Significance of the impact (the ratings are negative unless otherwise specified)	
		Unmitigated	Mitigated
Geology	Additional mineral resource and sterilization of mineral resources	M	H+
Topography	Hazardous excavations and infrastructure	H	M (Plant area) M-H (TSF area)
Soils and land capability	Loss of soil resources and land capability through contamination	H	L M-H (pipeline)
	Loss of soil resources and land capability through physical disturbance	H	M-H
Biodiversity	Physical destruction of biodiversity	H	M- H (habitat / vegetation type) M (other biodiversity aspects)
	General disturbance of biodiversity	H	M
Surface water	Contamination of surface water resources	H	L M (pipeline)
	Alteration of drainage patterns	H	M
Groundwater	Contamination of groundwater resources	H	L M (pipeline)
Air quality	Air pollution	H	L-H
Noise	Noise pollution	M	M
Traffic	Road disturbance and traffic safety	M	H+
Visual	Visual impacts	H	M
Heritage, palaeontological and cultural resources	Loss of heritage, palaeontological and cultural resources	H	L-M
Socio-economic	Economic impact	H+	H+
	Inward migration	H	M

Section	Potential impact	Significance of the impact (the ratings are negative unless otherwise specified)	
		Unmitigated	Mitigated
Land use	Land use impact	H	M-L L (at closure)

The assessment of the proposed project presents the potential for significant negative impacts to occur (in the unmitigated scenario in particular) on the bio-physical, cultural and socio-economic environments both on the project sites and in the surrounding area. With mitigation these potential impacts can be prevented or reduced to acceptable levels.

It follows that provided the EMP is effectively implemented there is no environmental, social or economic reason why the project should not proceed.

11.1.2 FINAL SITE MAP

The final preferred site layout plan is included in Appendix G.

11.1.3 SUMMARY OF THE POSITIVE AND NEGATIVE IMPLICATIONS AND RISKS OF THE PROPOSED ACTIVITY AND IDENTIFIED ALTERNATIVES

A detailed discussion of the positive and negative implications and risks of the proposed activity are discussed in Section 7.5 and a high level assessment of identified alternatives is provided in Section 7.7. As discussed, site layout alternatives were suggested as a result of the impact assessment and thus are a management measure to the proposed project.

In three cases, the recommendations for shifting infrastructure layouts has already been met through the final layout as provided by the applicant (Figure 0.1); Phase 1 housing and the product stockpiles which are not overlapping the watercourse buffer areas as well as the TSF which overlaps with less Marikana Thornveld and more secondary vegetation (Section 7.7).

For the other layouts alternatives the following was concluded:

- For the pipeline route alternative, there are no expected differences for impacts to groundwater, visual, proximity to residential areas, change in land use, economic and inward migration. For Option 2 for the pipeline, there will be less disturbance to sensitive biodiversity areas, there could be an impact to a heritage resource of low significance, the sensitive Sepane soils will be avoided and the route will be located outside of the 32 m of an ephemeral channel.

- For the Phase 1a housing, there are no expected differences for impacts to heritage, groundwater, visual, change in land use, economic impact and inward migration impacts. For Option 2, the housing will be outside of the 32m buffer areas, will avoid additional degradation of eroded soils and will reduce overlap with watercourse habitats.
- For the solar plant, there are no expected differences for impacts to heritage, soils, groundwater, surface water, proximity to residential areas, land use or economic or inward migration impacts. For Option 2 there will be a lower disturbance of areas with high biodiversity conservation value and sensitivity and a slightly lower visual impact.

In conclusion:

- The final site layout as provided by the applicant already meets the recommendations for the TSF, Phase 1 mine housing and the product stockpiles.
- The Option 2 layout is the preferred alternative for the tailings and return water pipelines, Phase 1a mine housing, and the solar plant.
- The Option 1 layout is the only feasible alternative for the return water dam and the TSF.

Appendix G shows a representation of these changes.

12 IMPACT MANAGEMENT OBJECTIVES AND OUTCOMES FOR INCLUSION IN THE EMPR

Based on the outcome of the impact assessment and where applicable the recommendations from specialists the proposed management objectives and outcomes for inclusion into the environmental management programme are detailed in this section.

12.1 PROPOSED MANAGEMENT OBJECTIVES AND OUTCOMES FOR ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACTS

Specific environmental objectives to control, remedy or stop potential impacts emanating from the proposed project is provided in Table 12.1 below.

TABLE 12.1: ENVIRONMENTAL OBJECTIVES AND OUTCOMES

Aspect	Environmental objective	Outcome
Geology	To maximise use of mineral resources and minimise residual deposits	To maximise sale of waste rock
Topography	To prevent physical harm to third parties and animals from potentially hazardous excavations and infrastructure	To ensure the safety of people and animals
Soil and land capability	To prevent soil pollution and to minimise the loss of soil resources and related land capability through physical disturbance, erosion and compaction	To handle, manage and conserve soil resources to be used as part of rehabilitation and re-establishment of the pre-mining land capability
Biodiversity	To prevent the unacceptable disturbance and loss of biodiversity and related ecosystem functionality through physical destruction and disturbance	To limit the area of disturbance as far as practically possible
Surface water	To prevent pollution of surface water resources and related harm to surface water users (if any) and to prevent unacceptable alteration of drainage patterns and related reduction of downstream surface water flow	To ensure surface water quality remains within acceptable limits for both domestic and agricultural purposes. To ensure that the reduction of the volume of run-off into the downstream catchment is limited to what is necessary and that natural drainage patterns are re-established as part of rehabilitation.
Groundwater	To prevent pollution of groundwater resources and related harm to water users and to prevent losses to third party water users.	To ensure groundwater quality remains within acceptable limits for both domestic and agricultural purposes. To ensure that groundwater continues to be available to current users.
Air	To prevent air pollution health impacts	To ensure that any pollutants emitted as a result of the proposed project remains with acceptable limits
Noise	To prevent unacceptable noise impacts	To ensure that any noise generated as a result of the proposed project remain within acceptable limits
Visual	To limit negative visual impacts	To ensure visual views that complement the surrounding environment
Traffic	To reduce the potential for safety and vehicle related impacts on road users	To ensure the mine's use of public roads is done in a responsible manner
Heritage and cultural	To prevent unacceptable loss of heritage resources and related information	To protect heritage resources where possible If disturbance is unavoidable, then mitigate impact in consultation with a specialist and the SAHRA and in line with regulatory requirements
Socio-economic	To enhance the positive economic impacts and limit the negative economic impacts	To work together with existing structures and organisations
Inward migration and	To limit the impacts associated with inward	To establish and maintain a good working

Aspect	Environmental objective	Outcome
social ills	migration	relationship with surrounding communities, local authorities and land owners
Land uses	To prevent unacceptable impacts on surrounding land uses and their economic activity	To co-exist with existing land uses To negatively impact existing land uses as little as possible

12.1.1 IMPACTS THAT REQUIRE MONITORING PROGRAMMES

Outcomes of the environmental objectives are the implementation of monitoring programmes. Impacts that require monitoring include:

- Hazardous excavations and structures
- Physical destruction and general disturbance of biodiversity (this includes a protected tree monitoring programme).
- Pollution of surface water resources
- Contamination of groundwater
- Depletion of groundwater resources (due to the approved operations)
- Increase in air pollution
- Increase in noise levels
- Blasting damage (due to the approved operations)
- Traffic increase and road use

12.1.2 ACTIVITIES AND INFRASTRUCTURE

The source activities of potential impacts which require management are detailed in Section 4.2 and listed below.

- Site preparation
- Civil works
- Earthworks
- Mining and mining related activities
- Waste rock management
- Mineral processing operations
- Tailings management
- Power Supply and Use
- Water supply and use
- Process and storm water management
- Transport systems
- General and hazardous waste management
- Sewage sludge management
- Site support services
- Housing
- Site/contract management
- Demolition
- Rehabilitation
- Maintenance and aftercare

12.1.3 MANAGEMENT ACTIONS

Management actions which will be conducted to control the project activities or processes which have the potential to pollute or result in environmental degradation are detailed in Section 28.

12.1.4 ROLES AND RESPONSIBILITIES

The key personnel to ensure compliance to this EMP report will be the operations executive, the environmental department manager and the stakeholder engagement manager/sustainability manager. As a minimum, these roles as they relate to the implementation of monitoring programmes and management activities will include:

- Senior Operational Manager and Environmental Department Manager
  - Ensure that the monitoring programmes and audits are scoped and included in the annual mine budget
  - Identify and appoint appropriately qualified specialists/engineers to undertake the programmes
  - Appoint specialists in a timeously manner to ensure work can be carried out to acceptable standards
- Stakeholder engagement department/ sustainability department:
  - Liaise with the relevant structures in terms of the commitments in the SLP
  - Ensure that commitments in the SLP are developed and implemented timeously
  - Establish and maintain good working relations with surrounding communities and landowners
  - Facilitate stakeholder communication, information sharing and grievance mechanism

13 FINAL PROPOSED ALTERNATIVES

The preferred alternatives for the project include the following:

- Site Layout Option 1B (Central Route) for the tailings and return water pipelines route with modification based on specialist recommendations – Site layout Option 2.
- For the Phase 1 housing, the housing footprint will be outside of the 32 m buffer.
- For the Concentrator Complex the product stockpiles will be outside of the 32 m buffer.
- For the Phase 1a housing, the preferred alternative is Site Layout Option 2 of shifting the layout to be outside of the 32 m buffer of the unnamed tributary of the Elands River.
- The final TSF layout covers less Marikana Thornveld and more secondary vegetation that the originally assessed layout.
- For the return water dam, the only feasible layout is Site Layout Option 1 (the original layout) as its location is based on the final TSF design which has been located in its final position to be as far away from Phatsima as possible. The approved return water dam footprint would have impacted the ephemeral drainage line as well and thus there is no new impact as a result of the updated design. Site Layout Option 1 is the only feasible option.
- For the PCD, the layout is within a footprint that was already approved for a dirty water containment area and thus there is no new impact. Shifting the approved location will also not be possible as there are roads, the sewage treatment plant and powerlines north and west of the approved location of the PCD. Therefore there is no space for shifting the PCD. Site Layout Option 1 is the only feasible option.

14 ASPECTS FOR INCLUSION AS CONDITIONS OF THE AUTHORISATION

Management measures including monitoring requirements as outlined in Sections 28 and 30 need to form part of the conditions of the environmental authorisation. With reference to Section 26 of GN 982 of NEMA, additional conditions that need to form part of the environmental authorisation that are not specifically included in the EIA and EMP report include the following:

- BPM must comply with all applicable environmental legislation whether specifically mentioned in this document or not and which may be amended from time to time.

15 ASSUMPTIONS, UNCERTAINTIES AND GAPS IN KNOWLEDGE

Assumptions, uncertainties and limitations associated with the proposed project are included below.

15.1 ENVIRONMENTAL ASSESSMENT LIMIT

The EIA and EMP focused on third parties only and did not assess health and safety impacts on workers because the assumption was made that these aspects are separately regulated by health and safety legislation, policies and standards, and that BPM will adhere to these.

15.2 PREDICTIVE MODELS IN GENERAL

All predictive models are only as accurate as the input data provided to the modellers. If any of the input data is found to be inaccurate or is not applicable because of project design changes that occur over time, then the model predictions will be less accurate.

15.3 CLOSURE COST ESTIMATE

The closure cost estimate was provided to SLR by the applicant and was deemed to be correct at the time of this study. No verification was done by SLR.

15.4 FAUNA

- The fieldwork component of the current survey was conducted in summer on the 18th and 19th November 2015. The single-season survey is deemed adequate for this survey as faunal activity levels are highest during spring / summer and due to the disturbance levels on site eliminating most of the potentially occurring Red Data species..
- After the completion of the fieldwork, a final pipeline alignment was provided in December 2015 and an updated Tailings Storage Facility (TSF) layout was provided in February 2016. As the November 2015 site visit entailed an assessment within a corridor surrounding the original design and much of the December 2015 pipeline layout falls within this corridor or its immediate surrounds, the findings of the November 2015 site visit are still deemed relevant. The changes in the TSF layout do not impact the findings of this report either and thus the mapping has been kept with the previous TSF layout.
- Emphasis was placed on searching for threatened species and compiling species lists at each of the proposed development sites so as to best compare the sensitivity of each site.
- Surveys occurred during daylight hours and no nocturnal surveys took place.
- No trapping of species was performed for sampling.

- An invertebrate study was not considered necessary for this study. Invertebrate studies are of such a nature that unless something specific needs to be looked for on site, conducting sampling of general invertebrates on site will not provide valuable information. By conserving habitat the invertebrates associated with that habitat will be conserved (*Pers. Comm.* Tony De Castro, 2016)

15.5 AIR QUALITY

- Emissions were based on the process description and layout plan as provided by BPM through SLR.
- This study only considered atmospheric emissions and impacts associated with the underground mining, concentrator plant, waste rock dump and TSF at BPM.
- Site specific particle size fraction, moisture or silt content data were not available for all sources and use was made of US EPA default values and values from similar operations in South Africa.
- Only routine emissions from operations were simulated.
- Dispersion models do not contain all the features of a real environmental system but contain the feature of interest for the management issue or scientific problem to be solved (MFE, 2001). Gaussian plume models are generally regarded to have an uncertainty range between -50% to 200%. It has generally been found that the accuracy of off-the-shelf dispersion models improve with increased averaging periods. The accurate prediction of instantaneous peaks are the most difficult and are normally performed with more complicated dispersion models specifically fine-tuned and validated for the location.
- The selected dispersion model, AERMOD, cannot compute real time processes; average process throughputs were therefore used, though the nature of operations may change over the life of operations.
- Gaseous emissions would result from vehicle exhaust and blasting. Emissions from blasting underground is expected to be intermittent and minimal. Emission rates for combustion sources are dependent on the amount of fuel used, type and size of vehicles used. The fuel use amount for plant vehicles was supplied and the main underground vehicles' type and size were available. Only vehicle exhaust emissions at the plant and underground were estimated and modelled.
- NO is rapidly converted in the atmosphere into the much more toxic NO_2. The rate of this conversion process is determined by the rate of the physical processes of dispersion and mixing of the plume and the chemical reaction rates as well as the local atmospheric ozone (O_3) concentration. 20% of NO_x emissions from vehicle exhaust were assumed to be to NO_2 (Howard, 1988).
- The construction, decommissioning and closure phases of the proposed additions to BPM are assessed qualitatively. It was assumed that all processing operations will have ceased by the closure phase. The potential for impacts during this phase will depend on the extent of demolition and rehabilitation efforts during decommissioning and on features which will remain. Information

regarding the extent of demolition and/or rehabilitation procedures were limited and therefore not included in the emissions inventory or the dispersion modelling.

15.6 GROUNDWATER NUMERICAL MODEL

- The aquifer systems at the proposed TSF area can be subdivided into hydrostratigraphic units to represent naturally occurring aquifers;
- Groundwater movement in the hydrostratigraphic units follows Darcy‟s law and hence can be modelled using the equivalent porous medium‟ approach. i.e. the use of effective (or bulk) hydraulic properties to approximate conditions in the aquifer;
- Net recharge to the area is limited and weathered aquifer is mostly dry except in areas close to the Elands River; and
- The Sandspruit can be adequately represented by drain nodes set below ground surface to receive flows from the aquifers.
- The transport simulation was run for 100 years was assumed.
- A recharge source term was used at 100 % of the contaminant concentration.
- Groundwater flow at the proposed TSF was simulated with a finite difference model MODFLOW-NWT.
- Layer Property Flow (LPF) flow package and the Newton solver were used to solve the flow matrix. The Elands River was modelled using the river (RIV) package. As well as the recharge (RCH), drain package (DRN).
- The groundwater model was simulated only for the updated TSF. The contamination plume for the waste rock dump area at the plant was not remodelled and the assessment in Appendix F is based on the assumption is that the previous modelling is still applicable as the waste rock dump is not increasing in size.
- For the impact assessment included in the Appendix F of the EIA report, the predicted pollution plume of sulphate was based on the source concentration of sulphate of approximately 2830 mg/l (as per the supernatant concentration included in the TSF report).

15.7 AQUATIC ECOLOGY

- Reference conditions are unknown: The composition of aquatic biota in the study area prior to regional disturbance is unknown. For this reason, reference conditions are hypothetical, and are based on professional judgement and/or inferred from the baseline environmental data collected as part of the Environmental Impact Assessment process for the BPM.
- Lack of suitable habitat: Limited SASS5 biotopes present at the various sites which is likely to limit the diversity and sensitivity of the macro-invertebrate community.

- Lack of strong flowing water: The diatom samples for Sites Bak1 and Bak2 were taken within stagnant waters which may be subject to strong fluctuations in their condition, specifically salinity, organic and nutrient levels. Any attempt to use existing diatom indices suitable for freshwater ecosystems to determine the biological integrity of such systems will likely result in misleading conclusions.
- The 2015 survey focused on macro-invertebrates and diatoms as indicators of river health and thus did not update the database of fish assemblages.

15.8 FLORA

- A total of five days of field work and seven days of data analysis, mapping and reporting were available for the completion of this study which included the revision of the available vegetation maps for the Frischgewaagd and Mimosa sections of the study area, the compilation of a new vegetation map for the pipeline corridor and mapping of vegetation and searches for threatened plant species within the proposed infrastructure footprints.
- Vegetation mapping was based on the existing vegetation and land-cover type maps compiled by De Castro and Brits CC (May, 2015). The current survey focussed on verifying, and where necessary modifying, the vegetation mapping within the existing infrastructure footprints.
- Most of the study area is mapped as Zeerust Thornveld, with a significant area of Western Sandy Bushveld in the western parts of the farm Mimosa 81 JQ and very small areas of Moot Plains Bushveld and Marikana Thornveld along the southern boundaries of the farms Mimosa 81 JQ and Frischgewaagd 96 JQ respectively. However, the vegetation specialist indicated that the NWBSP vegetation map was compiled at a provincial scale and relied strongly on land type mapping which is inaccurate for much of the study area. It was also indicated that while the vegetation of the project area shows some physiognomic, and to a lesser extent floristic, elements of Zeerust Thornveld, it does not show any significant similarities to Western Sandy Bushveld, and conforms far more closely to the Mucina and Rutherford (2006) description of Marikana Thornveld in terms of species composition and dominance.
- The species list provided in the specialist report is based on field surveys conducted in November 2014 and March and April 2015 for the purposes of a baseline botanical biodiversity assessment (De Castro & Brits cc, May 2015) as well as five days of field work conducted for the current study in November 2015. All surveys where therefore conducted during the growing season and reasonable seasonal coverage has been incorporated. The timing of the field surveys used to compile this study is therefore not seen as a significant limitation, though additional brief surveys aimed at searching for potentially occurring 'species of conservation concern' are recommended in the specialist report. Based on the authors experience the 414 plant species provided in Appendix 1 includes approximately 80% or more of the species actually present in the study area.

- The entire length of the proposed ca. 3.83 km pipeline alignment, as proposed by the client in November 2015, was subjected to a ‘walkover’ survey by the botanist. In December 2015, after the completion of the fieldwork, a final pipeline alignment was provided. After the completion of the fieldwork, a final pipeline alignment was provided in December 2015 and an updated Tailings Storage Facility (TSF) layout, which falls entirely within the larger original layout, was provided in February 2016. The final pipeline alignment closely follows the originally proposed alignment for most of its length, and was not subjected to a walkover survey, but was assessed at a desktop level and included in the mapping corridor for the tailings pipeline. As the November 2015 site visit entailed an assessment within a corridor surrounding the original design and much of the December 2015 pipeline layout falls within this corridor or its immediate surrounds, the findings of the November 2015 site visit are still deemed relevant. The changes in the TSF layout do not impact the findings of this report either and thus the mapping has been kept as per the previous TSF layout.
- Due to project scheduling constraints, the footprints of the proposed infrastructure were not subjected to seasonal surveys. Furthermore, the study area was experiencing a severe drought at the time of the field surveys (November) and the Mimosa section and pipeline mapping corridor were severely overgrazed. The species lists provided in the specialist report can therefore not be regarded as comprehensive. Based on the authors experience the plant species lists provided in Appendix 1 of the specialist report probably include no more than approximately 80% of the species present within the study area.

15.9 HERITAGE

- Not detracting in any way from the comprehensiveness of the fieldwork undertaken, it is necessary to realise that the heritage resources located during the fieldwork do not necessarily represent all the possible heritage resources present within the area. Various factors account for this, including the subterranean nature of some archaeological sites and the current dense vegetation cover.
- Not all the development footprints assessed as part of this study were known at the time of the fieldwork. Such omitted footprints include the Mine Housing Phase 1A area as well as the Waste Rock Dump. As these development footprint areas fall within the study area of a previous heritage impact assessment (Matakoma-ARM, 2007), additional fieldwork was not deemed necessary. However, this meant that sites which had been identified during the previous study and which now fall within some of these proposed development footprints were not visited in the field. The findings and information in this study are still considered relevant for the project.
- The study area of the heritage impact assessment undertaken by ARM-Matakoma (2007) included significant components of the proposed development footprint areas assessed for this report. As a result, the findings, significance assessments and mitigation measures outlined in the 2007 are integrated within this report.

- Following the completion of the site visit, the layout of the TSF was updated. The footprints of the old and new layout of the TSF are in the same area, with minor differences. The findings of this study are still relevant for the updated layout and no additional identified heritage sites are affected by the new layout.
- It is the understanding of the author of this report that a destruction permit was issued by SAHRA in terms of two Iron Age sites falling within the present study area, namely MHC002 and MHC004. This followed on mitigation work carried out by Matakoma-ARM in 2008. However, no copy of this destruction permit was available at the time that this current report was released. Furthermore, the author of this report was informed that these two sites were destroyed in terms of the permission provided by this destruction permit.

15.10 SURFACE WATER

- It is assumed for the unmitigated scenario that for the project area each hectare has an equal contribution to the reduction of mean annual runoff.

15.11 NOISE

- Noise is variable and can be influenced by climatic conditions so the findings of the noise study should not be taken as absolute/definitive.
- The tailings facility design and the pipeline alignment changed during the course of the compilation of this report. These changes do not impact on the findings of this study and thus mapping with the previous layout has been retained.
- Sound power level of some of the new equipment is not yet available. Data from similar type equipment was used in the calculations.

15.12 SOCIO-ECONOMIC

- It was assumed that information provided by BPM and SLR is accurate and that the technical specifications of the Project and site selection are in accordance with the relevant requirements.
- This report and assessment are dependent on the accuracy of the publicly available secondary information; such as Statistics South Africa (StatsSA, 2011), and the 2008 SIA. The data from these sources was considered sufficient for the purposes of this study.
- The economic information used in this SIA is the most recent that could be obtained.
- No further detailed community level survey was performed as part of this SIA; the 2008 SIA provided a detailed overview of the neighbouring communities of Ledig and Phatsima.
- The assessment is based on project information provided at the time of the study.

- At the time this SIA was submitted, none of the associated specialist studies were available for review and incorporation; namely the water, noise, air quality, traffic and visual assessments. No water related impacts have been identified or assessed. Cursory links have been made to the noise, air quality, traffic and visual impacts as nuisance factors.
- Selected key informant interviews were performed. Community concerns were identified using the public participation records (i.e. the comments and response register in the Final Scoping Report, 2015).
- The 2008 SIA has been used as a basis for impact identification, assessment and formulation of mitigation measures. This is to ensure that the findings are aligned with BPM's current management approach. Most impacts fall away completely and others are being managed through the existing management plan; the assumption is that BPM is in full compliance with all commitments in their existing Management Plan.

15.13 SOIL, LAND CAPABILITY AND LAND USE

- The site visit for this study was conducted in summer in November 2015. During December 2015 the layout for the pipeline changed. As the November 2015 site visit entailed an assessment of the soils within a corridor surrounding the original design and the December 2015 pipeline layout falls mostly within this corridor, the findings of the November 2015 site visit are still deemed relevant.

15.14 ROAD AND TRAFFIC DISTURBANCE

- The traffic study considered 910 housing units. Following the analysis the applicant indicated that there would be 400 houses. From the above it was concluded that the impact of fewer houses will decrease private vehicle/car trips from Gabonewe Estate and increase public transport trips from external housing developments. This will reduce the overall number of vehicle trips, i.e. have a lesser traffic impact during the peak hours and the proposed mitigation measures will still be adequate.
- It was assumed that none of the office staff, consisting mostly of managerial positions, would be allocated housing in Gabonewe Estate and would make use primarily of private transport.
- For the purposes of the report, it was assumed that Phase 1A would be the only mine housing provided for the time being, in order to analyse a worst-case scenario.
- During the decommissioning and closure phases it can be expected that the traffic impact of the mine will reduce and eventually discontinue.
- The 910 housing units are 70% of the total development for which the TIA was done. Only 70% of the trip generation for the housing were therefore included in the 2016 TIA as latent rights and the same distribution for these trips were also assumed.
- For the purpose of trip distribution, office employees were assumed to use private vehicles/cars, while the shift employees were assumed to make use of public transport (minibus taxis).

- An annual growth rate of 3% was assumed for background traffic.
- The peak hours considered for the analysis of the intersections was based on the shift change times and the existing peak hours observed during the traffic counts. In the mornings it was assumed that the shift ending at 06:00 would leave the mine between 06:00 and 07:00, this will coincide with the arrival of the office employees who start work at 07:00. This overlap in arrivals and departures was considered to be the worst case scenario.
- For the study, the upgraded layout suggested by the 2014 housing TIA conducted was assumed to be the intersection layout for the analysis of both the base and horizon years.
- It was assumed that the average heavy vehicle (HV) currently on the R565 is equivalent to 3.0 E80's. E80's defined by the Guidelines for Provision of Engineering Services and Amenities in Residential Township Development.
- For the additional heavy vehicle loading, it was assumed that all heavy vehicles, except slurry trucks, will be distributed equally to the north (via R565 and R556) and south (via R565 to/from Rustenburg) of the access.
- The 2008 TIA assumed two access points to the mine site: 1 from the R565 and another from the R556. It is now proposed only to have 1 access from the R565.
- The housing development was not considered as part of the 2008 TIA. A TIA was conducted for the Gabonewe housing development by Mott MacDonald PDNA in 2014, which recommended certain road upgrades and which were considered in the WSP study.
- The details contained in the 2008 TIA were very limited in terms of trip generation and distribution characteristics; mode of employee transport (private/public); and heavy vehicle trip generation and impact.
- The horizon year of the 2008 TIA was 2011. Typically traffic impact studies only stay relevant for a maximum period of 5 years and none of the road upgrades recommended in the 2008 TIA have yet been implemented.
- The TIA considered the trip generation of the full mine and not only the proposed changes, this was done based on the following reasons:
  - The TIA conducted by Trafftrans in 2008 for the approved project assumed two access points to the mine site: 1 from the R565 and another from the R556. It is now proposed only to have 1 access from the R565;
  - The housing development was not considered as part of the 2008 TIA. A TIA was conducted for the Gabonewe housing development by Mott MacDonald in 2014, which recommended certain road upgrades and which were considered in the 2016 study;
  - The details contained in the 2008 TIA were very limited in terms of trip generation and distribution characteristics; mode of employee transport (private/public); and heavy vehicle trip generation and impact;

- The horizon year of the 2008 TIA was 2011. Typically traffic impact studies only stay relevant for a maximum period of 5 years and none of the road upgrades recommended in the 2008 TIA have yet been implemented.

Considering the above, together with the fact that currently available staff volume estimations and information regarding mine operations and production are based on the full mine development, the 2016 TIA considered the trip generation of the full mine and then compared the mitigation measures with those recommended by Trafftrans (2008).

15.15 WATERCOURSE DELINEATION

- Wetland areas within transformed landscapes, such as urban, agricultural settings, or mining areas with existing infrastructure, are often affected by disturbances that restrict the use of available wetland indicators, such as hydrophytic vegetation or soil indicators (e.g. as a result of the dominance of alien vegetation, stock piling, sedimentation, hard surfaces, and infilling). Hence, a wide range of available indicators are considered, to help determine wetland boundaries more accurately.
- Wetland assessments are based on a selection of available techniques that have been developed through the Department of Water and Sanitation. These methods are, however, largely qualitative in nature with associated limitations due to the range of interdisciplinary aspects that have to be taken into consideration.

15.16 GENERAL

- Layouts included in the EIA and EMP are as per information and layouts provided by the applicant. For the solar plant and Phase 1a mine housing, only indicative positions have been included based on information provided by the applicant. Should these differ from the final layout, these areas would need to be re-assessed.
- The final preferred layouts based on changes suggested by the specialists (the tailings and return water pipelines, the solar plant and Phase 1a housing) have been shown on the final layout map as a representation of what the final layout will look like. This does not represent the final designed layouts and it is assumed the applicant will ensure designs and implementation of these meets the requirements of the specialist recommendations.
- The EIA and EMP have been compiled with the assumption the specialists and the applicant have provided the best available information and the information is true and correct.
- Information sourced from the approved mine EIA and EMP and the approved housing BAR and EMP is assumed to be true and correct.

16 REASONED OPINION AS TO WHETHER THE PROPOSED ACTIVITY SHOULD OR SHOULD NOT BE AUTHORISED

16.1.1 REASONS WHY THE ACTIVITY SHOULD BE AUTHORIZED OR NOT

The assessment of the proposed project presents the potential for significant negative impacts to occur (in the unmitigated scenario in particular) on the bio-physical, cultural and socio-economic environments both on the project sites and in the surrounding area. With mitigation these potential impacts can be prevented or reduced to acceptable levels. None of the specialist provided any objections to the implementation of the study based on their specific field of study. It follows that provided the EMP is effectively implemented there is no environmental, social or economic reason why the project should not proceed.

16.1.2 CONDITIONS THAT MUST BE INCLUDED IN THE AUTHORISATION

16.1.2.1 Specific conditions for inclusion in the EMPR

Refer to Section 14.

16.1.2.2 Rehabilitation Requirements

Refer to Section 29.1.1.

17 PERIOD FOR WHICH AUTHORISATION IS REQUIRED

The life of mine is expected to be approximately 28 years.

18 UNDERTAKING

I, Chiara D'Egidio Kotze, the Environmental Assessment Practitioner responsible for compiling this report, undertake that:

- the information provided herein is correct;
- the comments and inputs from stakeholders and IAPs has been included;
- inputs and recommendations from the specialist reports have been included where relevant.
- Any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested or affected parties are included where relevant

Signature of EAP Date

Signature of commissioner of oath Date

19 FINANCIAL PROVISION

19.1.1 METHOD TO DERIVE THE AMOUNT TO MANAGE AND REHABILITATE THE ENVIRONMENT

Estimated costs for implementing the technical and management actions identified in Section 28 are included in the table below (Table 19.1). Please note that the costs included in the table are based on conceptual estimates only (using experience in similar projects) and input by the applicant.

TABLE 19.1: ESTIMATED COSTS FOR IMPLEMENTING TECHNICAL AND MANAGEMENT OPTIONS

Potential impact	Technical and management options	Estimated costs
Resources	• All options need to be implemented with input from a dedicated environmental management resource at the mine.	• R700 000.00
Auditing and annual review	• Biannual EMP performance assessment (external) • Annual review of closure cost estimate • Water Use Licence Audit (external)	• R60 000.00 (EMP performance assessment) • R92 000.00 (Closure cost update) • R45 000.00 (WULA audit)
Hazardous structures	• Establish and maintain site security measures • Control site and facility access • Appropriate design of stockpiles, TSF, PCD with the potential to fail (and by qualified person) • Establish and maintain infrastructure security measures • Undertake third party awareness training	• Approximately 2 million to cover all aspects
Loss of soil resources	• Implement a site-specific soil management plan • Implement a non-mineralised waste management procedure (provide skips for waste sorting and waste removal contractor) • Rehabilitation of contaminated soils (as soon as possible)	• Approximately 1 million to cover all aspects
Biodiversity	• Survey for protected trees • Apply for permit to disturb protected trees • Implement a monitoring programme to remove alien and invasive species	• R35 000 (per survey) • R30 000.00 (Tree removal permit - as and when required) • R30 000 (Alien invasive species programme) •
Alternation of drainage patterns	• Construction of storm water controls (and by qualified person) •	• R20 000 000.00 (storm water controls – once off) •
Surface water pollution	• Maintain storm water controls and inspections • Update water balance on an annual basis • Surface water monitoring	• R30 000.00 (water balance) • R60 000.00 (maintain storm water controls and inspections) • R400 000.00 (monitoring)
Groundwater quality and quantity	• Groundwater monitoring. • Installation of liners in recycled water dams	• R400 000.00 (monitoring) • R 210 000 000.00 (liners – once off)
Air pollution	• Continue monitoring on site and install PM2.5 monitor	• R400 000.00 (monitoring). • R400 000 ($PM_{2.5}$ sampler – once off)
Disturbing noise	• Short term noise monitoring if required • Maintenance of equipment	• R60 000.00 (Noise sampling) • R 500 000.00 (maintenance)
Landscape and visual	• Retain natural vegetation as screens • Paint buildings and structures in colours that reflect landscape • Careful use of night lights • Prevent litter	• Approximately R500 000.00
Blast hazards	• Design and implement blast to meet threshold criteria • Monitor blasts and installation of seismographs	• R200 000.00 (blast design and monitoring)
Traffic	• On-going training of staff • Maintenance of vehicles and of roads	• R150 000.00 (training) • R2 000 000 (maintenance)
Heritage	• Phase 2 assessments for destruction of heritage resources.	• R200 000.00 (specialist assessment)

Potential impact	Technical and management options	Estimated costs
Socio-economic	• Quarterly meetings	• R100 000.00

The estimated total amount to manage and rehabilitate the environment amount to approximately R239 392 000. It is however important to note that some of these costs are once-off and will only be required during the construction phase as part of implementing facilities. The once off costs are approximately R230 400 000.

19.1.2 CONFIRM THAT THE AMOUNT CAN BE PROVIDED FOR FROM OPERATING EXPENDITURE

The amount required in order to manage and rehabilitate the environmental is provided for in the operating costs.

20 DEVIATIONS FROM SCOPING REPORT AND APPROVED PLAN OF STUDY

20.1.1 DEVIATION FROM THE METHODOLOGY USED IN DETERMINING THE SIGNIFICANCE OF POTENTIAL ENVIRONMENTAL IMPACTS AND RISKS

No deviations in terms of the methodology used to determine the significance of potential environmental impacts and risks were made as per the approved plan of study in the scoping report.

20.1.2 MOTIVATIONS FOR DEVIATION

Not applicable.

21 SPECIFIC INFORMATION REQUIRED BY THE COMPETENT AUTHORITY

21.1.1 IMPACT ON THE SOCIO-ECONOMIC CONDITIONS OF ANY DIRECTLY AFFECTED PERSON

The impacts associated with socio-economic conditions are discussed in Appendix F. Management and mitigation measures identified to address any socio-economic impacts are included in Section 28. It is however important to note that no person will be directly affected by the proposed project given that no IAPs currently reside within the proposed project footprint area.

21.1.2 IMPACT ON ANY NATIONAL ESTATE REFERRED TO IN SECTION 3(2) OF THE NATIONAL HERITAGE RESOURCES ACT

Some heritage sites of low significance will need to be destroyed as part of this project. Some heritage sites of medium/high significance will need to be relocated (e.g. graves); refer to Appendix F for further details. For the relocation of graves, the process as provided by the heritage specialist will need to be followed which includes:

- A detailed social consultation process, at least 60 days in length, comprising the attempted identification of the next-of-kin so as to obtain their consent for the relocation of the graves.
- Bilingual site notices (in the most appropriate languages) indicating the intent of the relocation.
- Bilingual newspaper notices indicating the intent of the relocation.
- Permit applications to the legally required authorities, including (but certainly not restricted to) the South African Heritage Resources Agency.
- An exhumation process that keeps the dignity of the remains and family intact.
- An exhumation process that will safeguard the legal rights of the families as well as that of the development company.
- The process must be done by a reputable company well versed in the mitigation of graves.

22 OTHER MATTERS REQUIRED IN TERMS OF SECTIONS 24(4)(A) AND (B) OF THE ACT

No other matters are required in terms of Section 24(4)(A) and (B) of the act.

PART B – ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT

23 DETAILS OF THE EAP

It is hereby confirmed that the details of the EAP who undertook the EIA and prepared this EMP are provided in Part A, Section 1 of the EIA report.

24 DESCRIPTION OF THE ASPECTS OF THE ACTIVITY

It is hereby confirmed that the activities covered by this EMP are fully described in Part A, Section 4 of the EIA report.

25 COMPOSITE MAP

A map indicating all surface infrastructure superimposed on the environmental sensitive areas of the preferred site is included in Appendix G.

26 DESCRIPTION OF THE IMPACT MANAGEMENT OBJECTIVES INCLUDING MANAGEMENT STATEMENTS

26.1 DETERMINATION OF CLOSURE OBJECTIVES

The closure objectives for the proposed project were determined taking into account the exiting type of environment as described in Section 7.4.1, in order to ensure that the closure objectives strive to achieve a condition approximating its natural state as far as possible. Further information pertaining to the closure objectives identified for the proposed project, refer to Section 29.1.1.

26.2 THE PROCESS FOR MANAGING ENVIRONMENTAL DAMAGE AS A RESULT OF UNDERTAKING THE ACTIVITY

The management measures outlined in Section 28 have been identified in order to manage and reduce impacts associated with the proposed project in order to prevent unnecessary damage to the environment as a result of the proposed project. In the event that incidents occur that may result in environmental damages the emergency response procedure as outlined in Section 31.2.2 will be implemented to avoid pollution or degradation.

26.3 POTENTIAL RISK OF ACID MINE DRAINAGE

As part of the proposed project a geochemistry analysis was undertaken. The results of the analysis indicate that there is no risk of acid mine drainage. Further information is provided in Section 7.4.1.7.

26.4 STEPS TAKEN TO INVESTIGATE, ASSESS AND EVALUATE THE IMPACT OF ACID MINE DRAINAGE

This section is not applicable as acid mine drainage is not associated with the proposed project.

26.5 ENGINEERING OR MINE DESIGN SOLUTIONS TO AVOID OR REMEDY ACID MINE DRAINAGE

This section is not applicable as acid mine drainage is not associated with the proposed project.

26.6 MEASURES IN PLACE TO REMEDY RESIDUAL OR CUMULATIVE IMPACT FROM ACID MINE DRAINAGE

This section is not applicable as acid mine drainage is not associated with the proposed project.

26.7 VOLUMES AND RATE OF WATER USE FOR MINING

Return water from the TSF is dependent on season; therefore this is not included in the water balances below. The scenarios below consider the water demands if no treated sewage water is utilised (Scenario 1), if treated sewage water is utilised (Scenario 2) and if treated sewage water from the mine and housing area is utilised (Scenario 3). The housing calculations assume 1200 houses from Phase 1 and Phase 1a.

Scenario 1 – No sewerage water

Peak Water Demand	Quantity	Unit
Wet Season Peak Water Demand:	7853	m3/day
Average Season Peak Water Demand:	7487	m3/day
Dry Season Peak Water Demand:	7305	m3/day
Peak Water Demand - No TSF Return Water:	8950	m3/day
Mean Water Demand	**Quantity**	**Unit**
Wet Season Mean Water Demand:	4927	m3/day
Average Season Mean Water Demand:	4943	m3/day
Dry Season Mean Water Demand:	5743	m3/day

Scenario 2 – Mine sewerage water of 607 m3/day

Peak Water Demand	Quantity	Unit
Wet Season Peak Water Demand:	6965	m3/day
Average Season Peak Water Demand:	6599	m3/day
Dry Season Peak Water Demand:	6417	m3/day
Peak Water Demand - No TSF Return Water:	8062	m3/day
Mean Water Demand	**Quantity**	**Unit**
Wet Season Mean Water Demand:	4039	m3/day
Average Season Mean Water Demand:	4055	m3/day
Dry Season Mean Water Demand:	4855	m3/day

Scenario 3 – Mine sewerage water of 607 m3/day plus housing sewerage of 807 m3/day for 1200 houses:

Peak Water Demand	Quantity	Unit
Wet Season Peak Water Demand:	6158	m3/day
Average Season Peak Water Demand:	5792	m3/day
Dry Season Peak Water Demand:	5610	m3/day
Peak Water Demand - No TSF Return Water:	7255	m3/day

Mean Water Demand	Quantity	Unit
Wet Season Mean Water Demand:	3232	m3/day
Average Season Mean Water Demand:	3248	m3/day
Dry Season Mean Water Demand:	4048	m3/day

26.8 HAS A WATER USE LICENCE BEEN APPLIED FOR

An amendment to the water use license application is required for the proposed project. The water use license amendment application will be submitted to the DWS in mid-2016. The DWS has been notified that a water use license application will be submitted as part of the proposed project. In this regard a copy of the notice of intent letter submitted to the DWS and minutes from meetings held with the DWS are in included in Appendix E.

26.9 IMPACTS TO BE MITIGATED IN THEIR RESPECTIVE PHASES

The section below focuses on mitigation measures that are specific to listed activities based on actions outlined in Section 28.

TABLE 26.1: MEASURES TO REHABILITATE THE ENVIRONMENT AFFECTED BY THE LISTED ACTIVITIES

Activities (Listed)		Phase	Size and scale of disturbance	Mitigation measures	Compliance with standards	Time period for implementation
Number	**Description**					
GNR 983 Activity 1	The development of facilities or infrastructure for the generation of electricity from a renewable resource where - (i) the electricity output is more than 10 megawatts but less than 20 megawatts; or (ii) the output is 10 megawatts or less but the total extent of the facility covers an area in excess of 1 hectare; excluding where such development of facilities or infrastructure is for photovoltaic installations and occurs within an urban area.	All phases	Additional area to be developed will cover approximately 90.4 ha	As part of construction and operation the following should be undertaken: • Limit the clearing of vegetation and limiting infrastructure, activities and related disturbance to those absolutely necessary • Conduct pre-construction surveys of protected plants and trees of development footprints to identify locations of species of concern Obtain the required tree and plant removal permits prior to vegetation clearing Implement vegetation monitoring programme as prescribed in Table 30.1 Implement an alien and invasive species management plan • Apply the soil management principles contained in Table 28.4. • Apply appropriate management measures (e.g. destruction permits, relocation permits) for heritage sites to be impacted. • Apply chance find procedures for change heritage site finds. • As part of con-current rehabilitation during the operational and decommissioning phases, all cleared areas should be re-seeded once the topsoil has been replaced with a seed mixture reflecting the current natural vegetation. Closure objective should aim to ensure effective rehabilitation to as close to pre-mining conditions as practically possible. In addition the designs of any permanent and potentially polluting structures (TSF) will take consideration of the requirements for long-term ecosystem functionality, pollution prevention and confirmatory monitoring • During closure final rehabilitated areas will be managed through a care and maintenance programme to limit and/or enhance the long term post closure visual impacts	The mitigation action to obtain a tree removal permit from DAFF is in accordance with the National Forests Act (No. 84 of 1998) that stipulates that no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree or any forest product derived from a protected tree, except under a license. Compliance with the National Heritage Resource Act No. 25 of 1999 in the event of any chance finds of heritage resources.	• On-going • Prior to construction • On-going • Prior to construction • As required • On-going • Closure
GNR 984 Activity 2	The development and related operation of facilities or infrastructure for the generation of electricity from a non-renewable resource where the electricity output is 20 megawatts or more.	All phases				
GNR 983 Activity 10	The development and related operation of infrastructure exceeding 1000 metres in length for the bulk transportation of sewage, effluent, process water, waste water, return water, industrial discharge or slimes - (i) with an internal diameter of 0,36 metres or more; or (ii) with a peak throughput of 120 litres per second or more; excluding where - (a) such infrastructure is for bulk transportation of sewage, effluent, process water, waste water, return water, industrial discharge or slimes inside a road reserve; or (b) where such development will occur within an urban area.	All phases				
GNR 983 Activity 28	Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture or afforestation on or after 01 April 1998 and where such development: (i) will occur inside an urban area, where the total land to be developed is bigger than 5 hectares; or (ii) will occur outside an urban area, where the total land to be developed is bigger than 1 hectare; excluding where such land has already been developed for residential, mixed, retail, commercial, industrial or institutional purposes.	All phases				
GNR 983 Activity 32	The continuation of any development where the environmental authorisation has lapsed and where the continuation of the development, after the date the environmental authorisation has lapsed will meet the threshold of any activity or activities listed in this Notice, Listing Notice 2 of 2014, or Listing Notice 3 or Listing Notice 4 of 2014.	All phases				
GNR 984 Activity 15	The clearance of an area of 20 hectares or more of indigenous vegetation, excluding where such clearance of indigenous vegetation is required for- (i) the undertaking of a linear activity; or (ii) maintenance purposes undertaken in accordance with a maintenance management plan.	All phases				
GNR 984 Activity 17	Any activity including the operation of that activity which requires a mining right as contemplated in section 22 of the Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002), including associated infrastructure, structures and earthworks, directly related to the extraction of a mineral resource, including activities for which an exemption has been issued in terms of section 106 of the Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002).	All phases				
GNR 985 Activity 4	The development of a road wider than 4 metres with a reserve less than 13.5 metres.	All phases				
GNR 984 Activity 21	Any activity including the operation of that activity associated with the primary processing of a mineral resource including winning, reduction, extraction, classifying, concentrating, crushing, screening and washing but excluding the smelting, beneficiation, refining, calcining or gasification of the mineral resource in which case activity 6 in this Notice applies.	All phases				
GNR 985 Activity 12	The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan.	All phases				
GNR 983 Activity 9	The development of infrastructure exceeding 1000 metres in length for the bulk transportation of water 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; excluding where - (a) such infrastructure is for bulk transportation of water or storm water or storm water drainage inside a road reserve; or (b) where such development will occur within an urban area.	All phases				

Activities (Listed)		Phase	Size and scale of disturbance	Mitigation measures	Compliance with standards	Time period for implementation
Number	**Description**					
GNR 983 Activity 12	The development of - (i) canals exceeding 100 square metres in size; (ii) channels exceeding 100 square metres in size; (iii) bridges exceeding 100 square metres in size; (iv) dams, where the dam, including infrastructure and water surface area, exceeds 100 square metres in size; (v) weirs, where the weir, including infrastructure and water surface area, exceeds 100 square metres in size; (vi) bulk storm water outlet structures exceeding 100 square metres in size; (vii) marinas exceeding 100 square metres in size; (viii) jetties exceeding 100 square metres in size; (ix) slipways exceeding 100 square metres in size; (x) buildings exceeding 100 square metres in size; (xi) boardwalks exceeding 100 square metres in size; or (xii) infrastructure or structures with a physical footprint of 100 square metres or more; where such development occurs - (a) within a watercourse; (b) in front of a development setback; or (c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse; - excluding - (aa) the development of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour; (bb) where such development activities are related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies; (cc) activities listed in activity 14 in Listing Notice 2 of 2014 or activity 14 in Listing Notice 3 of 2014, in which case that activity applies; (dd) where such development occurs within an urban area; or (ee) where such development occurs within existing roads or road reserves.	All phases	Additional area to be developed will cover approximately 90.4 ha (not all of this footprint will be near watercourses)	• In all phases mine infrastructure will be constructed, operated and maintained so as to comply with the provisions of the National Water Act (36 of 1998) and Regulation 704 (4 June 1999) of any future amendments thereto. These include: ○ Clean water systems are separated from dirty water systems through the storm water management plan ○ The water balance is refined on an on-going for water management and impact mitigation (Table 28.1). ○ The location of all activities and footprints are to be outside zones and/or flood lines of watercourses. If this is unavoidable the necessary exemptions/approvals will be obtained. • Ensure appropriate design, construction and management of water containment facilities. • Implementation of appropriate erosion control measures • Site rehabilitation will aim to restore surface drainage patterns as far as practically and economically feasible	National Water Act (36 of 1998) and Regulation 704 (4 June 1999) Water use licence in terms of Section 21c and i of the NWA.	• On-going • On-going • On-going • As required • On-going • On-going • Closure
GNR 983 Activity 13	The development of facilities or infrastructure for the off-stream storage of water, including dams and reservoirs, with a combined capacity of 50000 cubic metres or more, unless such storage falls within the ambit of activity 16 in Listing Notice 2 of 2014.	All phases	Return water dam 433 000m^3 (total) Reservoirs 3000m^3 (additional)			
GNR 983 Activity 19	The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 cubic metres from - (i) a watercourse; (ii) the seashore; or (iii) the littoral active zone , an estuary or a distance of 100 metres inland of the high water mark of the sea or an estuary, whichever distance is the greater but excluding where such infilling, depositing, dredging, excavation, removal or moving - (a) will occur behind a development setback; (b) is for maintenance purposes undertaken in accordance with a maintenance management plan; or (c) falls within the ambit of activity 21 in this Notice, in which case that activity applies.	All phases	Excavations will be done for the changes/additional infrastructure which will cover approximately 90.4 ha (not all of this footprint will be near watercourses)			
GNR 985 Activity 2	The development of reservoirs for bulk water supply with a capacity of more than 250 cubic metres.	All phases	0.3 ha, Reservoirs 3 000m^3 (additional)			
GNR 985 Activity 14	The development of - (i) canals exceeding 10 square metres in size ; (ii) channels exceeding 10 square metres in size; (iii) bridges exceeding 10 square metres in size;(iv) dams, where the dam, including infrastructure and water surface area exceeds 10 square metres in size; (v) weirs, where the weir, including infrastructure and water surface area exceeds 10 square metres in size;(vi) bulk storm water outlet structures exceeding 10 square metres in size;(vii) marinas exceeding 10 square metres in size;(viii) jetties exceeding 10 square metres in size;(ix) slipways exceeding 10 square metres in size;(x) buildings exceeding 10 square metres in size; (xi) boardwalks exceeding 10 square metres in size; or(xii) infrastructure or structures with a physical footprint of 10 square metres or more; where such development occurs - (a) within a watercourse ;(b) in front of a development setback ; or(c) if no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse; excluding the development of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour.	All phases	Additional area to be developed will cover approximately 90.4 ha (not all of this footprint will be near watercourses)			
GNR 985 Activity 23	The expansion of- (i) canals where the canal is expanded by 10 square metres or more in size; (ii) channels where the channel is expanded by 10 square metres or more in size;(iii) bridges where the bridge is expanded by 10 square metres or more in size;(iv) dams where the dam is expanded by 10 square metres or more in size;(v) weirs where the weir is expanded by 10 square metres or more in size; (vi) bulk storm water outlet structures where the structure is expanded by 10 square metres or more in size;(vii) marinas where the marina is expanded by 10 square metres or more in size; (viii) jetties where the jetty is expanded by 10 square metres or more in size;(ix) slipways where the slipway is expanded by 10 square metres or more in size;(x) buildings where the building is expanded by 10 square metres or more in size;(xi) boardwalks where the boardwalk is expanded by 10 square metres or more in size; or (xii) infrastructure or structures where the physical footprint is expanded by 10 square metres or more; where such development occurs -(a) within a watercourse ;(b) in front of a development setback adopted in the prescribed manner; or(c) if no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse ;excluding the expansion of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour.	All phases				

Activities (Listed)		Phase	Size and scale of disturbance	Mitigation measures	Compliance with standards	Time period for implementation
Number	**Description**					
GNR 983 Activity 34	The expansion or changes to existing facilities for any process or activity where such expansion or changes will result in the need for a permit or licence or an amended permit or licence in terms of national or provincial legislation governing the release of emissions or pollution , excluding - (i) where the facility, process or activity is included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case the National Environmental Management: Waste Act, 2008 applies; or (ii) the expansion of or changes to existing facilities for the treatment of effluent, wastewater or sewage where the capacity will be increased by less than 15 000 cubic metres per day.	All phases	Additional 36 ha of the TSF to be developed (includes the return water dam footprint)	• BPM will comply with both the National Water Act (36 of 1998) and Regulation 704 (4 June 1999) • All hazardous chemicals (diesel) must be handled in a manner that surface water is not polluted. This will be implemented by means of the following: ○ Pollution prevention through basic infrastructure design ○ Pollution prevention through maintenance of equipment ○ Pollution prevention through education and training of workers (permanent and temporary) ○ Pollution prevention through appropriate management of hazardous, materials and ○ The required steps to enable containment and remediation of pollution incidents • Specifications for post rehabilitation audit criteria to ascertain whether the remediation has been successful and if not, to recommend and implement further measures. • Infrastructure that has the potential to pollute groundwater resources will be designed and implemented in a manner that pollution is addressed in all mine phases. In this regard design of the TSF needs to comply with Section 7 of GN. 632 of NEM:WA where relevant. • Monitoring all potential impact zones to track pollution through the groundwater monitoring programme outlined in Section 30. • In the case of a major discharge incident that may result in the pollution of water resources, the emergency response procedure in Section Section 31.2.2 will be followed.	Water use licence in terms of Section 21g of the NWA. Regulations regarding the planning and management of residue stockpiles and deposits from a prospecting, mining, exploration or production operation in terms of NEM:WA, Regulation 632	• On-going • On-going • On-going • On-going • On-going • As required
GNR 984 Activity 4	The development of facilities or infrastructure, for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of more than 500 cubic metres.	All phases	> 500 m3 (total)			
GNR 984 Activity 25	The development and related operation of facilities or infrastructure for the treatment of effluent, wastewater or sewage with a daily throughput capacity of 15000 cubic metres or more.	All phases	0.44 ha			
GNR 921 Category B(7)	The disposal of any quantity of hazardous waste to land.	All phases	166 ha TSF			
GNR 921 Category B(10)	The construction of a facility for a waste management activity listed in Category 8 of this Schedule (not in isolation to associated waste management activity).	All phases	Additional 36 ha of the TSF to be developed (includes the return water dam footprint)			
GNR 921 Category B(11)	The establishment or reclamation of a residue stockpile or residue deposit resulting from activities which require a mining right, exploration right or production right in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002).	All phases				
GNR 921 Category C(3)	The storage of waste tyres in a storage area exceeding 500 m^2.	All phases	> 500 m3 (total)			

27 IMPACT MANAGEMENT OUTCOMES

The section below provides a description of the outcomes and objective of mitigation actions in order to manage, remedy, control or modify potential impacts. The mitigation actions identified to achieve these outcomes and objectives are described in Section 28. It should be noted that the table below includes additional impacts that did not need to be re-assessed as part of this project (refer to Appendix F) but have been incorporated in terms of their management measures as they were included in the approved 2008 EMP. These include changes to geology, groundwater levels, blasting and tourism.

TABLE 27.1: DESCRIPTION OF IMPACT MANAGEMENT OUTCOMES

Activity	Potential impact	Affected aspect	Phase	Mitigation type	Standard to be achieved (Impact management outcome/objectives)
Mining	Changes to geology	Geology	Construction Operation Decommissioning Closure	• Manage through efficient mining practices	• Optimal mining of ore reserve.
Construction of infrastructure	Impact of geology on infrastructure construction		Construction Operation Decommissioning Closure	• Manage through implementation of engineering inputs	• Minimise impact to structures
Waste rock management	Inclusion of additional mineral resources		Construction Operation Decommissioning Closure	• Manage through sale of all available aggregate waste rock	• Maximise the economic benefit of available minerals.
Site preparation Civil works Earthworks Waste rock management Mining and mining related activities Tailings management Demolition Rehabilitation Maintenance and aftercare	Hazardous excavations infrastructure and surface subsidence	Topography	Construction Operation Decommissioning Closure	• Control through access control • Control through management and monitoring • Control through rehabilitation • Remedy through emergency response procedure (Section 31.2.2) • Control and remedy through training	• To ensure the safety of people and animals in order to prevent physical harm from potentially hazardous excavations and infrastructure

Activity	Potential impact	Affected aspect	Phase	Mitigation type	Standard to be achieved (Impact management outcome/objectives)
Site preparation Earthworks Waste rock management Transport systems Housing Tailings management Demolition Rehabilitation Maintenance and aftercare	Loss of soil resources and land capability through physical disturbance	Soils and land capability	Construction Operation Decommissioning Closure	• Manage through the implementation of soil conservation management plan and waste management plan • Control through rehabilitation • Control through limiting project footprint • Control through erosion control measures	• To ensure that soil resources are handled and managed properly in order to conserve these resources for use as part of rehabilitation which will assist with the restoration of pre-mining land capability as far as possible.
Site preparation Earthworks Waste rock management Transport systems Tailings management Housing Process and storm water management Sewage sludge management Demolition Rehabilitation Maintenance and aftercare	Loss of soil resources and land capability through pollution		Construction Operation Decommissioning Closure	• Manage through the implementation of soil conservation management plan and waste management plan • Control through rehabilitation • Remedy through emergency response procedure (Section 31.2.2) • Control and remedy through training	• To ensure that soil resources are handled and managed properly in order to conserve these resources for use as part of rehabilitation which will assist with the restoration of pre-mining land capability as far as possible.
Site preparation Civil works Earthworks Tailings management Waste rock management Transport systems Housing Process and storm water management Sewage sludge management Site/contract management Demolition Rehabilitation	Physical destruction of biodiversity	Biodiversity	Construction Operation Decommissioning Closure	• Modify through placement of infrastructure • Control through species relocation and an invasive species management plan • Remedy through conservation and rehabilitation measures • Control through monitoring and inspections • Control through limiting disturbance	• To prevent loss of biodiversity due to unnecessary clearing during construction activities. • To limit and prevent the establishment of invasive and/or alien vegetation. • To promote the establishment of vegetation at any areas that have been rehabilitated. • To return the land to its pre-construction capability once mining is completed. • To avoid transformation of vegetation surrounding footprints • To manage areas for optimal biodiversity • To avoid confirmed habitat for plant species of conservation concern

Activity	Potential impact	Affected aspect	Phase	Mitigation type	Standard to be achieved (Impact management outcome/objectives)
Maintenance and aftercare					
Site preparation Civil works Earthworks Tailings management Waste rock management Transport systems Housing Process and storm water management Sewage sludge management Site/contract management Demolition Rehabilitation Maintenance and aftercare	General disturbance of biodiversity	Biodiversity	Construction Operation Decommissioning Closure	• Can be controlled through pollution management • Can be controlled through implementation of procedures, management plans and personnel training • Can be managed through an invasive species management plan	• To prevent loss of biodiversity due to unnecessary clearing during construction activities. • To limit and prevent the establishment of invasive and/or alien vegetation. • To promote the establishment of vegetation at any areas that have been rehabilitated. • To return the land to its pre-construction capability once mining is completed. • To avoid transformation of vegetation surrounding footprints • To manage areas for optimal biodiversity • To avoid confirmed habitat for plant species of conservation concern.
Site preparation Civil works Earthworks Transport systems Mining and mining related activities Waste rock management Tailings management Process and storm water management General and hazardous waste management Sewage sludge management Site support services Demolition Rehabilitation Maintenance and aftercare	Contamination of surface water resources	Surface water	Construction Operation Decommissioning Closure	• Control through storm water management and design • Remedy through emergency response procedure (Section 31.2.2)	• To ensure surface water quality remains within acceptable limits for both domestic and agricultural purposes to prevent pollution of surface water resources and related harm to surface water users.
Site preparation Civil works Earthworks	Alteration of natural drainage patterns		Construction Operation Decommissioning	• Control through appropriate design / re-alignment • Control through the separation	• Minimise the alteration of the drainage patterns in the project area. • To reduce the area of the catchment not contributing

Activity	Potential impact	Affected aspect	Phase	Mitigation type	Standard to be achieved (Impact management outcome/objectives)
Transport systems Waste rock management Tailings management Process and storm water management Demolition Rehabilitation Maintenance and aftercare			Closure	of dirty and clean water	to runoff in order to minimise the impact on the catchment yield. • To minimise water consumption from external sources and recycle as much water as possible.
Site preparation Civil works Earthworks Transport systems Mining and mining related activities Waste rock management Tailings management Process and storm water management General and hazardous waste management Sewage sludge management Site support services Demolition Rehabilitation Maintenance and aftercare	Contamination of groundwater resources	Groundwater	Construction Operation Decommissioning Closure	• Control through monitoring • Remedy through emergency response procedure (Section 31.2.2)	• To prevent pollution of groundwater.
Site preparation Civil works Earthworks Transport systems Waste rock management Tailings management Process and storm water management Demolition Rehabilitation	Changes in groundwater levels and availability		Construction Operation Decommissioning	• Control through water management measure • Control through monitoring	• To minimise impacts on the volume of ground water available for use. • To improve safety conditions. • To gather sufficient information to allow future interpretations and to guide planning for closure. • To prevent large scale mounding of groundwater.

Activity	Potential impact	Affected aspect	Phase	Mitigation type	Standard to be achieved (Impact management outcome/objectives)
Maintenance and aftercare					
Site preparation Civil works Earthworks Mining and mining related activities Waste rock management Mineral processing operations Tailings management Power Supply and Use Transport systems Housing Demolition Rehabilitation Maintenance and aftercare	Air pollution	Air	Construction Operation Decommissioning Closure	• Control through implementation of dust control measures • Monitor through the continuation of the monitoring programme	• To ensure that any pollutants emitted as a result of the proposed project remain with acceptable limits so as to prevent health related impacts.
Site preparation Earthworks Civil works Waste rock management Tailings Management Transport systems Demolition Rehabilitation Waste rock management Mineral processing operations Mining and mining related activities	Noise pollution	Noise	Construction Operation Decommissioning	• Control through noise control measures and monitoring (if required)	• To ensure that any noise generated as a result of the proposed project remains within acceptable limits to avoid the disturbance of third parties. • To limit occupational health and safety noise levels within specified regulatory parameters
Mining and mining related activities	Blasting impacts (fly rock, air blasts and ground vibrations)	Blasting	Construction Operation	• Manage through effective communication with surrounding communities • Manage through appropriate blast design • Manage through compliance with BPM' s blasting procedure	• To limit ground vibration from blasting during construction and mining activities to avoid structural damage to local buildings. • To provide the community with advanced warning of blasting and the probable experiences related thereto.
Transport systems	Road disturbance and traffic safety	Traffic	Construction Operation	• Modify through the introduction of a roundabout and converting	• To ensure the mine's use of public roads is done in a responsible manner to reduce the potential for safety

Activity	Potential impact	Affected aspect	Phase	Mitigation type	Standard to be achieved (Impact management outcome/objectives)
			Decommissioning Closure	a lane into turning lane only. • Control through appropriate design • Management through the implementation of traffic safety programme • Remedy through emergency response procedure (Section 31.2.2)	and vehicle related impacts on road users. •
Site preparation Civil works Earthworks Mining and mining related activities Waste rock management Mineral processing operations Tailings management Housing Demolition Maintenance and aftercare of final land forms and rehabilitated areas	Negative visual views	Visual	Construction Operation Decommissioning Closure	• Control through visual controls and concurrent rehabilitation	• To limit the perception of visual intrusion of the mining activities, where reasonably possible
Site preparation Earthworks Transport systems Housing Site/contract management Tailings management Demolition Rehabilitation	Loss of heritage, cultural and palaeontological resources	Heritage/ cultural and palaeontological resources	Construction Operation Decommissioning	• Control through relocation of graves • Avoid through data collection • Control through additional site assessments prior to development • Remedy through emergency response procedure (Section 31.2.2)	• To ensure the preservation of identified sites of cultural importance and graves that do not fall within the mine footprint. • To ensure that destruction or relocation of identified cultural sites that fall within the mine foot print is done in accordance with the National Heritage Resources Act (NHRA) and under the guidance of SAHRA. • To train all relevant construction staff in archaeological identification
Site preparation Civil works Earthworks Mining and mining related activities Waste rock management Mineral processing operations	Economic impact	Socio-economic	Construction Operation Decommissioning Closure	• Control through procurement programme and bursary and skills development programme	• To enhance the positive economic impacts by working together with existing structures and organisations.

Activity	Potential impact	Affected aspect	Phase	Mitigation type	Standard to be achieved (Impact management outcome/objectives)
Tailings management Power Supply and Use Water supply and use Process and storm water management Transport systems General and hazardous waste management Sewage sludge management Site support services Housing Site/contract management Demolition Rehabilitation Maintenance and aftercare					
Site preparation Civil works Earthworks Mining and mining related activities Waste rock management Mineral processing operations Tailings management Power Supply and Use Water supply and use Process and storm water management Transport systems General and hazardous waste management Sewage sludge management Site support services Housing Site/contract management Demolition	Inward migration and associated social ills		Construction Operation Decommissioning Closure	• Control through health policy, monitoring the development of informal settlements • Remedy through emergency response procedure (Section 31.2.2)	• To establish and maintain a good working relationship with surrounding communities, local authorities and land owners in order to limit the impacts associated with inward migration.

Activity	Potential impact	Affected aspect	Phase	Mitigation type	Standard to be achieved (Impact management outcome/objectives)
Rehabilitation Maintenance and aftercare					
Site preparation Civil works Earthworks Mining and mining related activities Waste rock management Mineral processing operations Tailings management Power Supply and Use Water supply and use Process and storm water management Transport systems General and hazardous waste management Sewage sludge management Site support services Housing Site/contract management Demolition Rehabilitation Maintenance and aftercare	Tourism	Socio-economic	Construction Operation Decommissioning Closure	• Control through application of socio-economic and environmental management plans	• Designing and constructing a mining complex that adheres to the provisions made in the EMP and related environmental legislation.
Construction of project components Operation of the mine Decommissioning of project components Final land forms	Loss or changes to existing land use	Land use	Construction Operation Decommissioning Closure	• Control through closure planning • Manage through implementation of mitigation measures for environmental and social impacts	• To co-exist with existing land uses and to negatively impact on land uses as little as possible in order to prevent unacceptable impacts on surrounding land uses and their economic activity. • To limit the impact of the mining operations to as small a footprint as is possible. • To manage and rehabilitate the disturbed areas in such a manner that it is possible to restore it to its pre-disturbance potential. • To minimise nuisance factors and communicate frequently with affected stakeholders to ensure they have information about activities that will generate nuisance factors.

28 IMPACT MANAGEMENT ACTIONS

The mitigation actions for all phases (construction, operation, decommissioning and closure) to achieve the objectives and outcomes set out in Section 27 are listed in tabular format below. The action plans include the timeframes for implementing the mitigation actions together with a description of how mitigation actions comply with relevant standards. Mitigation actions and recommendations identified by specialists have been summarised and are included into Table 28.1 below.

Management actions described below consider the approved EMPs (mine (2008) and housing (2014)) and additional management measures are provided where required. New measures that were not previously covered in the existing EMPs, or measures that have been updated have been underlined. Management actions for the approved Phase 1 housing are to be applied to the Phase 1a housing. The housing and mining EMPs have been provided separately. The mine EMP is contained in Table 28.1 below. The approved housing EMP is contained in Appendix T. Additional measures to be implemented following specialist assessments conducted for this EIA are contained in Table 28.2. These mine and housing EMP commitments have been separated as they have differing management measures as applicable to their respective operation and for ease of reference and auditing purposes.

TABLE 28.1: DESCRIPTION OF IMPACT MANAGEMENT ACTIONS

Activity	Potential impact	Mitigation type	Time period for implementation	Compliance with standards
Mining and mining related activities	Blasting impacts (fly rock, air blasts and ground vibrations)	• Explosive quantities during site preparation and sinking operations will be kept below quantities that could cause structures to be damaged. • The shaft and plant infrastructure was moved some 600 m further south east away from the nearest neighbour. • Blasting will be undertaken in accordance with relevant Mine Health and Safety legislation and international blasting standards. • Blasting noise will be monitored and recorded during blasting activities to ensure adherence to stipulated guidelines. • Blasting will take place within the required legal parameters. The area should be cleared of people and livestock in a radius of 500 m before blasting commences. • Ground vibrations to be kept below 10 mm/s (USBM guidelines) at the nearest structure. • Air blast levels will be kept below 135 dB. • A siren will signal the commencement of blasting in the area. • A program to inform the community on the impacts of blasting, seismics, air blast, etc. will be developed and communicated prior to the commencement of shaft sinking and surface preparation. • A schedule for all blasting work on surface and for the first 50 m of the shaft sinking should be provided to the local communities most likely to hear the noise of the blasts, especially schools and hospitals. A reminder or warning system, such as bulk SMSes, should be sent out to community representatives who can inform their neighbours. • The mine will register and address all complaints concerning possible structural damage in the complaints system and an investigation will be undertaken. • Vibration and air blast levels monitoring as per the monitoring programme.	• Prior to construction • Prior to construction • Construction • Construction • Construction • Construction • Construction • Construction • Construction • Construction • On-going • Construction	Not applicable
Mining	Changes to geology	• The ore body will be mined and processed in such a way to ensure the most effective extraction of the non-renewable resource. • Mining will take place according to industry best practice and safety measures specific to the underground conditions on the mine and will be implemented to prevent possible collapse of underground workings.	• On-going • On-going	Not applicable
Site preparation Civil works Earthworks Mining and mining related activities Waste rock management Mineral processing operations Tailings management Demolition Maintenance and aftercare of final land forms and rehabilitated areas	Negative visual impacts	• Mining infrastructure is generally designed according to functional engineering requirements. Efforts are to be made, where possible, to design structures with a more aesthetic appeal. • A noise attenuation structure and visual barrier will be constructed between the shaft bank and the receptive community areas. The structure will be designed to be as aesthetically pleasing as possible. The final design will be concluded prior to the commencement of the construction phase and will be signed off by a professional engineer. The design will include both visual and noise design criteria. • Designs are to be optimised to try to decrease visual exposure of mining infrastructure. • Lighting infrastructure should be designed to minimise the impact on neighbouring communities. • The TSF, stockpiles and waste rock dump are to be shaped to reduce their visual intrusion. • The use of bright colours or highly reflective surfaces should be avoided. • Paint structures and buildings in colours (browns and greens) that reflect and compliment the natural landscape. • The unnecessary removal of vegetation during construction should be avoided. This is extremely important on the boundaries of the mine where vegetation can assist with screening. • Exclusive use of laydown areas will be enforced and the uncontrolled dumping of waste or construction material will be prohibited. • Screening of various structures is to be achieved through landscaping and planting of vegetation. This will be undertaken where the visual impact on sensitive receptors is considered high. All vegetation that is planted as part of rehabilitation should reflect the natural vegetation of the area and be indigenous to the site. • The TSF will be screened with indigenous vegetation where the visual impact on sensitive receptors is considered high. • There must be concurrent rehabilitation on the TSF. The successful establishment of the vegetation must be demonstrated during the life of the mine so that there is little additional work to be done at closure. • Uncontrolled, open fires are prohibited on site. • Dust is to be controlled using appropriate dust suppression measures. • Implement the recommended air pollution control system to avoid plumes of dust that can reduce visibility. • The mine and plant will operate on a 24 hour basis. Lighting is thus required for safe operating conditions. As far as is possible, without compromising safety of mine personnel and operating processes, all light sources should be directed downwards and away from the public roads and surrounding communities. • Rehabilitated areas, especially on the TSF, will be maintained and monitored. • Rehabilitation is to take place according to the proposed Rehabilitation Plan contained in Section 29.1.3. • Rehabilitated areas will be maintained and monitored and managed through an aftercare and maintenance programme to limit and/or enhance the long-term post closure visual impacts.	• Prior to construction • Prior to construction • Prior to construction • Prior to construction • Prior to construction • Prior to construction • Construction • On-going • Construction • Construction • Construction • On-going • On-going • On-going • On-going • On-going • On-going • Closure • Closure • On-going	Not applicable

Site preparation
Civil works
Earthworks
Waste rock management
Mining and mining related activities
Tailings management
Demolition
Rehabilitation
Maintenance and aftercare
	Hazardous excavations infrastructure and surface subsidence	• All mineralised waste facilities and water dams will be designed, constructed, operated and closed in a manner to ensure stability and related safety risks to third parties and animals are addressed. It will furthermore be monitored according to a schedule that is deemed relevant to the type of facility by a professional engineer. As part of closure, BPM should ensure that provision is made to address long term safety risks in the decommissioning and rehabilitation planning.
		• Bakubung will survey its mining area and update its mine plan map on a routine basis to ensure that the position and extent of all potential hazardous excavations, hazardous infrastructure and subsidence is known as part of construction, operation and decommissioning. It will further more ensure that appropriate management measures are taken to address the related safety risks to third parties and animals
		• As part of construction and operation, the safety risks associated with identified hazardous excavations, subsidence and infrastructure will be addressed through one or more of the following:
		  ○ Fencing, berms, barriers and/or security personnel to prevent unauthorized access
		  ○ Warning signs in the appropriate language(s). Warning pictures can be used as an alternative
		• During decommissioning planning of any part of the mine, provision will be made to address long term safety risks in the decommissioning and rehabilitation phases.
		• At closure of any part of the mine, the hazardous infrastructure will either have been removed or decommissioned and rehabilitated in a manner that it does not present a long term safety and/or stability risk.
		• At closure the hazardous excavations and subsidence will have been dealt with as follows:
		  ○ All excavated areas will have been backfilled and rehabilitated
		  ○ Monitoring and maintenance will take place to observe whether the relevant long term safety objective have been achieved and to identify the need for additional intervention where the objectives have not been met.
			• On-going
			• On-going
			• On-going
			• Decommissioning
			• Closure
			• Closure
				Not applicable

Activity	Potential impact	Mitigation type	Time period for implementation	Compliance with standards
		• In case of injury or death due to hazardous excavations, the emergency response procedure in Section 31.2.2 will be followed.	• As required	
Site preparation Civil works Earthworks Waste rock management Mining and mining related activities Tailings management Demolition Rehabilitation Maintenance and aftercare	Alteration to topography and impact on infrastructure	• The sides of the TSF are to be designed with curves and rounded corners in order to allow the slopes to blend better into the surrounding topography. • Topographical management measures are to be included in the final TSF design document. • Any material removed from the footprint of the shaft complex, waste rock dump and TSF during bulk excavations and initial site clearing are to be temporarily stockpiled at the demarcated areas and vegetated if possible. • Upslope storm water diversion berms are to be constructed above the shaft/plant complex and TSF to prevent runoff across the cleared areas and away from stockpiles. • All storm water diversion berms will be vegetated and sloped to ensure stability and conservation of topsoil materials. • No unnecessary earthworks and clearing should be done outside of the stipulated footprint of the mining activities and TSF. • Upslope storm water diversion berms will be maintained to prevent runoff and erosion across the sites, especially around the sides of the TSF. • The development of the TSF will be in accordance with the final TSF design document and the mandatory TSF Code of Practice (COP). • Soil will be placed on the outer slopes of the TSF and vegetation will be established. Refer to Section 29.1.3 for a description of the proposed Rehabilitation Plan. • The soil and vegetation will be maintained until the vegetation is self-sustaining. • Rehabilitation and/or re-vegetation of structures selected, except the waste rock dump, that obtrude in the landscape should take place as soon as is possible and on a continuous basis. • Measures should be implemented to prevent erosion features developing on prominent structures, like the TSF. • Profiling of the landscape will take place to ensure the area is rehabilitated as close to its natural state as possible. • Additional composting material and soil will be brought in if required. • The landscape will be profiled to ensure that surface water runs off freely and does not pond anywhere. • Judicious planting of screening vegetation will be considered to ameliorate views of the taller structures from sensitive viewpoints.	• Planning and design • Planning and design • Construction • Construction • Construction • Construction • On-going • On-going • On-going • On-going • On-going • On-going • Closure • Closure • Closure • Closure	Not applicable

Construction of project components
Operation of the mine
Decommissioning of project components
Final land forms
	Loss or changes to existing land use	• Do not disturb areas unnecessarily.
		• Identify, in conjunction with tribal council, specific rights of the affected parties eligible for compensation.
		• Establish an appropriate compensation method and the measures by which it will be implemented.
		• Rehabilitate disturbed areas according to the rehabilitation plan included in Section 29.1.3 and according to recommendations from vegetation specialist included in this EMP.
		• Effective implementation of all mitigation measures as outlined in this EMP report to reduce the mine's overall impact on the environment and surrounding land-uses
		• Closure planning to incorporate measures to achieve future land use.
		• Should the impact on the surrounding land use and/or economic activity still prove unacceptable, BPM will compensate the relevant landowners accordingly.
		• Periodic communication (annual at a minimum) and feedback should be undertaken to the affected communities and stakeholders in respect of the activities that will generate nuisance factors.
		• Implement all mitigation measures as specified in the relevant specialist inputs, without compromising the safety of people, namely:
		  o noise impact assessment;
		  o air quality impact assessment;
		  o traffic impact assessment; and
		  o visual impact assessment in the EIA.
		• The existing grievance/complaints register should be maintained in which all community and IAP complaints are recorded and addressed.
		
		Construction staff, plant and equipment:
		• All construction staff will agree to a Code of Conduct (CoC) that outlines protocols and standards for working on the affected land. The CoC should address the following:
		  o respect for local residents;
		  o respect for existing livelihood activities and the environment;
		  o no hunting, snaring or unauthorised taking of any property belonging to someone else;
		  o compliance with the Traffic Management Plan and all associated regulations;
		  o unambiguous disciplinary measures for not adhering to the Code of Conduct.
		• Community members / affected land users will be able to lodge grievances with BPM using the existing grievance procedure. In the event that the grievance is not addressed or closed out properly, there should be an avenue through which the matter is escalated to a higher level of authority within Bakubung Platinum Mine.
		• Bakubung Platinum Mine and the *Bakubung-Ba-Ratheo* Traditional Authority will discuss appropriate mitigation measures including methods and procedures to minimise the disruption to land use patterns and livelihood activities. This will include, fencing off the construction site to ensure that community members and livestock do not get injured due to construction activities and providing access points (both during construction and during operations and maintenance) across, over or under the pipeline to ensure unhindered movement for pedestrian and livestock as well as a clear and simple claim mechanism in the event of proven damage to property by the contractor.
		• Compliance with relevant mitigation measures as outlined in the noise, air quality, and heritage assessments.
		
		Pipeline crossings:
		• Identify and confirm all affected land uses and land user groups with input from the *Bakubung-Ba-Ratheo* Traditional Authority.
		• Consider all possible measures to enable convenient and safe pedestrian and livestock crossing of the construction site and the pipeline, post construction. These may include providing overpasses and underpasses at regular intervals or in designated locations along the pipeline route.
		• Together with the *Bakubung-Ba-Ratheo* Traditional Authority and affected land user groups identify practical and cost-effective engineering solution to cross the construction site and the pipelines.
		• The pipelines should not be fenced during operations as this will completely prevent all pedestrian and livestock from crossing.
		
		If required:
		• Hold discussions with the Traditional Authority to confirm that they are in agreement that all livelihoods activities can proceed unhindered. Should they raise concerns, these should be defined and investigated, suitable mitigation should be agreed.
			• On-going
			• On-going
			• On-going
			• On-going and Closure
			• On-going
			• On-going
			• As required
			• On-going as per mitigation measure
			• On-going
			• On-going
			• On-going
			• On-going
			• On-going
			• On-going
			• Prior to construction
			• Prior to construction
			• Prior to construction
			• On-going
			• As required
				Re-zoning applications need to be submitted in terms of the Spatial Planning and Land Use Management Act (No. 16 of 2013), or the Cape Land Use Planning Ordinance (No. 15 of 1985) whichever is applicable at the time of the submission of the re-zoning application.

Activity	Potential impact	Mitigation type	Time period for implementation	Compliance with standards
		• Update BPM's "Grazing Compensation Assessment Procedure". Implement as and when required. • A practical and cost effective yet fair agreement should be reached between all parties. Possible mitigation measures may therefore include the construction of overpasses and underpasses at designated locations along the pipeline route or pursuing other options as detailed in the procedure. Should the pipeline prohibit livestock movement to the extent that livelihoods are compromised, BPM should enhance/ extend the *Bakubung-Ba-Ratheo* Farming Project to provide opportunities for the affected people. • Mitigation measures should be approached in accordance with the principles of the International Finance Corporation's Performance Standard 5 on Land Acquisition and Involuntary Resettlement (IFC PS5, 2012), namely to achieve fair compensation that will not leave affected parties worse off than their position pre-project intervention.	• As required • As required • As required	
Transport system	Road disturbance and traffic safety	• Designs of the intersection layouts of the access roads with the main roads must address design standards and elements such as alignment, sign distances, cross-sections and provisions for other road users including pedestrians. • Put into place a system whereby overloading of mine vehicles, as well as contractors' vehicles (weigh bridge), can be prevented and impose adherence to these standards in the strictest possible way to minimise damage to tarred road surfaces that are travelled upon and to reduce the risk of accidents. • Inspect mine vehicles weekly for clean and operational tail lights, indicators, reflective signage and reverse hooters to ensure visibility of vehicles, especially at night. • Impose safety restrictions on drivers of mine fleet vehicles and include similar stipulations in contracts signed with contractors: ○ Encourage drivers of mine vehicles to not stop on the side of the R556 and R565 at any time, except in emergencies, to retain the integrity of the road shoulders. ○ All employees and contractors must adhere to the speed limits and other road safety procedures. ○ Trucks that are transporting concentrate will be sealed and covered. • As far as is possible, heavy vehicle deliveries and collections will be kept to off peak traffic periods. • The needs of pedestrians should be taken into consideration in the planning and design of the access to the proposed site, as well as the design of the road infrastructure. • A single-lane access road with stop-control at the access to the shaft plant on the R565 and R556. • A right-turn lane on the R565 and R556 to access the roads to the proposed site would also be an additional safety feature. • Provide large visible road signage indicating the presence of heavy vehicle traffic at least 500 m before, on either side of the mine site access road intersections with the R565 and R556. • Road safety issues must be included as part of the overall on-site safety training and at induction. • In case of a person or animal being injured by transport activities the emergency response procedure in Section 31.2.2will be followed. • The mine will record and respond, appropriately and without delay, to any complaints about usage of roads by mine vehicles. • Bakubung needs to ensure that proper road markings, reflective road studs, road signs, overhead lighting and proper pedestrian crossings are provided and maintained at the entrance to the mine and TSF. This would need to be done in liaison with the roads department that has jurisdiction on the roads. • BPM is to share the recommendations for road infrastructure changes and upgrades provided in the 2016 traffic impact assessment report to the roads department.	• Planning and design phase • On-going • Weekly • On-going • On-going • On-going • On-going • Prior to construction • On-going • On-going • As required • On-going • On-going Prior to construction	Not applicable
Site preparation Earthworks Waste rock management Transport systems Site/contract management Tailings management Demolition Rehabilitation	Loss of heritage, cultural and palaeontological resources	• A phase two heritage investigation is to be undertaken for sites to be destroyed or relocated. • Based on the heritage investigation the preservation or the destruction of the sites will take place prior to the commencement of the construction activities. • Should destruction of the sites be necessary, destruction permits must be in place prior to construction activities commencing at or near the relevant identified sites. • The grave site (MCH017) and stone cairn (MCH021) will be fenced off to afford them greater protection. • All relevant construction staff will receive training in basic archaeological identification and the communication routes to follow in the case of a discovery. • Additional heritage resources may be unearthed during construction. Should this occur, work in that area should be halted until such time as an appropriately qualified person can make an expert decision on the mitigation measures required. The expert must notify SAHRA and carry out an emergency recovery (Emergency Response Procedure Section 31.2.2). • Where graves have been identified, if they are not to be relocated, they will be monitored and fences will be maintained during the life of mine. • Where stone cairns have been identified, if they are not to be destroyed or moved, they will be monitored and fences will be maintained during the life of mine. • For graves to be relocated the following procedure is required: ○ A detailed social consultation process, at least 60 days in length, comprising the attempted identification of the next-of-kin so as to obtain their consent for the relocation of the graves. ○ Bilingual site notices (in the most appropriate languages) indicating the intent of the relocation. ○ Bilingual newspaper notices indicating the intent of the relocation. ○ Permit applications to the legally required authorities, including (but certainly not restricted to) the South African Heritage Resources Agency. ○ An exhumation process that keeps the dignity of the remains and family intact. ○ An exhumation process that will safeguard the legal rights of the families as well as that of the development company. ○ The process must be done by a reputable company well versed in the mitigation of graves. • If any evidence of archaeological sites or remains (e.g. remnants of stone-made structures, indigenous ceramics, bones, stone artefacts, ostrich eggshell fragments, charcoal and ash concentrations), fossils or other categories of heritage resources are found during the proposed development, SAHRA APM Unit (Natasha Higgitt/Phillip Hine (or whoever is applicable at the time) 021 462 5402) must be alerted. If unmarked human burials are uncovered, the SAHRA Burial Grounds and Graves (BGG) Unit (Itumeleng Masiteng/Mimi Seetelo (or whoever is applicable at the time) 012 320 8490), must be alerted immediately. A professional archaeologist or palaeontologist, depending on the nature of the finds, must be contracted as soon as possible to inspect the findings. If the newly discovered heritage resources prove to be of archaeological or palaeontological significance, a Phase 2 rescue operation may be required. **SITE SPECIFIC MEASURES:** **Iron Age sites** *For MCH003:* • Shovel pit test to determine depth and integrity of archaeological deposit of site and for sites with ceramics to positively establish group identity. • Test pit excavations will be aimed at identifying structures.	• Prior to construction • Prior to construction • Prior to construction • On-going • On-going • As required • On-going • On-going • Prior to construction • As required • Prior to construction • Prior to construction	Compliance with the National Heritage Resource Act No. 25 of 1999 in the event of any chance finds.

Activity	Potential impact	Mitigation type	Time period for implementation	Compliance with standards
		• Based on the findings further assessment of the site might be required. • Before destruction of the site, a destruction permit must be applied for (for sites that require destruction permits) and received from the South African Heritage Resources Agency. • This work can only be undertaken by a suitably qualified and experienced archaeologist. • This work may only be undertaken after permits have been received from the South African Heritage Resources Agency allowing such mitigation measures to be undertaken. • Permits for mitigation in terms of Section 35 of the NHRA must be applied for MHC003. Mitigation measure should include Shovel Test Pits and test pit excavations. These excavations must be documented by means of a Phase 2 Archaeological Investigation Report that must be submitted to SAHRA for further comment. An agreement with a recognised repository must be sought to house excavated artefacts for long term curation. *For MHC005:* • If the site is impacted upon, an archaeologist must monitor the site during construction to mitigate accidental finds. • Before destruction of the site, a destruction permit must be applied for and received from the South African Heritage Resources Agency. • This work can only be undertaken by a suitably qualified and experienced archaeologist. • A Watching Brief must be conducted for sites MHC005. A Watching Brief Report must be compiled and submitted to SAHRA upon completion **Early Stone Age:** • An Early Stone Age specialist must assess the study area in particular the pebble layers that contain artefacts. New dating techniques could be used here. **MHC025, MHC026, MHC027A, C, D, E, F and G** • A social consultation process in terms of section 36 of the NHRA and Chapter XI of the NHRA Regulations must be completed for sites MHC025, MHC026, MHC027A, C, D, E, F and G, thereafter a permit for relocation may be applied for.	• Prior to construction • Prior to construction • During construction and prior to destruction • During construction and prior to destruction • Prior to destruction • As required, during construction • Prior to destruction • Prior to destruction • As required, during construction • Prior to construction • Prior to destruction	
Site preparation Earthworks Civil works Waste rock management Transport systems Demolition Rehabilitation Waste rock management Mineral processing operations Mining and mining related activities	Noise Pollution	• The shaft and plant infrastructure was moved some 600 m further south east away from the nearest neighbour. • The prevailing wind directions is to be taken into consideration when planning the location of noise emitting installations/plant on surface • A noise attenuation structure and visual barrier will be constructed between the shaft bank and the receptive community areas. The structure will be designed to be as aesthetically pleasing as possible. The final design will be concluded prior to the commencement of the construction phase and will be signed off by a professional engineer. The design will include both noise and visual design criteria. • The designs of the shaft complex and concentrator plant should incorporate all necessary acoustic design aspects required in order to ensure that the overall generated noise level does not exceed a maximum equivalent continuous day/night rating level (LRdn) of 70 dBA inside the property boundary, as specified for industrial districts in SANS 10103. Notwithstanding this provision, the design is also to take into account the maximum allowable equivalent continuous day and night rating levels of the potentially impacted sites outside the mine property. Where the noise level at such an external site is presently lower than the maximum allowed, the maximum for that land use zoning shall not be exceeded. Where the noise level at the external site is presently at or exceeds the maximum, the existing level shall not be increased by more than indicated as acceptable in SANS 10103. Note that the induced ambient noise levels in the residential areas of Ledig Village should ideally not exceed 50dBA during the day and 40dBA at night. • Sound muffs will be used on the main ventilation fans. • Noise will be periodically (construction) and continually (operations) monitored at relevant boundary points nearest the neighbouring communities according to national standards. • Any complaints from any of the neighbours or other IAPs with regards to noise and vibration will be registered (A complaints system is to be established) and dealt with by the mine management. • Construction site yards, concrete batching plants, asphalt batching plants and other potentially noisy fixed facilities are to be located as far away as is possible from noise sensitive areas adjacent to the development site. • The ventilation fan outlets have been positioned facing south east, away from the village and facing slightly upwards. • All construction vehicles, mine fleet vehicles and equipment are to be kept in good repair and fitted with appropriate sound suppression devices. • Activities, particularly the noisy ones, are to be restricted as far as possible to daylight hours. • The noise from mechanical implements and mining activities will be maintained within the requirements of the Mine Health and Safety Act (No 29 of 1996). • Site generators to be equipped with suitable sound attenuation measures. • Blasting noise will be monitored and recorded during blasting activities to ensure adherence to stipulated guidelines. • A schedule for all blasting work on surface and for the first 50 m of the shaft sinking should be provided to the local communities most likely to hear the noise of the blasts, especially schools and hospitals. A reminder or warning system, such as bulk SMSes, should be sent out to community representatives who can inform their neighbours. • A siren will be sounded prior to a blast. • Personal Protection Equipment (PPE) will be worn at all times as required by the appropriate workplace health and safety legislation. • Demolition and rehabilitation activities are to be restricted to daylight hours. • Local residents are to be notified of any potentially noisy field survey works or other works during the planning and design phase and these activities are to be undertaken at reasonable times of the day. These works should not take place at night or on weekends. • During the pre-construction phase, consideration must be given to the noise mitigation measures required during the construction phase that should be included in the tender document specifications and the design. • Construction site yards, concrete batching plants, asphalt batching plants, and other noisy fixed facilities should be located well away from noise sensitive areas adjacent to the development site. • The temporary ventilation system for the shaft construction should incorporate all the applicable noise mitigation measures. • With regard to unavoidable very noisy construction activities in the vicinity of noise sensitive areas, BPM should liaise with local residents on how best to minimise impact. • In general operations should meet the noise standard requirements of the Occupational Health and Safety Act (Act No 85 of 1993).	• Prior to construction • Prior to construction • Prior to construction • Prior to construction • On-going • On-going • On-going • Construction • Construction • On-going • On-going • On-going • On-going • Construction • Construction • Construction • On-going • Decommissioning and Closure • As required • Prior to construction • Construction • Construction • As required	As described in mitigation measures

Activity	Potential impact	Mitigation type	Time period for implementation	Compliance with standards
		• Construction staff working in areas where the 8-hour ambient noise levels exceed 75dBA should wear ear protection equipment. • The latest technology incorporating maximum noise mitigation measures for the shaft complex and concentrator plant components should be designed into the system. • The design process is to consider, inter alia, the following aspects: ○ The position and orientation of buildings on the site. ○ The design of the buildings to minimise the transmission of noise from the inside to the outdoors. ○ The insulation of particularly noisy plants. • Specifically measures need to be taken for the two types of equipment, which are responsible for the highest noise levels from the shaft complex, namely the compressor house and the mine ventilation system (upcast vent fans): ○ The compressors should be fitted with effective silencers and the walls and roof of the compressor house should be constructed of a sufficiently dense material so as to achieve at least a 20dBA reduction (insertion loss) between the indoor noise and that transmitted to the outside of the building. Ventilation openings, if required, should be placed on the side of the building facing away from the noise sensitive areas. ○ The mine ventilation system should preferably use centrifugal fans rather than radial fans. The upcast vent fan outlets should be oriented slightly upwards and to the south-east away from Ledig Village, and if possible the enclosure of the surface infrastructure in an insulated building should also be considered. ○ Irrespective of the aforementioned mitigation measures that need to be taken at the sources of the noise, earth berms (noise attenuation barriers) should also be constructed: ○ Along the eastern perimeter of Ledig Village. ○ North of mine along the southern perimeter of the planned Gabonewe Estate (mine housing). • The design of the pump stations at the planned tailings dam is to incorporate all the necessary acoustic design aspects required in order that the induced ambient noise levels in the residential areas of Phatsima Village and Reagile informal settlement shall not exceed 50dBA during the day and 40dBA at night. • The National Noise Control Regulations and SANS 10103 should be used as the main guidelines for addressing the potential noise impact on this project. • The noise mitigation measures will need to be designed and/or checked by an acoustical engineer in order to optimise the design parameters and ensure that the cost/benefit of the measure is optimised. • At commissioning of the mine, the noise footprint of the new shaft complex, the concentrator plant and the tailings dam area should be established by measurement in accordance with the relevant standards, namely SANS ISO 8297:1994 and SANS 10103. The character of the noise (qualitative aspect) should also be checked to ascertain whether there is any nuisance factor associated with the operation.	• On-going • Construction • On-going • On-going • On-going • On-going • On-going • Prior to construction • Prior to operations	
Site preparation Earthworks Waste rock management Transport systems Tailings management Demolition Rehabilitation Maintenance and aftercare	Loss of soil resources and land capability through physical disturbance	• Soil stripping is to be stripped according to the soil stripping guide (Table 28.4). • Earthworks and clearing will be limited to the stipulated footprints of the infrastructural areas. • The soil conservation plan in Table 28.4 is to be followed. • Place infrastructure in already transformed areas or where transformation will occur as far as possible. • Avoid drainage lines and sensitive soils (particularly Sepane soil form). • The rehabilitation plan in Section 29.1.3 provides a guideline of the procedures for soil and vegetation to be followed for the rehabilitation of the shaft and plant complex and the remaining benches on the TSF. • Ameliorate altered physical and chemical properties of soil using appropriate methodologies and monitoring the progress thereof. • All staff and contractors handling topsoil and sub-soils are to receive the necessary training in terms of stripping guide, handling and storage procedures. • Restore affected surface areas to their pre-disturbance potential. • The surface will be contoured to potentially replicate the pre-mining conditions. • All soils compacted as a result of activities falling outside of project footprint areas should be ripped and profiled. • To prevent the erosion of topsoils, management measures to minimise erosion should include installation of berms, silt traps, hessian curtains and other appropriate engineering materials/designs at erodible areas and storm water diversion away from areas susceptible to erosion. • All areas should be monitored for erosion and incision. • Construct in the dry season	• Construction • Construction • On-going • Construction • Construction • Decommissioning • On-going • On-going • Decommissioning • Decommissioning • As required • Construction and ongoing management • On-going • Construction	Not applicable
Site preparation Earthworks Waste rock management Transport systems Tailings management Process and storm water management Sewage sludge management Demolition Rehabilitation Maintenance and aftercare	Loss of soil resources and land capability through pollution	• During the construction, operational and decommissioning phases, Bakubung will ensure that all hazardous chemicals (new and used), dirty water, mineralized wastes and non-mineralised wastes are transported, handled and stored in a manner that they do not pollute soils. This will be implemented through a procedure(s) covering the following: ○ All contaminated soils should be rehabilitated or replaced with uncontaminated soils ○ All hydrocarbons will be stored in a bunded area during all the phases of the project. ○ Pollution prevention through appropriate management of hazardous materials and waste as outlined in Table 28.3. ○ Pollution prevention through basic infrastructure design and re-alignment of the tailings pipeline ○ Pollution prevention through maintenance of equipment ○ Maintenance of equipment should be done either on impermeable surfaces or drip trays should be used. ○ Pollution prevention through education and training of workers (temporary and permanent) ○ A soil remediation plan developed by a soil chemist and hydrologist is to be implemented following a spill event. ○ The required steps to enable fast reaction to contain and remediate pollution incidents. In this regard the remediation options include containment and in situ treatment or disposal of contaminated soils as hazardous waste. In situ treatment is generally considered to be the preferred option because with successful in situ remediation the soil resource will be retained in the correct place. The in situ options include bioremediation at the point of pollution, or removal of soils for washing and/or bio remediation at a designated area after which the soils are returned. Following spillages, the pollution plume should be determined by a soil chemist, geohydrologist or hydrologist. ○ Specifications for post rehabilitation audit to ascertain whether the remediation of any polluted soils and re-establishment of soil functionality has been successful and if not, to recommend and implement further measures. • In case of major spillage incidents the emergency response procedure in Section 31.2.2 will be followed. • If spillage occurs, the spill must be contained with swales and berms, after the leakage has been repaired the spilled material should be removed and pollution plume should be determined by a soil chemist and hydrologist and geohydrologist. • Implement the soil conservation plan (Table 28.4)	• On-going • As required • As required • On-going	Spillage clean-up in accordance with the MPRDA
Site preparation Civil works	Destruction to biodiversity	• The area to be disturbed during the construction of the mine and its associated infrastructure is to be kept as small as possible to limit disturbance to existing vegetation.	• Construction	The mitigation action to obtain a tree removal permit from DAFF is in

Activity	Potential impact	Mitigation type	Time period for implementation	Compliance with standards
Earthworks Tailings management Waste rock management Transport systems Process and storm water management Sewage sludge management Site/contract management Demolition Rehabilitation Maintenance and aftercare		• Specimen trees on site will be identified and efforts will be made to conserve these. • Should this not be possible, then trees and large shrubs cleared during the site clearance phase should be made available to the local community as firewood. • Site clearing shall be carried out by mechanical means. Fire will not be used for bush clearing. • Indigenous vegetation will be planted for screening and landscaping purposes, especially around the TSF. • Pollution prevention measures will be established, maintained and monitored, including spill prevention, dumping of domestic waste or building rubble outside of designated waste transfer stations. • Vehicles will be restricted to designated roads and laydown areas. • Areas of biological importance, such as the riparian zone of the Elands River, should not be disturbed by mining activities in order to preserve the existing floral and faunal habitats. • All activities are to remain within the designated infrastructure footprints • Implement the waste management procedures (Table 28.3) • No unnecessary clearing of vegetation should take place during the operational phase. • On-going rehabilitation and monitoring of previously disturbed areas will take place, especially at the TSF. • Vegetation planted for screening and landscaping purposes should be monitored and maintained. • Implement the rehabilitation plan (Section 29.1.3) • Seeds from indigenous grasses common to the area will be harvested and added to the rehabilitation seed mix. • An alien and invader species management programme is to be developed and implemented in areas where BPM has control and will include a monitoring phase to evaluate successes achieved. This will be managed throughout the project life and for an additional three-year period after rehabilitation. • The annual vegetation survey will be continued to ascertain the progress and success of rehabilitation. This will include the TSF. • Additional surveys to be performed if expansion of infrastructure is planned in the future. • Conduct additional, brief floristic surveys, focused on searching for *Drimia sanguinea, Stentonstelma umbelluliferum*, *Boophone disticha* and *Hypoxis hemerocallidea* within the final development footprints prior to construction. Surveys should be conducted in late October to early November and in January. • The mine will ensure that all staff members and contractors are familiar with the conservation policy of the company through training and induction. • No snaring, trapping, hunting, poisoning or disturbance of fauna will be allowed by any employee or contractor or their employees. • Perimeter fences are to be inspected monthly to determine if breached by poachers. • Speed restrictions will be enforced on all access roads. • Prevent any pollution of water, soil or vegetation which can cause harm to animal life. • Apply sound veld management principles to ensure maximum biodiversity. This would include sound fire management and grazing techniques to ensure optimal vegetation condition and biodiversity levels in areas of Marikana Thornveld and spatially restricted untransformed vegetation units not destroyed by the project. • No uncontrolled or camp fires are permitted on site • Develop and implement a water course rehabilitation plan near the end of the construction phase to address remnant impacts. • All reseeding activities must be undertaken at the end of the dry season to ensure optimal conditions for germination and rapid vegetation establishment. • Any damage to the drainage lines necessary to complete the work must be limited in extent. • Avoid placement of any infrastructure footprints within the buffer zones for the biological corridors recommended in the vegetation impact assessment. • Botanical research and conservation institutions (e.g. SANBI and universities), should also be afforded an opportunity to search the footprint for species that are of research or horticultural interest, prior to commencement of development. • Buffer zones need to be maintained during the operational phase of the project in order to be effective. This includes the maintenance of a well vegetated grass cover that is free of aliens and erosion features. Any aliens and/or erosion features observed within the buffer zone need to be addressed in order to ensure buffer functioning. • Construction teams to be housed off-site to reduce human presence on site. • Delineated watercourses and buffers should be treated as sensitive no-go areas as far as possible. No unauthorized access is allowed in these features. • Dewatering that may be required during excavation activities should not be released directly into watercourses. • Ensure that geotechnical and geohydrological mitigation measures are in place around the proposed tailings storage facility to prevent seepage into nearby watercourses. • Water storage, waste and stockpile facilities are to constructed and operated according to specifications to reduce the likelihood of structure failure • Fence off surrounding untransformed vegetation (applicable to all footprints except the pipeline); • Illegal medicinal plant harvesting should be discouraged through control of access to untransformed habitats and vegetation within the study area. • Implement and maintain sediment control structures upslope of watercourses, in between stockpiles and construction activities that may act as sources of sediment. • The damaging or destruction of any plant species protected in terms of the National Forest Act or the Biodiversity Act should be avoided wherever possible, and the relevant permits for the destruction, removal or translocation of any such protected plant must be obtained prior to development from the provincial Directorate of Biodiversity Management • In the event of any 'Declining' plant species being recorded within approved development footprints in future, permission for their removal or destruction should be obtained from the provincial Directorate of Biodiversity Management. Where feasible, viable populations of such species should be translocated to degraded or untransformed areas within the study area which provide potentially suitable habitats, but such translocations will have to be carried out in a way that ensures no ecological degradation of the host habitat occurs, and will have to be evaluated by a botanist for each species and each potential translocation area. • In the event of any threatened (i.e. Critically Endangered, Endangered and Vulnerable) or Near Threatened plant species being recorded within the study area or proposed development footprints in future, appropriate in situ and/or ex situ conservation measures should be developed in consultation with the North-West Province Directorate of Biodiversity Management. • It must be ensured that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage. • Limit damage and access to riparian vegetation during bridge construction. • Limit transformation only to development footprints. • Maintain the pipeline in a good working order with regular checks and inspections to help reduce the risk of spillage events. • Maintain untransformed vegetation in a natural state. • Maintain sediment control structures in a functional manner during the entire throughout the construction and operational phases.	• Construction • Construction • Construction • Construction • Ongoing • Ongoing • Ongoing • Ongoing • Ongoing • Ongoing • Ongoing • Ongoing • Ongoing • Ongoing • Ongoing • Ongoing • As required • End of construction • On-going • On-going • On-going as per management measure • On-going • On-going • On-going • On-going • On-going • Post construction • On-going • Construction • Construction • Prior to construction • On-going • Construction • On-going • Construction • On-going • On-going • On-going • On-going • On-going • Prior to construction • Prior to construction • On-going • On-going • Prior to construction • On-going • On-going	accordance with the National Forests Act (No. 84 of 1998) that stipulates that no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree or any forest product derived from a protected tree, except under a license.

Activity	Potential impact	Mitigation type	Time period for implementation	Compliance with standards
		• Modify infrastructure footprints so as to avoid overlap of watercourses, as well as the 32m and 100m buffers as far as possible. This pertains specifically to a portion of the tailings/return water pipelines. • Reporting of faunal species of conservation-concern and implementing a monitoring programme • Modify infrastructure footprints so as to reduce the area of spatially restricted vegetation units and Marikana Thornveld within the footprints wherever possible. Realigned footprints should be placed within the 'Secondary vegetation' unit in as far as possible. • Modify TSF footprint so as to maximise the surface area comprising Secondary vegetation and minimise the extent of Marikana Thornveld within the footprint. • Realign the Frischgewaagd section of the tailings and return water pipeline alignment along the recently constructed access road and reduce the width of the construction servitude in untransformed habitats. • Bridge designs need to be modified to prevent further habitat loss due to expected anthropogenic erosion damage. • Proposed bridge crossings should contain culverts across the length of the crossing and armouring on the downstream channel banks and bed to avoid further channel incision and channel bank scour during high flow events. Pipes are not recommended as they can become easily blocked with alluvial material, which can lead to further scour damage in the watercourse. • Tie-in points at riverbanks (i.e. where infrastructure is placed into the ground) must be suitably safeguarded with gabion cut-off walls to prevent erosion. • All final footprints should be searched for protected plant species prior to the commencement of construction. The surveys should focus on searching for Drimia sanguinea, Stentonstelma umbelluliferum, Boophone disticha and Hypoxis hemerocallidea within the final development footprints prior to construction, and should be conducted in late October to early November and in January. • A restricted servitude width for pipeline river crossings should be used, and no construction activities should occur within the instream and riparian habitats. • The pipeline should be spanned across the watercourse with plinths, plinths can be located within the 32m buffer, but not within delineated riparian habitat. • No new access roads may be created through watercourses along the pipeline alignment. All new tracks and roads that intersect delineated watercourses and the 32m buffer will have to receive environmental approval before they can be constructed. • No refueling of any vehicles, stockpiling of material or the positioning of portable toilets should be allowed within any of the watercourses or their associated buffer zones. • Permit only essential construction personnel within 32m of the riparian habitat, if absolutely necessary that they enter the buffer zone; • Regular monitoring of the tailings pipeline is recommended during the operational phase to prevent potential spills/leakages. • Rehabilitate all drainage line and riparian habitat areas if required, in order to ensure that the ecology of these areas is re-instated during all phases. Edge effects of activities including erosion and alien/weed control need to be strictly managed in these areas. • Repair erosion damage within watercourse through the use of either soft or hard rehabilitation interventions. Hard interventions, such as gabion drop inlets and other features, will require design by an engineer with rehabilitation experience. Soft rehabilitation interventions include rehabilitation interventions that do not consists of rock and concrete, examples include earth berms, revegetation with indigenous species and biojute fabrics. Note also that rehabilitation works in watercourses require a WUL. • Sheet runoff from access roads should be slowed down by the strategic placement of berms; • Stockpiles should be protected from erosion during the wet season to prevent sedimentation in watercourses. • Discharged storm water must be released in a controlled manner in a diffuse flow pattern across a buffered vegetation strip and be accompanied by energy dissipating interventions to prevent erosion damage. • Limit the amount of impervious material near watercourses as far as possible, and demarcate setbacks from watercourses in the form of a buffer zone with a natural vegetation cover. • Structural control measures such as treatment techniques or naturally vegetated detention basins could be used to improve storm water quality. • Other structural control measures include grass swales, infiltration trenches and basins, wet ponds, and constructed wetlands to intercept and partially treat storm water before it is released. A combination of source controls and structural controls can result in an integrated solution, which is likely to provide the best benefits. • Since the downstream sites in both the Sandspruit and unnamed tributary of the Elands River displayed higher SASS scores this spatial trend should not show a deterioration in the future once the proposed development takes place and this trend should be considered a Key Performance Indicator for the project throughout the life of the infrastructure. • Environmental control officers should ensure that signage to identify watercourses and their buffers are kept in place and remain well visible during the construction process and that no unauthorised access occurs. Toolbox talks should address the importance and sensitivity of wetlands and other watercourses. • If herbaceous protected plant species that are readily transplantable are found (e.g. many geophytes), viable populations of such species can also be translocated to transformed (including rehabilitation areas) or untransformed areas within the study area which provide potentially suitable habitats, but such translocations will have to be carried out in a manner that ensures that no ecological degradation of the host habitat occurs, and will have to be evaluated by a botanist for each species and each potential translocation area. • Develop and implement a rehabilitation plan for the tailings pipeline construction servitude. The principal objectives of the plan should be the optimal reintroduction of stripped topsoil and the establishment of indigenous seral plant communities through the natural process of secondary succession. • Modify the solar plant footprint so as reduce the extent of vegetation units with High biodiversity conservation value and sensitivity as far as possible and covering a greater extent of secondary vegetation.	• On-going • On-going • On-going • Prior to construction • Prior to construction • Prior to construction • Prior to construction • Prior to construction • Construction • Construction • Prior to construction • Construction • Construction • Construction • On-going • Construction • On-going • As required • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going • During construction • Construction • On-going • Design phase	
Site preparation Civil works Earthworks Tailings management Waste rock management Transport systems Process and storm water management Sewage sludge management Site/contract	General disturbance to biodiversity	• The use of light will be kept to a minimum, and where it is required, yellow lighting will be used where possible • Workers (permanent and temporary) will be trained on the value of biodiversity and the need to conserve the species and ecosystems, as well as fire control and prevention. This will be included in induction training as well as relevant follow-up training. • There will be zero tolerance with respect to the killing or collecting of any biodiversity by anybody working for or on behalf of Bakubung Platinum Mine within or adjacent to the mine area • Strict speed control measures will be implemented on access roads and vehicles will be restricted to travel on designated roads • Alien plant species proliferation, which may affect floral and faunal diversity, will be controlled in accordance with legislation and in a manner that no additional loss of indigenous plant species occurs • Effective implementation of the following management plans (as described in the EMP): o Surface and groundwater management plans o Soil management plan o Dust management plan o Waste management plan	• On-going • On-going • On-going • On-going • On-going • On-going	The mitigation actions regarding veld fires are in accordance with the National Veld and Forest Fire Act No. 101 of 1998. The purpose of this Act is to prevent and combat veld, fires and places the responsibility on landowners to develop and maintain firebreaks as well as be sufficiently prepared to combat veld fires in terms of equipment as well as suitably trained personnel.

Activity	Potential impact	Mitigation type	Time period for implementation	Compliance with standards
management Demolition Rehabilitation Maintenance and aftercare		○ Noise management plan ○ Blast management plan • Concurrent and final rehabilitation of the TSF. • Concurrent rehabilitation of areas no longer required for mining activities with a particular focus on establishing indigenous vegetation cover • As part of closure planning, the designs of any permanent and potentially polluting structures (TSF) will take consideration of the requirements for long-term ecosystem functionality, pollution prevention and confirmatory monitoring	• On-going • On-going • Closure	
Site preparation Civil works Earthworks Transport systems Waste rock management Tailings management Process and storm water management Demolition Rehabilitation Maintenance and aftercare	Alteration to natural drainage patterns and changes to water quantity	• Surface water, particularly storm water for all phases of the proposed mining operation, is to be managed in accordance with legislative requirements of the NWA and Regulation 704 (4 June 1999). • Temporary storm water diversion berms will be constructed around all construction sites to divert clean water around and away from the sites. • Water consumption will be managed by setting key performance indicators to achieve water reduction based on the current water balance and the implementation of annual water audits. • All surface water management measures to be implemented in accordance with the Integrated Water and IWWMP and IWUL. • As the TSF develops, surface water control structures (contours and down drains) will be installed to prevent erosion and guide water into the return water dam. • An approved storm water management plan is to be implemented on site where clean and dirty water will be separated and clean water will be diverted around dirty areas and allowed to return to its normal flow path. • Site rehabilitation will aim to restore surface drainage patterns as far as practically and economically feasible. • Infrastructure is to be re-aligned in accordance with the recommendations provided by the wetland specialist; this includes modifying infrastructure footprints so as to avoid overlap of watercourses, as well as the 32m and 100m buffers as far as possible including the tailings and return water pipelines. • A well designed and implemented storm water management system is required to attenuate flood peak events and consider buffer zones in order to prevent erosion impacts and the creation of channelised flows at discharge points. • Interventions and mechanisms in the storm water management system can include measures to facilitate a higher percentage of infiltration and reduce runoff volumes and velocities, without concentrating their outflows as far as practically possible.	• On-going • Construction • On-going • On-going • On-going • Construction • Closure • Prior to construction • Prior to construction and on-going • Prior to construction and on-going	As outlined in mitigation type.
Site preparation Civil works Earthworks Transport systems Mining and mining related activities Waste rock management Tailings management Process and storm water management General and hazardous waste management Sewage sludge management Site support services Demolition Rehabilitation Maintenance and aftercare	Contamination of surface water resources	• Surface water, particularly storm water for all phases of the proposed mining operation, is to be managed in accordance with legislative requirements of the NWA and Regulation 704 (4 June 1999). • The entire mine area (plant and TSF) subscribes to a zero-discharge policy for all dirty water. • All applicable water uses are to be licensed. • Temporary storm water diversion berms will be constructed around all construction sites to divert clean water around and away from the sites. • Pollution control dams will be constructed downslope of the shaft and plant site to capture all dirty water run-off. • The pollution control dams will be sized to accommodate all the dirty water from the area and not spill once in 50 years due to a storm event. The dams will have a minimum of 0.8m free board as required in Regulation GN R704. • The pollution control dams, TSF and return water dam are to include appropriate barrier systems in accordance with legislative requirements with designs approved by the DWS. • Silt traps will be constructed upslope of the pollution control dams and return water dam. • Ensure that all contractors and employees that are employed on site are aware of their responsibilities with regard to the prevention of pollution of water according to the requirements of the NWA. • The pollution control facilities (pollution control dams, silt traps and return water dam) will be placed on planned maintenance, routine inspections will be implemented and they will be de-silted periodically to ensure effective performance. • Water in the pollution control dams will be used for dust suppression, industrial water, for construction, during underground mining activities, as make up water for the mine service water system and, should the quality be suitable, it will be used in the plant. as required • The contractors' laydown areas are to be surfaced and are to drain to a sump with silt traps and hydrocarbon collectors. • Portable chemical toilets will be provided during the construction phase. They are to be routinely cleaned and sewage disposed of at a licensed sewage treatment plant with the safe disposal certificate to be provided. • All chemicals, bulk fuels, oils and grease and any other hazardous substance, will be stored and handled as per all applicable legislation and national standards. • Temporary hazardous waste disposal facilities will be licensed prior to construction. Temporary waste disposal facilities are to be provided for the collection of waste, which will be removed regularly by a reputable contractor to the permitted waste disposal site. • All vehicle transfer of hazardous materials must be done within bunded areas to minimise potential effects of spills. • DWS are to be given details of the design of pollution control facilities before these are constructed. • All surface water management measures to be implemented in accordance with the Integrated Water and IWWMP and IWUL. • A sewage plant will be provided and the treated effluent water will contained in the pollution control dams and will be recycled. • Water on the surface of the TSF will migrate toward the penstock, from where it will be channeled to the return water dam. • Seepage water captured by drains beneath the TSF will be channeled to the return water dam and into the pollution control dams for re-use in the plant. • A site wide water balance will be kept and updated annually. • Waste management procedures will be implemented including hazardous waste handling, storage and disposal of all waste types. • Hazardous materials handling and storage procedure will be implemented, including the availability of Material Safety Data Sheets (MSDS). • Hazardous materials spill procedures and an emergency response plan will be implemented. • Soil will be placed on the TSF as soon as deposition activities have moved high enough (one bench) to allow rehabilitation to begin. These re-soiled areas will be vegetated in the following growing season. • Tailings, chemical and hydrocarbon spillages from trucks, conveyors and pipelines will be cleaned up timeously in order to prevent contamination. • The return water dam and all pollution control dams will remain until such time that monitoring proves that surface water qualities are adequate thus allowing surface water to be released directly into the watercourses. • Bakubung Platinum Mine are to implement containment measures along the length of the tailings pipeline route, at locations where there is the potential for the pipe to leak or burst, to ensure spills or leaks from the pipeline do not enter watercourses, these can include berms, containment ponds or other suitable measures. These designs are to be completed prior to construction. It must be ensured that measures implemented do not impede cattle access to watercourses. • Daily inspections of the tailings pipeline, joints and casing to ensure integrity and to check for leaks. • Monthly inspections to check thickness of the tailings pipeline. • Rehabilitation will be done according the provisional rehabilitation plan in Section 29.1.3 in order to encourage clean surface flow off the rehabilitated	• On-going • On-going • Prior to construction • Construction • Construction • Prior to construction • Construction • Construction • On-going • On-going • On-going • Construction • Construction • On-going • On-going • On-going • Prior to construction • On-going • On-going • On-going • On-going • On-going as per requirement • On-going • On-going • On-going • On-going • On-going • On-going • Prior to construction • On-going • On-going • Closure	

Activity	Potential impact	Mitigation type	Time period for implementation	Compliance with standards
		surfaces. • Surface water quality needs to be monitored until any impacts attributable to mining have been eliminated and are acceptable to the receiving water environment. • Results from the water monitoring program must be presented to DWS on an annual basis until acceptable limits are achieved.	• Closure • Closure	
Site preparation Civil works Earthworks Transport systems Waste rock management Tailings management Process and storm water management Demolition Rehabilitation Maintenance and aftercare	Changes of groundwater levels and availability	• The shafts will be sealed during the construction phase to prevent the ingress of groundwater. • The shafts will be concrete lined and any water bearing fissures encountered during shaft sinking will be plugged to prevent further ingress of water. • Water pumped from underground during construction should be treated as dirty water and will be pumped to the settling ponds or pollution control dams. • The impact of shaft sinking on the surrounding aquifers will be monitored and reported on. Should there be a reduction as a direct result of the cone of dewatering from the shaft then an alternative source of water will be identified for the particular borehole user(s). • Groundwater inflow into the mine workings will be minimised by using appropriate measures. • Water encountered underground will be collected and re-circulated to surface. • All unwanted water accumulating in the excavations will be used or discharged into pollution control dams or settling ponds • Monitoring of groundwater levels should continue post closure. If a groundwater abstraction scheme is required around the TSF, this process must be scoped and discussed with all the authorities. The abstraction and disposal of polluted water must be licensed. • Groundwater levels should be continuously monitored for any type of impact;	• Construction • Construction • Construction • Construction • On-going • On-going • Construction • On-going and post closure • On-going as per monitoring programme	Not applicable
Site preparation Civil works Earthworks Transport systems Mining and mining related activities Waste rock management Tailings management Process and storm water management General and hazardous waste management Sewage sludge management Site support services Demolition Rehabilitation Maintenance and aftercare	Contamination of ground water resources	• The TSF and return water dam will be constructed in accordance with the proposed TSF design document. • Suitable clay soils found on site at the TSF, waste rock dump and pollution control dams will be compacted to form an impermeable layer that will minimise the flow of leachate into the groundwater regime. • The return water dam will be lined with an appropriate barrier system approved by the DWS to prevent seepage. • All plant and surface infrastructure (including TSF, waste rock dump and pollution control dams) to be designed in accordance with national standards and applicable legislative requirements, to prevent ingress of surface water into the groundwater regime. • The in situ subsoil layer containing clay will be compacted beneath the waste rock dump, TSF and pollution control dams to act as an impermeable layer. • All plant and surface infrastructure (including TSF, waste rock dump and pollution control dams) to be constructed in accordance with national standards and applicable legislative requirements, to prevent ingress of surface water into the groundwater regime. • All chemicals, bulk fuels, oils, grease and any other hazardous substance, will be stored and handled as per all applicable legislation and national standards. • All dirty face water will be captured and stored in underground settling ponds. • All groundwater management measures to be implemented in accordance with the Integrated Water and IWWMP and IWUL. • Waste management procedures to be implemented including hazardous waste handling, storage and disposal of all waste types. • Hazardous materials handling and storage procedure to be implemented, including the availability of Material Safety Data Sheets (MSDS). • Hazardous materials spill procedures and emergency response plan to be implemented. • All chemicals, bulk fuels, oils, grease and any other hazardous substance, will be stored and handled as per all applicable legislation and national standards. • Clean and dirty water will be separated. • All tailings spills require immediate clean up to prevent contamination of water resources. • Groundwater quality and level monitoring will be conducted on a monthly basis as per the water management plan. Internal quarterly reporting will be undertaken and an annual report will be submitted to DWS. • Seepage from under drains of TSF plus that from the penstock will be circulated back to the return water dam and the pollution control dams for use in the plant or for other mining purposes. • All hydrocarbon spills should be cleaned up as soon as possible to prevent ingress of pollutants into the ground water regime. • Surface water quality needs to be monitored until any impacts attributable to mining have been eliminated and are acceptable to the receiving water environment. • Results from the water monitoring program must be presented to DWS on an annual basis until acceptable limits are achieved. • The TSF should be rehabilitated correctly to prevent the ingress of surface water after closure, thus reducing the potential for the generation of leachates. • Excess water that accumulates during the construction phase will be dealt with as part of the construction phase water balance; • Clean runoff will be diverted around the total TSF complex. • All excess water must be managed as part of operational phase water balance. Return water from the TSF must be used as much as possible; • All water coming to the TSF must be treated as polluted. Where water is not returned to the plant area, disposal must take place in the correct polluted water facility; • Groundwater quality should be continuously monitored for any type of impact; • If required, a groundwater abstraction scheme should be implemented around the TSF to capture polluted ground water, and to prevent the migration of polluted water away from the site. • Monitoring of groundwater qualities should continue post closure. If a groundwater abstraction scheme is required around the TSF, this process must be scoped and discussed with all the authorities. The abstraction and disposal of polluted water must be licensed. • Groundwater monitoring has to continue during all phases of the TSF operation to identify the impact on the groundwater resources over time, so effective measures can be taken at an early stage before serious damage to the environment occurs. • In total nine monitoring points are recommended for the proposed groundwater monitoring program four shallow (to monitor the water level and quality in the weathered aquifer), four deep (to monitor groundwater conditions in the fractured aquifer) and one by the Elands River).	• Prior to construction • rigor to construction • Prior to construction • Prior to construction • Construction • Construction • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going as per measure • On-going • As required • On-going as per monitoring programme • On-going as per monitoring programme • On-going • Construction • On-going • On-going • On-going • On-going as per monitoring programme • As required • On-going as per monitoring programme • On-going as per monitoring programme • On-going as per monitoring programme	As outlined in mitigation type.
Site preparation Civil works Earthworks Mining and mining related activities Waste rock management	Economic impact	• A policy regarding labour recruitment and employment will be compiled for use during the onset of the construction phase and early life of mine. The policy is to be reviewed at least once every two years. • Recruitment may not take place at any other point other than at the designated offices. • To compile a policy regarding labour training programs to guide contractor contracts as well as BPM. • Create a database of employable community members. This database will include identification documents, certificates of highest qualifications and proof of residence confirmed by the leader of the community. • A suitably qualified recruiting company will assist with the employment of individuals, both contractors and permanent, during both the construction and	• Planning and design • Planning and design • Planning and design • Planning and design • Planning and design	

Activity	Potential impact	Mitigation type	Time period for implementation	Compliance with standards
Mineral processing operations Tailings management Power Supply and Use Water supply and use Process and storm water management Transport systems General and hazardous waste management Sewage sludge management Site support services Site/contract management Demolition Rehabilitation Maintenance and aftercare		operational phases. This assistance will be in the form of interviews and a register held by the recruiting company. • Development of a policy regarding procurement/contracting of local SMMEs and BEE and creation of business opportunities to be developed. • Local products and services will be used where possible. • A policy regarding the preferred use of local SMME's as service providers will be compiled for use throughout the life of mine. • Provide contractors with the policy regarding labour recruitment and employment for their implementation. • Ensure that this policy is clearly communicated to all employees and to the communities. • Fair and equitable recruitment opportunities will be afforded to all with equivalent qualifications. • Recruitment practices must be transparent and auditable. • Stipulate the preferential use of local labour in all contracts, from Phatsima and Ledig, from communities within 50 km of the mine site, and then those areas from further afield, but without disregarding a person's constitutional rights. • Any job vacancy that is advertised must clearly indicate the required and appropriate skills for that position. • BPM will comply with the requirements of the mining charter with respect to employment equity, women in mining and employment of disabled persons. Policies with respect to this have been drafted. • BPM will identify candidates from the local communities for apprenticeships and on the job training programs • Employees Training and skills development: • BPM has developed a policy and program for the training, development, mentorship, skilling and career progression of its permanent employees as per the requirements of the SLP. Any BPM contractor will also be expected to meet the requirements of the SLP. All training will be carried out in accordance with the requisite SETA and NQA. • Communicate recruitment and appointment policy in transparent manner at local level. • Where retrenchments are unavoidable, they should be managed according to legislative requirements. • Provide contractors with the policy regarding the preferred use of local SMME's. • Preference should be given to local SMMEs as sub-contractors wherever possible. • Larger contractors will also be required, where possible, to sub-contract and mentor local SMMEs. • Make use of locally available raw materials, goods, and services as far as possible, and where appropriate, during construction and operation. • Through the correct implementation of the SLP the mine are to put in place alternative forms of employment and generation of income prior to its closure, to hopefully ensure the sustainability of the neighbouring communities. • A grievance/ complaints register should be maintained in which all community and Interested and Affected Parties (IAP) complaints are recorded and addressed. • Periodic communication (annual at a minimum) and feedback should be undertaken to the community and IAPs in respect of the progress of the Project and the implementation of the EIA management plans • Review all commitments outlined in the SLP and EMP, update to ensure that there is an increased benefit directed towards Phatsima. This should include meaningful interventions that promote long-term investment and expenditure in the community. • All directly affected communities will be considered for corporate social investment initiatives. Bakubung Platinum Mine is to clearly define beneficiaries (notably Ledig and Phatsima). Specific initiative should be defined for these communities. • BPM will continue to support the *Bakubung-Ba-Ratheo* Non-Mining Economic Development Trust and the *Bakubung-Ba-Ratheo* Economic Development Unit (EDU) sustainable development initiatives and monitor their effectiveness. • All IAPs should be informed of the commencement of the decommissioning phase and the date of mine closure on a regular basis. • BPM must ensure that rehabilitation has taken place correctly, as stated in Section 13.17 of the SLP and according to legislation and the final end land users' requirements.	• Planning and design • Planning and design • Planning and design • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going • Decommissioning • On-going • On-going • On-going • On-going • Prior to closure • On-going • On-going as per mitigation stipulation • Annually • On-going • On-going • Prior to decommissioning • On-going and Closure	
Site preparation Civil works Earthworks Mining and mining related activities Waste rock management Mineral processing operations Tailings management Power Supply and Use Water supply and use Process and storm water management Transport systems General and hazardous waste management Sewage sludge management Site support services Site/contract management Demolition Rehabilitation Maintenance and aftercare	Inward migration and associated social ills	• Worker accommodation (construction and operation phases) must comply with the standards of international best practice; i.e. Workers Accommodation Processes and Standards: A Guidance Note by IFC and EBRD (2009). • Focus on employing local labour and the appointment of contractors. • Link with relevant forums/organisations on issues of community safety and provision of emergency response services. • Plan a medical facility for employee needs. • Through the CSI department, identify opportunities to improve the health of the community. • Communicate the fact that BPM will operate through contractors, and that recruitment is to be done at specified centres that will be regularly advertised to the local communities. • Ensure the inclusion of stipulations in the contractors' agreements which prohibit them from employing people from the street or on-site. • Negotiate the establishment of a recruitment facility at the Traditional Council's offices/ information centre in Ledig and at an equivalent facility in Phatsima. • Actively downplay (through clear, simple, and persistent communication) inflated expectations of unlimited employment opportunities. • Liaise regularly with the Community Policing Forums. • A zero tolerance policy will be adopted for with respect to drugs and alcohols on site. • Access to councilors will be made available to employees attend to conflict resolution, HIV/AIDS issues, and any other relevant social issues. • Join established forums in conjunction with BDM and the MKLM that deal collectively with emergency incidents, such as the Western Limb Local Producer's Forum or other relevant forums/organisations. Discover where effective contributions to these services can be made. • Through this establish linkages with the respective municipalities' Disaster Management Plans to determine if any contribution can be made to these plans. • Through the *Bakubung-Ba-Ratheo* Non-Mining Economic Development Trust and the *Bakubung-Ba-Ratheo* Economic Development Unit and BPM's corporate social investment program investigate opportunities to improve local health care. • Communicate with other mining houses and the local municipalities with regards to the support and implementation of emergency services as well as essential general services. • BPM will work closely with the *Bakubung-Ba-Ratheo* tribal authority on the management of informal settlements that entails that no newcomers to the area will be permitted to construct any form of informal housing structure on land held in trust for the Bakubung. • BPM will ensure that contractor accommodation is provided for contractors, of a particular standard, and is managed in an environmentally and socially acceptable manner. All necessary authorisations for the construction of the contractors' camp will be obtained prior to the commencement of construction. • The adherence to the EMP specifications for the construction and operational phases will be made a conditional precedent of the contract. • Actively support the endeavours of the *Bakubung-Ba-Ratheo* Traditional Council and the Moses Kotane and Rustenburg Local Municipalities to prevent squatting and to formalise settlement of newcomers in demarcated stands.	• On-going as per mitigation stipulation • Planning and design • Planning and design • Planning and design • Planning and design • On-going • On-going • As required • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going	Not Applicable

Activity	Potential impact	Mitigation type	Time period for implementation	Compliance with standards
		• BPM will, in accordance with other mining practice, provide a housing allowance for their employees. However, this allowance will be paid in cash only to those employees who can prove that they own their own local residences. • Those who do not own houses will be given the opportunity to purchase houses through a housing scheme that will be backed by a major financial institution in cooperation with BPM. • Those who neither currently own a local house and who do not wish to purchase locally will be provided with accommodation that will be paid for directly by the mine in order to discourage workers from taking up residence in informal settlements. • Compile a policy on HIV/AIDS. • Ensure that all applicable health legislation is strictly adhered to by both BPM and its contractors. • Actively inform employees and contractor employees about the HIV/AIDS pandemic and how they can help reduce the spread of the disease HIV/AIDS amongst their families, relatives and communities in which they live. • Educate employees and contractor employees about promoting good health practices, and inform them about other communicable diseases, and the prevention of the spread thereof. • Provide access to voluntary testing and counselling. • Provide free condoms at the workplace. • Facilitate appropriate information sessions with regard to HIV/AIDS for employees on all levels. • The facilitation of health training sessions.	• On-going • On-going • Planning and design • On-going • On-going • On-going • On-going • On-going • On-going • On-going	

Site preparation
Civil works
Earthworks
Mining and mining related activities
Waste rock management
Mineral processing operations
Tailings management
Power Supply and Use
Water supply and use
Process and storm water management
Transport systems
General and hazardous waste management
Sewage sludge management
Site support services
Site/contract management
Demolition
Rehabilitation
Maintenance and aftercare
	Tourism	• Implement all mitigation measures as specified in the relevant specialist inputs, without compromising the safety of people. Namely:
		  ○ noise impact assessment;
		  ○ air quality impact assessment;
		  ○ traffic impact assessment; and
		  ○ visual impact assessment in the EIA.
		• A grievance/complaints register should be compiled and implemented in which all community and IAP complaints are recorded and addressed.
		• BPM is to undertake to act in all its activities in a sustainable and environmentally and socially acceptable manner.
		• BPM seeks to engage with established forums to discuss matters of mutual environmental concern.
		• Ensure that construction of the mining complex adheres to the provisions made in the EMP and environmental legislation.
		• Ensure that open communication is set-up between BPM, contractors, Pilanesberg National Park, Sun City and other tourism operators in the area, in order to pro-actively and “in-house” manage matters of mutual environmental concern.
		• Minimise light pollution as far as is practically possible.
		• Establish ties between BPM, the EDU, the Ipopeng Farmers’ Association, and applicable local environmental NGOs, to consider appropriate sustainable use development programs, driven through ventures creation in Ledig and Phatsima.
		• Establish a forum between BPM, BDM, MKLM and RLM, the Pilanesberg National Park, Sun City, the Traditional Council and other tourism operators in the area to meet a minimum of annually to discuss matters of mutual environmental concern.
		• Ensure the correct implementation of the Rehabilitation Plan so the land will be returned to a grazing land use after decommissioning and the wilderness feel to the area will be promoted
			• On-going
			• On-going
			• On-going as per mitigation stipulation
			• On-going
			• On-going
			• Construction
			• On-going
			• On-going
			• On-going
			• On-going	

Site preparation Civil works Earthworks Mining and mining related activities Waste rock management Mineral processing operations Tailings management Power Supply and Use Transport systems Demolition Rehabilitation Maintenance and aftercare	Air Pollution	• Maintain the weather station on site to provide required weather data. • Maintain the mine and plant designs that have been developed to reduce dust emissions on surface. • Ensure the position of the TSF, waste rock dump and mine have been positioned to reduce as far as is possible the impact on the neighbouring communities. • All vehicles and machines should be equipped such that gaseous emissions from engine exhausts are kept to a minimum. • A refrigeration plant (marine chiller) is to be installed to meet current legal practice and be a closed system with zero emissions (non-ozone depleting substance technology). • Ventilation fans are to be placed in a manner to ensure directional ventilation along with prevailing winds and away from communities. • Paste technology, cyclone underflow, waste rock impoundment and spigotting are to be actively investigated from an environmental, technological and economic perspective to determine the viability of these and/or other technologies. • The TSF design is to include erosion control design measures such as energy dissipaters and optimal slope angles and lengths. • A dust monitoring program will be implemented prior to the commencement of construction, and will be on-going as part of the overall environmental monitoring program for the mining area. The dust monitoring program will continue through the decommissioning phase in order to assess dust levels generated by closure activities. • Alternative dust suppression methods, other than water, will be investigated, in order to reduce the consumption of water by the mine, particularly during the windier, winter months when water is scarce. • Roads on the mine and plant area will be surfaced or managed by water sprays or dust suppressants resulting in 75% control efficiency. • Vehicles will be maintained and inspected regularly to reduce emissions. • Disturbed sites will be re-vegetated as soon as possible. Regular inspection of vegetation cover will be undertaken to ensure dust does not emanate from soil surface. • Blasting will be undertaken in accordance with relevant Mine Health and Safety legislation and international blasting standards. • Vehicle speeds and routes on un-surfaced roads will be controlled to reduce dust entrainment by vehicles. • BPM are to operate within the law at all times and will undertake to assist in finding ways in which to reduce existing local emissions	• On-going • Planning and design • Planning and design • On-going • On-going • Planning and design • Planning and design • Planning and design • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going	National Atmospheric Emission Reporting Regulations in terms of the NEMAQA requires that holders of mining rights register on the National Atmospheric Emissions Inventory System (NAEIS) and to ensure that annual monitoring reports are uploaded onto the NAEIS. South African National Ambient Air Quality Standards as set out by the NEMAQA National Dust Control Regulations

Activity	Potential impact	Mitigation type	Time period for implementation	Compliance with standards
		• A dust suppression sprinkler system will be implemented over the crest of the TSF wall and extending over the accessible dry portions of the beach. • All uncontrolled fires will be prohibited on site. • Mine vehicle fleets (diesel driven vehicles) will be serviced regularly and tested for compliance with exhaust emission regulations. • Personal Protection Equipment (PPE) will be worn at all times as required by the appropriate workplace health and safety legislation. • Firefighting equipment will be placed around the site to enable rapid control of fires. • Unpaved surfaces and exposed areas to be regularly sprayed with water or periodically treated with chemical dust suppressants. • All conveyor tipping or transfer points will have dust suppression systems on them. • Application of relevant and applicable best practice vegetation establishment and erosion control as determined for the particular TSF design, according to the rehabilitation plan. • Earthen berms may also be placed between the prevailing winds and the TSF. • The installation and maintenance of permanent hydro-sprays are recommended on the traditionally, drier outer annulus of the TSF. • The side walls of the TSF will be progressively re-vegetated as the facility increases in height. • The TSF slope is to be designed to reduce the dusting effects of laminar wind flow over the slopes. • The TSF will be rehabilitated and closed properly to prevent the ingress of water. • Topsoils should be wetted as moist topsoil will reduce the potential for dust generation when tipped onto stockpiles. • Trees will be planted around the TSF to partially break laminar wind flow. • Upstream development of the TSF allowing simultaneous rehabilitation as close behind the active working area as possible. • Vegetation to be planted on exposed side slopes of the TSF as and where applicable. • Water sprays should be used for underground roads, material handling points and drilling points resulting in 75%, 50% and 70% Control Efficiency (CE) respectively. • $PM_{2.5}$ and PM_{10} ambient samplers must have no exceedances of the selected criteria. • SO_2 and NO_2 ambient samplers must have no exceedances of the selected criteria. • Ensure travel distance between clearing area and topsoil piles to be at a minimum. • For crushing and screening, a minimum mitigation measure of enclosure with fabric filters resulting in 83% CE is to be implemented. • Freshly graded areas to be kept to a minimum. • Haul routes should be shortened where possible • Keep active TSF and WRD surfaces to a minimum to decrease wind erosion. • During the life of the project monthly dustfall rates should not exceed 600 mg/m²/day at residential dustfall bucket locations and 1 200 mg/m²/day at non-residential dustfall bucket locations. • During demolition ensure the site is restored to pre-mining conditions. • Demolition of infrastructure to have water sprays where a lot of vehicle activity is required. • Site inspections and progress reporting be undertaken at regular intervals (at least quarterly) during operations, with annual environmental audits being conducted. • Results from site inspections and off-site monitoring efforts should be combined to determine progress against source- and receptor-based performance indicators. Progress should be reported to all interested and affected parties, including authorities and persons affected by pollution. • Corrective action or the implementation of contingency measures must be proposed to the stakeholder forum in the event that progress towards targets is indicated by the quarterly/annual reviews to be unsatisfactory. • Stakeholder forums at specific intervals should be held for information dissemination and consultation. • The final design of the ventilation shafts will include measures to ensure $PM_{2.5}$ levels are within acceptable limits at third party residential receptors. These considerations can include position, height and orientation, or alternative appropriate means.	• On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going • On-going • Construction • On-going • On-going as per monitoring programme • Decommissioning • Decommissioning • On-going as per requirement • On-going in line with annual monitoring programme • As required • Regularly as per mitigation requirement • Design phase prior to construction	

TABLE 28.2:DESCRIPTION OF IMPACT MANAGEMENT ACTIONS FOR THE HOUSING (ADDITIONAL MEASURES)

Activity	Potential Impact	Mitigation Types	Time Period for Implementation	Compliance with Standards
Housing	Biodiversity	Modify infrastructure footprints to avoid overlap between watercourses, as well as the 32m and 100m buffers as far as possible.	• Prior to construction	Not applicable
Housing	Traffic	• Public transport facilities must be provided to accommodate the movement of residents and mine workers to and from the proposed township. • Pedestrians must have ease of access and safe mobility on internal roads and along the R556. • Traffic calming measures within the development should be considered to contribute to pedestrian safety.	• On-going • On-going • On-going	Not applicable
Housing	Heritage	**Iron Age sites** *For MHC018, MCH020:* • Shovel pit test to determine depth and integrity of archaeological deposit of site and for sites with ceramics also to collect more diagnostic ceramics to positively establish group identity. • Test pit excavations will be aimed at identifying structures. • Based on the findings further assessment of the site might be required. • Before destruction of the site, a destruction permit must be applied for (for sites that require destruction permits) and received from the South African Heritage Resources Agency. • This work can only be undertaken by a suitably qualified and experienced archaeologist. • This work may only be undertaken after permits have been received from the South African Heritage Resources Agency allowing such mitigation measures to be undertaken. • Permits for mitigation in terms of Section 35 of the NHRA must be applied for MHC018 and MHC020. Mitigation measure should include Shovel Test Pits and test pit excavations. These excavations must be documented by means of a Phase 2 Archaeological Investigation Report that must be submitted to SAHRA for further comment. An agreement with a recognised repository must be sought to house excavated artefacts for long term curation. *MHC019:* • An archaeologist must monitor the site during construction to mitigate accidental finds.	 • Prior to construction • Prior to construction • Prior to construction • Prior to construction • Prior to construction • Prior to construction • Prior to construction • During construction	Compliance with the National Heritage Resource Act No. 25 of 1999 in the event of any chance finds.

Activity	Potential Impact	Mitigation Types	Time Period for Implementation	Compliance with Standards
		• This work can only be undertaken by a suitably qualified and experienced archaeologist. • A Watching Brief must be conducted for sites. A Watching Brief Report must be compiled and submitted to SAHRA upon completion. **Stone Cairn** *MHC021* • The stone cairn (MCH021) will be fenced off to afford them greater protection. • A Watching Brief must be conducted for sites. A Watching Brief Report must be compiled and submitted to SAHRA upon completion. • A Watching Brief Report must be compiled and submitted to SAHRA upon completion. Additionally, a Conservation Management Plan (CMP) must be developed for site MHC021, following a social consultation process in terms of section 36 of the National Heritage Resources Act, 1999 (NHRA) and Chapter XI of the NHRA Regulations. **General** • Additional heritage resources may be unearthed during construction. Should this occur, work in that area should be halted until such time as an appropriately qualified person can make an expert decision on the mitigation measures required. The expert must notify SAHRA and carry out an emergency recovery (Emergency Response Procedure Section 31.2.2). • If any evidence of archaeological sites or remains (e.g. remnants of stone-made structures, indigenous ceramics, bones, stone artefacts, ostrich eggshell fragments, charcoal and ash concentrations), fossils or other categories of heritage resources are found during the proposed development, SAHRA APM Unit (Natasha Higgitt/Phillip Hine (or whoever is applicable at the time) 021 462 5402) must be alerted. If unmarked human burials are uncovered, the SAHRA Burial Grounds and Graves (BGG) Unit (Itumeleng Masiteng/Mimi Seetelo (or whoever is applicable at the time) 012 320 8490), must be alerted immediately. A professional archaeologist or palaeontologist, depending on the nature of the finds, must be contracted as soon as possible to inspect the findings. If the newly discovered heritage resources prove to be of archaeological or palaeontological significance, a Phase 2 rescue operation may be required.	• During construction • During construction • On-going • As required, during construction • As required, during construction • As required • As required	

The waste management and soil conservation procedures applicable to the proposed project are included in Table 28.3 and Table 28.4 below.

TABLE 28.3: WASTE MANAGEMENT PROCEDURES FOR GENERAL AND HAZARDOUS WASTE

Items to be considered		Intentions
General	**Specific**	
Classification and record keeping	General	The waste management procedure for the mine will cover the storage, handling and transportation of waste to and from the mine. The mine will ensure that the contractor's responsible are made aware of these procedures.
	Waste opportunity analysis	In line with DWS/DEA's strategy to eliminate waste streams in the longer term, Bakubung Platinum Mine will assess each waste type to see whether there are alternative uses for the material. This will be done as a priority before the disposal option.
	Classification	Wastes (except those listed in Annexure 1 of the new Waste Regulations) will be classified in accordance with SANS 10234 within one hundred and eighty (180) days of generation. Waste will be re-classified every five (5) years, or within 30 days of modification to the process or activity that generated the waste, changes in raw materials or other inputs, or any other variation of relevant factors.
	Safety data sheets	The mine will maintain, where required in terms of the Regulations, the safety data sheets for hazardous waste (prepared in accordance with SANS 10234).
	Inventory of wastes produced	The mine will keep an accurate and up to date record of the management of the waste they generate, which records must reflect: The classification of the wastes The quantity of each waste generated, expressed in tons or cubic metres per month The quantities of each waste that has either been re-used, recycled, recovered, treated or disposed of By whom the waste was managed.
	Labelling and inventory of waste produced	Any container or storage impoundment holding waste must be labelled, or where labelling is not possible, records must be kept, reflecting: The date on which waste was first placed in the container The date on which waste was placed in the container for the last time when the container was filled, closed, sealed or covered The dates when, and quantities of, waste added and waste removed from containers or storage impoundments, if relevant The specific category or categories of waste in the container or storage impoundment as identified in terms of the National Waste Information Regulations, 2012 The classification of the waste in terms of Regulation 4 once it has been completed (if required).
	Disposal record	Written evidence of safe disposal of waste will be kept.
	Record keeping	Records will be retained for a period of at least 5 years and will be made available to the Department on request.
Waste management	Collection points	Designated waste collection points will be established on site. Care will be taken to ensure that there will be sufficient collection points with adequate capacity and that these are serviced frequently.
	Laydown/ salvage areas	During decommissioning and closure, lay down areas for re-usable non-hazardous materials will be established.
	General waste	Will be stored in designated skips and removed by an approved contractor for disposal at a licensed facility.
	Scrap metal and building rubble	Care will be taken to ensure that scrap metal and building rubble does not become polluted or mixed with any other waste. The scrap metal will be collected in a designated area for scrap metal. It will be sold to scrap dealers.
	Hazardous wastes	Medical waste will be temporarily stored in sealed containers in a bunded store before removal by an approved waste contractor and disposal in a licenced facility.

Items to be considered		Intentions
General	**Specific**	
	Oil and grease	Oil and grease will be collected in suitable containers at designated collection points. The collection points will be bunded and underlain by impervious materials to ensure that any spills are contained. Notices will be erected at each waste oil point giving instructions on the procedure for waste oil discharge and collection. An approved subcontractor will remove oil from site.
	Diesel tanks	Bunds should be established around the diesel tanks
	Any soil polluted by a spill	If remediation of the soil in situ is not possible, the soils will be classified as a waste in terms of the Waste Regulations and will be disposed of at an appropriate permitted waste facility.
	Mixing of wastes	Waste will not be mixed or treated where this would reduce the potential for re-use, recycling or recovery; or result in treatment that is not controlled and not permanent.
Disposal	Off-site waste disposal facilities	Waste will be disposed of at appropriate permitted waste disposal facilities.
		Unless collected by the municipality, the mine must ensure that their waste is assessed in accordance with the Norms and Standards for Assessment of Waste for Landfill Disposal set in terms of section 7(1) of the Waste Act prior to the disposal of the waste to landfill.
		Unless collected by the municipality, the mine must ensure that the disposal of their waste to landfill is done in accordance with the Norms and Standards for Disposal of Waste to Landfill set in terms of section 7(1) of the Waste Act.
Waste transport	Contractor	A qualified waste management subcontractor will undertake the waste transport. The contractor will provide an inventory of each load collected and of proof of disposal at a licensed facility.
Banned practices	Long-term stockpiling of waste	Stockpiling of waste is a temporary measure. Waste stockpiling sites must have an impervious floor, be bunded and have a drainage system for collection and containment of water on the site.
	Burying of waste	No wastes will be buried on site.
	Burning of waste	Waste may only be burned in legally approved incinerators.

TABLE 28.4: SOIL MANAGEMENT PRINCIPLES

Steps	Factors to consider	Detail
Delineation of areas to be stripped		Stripping will only occur where soils are to be disturbed by activities that are described in the EIA and EMP report, and where a clearly defined end rehabilitation use for the stripped soil has been identified. Plan and construct infrastructure in such a manner that minimises soil disturbance.
Reference to biodiversity action plan		All requirements for moving and preserving fauna and flora according to the biodiversity management plan as per the EMP will be adhered to.
Stripping	Soil horizons are to be stripped and stockpiled separately and replaced in the correct order: C-horizon material to be backfilled first followed by B- and A-horizon material and a map of where the different soil types are placed will be kept. Topsoil should, if possible, be stripped during the dry winter months to protect the structural integrity of the soils. Stripped soil is to be back-filled as soon as possible.	
	Topsoil	Soils will be stripped to the competent rock. Where this is not possible, topsoil will be stripped to at least 300 mm where available and stockpiled for later use as a cover material. The stripped soils from the TSF area will be used for the ongoing rehabilitation of the TSF and for rehabilitation of disturbed areas on closure.
	Subsoil	**Shaft & plant complex and housing:** Subsoil will be stripped to at least 200 mm where available and stockpiled for later use as a cover material.
		TSF: The entire site is covered by either black sandy/silty clay colluvium (Soil Zone A) or reddish brown/red colluvium (Soil Zone B). *Zone A:* The stiff black colluvium will be used for the foundations of the starter walls. The foundations will be ripped to 300 mm below surface compacted to at least 98% of Proctor density to ensure the soil horizon has a low permeability. The stiff clayey soil has a very high potential for expansiveness therefore, moisture fluctuation should be monitored or controlled.

Steps	Factors to consider	Detail
		Residual Norite will be used for construction of the starter wall and other embankments. The soft to very soft rock norite is considered suitable for foundations of heavy structures. *Zone B*: Reddish brown/red colluvium will be excavated to a depth of 500 mm and ripped an additional 300 mm. The base of the excavation will then be compacted to 98% Proctor maximum dry density. The reddish brown/red colluvium may be used as the inner core of the zoned embankment for the TSF. The black and reddish brown/red colluvium soils may be reused for the inner core of the zoned embankment walls. This material has very low permeability k-values.
Delineation of stockpiling areas	Location	Stockpiling areas are located close to the shaft and concentrator complexes which are in close proximity to the source of the soil to limit handling and to promote reuse of soils in the correct areas. Topsoil from the TSF will be located near the TSF. All stockpiled material must be easily accessible without any environmental damage to adjacent undisturbed areas.
	Designation of the areas	Soil stockpiles will be clearly marked to identify the soil type.
Stockpile management	Vegetation establishment and erosion control	Rapid growth of vegetation on the topsoil stockpiles will be promoted (e.g. by means of watering or fertilisation). The purpose of this exercise will be to encourage vegetation growth on soil stockpiles and to combat erosion by water and wind. Monitor vegetation on soil stockpiles to prevent erosion and loss of topsoil. Disturbed or excavated areas should be backfilled with the soil material that was removed from it, shaped to free draining slopes and planted with sustainable grass species. Erosion control measures using sustainable methods and natural vegetation must be in place and must be monitored and maintained to minimise the loss of material from erosion.
	Storm water controls	Stockpiles will be established with storm water diversion berms to prevent run off erosion. Stockpiles are to be monitored for erosion.
	Height	Utilisable topsoil will be stockpiled in berms. Soils to be stored for longer than three years should preferably not be stockpiled in piles greater than 1.5 m in height. Slopes of the berm/stockpiles should be constructed to minimise the chances of erosion of the soils.
	Waste	No waste material will be placed on the soil stockpiles.
	Vehicles	Equipment movement on top of the soil stockpiles will be limited to avoid topsoil compaction and subsequent damage to the soils and seedbank. The handling of soil will also be limited.
Rehabilitation of disturbed land: restoration of land capability	Placement of soil	A minimum layer of 300 mm of topsoil will be replaced. Soil horizons are to be replaced in the correct order: C-horizon material to be backfilled first followed by B- and A-horizon material.
	Fertilisation	A soil specialist will be consulted to sample the stockpiled soils at relevant depths in the topsoil stockpile berms to determine the nutrient status of the soil. As a minimum the following elements will be tested for: cation exchange capacity, pH and phosphate. These elements provide the basis for determining the fertility of soil. Based on the analysis, the soils specialist will advise if fertilisers must be applied.
	Vegetation	Refer to the rehabilitation plan which provides a guideline of the procedures for soil and vegetation to be followed for rehabilitation. Topsoil stockpiles should be vegetated as soon as possible and monitored to prevent loss of the resource by wind and water erosion and to retain its micro-biological functions.
	Erosion control	Erosion control measures will be implemented to ensure that the topsoil is not washed away and that erosion gulleys do not develop prior to vegetation establishment. If soil erosion has occurred, an erosion control plan entailing hard (i.e. gabion construction) and/or soft (i.e. breaking surface water flow velocities) should be designed by a competent person.

Steps	Factors to consider	Detail
Pollution of soils	In situ remediation	If soil (whether stockpiled or in its undisturbed natural state) is polluted, the first management priority is to treat the pollution by means of in situ bio-remediation alternatively by the removal and handling as per waste management plan. If the spill covers an extensive area the soil must be removed and rehabilitated elsewhere, then replaced.
	Off-site disposal	If in situ treatment is not possible or acceptable then the polluted soil must be classified according to the Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste (DWAF 1998) and disposed at an appropriate, permitted, off-site waste facility.

29 FINANCIAL PROVISION

29.1 DETERMINATION OF THE AMOUNT OF THE FINANCIAL PROVISION

29.1.1 DESCRIPTION OF THE CLOSURE OBJECTIVES AND THE ALIGNMENT WITH THE BASELINE ENVIRONMENT

The closure objective for the proposed project including how with the objective will align with the current baseline environment includes the following:

- Meet all regulatory conditions;
- Maintain Bakubung Mine's Reputation;
- No lost time injuries during closure and post-closure activities;
- Removal of surface infrastructure except for the TSF (remains on site and revegetated) and housing and the training/community centre (to be retained for community use);
- Minimise post-closure health and safety hazards;
- Mitigate micro-and macrotopographic impacts created during the operational phase through landscaping the area to as close as possible its original state. Ensure that free drainage of surface water is initiated;
- Provide viable soils for post closure land uses through use of stockpiled topsoil for rehabilitation and amelioration where required;
- Minimise adverse air quality, especially dust, impacts through re-vegetating remaining exposed surfaces;
- Maintain noise levels within the requirements of the Mine Health and Safety Act (Act No 29 of 1996) during and post closure;
- Reduce visual impacts on the landscape post closure through contouring and use of vegetation to screen areas of low visual worth;
- Ensure rehabilitated land is stable in the long term, both from the point of view of soil erosion and self-sustaining vegetation cover;
- Minimises long term maintenance on rehabilitated areas;
- Annual inspection and monitoring of rehabilitated areas post closure for a period of three to five years;
- Ensure the successful reestablishment of a range of indigenous species;
- Minimise impacts on downstream surface water and groundwater uses by complying with water quality objectives with the regulator;
- Any waste produced during closure will be disposed of to minimise environmental risks and community impacts;
- Workforce is enabled to plan for closure;
- Empower the workforce to develop skills that will equip them to obtain employment in other sectors of the economy after mine closure;

- Contribute to the development of a self-reliant (not dependent on the mine) community surrounding the area of operation;
- Open, accurate, accessible and transparent communication on closure with stakeholders; and
- Mine closure is achieved efficiently and cost effectively.

The above measures are to be carried out to return the area to its pre-mining potential of grazing. Housing and the training/community centre are to be retained for community use and the TSF will remain on site and be re-vegetated.

29.1.2 Confirmation that the closure objectives have been consulted with landowners and IAPs

The high level closure objective of returning the land to pre-mining potential has been sourced from the approved EIA and EMP and was outlined in the scoping report which was made available to IAPs, including landowners for review and comment (Section 7.2.5). Further to this, IAPs including landowners will be given a further opportunity to review the closure objectives described in Section 29.1.1, associated with the proposed project as part of the review of the EIA and EMP report (Section 7.2.9).

As the mine gets closer to closure the stakeholder engagement will increase with the relevant affected stakeholders.

To date no comments regarding the closure objectives associated with the proposed project have been received from IAPs including landowners.

29.1.3 Rehabilitation Plan

The rehabilitation plan as provided in the approved mining EIA and EMP has been incorporated here.

Proposed Rehabilitation Plan as per approved mine EIA (TWP, 2008):
The main objective of a rehabilitation plan for a mine is to restore the land pre-mining land capabilities and to create a self-sustaining land surface, in this instance to grazing and wilderness. Other key aims of the plan are to:

- Ensure the successful re-establishment of a range of indigenous species.
- Manage the natural and rehabilitated vegetation so as to avoid the loss of species diversity and habitats within the stipulated mine infrastructural areas.
- Ensure that rehabilitated land is stable in the long term, both from the point of view of soil erosion and self-sustaining vegetation cover.

Much of the area on which the mine is to be developed has been impacted by anthropogenic disturbances. The level of impact ranges from low, in areas such as the hillslope to the west of the farm Mimosa, to high, in areas such as the central and southern areas of the farm Frischgewaagd.

Most of the impacts as a result of the BPM (approved operations and proposed project changes) that will be brought about during the construction and operational phases will be reduced and eventually cease to occur through the decommissioning and closure phases

The following actions need to be implemented in order to rehabilitate disturbed areas and achieve the above mentioned objectives and aims. Some of the following actions are also relevant to the rehabilitation of the TSF during the operational phase:

- Rehabilitation goals (the state to which the land will be rehabilitated) must be ascertained in consultation with the authorities and local IAPs. This will be done during the operational phase of the mine so that ongoing rehabilitation can be directed towards the agreed upon end land use.
- Consultation with the community will result in a decision as to which structures will remain for use by the community. All infrastructure that will not remain will be demolished and sold as scrap or spares, where feasible. Building foundations will be removed to a depth of 0.4 m below surface.
- Rubble will be disposed of according to instruction of the local authority and/or DMR. The site will be selected in consultation with the relevant authorities.
- Any topsoils or subsoils that have been compacted must be scarified.
- All land exposed by the demolition of infrastructure and other land disturbed by the mining activities will be rehabilitated by replacing the stored and ameliorated topsoil, which was stripped during the construction phase.
- Topsoil will be placed on the slope of the TSF once a step-in has been created and the development of the next slope is in process.
- Disturbed areas will be profiled to be free draining through landscaping, topsoil replacement and the establishment of natural vegetation, as far as possible. Where practical, rehabilitation will take place during the life of the mine.
- All access road surfaces will be ripped and rehabilitated.
- The soils will be profiled and the depths will be sampled.
- Soil will be sampled, composted and fertilised prior to re-vegetation, if necessary.
- The correct order of replacement of the soils and the preparation of an adequate planting medium will facilitate the re-vegetation program and will help to limit the potential for erosion;
- The rehabilitated sites will be seeded. Table 29.1 provides a list of species to be sustained or propagated on site.

TABLE 29.1:SPECIES TO BE SUSTAINED OR PROPAGATED ON SITE

Trees and Shrubs	Grasses
Acacia tortilis	*Cenchrus ciliaris*
Acacia karroo	*Digitaria eriantha*
Rhus leptodictya	*Eragrostis rigidior*
Rhus pyroides	*Cynodon dactylon*
Ehretia rigida	*Enneapogon cenchroides*
Grewia flavescens	

Seeds from local indigenous grasses commonly occurring in the area will also be added to the seed mix. The seed mix proposed for the TSF is indicated in below.

TABLE 29.2: SPECIES TO BE SUSTAINED OR PROPAGATED ON THE TSF

Common Name	Latin Name	Volume
Buffalo grass	*Cenchrus ciliaris*	5 kg/ha
Rhodes grass	*Chloris gayana*	1 kg/ha
Guinea grass	*Panicum maximum*	3 kg/ha
Couch grass	*Cynodon dactylon*	5 kg/ha
Finger grass	*Digitaria eriantha*	1 kg/ha
Weeping love grass	*Eragrostis curvula*	2 kg/ha
Tef	*Eragrostis tef*	1 kg/ha

- Additional hand plants should be incorporated into the seed mix for the TSF. Suggested hand plants include Blue thatching grass (*Hyparrhenia tamba*), River bed Grass (*Pennisetum macrourum*), Common thatching grass (*Hyparrhenia hirta*), Pinhole grass (*Bothriochloa insculpta*), Couch grass (*Cynodon dactylon*) and Vetiver grass (*Vetiver zizanoides*).
- In addition to the grassing and hand plants, trees of various types (listed above in Table 29.2) would also be planted on the TSF.
- The primary purpose of the vegetation is to prevent erosion, improve soil structure and assist in micro-organism re-establishment. Therefore the sward will not be removed during the first season until the grass has begun to take root. Measures will be taken to prevent veldt fires.
- Where possible the planted seeds should be covered with a mulch.
- Appropriate watering and fertilisation regimes will be developed to facilitate rapid re-vegetation of disturbed areas.
- Soil properties and vegetation cover will be monitored annually and remediation measures be implemented, should it be necessary.
- Pollution control dams, cut-off trenches and other surface water management infrastructure will be maintained until closure, and possibly permanently if they can be used as part of the planned end use for the land.

- Just prior to closure, all water management structures will be cleaned, concrete broken and removed, backfilled and re-vegetated as outlined above. Alternatively they will be left open and managed if the end use so requires.
- The proposed rehabilitation plan will be incorporated into the first closure plan and will be elaborated upon for implementation. The updated/elaborated rehabilitation plan is to take into consideration recommendations provided by specialists in the EMP and future surveys to ensure effective implementation. This rehabilitation plan will form part of the closure plan, which will be updated as required.

In order to effectively rehabilitate and manage the project area, the mitigation measures as provided in the EMP in Section 28 which is based on specialist inputs also needs to be adhered to.

29.1.4 COMPATIBILITY OF THE REHABILITATION PLAN WITH THE CLOSURE OBJECTIVES

It can be confirmed that the rehabilitation plan is compatible with the closure objectives given that the closure objectives were taken into account during the determination of the financial provision.

29.1.5 CALCULATE AND STATE THE QUANTUM OF THE FINANCIAL PROVISION

The information in this section was sourced from the closure cost calculation study completed by Worley Parsons and is included in Appendix S. The closure cost assessment was undertaken in accordance to the DMR Guideline Document for the Evaluation of the Quantum of Closure-Related Financial Provision Provided by a Mine based on the 2010 DMR master rates escalated at 6.5% per annum.

The financial closure liability associated with the proposed Bakubung Platinum Mine (as at life of mine), is R1 247 970 412 (including VAT). The annual forecasted financial provision for the first 10 years (2019 – 2028) and life of mine (2044) of the proposed project is provided in Table 29.3 below. Further details regarding the closure cost calculation is included in the closure cost assessment (Worley Parsons, 2016).

TABLE 29.3: FINANCIAL PROVISION (WORLEY PARSONS, 2016)

Year	Financial provision (R, including vat)
1	R 258 378 967
2	R 275 173 600
3	R 293 059 884
4	R 312 108 777
5	R 332 395 847
6	R 354 001 577
7	R 377 011 680
8	R 401 517 439
9	R 427 616 073

Year	Financial provision (R, including vat)
10	R 455 411 117
Life of mine	**R 1 247 970 412**

30 MECHANISMS FOR MONITORING COMPLIANCE AND PERFORMANCE AGAINST THE EMP

Environmental impacts requiring monitoring are listed in Table 30.1 below. Existing monitoring points for air quality, surface water and groundwater are shown in Figure 7-23 and Figure 7-19. Additional groundwater monitoring points are provided in the table below.

TABLE 30.1: MONITORING OF COMPLIANCE AND PERFORMANCE IN TERMS OF EMPR

Activity	Impacts requiring monitoring	Functional requirements for monitoring	Roles and responsibilities	Monitoring and reporting frequency and time period for management actions
Site preparation Civil works Earthworks Waste rock management Mining and mining related activities Tailings management Demolition Rehabilitation Maintenance and aftercare	Hazardous infrastructure	• All mineralised waste facilities and water dams will be monitored to ensure stability, safety and prevention of environmental impacts. The findings will be documented for record-keeping and auditing purposes and addressed where relevant to achieve the stated objectives.	Qualified engineer	• The frequency of the monitoring and the qualification of the monitoring personnel will be determined on an infrastructure specific basis. • Monitoring will be undertaken for the duration of the mine.
Site preparation Earthworks Waste rock management Transport systems Tailings management Housing Process and storm water management Sewage sludge management Demolition Rehabilitation Maintenance and aftercare	Physical disturbance and contamination of soil resources	<u>Soil compaction:</u> • Inspection of compacted areas using a penetrometer or similar instrument. • A soil scientist should recommend whether or not ripping of the soils should be done after a year of monitoring. This decision must be based on the monitoring data • Visual inspections of stockpiles, TSF and disturbed areas to ensure adherence to the soil conservation plan and rehabilitation plan <u>Soil erosion:</u> • Visual inspection of the impacted area. <u>Chemical composition</u> • Chemical composition of stockpiles are to be monitored to ensure they maintain fertility.	Environmental Department	• Soil compaction must be inspected every three months during construction and upon completion of construction. • Quarterly • Soil erosion inspection must be done every month in the rainy season and every three months in the dry season. • Annually
Site preparation	Aquatic	• On-going aquatic ecological monitoring must take	Environmental	• Every 6 months during construction and operation

Activity	Impacts requiring monitoring	Functional requirements for monitoring	Roles and responsibilities	Monitoring and reporting frequency and time period for management actions
Civil works Earthworks Tailings management Waste rock management Transport systems Housing Process and storm water management Sewage sludge management Site/contract management Demolition Rehabilitation Maintenance and aftercare	Ecology	place by an SA RHP Accredited assessor; • Post closure aquatic ecological monitoring is recommended to ensure that no impact on the aquatic resources in the area takes place after decommissioning and closure has taken place;	Department	• Post closure
Site preparation Civil works Earthworks Tailings management Waste rock management Transport systems Housing Process and storm water management Sewage sludge management Site/contract management Demolition Rehabilitation Maintenance and aftercare	Flora	• Monitoring that activities are restricted to infrastructure footprints and that impacts such as setting of fires, cutting of trees and collection of firewood are not occurring. • Implementation of a simple vegetation monitoring programme that focuses on the use of repeatable fixed point photography and should include: ○ Monitoring remaining Marikana Thornveld and other untransformed vegetation within the study area (including sampling where necessary), emphasis is on the untransformed vegetation situated in close proximity to infrastructure (particularly areas around the TSF and tailings / return water pipelines). ○ A brief evaluation of the success of any future rehabilitation activities should also be included in monitoring. ○ Monitoring of the medicinal plant Hypoxis henorocallidea and all subpopulations of plant ‘species of conservation concern’ recorded within the study area in future. Emphasis must be placed on monitoring any threatened or Near Threatened species that may be recorded in future. Monitoring should	Environmental Department	• Continuous during construction • Baseline monitoring should be conducted prior to the construction phase and monitoring should be conducted annually thereafter.

Activity	Impacts requiring monitoring	Functional requirements for monitoring	Roles and responsibilities	Monitoring and reporting frequency and time period for management actions
		include counts or estimates of the number of plants present and the age structure.		
Site preparation Civil works Earthworks Tailings management Waste rock management Transport systems Housing Process and storm water management Sewage sludge management Site/contract management Demolition Rehabilitation Maintenance and aftercare	Wetland	• Monitor that activities are restricted to infrastructure footprints. Temporary structures, such as stockpiles and lay down areas should be excluded from delineated watercourse footprints. • Ensure that signage to identify watercourses and their buffers are kept in place and remain well visible during the construction process and that no unauthorised access occurs. • Fix point photography of wetlands and other watercourses should be undertaken. • Sediment control and storm water control measures should be monitored and maintained to ensure they remain functioning • Regular monitoring and maintenance by a suitably qualified specialist to ensure that the pipeline remains in a good working order and that weak points are repaired once observed. • Monitoring the proliferation of alien and invasive species to evaluate successes achieved from the alien and invasive species management plan.	Environmental Department	• Continuous during construction • Continuous during construction • Prior to the start of construction and during construction • Continuous, especially during the wet season. • Continuous • Quarterly
Site preparation Civil works Earthworks Tailings management Waste rock management Transport systems Housing Process and storm water management Sewage sludge management Site/contract management Demolition Rehabilitation Maintenance and aftercare	Fauna	• Inspections of all untransformed areas to assess whether habitat is being disturbed or damaged through illegal operations; • Inspections of fence lines to assess breaches / deterioration of the perimeter. • Monitoring and reporting species of conservation concern through a monitoring programme	Environmental Department	• Monthly • Monthly • Quarterly
Site preparation	Surface water	• Continuation of monitoring plans on site. • Regular surface water quality and quantity	Environmental	• On-going

Activity	Impacts requiring monitoring	Functional requirements for monitoring	Roles and responsibilities	Monitoring and reporting frequency and time period for management actions
Civil works Earthworks Transport systems Waste rock management Tailings management Process and storm water management Demolition Rehabilitation Maintenance and aftercare		monitoring programs as per the IWUL. • The surface water monitoring parameters will be sampled according to determinants and frequencies as stated in the IWUL. • The surface water monitoring program will be assessed, optimised and updated.	Department	• Monthly, quarterly and annual reporting. • Monthly and quarterly monitoring. <u>Monthly</u>: pH, electrical conductivity, total dissolved solids, temperature and total suspended solids <u>Quarterly</u>: pH, electrical conductivity, total dissolved solids, temperature, total suspended solid, total alkalinity, bicarbonate as HCO3, Carbonate as CO3,Cl, SO4, F, N, Ag, Al, As, B, Ba, Bi, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, P, Pb, S, Sb, Se, Si, Sn, Sr, Ti, V, W, Zn, Zr, ammonia and E.coli. • Annually
Site preparation Civil works Earthworks Transport systems Waste rock management Tailings management Process and storm water management Demolition Rehabilitation Maintenance and aftercare	Groundwater	• Groundwater Level • Ground water quality	Environmental Department	• Monthly • Monthly and quarterly monitoring. <u>Monthly</u>: pH, electrical conductivity, total dissolved solids (TDS) and temperature <u>Quarterly</u>: pH, EC, TDS, total alkalinity, bicarbonate as HCO3, Carbonate as CO3,Cl, SO4, F, N, Ag, Al, As, B, Ba, Bi, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, P, Pb, S, Sb, Se, Si, Sn, Sr, Ti, V, W, Zn, Zr, ammonia and E.coli. Proposed borehole locations for monitoring (D = deep, 30 – 60 mbgl, S= shallow, 15 mbgl):

<table>
<tr><th>Activity</th><th>Impacts requiring monitoring</th><th>Functional requirements for monitoring</th><th>Roles and responsibilities</th><th>Monitoring and reporting frequency and time period for management actions</th></tr>
<tr><td></td><td></td><td></td><td></td><td>
<table>
<tr><th>BHID</th><th>X-Coordinate</th><th>Y-Coordinate</th><th>Purpose</th></tr>
<tr><td>MBH01D* and S</td><td>3184</td><td>-2810436</td><td>West of TSF</td></tr>
<tr><td>MBH04 D* and S</td><td>3104</td><td>-2809560</td><td>North western corner of TSF</td></tr>
<tr><td>MBH05 D* and S</td><td>4951</td><td>-2809492</td><td>North eastern corner of TSF</td></tr>
<tr><td>MBH07 D and S</td><td>4449</td><td>-2810839</td><td>South of TSF</td></tr>
<tr><td>MBH06</td><td>5106</td><td>-2810980</td><td>Elands River</td></tr>
</table>
*These boreholes already exist and will serve as deep monitoring boreholes.</td></tr>
<tr><td>Site preparation
Civil works
Earthworks
Mining and mining related activities
Waste rock management
Mineral processing operations
Tailings management
Power Supply and Use
Transport systems
Housing
Demolition
Rehabilitation
Maintenance and aftercare</td><td>SO2, NO2, PM2.5 and PM10</td><td>• Monthly dustfall monitoring as well as ambient SO2, NO2 and PM10 monitoring.
• It is recommended that PM2.5 sampling be conducted to determine if there are significant PM2.5 concentrations. The recommended location for the PM2.5 sampling would be close to the current PM10 sampling site.
• It is recommended that the on-site meteorological monitoring remain where it is located and be kept in good working order. The meteorological station must be calibrated and data validation carried out to ensure the data reported are correct.
• Site inspections and progress reporting to be undertaken at regular intervals during operations
• Environmental audits to be conducted forming part of the overall environmental management systems at the mine.</td><td>Environmental Department</td><td>• Data collection ongoing, collected bi-weekly. Monthly, quarterly and annual reporting
• Data collection ongoing, collected bi-weekly. Monthly, quarterly and annual reporting
• Ongoing, calibration at least once a year with regular span checks
• Quarterly
• Annually</td></tr>
<tr><td>Site preparation
Earthworks
Civil works
Waste rock management</td><td>Noise pollution</td><td>• Ambient noise surveys will be conducted.</td><td>Environmental Department</td><td>• Every six months</td></tr>
</table>

Activity	Impacts requiring monitoring	Functional requirements for monitoring	Roles and responsibilities	Monitoring and reporting frequency and time period for management actions
Transport systems Demolition Rehabilitation Waste rock management Mineral processing operations Mining and mining related activities				
Mining and mining related activities	Blasting impacts (fly rock, air blasts and ground vibrations)	• Vibration and air blast levels will be monitored and recorded during blasting activities in the early construction phase. • Vibration monitoring equipment will be installed in certain structures to provide information regarding ground vibrations specifically related to blasting associated with mining. • Blasting noise will be monitored and recorded during blasting activities to ensure adherence to stipulated guidelines.	Qualified blasting specialist	• Blast monitoring will take place for the duration of blasting activities.
Transport systems	Road disturbance and traffic safety	• Routine vehicle inspections. • Incident and accident reports. • Road maintenance and signage inspections. •	Environmental Department	• On-going • Monthly • Monthly
Site preparation Civil works Earthworks Mining and mining related activities Waste rock management Mineral processing operations Tailings management Housing Demolition Maintenance and aftercare of final land forms and rehabilitated areas	Visual impacts	• Regular housekeeping inspections will be implemented. • Vegetation monitoring. • Complaints and incident register.	Environmental Department	• Monthly • Annual • On-going
Site preparation	Physical disturbance of	• Periodic observations of all excavation or ground breaking activities (particularly at MHC005 and	Environmental	• Monthly during construction

Activity	Impacts requiring monitoring	Functional requirements for monitoring	Roles and responsibilities	Monitoring and reporting frequency and time period for management actions
Earthworks Waste rock management Transport systems Housing Site/contract management Tailings management Demolition Rehabilitation	heritage resources	MHC019) during the construction. • Annual survey to identify the status of existing heritage sites during the operational phase. • Feedback reports to be produced for the mine and SAHRA should more discoveries be made.	Department	• Annual • As required
Construction of project components Operation of the mine Decommissioning of project components Final land forms	Land Use	• Monitoring of land use will take place on the TSF and disturbed areas and monitoring of flora, fauna and soils as given in this table.	Environmental Department	• Annually

30.1 FREQUENCY OF PERFORMANCE ASSESSMENT REPORT

The environmental department manager will conduct internal management audits against the commitments in the EMP. These audits will be conducted on an on-going basis until final closure. The audit findings will be documented for both record keeping purposes and for informing continual improvement. In addition, and in accordance with mining regulation R527 and as set out in NEMA GNR982, an independent professional will conduct an EMP performance assessment every 2 years or in accordance with the timeframes as specified in the Environmental Authorisation (if provided). The site's compliance with the provisions of the EMP and the adequacy of the EMP report relative to the on-site activities will be assessed in the performance assessment and will be submitted to the competent authority at intervals as indicated in the environmental authorisation.

31 ENVIRONMENTAL AWARENESS PLAN

31.1 MANNER IN WHICH APPLICANT INTENDS TO INFORM EMPLOYEES OF THE ENVIRONMENTAL RISKS

This section includes an environmental awareness plan for the proposed mine. The plan describes how employees will be informed of environmental risks which may result from their work, the manner in which the risk must be dealt with in order to avoid pollution or degradation of the environment and the training required for general environmental awareness and the dealing of emergency situations and remediation measures for such emergencies.

All contractors that conduct work on behalf of BPM are bound by the content of the EMPr and a contractual condition to this effect will be included in all such contracts entered into by the mine. If contractors are used, the responsibility for ensuring compliance with the EMPr will remain with BPM.

The purpose of the environmental awareness plan is to ensure that all personnel and management understand the general environmental requirements of the site. In addition, greater environmental awareness must be communicated to personnel involved in specific activities which can have a significant impact on the environment and ensure that they are competent to carry out their tasks on the basis of appropriate education, training and/or experience. The environmental awareness plan should enable BPM to achieve the objectives of the environmental policy.

31.1.1 ENVIRONMENTAL POLICY

BPM will display the environmental policy. To achieve world class environmental performance in a sustainable manner BPM is currently committed to:

- Integrating environmental management into all aspects of our business, including the entire product life cycle;
- Complying with all applicable legislation and other requirement to which BPM subscribes;
- Practising responsible stewardship by adopting world class standards;
- Proactively identifying and managing significant environmental aspects in order to:
    - Minimise emissions to atmosphere
    - Minimise the release of effluent
    - Optimise resource consumption
    - Mitigate our impacts on climate change
    - Minimise waste
    - Rehabilitate disturbed land and protect environmental biodiversity
    - Protect cultural heritage resources.

- Ensuring environmental awareness and appropriate competency among employees and promoting environmental awareness in the community
- Engaging with all IAPs towards the shared goal of improving the environment;
- Setting objectives and, where possible, quantitative targets, to determine continual improvement in environmental performance and the prevention of pollution

31.1.2 STEPS TO ACHIEVE THE ENVIRONMENTAL POLICY OBJECTIVES

BPM's environmental policy will be realised by setting specific and measurable objectives. It is proposed that new objectives are set throughout the life of mine, but initial objectives are as follows:

- Management of environmental responsibilities:
  - BPM will establish and appoint Managers at senior mine management level at each site, who will be provided with all necessary resources to carry out the management of all environmental aspects of the site irrespective of other responsibilities, for example:
    - Compliance with environmental legislation and EMP commitments
    - Implementing and maintaining an environmental management system
    - Developing environmental emergency response procedures and coordinating personnel during incidents
    - Manage routine environmental monitoring and data interpretation
    - Environmental trouble shooting and implementation of remediation strategies
    - Closure planning.
- Communication of environmental issues and information:
  - Meetings, consultations and progress reviews will be carried out, and specifically BPM will:
    - Set the discussion of environmental issues and feedback on environmental projects as an agenda item at all company board meetings
    - Provide progress reports on the achievement of policy objectives and level of compliance with the approved EMP to the DMR
    - Ensure environmental issues are raised at monthly mine management executive committee meetings and all relevant mine wide meetings at all levels
    - Ensure environmental issues are discussed at all general liaison meetings with local communities and other interested and affected parties.
- Environmental awareness training:
  - BPM will provide environmental awareness training to individuals at a level of detail specific to the requirements of their job, but will generally comprise:
    - Basic awareness training for all prior to granting access to site (e.g. short video presentation requiring registration once completed). Employees and contractors who have not attended the training will not be allowed on site.

- General environmental awareness training will be given to all employees and contractors as part of the Safety, Health and Environment induction programme. All non-BPM personnel who will be on site for more than three days must undergo the SHE induction training.
- Specific environmental awareness training will be provided to personnel whose work activities can have a significant impact on the environment (e.g. workshops, waste handling and disposal, sanitation, etc.).

- Review and update the environmental topics already identified in the EMP which currently includes the following purpose
  - Geology (additional minerals and impact of geology on infastructure);
  - Topography (hazardous excavations and surface subsidence);
  - Soil management (loss of soil resource);
  - Land capability (loss of land with agricultural and conservation potential);
  - Surrounding land use (traffic management, reduction in land available to livestock grazing);
  - Management of biodiversity (impacts on land and water related habitats and species);
  - Surface water management (alteration of surface drainage and pollution of surface water);
  - Groundwater management (changes in groundwater levels/availability and groundwater contamination);
  - Management of air quality (dust generation);
  - Noise (specifically management of disturbing noise);
  - Visual aspects (reduction of negative visual impacts);
  - Heritage resources (management of archaeological, cultural and historical sites);
  - Socio-economic impacts (management of positive and negative impacts); and
  - Interested and affected parties
- All mine projects will be designed to minimise impact on the environment and to accomplish closure/rehabilitation objectives.
- BPM will maintain records of all environmental training, monitoring, incidents, corrective actions and reports.
- Contractors and employees will be contractually bound to participate in the achievement of environmental policy objectives and compliance with the EMP.

31.1.3 TRAINING OBJECTIVES OF THE ENVIRONMENTAL AWARENESS PLAN

The environmental awareness plan ensures that training needs are identified and that appropriate training is provided. The environmental awareness plan should communicate:

- The importance of conformance with the environmental policy, procedures and other requirements of good environmental management
- The significant environmental impacts and risks of individuals work activities and explain the environmental benefits of improved performance

- Individuals roles and responsibilities in achieving the aims and objectives of the environmental policy
- The potential consequences of not complying with environmental procedures.

31.1.3.1 General Contents of the Environmental Awareness Plan

To achieve the objectives of the environmental awareness plan the general contents of the training plans are as follows:

- Module 1 – Basic training plan applicable to all personnel entering the site:
  - Short (15 min) presentation to indicate the site layout and activities at specific business units together with their environmental aspects and potential impacts.
  - Individuals to sign off with site security on completion in order to gain access to the site.
- Module 2 – General training plan applicable to all personnel at the site for longer than three days:
  - General understanding of the environmental setting of the mine (e.g. local communities and industries and proximity to natural resources such as rivers);
  - Understanding the environmental impact of individuals activities on site (e.g. excessive production of waste, poor housekeeping, energy consumption, water use, noise, etc.);
  - Indicate potential site specific environmental aspects and their impacts;
  - BPM's environmental management strategy;
  - Identifying poor environmental management and stopping work which presents significant risks;
  - Reporting incidents;
  - Examples of poor environmental management and environmental incidents; and
  - Procedures for emergency response and cleaning up minor leaks and spills.
- Module 3 – Specific training plan:
  - Environmental setting of the workplace (e.g. proximity of watercourses, vulnerability of groundwater, proximity of local communities and industries, etc.);
  - Specific environmental aspects such as:
    - Spillage of hydrocarbons at workshops
    - Spillage of explosive liquids
    - Poor waste management such as mixing hazardous and general wastes, inappropriate storage and stockpiling large amounts of waste
    - Poor housekeeping practices
    - Poor working practices (e.g. not carrying out oil changes in designated bunded areas)
    - Excessive noise generation and unnecessary use of hooters
    - Protection of heritage resources.
  - Impact of environmental aspects, for example:
    - Hydrocarbon contamination resulting in loss of resource (soil, water) to downstream users;
    - Groundwater contamination also resulting in loss of resource due to potential adverse aesthetic, taste and health effects; and
    - Dust impacts on local communities (nuisance and health implications).

- BPM's duty of care (specifically with respect to waste management); and
- Purpose and function of BPM's environmental management system.

Individuals required to complete Module 3 (Specific training module) will need to complete Modules 1 and 2 first. On completion of the Module 3, individuals will be subject to a short test (written or verbal) to ensure the level of competence has been achieved. Individuals who fail the test will be allowed to re-sit the test after further training by the training department.

The actual contents of the training modules will be developed based on a training needs analysis.

Key personnel will be required to undergo formal, external environmental management training (e.g. how to operate the environmental management system, waste management and legal compliance).
In addition to the above BPM will:

- Conduct refresher training/presentations on environmental issues for mine employees (permanent and contractors) at regular intervals.
- Promote environmental awareness using relevant environmental topic posters displayed at strategic locations on the mine. These topics will be changed monthly, and will be reviewed annually by the Environmental Manager to ensure relevance.
- Participate and organise events which promote environmental awareness, some of which will be tied to national initiatives e.g. National Arbour Week, World Environment Day and National Water Week.

31.2 MANNER IN WHICH RISKS WILL BE DEALT WITH TO AVOID POLLUTION OR DEGRADATION

31.2.1 ON-GOING MONITORING AND MANAGEMENT MEASURES

The monitoring programme as described in Section 30 will be undertaken to provide early warning systems necessary to avoid environmental emergencies.

31.2.2 PROCEDURES IN CASE OF ENVIRONMENTAL EMERGENCIES

Emergency procedures apply to incidents that are unexpected and that may be sudden, and which lead to serious danger to the public and/or potentially serious pollution of, or detriment to the environment (immediate and delayed). Procedures to be followed in case of environmental emergencies are described in the table below (Table 31.1).

31.2.2.1 General emergency procedure

The general procedure that should be followed in the event of all emergency situations is as follows:

- Applicable incident controller defined in emergency plans must be notified of an incident upon discovery
- Area to be cordoned off to prevent unauthorised access and tampering with evidence
- Undertake actions defined in emergency plant to limit/contain the impact of the emergency
- If residue facilities/dams, storm water diversions, etc., are partially or totally failing and this cannot be prevented, the emergency siren is to be sounded (nearest one available). After hours the Operations Engineer on shift must be notified
- Take photographs and samples as necessary to assist in investigation
- Report the incident immediately to the environmental department for emergencies involving environmental impacts or to the safely department in the case of injury
- The Environment department must comply with Section 30 of the National Environmental Management Act (107 of 1998) such that:
  - The Environment department must immediately notify the Director-General (DWS and DEA, DMR and Inspectorate of Mines as appropriate), the South African Police Services, the relevant fire prevention service, the provincial head of READ, the head of the local municipality, the head of the regional DWS office and any persons whose health may be affected of:
    - The nature of the incident
    - Any risks posed to public health, safety and property
    - The toxicity of the substances or by-products released by the incident
    - Any steps taken to avoid or minimise the effects of the incident on public health and the environment.
- The Environment department must as soon as is practical after the incident:
    - Take all reasonable measures to contain and minimise the effects of the incident including its effects on the environment and any risks posed by the incident to the health, safety and property of persons;
    - Undertake clean up procedures;
    - Remedy the effects of the incident; and
    - Assess the immediate and long term effects of the incident (environment and public health);
  - Within 14 days the Environment department must report to the Director-General DWS and DEA, the provincial head of DMR, the regional manager of the DMR, the head of the local and district municipality, the head of the regional DWS office such information as is available to enable an initial evaluation of the incident, including:
    - The nature of the incident
    - The substances involved and an estimation of the quantity released
    - The possible acute effects of the substances on the persons and the environment (including the data needed to assess these effects)
    - Initial measures taken to minimise the impacts

- Causes of the incident, whether direct or indirect, including equipment, technology, system or management failure
- Measures taken to avoid a recurrence of the incident.

31.2.2.2 Identification of Emergency Situations

The site wide emergency situations that have been identified together with specific emergency response procedures are outlined in Table 31.1.

31.2.3 TECHNICAL, MANAGEMENT AND FINANCIAL OPTIONS

Technical, management and financial options that will be put into place to deal with the remediation of impacts in cases of environmental emergencies are described below.

- The applicant will appoint a competent management team with the appropriate skills to develop and manage a mine of this scale and nature.
- To prevent the occurrence of emergency situations, the mine will implement as a minimum the mine plan and mitigation measures as included in this EIA and EMP report.
- The mine has an environmental management system in place where all operation identify, report, investigate, address and close out environmental incidents.
- As part of its annual budget, the mine will allow a contingency for handling of any risks identified and/or emergency situations.
- Where required, the mine will seek input from appropriately qualified people.

TABLE 31.1: EMERGENCY RESPONSE PROCEDURES

Item	Emergency Situation	Response in Addition to General Procedures
1	Spillage of chemicals, engineering substances and waste	Where there is a risk that contamination will contaminate the land (leading to a loss of resource), surface water and/or groundwater, Bakubung Platinum Mine will: 1. Notify residents/users downstream of the pollution incident. 2. Identify and provide alternative resources should contamination impact adversely on the existing environment. 3. Cut off the source if the spill is originating from a pump, pipeline or valve (e.g. TSF delivery pipeline, refuelling tanker) and the infrastructure 'made safe'. 4. Contain the spill (e.g. construct temporary earth bund around source such as road tanker). 5. Pump excess hazardous liquids on the surface to temporary containers (e.g. drums, mobile tanker, etc.) for appropriate disposal. 6. Remove hazardous substances from damaged infrastructure to an appropriate storage area before it is removed/repaired.
2	Discharge of dirty water to the environment	1. Apply the principals listed for Item 1 above. 2. To stop spillage from the dirty water system the mine will: a. Redirect excess water to other dirty water facilities where possible; b. Pump dirty water to available containment in the clean water system, where there is no capacity in the dirty water system; and c. Carry out an emergency discharge of clean water and redirect the spillage to the emptied facility. 3. Apply for emergency discharge as a last resort.
3	Pollution of surface water	1. Personnel discovering the incident must inform the SHEQ department of the location and contaminant source. 2. Apply the principals listed for Item 1 above. 3. Absorbent booms will be used to absorb surface plumes of hydrocarbon contaminants. 4. Contamination entering the surface water drainage system should be redirected into the dirty water system. 5. The SHEQ department will collect in-stream water samples downstream of the incident to assess the immediate risk posed by contamination.
4	Groundwater contamination	1. Use the groundwater monitoring boreholes as scavenger wells to pump out the polluted groundwater for re-use in the process water circuit (hence containing the contamination and preventing further migration). 2. Investigate the source of contamination and implement control/mitigation measures.
5	Burst water pipes (loss of resource and erosion)	1. Notify authority responsible for the pipeline (if not mine responsibility). 2. Shut off the water flowing through the damaged area and repair the damage (if Bakubung Platinum Mine pipeline). 3. Apply the principals listed for Item 1 above if spill is from the dirty/process water circuit.
6	Flooding from failure of surface water control infrastructure	1. Evacuate the area downstream of the failure (e.g.PCDs, return water dam). 2. Using the emergency response team, rescue/recover and medically treat any injured personnel. 3. Temporarily reinstate/repair storm water diversions during the storm event (e.g. emergency supply of sandbags). 4. Close the roads affected by localised flooding or where a storm water surge has destroyed crossings/bridges.
7	Risk of drowning from falling into water dams	1. Attempt rescue of individuals from land by throwing lifeline/life saving ring. 2. Get assistance of emergency response team whilst attempting rescue or to carry out rescue of animals. 3. Ensure medical assistance is available to recovered individual.
8	Veldt fire	1. Evacuate mine employees from areas at risk.

Item	Emergency Situation	Response in Addition to General Procedures
		2. Notify down wind residents and industries of the danger. 3. Assist those in imminent danger/less able individuals to evacuate until danger has passed. 4. Provide emergency firefighting assistance with available trained mine personnel and equipment.
9	Overtopping or failure of the tailings dam	1. Sound the alarm to evacuate danger area. 2. Pump water from top of dam and follow redirection of water as indicated in Item 2 above. 3. Stop pumping tailings to the TSF. 4. Recover casualties resulting from dam failure using the emergency response team. 5. Make the remaining structure safe. 6. Apply the principles of Item 1 above.
10	Falling into hazardous excavations	1. Personnel discovering the fallen individual or animal must mobilise the emergency response team to the location of the incident and provide a general appraisal of the situation (e.g. human or animal, conscious or unconscious, etc.). 2. The injured party should be recovered by trained professionals such as the mine emergency response team. 3. A doctor (or appropriate medical practitioner)/ambulance should be present at the scene to provide first aid and transport individual to hospital.
11	Road traffic accidents (on site)	1. The individual discovering the accident (be it bystander or able casualty) must raise the alarm giving the location of the incident. Able personnel at the scene should shut down vehicles where it is safe to do so. 2. Access to the area should be restricted and access roads cleared for the emergency response team. 3. Vehicles must be made safe first by trained professionals (e.g. crushed or overturned vehicles). 4. Casualties will be moved to safety by trained professionals and provided with medical assistance. 5. Medical centres in the vicinity with appropriate medical capabilities will be notified if multiple seriously injured casualties are expected.
12	Development of informal settlements	The mine will inform the local authorities (municipality and police) that people are illegally occupying the land and ensure that action is taken within 24hrs.
13	Uncovering of graves and sites	Personnel discovering the grave or site must inform the SHEQ department immediately. Prior to damaging or destroying any of the identified graves, permission for the exhumation and relocation of graves must be obtained from the relevant descendants (if known), the National Department of Health, the Provincial Department of Health, the Premier of the Province and the local Police. The exhumation process must comply with the requirements of the relevant Ordinance on Exhumations, and the Human Tissues Act, 65 of 1983.

32 SPECIFIC INFORMATION REQUIRED BY THE COMPETENT AUTHORITY

The following documents will be submitted to the DMR from the start of construction until mine closure:

- In accordance to Section 34 of GNR. 982 of NEMA, the holder of a mining right needs to submit an environmental audit report, prepared by an independent person, to the DMR at intervals indicated in the environmental authorisation. The purpose of the environmental audit report is to ensure compliance with the conditions of the environmental authorisation and the EMP.
- The financial provision will be updated on an annual basis and submitted to the DMR

33 UNDERTAKING

I, Chiara D'Egidio Kotze, the Environmental Assessment Practitioner responsible for compiling this EMPR hereby confirm:

- The correctness of the information provided in the report;
- The inclusion of comments and inputs from stakeholders and IAPs;
- The inclusion of inputs and recommendations from the specialist reports where relevant; and
- The acceptability of the project in relation to the finding of the assessment and the level of mitigation proposed.

_________________________ Date: ___________________

Signature of the EAP

34 REFERENCES

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- De Castro and Brits, 2016a. Botanical biodiversity assessment report for the footprints of changes to infrastructure at the Bakubung Platinum Mine.
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- SLR, 2016. Wesizwe Platinum Mine: Monthly water monitoring report: January 2016.
- TWP-ES, 2008. Environmental impact assessment and environmental management program for a platinum mine and associated infrastructure.

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APPENDIX A: PROOF OF EAP QUALIFICATIONS

APPENDIX B: CURRICULUM VITAE OF EAP

APPENDIX C: LOCAL AND REGIONAL SETTING

APPENDIX D: SITE LAYOUT

APPENDIX E: STAKEHOLDER ENGAGEMENT DOCUMENTS

- NEMA/NEMWA application form and DMR acceptance letter of application
- Section 102 EMP amendment application form
- Database
- Background information document in English and Setswana
- Notices
  - Site notices in English and Setswana and photos of the site notices
  - Advertisements placed in the Sowetan, Rustenburg Herald and the Ledig Sun.
- Notifications to public and authorities
  - Formal invitations sent to IAPs to notify them of the open day
  - Formal invitations sent to Regulatory authorities to notify them of the authorities meeting
- Minutes of the regulatory authorities meeting including the attendance register
- Copies of the posters, attendance registers and photos of the public open day
- Correspondence to land owner
- Summary document of the scoping report submitted to IAPs and regulatory authorities in English, Setswana and Zulu
- Proof of distribution of the draft scoping report and summaries to IAPs and regulatory authorities for review and comment
- Comments received during the review of the draft scoping report by IAPs and regulatory authorities
- Proof of distribution of the final scoping report and summaries to IAPs and regulatory authorities for review and comment
- Comments received during the review of the final scoping report by IAPs and regulatory authorities
- Acceptance of final scoping report
- Proof of distribution of the draft EIA report and summaries to IAPs and regulatory authorities for review and comment
- Comments received during the review of the draft EIA report by IAPs and regulatory authorities
- Site notices and invitations to EIA feedback meetings
- Minutes of the EIA feedback meetings
- Site visit with RLM
- Summary document of the draft EIA report submitted to IAPs and regulatory authorities in English, Setswana and Zulu
- Acknowledgment from DWS of notice of intent to apply for WULA

APPENDIX F: IMPACT RATING FOR EACH POTENTIAL IMPACT

Potential environmental and socio-economic impacts were identified by SLR and other stakeholders. The impacts are discussed under issue headings in this section. All identified impacts are considered in a cumulative manner such that the current baseline conditions on site and in the surrounding area are discussed and assessed together. In addition, the assessment considers the approved operations including the housing and provides an updated assessment of the approved operations together with the proposed project changes. The criteria used to rate each impact is outlined in Section 7.6. The potential impacts are rated with the assumption that no mitigation measures are applied and then again with mitigation. An indication of the phases in which the impact will occur including the activity associated with each impact is provided below. A summary of the impact assessment is summarised in Section 9 of the main report.

It should be noted that in the approved mine EIA and EMP, impacts during the decommissioning and closure phases were assessed in relation to the construction and operational phases of the mine and therefore were often assessed as positive impacts. In this assessment, impacts have been considered collectively across the life of mine and are assessed in relation to the pre-mining baseline conditions.

In the impact assessment below, the approved EIA and EMP has been referred to as the mine EIA and the approved BAR and EMP has been referred to as the housing BAR.

Environmental impacts that will be assessed/discussed in this section include the following:

- Addition of a mineral resource
- Hazardous excavations, infrastructure and surface subsidence
- Loss of soil resources and land capability through contamination
- Loss of soil resources and land capability through physical disturbance
- Physical destruction of biodiversity
- General disturbance of biodiversity
- Contamination of surface water resources
- Alteration of natural drainage patterns
- Changes in groundwater levels
- Contamination of groundwater resources
- Air pollution
- Noise pollution
- Blasting
- Disturbance to roads and traffic
- Visual impacts
- Loss of heritage, cultural and palaeontological resources
- Economic impact
- Inward migration
- Tourism
- Land use impact

GEOLOGY

ISSUE: INCLUSION OF ADDITIONAL MINERAL RESOURCE

Information in this section was sourced from the project team.

Introduction

The information for this section was sourced from approved mine EIA and housing BAR.

Introduction

The placement of infrastructure and activities on or in close proximity to mineral resources preventing access to potential mining areas as well as disposal of mineral resources onto mineralised waste facilities can result in the sterilisation or loss of these resources. This would have negative economic impacts as the economic potential of the minerals are not realised.

Bakubung Minerals (Pty) Ltd hold the mineral rights for the areas where the plant and housing are located and a section of Mimosa where the TSF is located. However, a portion of the TSF area and the tailings and return water pipelines fall on areas that are not included in this mineral right. The mineral rights of these areas belong to Maseve, a neighbouring mine, owned by Platinum Group Metals (RSA) (Pty) Ltd and Wesizwe. BPM has however indicated that there will not be sterilisation of minerals as a result of this project.

Bakubung Platinum Mine does not plan to reprocess the TSF material. This has not changed from the previous EIA and thus has not been included in the assessment for this project.

As part of this project, Bakubung Minerals (Pty) Ltd are applying for the inclusion of aggregate in their existing mineral right. The inclusion of additional minerals has positive economic value as economic benefit of a mineral is maximised.

The approved mine EIA assessed the changes to geology as a result of the development of the mine. The approved housing BAR considered two aspects jointly; the impact that the geology will have on the development of the infrastructure and the impact that the housing will have on the underlying rock formations.

With regard to geology, the concern of the impact to geology relates to how a resource will be affected by the activities of a project. The assessment below considers how the project could impact the geology in terms of its use as a resource, in this case as a result of the inclusion of additional minerals in the mining right. The economic impacts are discussed in Socio-Economic impact section.

The impacts on the natural geology as a result of mining and related activities as assessed in the approved EIA, BAR and EMPs have not been re-assessed in this report as there are no changes to the underground mining. However, the approved mitigation measures linked to these have been included in the EMP report, Section 28 for completeness.

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure
Waste Rock Management	Waste Rock Management	Waste Rock Management	Waste Rock Management

Rating of impact

Severity / nature

Waste rock is currently being produced from the shaft sinking occurring on site. Waste rock will continue to be produced during construction and mining and will either be used to develop the bank areas (this includes roads, terraces and housing foundations) or will be stockpiled on the approved waste rock dump.

BPM is proposing to crush waste rock from the waste rock dump, and sell it as aggregate. The mining and sale of this additional mineral has a positive economic benefit and thus a positive geological impact. However, the benefit will depend on the quantity of waste rock sold; if waste rock is not sold and kept on site this benefit will not be realised. Any waste rock remaining on site at the end of the life of mine not sold will be backfilled down the shaft and there will not be a residual waste rock dump on surface.

Prior to mitigation (retaining waste rock on site and having minimal sale of waste rock) the severity is low negative, with mitigation (selling all remaining waste rock) the severity is high positive.

Duration

The duration for the mitigated and unmitigated scenario will last the life of the project.

Spatial scale / extent

In the unmitigated and mitigated scenario the spatial scale is widespread as the economic effect can be felt on a regional or even national scale.

Consequence

Without mitigation, the consequence is medium, with mitigation it is high positive.

Probability

The probability of the impact occurring in both the unmitigated and mitigated scenarios is possible.

Significance

Without mitigation, the significance of not selling all the available aggregate waste rock on site will have a medium negative impact as the aggregates economic potential will not be realised. With the sale of all the available aggregate waste rock (the mitigated scenario) there will be a high positive significance as the economic potential of the aggregate mineral will be realised.

Tabulated summary of the assessed impact

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	L	M	H	M	M	M
Mitigated	H+	M	H	H+	M	H+

TOPOGRAPHY

ISSUE: HAZARDOUS EXCAVATIONS AND INFRASTRUCTURE

The information for this section was sourced from approved EIA, BAR and EMPs.

Introduction

The approved mine EIA assessed the impact to the change in topography due to construction activities and mining operations. The approved housing BAR assessed the impact that changed topography can have on stormwater dispersal (discussed further in the surface water impact section below). This assessment considers how topography is altered by construction and mining activities and links this alteration to safety risks associated with the development of hazardous excavations and infrastructure.

Hazardous excavations and infrastructure include all excavations, structures or land forms into or off which third parties (non-mine personnel) and animals can fall and be harmed. Included in this category are facilities that can fail such as the TSF. Hazardous excavations and infrastructure occur in all project phases from construction through operation to decommissioning and closure. In the construction and decommissioning phases these hazardous excavations and infrastructure are temporary in nature, usually existing for a few weeks to a few months. The operational phase will present more long term hazardous excavations and infrastructure and the closure phase will present final land forms that are considered hazardous (TSF).

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Civil works Earthworks Waste rock management	Mining and mining related activities Waste rock management Mineral processing operations Tailings management	Demolition Rehabilitation	Maintenance and aftercare

Rating of impact

<u>Severity / nature</u>

In the approved mine EIA the severity of the impact that construction and operations would have on the topography was rated as moderate to severe for the construction and operational phases. Most of the approved infrastructure has not yet been constructed (concentrator plant, TSF) and some of the already present infrastructure has not yet reached its maximum height and footprint (the waste rock dump).

For this project, while the TSF is not increasing in height it is increasing in footprint. There will also be additional topsoil stockpiles and establishment of additional infrastructure which will present a potential risk of injury and/or death to both people and animals. This results in a high severity in the unmitigated scenario and decreases to medium with mitigation.

When considering this impact cumulatively with the approved operations, the severity rating for the overall mine is high in the unmitigated scenario and decreases to medium with mitigation.

Duration

In the context of this assessment, death or permanent injury is considered a long term, permanent impact.

Spatial scale / extent

For the most part, the direct impacts will be located within the site boundary, but the indirect impacts will extend to the communities to which the people / animals belong.

Consequence

The consequence relating to death and/or injury is high in both the unmitigated and mitigated scenario.

Probability

Changes to mining operations and infrastructure are taking place within the existing mine boundaries. Mitigation measures and emergency procedures with a focus on infrastructure safety and limiting access to third parties and animals and implementing effective stormwater management can decrease the probability of incidences. In the absence of these measures, the probability is high. With mitigation, the probability reduces to low for the plant area and somewhere between medium and low for the TSF area.

Significance

In the approved mine EIA the significance to changed topography was rated as high without mitigation. During decommissioning the surface infrastructure related to the mine will be removed and the areas will be levelled as best as possible. The TSF will remain after closure but with final shaping, capping, rehabilitation and re-vegetation of the TSF the impact would reduce. With mitigation the significance was predicted to decrease to moderate (plant areas) to moderate to high (TSF area).

When considering the project's impact cumulatively with the approved operation, the significance rating for the overall mine is high in the unmitigated scenario and medium (plant area) and medium to high (TSF area) in the mitigated scenario.

Tabulated summary of the assessed impact

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						

Unmitigated	H	H	M	H	H	H
Mitigated	M	H	M	H	L (plant area) M-L (TSF area)	M (plant area) M-H (TSF area)

SOIL AND LAND CAPABILITY

ISSUE: LOSS OF SOIL RESOURCES AND LAND CAPABILITY THROUGH PHYSICAL DISTURBANCE

The information is based on the soils specialist studies (De Castro and Brits, 2016 and Rehab Green, 2007).

Introduction

Soil is a valuable resource that supports a variety of ecological systems and is key to re-establishing post closure land capabilities. The project has the potential to damage soil resources and associated land capability through physical disturbance and/or contamination. These physical and contamination aspects have been considered separately. The approved mine EIA assessed soil impacts, and land capability impacts separately, and the housing BAR only assessed soil impacts whereas this assessment considers these two aspects together as an impact to the soil resource is linked to the impact on the land capability.

In the construction and decommissioning phases these activities are temporary in nature, usually existing from a few weeks to a few months. The operational phase will present more long-term activities and the closure phase will present final landforms that may be susceptible to erosion.

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks Waste rock management Transport systems	Tailings management Waste rock management Transport systems Housing	Tailings management Waste rock management Transport systems Housing Demolition Rehabilitation	Maintenance and aftercare

Rating of impacts

Severity / nature

The approved mine EIA found the physical impact to the soil resource and land capability to be between moderate and severe depending on the mine phase. The severity post-mitigation was not indicated. The housing BAR didn't specify severity.

Approved infrastructure will cover approximately 407 ha. This project will have an additional footprint of approximately 90.4 ha. Of this 79 ha is within areas already approved for mining and 11.4 ha is of new land impacted by the tailings and return water pipeline. The approved development would disturb a wide range of soil types with varying land capabilities; the infrastructure of this project will disturb similar soil types and land capabilities. Some of these soils are considered to be sensitive. Where possible the more sensitive soils have been avoided. In the unmitigated scenario, the physical disturbance can result in the loss of soil functionality. In terms of compaction it negatively impacts on plant root growth and development, and in terms of erosion it results in loss of soils in the area of disturbance which impacts negatively on land capability and the biodiversity of the natural area. At the TSF, the clay present on site will be stripped and re-compacted for the liner of the TSF. The in-situ clay soil will be used to act (in conjunction with other liner materials) as a natural liner for pollution control. Soils may also be reused for the inner core of the zoned embankment walls. For all other areas, topsoil will be stripped for use in rehabilitation and closure. This amounts to a high severity for both the mitigated and unmitigated scenario for the project.

When considering the project's impact cumulatively with the approved operations, the severity rating for the overall mine is high for both the unmitigated and mitigated scenarios.

Duration

In the unmitigated scenario the loss of soil and the related land capability is long term and will continue after the life of the project. In the mitigated scenario, measures provide for soils that are to be stripped to be appropriately stockpiled, conserved and replaced in areas that require rehabilitation; this reduces the duration of the impact to the life of the project. Some soils will however be lost forever due to the need to retain an in-situ layer of clay below the TSF.

Spatial scale / extent

The extent of the physical impact can vary, with compaction being localised and erosion possibly extending beyond the site boundary, particularly near drainage complexes. In the unmitigated scenario for all project phases, this is a medium spatial scale. With mitigation measures the impact will be limited to the within the site boundary.

Consequence

In the unmitigated scenario the consequence is high. In the mitigated scenario the consequence is medium-high as some soils will be lost as part of the TSF liner.

Probability

Without mitigation measures the probability of losing soil resources and the associated land capability is definite. With the implementation of mitigation measures this can be reduced to medium. Although emphasis is placed on soil conservation and re-establishment as far as possible, soils below mineralised waste facilities will be lost permanently.

<u>Significance</u>

In the approved mine EIA the significance was indicated to range between moderate to high depending on the mine phase and specific activity of the project. The housing BAR found impact significance to be low to medium with mitigation implemented.

When considering the project's impact cumulatively with the approved project, the significance for the unmitigated scenario is high. The mitigated scenario is medium-high due to the need to retain an in-situ layer of clay below the TSF which covers approximately 41% of the total project area. Retaining the layer of clay soil below the TSF is unavoidable. The significance can be decreased if alternative sources of soil material are considered during the decommissioning phase to replace the soil that has been lost.

Tabulated summary of the assessed impact

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	H	H
Mitigated	H	M-H	L	M-H	M	M-H

ISSUE: LOSS OF SOIL RESOURCES AND LAND CAPABILITIES THROUGH POLLUTION

The information is based on the soils specialist studies (De Castro and Brits, 2016d and Rehab Green, 2007).

Introduction

Soil is a valuable resource that supports a variety of ecological functions. There are a number of activities/infrastructure in all phases that have the potential to damage soil resources through contamination from runoff, spillages and seepage. Contamination of soils also has the potential to impact both surface and groundwater resources (see the surface water and groundwater impact sections below for water related impacts). The loss of soil resources has a direct impact on the potential loss of the natural capability of the land. This section focuses directly on the potential for contamination of the soil resources and the effect this has on land capability.

In the construction and decommissioning phases these activities are temporary in nature, usually existing from a few weeks to a few months. The operational phase will present more long-term activities and the closure phase will present final landforms that may be susceptible to erosion.

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks Waste rock management Transport systems	Tailings management Waste rock management Transport systems Housing Process and storm water management Sewage sludge management	Tailings management Waste rock management Transport systems Housing Process and storm water management Sewage sludge management Demolition Rehabilitation	Maintenance and aftercare

Rating of impact

Severity / nature

The approved mine EIA found the pollution impact to the soil resource and land capability to be between moderate and severe depending on the phase of the mine. The severity post-mitigation was not indicated. Pollution impacts to soil were not assessed in the housing BAR.

The approved mine EIA identified a number of pollution sources. The project components present similar sources of contamination in similar locations as for the approved operations. These include the addition of a tailings pipeline, a return water pipeline, a larger TSF, which can have an impact on the soil resource through contamination from seepage from the TSF and/or spillage from the pipelines, spillage from sewage pipelines linking to the sewage treatment plant, dripping vehicles, chemical spills e.g. lubricants, oils or improper environmental practices e.g. disposal of waste materials onto soil resources, at the housing developments.

Potential seepage and/or dirty runoff from the TSF, dripping vehicles, spilled sewage or improper disposal could alter the soil composition, negatively impacting on the chemistry of the soils such that current growth conditions are impaired. The soils in the study area do have the capacity to buffer chemical change. The soils are high in 2:1 swelling-shrinking clays which have the capacity to sorb high levels of cationic heavy metals, especially under near neutral to slightly alkaline pH values and oxidising conditions. However, the capacity of the soils to sequester heavy metals can reach a saturation point and thus this cannot be seen as a mitigation measure should there be spillages.

In the unmitigated scenario, the chemical disturbance can result in the loss of soil functionality and thus also land capability. This amounts to a high severity for the unmitigated scenario for the project should there be dam failure, liner failure, spillage from pipelines or improper disposal to soil resources. With mitigation the severity can be reduced to medium to low depending on the reaction time of clean-up teams and the maintenance of pollution control facilities. The specialist assessment conducted for the pipeline provided a high severity for both unmitigated and mitigated scenarios and indicated that while mitigation measures implemented when spillages occurs will limit the extent of the impact, they do not impact the severity.

For this project’s components the severity is considered to be medium to low, except the pipeline which is high.

When considering the project’s impact cumulatively with the approved operations, the severity rating for the overall mine is high for the unmitigated and mitigated scenario.

<u>Duration</u>

In the unmitigated scenario most of the pollution impacts and the associated loss of land capability will remain after mine closure. In the mitigated scenario, these potential impacts should either be avoided or remedied immediately; this can reduce the impact to the life or less than the project life. This can be achieved through effective management of the facilities, regular inspections for early detection and effective reaction time of the clean-up team.

<u>Spatial scale / extent</u>

In the unmitigated scenario, the extent of the pollution impact can extend far beyond the site boundary by contaminated runoff or seepage from the project sites. In the mitigated scenario for all the project phases, the impacts will be restricted to be within the site boundary.

Consequence

In the unmitigated scenario the consequence is high. In the mitigated scenario the consequence is medium.

Probability

Without mitigation measures the probability of losing soil resources and the associated land capability is definite. With the implementation of mitigation measures this can be reduced to low because emphasis is placed on preventing pollution events and on quick and effective remediation if pollution events do occur. The soil assessment for the pipeline indicates that the probability stays high for the pipeline, though it was also indicated by the specialist that the impact can be avoided and is preventable through maintenance of the pipeline. When considering these aspects jointly, the probability is more likely to be medium to high than high for the pipeline. The probability for the mitigated scenario is therefore rated as low except for the pipeline which is medium to high.

Significance

In the approved mine EIA the significance was indicated to range between moderate to high depending on the phase and activity of the project. When considering the project's impact cumulatively with the approved project, the significance for the unmitigated scenario is high and the mitigated scenario is low and medium to high for the pipeline.

Tabulated summary of the assessed impact

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	H	H	H	H
Mitigated	H	M	L	M	L M-H (pipeline)	L M-H (pipeline)

BIODIVERSITY

ISSUE: PHYSICAL DESTRUCTION OF BIODIVERSITY

Information from this section is sourced from the approved mine EIA and housing BAR and the following studies:

- Aquatic ecological assessment: Scientific Aquatic Services (2015)
- Vegetation assessment: De Castro and Brits (2016a)
- Watercourse assessment: De Castro and Brits (2016b)
- Faunal assessment: De Castro and Brits (2016c)

Introduction

There are activities/infrastructure in all phases that have the potential to destroy biodiversity in the broadest sense. In this regard, the discussion relates to the physical destruction of specific biodiversity areas, of linkages between biodiversity areas and related species which are considered to be significant because of their status, and/or the role that they play in the ecosystem. The approved mine EIA and the housing BAR assessed all impacts on fauna jointly and all impacts on flora jointly but in separate sections. This assessment assesses destruction and general disturbance of biodiversity separately but assesses fauna, flora, wetlands and aquatic ecosystems together as they each play an integral part in the overall biodiversity of an area. This section focuses on the destruction to biodiversity.

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Civil works Earthworks Waste rock management Transport systems Housing Site/contract management	Tailings management Waste rock management Transport systems Housing Process and storm water management Sewage sludge management Site/contract management	Tailings management Waste rock management Transport systems Housing Process and storm water management Sewage sludge management Site/contract management Demolition Rehabilitation	Maintenance and aftercare

Rating of impact

<u>Severity / nature</u>

High biodiversity areas are functioning biodiversity areas with species diversity and associated intrinsic value. In addition, some of these high biodiversity areas host several red data and protected species. The linking areas have value because of the role they play in allowing the migration or movement of flora and fauna between the areas of high biodiversity, which is a key function for the broader ecosystem. The transformation of land for any purpose, including mining and associated activities, increases the destruction of site-specific biodiversity, reduces its intrinsic functionality and reduces the linkage role that undeveloped land fulfils between different areas of biodiversity importance.

In the approved mine EIA, the severity for fauna and flora impacts were rated as moderate for the construction and operational phases.

The following is relevant with regard to biodiversity within the project area and specifically within the footprint areas of the project components:

- In terms of national guidelines, the project area is located within a high biodiversity area in terms of the Mining and Biodiversity guidelines.
- The project area falls entirely within a terrestrial Critical Biodiversity Area, CBA2, which has a management objective to maintain it in a natural or near natural state that maximises the retention of biodiversity pattern and ecological process. Important in this area are the natural corridor linkages and natural protected area buffer of the Pilanesberg National Park. It is important to note that these national guidelines and assessments were published after the mine was approved in 2008.
- Approximately 57% of the proposed project footprints (including approved but not yet built infrastructure) fall within transformed habitats or secondary vegetation.
- Approximately 41% of the proposed project footprints fall within the Vulnerable Marikana Thornveld.
- There are two protected tree species in terms of the NFA that have been identified on site; these include *Boscia albitrunca* and *Sclerocarya birrea subsp. Africana*.
- Several wetlands and watercourses were identified. These could be impacted to varying degrees by project components. The present ecological state of these features ranges from Category B (largely unmodified) in the case of ephemeral channels 3, 9, and 10, and ephemeral drainage lines 7, 8, 13, to Category D (largely modified) in the case of the unchannelled valley bottom wetland which has been impacted by mining infrastructure.
- The ecological importance and sensitivity of the watercourses is moderate to very high, with the ephemeral channel 2 (PES C) being very high.
- The Sandspruit and Elands River tributary show conditions that are deteriorated from what could be expected. However, these systems are deemed important in terms of the provision of services to the terrestrial fauna of the area as well as from a socio-cultural point of view.
- While only two red data species (1 floral and 1 mammal) were identified on site, there is the likelihood of other red data species/ species of conservation concern being present. This includes 1 arthropod (low likelihood), 5 floral species (3 having a moderate likelihood and 2 having a low likelihood), 21 mammals (18 having a moderate likelihood and 2 having a low likelihood), 23 birds (6 having a moderate likelihood and 17 having a low likelihood) and 1 amphibian (low likelihood).

Taking the above points into account, the severity of potential impacts of the project is rated as high in the unmitigated scenario. In the mitigated scenario, the severity reduces to medium for all impacts except for the permanent loss of Vulnerable Marikana Thornveld which remains high.

When considering this impact cumulatively with the approved operations, the severity rating for the overall mine is high in the unmitigated scenario and medium to medium-high in the mitigated scenario, due to the permanent loss of Vulnerable Marikana Thornveld.

Duration

In the unmitigated scenario, the impacts will extend beyond the life of the project as there could be permanent loss and/ or disturbance to habitats, decrease in diversity and species of conservation concern. In the mitigated scenario, this reduces to medium for all terrestrial impacts except for the loss of the Marikana Thornveld which remains high. For aquatic habitats, the permanent loss of a small section of wetland habitat will extend beyond the life of the project.

Spatial scale / extent

In the unmitigated scenario the impact can extend beyond the project boundary, whereas with mitigation this can be limited to the project boundary.

Consequence

For the unmitigated scenario, the consequence is high. For the mitigated scenario the consequence decreases to medium, except for the loss of Marikana Thornveld, which would be moderate-high.

Probability

The probability of impacts occurring in the unmitigated scenario is high. With mitigation the probability decreases to medium for all terrestrial impacts, except for the loss of Marikana Thornveld which remains high. For aquatic habitats, the permanent loss of a small section of wetland habitat is definite. However, during decommissioning the re-instatement of the drainage channels will decrease it to the life of the project.

Significance

In the approved mine EIA the significance of impacts on fauna and flora was rated as moderate and decreased to low with mitigation. For the approved housing BAR the significance of fauna and flora-related impacts was rated low post-mitigation.

When considering the project's cumulative impact with the approved operations, the significance rating is high without mitigation. The higher significance is attributed to the permanent loss of additional Marikana Thornveld which is now categorised as Vulnerable, as well as the location of the project area within a

CBA2 area (these two aspects were not applicable at the time of the previous EIA approval). With mitigation this can be decreased to moderate for all impacts except for the impact to the Marikana Thornveld vegetation type which is medium-high. The floral specialist has indicated that in his professional opinion the significance rating is medium-high as the proposed mitigation measures will lead to a significant and meaningful reduction in the destruction of Marikana Thornveld.

Tabulated summary of the assessed impact

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	H	H
Mitigated	M - H (vegetation type) M	H (vegetation type) M	L	M-H (vegetation type) M	H (habitat / vegetation type) M	M- H (habitat / vegetation type) M

ISSUE: GENERAL DISTURBANCE OF BIODIVERSITY

Information from this section is sourced from the approved mine EIA and housing BAR and the following studies:

- Aquatic ecological assessment: Scientific Aquatic Services (2015)
- Vegetation assessment: De Castro and Brits (2016a)
- Watercourse assessment: De Castro and Brits (2016b)
- Faunal assessment: De Castro and Brits (2016c)

Introduction

There are a number of activities/infrastructure that have the potential to disturb vegetation and fauna in all project phases, particularly in the unmitigated scenario. In the construction and decommissioning phases these activities are temporary in nature, usually existing for a few weeks to a few months. The operational phase will present more long term occurrences and the closure phase will present final land forms (rehabilitated areas). The approved mine EIA and housing BAR assessed all impacts on fauna jointly and all impacts on flora jointly but in separate sections. This assessment assesses destruction and general disturbance of biodiversity separately but assesses fauna, flora, wetlands and aquatic ecosystems together as they each play an integral part of overall biodiversity of an area. This section focuses on the general disturbance to biodiversity.

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Civil works Earthworks	Tailings management Waste rock management Transport systems	Tailings management Waste rock management Transport systems	Maintenance and aftercare

Construction	Operational	Decommissioning	Closure
Waste rock management Transport systems Housing Site/contract management	Housing Process and storm water management Sewage sludge management Site/contract management	Housing Process and storm water management Sewage sludge management Site/contract management Demolition Rehabilitation	

Rating of impact

Severity / nature

In the approved mine EIA, the severity for fauna and flora impacts were rated as moderate for the construction and operational phases. In the approved housing BAR severity was not indicated.

In the unmitigated scenario, biodiversity will be disturbed by the project components in the following ways:

- Where additional lighting is required, lighting can attract large numbers of invertebrates which become easy prey for predators. This can upset the invertebrate population balances.
- Contamination of water and soil and general litter as well as dust may directly impact on the survival of individual plants, vertebrates and invertebrates and downstream ecosystems.
- Noise and equipment vibration from project activities may scare off vertebrates and invertebrates. In some instances the animals may be deterred from passing close to noisy activities which can effectively block some of their migration paths. In other instances, vertebrates and invertebrates that rely on vibration and noise senses to locate for, and hunt, prey may be forced to leave the vicinity of noisy, vibrating activities.
- The tailings and return water pipelines can block migration pathways for animals.
- Harvesting and killing of plant and animal species in adjacent areas for medicinal use, food, fire wood, for sport, and persecution of predators can decrease species populations and diversity. Increased wood harvesting could cause a loss of cover for faunal species and tree nesting habitat for birds.
- Following area clearance during construction, alien invasive species can proliferate altering the biodiversity of the terrestrial and aquatic systems.
- Sedimentation in watercourses as a result of runoff from poorly vegetated areas and/or stockpiles areas can impact the ecological integrity of watercourses.

The disturbance of biodiversity has been rated as having a high severity during all project phases. This can however be reduced to low with the implementation of management and mitigation measures.

When considering this impact cumulatively with the approved operations, the severity rating for the overall mine is high in the unmitigated scenario and medium in the mitigated scenario.

Duration

In the unmitigated scenario, the impacts will continue for the life of the project. In the mitigated scenario, this reduces to medium.

Spatial scale / extent

The disturbance of biodiversity could affect the ecosystem beyond the site boundary because of the linkages between biodiversity components and areas. This is particularly true for animals which may migrate on a periodic basis in search of food, water or breeding areas and aquatic ecosystems. This spatial scale cannot be significantly reduced with mitigation.

Consequence

In the unmitigated scenario, the consequence of this potential impact is high. In the mitigated scenario, this reduces to medium because the severity and duration of the impact is reduced.

Probability

Without any mitigation the probability of negatively impacting on biodiversity through multiple disturbance events as a result of the project components is high. With mitigation, the probability will be reduced to medium because most of the disturbances can be controlled through implementation and enforcement of practices, policies and procedures.

Significance

In the approved mine EIA the significance of impacts to fauna and flora was rated as moderate and decreased to low with mitigation. For the approved housing BAR the significance for fauna and flora was rated low post-mitigation.

When considering the project's impact cumulatively with the approved operations, the significance rating for the overall mine is high in the unmitigated scenario and medium in the mitigated scenario.

Tabulated summary of the assessed impact

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	H	H
Mitigated	M	M	M	M	M	M

SURFACE WATER

ISSUES: ALTERATION OF NATURAL DRAINAGE PATTERNS

The information for this section was sourced from the approved mine EIA and housing BAR and the watercourse assessment report (De Castro and Brits, 2016d).

Introduction

There is a stormwater management system at the mine (as required by legislation) and therefore pre-mining drainage patterns have been altered to a certain extent. There has also been the construction of berms contributing to the alteration of drainage patterns. Surface drainage patterns can be further altered through changes to this stormwater management system to accommodate the project components, which may reduce the volume of runoff entering a watercourse and lead to a reduction in flows. Development within the floodlines may impede conveyance within the channel altering flood levels upstream of the development. This will last during the construction, operational and decommissioning phases. During the closure phase rehabilitation will allow for the restoration of drainage patterns to an extent.

This assessment focuses on the changes to the drainage patterns which links to the surface water quantity aspect assessed in the approved mine EIA and the flooding impact assessed in the housing BAR. Impacts on surface and groundwater quality are assessed separately.

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Civil works Earthworks Transport systems	Waste rock management Tailings management Process and storm water management	Tailings management Demolition Rehabilitation	Maintenance and aftercare

Rating of impact

<u>Severity / nature</u>

The approved mine EIA indicated that the approved operations would reduce runoff volumes, as runoff from the surface area of the entire mining site and TSF area would be removed from the catchment area. Since the loss was considered to be low (less than 1.2% of the quaternary catchment), the unmitigated severity was rated as moderate for the construction and operation phase. There was no indication of the severity for the mitigated scenario. The approved housing BAR considered the possibility of flooding as a result of intense rainfall events, and the impact of topography on storm water dispersal. Stormwater dispersal as a result of topography would have been a concern as personnel living in the housing area on low gradients could be affected, however no severity was indicated. Significantly, in the approved mine EIA, no surface infrastructure would be located within floodlines.

In terms of runoff, the approved mine EIA assessed the entire mining site including the TSF and considered a total area of 365 ha. The housing will not retain any water received and will all be diverted off site. The components of this project will occupy an additional 90.4 ha. This will have an additional reduction of runoff yield of 14.36 Ml/annum which equates to 0.29% of the quaternary catchment in the unmitigated scenario. This calculation assumes that each hectare has an equal contribution and also considers the worst case scenario of removing all the water from site from the catchment area. Even unmitigated the additional reduction has a low severity.

There are a number of water courses draining the mine and project site. Most of these are ephemeral in nature. The more significant water course is the Elands River. In the unmitigated scenario, project components can alter drainage patterns in the following ways (this also takes into consideration changed approved facilities):

- The return water dam will overlap with an ephemeral drainage line on the farm Mimosa;
- The Gabonewe Estate Mine housing area will overlap with ephemeral channels;
- The tailings and return water pipelines will cross over ephemeral drainage lines, an ephemeral drainage channel and the Sandspruit;
- A bridge will be constructed between the mine housing;
- An existing bridge needs to be refurbished north of the mine housing;
- There will be a road crossing over an ephemeral channel and drainage lines;
- The Magalies Water Board pipeline will cross over the unnamed tributary of the Elands River; and
- Erosion control measures will be implemented along the unnamed tributary of the Elands River.

In the unmitigated scenario, the severity is considered high. With mitigation that focuses on re-aligning infrastructure where possible to avoid drainage lines/channels and caters for appropriate design of water course crossings, the severity reduces to medium.

When considering the above cumulatively with the approved operations, the severity is high in the unmitigated scenario and medium in the mitigated scenario.

Duration

The alteration of drainage patterns will be long-term and extend beyond the life of the project due to the TSF remaining on site. The duration cannot be significantly reduced with mitigation.

Spatial scale / extent

In the unmitigated scenario, the alteration of drainage patterns could extend beyond the project boundaries to downstream users. With mitigation this can be contained to the project site.

<u>Consequence</u>

The consequence is high for the unmitigated scenario and medium for the mitigated scenario.

<u>Probability</u>

The probability is high and reduces to moderate in the mitigated scenario.

<u>Significance</u>

The approved mine EIA indicated that the significance for the unmitigated scenario is high and with mitigation it is low for the construction and operation phases. In the approved housing BAR, the significance of the impact of topography on stormwater dispersal was rated as low to medium in the mitigated scenario. Significance pre-mitigation is not specified.

When considering the approved project and this project cumulatively, the unmitigated significance is high and reduces to medium with mitigation measures implemented.

Tabulated summary of the assessed impact

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	H	H
Mitigated	M	H	L	M	M	M

ISSUE: CONTAMINATION OF SURFACE WATER RESOURCES

The information for this section was sourced from the approved mine EIA and housing BAR, the annual surface water monitoring report (SLR, 2015a), the September 2015 and December 2015 quarterly reports (SLR, 2015b and 2016c).

Introduction

On site and off site (downstream of project-related infrastructure and activities) surface water resources could be polluted if there are discharges of contaminated substances into these resources. Pollution of water resources can have negative health impacts on both people and animals, and it can negatively impact on the water course related biodiversity. Biodiversity and soil related impacts are discussed above.

In the construction and decommissioning phases these potential pollution sources are temporary in nature, usually existing for a few weeks to a few months. Although these sources may be temporary, the potential pollution may be long term. The operational phase will present more long term potential sources and the closure phase will present final land forms that may have the potential to contaminate surface water through long term seepage and/or run-off.

The approved housing BAR assessed impacts on water quality of ground and surface water collectively. This assessment considers the impacts on surface and ground water quality separately. The focus in this section is on the contamination of surface water resources.

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Civil works Earthworks Waste rock management Tailings management Transport systems	Mining and mining related activities Waste rock management Tailings management Process and storm water management General and hazardous waste management Sewage sludge management Site support services	Tailings management Demolition Rehabilitation	Maintenance and aftercare

Rating of impact

Severity / nature

In the approved mine EIA, the severity rating for impacts to surface water quality were severe for the construction and operational phases prior to mitigation. The severity with mitigation was not indicated. In the approved housing BAR severity was not indicated.

For the project components, in the unmitigated scenario, during the construction phase, pollution sources include sedimentation from erosion, and spillage of construction solvents, paint, fuel, oil, and cement. During operation and decommissioning phases pollution sources include the TSF, the tailings and return water pipelines spills of fuel and oil, the sewage treatment plant, sewage pipelines, workshops, dangerous goods, dripping vehicles, the salvage yard and sedimentation from erosion contaminated discharges from the dirty water systems including: the PCDs, the return water dam. This amounts to a high severity in the unmitigated scenario and reduces to medium in the mitigated scenario.

When considering this impact cumulatively with the approved operations, the severity rating for the overall mine is high in the unmitigated scenario and reduces to medium in the mitigated scenario.

Duration

The pollution of surface water resources could have long-term effects on both people and animals during all project phases. The implementation of mitigation measures could reduce the duration.

Spatial scale / extent

In both the unmitigated and mitigated scenarios for all phases of the project, there is potential for contamination to extend beyond the site boundary (worst case).

Consequence

In the unmitigated scenario, the consequence is high. In the mitigated scenario the consequence is medium as the severity and duration of the impact is reduced.

Probability

The probability of the impact occurring relies on a causal chain that comprises three main elements:

- Does contamination reach surface water resources?
- Will people and livestock utilise this contaminated water?
- Is the contamination level harmful?

The first element is that contamination reaches the surface water resources within the proposed project area. Due to the proximity of the project to ephemeral drainage lines and channels, the Elands River and the Sandspruit, contaminants could reach surface water resources. However, these watercourses are ephemeral in nature and thus are dry for most of the dry months.

The second element is that third parties and/or livestock use this contaminated water for drinking purposes. This is a possibility as the surrounding communities use the water for fishing and for livestock watering when water is available.

The third element is that it is likely that only some contaminants will be at a level which is harmful to humans and livestock. This is influenced both by the quality of any discharged water and by the diluting effect of any rainwater particularly in the rainy season. However, conservatively it is assumed there could be contaminants that could reach levels that are harmful to humans and livestock if unmitigated, particularly if they add to existing baseline exceedances further deteriorating the water quality.

Based on the above, the probability is high for the unmitigated scenario and low for the mitigated scenario.

Significance

In the approved EIA and EMP, the significance of contamination of surface water resources without mitigation was rated as moderate for the shaft and plant area for construction and operation and low and high for the TSF for construction and operation respectively. With mitigation this decreased to low and very low.

In the approved BAR and EMP, the significance of contamination of surface water resources occurring was considered to be low with mitigation measures implemented.

When considering the project's impact cumulatively with the approved operations, the significance rating for the overall mine is high in the unmitigated scenario and reduces to low in the mitigated scenario.

Tabulated summary of the assessed impact

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	H	H
Mitigated	M	M	M	M	L	L

GROUNDWATER

ISSUE: CHANGES IN GROUNDWATER LEVELS AND AVAILABILITY

Discussion

A reduction in ground water levels could impact on the flow of streams as well as groundwater resources used by third parties. Local communities use streams and groundwater in the area for domestic and agricultural (livestock watering and irrigation) purposes. The main activities influencing ground water levels are dewatering to ensure safe operations. This has not changed from the approved operations and thus dewatering has not been re-assessed. However, the mitigation measures as provided in the approved mine EMP have been included in the EMP in Section 28 for completeness.

ISSUE: CONTAMINATION OF GROUNDWATER RESOURCES

The information for this section was sourced from the approved mine EIA and housing BAR, and the groundwater modelling report (DTM, 2016).

Introduction

There are activities associated with the changes in infrastructure and operations at the mine that have the potential to pollute groundwater. These activities include the larger TSF, the existing waste rock dump and diffuse sources such as adhoc spills of hydrocarbons, chemicals and untreated sewage effluent. Although pollution sources are temporary in nature with the exception of the TSF and waste rock dumps, the potential for pollution may be long term. The operational phase will present more long-term potential sources.

The approved housing BAR assessed impacts on water quality of ground and surface water collectively. This assessment considers surface and ground water quality impacts separately. The focus in this section is on the contamination of groundwater resources.

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Civil works Earthworks Waste rock management Transport systems	Mining and mining related activities Waste rock management Tailings management Process and storm water management General and hazardous waste management Sewage sludge management Site support services General and hazardous	Tailings management Demolition Rehabilitation	Maintenance and aftercare

Construction	Operational	Decommissioning	Closure
	waste management		

Rating of impact

Severity / nature

In the approved mine EIA, the severity for impacts to groundwater quality were rated as slight for the construction phase for the plant and shaft area and moderate for the operational phase for the plant and shaft area and the TSF. The severity for the mitigated scenario was not indicated. For the approved housing BAR the severity was not indicated.

As part of this project, the contamination plume for the TSF area was remodelled with the updated layout. The contamination plume for the waste rock dump area at the plant was not remodelled and the assumption is that the previous modelling is still applicable as the waste rock dump is not increasing in size. At the plant area, the waste rock dump pollution plume was modelled for 50 years and the plume was predicted to move in a southerly direction reaching the southern edge of the proposed solar plant area.

As discussed in the geology baseline section (Section 7.4.1.2), the tailings and waste rock are considered to be non-acid forming and were indicated to have negligible potential to mobilise metals. Although acid production and metals mobilisation may not occur, the sulphide content may be sufficient to produce some soluble sulphates under oxidising conditions. This may increase the sulphate concentration in water that comes into contact with the tailings if there is not sufficient buffering capacity. Mobilisation of other, non-pH dependent contaminants such as salts, is also possible. These manifest as increased electrical conductivity from increased salt loads. In the unmitigated scenario, artificial recharge is predicted to occur under the TSF thus, any potential contaminant emanating from the TSF will potentially migrate downstream.

A mass transport simulation was carried out to predict the direction and receptor area of any potential plume. A transport simulation run for 100 years was assumed. A recharge source term was used at 100 % of the contaminant concentration. Up to 45 % of the initial source concentration is predicted to reach the weathered aquifer underneath the TSF footprint. Based on groundwater modelling, the pollution plume is predicted to travel south-south east from the TSF towards the Elands River. It is predicted that a pollution plume with a concentration of 500 mg/l of sulphate (drinking water guideline limit in terms of SANS: 241 (2015)) will extend approximately 112 m south-south east from the TSF. The Elands River is not predicted to be impacted by potential contamination from the TSF.

The plant area has a higher rate of hydraulic conductivity than the TSF area. Potential contaminants to the groundwater can therefore migrate faster in these areas. Potential contaminants that could arise from the plant area can include untreated sewage, spilled tailings along the pipeline route, spilled hydrocarbons and chemicals and polluted water.

For this project, the severity for the unmitigated scenario is considered to be high with mitigation this decreases to medium.

When considering this impact cumulatively with the approved operations, the severity rating for the overall mine is high in the unmitigated scenario and reduces to medium in the mitigated scenario

Duration

In the unmitigated and mitigated scenarios, the potential pollution and in turn the potential for health impacts on third party water users could extend beyond the life of the project.

Spatial scale / extent

Unmitigated groundwater pollution impacts are likely to extend beyond the project boundaries. This is a medium spatial scale. With mitigation, groundwater pollution impacts will be minimised or prevented through appropriate design of facilities such as the TSF and undertaking good housekeeping in the operations on site. The spatial scale in the mitigated scenario therefore reduces to low.

Consequence

For the unmitigated scenario the consequence is high. With mitigation this decreases to medium.

Probability

The probability of the impact occurring relies on a causal chain that comprises three main elements:

- Does contamination reach groundwater resources?
- Will people and animals utilise this contaminated water?
- Is the contamination level harmful?

The first element is that contamination reaches the groundwater resources underneath or adjacent to the proposed project area. Due to the proximity of the sources to shallow aquifer systems and the possibility that there could be artificial recharge under the TSF (unmitigated) (thus increasing water levels), contaminants could reach groundwater resources.

The second element is that third parties and/or livestock use this contaminated water for drinking purposes. There are boreholes on Frischgewaagd and Mimosa used for monitoring. Domestic, agriculture and irrigation boreholes are present in Ledig and Phatsima. During the hydrocensus conducted for the updated modelling, boreholes identified on site were indicated to only be for monitoring. No third party boreholes are known to be located within the potential contamination plume zone.

The third element is whether contamination is at concentrations which are harmful to users. The monitoring taking place on site indicates that there are several contaminants that have been identified in the groundwater likely attributed to the populated areas. The baseline groundwater quality in the area was generally good with most of the water samples fit for human consumption. Therefore, should there be contamination; there will be a deterioration of water that is mostly fit for human consumption. The conservative approach is to assume that contaminants could be harmful to users.

Based on the above, the probability of the impact occurring for the unmitigated scenario is high. With mitigation measures implemented, that intercede pollution plumes, the probability decreases to low.

Significance

In the approved mine EIA, the significance of the impact was rated as low and moderate for the plant area during construction and operations respectively. With mitigation this decreased the rating to very low and low. For the TSF the significance was rated as high. Following mitigation this decreased to moderate. It should be noted in the approved mine EIA, a liner under the TSF was not required and was not part of mitigating the impact.

In the approved housing BAR the significance of groundwater pollution was considered to be low with mitigation measures implemented.

When considering the project's impact cumulatively with the approved operations, and that the TSF will now be constructed with an appropriate barrier system, the significance for the unmitigated scenario is high and with mitigation it decreases to low.

Tabulated summary of the assessed impact

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	H	H
Mitigated	M	H	L	M	L	L

AIR QUALITY

ISSUES: AIR POLLUTION

Information in this section was sourced from the air quality assessment report conducted by Airshed (2016).

Introduction

There are activities/infrastructure in all phases that have the potential to generate dust and gaseous emissions. The more significant pollutants associated with mining related operations are TSP and inhalable particulate matter less than 10/2.5 microns in size (PM10 and PM2.5). In both the construction and decommissioning phases, these activities will be temporary in nature, usually lasting from a few weeks to a few months. The operation phase will present more long term sources of dust as well as gaseous emissions from vehicles and the ventilation shafts. As the concentration of gasses released by vehicle tailpipe emissions are expected by the specialist to be negligible, these are not discussed further below. The 2016 air quality study assessed the cumulative impact of the full operations of the site (approved and proposed). Therefore, the impact assessment information from the approved mine EIA and housing BAR has not been considered in the impact assessment below.

Air pollution related impacts on biodiversity have been discussed in the biodiversity impact assessment above and therefore this section focuses on the potential for human health impacts.

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Civil works Earthworks Mining and mining related activities Waste rock management Transport systems	Mining and mining related activities Waste rock management Mineral processing operations Tailings management Power Supply and Use Transport systems Housing	Mining and mining related activities Waste rock management Mineral processing operations Tailings management Power Supply and Use Transport systems Housing Demolition Rehabilitation	Maintenance and aftercare

Rating of impact

<u>Severity / nature</u>

The most significant source of $PM_{2.5}$ and PM_{10} emissions are the ventilation shafts (activities include: drilling and blasting, waste removal and handling, ore removal and handling, vehicle entrained dust and exhaust emissions from vehicle travelling on unpaved roads) and the most significant sources of TSP emissions are crushing and screening. The second most significant source of $PM_{2.5}$ and PM_{10} emissions is crushing and screening and the second most significant source of TSP emissions are the ventilation shafts. The least significant source of $PM_{2.5}$, PM_{10} and TSP emissions is surface vehicle exhausts. For underground and plant vehicle exhaust emissions, the simulated diesel particulate matter (DPM), CO, SO_2 and Volatile organic compound(s) (VOC) concentrations are not expected to exceed the NAAQ limits. The hourly NO_2 concentrations could exceed the NAAQ limit, but for an annual average it is unlikely to exceed the NAAQ limit.

It is predicted under simulated scenarios that the limit for $PM_{2.5}$ and PM_{10} of the TSF will not exceed the annual concentration threshold or the allowable annual exceedances. The TSF is not considered to be the main source of emissions on site and thus its proximity to Ledig and Phatsima is not considered by the specialist as a high impact in terms of air quality.

In the construction and closure phase for the unmitigated scenario, the activities (approved and proposed) are expected to have a moderate deterioration for $PM_{2.5}$ and PM_{10} as the recommended daily NAAQ limit will occasionally be exceeded. For dustfall the deterioration is expected to be low. The specialist indicated that the recommended residential limit is unlikely to be violated. The unmitigated operational phase is expected to have substantial deterioration for air quality for $PM_{2.5}$ and PM_{10}. For dustfall, SO_2, NO_2, CO, DPM and VOCs the expected deterioration is low. With mitigation measures implemented the severity for construction will decrease to low for PM_{10} and dustfall. With mitigation in the operational phase, the severity will decrease to low for PM_{10} and dustfall but remains high for $PM_{2.5}$.

In terms of simulated health impacts, the construction phase will be less significant than the overall operational activities as construction related activities are temporary in nature. For the unmitigated operational phase, the $PM_{2.5}$ daily average concentration exceeds the NAAQ limits of 40 µg/m³ for more than 4 days per year at the south eastern section of Ledig, the Gabonewe Housing Estate and off-site (i.e. just off the property boundary). Over an annual average there are no expected exceedances. For the mitigated scenario, there is still an exceedance for daily $PM_{2.5}$ concentration at the Gabonewe Housing Estate and slightly off-site.

Overall the severity for the unmitigated scenario is high and with mitigation it decreases to low except for $PM_{2.5}$ which stays high.

<u>Duration</u>

While the sources of the impacts will last for the project life, in both the unmitigated and mitigated scenario, if human health impacts occur these are potentially medium to long term in nature.

<u>Spatial scale / extent</u>

The spatial scale of the potential impact is directly related to the spatial scale of the dispersion of any air pollution that has the potential to cause human health impacts. In the unmitigated scenario, the potential impacts extend beyond the site boundary. With mitigation, impacts remain mainly within the site boundary except for $PM_{2.5}$ that extends to parts of Gabonewe Housing Estate and slightly off-site.

Consequence

For the unmitigated scenario the consequence is high and with mitigation it is medium to low, except for $PM_{2.5}$ which is medium to high.

Probability

Whether the predicted air pollution will result in human health impacts depends on the extent of the pollution plume, the concentration of the different pollution components, and the exposure of receptors to exceedances of the relevant evaluation criteria.

The probability of the exceedances of the selected criteria off-site and at sensitive receptors without mitigation is possible. With mitigation, the probability for $PM_{2.5}$ is possible to unlikely as the ventilation shaft emissions which are the contributor to exceedances off-site and at the Gabonewe Housing Estate are not likely to be the same as the total PM emissions as has been assumed in the model. If suitable mitigation can be implemented during the design phase to decrease $PM_{2.5}$ levels (e.g. shaft vent position, orientation, height or other suitable measures), the probability of exceedances could decrease to low. For PM_{10} and dustfall the exceedance is possible.

Significance

When considering the approved and proposed project cumulatively, for the unmitigated scenario the significance is high. For the mitigated scenario, it is medium for dustfall and PM_{10} and low to medium for $PM_{2.5}$ (provided adequate mitigation measures are implemented to decrease $PM_{2.5}$ during the design phase). The range in significance for $PM_{2.5}$ is due to the conservative assumptions used for the modelled predictions. In this regard the ventilation shaft emissions which are the contributor to $PM_{2.5}$ exceedances off-site and at the Gabonewe Housing Estate are not likely to be the same as the total PM emissions as has been assumed in the model.

Tabulated summary of the assessed impact

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	M	H
Mitigated	L (PM_{10} & Dustfall) H ($PM_{2.5}$)	H - M	M	M - L (PM_{10} & Dustfall) H- M ($PM_{2.5}$)	M (PM_{10} & Dustfall) L ($PM_{2.5}$)	M (PM_{10} & Dustfall) M -L ($PM_{2.5}$)

NOISE

ISSUES: NOISE POLLUTION

The information for this section was sourced from the approved mine EIA and housing BAR and the updated noise impact assessment conducted for the project by JKA (2016).

Introduction

Based on noise monitoring surveys, noise emissions from the activities in the surrounding areas and at the mine do contribute to the general ambient noise in the area (Section 7.4.1.9). The project components present the possibility of generating additional noise disturbances and noise nuisances in all project phases as outlined in the table below. The cumulative impact of the approved and proposed project is assessed below.

The Noise Impact Assessment conducted for this project considered the cumulative impact of this project and the approved project, as it was indicated to not be meaningful to calculate incremental noise impact in isolation. This is due to the fact that cumulative impact of noise is calculated on a logarithmic scale, not a linear scale. The specialist did provide information on the incremental impact to discuss the additional noise that will be generated by the project. Based on this, only the current assessment is considered below as it has considered the cumulative impact already.

The noise impact assessment conducted for the approved mine EIA (TWP, 2008) indicated the anticipated daily traffic generated by the site during operations will be insignificant compared to anticipated daily traffic on the external main road system. The 2016 noise impact assessment also indicated that additional traffic volumes for this project are not expected to add significantly to noise pollution of the project. Therefore, the noise pollution from traffic is not specifically assessed below.

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks Civil works Waste rock management Transport systems	Transport systems Waste rock management Mineral processing operations Tailings management Mining and mining related activities Tailings management	Transport systems Tailings management Demolition Rehabilitation	Maintenance and aftercare activities - negligible

Rating of impact

Severity / nature

The severity of the noise impacts related to the construction phase of this project will mainly be a nuisance in nature and at times there may be loud short-term noises. The construction of the additional infrastructure will not increase the total construction noise footprint significantly. The cumulative severity is rated as medium. The construction operations are unlikely to exceed 70 dBA at the closest noise receptors. There could be some nuisance effects from intermittent loud noises on people living on the eastern periphery of the urban area. No major noise impacts are anticipated in Phatsima Village. Reagile informal settlement may be slightly affected by the construction activities of the tailings and return water pipelines to the TSF.

For the operational phase, the additional elements will have a low noise severity and will not have a perceptible increase above the approved operations. In the unmitigated scenario, the predicted increase in noise levels is by 0.6 dBA at the Shaft Complex, a 1.7 dBA at the Concentrator Plant, and the additional traffic is not anticipated to have a significant increase in noise. The severity of the impact is also dependent on the distance of the receptor from the activity; the closer the receptor the higher the severity. The Gabonewe Estate mine housing and the south eastern edge of the Ledig Village are the closest receptors and fall within the 50 dBA noise contour.

The noise from the pumps at the TSF is not expected to be problematic at noise sensitive sites more than 300 m from a pump station. Residents in Phatsima Village Reagile informal settlement are unlikely to be negatively affected by the noise. It is unlikely that there will be a noise disturbance for the residents on the farms to the south of the Elands River as well as the livestock and game (where relevant) on these farms. However the character of the noise climate will alter in some parts of these southern areas that lie close to the TSF.

Looking at the cumulative impact, the severity for the unmitigated scenario and mitigated scenario is medium.

It is important to note that the severity of the noise impact will decrease with increasing distance from the source of the noise.

Duration

The duration of the noise pollution impact will last for the life of the project for the mitigated and unmitigated scenario.

Spatial scale / extent

In both the unmitigated and mitigated scenarios, the noise impacts extend beyond the site boundaries to the nearest noise sensitive receptors. This is a medium spatial scale.

Consequence

For the unmitigated and mitigated scenario the consequence medium.

Probability

In the unmitigated scenario, the probability of noise related impacts is definite (though this is dependent on the distance of receptors from noise generating activities). For the mitigated scenario the probability decreases to medium.

Significance

Cumulatively, the significance of the approved operations and proposed project is medium without mitigation and with mitigation it stays medium. While the significance may be unchanged from the unmitigated scenario, the mitigation will decrease the likelihood of the impact occurring. The significance with mitigation is unchanged from the approved project.

Tabulated summary of the assessed impact

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	M	M	M	M	H	M
Mitigated	M	M	M	M	M	M

BLASTING

ISSUE: BLASTING IMPACTS

Discussion

This project does not deal with underground mining activities, which formed part of the approved project. No additional areas will be mined and there are no changes to approved underground mining activities. Therefore no additional blasting and vibration impacts were identified. The information contained in the approved mine EIA is still applicable to the approved operations. Blasting was considered in the emissions inventory of the Air Quality Impact Assessment due to the addition of ventilation shafts; refer to the Air Quality Impact Assessment above. The management measures and monitoring requirements for blasting and vibrations as provided in the approved mine EIA have been included in the EMP section of this EIA and EMP report, refer to Section 28, for completeness.

TRAFFIC

ISSUE: ROAD AND TRAFFIC DISTURBANCE

The information for this section was sourced from the TIA conducted by WSP, 2016.

Introduction

Traffic will be generated in all phases of the project when trucks, buses, and private vehicles make use of the public and internal transport network in and adjacent to the mine. The key potential traffic related impacts are on road capacity. These are assessed below.

Public safety has not been specifically assessed as the traffic specialist indicated that these are expected to be limited as the majority of mine generated pedestrians is expected to be generated by the Gabonewe Estate and will therefore travel along the internal road network and not along highly trafficked public roads. Recommendations regarding pedestrian safety however were provided and are included in the EMP in Section 28. All safety mitigation measures from approved mine EMP have also been incorporated in the EMP in Section 28.

Traffic impacts are expected from construction through to the end of the decommissioning phases when trucks, buses, and private vehicles make use of the private and public transport network in and adjacent to the proposed project area. The closure phase will have minimal traffic impacts and will mainly involve travel for maintenance and aftercare. Since the approved mine EIA there have been changes that have had an influence on traffic. This includes changes to mine access from two access points to one and plans for new mine housing. With these changes and since it is difficult to quantify the changes in traffic that are specific only to this project, the 2016 traffic study assessed the cumulative impact of the full operations of the site (approved and proposed). Therefore, the impact assessment information from the approved mine EIA and housing BAR has not been considered in the impact assessment below.

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure
Transport systems	Transport systems	Transport systems	Transport systems

Rating of impact

<u>Severity / nature</u>

The full mine and project-related traffic will include transport on internal mine roads and transport on external public roads. The transport on external roads will include transport of staff during construction and operation, mine and plant equipment during construction, wet concentrate slurry which will be transported to a nearby platinum smelter for further processing and deliveries and collections from site including waste collection. There will also be minimal travel to the TSF site.

During the AM peak hour the impact of the additional mine traffic (approved project and this project) at the intersection of the R565 and the R556 will be moderate, whereas during the PM peak hour the impact will be low. The recommended operating level will be violated on a number of movements during AM and PM peak hours. For the PM peak hour, these movements are operating at critical levels of service under existing traffic conditions and the additional impact is not considered to be significant. The impact is therefore medium without mitigation. With the implementation of mitigation of changing the intersection, the severity becomes high positive as the mitigation improves the current situation.

It should be noted that the LOS of the roads will be LOS F even without the mine, though the mine will contribute to the lowered LOS.

Duration

The impact of the additional mine traffic (approved project and this project) will continue as long as the mine is operational. During the decommissioning and closure phases it can be expected that the traffic impact of the mine will reduce and eventually discontinue. The duration of the impact is therefore medium term for both the mitigated and unmitigated scenarios.

Spatial scale / extent

The impact of the additional mine traffic (approved project and this project) will be fairly widespread and be beyond the project area. The spatial scale is medium in the unmitigated and mitigated scenarios.

Consequence

The consequence will be medium for the unmitigated scenario though it will be high positive for the mitigated scenario as the mitigation measures will improve the current and projected traffic conditions.

Probability

In the unmitigated scenario, the probability of the mine negatively impacting the surrounding road network is high. The mine will be the source of a large number of employment opportunities and a large number of daily commuters are expected. With mitigation that caters for improvements in road capacity, the probability of the mine positively impacting the surrounding road network is high positive.

Significance

The significance of the impact of the additional mine traffic is medium negative in the unmitigated scenario. The mitigation measures of introducing a roundabout and adding another approach lane to the north-eastern approach, separating the through and right turning movements, in the opinion of the specialist, will fully mitigate the negative impact of the mine traffic and will improve the service levels to above the existing levels. With mitigation this is a high positive significance.

Tabulated summary of the assessed impact

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	M	M	M	M	H	M
Mitigated	H+	H	M	H+	H+	H+

VISUAL

ISSUE: NEGATIVE VISUAL IMPACT

For the approved mine EIA a specialist study was conducted by MetroGIS (Pty) Ltd (2007). This information has been updated by SLR for the purposes of this study.

Introduction

Visual impacts will be caused by activities and infrastructure in all project phases. These activities will be visible, to varying degrees from varying distances around the mine site. The construction period will involve the construction of the rest of the approved infrastructure as well as the additional/changed infrastructure as part of this project. Impacts are expected during the operational phase as the development of the TSF advances. In addition, there will be the remaining TSF at mine closure.

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Civil works Earthworks Mining and mining related activities Waste rock management	Mining and mining related activities Waste rock management Mineral processing operations Tailings management Housing	Demolition	Maintenance and aftercare of final land forms and rehabilitated areas

Rating of impact

<u>Severity / nature</u>

The severity of visual impacts is determined by assessing the change to the visual landscape as a result of mine and project related infrastructure and activities. In the approved mine EIA report the severity of the visual impact was rated as severe for the construction and operational phases. The approved housing BAR did not assess the visual impact.

When considering the potential change to the visual landscape as a result of the project components the key issues are visual exposure, visual intrusion, and sensitivity of receptors. Each of these is discussed further below, taking into consideration how this project adds to the approved project as if all the approved facilities already existed. Consideration of the tailings and return water pipelines was included in the assessment of the previous visual study, however since it did not form part of the approved mine EIA it is considered below.

In the unmitigated scenario for the infrastructure as part of this project:

- None of the new/changed infrastructure is expected to be higher than approved infrastructure with the approved mine shaft head gear being the most prominent feature at approximately 82 m in height. The new TSF height will be 4 m less than the approved height, though the additional footprint adds to the visual intrusion and thus is as significant as the vertical dimension. The visual intrusion of the additional/changed infrastructure will be low because the infrastructure will be absorbed by approved mining activities, will not change the already assessed landscape character of the area and will result in only minor changes to a few key views (when considering all the approved infrastructure already built).
- Visual exposure is the extent to which project infrastructure and activities will be visible. It follows that the closer the infrastructure and activities, the greater the visual exposure. The main new/ changed project components that will influence the visibility of the mine are the larger TSF (footprint increasing by 36 ha but height decreasing by 4 m), the tailings and return water pipeline, the relocated crusher above ground, the solar plant (height assumed to be equal or less than average building height), the Phase 1 (not assessed previously) and Phase 1a housing, and larger stockpiles. A turf stockpile berm has already been constructed between the plant area and the south eastern edge of Ledig (Lekwadi) and a noise berm has been constructed between the plant and Phase 1 mine housing aiding in decreasing the visual impact. The approved operations will mostly shield the remaining project components. Views from local roads, communal grazing areas and local residences will present the greatest visual exposure. Overall the infrastructure will form part of the mine structures and contribute to the overall visibility of the mine. The visibility is therefore regarded as moderate
- Sensitivity of receptors relates to the way in which people will view the visual intrusion. In this regard it is anticipated that receptors west of the TSF, and west, north and south east of the plant will be highly sensitive due to increased change in views and these areas having been the identified sensitive receptors in the approved EIA and EMP. The receptors include Sun City, tourists travelling on the R565 and R556 (very high sensitivity) as well as residents in Ledig, Phatsima and Chaneng (high sensitivity).

The project components will have a low severity visual impact because this infrastructure will be absorbed into the overall mine infrastructure.

When considering this impact cumulatively with the approved operations, the severity rating for the overall mine in the unmitigated scenario is high. With mitigation, that focuses on designing and implementing measures where the TSF side slopes can be rehabilitated during the operational phase (concurrent rehabilitation) and tree lines are planted between the TSF and closest receptors, the severity rating for the overall mine is high to medium depending on the effectiveness of rehabilitation measures.

<u>Duration</u>

The duration of this impact is expected to be long-term for all project phases in the unmitigated scenario because the impacts will extend beyond the life of the project. In the mitigated scenario, the duration will be reduced to the life of the project, and only the rehabilitated TSF will remain after closure, which, if correctly rehabilitated, will not be associated with negative visual impacts.

Spatial scale / extent

In all phases, visual impacts are likely to extend beyond the site boundary. This is a medium spatial scale in both the unmitigated and mitigated scenarios.

Consequence

The unmitigated consequence is high and reduces to high - medium in the mitigated scenario.

Probability

The unmitigated probability is high in all the phases. With mitigation, the probability is low with effective rehabilitation measures.

Significance

In the approved mine EIA, the significance of the visual impact was rated as high for the plant area and moderate for the TSF during construction. For the operational phase the TSF rating increased to very high as it increases in size. In this project, the waste rock dump will not remain on site as waste rock will either be sold as aggregate or if any waste rock remains it will be backfilled into the shaft.

When considering the project's impact cumulatively with the approved operation, the significance rating for the overall mine is high in the unmitigated scenario and reduces to medium with mitigation.

Tabulated summary of the assessed impact

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	H	H
Mitigated	H-M	M	M	H-M	L	M

HERITAGE/CULTURAL AND PALAEONTOLOGICAL RESOURCES

ISSUE: LOSS OF HERITAGE/CULTURAL AND PALAEONTOLOGICAL RESOURCES

The information is based on the heritage study conducted by PGS (2016).

Introduction

The project has the potential to damage heritage resources and result in the loss of the resource for future generations. Heritage resources include sites of archaeological, cultural or historical importance. The more significant of these are expected to occur during the construction and operational phases when most of the project infrastructure will be established on site. No impacts are expected to occur during the decommissioning and closure phases however the potential for uncovering new heritage resources during the operational and decommissioning phases does exist.

As discussed in the heritage baseline section, 7.4.1.11, the project area has no significant/zero palaeontological significance.

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure
			N/A
Site preparation Earthworks Transport systems Housing Site/contract management	Tailings management Transport systems Housing Site/contract management	Tailings management Transport systems Housing Site/contract management Demolition Rehabilitation	

Rating of impact

Severity / nature

In the approved mine EIA the significance was indicated to range between severe and very severe depending on the mine phase and specific activity of the project. There is no distinction made between a mitigated and unmitigated scenario. The housing BAR did not identify any additional heritage resources and thus did not assess heritage resources.

Heritage resources that will be impacted by the positioning of project-related infrastructure include graves and cemeteries which are considered to have high significance. While there are sites that were identified to have low and medium significance, cumulatively the severity of destruction to the sites on site without mitigation is high. With mitigation measures implemented the severity can decrease to medium and low depending on the resource.

Duration

Should there be an impact to the resources identified, the impact would be permanent and is thus classified as high. With mitigation involving relocation or preservation of resources, the social significances of a site can be retained and some value can be re-instated, though the impression of the value might not stay the same. With mitigation, the duration is medium to high, depending on the resource.

Spatial scale / extent

The actual loss of the resource will occur within the site boundary, though with some of the identified heritage sites, the impact can occur beyond the site boundary with and without mitigation as there is the loss to the history of the area and the loss can be felt by outside the site boundary.

Consequence

For the unmitigated scenario the consequence is high. With mitigation measures implemented this can decrease to low to high.

Probability

In the unmitigated scenario, the loss of heritage resources will be definite. With mitigation, the probability can decrease to low where graves will be relocated and the information within heritage sites preserved through further investigation, sample collection and record keeping. For the sites identified in the buffer of the magazine area these will only be impacted if there is an accidental explosion, which is unlikely.

Significance

In the approved mine EIA the significance was indicated to range between moderate and very high to moderate positive depending on the mine phase and specific activity of the project.

When considering the project's cumulative impact, in the unmitigated scenario the significance of the impact is considered high. With the implementation of mitigation measures, the significance decreases to low to medium depending on the heritage resource impacted.

Tabulated summary of the assessed impact

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	H	H
Mitigated	L-M	M-H	M	L-H	L	L-M

SOCIO-ECONOMIC

ISSUE: INWARD MIGRATION AND ASSOCIATED ILLS

Information in this section was sources from the Social Impact Assessment that was conducted by Kerryn Desai (2016) and the approved mine EIA and housing BAR.

Introduction

Mining projects tend to bring with them an expectation of employment in all project phases prior to closure. This expectation can lead to the influx of job seekers to an area which in turn increases pressure on existing communities, housing, basic service delivery and raises concerns around safety and security. The approved EIA and EMP assessed influx, development of informal settlements, and health risks separately. The approved BAR discussed skills development. The assessment below considers these aspects together, focusing on the potential for the inward migration and associated social issues.

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure
			N/A
Construction of project components	Operation of the mine	Decommissioning of project components	

Rating of impact

<u>Severity / nature</u>

In the approved mine EIA the severity linked to influx ranged from severe (all related aspects for construction and operation) to very severe (decommissioning phase and the related establishment of informal settlements impact).

For the project components, there will be some short term employment opportunities during construction but no additional employment during operation. The project components will be undertaken as an extension of the approved mining operations. Contractors will also be used where required. The potential exists for inward migration of people seeking employment and the associated social issues and pressures. According to the social specialist (Desai, 2016), as a worst-case scenario, these changes can increase levels of crime/ theft, drug and alcohol abuse, increase the incidence of sex work, spread of sexually transmitted diseases (STDs), domestic violence, and general unrest due to increased competition. The relative size of the project compared to the already approved mine will not increase the level of social ills linked to the influx of workers and job-seekers already assessed in the approved EIA and EMP. The severity for the proposed project will therefore be low in the unmitigated and mitigated scenario.

In terms of pressure on housing and basic service delivery, the approved housing BAR and this project makes provision for housing facilities. The approved housing BAR indicated that this provision relates to one of the demands made by miners during the 5 month protracted strike in 2014, for adequate social facilities (including housing) to be provided. As this contributes to alleviating pressure on housing, the related severity is considered to be positive in both the unmitigated and mitigated scenarios.

When considering this impact cumulatively with the approved operations, the severity rating for the overall mine will be high, mainly due to the size of the workforce required for the approved mine. With mitigation, it can be reduced to medium.

Duration

In the normal course, social impacts associated with each phase of the project will occur for the life of the project, but negative social issues associated with inward migration can continue beyond the closure of the mine, particularly in the unmitigated scenario.

Spatial scale / extent

In both the unmitigated and mitigated scenarios, the impacts of inward migration and associated social ills could extend beyond the project areas into surrounding communities.

Consequence

In the unmitigated and mitigated scenario the consequence associated with inward migration and associated social ills is high.

Probability

The probability of influx and related impacts is possible. With mitigation, impacts associated with inward migration are considered to be less likely, but they are unlikely to be eliminated.

Significance

In the approved mine EIA the influx and development of informal settlements was considered to be high. For the increased health risks the impact was considered to be moderate to high prior to mitigation and moderate with mitigation. For this project's components, a significant change to the influx of workers and the associated social ills is not expected. The approved housing BAR did not discuss impacts relating to influx and associated social issues.

When considering the approved mine EIA and housing BAR and this project's components cumulatively, the significance is considered high without mitigation and with mitigation it reduces to medium.

Tabulated summary of the assessed impact

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						

Unmitigated	H	H	H	H	M	H
Mitigated	M	H	H	H	L	M

ISSUE: CHANGES TO TOURISM

Discussion

The approved mine EIA assessed the impact that the project will have on tourism and indicated that the significance would be low for the unmitigated scenario and very low for the mitigated scenario. The approved mine EIA and 2016 SIA (Desai, 2016) indicated that tourism has been increasing in the area and tourism is likely to continue as it has done despite the increases in mining.

The components of this project are not expected to contribute significantly to changes in tourism as changes are mainly within project footprints and are related to the already approved operations. The approved mine impact assessment for tourism is thus considered to still be applicable.

The mitigation measures that link to the above impacts from the approved mine EIA have been incorporated into the EMP in Section 28 for completeness.

ISSUE: ECONOMIC IMPACT

Information in this section was sources from the Social Impact Assessment that was conducted by Kerryn Desai (2016) and the approved mine EIA and housing BAR.

Introduction

Mining projects in general have the potential to impact on the economy both positively through potential growth in the mining sector and job and income creation and negatively through the potential loss of existing economic activities. The approved mine EIA assessed direct and indirect employment impacts separately and the approved housing BAR assessed direct employment.

For the loss of pre-mining economic activities, in terms of the approved mine footprint, it is assumed that as part of the land purchase/lease agreements fair market price was/is being paid for the land and therefore any potential negative economic impacts associated with the loss of land are compensated for and are not considered further in this assessment. Land along the pipeline route is considered a communal resource (Desai, 2016) and therefore the loss of this land for community grazing is assessed in the land use impact assessment section and does not form part of the economic assessment below.

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure
			N/A

Construction	Operational	Decommissioning	Closure
			N/A
Construction of project components	Operation of the mine	Decommissioning of project components	

Rating of impact

Severity / nature

In the approved mine EIA, the severity of positive socio-economic impacts associated with the approved operations was rated to be beneficial. There was no distinction made between the unmitigated and mitigated scenarios. The approved housing BAR did not specify severity in relation to socio-economic impacts.

As part of the approved operations, the mine is expected to generate employment for 3130 personnel (at full production) and the construction of the Phase 1 mine housing will create 200 jobs, though only 25 would remain as permanent jobs. The approved operations will also contribute towards local economic growth through revenue on sale of platinum which contributes to broadening tax bases, and local and regional spending on services and infrastructure/equipment.

This project comprises a number of changes to the approved mine operations which will result in the inclusion of additional minerals (aggregate), increased mineral processing capacity, additional housing and increased Life of Mine of an additional two years. As a result the project components could have the following negative and/or positive impacts:

- employment for local communities – although this will be limited to approximately 570 additional construction phase jobs and no additional operational phase jobs. While there will be no additional operational phase jobs, some of these will be sourced from existing Bakubung workers thereby ensuring continuation of employment;
- provision of additional housing for mine employees;
- additional benefit to the local and regional economy through additional spending and income from sale of another mineral (waste rock as aggregate) and increased capacity of the concentrator plant by 15%;
- additional impact on land value of properties surrounding the project – additional mine development could be perceived to be a negative impact; and
- impacts on livelihoods of community who make use of immediately surrounding land.

Although the mine housing is removing land with agricultural potential it is contributing to housing provision in the area. The approved BAR indicated that this provision relates to one of the demands made by miners during the 5 month protracted strike in 2014, for adequate social facilities (including housing) to be provided. The housing was seen as a benefit as there would be employment generated, affordable housing needs would be partially addressed, and the tax base of the local municipality would be broadened.

The development of the project components which increases the economic benefits of the mine and does not require additional land to be purchased and/or leased will therefore have a moderate positive severity until closure. This positive impact may be enhanced with the implementation of management and mitigation measures. After closure, the positive economic impact from mining will cease but with rehabilitation, the respective pre-mining activities can resume in appropriate areas.

When considering the approved and proposed project aspects cumulatively, the severity rating for the overall mine is medium high positive in the unmitigated and high positive in the mitigated scenario

Duration

The positive economic impacts described above will be limited to the life of project. After closure there may still be some positive impacts through maintenance and aftercare activities.

Spatial scale / extent

The positive economic impacts will be far-reaching in both the unmitigated and mitigated scenarios for all project phases until closure.

Consequence

The consequences for the mitigated and unmitigated scenarios are high positive.

Probability

The probability is considered to be high in both the unmitigated and mitigated scenarios for all project phases until closure.

Significance

The approved mine EIA rated the significance as being high to moderate high before mitigation and high after mitigation.

The approved housing BAR rated the significance of employment (and skills development) as medium to high (it is assumed to be positive based on the impact description).

When considering the cumulative significance of the approved projects and this project, the significance is high positive.

Tabulated summary of the assessed impact

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	M–H+	M	H	H+	H+	H+
Mitigated	H+	M	H	H+	H+	H+

LAND USE

ISSUE: LOSS OR CHANGES TO EXISTING LAND USE

The information for this section was sourced from approved EIA and EMP as well as specialist studies including the social impact assessment (Desai, 2016) and the heritage impact assessment (PGS, 2016).

Introduction

There are project related activities and infrastructure that may have an impact on other land uses in all project phases. This section focuses on potential impacts affecting land use on and surrounding the project sites.

When considering impacts on land use, consideration needs to be given to the range of environmental impacts that could occur as a result of the project. These include: groundwater, noise, visual, air, traffic, heritage, soils, and socio-economic. With this in mind, the main activity that could have an impact on existing land uses is the development of the project components together with the operation of the approved mine as a whole. These activities will continue for the planned life of the mine. At closure, final land forms (TSF) will remain on site in perpetuity. This section focuses on the potential loss and/or change of the land uses.

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure
Construction of project components	Operation of the mine	Decommissioning of project components	Final land forms

Rating of impact

Severity / nature

The approved mine EIA rated the severity of changes in land use to be severe for the construction and operational phases, with land returning to wilderness or grazing status post closure. A rating for the mitigated scenario was not indicated.

The project area is located in an area where mining is a dominant land use inter-mixed with agriculture, tourism and residential land use type activities. Apart from the tailings and return water pipeline footprint, the placement of infrastructure is within areas already approved for mining. The area where the TSF is located is owned by Wesizwe which was purchased from the RLM. BPM is allowing grazing to continue on the property until the TSF is constructed. Locating or allocating alternative grazing land falls within the RLM's responsibility. The area where the tailings and return water pipelines are to be constructed is communal grazing land, this land use can continue with the development of the pipelines, though there will be a reduction of available area from the servitude development.

When considering surrounding land uses, these land uses may be affected by one or more of the following potential environmental and social impacts: hazardous excavations and structures, disturbance of biodiversity, surface and groundwater quality and quantity, dust generation, increase in traffic, noise pollution, visual and negative socio-economic impacts. These impacts would primarily be experienced by the residents of the nearest villages, any nearby grazing areas as well as travellers on the surrounding roads. In this regard, the severity of the project's unmitigated potential impacts on the surrounding non-mining land uses is medium. With mitigation that is focused on prevention and/or controls for each environmental and social impact type, the severity reduces to low.

When considering the project's impact cumulatively with the approved operations, the significance rating for the overall mine is high in the unmitigated scenario reducing medium - low in the mitigated scenario.

Duration

In the unmitigated scenario, and using a conservative approach, land use impacts could be experienced after the life of mine. With mitigation, these impacts can be avoided and/or remedied within the life of the project.

Spatial scale / extent

The spatial scale extends beyond the mining footprint, in both the unmitigated and mitigated scenarios.

Consequence

The unmitigated consequence is high in all project phases. The mitigated consequence is medium to low in all the project phases.

Probability

In the unmitigated scenario, where environmental and social impacts are uncontrolled, the probability that land uses on and surrounding the project sites will be impacted by mining is definite. With mitigation, the probability reduces to medium prior to closure and low post closure.

Significance

When considering the project's impact cumulatively with the operations, the significance rating for the overall mine is high in the unmitigated scenario. With mitigation that is focussed on prevention and/or controls for each environmental and social impact type, the severity reduces to between medium and low for all phases except closure which will be low.

Tabulated summary of the assessed impact

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	H	H
Mitigated	M-L	M-L	M	M-L	M L (at closure)	M-L L (at closure)

APPENDIX G: COMPOSITE MAP

APPENDIX H: GROUNDWATER IMPACT ASSESSMENT REPORT

APPENDIX I: WATERCOURSE IMPACT ASSESSMENT REPORT

APPENDIX J: SOILS AND LAND CAPABILITY IMPACT ASSESSMENT REPORT

APPENDIX K: VEGETATION IMPACT ASSESSMENT REPORT

APPENDIX L: FAUNAL IMPACT ASSESSMENT REPORT

APPENDIX M: AQUATIC ECOLOGY IMPACT ASSESSMENT REPORT

APPENDIX N: NOISE IMPACT ASSESSMENT REPORT

APPENDIX O: TRAFFIC IMPACT ASSESSMENT REPORT

APPENDIX P: SOCIO-ECONOMIC IMPACT ASSESSMENT

APPENDIX Q: HERITAGE/CULTURAL AND PALEONTOLOGICAL IMPACT ASSESSMENT REPORT

APPENDIX R: AIR QUALITY IMPACT ASSESSMENT

APPENDIX S: CLOSURE COST ASSESSMENT

APPENDIX T: 2014 HOUSING EMP

APPENDIX U: TSF DESIGN REPORT

RECORD OF REPORT DISTRIBUTION

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