



Applicant: Impala Platinum Limited

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NO 18 SHAFT, TAILINGS BACKFILL AND SEWAGE TREATMENT PLANTS PROJECT

ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PROGRAMME AMENDMENT REPORT

**SUBMITTED FOR AN AMENDMENT OF A MINING
RIGHT IN TERMS OF SECTION 102 OF THE MINERAL
AND PETROLEUM RESOURCES DEVELOPMENT ACT,
2002 (ACT NO. 28 OF 2002) (the Act)**

AND

**AS REQUIRED IN TERMS OF REGULATION 385 OF THE
NATIONAL ENVIRONMENTAL MANAGEMENT ACT
(ACT NO. 107 OF 1998)**

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IDENTIFICATION OF THE REPORT

Herewith I, the person whose name and identity number is stated below, confirm that I am the person authorised to act as representative of the applicant in terms of the resolution submitted with the application, and confirm that the above report comprises EIA and EMP compiled in accordance with the guideline on the Departments official website and directive in terms of Sections 29 and 39(5) in that regard.

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NO 18 SHAFT, TAILINGS BACKFILL AND SEWAGE TREATMENT PLANTS PROJECT

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ACCRONYMS AND ABBREVIATIONS

Below is a list of acronyms and abbreviations used in this report.

Acronyms / Abbreviations	Definition
ABA	Acid Base Accounting
AER	Acceptable Environmental Risk
AP	Acid Potential
ARL	Acceptable Risk Level
BMR	Base Metal Refinery
BPDM	Bojanala Platinum District Municipality
Ca	Calcium
CEC	Cation Exchange Capacity
Cl	Chlorine
CIS	Computerized information system
CO	Carbon monoxide
CO ₂	Carbon dioxide
Cr	Chromium
DMR	Department of Mineral Resources
DWA	Department of Water Affairs
DWEA	Department of Water and Environmental Affairs
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
EMP	Environmental Management Programme
ERD	Effective Rooting Depth
ESS	Earth Science Solutions
GCS	Groundwater Consulting Services
HCs	Hydrocarbons
GGP	Gross Geographic Product
HR	Hazardous rating
IDW	Inverse Distance Weight
K	Potassium
Mamsl	Metres above mean sea level
MAP	Mean annual precipitation
MAR	Mean annual runoff
SLR	Metago Water Geosciences
NCO	Nature Conservation Ordinance
NO _x	Nitrogen oxides
MPRDA	Mineral and Petroleum Resources Development Act

Acronyms / Abbreviations	Definition
Na	Sodium
NAG	Net Acid Generating
NEMA	National Environmental Management Act
Ni	Nickel
NNP	Net Neutralising Potential
NCO	Nature Conservation Ordinance
NP	Neutralising Potential
NWU	North West University
PAH	Polycyclic Aromatic Hydrocarbons
Pb	Lead
PRECIS	National Herbarium Pretoria (PRE) Computerized Information System
PMR	Precious Metal Refinery
RMF	Regional Maximum Flood
PMR	Precious Metals Refinery
RP	Return periods
ROM	Run of mine
SANBI	South African National Botanical Institute
SANS	South African National Standards
SAR	Sodium Absorption Ration
SAWS	South African Weather Services
SO ₂	Sulphur dioxide
SO ₄	Sulphate
SPLP	Synthetic Precipitation Leaching Procedure
SVOCs	Semi-Volatile Organic Compounds
TDS	Total Dissolved Solids
VOC	Volatile Organic Carbons
WHO	World Health Organisation
WR	Water resources

EXECUTIVE SUMMARY

Introduction

Impala Platinum Limited (Impala) operates a platinum mining and processing operation near Rustenburg in the North West Province. The operation has an approved environmental impact assessment (EIA) and environmental management programme (EMP) report (SRK, August 1997) that has been amended numerous times to incorporate a range of expansion projects. A consolidated EMP has been compiled by SLR Consulting which consolidates all of the approved EMP documents. This document was submitted to the Department of Mineral Resources (DMR) and approved in 2013. Subsequent to this, an EMP amendment was submitted to DMR for the development of the No 5 and 6 Tailings storage Facility (TSF), and is pending approval. This TSF was approved by the Department of Economic Development, Environment, Conservation and Tourism (DEDECT) (Ref: NWP/EIA/58/2010).

Impala now plans to develop the following new projects:

- Development of No 18 shaft complex and associated linear infrastructure (during the initial stage of the EIA process it was mentioned that No 19 Shaft complex would also form part of this set of projects, but this has since been removed from the project scope)
- Development of three new sewage treatment plants and associated pipelines:
 - At the existing No 17 Shaft
 - At the proposed No 18 Shaft within the shaft bank
 - A new centralised plant close to the No 11C Shaft.
- The support of some mined out areas at No 17 and 18 shafts using backfill prepared from tailings from the processing plant. These shafts will each require a tailings treatment plant, to prepare the tailings for usage as support and ventilation barriers in mined out areas, as well as associated pipelines to convey tailings to the tailings treatment plants.

The proposed infrastructure is all located within Impala's existing converted mining rights areas. Underground mining from the proposed No 18 Shaft will take place in an area where the Impala/Royal Bafokeng Resources Platinum (Pty) Ltd and the Royal Bafokeng Nation currently holds prospecting rights. However, a section 102 application, together with the required section 11 transfer of rights applications, was lodged on 6 June 2013 to obtain ministerial consent to include the relevant prospecting right areas into the Impala converted mining rights areas adjacent thereto (CMR131MR) in terms of the MPRDA.

The project area falls within the Rustenburg Local Municipality and the Bojanala Platinum District Municipality in the North West province. The location of the project is outlined below.

TABLE 1: PROJECT LOCALITY INFORMATION

Location of project	
Province	North West Province
District	Bojanala Platinum District
Municipality	Rustenburg Local Municipality
Farms where surface infrastructure will be established	Klein Doornspruit 108 JQ Toulon 111 JQ Goedgedacht 114 JQ Vaalkop 275 JQ Welbekend 117 JQ Vlakfontein 276 JQ
Nearest towns	Rustenburg city centre lies approximately 18 km south of the project area
Nearest villages	Communities closest to the proposed No 18 Shaft site include: <ul style="list-style-type: none"> • Maile – approximately 5,5 km north-east of the site • Mogono (Luka North) – approximately 5 km south-west of the site • Chaneng, Robega and Rasimone – approximately 9,8 km west of the site • Diepkuil - approximately 5,7 km east of the site • Kopman – approximately 8,7 km north-east of the site • Mamerotse – approximately 11, 3 km east of the site. Communities closest to the proposed No 17 Shaft site include: <ul style="list-style-type: none"> • Serutube – approximately 1.3 km east of the site • Mafika – approximately 1.5 km south-east of the site • Tsitsing – approximately 7.8 km north-east of the site • Kanana – approximately 4.5 km south of the site • Luka South 9.8 km north-west of the site • Phokeng – approximately 11.5km south-west of the site
Catchment	The project area is located in the Limpopo Basin, in the catchment of the Crocodile River. The proposed No 18 Shaft falls within the A22F quaternary catchment.

Project motivation (need and desirability)

The proposed new vertical shaft complex is intended to replace production from older shafts that are reaching the end of their life. The development of the additional sections of the mine and other infrastructure will benefit society and the surrounding communities both directly and indirectly by ensuring the continued operation of the Impala Mine. Direct economic benefits will be derived from wages, taxes and profits. Indirect economic benefits will be derived from the procurement of goods and services and the spending power of employees.

New sewage treatment plants are needed to provide sewage treatment capacity in this part of the Impala converted mining rights area and to ensure that grey water produced can be used for mining.

The use of a tailings mixed with stabilisers and used as support in mine voids will assist with more effective ventilation and safer mining. There is also a waste management benefit in using tailings waste which will reduce the need for other support products.

Legal framework and environmental assessment process

Prior to the commencement of the project, environmental authorisation is required on the basis of an environmental assessment process. The projects incorporate material changes to the Impala infrastructure and activities, therefore authorisation is required from the DMR in terms of the Mineral and Petroleum Resources Development Act, 28 of 2002 (MPRDA). The project incorporates listed environmental activities, therefore authorisation is also required from the Department of Economic Development, Environment, Conservation and Tourism (DEDECT) in terms of the National

Environmental Management Act, 107 of 1998 (NEMA) and the Department of Environmental Affairs (DEA) in terms of NEM: Waste Act, 59 of 2008 (NEM:WA). The related environmental assessment process incorporated the following steps:

- The scoping process was conducted to identify relevant environmental and social issues and to define the terms of reference for the required specialist studies and the EIA
- Specialist studies were commissioned in accordance with the relevant terms of reference. The specialists were selected on the basis of their expertise and knowledge of the project area
- The EIA report was compiled on the basis of the findings of the specialist studies and the project team
- The EMP incorporates Impala's existing mitigation and management commitments in addition to those mitigation commitments that have been identified and described in this EIA.

Other approvals/permits needed for the project as identified during the process, including authorisation of relevant water uses, will be applied for at the required time.

SLR Africa (Pty) Ltd (SLR) is the independent firm of consultants that has been appointed by the applicant company to undertake the environmental impact assessment (EIA) and related processes. The EIA and environmental management programme amendment (EMP amendment) report is the product of the EIA process and provides a detailed description of the project, presents the results of specialist investigations, identifies and assesses potential impacts and recommends mitigation measures should the project be approved.

Stakeholder engagement

The stakeholder engagement process commenced prior to scoping and has continued throughout the environmental assessment process. As part of this process, authorities and interested and affected parties (IAPs) were given the opportunity to attend public meetings and focussed meetings, submit questions and comments to the project team, and review the background information document, scoping report and now the EIA/EMP amendment report. All comments that have been submitted to date by the authorities and IAPs have been included and addressed in the EIA/EMP amendment report. Further comments arising from the EIA/EMP amendment report review process will be handled in a similar manner.

Environmental setting

A summary of the environmental aspects that describe the pre-mining environment as informed by specialist studies are listed below.

Geology:

The Impala converted mining rights area is situated in the Bushveld Igneous Complex. There are four main limbs to the complex, namely the Northern Limb, the Eastern Limb, the Southern Limb and the Western Limb. Impala is located in the Western Limb. The ultramafic-mafic rocks of the Bushveld Igneous Complex are known as the Rustenburg Layered Suite. The Rustenburg Layered Suite is further subdivided into the Marginal, Lower, Critical, Main and Upper zones. The UG2 and Merensky reefs are both currently being mined at Impala. Various geological features were identified in the project area and present barriers to groundwater flow across them, with limited potential for groundwater flow along them.

Climate

The Impala converted mining rights area falls within the Highveld Climatic Zone. The area is characterised by dry seasons with heavy thunderstorms that last for short periods at a time. High evaporation rates reduce infiltration rates, while the high rainfall levels can increase the erosion potential and the formation of erosion gullies. The presence of vegetation does however allow for surface infiltration thereby reducing the effects of erosion. The mixing of layers resulting in the formation of temperature inversion and the presence of cloud cover limits the dispersion of pollutants into the atmosphere. In general wind speeds are below 5.4 m/s and not able to carry dust particles, however this is dependent on the material type, as fine dust can be carried by winds speeds less than 5.4m/s.

Topography

The Impala converted mining rights area is characterised by koppies, hills and gentle undulating plains at an altitude of approximately 1 130 meters above mean sea level (mamsl), approximately 10 km north-east of the northern most section of the Magaliesberg Range. Peaks in this section of the Magalies rise to heights of between 1 400 and 1 500 mamsl. The Pilanesberg occurs to the north-west of the area. The Thlatlhane (1 126 mamsl) and Sefakwe koppies (1 139 mamsl) lie directly north and east of the No 18 Shaft bank area respectively. The Pilwane (1 165 mamsl) koppie lies to the east of the No 18 Shaft linear infrastructure, while the Ga Nape (1 256 mamsl) and Mammanthane (1 180 mamsl) koppies occur further to the east of this infrastructure as well as lying to the north of the existing No 17 Shaft.

Soil and land capability

Soil forms found within the Impala converted mining rights area, as well as within the project area (defined as the area designated for the No 18 Shaft and associated linear infrastructure, the central STP position, the proposed No 17 Shaft STP and linear infrastructure) are predominately highly structured, relatively shallow soils with a high clay content which allows for high water retention. These soil forms are therefore not highly erodible but are susceptible to compaction as a result of water retention and swelling clays. Poor drainage capacity of these soil forms reduces the dry

production potential as well as the irrigation potential. These soil forms are difficult to work and have a limited utilization potential. In addition, even though these soils are slightly alkaline in character and therefore promote good nutrient mobility, their soil fertility is low as a result of a deficit of key nutrients.

The current land capability within the project area is a mixture of grazing, wilderness, wetland and rivers. The land capability is dominated by wilderness use, with only 15 % suitable for grazing. The land capability within the project area will be changed with the establishment of surface infrastructure. Therefore, impact management and rehabilitation planning are required to achieve acceptable post rehabilitation land capabilities.

Biodiversity

The proposed site for the No 18 Shaft and associated linear infrastructure, as well as the central STP is situated in Zeerust Thornveld. Zeerust Thornveld is recognised as Least Threatened, with less than four percent of this vegetation type statutorily conserved. Over 16 % is transformed mainly through cultivation. This is a deciduous region that is open to short thorny woodland dominated species such as the *Acacia* species with a grassy herbaceous layer. A portions of the proposed No 17 Shaft linear infrastructure traverse a section of Marikana Thornveld. The existing No 17 Shaft is also located within Marikana Thornveld. Marikana Thornveld is regionally considered to be a more sensitive vegetation type than the Zeerust Thornveld. This vegetation type is more open to the *Acacia karroo* woodlands.

The Mining and Biodiversity Guidelines (DEA *et al*, 2013) provides explicit direction in terms of where mining-related impacts are legally prohibited, where biodiversity priority areas may present high risks for mining projects and where biodiversity may limit the potential for mining. The guideline distinguishes between four categories of biodiversity priority areas in relation to their importance from a biodiversity and ecosystem service point of view, as well as the implications for mining. The project area covers some of the extent of High and Moderate Biodiversity Importance areas.

The National Environmental Management: Biodiversity Act (Act 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. According to the National List of Threatened Terrestrial Ecosystems (2011) Marikana Thornveld Ecosystem is listed as vulnerable (SAS, 2013).

A National Protected Area Expansion Strategy (NPAES) has also 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 (SAS, 2013). 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 majority of the proposed linear and sewage infrastructure associated with the development, as well as the proposed No 18 Shaft, falls within an area earmarked for expansion of a National Protected Area.

There are a number of conservation important faunal and floral species within the project area. In addition, various areas of high ecosystem function and significance, as well as watercourse associated wetlands of low ecological significance have been identified within the project area. This information was provided to the project team in an effort to avoid areas of high significance, or where this was not possible, to minimize the impact on these areas.

Hydrology (Surface water)

The Impala converted mining rights area is located in the Limpopo Basin, in the catchment of the Crocodile River. Drainage into the Crocodile River is along two routes, via the Elands and Hex Rivers. The proposed project area, falls within the A22F quaternary catchment.

A tributary of the non-perennial Leragane stream has the start of its reach in the footprint of the No 18 Shaft complex. The Leragane stream flows into the Elands River, which ultimately flows into the Vaalkop Dam, which is situated on the Crocodile River. Linear infrastructure associated with No 18 Shaft crosses tributaries of the Leragane Stream in various locations. Water quality in the Leragane Stream at a point close to the proposed shaft showed exceedance of the relevant guidelines of Electrical conductivity, Chloride, sulphate, Fluoride, Nitrate, Calcium, Magnesium, Sodium, Lead, Iron and Manganese.

A tributary of the Rasekanyane stream has the start of its reach to the east of the No 17 Shaft complex. The proposed No 17 Shaft linear infrastructure crosses tributaries in various locations.

There are no watercourses in the immediate vicinity of the proposed central STP.

Water could be abstracted both up and downstream of the mine for domestic purposes and livestock watering. The precise quantities of abstraction are unknown. It is unlikely that there is significant reliance for community consumption because of the fact that many of the watercourses are dry for most of the year and many of the communities receive reticulated water.

Groundwater

The Bushveld Complex aquifers at a regional scale can be described as having two layers: a shallow weathered aquifer system (i.e. intergranular water table aquifer) that may be laterally connected to alluvial aquifers associated with river systems and a deeper, fractured bedrock aquifer system.

Groundwater levels in the shallow weathered aquifer vary between 3.7 and 19.3 mbgl with an average depth of 6.8 mbgl. The groundwater level for the deeper fractured aquifer varies between 9.3 and 48.6 mbgl with an average depth of 21.8 mbgl.

The aquifer is classified as a minor aquifer system, particularly in the vicinity of the No 17 and 18 Shafts, due to the low yields of the aquifer.

The groundwater quality in vicinity of No 18 Shaft presented a combination of water types, namely a Mg-Na-Ca-HCO₃ water facies that represents an evolved, ambient groundwater quality associated with the weathering of silicate and ferromagnesian minerals as a major source of mineralization and a Na-SO₄-HCO₃ water type.

Just over half of the boreholes within the Impala mining rights use area are used for groundwater monitoring while approximately 27 % of boreholes are used for domestic, irrigation or livestock watering. Use of groundwater for domestic purposes is generally limited because communities within and outside the Impala area generally have access to reticulated water supply.

Air quality

Major air pollution sources within Rustenburg include emissions from manufacturing and mining industries, townships and informal settlements and vehicle activity. Primary atmospheric emissions released from these sources include sulphur dioxide (SO₂) nitrogen oxides (NO_x), carbon monoxide (CO), particulate matter (PM_{2.5} and PM₁₀) and Volatile Organic Compounds (VOCs). Secondary pollutants such as ozone (O₃) are formed in the atmosphere through the chemical transformation of precursors such as VOCs and NO_x. Heavy metals such as lead (Pb), chromium (Cr) and nickel (Ni) do also occur in the Rustenburg area due to mining and smelting activities.

Impala has various monitoring stations; however the nearest monitoring station is situated at Ga-Luka. Existing data from the Luka monitoring station indicates that the PM₁₀ concentrations are in exceedance of the relevant ambient standards.

Noise

The proposed project area is located in an area where, in most areas, the ambient noise still has a rural village character. With the exception of Mogono (Luka North) and villages closest to the existing No 17 Shaft, villages nearest to the proposed development components are still outside audible reach of noise emanating from existing Impala Mine operations, such as the plant and shaft complexes, as well as noise from other existing mines and industries in the district. Ambient noise comprises mainly of relatively low levels of road traffic and community activity noise.

Visual character

The western section of the project area leaves an overriding impression (sense of place) of a flat and relatively featureless natural landscape, dominated by mining, utility and township land uses. These areas are considered to have a low visual quality i.e. the landscape generally is negative in character with few, if any, valued features.

The hills and koppies, which occur along the eastern side of the project area create a contained, complex yet coherent spatial dimension, which invites the visitor into a scene dominated by these natural edges and which add 'wildness' to the scene. These factors combine to evoke a strong emotional response in the visitor, created by a landscape that is somewhat unique and has a distinct character of its own. This landscape type has a visual quality that is rated high i.e. a landscape that exhibits a very positive character with valued features that combine to give the experience of unity, richness and harmony. It is a landscape that may be considered to be of particular importance to conserve. It may be sensitive to change in general and may be detrimentally affected if change is inappropriately dealt with.

A moderate value is placed on the grasslands, which occur in the northern and middle sections of the project area. The proposed new infrastructure occurs predominantly within this landscape type. The existing No 17 Shaft and proposed linear infrastructure has already altered the landscape in the vicinity of that shaft and the existing tailings dam.

Land use

The sites for the proposed No 18 Shaft and associated linear infrastructure corridor are currently used for grazing, wood harvesting and wilderness. The No 18 Shaft site shows evidence of cattle grazing, wood harvesting and there are various excavations that may be the result of mining exploration activities in the area. The central STP is located immediately north of existing TSF and proposed TSF 5, while the proposed No 17 Shaft sewage pipeline will follow the servitude on the eastern boundary of the TSF 5, which has recently been approved by DEDECT and approval is pending from DMR. The proposed No 17 Shaft tailings pipelines follow an existing railway servitude, however a small section will traverse a piece of land used for cultivation. The proposed No 17 Shaft STP will be located within the existing shaft bank.

The RBA, as land owners, allocated some of the project area to Bafokeng people for agricultural use. As such, some of the farm workers live in dwellings in the project area. Several dwellings were found within and close to the project area.

Impala has a lease agreement in place with the RBN for the use of various portions of the project area, except for the farm Welbekend. Impala is in negotiations with the RBN to obtain the right to use part of the Welbekend farm for surface infrastructure as per the project requirements. Adjacent land

use is that of mining activities in the form of existing Impala mining activities and infrastructure and community land use for suburban areas and agriculture.

Heritage (including cultural) resources

Heritage resources include sites of archaeological, cultural or historical importance. Various types of resources were identified within the project area and immediate surrounds. These heritage resources mainly consist of stone walled sites, stone structures and archaeological deposits which date from the Late Iron Age. The significance of these resources has been determined to be medium to low. No heritage resources were observed in the linear infrastructure corridors.

Paleontological resources

The entire project area is underlain by igneous rocks of the Rustenburg Layered Suite of the Bushveld Igneous Complex. It is therefore considered unlikely that paleontological resources will be found within the project area.

Socio-economic environment

The surrounding communities form part of the wider Bafokeng Municipal Place, which is a municipal demarcation and does not mean that all of the communities are regarded as part of the Royal Bafokeng Nation, although most do. The Bafokeng has a relatively large population. The mining sector accounts for the most jobs in the affected area. On average, the estimated Bafokeng unemployment rate was 23 % in 2009. The percentage of the population that matriculated was 25 % for the Bafokeng area in 2009. More than half of the houses in communities within a six kilometer radius of the project area have been electrified, but water piping into the dwelling is considered to be inadequate. Most houses have a pit latrine and very few had flush toilets. However, well over 90 % of communities within a six kilometer radius of the project area had access to a telephone (mobile, landline or public) in 2009. The affected communities had 65 % formal and only 25 % informal dwellings in 2009.

Summary of environmental impacts

Potential environmental impacts were identified by SLR in consultation with IAPs, regulatory authorities, specialist consultants and Impala. The range of environmental issues considered in the EIA was given specific context and focus through consultation with authorities and IAPs. All identified impacts are considered in a cumulative manner such that the impacts of the current baseline conditions on and surrounding the site and those potentially associated with the project are discussed and assessed together. A summary of the potential impacts (as per Section 7 of this report) in the unmitigated and mitigated scenarios is provided in Table 2 below.

TABLE 2: POTENTIAL IMPACTS AND SIGNIFICANCE RATINGS

Impact	Significance	
	Unmitigated	Mitigated
Hazardous excavations/structures/surface subsidence	High	Medium
Loss of soil resources and land capability through contamination	High	Low
Loss of soil resources and land capability through physical disturbance	Medium	Medium
Physical destruction of biodiversity	High	High – construction Medium – other phases
General disturbance of biodiversity	High	Medium – construction to decommissioning Low - closure
Alteration of drainage patterns	Medium	Medium
Pollution of surface water resources	High	Low
Dewatering	Low	Low
Contamination of groundwater	High	Low/Medium
Air pollution	High	Medium
Noise pollution	High	Low
Negative landscape and visual impacts	High	Low
Loss of current land uses	High	Medium
Blasting hazards	High	Medium
Project-related road use and traffic	High	Medium
Destruction and disturbance of heritage (including cultural) and paleontological resources	High	Low
Economic impact (positive impact)	High +	High +
Inward migration impact	High	Medium
Relocation of farm dwellers	High	Low

Project timing

Impala plans to commence development of the proposed project in the second half of 2015, provided the relevant approvals are obtained by this time.

Conclusion

The project is expected to benefit nearby communities both directly and indirectly by allowing the mine to continue operating. Direct economic benefits will be derived from wages, taxes and profits. Indirect economic benefits will be derived from the procurement of goods and services and the increased spending power of employees. Some local negative socio-economic impacts are expected in the immediate vicinity of the mine if the mitigation as presented in Section 19 is not effectively implemented. The challenge facing Impala is to contribute to the positive benefits while at the same time preventing and/or mitigating potential negative social and environmental impacts as discussed in detail in Section 7.

NO 18 SHAFT, TAILINGS BACKFILL AND SEWAGE TREATMENT PLANTS PROJECT

INTRODUCTION AND LEGAL FRAMEWORK

Introduction

Impala Platinum Limited (Impala) operates a platinum mining and processing operation near Rustenburg in the North West Province (refer to Figure 1 for the local and regional setting). The operation has an approved environmental impact assessment (EIA) and environmental management programme (EMP) report (SRK, August 1997) that has been amended numerous times to incorporate a range of expansion projects. A consolidated EMP has been compiled by SLR Consulting which consolidates all of the approved EMP documents. This document has been submitted to the Department of Mineral Regulation for approval early in 2012.

Impala now plans to develop the following new projects:

- Development of the No 18 shaft complex and associated linear infrastructure (during the initial stage of the EIA process it was mentioned that No 19 shaft complex would also form part of this set of projects, but this has since been removed from the project scope)
- Development of three new sewage treatment plants and associated pipelines:
 - At the existing No 17 Shaft
 - At the proposed No 18 Shaft
 - A new centralised plant close to the No 11C Shaft
- The support of some mined out areas at No 17 and 18 shafts using backfill prepared from tailings from the processing plant. These shafts will each require a tailings treatment plant, to prepare the tailings for usage as support and ventilation barriers in mined out areas, as well as pipelines to convey tailings to the tailings treatment plants.

The proposed infrastructure is all located within Impala's existing converted mining rights areas. Underground mining from the proposed No 18 Shaft will take place in an area where the Impala/Royal Bafokeng Resources Platinum (Pty) Ltd and the Royal Bafokeng Nation currently holds prospecting rights. However, a section 102 application, together with the required section 11 transfer of rights applications, was lodged on 6 June 2013 to obtain ministerial consent to include the relevant prospecting right areas into the Impala converted mining rights areas adjacent thereto (CMR131MR) in terms of the MPRDA.

The project area falls within the Rustenburg Local Municipality and the Bojanala Platinum District Municipality in the North West province.

FIGURE 1: REGIONAL AND LOCAL SETTING

Decisions required and legal framework

Prior to the commencement of the proposed project, EIA related environmental authorisation is required from key government departments. These include:

- Environmental authorisation from the North West Department of Economic Development, Environment, Conservation and Tourism (DEDECT) in terms of the National Environmental Management Act, 107 of 1998 (NEMA). The proposed project incorporates several listed environmental activities. An application was submitted by SLR to DEDECT and was accepted by the department (Appendix B). The EIA regulation being followed for this project is Regulation 543 (2010 EIA Regulations).
- An environmental decision from the Department of Mineral Resources (DMR) in terms of Section 102 of the Mineral and Petroleum Resources Development Act (MPRDA), 28 of 2002 in the form of an approved amended Environmental Impact Assessment and Environmental Management Programme (EIA/EMP amendment) report
- Waste license for waste-related activities from the Department of Environmental Affairs (DEA) in terms of NEMA: Waste Act, 59 of 2008 (see Section 2.5). An application was submitted to DEA and was accepted by the department (Appendix B).

This report is the environmental impact assessment (EIA) (Section 1) and environmental management programme (EMP) (Section 2) for the project. Given the legal framework above, this report has been compiled to meet the requirements of the EIA Regulations and MPRDA Regulations. In this regard, the new DMR report structure template has been used. To assist with cross-referencing in the report, the chapter numbering in the EMP section follows on from the chapter numbering in the EIA section.

In terms of Regulation 543 of the 2010 EIA Regulations, Table 3 provides a guide to the relevant sections where the information is contained. It should be noted that Section 1 of this document is focussed on the proposed project only, whereas Section 2, the EMP, addresses the existing Impala operations as well as the proposed project i.e. a consolidated EMP.

TABLE 3: REQUIREMENTS FOR EIA AND EMP REPORTS

Environmental Regulation 385	Section in report
Environmental impact assessment (EIA)	
Description of the property and location of the activity on the property	1.3.1 and 1.4
Details of the person who compiled the EIA, and his/her expertise	Introduction
Details on the public involvement process including –compliance with the PSS, IAP database, issues table, additional comments/objections	10, Appendix A, Appendix B and Appendix C
Comment on the need and desirability of the proposed activity(ies) in the context of alternatives	Introduction
Description and comparative assessment of alternatives identified during the EIA	8
Description of proposed activity(ies)	1
A description of the environment that may be affected by the activity	1

Environmental Regulation 385	Section in report
Methodology used to determine impact significance	7.3
Summary of findings and recommendations of specialist reports	Throughout document
Description of environmental issues, assessment of significance, and extent to which these can be mitigated	7
Assessment to include: cumulative impacts, nature, extent, duration, probability, reversibility of resource loss, mitigation	7
Assumptions, uncertainties and knowledge gaps	1
Provide an authorisation opinion – with possible conditions	27
Environmental impact statement – summary of key findings and comparative assessment of the positive and negative implications of the activity and alternatives	27
Specialist reports as appendices	See appendices
Environmental management programme/plan (EMP)	
Details of the person who compiled the EMP, and his/her expertise	Introduction
Detailed description of the activity aspects covered in the EMP	1
Details on the management/mitigation measures from planning and design stages through to closure (where relevant)	7.2, 18, and 19
Time frames for implementation where appropriate	19
Identification of responsible persons for implementation	19

Other approvals / permits

Other approvals/permits needed for the project are listed below. In this regard, there are other approvals that are required prior to construction and/or commissioning of the mining and related activities. This list does not cover occupational health and safety legislation requirements.

- Prior to conducting any water uses as defined in Section 21 of the National Water Act, 36 of 1998, Impala will submit a water use license amendment application (WULA) to the Department of Water Affairs (DWA). This will include any exemptions from Regulation 704 of 4 June 1999. The water uses and exemptions could include:
 - Section 21(g) Water Use Disposing of waste in a manner which could detrimentally impact upon a water resource - the support of some mined out areas at No 17 and 18 Shafts using backfill prepared from tailings from the processing plant, the waste rock dumps and dirty water storage dams at the No 18 shaft.
 - Section 21 (j) Water Use Removing water from underground for the safe continuation of an activity - the dewatering of the underground mine areas. The water removed from underground will be reused, therefore this activity will also be authorised as a 21 (a) Water Use – taking water from a water resource
 - Section 21 (c) and (i) Water Use Impeding or diverting the flow of water in a watercourse and Altering the beds, banks, course or characteristics of a watercourse – the No 18 shaft bank will destroy the headwaters of a non-perennial watercourse and associated wetland of low ecological significance
 - Section 21 (i) Water Use Altering the beds, banks, course or characteristics of a watercourse – linear infrastructure will cross streams in several instances

- Regulation 704 (R704) exemption for Condition 4a – “Locate or place any residue deposit, dam, reservoir, together with any associated structure within 1:100 year flood-line or within a horizontal distance of 100 m of a watercourse or borehole, excluding boreholes drilled specifically to monitor the pollution of ground water, or on ground likely to become water-logged, undermined, unstable or cracked”. the No 18 shaft bank (which incorporates waste rock dump and dams) will destroy the headwaters of a non-perennial watercourse
- R704 exemption for Condition 4b – “Carry on any underground or opencast mining, prospecting or any other operation or activity under or within the 1:50 year flood-line or within a horizontal distance of 100 metres from any watercourse or estuary, whichever is greatest”. The No 18 shaft bank will destroy the headwaters of a non-perennial watercourse. In addition, the underground mining area will extend below non-perennial watercourses, and these watercourses will therefore be under-mined
- R704 exemption for Condition 5 – “May not use any residue or substance which causes or is likely to cause pollution of water resource for the construction of any dam or other impoundment or any embankment, road or railway or for any other purpose which is likely to cause pollution of a water resource”. The construction of roads and containment facilities may require the use of waste rock. Tailings backfill material will also be used as support in the mined out areas of the No 17 and 18 Shafts.
- All dams with both a wall greater than 5m and a capacity of 50 000 m³ must be registered as safety risk dams with DWA in terms of the National Water Act, 36 of 1998
- Prior to operating the sewage plant, Impala or its contractor will obtain registration of both the sewage plant and the required personnel from DWA in terms of Regulation 2834 of 27 December 1965
- Prior to damaging or removing heritage resources, permissions are required in terms of the National Heritage Act, 25 of 1999
- Prior to removing or damaging any protected plant species, the necessary permits will be obtained from DWA in terms of the National Forests Act, 84 of 1998
- Prior to storage, handling, transportation and disposal of explosives the relevant licenses and written permissions are required in terms of the Explosives Act, 25 of 1956, and the Mine Health and Safety Act, 29 of 1996, as amended.

EIA approach and process

A summary of the approach and key steps in the combined EIA process and corresponding activities are outlined in Table 4.

TABLE 4: EIA PROCESS

Objectives	Corresponding activities
Project initiation and application phase (April – September 2011)	
<ul style="list-style-type: none"> • Notify the decision making authority of the proposed project. 	<ul style="list-style-type: none"> • DMR was informed in writing of Impala's intention to submit a section 102 EMP amendment on 11 April 2011. • NEMA revised application for listed activities submitted to DEDECT on

Objectives	Corresponding activities
<ul style="list-style-type: none"> Initiate the environmental impact assessment process. 	<ul style="list-style-type: none"> 6 June 2011. Application accepted. Waste license application submitted to DEA on 12 September 2011. Application accepted.
Scoping phase (May – October 2011)	
<ul style="list-style-type: none"> Identify interested and/or affected parties (IAPs) and involve them in the scoping process through information sharing. Identify potential environmental issues associated with the proposed project. Consider alternatives. Identify any fatal flaws. Determine the terms of reference for the ESIA. 	<ul style="list-style-type: none"> Notify IAPs of the project and environmental assessment process (distribution of BIDs, newspaper advertisements, telephone calls and site notices) (May – June 2011) Scoping phase focussed and public meetings with stakeholder groups (June to July 2011) Submission of draft scoping report to DMR (July 2011) Distribute draft scoping report to IAPs and other regulatory authorities for review (July 2011). Record comments (in writing and at meetings) (June to September 2011) Distribute notice on final scoping report to IAPs (October 2011) Submit final scoping report to DEDECT and DEA with IAP comments (October 2011).
Detailed specialist investigations (May 2011 to August 2013)	
<ul style="list-style-type: none"> Describe the affected environment. Define potential impacts. Give management and monitoring recommendations. 	<ul style="list-style-type: none"> Investigations by technical project team and appointed specialists (see Table 5) of issues identified during the scoping stage including investigations into alternatives. The specialist studies were revised in 2013 due to the re-positioning of the No 18 Shaft and associated infrastructure.
EIA/EMP AMENDMENT phase (October 2011 to October 2013)	
<ul style="list-style-type: none"> Assessment of potential environmental impacts. Design requirements and management and mitigation measures. Receive feedback on application 	<ul style="list-style-type: none"> EIA Phase continued in 2013 due to the re-positioning of the No 18 Shaft and associated infrastructure. Compilation of draft EIA and EMP report (August to October 2013) Distribute draft EIA and EMP report to IAPs, DMR and other regulatory authorities for review (planned for October/November 2013) Feedback open days with IAPs (planned for November 2013) Record comments (planned for November 2013) Submit final EIA and EMP report to DEDECT and DEA for review (planned for November/December 2013) Circulate record of decisions to all registered IAPs registered.

EIA team

SLR Consulting Africa (Pty) Ltd (SLR) is the independent firm of consultants that has been appointed by the applicant company to undertake the environmental assessment and related processes. Linda Munro (project manager) has over twelve years of relevant experience and is registered with the South African Council for Natural Scientific Professions (SACNSP) as a professional natural scientist (PrSciNat) (Environmental Management). Brandon Stobart (project reviewer) has over 15 years of relevant experience and is registered Environmental Assessment Practitioner (EAPSA).

Neither Linda, Brandon nor SLR has any interest in the project other than fair payment for consulting services rendered as part of the environmental assessment process.

The environmental project team comprises SLR's environmental assessment practitioners, specialist consultants and the technical feasibility team (Table 5).

TABLE 5: PROJECT TEAM

Name	Designation	Tasks and roles	Company
Environmental impact assessment and public involvement team			
Linda Munro	Project manager	Management of the assessment process, stakeholder engagement and report compilation.	SLR
Caitlin Pringle	Project administrator		
Stella Moeketse	Stakeholder Engagement		
Brandon Stobart			
Brandon Stobart	Project reviewer	Report and process review	
Specialist environmental assessment consultant team			
Stephen van Staden and team	Terrestrial ecological specialist	Terrestrial ecological assessment	Scientific Aquatic Services (SAS)
Dr. Rian Titus	Groundwater specialist	Groundwater assessment	SLR
Luke Wiles and Mark Bollaert	Water scientists	Surface water, hydrology and design of water facilities	Highlands Hydrology
Ben van Zyl	Noise specialist	Noise study	Acusolv
Dr Julius Pistorius	Heritage consultant	Heritage study	Private Consultant
Professor Bruce Rubidge	Palaeontology specialist	Palaeontology study	BPI for Paleontological Research
Gerrie Muller	Socio-economic consultant	Socio-economic impact assessment	Strategy4Good
Graham Young and Mitah Theron	Visual	Visual impact assessment	Newtown Landscape Architects
Paul Harris	Engineer	Closure cost estimate	E-tek
Chris Hughes	Engineer	Waste Rock Dump designs	TWP
Technical project team			
Jacey Kruger	Impala Project Manager		Impala
Josephine Krzyzanowska	Impala Project Environmental Manager		
Michael Yates	TWP Project Manager		TWP

Contact details for responsible parties

Details of the applicant are provided in the table below.

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Project motivation (need and desirability)

The proposed new vertical shaft complex is intended to replace production from older shafts that are reaching the end of their life. The development of the additional sections of the mine and other infrastructure will benefit society and the surrounding communities both directly and indirectly by ensuring the continued operation of the Impala Mine. Direct economic benefits will be derived from wages, taxes and profits. Indirect economic benefits will be derived from the procurement of goods and services and the spending power of employees.

New sewage treatment plants are needed to provide sewage treatment capacity in this part of the Impala converted mining rights area and to ensure that grey water produced can be used for mining.

The use of a tailings mixed with stabilisers and used as support in mine voids will assist with more effective ventilation and safer mining. There is also a waste management benefit in using tailings waste which will reduce the need for other support products.

SECTION 1 – ENVIRONMENTAL IMPACT ASSESSMENT

It should be noted that this section focusses on the proposed project activities and infrastructure only.

1 DESCRIPTION OF THE BASELINE ENVIRONMENT

This section provides a description of the current baseline conditions of the project site and surrounding areas within which the project will be undertaken. Each discussion provides a link to anticipated impacts and highlights the relevance of the information provided, identifies how data was collected (either by the specialist and/or SLR) to inform the baseline description, provides the results/outcomes of research and/or studies undertaken and concludes with the main findings as relevant to the impact assessment and management plan.

The environmental aspects are discussed as follows:

- Baseline description of bio-physical environment (Section 1.1)
- Baseline description of land uses, socio-economic conditions, heritage and cultural aspects (Section 1.3).

Key environmental aspects requiring protection or remediation are identified in Section 1.2. Maps showing environmental features on and off site are included in Section 1.4 and cross-referenced in the relevant baseline descriptions. A list of supporting specialist information used in the baseline description is included in Section 1.5. Assumptions and uncertainties identified by the specialist studies are outlined in Section 1.

1.1 ON-SITE ENVIRONMENT (BIO-PHYSICAL) RELATIVE TO SURROUNDING ENVIRONMENT (BIO-PHYSICAL)

1.1.1 GEOLOGY BASELINE

Introduction and link to anticipated impact

The geology of a particular area will determine the following factors:

- The type of soils present since the soils will be derived from the parent rock material
- The presence and quality of groundwater and the movement of the groundwater in the rock strata
- The presence of paleontological resources in the rock strata
- The potential for acid generation.

All of these aspects are considered in this EIA in the relevant sections below.

Geology related issues are more relevant for the No 18 Shaft complex and the proposed tailings backfill components of the project and less relevant for the sewage plants and associated pipelines.

Data Collection

Geological baseline information was sourced from geological maps and by the geophysical investigations completed by the groundwater specialists, SLR.

Geophysical surveys were conducted in June 2011 to identify potential geological lineaments such as faults, dykes and/or anomalous zones in the No 18 Shaft mining areas.

Geochemical testing was conducted by SLR to characterise waste rock and sludge from the dewatering system for the proposed No 18 Shaft, as well as backfill material (tailings) for the proposed backfilling of the No 17 and 18 Shaft mining areas. Samples for the geochemical test work included tailings material from the chrome beneficiation plant and, since no waste rock or sludge samples are obviously yet available from the proposed shaft, analogue samples were collected at 11 and 5 Shaft. Based on the uniform lithologies of the Bushveld Igneous Complex underlying the site and mineralised horizons mined, the samples are considered representative of the mine residues (waste rock and sludge) generated by future shaft developments on samples of tailings, waste rock, and sludge at Impala. Acid base accounting (ABA) and leach tests were conducted on the samples to determine the potential for pollution to leach from the waste rock dumps and dewatering systems at the No 18 Shaft, and from backfilled areas at No 17 and 18 Shafts.

Results

Regional geology

Impala is situated in the Bushveld Igneous Complex. The Bushveld complex is an intrusive igneous body, extending about 400 km from east to west and about 350 km from north to south. It comprises a series of ultramafic-mafic layers and a suite of associated granitoid rocks. There are four main limbs to the complex, namely the Northern Limb, the Eastern Limb, the Southern Limb and the Western Limb. Impala is located in the Western Limb, where the layers dip at approximately 10 - 20° into the basin. The ultramafic-mafic rocks of the Bushveld Igneous Complex are known as the Rustenburg Layered Suite. The Rustenburg Layered Suite is further subdivided into the Marginal, Lower, Critical, Main and Upper zones.

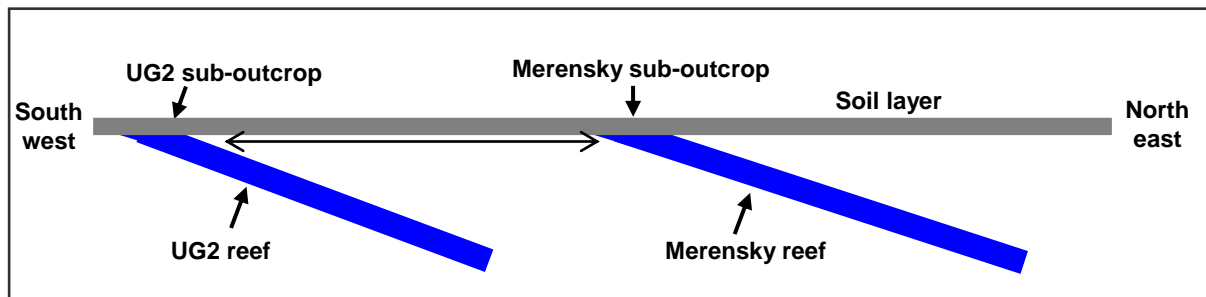
The Impala converted mining rights area is predominantly underlain by the Mathlagame Norite-anorthosite formation of the Critical Zone and the Pyramid gabbro-norites of the Main Zone. Rocks of the Critical Zone comprises of alternating layers of norite, anorthosite pyroxenite and chromitite while the Main Zone consists predominantly of norite. The ultramafic-mafic rocks of the Bushveld Igneous Complex are known as the Rustenburg Layered Suite. The stratigraphy of the Rustenburg suite is summarised as follows:

- Upper zone consisting of norites, gabbros and diorites, magnetite seams
- Main zone consisting of norites and gabbros

- Critical zone consisting of pyroxenities, norities and anorthosites. It is within this layer that the platinum group metals are found
- Lower Zone consisting of pyroxenities and harzburgites, chromitite seams
- Marginal zone consisting of pyroxenites and norites.

The UG2 and Merensky reefs are both currently being mined at Impala. These two reefs outcrop just below the surface. A simple conceptual illustration of the relationship between the Merensky and UG2 reefs is given in Figure 2. The UG2 chromitite layer has an average thickness of 0.64 m in the mining area and dips at an angle of between 9 and 12° in a north-easterly direction. The Merensky chromitite layer has an average thickness of approximately 1 m and dips at an angle of between 9 and 12° in a north-easterly direction.

FIGURE 2: ILLUSTRATION SHOWING THE RELATIONSHIP BETWEEN THE MERENSKY AND UG2 REEFS (METAGO, 2005)



A black turf of almost 2 m thick covers most of the Impala mining rights area formed due to the in-situ weathering of the gabbro/norite rocks.

Various dolerite dykes (up to 40 m thick) and lamprophyre dykes (0.2 to 2 m thick) occur in the area (SRK 1997). The dykes occur in the form of swarms and generally trend south-easterly to north-westerly.

Local geology

The Merensky Reef and UG2 Chromitite Layer in the Upper Critical Zone and will be mined simultaneously at the No 18 Shaft at depths in excess of a 1 000 m below surface. The Merensky Reef and UG2 Chromitite Layer dip in a north-north-east direction at the No 18 Shaft with an average dip in the region of 12° for both mineralised horizons. The average strike-length is approximately 6 km while the dip is 3 km in No 18 Shaft block. The vertical separation between the Merensky and UG2 reef horizons varies from 30 m to 60 m.

Structures/lineaments

The geophysical survey employed the magnetic and electromagnetic methods and was aimed at identifying potential geological lineaments such as faults, dykes and/or anomalous zones in order to

select suitable drilling targets for monitoring boreholes. Six new boreholes were drilled in the vicinity of the proposed No 18 Shaft – refer to Figure 35. Limited groundwater was encountered and two dry boreholes were drilled. The lack of water strikes encountered in the boreholes, drilled to depths of 50 m, is an indication of the limited water bearing capacity of the host rocks.

The geophysical survey intersected a dolerite dyke at approximately 20 m depth in borehole MWG 18-5 located in the vicinity of the proposed 18 Shaft (SLR, 2013) (refer to Figure 3). This structure has a lower transmissivity than the surrounding rock and represents a flow barrier.

FIGURE 3: GEOLOGICAL STRUCTURES IDENTIFIED IN THE PROJECT AREA (SLR, 2013)

Geochemical analysis – tailings

Tailings will be mixed with cement and various additives to be used as backfill material in the No 17 and 18 underground mining areas during the operational phase. The backfill will be used as support and ventilation barriers during mining activities (refer to section 2.7.2.7 for more information). Since no actual backfill sample was available for geochemical testing, two samples of the tailings were tested on its own. The solid fraction and tailings liquid fraction were tested separately. It should however be noted that testing with the actual backfill material will be conducted at a later stage to confirm the results of the current study.

ABA and Sulphur speciation

The ABA results and sulphur speciation of the waste products from the chrome beneficiation plant that may be utilised as backfill material (Tailings 1 and 2) are provided in the table below.

TABLE 6: SUMMARY OF ABA RESULTS FOR TAILINGS SOLID FRACTION SAMPLES (SLR, 2011)

	Tailings 1	Tailings 2
Waterlab Sample Number	7484	7485
Paste pH	9	9.2
Total Sulphur (%) (LECO)	0.03	0.03
Sulphate (SO₄²⁻) Sulphur (%)	0.02	0.02
Sulphide (S²⁻) Sulphur (%)	<0.01	<0.01
Acid Potential (AP) (kg/t)	0.94	0.94
Neutralization Potential (NP)	27.63	31.19
Net Neutralization Potential (NNP)	26.69	30.25
Neutralizing Potential Ratio (NP : AP)	29.47	33.27
NAG pH: (H₂O₂)	4.4	4.5
NAG_{4.5} (kg H₂SO₄ / t)	0.588	<0.01
NAG₇ (kg H₂SO₄ / t)	10	9.41
Assessment	Net Alkaline Leachate Quality	Net Alkaline Leachate Quality

The positive net neutralising potentials (NNP) due to the limited total sulphur content and ample neutralising potential of the Tailings samples flag both samples as non-acid generating, and potentially acid neutralising. The positive NNP values for the Tailings samples also indicate a predicted net alkaline drainage (or leachate) water quality. Most of the total sulphur in the Tailings samples occurs furthermore as non-acid producing sulphate sulphur. If a significant part of the total sulphur occurs as sulphate sulphur instead of sulphide sulphur, the overall risk of acid generation is reduced. A plot of the neutralising potential ratio (NPR) and sulphide sulphur content places the Tailings samples clearly in the non-acid generating field (refer to Figure 4). The alkaline paste pH values of the samples furthermore suggest a net neutral to alkaline leachate composition.

The acid-base-accounting assessment is furthermore confirmed by the net acid generation (NAG) test. The NAG pH values of 4.4 and 4.5 for Tailings 1 and 2 samples respectively indicate a low risk of acid generation (SLR, 2011).

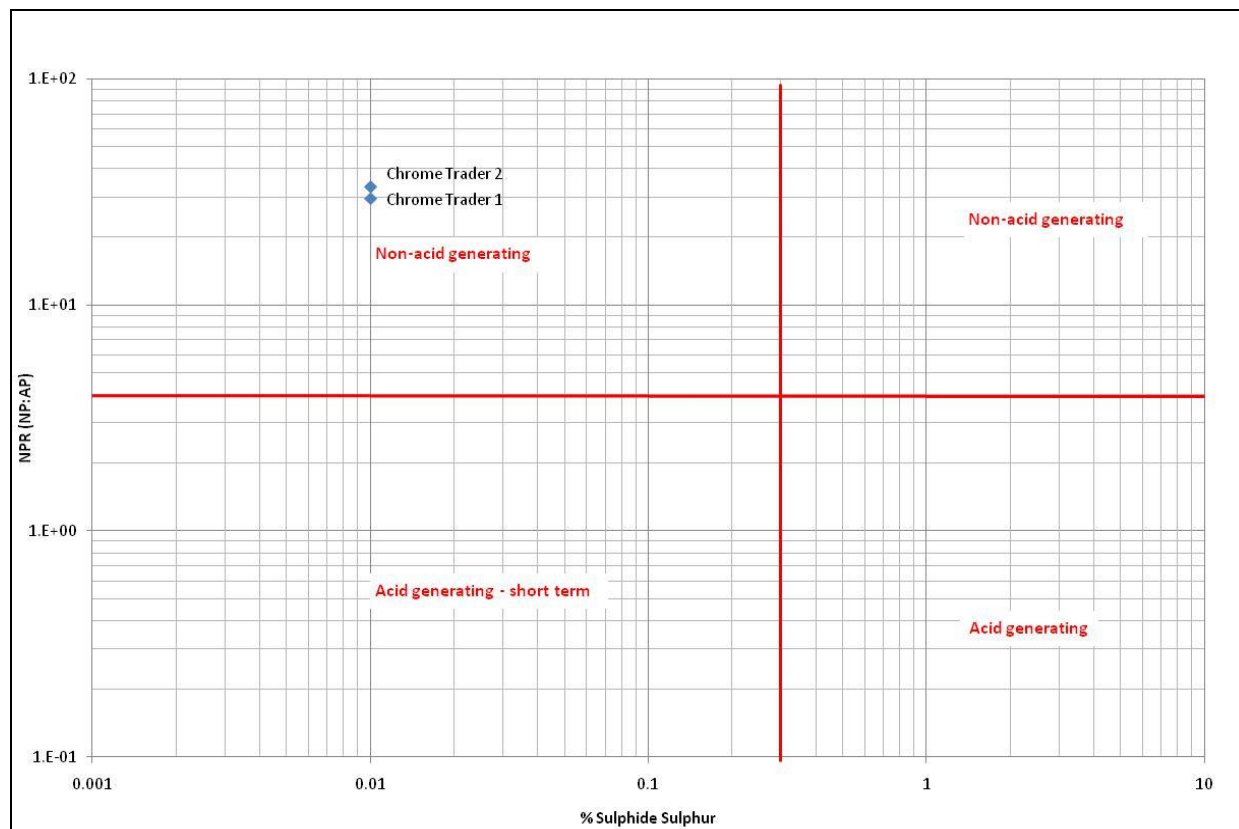


FIGURE 4: NEUTRALIZATION POTENTIAL RATIO VERSUS SULPHIDE SULPHUR CONTENT (%) (SLR, 2013)

Synthetic Precipitation Leaching Procedure (SPLP)

SPLP tests were conducted on the tailings solid fraction samples under varying pH values to determine the potential leachate quality. It should however be noted that the pH of the extraction fluid was in deviation from the original EPA method adjusted using deionised water with sulphuric acid / nitric acid (60/40 weight percent mix) to a pH of 4, with deionised /distilled water to a pH of 7 as well as deionised water adjusted with sodium hydroxide to a pH of 10. This was done to simulate the predicted net alkaline drainage quality for the tailings samples. The results are provided in Table 9, Table 10 and Table 11

The potential leachate quality emanating from the tailings samples do generally not exceed acceptable drinking water limits (i.e. WHO and SANS 241 guidelines) and / or mining effluent limits (i.e. IFC guidelines) for all pH ranges tested. Only the chrome VI (Cr^{+6}) concentration for the distilled water extraction equals the WHO (2008) drinking water standard of 0.05 mg/L but is well below the IFC mining effluent guideline of 0.1 mg/L. However, if the material is to be used for backfilling, reducing groundwater conditions are expected and are likely to prevent the oxidation of chrome to chrome VI as observed in the

laboratory experiment under oxidising conditions. The chrome VI exceedance is therefore considered irrelevant (SLR, 2013).

With most trace elements below the limit of detection and low major element concentrations, the leachate quality likely to emanate from the tailings solid material is under a wide range of pH values (pH 4 – 10) considered to be relatively benign and acceptable (even for potable purposes).

Geochemical analysis – tailings liquid

The tailings liquid samples from the chrome beneficiation plant were analysed for major and trace elements. General indicators (i.e. EC) of water quality, substances (i.e. SO_4) at concentrations which may lead to health problems and substances (i.e. Ca, Cl, K, Mg and Na) present at concentrations of aesthetic and economic (i.e. treatment cost) concern in the water samples either fall within the upper limits or significantly exceed applicable drinking water quality guideline limits, i.e. WHO guidelines for drinking-water quality, SANS 241 Class II guidelines with a limited period of consumption. The specific constituents of concern are:

- The EC of the tailings liquid exceeds the SANS Class II guidelines with a prescribed period for consumption of seven years. The electrical conductivity affects the taste of the water
- The concentrations of substances such as Ca, Cl, and Na exceed both the SANS Class II guidelines and the WHO guidelines for drinking-water quality. The magnesium (Mg) concentrations exceed the SANS Class II guidelines for drinking-water quality for the tailings liquid samples. Elevated concentrations of these substances may be of aesthetic and economic (i.e. treatment cost) concern and may result in taste and health problems at very high concentrations
- The sulphate (SO_4) concentrations significantly exceed the SANS Class II guidelines for drinking-water quality for all samples analysed. Excessive concentrations can cause health problems particularly for users not accustomed to drinking water with high sulphate concentrations.
- The nitrate as N ($\text{NO}_3\text{-N}$) concentrations for the tailings liquid exceed WHO and SANS 241 Class II drinking water guideline limits. Elevated $\text{NO}_3\text{-N}$ concentrations of the tailings liquid might originate from explosives used during blasting.

This analysis shows that while the tailings solid material is not a significant source of leachate contamination when tested under lab conditions, the tailings liquid are a significant source of contamination.

Geochemical analysis – waste rock and sludge

No 18 Shaft complex incorporates sludge handling facilities and a waste rock dump.

ABA and sulphur speciation

The ABA results and sulphur speciation of waste rock and sludge samples are provided in Table 7. The positive net neutralising potentials (NNP) due to the limited total sulphur content and ample neutralising

potential (NP) flag both waste rock samples as non-acid generating, and potentially acid neutralising. The positive NNP and alkaline paste pH values for the waste rock samples also indicate a predicted net alkaline drainage water (or leachate) quality (SLR, 2013).

Most of the total sulphur in the samples occurs as non-acid producing sulphate sulphur and reduces the overall risk of acid generation even further. A plot of the neutralising potential ratio (NPR) and sulphide sulphur content places the waste rock samples clearly in the non-acid generating field (refer to Figure 5). Even under the worst case scenario or assumption that the total sulphur content is potentially acid generating, the waste rock samples have sufficient buffer capacity to offset any acid generation. The acid-base-accounting (ABA) assessment is furthermore confirmed by the net acid generation (NAG) test. The NAG pH values vary between 4.1 and 5.8 and indicate a low risk of acid generation.

The alkaline paste pH values of the sludge samples and NAG pH values between 6.2 and 7 suggest a net neutral to alkaline leachate composition. However, all sludge samples (No 5 and 11 Shafts) have substantially higher total sulphur content when compared to the waste rock samples, and thus have a higher acid generating potential.

The negative net neutralising potential (NNP) based on the laboratory results for the sludge samples from No 5 Shaft point to an insufficient neutralising potential to buffer potentially generated acidity and flag these samples as potentially acid generating. However, the positive net neutralising potential (NNP) of the sludge samples for No 11 Shaft flag both samples as non-acid generating, and potentially acid neutralising.

The neutralising potential ratios (NPR) for the sludge samples (for both No 5 and 11 Shafts) are below 2, indicating that the sludge samples are potentially acid generating. A plot of the neutralising potential ratio (NPR) and sulphide sulphur content also places the sludge samples for the No 5 and 11 Shafts in the short-term acid generating field (Figure 5). Acid generation of samples with a calculated sulphide sulphur content (= difference between total and sulphate sulphur) below 0.3 % is furthermore considered short-term (Price & Errington 1995, Soregaroli & Lawrence 1998 as cited in SLR, 2013).

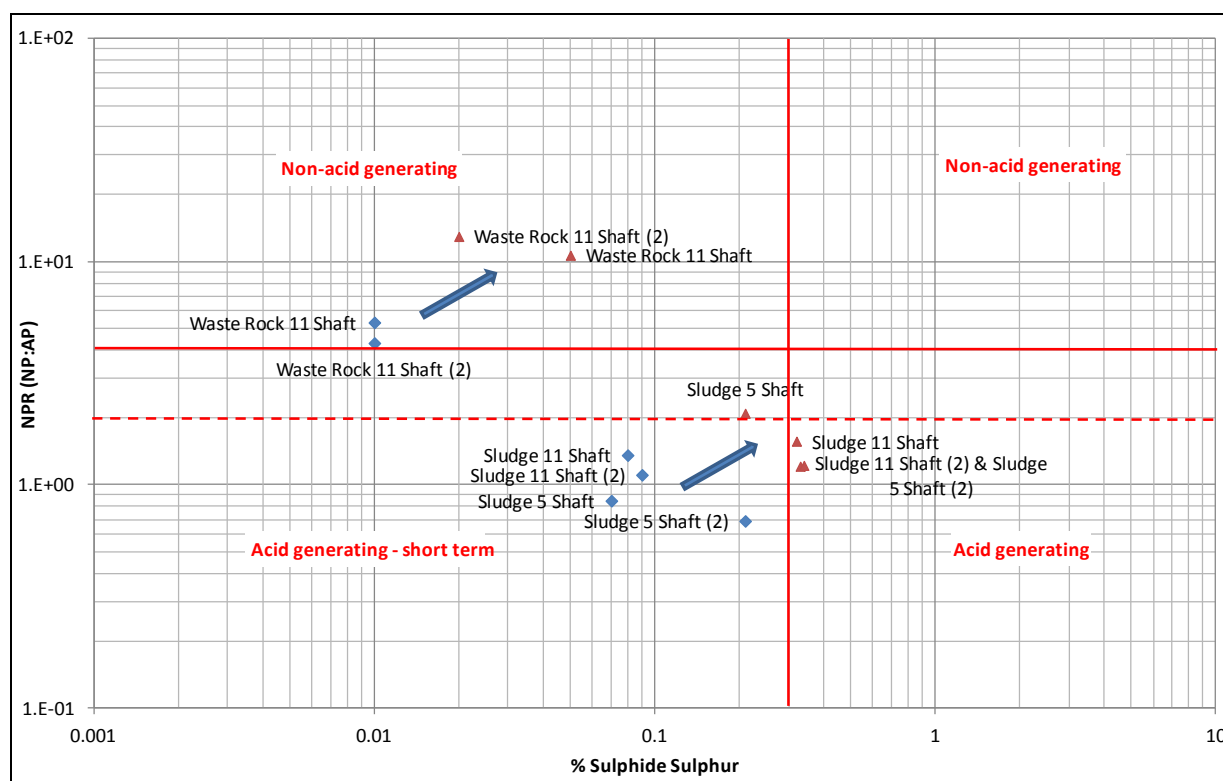
However, because sulphur speciation results provided by WaterLab could not be balanced, as a precautionary approach, it was assumed that the difference between total sulphur and sulphate sulphur content equates to the sulphide sulphur content and the AP, NNP as well as the NPR was therefore recalculated. The approach is conservative, as the determined sulphide contents of the samples are generally higher than the recalculated values. Since only the sulphide sulphur content is used to recalculate the AP (and not the total sulphur content), the overall AP value decreased while the NNP and NPR increased. A plot of the recalculated neutralising potential ratio (NPR) and sulphide sulphur content places the sludge samples for No 5 and 11 Shaft lie on the border between the acid generating and non-acid generating fields (Figure 5).

Considering the uncertainties (i.e. sulphur speciation) inherent in the analyses, the results for the sludge samples should be regarded as inconclusive.

TABLE 7: SUMMARY OF ABA WASE ROCK RESULTS (SLR, 2013)

Modified Sobek (EPA-600)	Waste Rock 11 Shaft	Waste Rock 11 Shaft (2)
Waterlab Sample Number	8380	8381
Paste pH	6.4	8.0
Total Sulphur (%) (LECO)	0.10	0.06
Sulphate (SO₄²⁻) Sulphur (%)	0.05	0.04
Sulphide (S²⁻) Sulphur (%)	0.01	0.02
S²⁻ - Reworked	0.05	0.02
Acid Potential (AP) (kg/t) = MPA	3.13	1.88
AP- Reworked	1.56	0.63
Neutralization Potential (NP)	16.68	8.10
Net Neutralization Potential (NNP)	13.55	6.22
NNP - Reworked	15.12	7.48
Neutralizing Potential Ratio (NP : AP)	5.34	4.32
NPR - Reworked	10.68	12.96
NAG pH: (H₂O₂)	5.80	4.50
NAG_{4.5} (kg H₂SO₄ / t)	<0.01	<0.01
NAG₇ (kg H₂SO₄ / t)	2.55	4.31
Assessment	Net Alkaline Drainage/Leachate Quality	Net Alkaline Drainage/Leachate Quality

Note: Recalculated values highlighted in yellow



Note: Arrows indicate changes in ratios based on recalculated sulphide sulphur values

FIGURE 5: NEUTRALIZATION POTENTIAL RATIO VERSUS SULPHIDE SULPHUR CONTENT (%) (SLR, 2013)

Because the current sludge testing proved to be inconclusive, SLR reverted to previous studies on sludge samples. Wade and Glass conducted analysis on three sludge samples in 2008 to determine the acid drainage potential of sludge material. The ABA results of the three samples are summarised in Table 8 below.

TABLE 8: SUMMARY OF ABA RESULTS FOR SLUDGE MATERIAL (WADE AND GLASS, JULY 2008)

Components	Sample 1	Sample 2	Sample 3
Paste pH	9.21	11.2	10.61
Total sulphur (%)	0.04	0.32	0.46
Acid potential (AP) (kg/t)	1.4	10.1	14.5
Neutralisation Potential (NP)	111.9	275	337.5
Net Neutralisation Potential (NNP = NP + NA)	110.6	264.9	323
Neutralising Potential Ratio	81.41	27.33	23.23

The positive NNP is due to the limited sulphur content and ample neutralising potential of the sludge material flag for all samples as non-acid generating, definite acid neutralising and with a net alkaline drainage water quality. The paste pH of the samples indicates a net alkaline leachate composition or

drainage water quality. From an ABA perspective the sludge material is considered to have sufficient neutralizing potential and is therefore regarded as non-acid generating.

SPLP

SPLP tests were also conducted on the waste rock and sludge samples under varying pH values to determine the potential leachate quality. The pH of the extraction fluid was in deviation from the original EPA method adjusted using deionised water with sulphuric acid / nitric acid (60/40 weight percent mix) to a pH of 4, with deionised /distilled water to a pH of 7 as well as deionised water adjusted with sodium hydroxide to a pH of 10. This was done to simulate the predicted net alkaline drainage quality for the waste rock. The results are provided in Table 9, Table 10 and Table 11.

The SPLP leachate quality from the waste rock and sludge samples exceeds drinking water (WHO, SANS 241 Class II guidelines) and or mining effluent limits (IFC guidelines) for numerous metalliferous (Fe, Mn and Ni) elements.

Manganese and nickel are only readily leachable and mobile under acidic conditions and exceed WHO drinking water limits. However, with the exception of the sludge sample from No 11 Shaft, observed concentrations still fall within the SANS 241 Class II drinking water limits. No exceedances are observed for neutral and alkaline leach conditions.

Leached iron concentrations fall for neutral (pH 7) and acidic (pH 4) conditions into the SANS drinking water class II and remain apparently relatively constant for these pH ranges. An exception is the waste rock sample from No 11 Shaft, which shows a significant higher iron concentration (11 mg/L) for pH 4, exceeding the IFC mining effluent limit. It appears that the sludge sample from No 11 Shaft has, in comparison to the other samples, a significant iron content, which is mobilised under acidic conditions.

Other constituents of concern include nitrate for the waste rock sample from the No 11 Shaft and chloride for the sludge sample from No 11 Shaft, both exceeding applicable limits for the entire tested pH range. The elevated nitrate concentrations in the waste rock sample are probably related to the use of explosives, and the origin of the elevated chloride concentrations in one sludge sample only might be related to evaporative concentration, but remains otherwise unclear (SLR, 2013).

The leachate results of the sludge leachate laboratory tests area based on neutral pH conditions and are presented in Table 13 below. Results indicate that parameters, EC, Cl, Fe, K, Mg and Na are exceeded for various guideline limits in specific samples (refer to Table 9). No livestock watering limits were exceeded.

TABLE 9: LEACHATE ANALYSIS RESULTS FOR SOLID TAILINGS FRACTION, WASTE ROCK AND SLUDGE (IN MG/L AND PH = 4) (SLR, 2013)

All in [mg/L]	Alkalinity as CaCO ₃	EC (mS/m)	pH	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Cl
WHO Drinking Water (2008)	N/A		N/A	N/A	0.2	0.01	0.5	0.7	N/A	N/A	300	0.003	250
IFC Mining Effluents (2007)	N/A		N/A	N/A	N/A	0.1	N/A	N/A	N/A	N/A	N/A	0.05	N/A
SANS Class I		<150	5.0-9.5		<0.3	<0.01					<150	<0.005	<200
SANS Class II		150 - 370	4.0-10		0.3 - 0.5	0.01 - 0.05					150-300	0.005 - 0.01	200-600
SANS Class II (Period of Consumption)		7 years			1 year	1 year					7 years	6 mnths	7 years
Livestock watering	N/A	N/A	N/A	N/A	0 - 5	0 - 1	0 - 5	N/A	N/A	N/A	0 - 1000	0 - 10	0 - 3000
Tailings	148	35.2	6.5	<0.01	<0.01	<0.01	<0.01	0.07	<0.01	<0.01	36	<0.01	8
Waste Rock 11 Shaft	284	122	6.1	<0.01	<0.01	<0.01	<0.01	0.15	<0.01	<0.01	248	<0.01	69
Waste Rock 11 Shaft (2)	60	37.3	5.5	<0.01	<0.01	<0.01	<0.01	0.03	<0.01	<0.01	46	<0.01	26
Sludge 11 Shaft	460	349	6.1	<0.01	<0.01	<0.01	<0.01	0.12	<0.01	<0.01	258	<0.01	664
Sludge 5 Shaft	412	194	6.1	<0.01	<0.01	<0.01	<0.01	0.04	<0.01	<0.01	360	<0.01	155

All in [mg/L]	Co	Cr	Cu	F	Fe	K	Li	Mg	Mn	Mo	Na	Ni	Cr ⁺⁶
WHO Drinking Water (2008)	N/A	0.05	2	1.5	N/A	N/A	N/A	N/A	0.400	0.07	200	0.07	0.05
IFC Mining Effluents (2007)	N/A	N/A	0.3	N/A	2	N/A	N/A	N/A	N/A	N/A	N/A	0.5	0.1
SANS Class I	<0.5	<0.1	<1	<1.0	<0.2	<50		<70	<0.1		<200	<0.15	
SANS Class II	0.5-1	0.1 - 0.5	1-2	1.0-1.5	0.2-2	50 - 100		70-100	0.1-1		200 - 400	0.15- 0.35	
SANS Class II (Period of Consumption)	1 year	3 mnths	1 year	1 year	7 years	7 years		7 years	7 years		7 years	1 year	
Livestock watering	0 - 1	0 - 1	0 - 1	0 - 2	0 - 10	N/A	N/A	0 - 500	0 - 10	0 - 0.01	0 - 2000	0 - 1	0 - 1
Tailings	0.01	<0.01	<0.01	<0.2	<0.01	2.66	<0.01	5.32	0.40	<0.01	4.57	0.13	<0.010
Waste Rock 11 Shaft	<0.01	<0.01	<0.01	<0.2	0.30	8.00	<0.01	5.65	0.58	<0.01	28	0.12	<0.01
Waste Rock 11 Shaft (2)	<0.01	<0.01	<0.01	<0.2	11.00	1.20	<0.01	1.83	0.34	<0.01	11	0.04	<0.01
Sludge 11 Shaft	0.02	<0.01	0.14	<0.2	0.45	81.00	0.01	133.00	1.38	<0.01	300	0.48	<0.01
Sludge 5 Shaft	<0.01	<0.01	0.12	<0.2	0.24	16.80	<0.01	38.00	0.65	<0.01	83	0.26	<0.01

All in [mg/L]	NO ₃ -N	P	Pb	SO ₄	Sb	Se	Si	Sn	Sr	Ti	V	Zn
WHO Drinking Water (2008)	11.3	N/A	0.01		0.02	0.01	N/A	N/A	N/A	N/A	N/A	N/A
IFC Mining Effluents (2007)	N/A	N/A	0.2		N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.5
SANS Class I	<10		<0.02	<400	<0.01	<0.02					<0.2	<5
SANS Class II	10 - 20		0.02 - 0.05	400-600	0.01- 0.05	0.02- 0.05					0.2- 0.5	5 - 10
SANS Class II (Period of Consumption)	7 years		3 mnths	7 years	1 year	1 year					1 year	1 year
Livestock watering	0 - 100	N/A	0 - 0.1	0 - 1000	N/A	N/A	0 - 50	N/A	N/A	N/A	0 - 1	0 - 20
Tailings	0.60	<0.800	<0.01	15	<0.01	<0.01	<0.01	<0.01	0.13	<0.01	<0.01	<0.01
Waste Rock 11 Shaft	25	<0.800	<0.01	48	<0.01	<0.01	<0.01	<0.01	0.711	<0.01	<0.01	0.162
Waste Rock 11 Shaft (2)	7.2	<0.800	<0.01	7	<0.01	<0.01	<0.01	<0.01	0.109	<0.01	<0.01	<0.01
Sludge 11 Shaft	2.5	<0.800	<0.01	184	<0.01	0.010	<0.01	<0.01	0.812	<0.01	<0.01	0.287
Sludge 5 Shaft	9.6	<0.800	<0.01	421	<0.01	<0.01	<0.01	<0.01	0.566	0.342	<0.01	<0.01

Red- Exceedance of all specified guideline limits

TABLE 10: LEACHATE ANALYSIS RESULTS FOR SOLID TAILINGS FRACTION, WASTE ROCK AND SLUDGE (IN MG/L AND PH = 10) (SLR, 2013)

All in [mg/L]	Alkalinity as CaCO ₃	EC (mS/m)	pH	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Cl
WHO Drinking Water (2008)	N/A		N/A	N/A	0.2	0.01	0.5	0.7	N/A	N/A	300	0.003	250
IFC Mining Effluents (2007)	N/A		N/A	N/A	N/A	0.1	N/A	N/A	N/A	N/A	N/A	0.05	N/A
SANS 241 Class I (2006)		<150	5.0-9.5		<0.3	<0.01					<150	<0.005	<200
SANS 241 Class II (2006)		150 - 370	4.0-10		0.3 - 0.5	0.01 - 0.05					150-300	0.005 - 0.01	200-600
SANS Class II (Period of Consumption)		7 years			1 year	1 year					7 years	6 mnths	7 years
Livestock watering	N/A	N/A	N/A	N/A	0 - 5	0 - 1	0 - 5	N/A	N/A	N/A	0 - 1000	0 -10	0 - 3000
Tailings	12	11	8.7	<0.01	<0.01	<0.01	<0.01	0.07	<0.01	<0.01	36	<0.01	9
Waste Rock 11 Shaft	16	61.7	8.4	<0.01	<0.01	<0.01	<0.01	0.06	<0.01	<0.01	56	<0.01	74
Waste Rock 11 Shaft (2)	8	20.5	8.6	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	18	<0.01	27
Sludge 11 Shaft	20	277	7.9	<0.01	<0.01	<0.01	<0.01	0.06	<0.01	<0.01	71	<0.01	657
Sludge 5 Shaft	8	146	7.6	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	152	<0.01	153

All in [mg/L]	Co	Cr	Cu	F	Fe	K	Li	Mg	Mn	Mo	Na	Ni	Cr ⁺⁶
WHO Drinking Water (2008)	N/A	0.05	2	1.5	N/A	N/A	N/A	N/A	0.400	0.07	200	0.07	0.05
IFC Mining Effluents (2007)	N/A	N/A	0.3	N/A	2	N/A	N/A	N/A	N/A	N/A	N/A	0.5	0.1
SANS 241 Class I (2006)	<0.5	<0.1	<1	<1.0	<0.2	<50		<70	<0.1		<200	<0.15	
SANS 241 Class II (2006)	0.5-1	0.1 - 0.5	1-2	1.0-1.5	0.2-2	50 - 100		70-100	0.1-1		200 - 400	0.15- 0.35	
SANS Class II (Period of Consumption)	1 year	3 mnths	1 year	1 year	7 years	7 years		7 years	7 years		7 years	1 year	
Livestock watering	0 -1	0 -1	0 - 1	0 - 2	0 -10	N/A	N/A	0 - 500	0 - 10	0 – 0.01	0 - 2000	0 - 1	0 -1
Tailings	0.01	<0.01	<0.01	<0.2	<0.01	2.66	<0.01	5.32	0.40	<0.01	4.57	0.13	<0.010
Waste Rock 11 Shaft	<0.01	<0.01	<0.01	<0.2	0.10	3.40	<0.01	1.98	<0.01	<0.01	27	<0.01	<0.01
Waste Rock 11 Shaft (2)	<0.01	<0.01	<0.01	<0.2	0.06	0.70	<0.01	0.59	<0.01	<0.01	9.33	<0.01	<0.01
Sludge 11 Shaft	<0.01	<0.01	0.01	<0.2	<0.01	56.00	<0.01	88.00	<0.01	<0.01	269	<0.01	<0.01
Sludge 5 Shaft	<0.01	<0.01	0.01	<0.2	0.05	10.10	<0.01	29.00	<0.01	<0.01	77	0.01	<0.01

All in [mg/L]	NO ₃ _N	P	Pb	SO ₄	Sb	Se	Si	Sn	Sr	Ti	V	Zn
WHO Drinking Water (2008)	11.3	N/A	0.01		0.02	0.01	N/A	N/A	N/A	N/A	N/A	N/A
IFC Mining Effluents (2007)	N/A	N/A	0.2		N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.5
SANS 241 Class I (2006)	<10		<0.02	<400	<0.01	<0.02					<0.2	<5
SANS 241 Class II (2006)	10 - 20		0.02 - 0.05	400-600	0.01- 0.05	0.02- 0.05					0.2- 0.5	5 - 10
SANS Class II (Period of Consumption)	7 years		3 mnths	7 years	1 year	1 year					1 year	1 year
Livestock watering	0 - 100	N/A	0 – 0.1	0 - 1000	N/A	N/A	0 - 50	N/A	N/A	N/A	0 – 1	0 -20
Tailings	0.3	<0.800	<0.01	16	<0.01	<0.01	<0.01	<0.01	0.13	<0.01	<0.01	<0.01
Waste Rock 11 Shaft	26	<0.800	<0.01	44	<0.01	<0.01	<0.01	<0.01	0.33	<0.01	<0.01	<0.01
Waste Rock 11 Shaft (2)	7.8	<0.800	<0.01	6	<0.01	<0.01	<0.01	<0.01	0.05	<0.01	<0.01	<0.01
Sludge 11 Shaft	2.6	<0.800	<0.01	180	<0.01	<0.01	<0.01	<0.01	0.48	<0.01	<0.01	<0.01
Sludge 5 Shaft	9.5	<0.800	<0.01	356	<0.01	<0.01	<0.01	<0.01	0.40	0.22	<0.01	<0.01

Red- Exceedance of all specified guideline limits

TABLE 11: LEACHATE ANALYSIS RESULTS FOR SOLID TAILINGS FRACTION, WASTE ROCK AND SLUDGE (IN MG/L AND PH = 7) (SLR, 2013)

All in [mg/L]	Alkalinty as CaCO3	EC (mS/m)	pH	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Cl
WHO Drinking Water (2008)	N/A		N/A	N/A	0.2	0.01	0.5	0.7	N/A	N/A	300	0.003	250
IFC Mining Effluents (2007)	N/A		N/A	N/A	N/A	0.1	N/A	N/A	N/A	N/A	N/A	0.05	N/A
SANS Class I		<150	5.0-9.5		<0.3	<0.01					<150	<0.005	<200
SANS Class II		150 - 370	4.0-10		0.3 - 0.5	0.01 - 0.05					150-300	0.005 - 0.01	200-600
SANS Class II (Period of Consumption)		7 years			1 year	1 year					7 years	6 mnths	7 years
Livestock watering	N/A	N/A	N/A	N/A	0 - 5	0 - 1	0 - 5	N/A	N/A	N/A	0 - 1000	0 - 10	0 - 3000
Tailings	24	11.30	8.7	<0.01	<0.01	<0.01	<0.01	0.23	<0.01	<0.01	6.08	<0.01	11
Waste Rock 11 Shaft	20	58.5	7.90	<0.01	<0.01	<0.01	<0.01	0.06	<0.01	<0.01	74	<0.01	73
Waste Rock 11 Shaft (2)	8	22.5	7.90	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	22	<0.01	32
Sludge 11 Shaft	16	263	8.20	<0.01	<0.01	<0.01	<0.01	0.07	<0.01	<0.01	75	<0.01	637
Sludge 5 Shaft	16	113	7.40	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	119	<0.01	151

All in [mg/L]	Co	Cr	Cu	F	Fe	K	Li	Mg	Mn	Mo	Na	Ni	Cr ⁺⁶
WHO Drinking Water (2008)	N/A	0.05	2	1.5	N/A	N/A	N/A	N/A	0.400	0.07	200	0.07	0.05
IFC Mining Effluents (2007)	N/A	N/A	0.3	N/A	2	N/A	N/A	N/A	N/A	N/A	N/A	0.5	0.1
SANS Class I	<0.5	<0.1	<1	<1.0	<0.2	<50		<70	<0.1		<200	<0.15	
SANS Class II	0.5-1	0.1 - 0.5	1-2	1.0-1.5	0.2-2	50 - 100		70-100	0.1-1		200 - 400	0.15- 0.35	
SANS Class II (Period of Consumption)	1 year	3 mnths	1 year	1 year	7 years	7 years		7 years	7 years		7 years	1 year	
Livestock watering	0 - 1	0 - 1	0 - 1	0 - 2	0 - 10	N/A	N/A	0 - 500	0 - 10	0 - 0.01	0 - 2000	0 - 1	0 - 1
Tailings	0.01	0.10	0.02	<0.2	0.79	1.68	<0.01	1.34	0.02	<0.01	6.16	0.02	0.05
Waste Rock 11 Shaft	<0.01	<0.01	<0.01	<0.2	0.354	5.0	<0.01	1.58	<0.01	<0.01	26	<0.01	<0.01
Waste Rock 11 Shaft (2)	<0.01	0.062	<0.01	<0.2	0.780	2.0	<0.01	0.395	0.011	<0.01	9.9	<0.01	<0.01
Sludge 11 Shaft	<0.01	<0.01	0.011	<0.2	0.358	72	<0.01	83	<0.01	<0.01	252	<0.01	<0.01
Sludge 5 Shaft	<0.01	<0.01	0.010	<0.2	0.393	12.5	<0.01	27	<0.01	<0.01	82	0.010	<0.01

All in [mg/L]	NO3_N	P	Pb	SO4	Sb	Se	Si	Sn	Sr	Ti	V	Zn
WHO Drinking Water (2008)	11.3	N/A	0.01		0.02	0.01	N/A	N/A	N/A	N/A	N/A	N/A
IFC Mining Effluents (2007)	N/A	N/A	0.2		N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.5
SANS Class I	<10		<0.02	<400	<0.01	<0.02					<0.2	<5
SANS Class II	10 - 20		0.02 - 0.05	400-600	0.01- 0.05	0.02- 0.05					0.2- 0.5	5 - 10
SANS Class II (Period of Consumption)	7 years		3 mnths	7 years	1 year	1 year					1 year	1 year
Livestock watering	0 - 100	N/A	0 - 0.1	0 - 1000	N/A	N/A	0 - 50	N/A	N/A	N/A	0 - 1	0 - 20
Tailings	0.20	<0.800	<0.01	17	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01
Waste Rock 11 Shaft	24	0.763	<0.01	46	<0.01	<0.01	<0.01	<0.01	0.315	<0.01	<0.01	<0.01
Waste Rock 11 Shaft (2)	9	0.778	<0.01	9	<0.01	<0.01	<0.01	<0.01	0.068	<0.01	<0.01	<0.01
Sludge 11 Shaft	2.4	<0.800	<0.01	170	<0.01	<0.01	<0.01	<0.01	0.443	<0.01	<0.01	<0.01
Sludge 5 Shaft	9.7	<0.800	<0.01	245	<0.01	<0.01	<0.01	<0.01	0.284	0.220	0.010	<0.01

Red- Exceedance of all specified guideline limits

TABLE 12: RESULTS OF THE ANALYSIS OF TAILINGS LIQUID (SLR, 2013)

All in [mg/L]	Alkalinity as CaCO ₃	EC (mS/m)	pH	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Cl
WHO Drinking Water (2008)	N/A		N/A	N/A	0.2	0.01	0.5	0.7	N/A	N/A	300	0.003	250
IFC Mining Effluents (2007)	N/A		N/A	N/A	N/A	0.1	N/A	N/A	N/A	N/A	N/A	0.05	N/A
SANS 241 Class I (2006)		<150	5.0-9.5		<0.3	<0.01					<150	<0.005	<200
SANS 241 Class II (2006)		150 - 370	4.0-10		0.3 - 0.5	0.01 - 0.05					150-300	0.005 - 0.01	200-600
SANS Class II (Period of Consumption)		7 years			1 year	1 year					7 years	6 mnths	7 years
Livestock watering	N/A	N/A	N/A	N/A	0 - 5	0 - 1	0 - 5	N/A	N/A	N/A	0 - 1000	0 - 10	0 - 3000
Lowest Reported Concentration (WaterLab)												<0.005	
Tailings	32	441	7.7	<0.01	<0.01	0.0	<0.01	0.1	<0.01	<0.01	403	<0.01	631

All in [mg/L]	Co	Cr	Cu	F	Fe	K	Li	Mg	Mn	Mo	Na	Ni	Cr ⁺⁶
WHO Drinking Water (2008)	N/A	0.05	2	1.5	N/A	N/A	N/A	N/A	0.400	0.07	200	0.07	0.05
IFC Mining Effluents (2007)	N/A	N/A	0.3	N/A	2	N/A	N/A	N/A	N/A	N/A	N/A	0.5	0.1
SANS 241 Class I (2006)	<0.5	<0.1	<1	<1.0	<0.2	<50		<70	<0.1		<200	<0.15	
SANS 241 Class II (2006)	0.5-1	0.1 - 0.5	1-2	1.0-1.5	0.2-2	50 - 100		70-100	0.1-1		200 - 400	0.15- 0.35	
SANS Class II (Period of Consumption)	1 year	3 mnths	1 year	1 year	7 years	7 years		7 years	7 years		7 years	1 year	
Livestock watering	0 - 1	0 - 1	0 - 1	0 - 2	0 - 10	N/A	N/A	0 - 500	0 - 10	0 - 0.01	0 - 2000	0 - 1	0 - 1
Lowest Reported Concentration (WaterLab)	<0.025	<0.025	<0.025		<0.025	<1	<0.025	<2	<0.025	<0.025	<2	<0.025	
Tailings	<0.01	<0.01	<0.01	<0.2	0.1	51.0	<0.01	182.0	0.0	0.0	398.0	0.04	<0.01

All in [mg/L]	NO ₃ _N	P	Pb	SO ₄	Sb	Se	Si	Sn	Sr	Ti	V	Zn
WHO Drinking Water (2008)	11.3	N/A	0.01		0.02	0.01	N/A	N/A	N/A	N/A	N/A	N/A
IFC Mining Effluents (2007)	N/A	N/A	0.2		N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.5
SANS 241 Class I (2006)	<10		<0.02	<400	<0.01	<0.02					<0.2	<5
SANS 241 Class II (2006)	10 - 20		0.02 - 0.05	400-600	0.01- 0.05	0.02- 0.05					0.2- 0.5	5 - 10
SANS Class II (Period of Consumption)	7 years		3 mnths	7 years	1 year	1 year					1 year	1 year
Livestock watering	0 - 100	N/A	0 - 0.1	0 - 1000	N/A	N/A	0 - 50	N/A	N/A	N/A	0 - 1	0 - 20
Lowest Reported Concentration (WaterLab)		<0.025	<0.020		<0.010	<0.020	<0.2	<0.025	<0.025	<0.025	<0.025	<0.025
Tailings	70.0	1.2	<0.01	966.0	<0.01	<0.01	<0.01	<0.01	1.7	0.6	<0.01	<0.01

Red- Exceedance of all specified guideline limits

TABLE 13: RESULTS OF THE ANALYSIS OF THE LEACHATE ON SLUDGE (WADE AND GLASS 2008)

All in [mg/L]	Alkalinty as CaCO3	EC (mS/m)	pH	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Cl
WHO Drinking Water (2008)	N/A		N/A	N/A	0.2	0.01	0.5	0.7	N/A	N/A	300	0.003	250
IFC Mining Effluents (2007)	N/A		N/A	N/A	N/A	0.1	N/A	N/A	N/A	N/A	N/A	0.05	N/A
SANS Class I		<150	5.0-9.5		<0.3	<0.01					<150	<0.005	<200
SANS Class II		150 - 370	4.0-10		0.3 - 0.5	0.01 - 0.05					150-300	0.005 - 0.01	200-600
SANS Class II (Period of Consumption)		7 years			1 year	1 year					7 years	6 mnths	7 years
Livestock watering	N/A	N/A	N/A	N/A	0 - 5	0 - 1	0 - 5	N/A	N/A	N/A	0 - 1000	0 -10	0 - 3000
Sample 1	16	263	8.20	<0.01	<0.01	<0.01	<0.01	0.07	<0.01	<0.01	75	<0.01	637
Sample 2	16	113	7.40	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	119	<0.01	151

All in [mg/L]	Co	Cr	Cu	F	Fe	K	Li	Mg	Mn	Mo	Na	Ni	Cr ⁺⁶
WHO Drinking Water (2008)	N/A	0.05	2	1.5	N/A	N/A	N/A	N/A	0.400	0.07	200	0.07	0.05
IFC Mining Effluents (2007)	N/A	N/A	0.3	N/A	2	N/A	N/A	N/A	N/A	N/A	N/A	0.5	0.1
SANS Class I	<0.5	<0.1	<1	<1.0	<0.2	<50		<70	<0.1		<200	<0.15	
SANS Class II	0.5-1	0.1 - 0.5	1-2	1.0-1.5	0.2-2	50 - 100		70-100	0.1-1		200 - 400	0.15- 0.35	
SANS Class II (Period of Consumption)	1 year	3 mnths	1 year	1 year	7 years	7 years		7 years	7 years		7 years	1 year	
Livestock watering	0 -1	0 -1	0 - 1	0 - 2	0 -10	N/A	N/A	0 - 500	0 - 10	0 – 0.01	0 - 2000	0 - 1	0 -1
Sample 1	<0.01	<0.01	0.011	<0.2	0.358	72	<0.01	83	<0.01	<0.01	252	<0.01	<0.01
Sample 2	<0.01	<0.01	0.010	<0.2	0.393	12.5	<0.01	27	<0.01	<0.01	82	0.010	<0.01

All in [mg/L]	NO3_N	P	Pb	SO ₄	Sb	Se	Si	Sn	Sr	Ti	V	Zn
WHO Drinking Water (2008)	11.3	N/A	0.01		0.02	0.01	N/A	N/A	N/A	N/A	N/A	N/A
IFC Mining Effluents (2007)	N/A	N/A	0.2		N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.5
SANS Class I	<10		<0.02	<400	<0.01	<0.02					<0.2	<5
SANS Class II	10 - 20		0.02 - 0.05	400-600	0.01- 0.05	0.02- 0.05					0.2- 0.5	5 - 10
SANS Class II (Period of Consumption)	7 years		3 mnths	7 years	1 year	1 year					1 year	1 year
Livestock watering	0 - 100	N/A	0 – 0.1	0 - 1000	N/A	N/A	0 - 50	N/A	N/A	N/A	0 – 1	0 -20
Sample 1	2.4	<0.800	<0.01	170	<0.01	<0.01	<0.01	<0.01	0.443	<0.01	<0.01	<0.01
Sample 2	9.7	<0.800	<0.01	245	<0.01	<0.01	<0.01	<0.01	0.284	0.220	0.010	<0.01

Red- Exceedance of all human health guideline limits

Bdl = below detectable limit

*SANS Class 1: Good quality water suitable for lifetime consumption.

**SANS Class II: Marginal water quality with a maximum allowance for consumption. The period of consumption is indicated in years in the above table.

Conclusion

The geochemical analysis conducted shows that:

- The tailings solid fraction material, waste rock samples and sludge samples indicate no risk of acid generation and a net neutral to alkaline leachate composition
- While the tailings solid material is not a significant source of leachate contamination when tested under lab conditions, the tailings liquid is a significant source of contamination
- There is some potential for seepage concentrations from the waste rock and sludge handling facilities to exceed the drinking water guideline limits for various parameters.

This presents a pollution risk for both surface and groundwater in the both the short and long term. It follows that short and long term pollution prevention and/or treatment measures must be considered.

Various geological features were identified and present barriers to groundwater flow across them with limited potential for groundwater flow along them.

1.1.2 CLIMATE

Information in this section was sourced from the Impala EMP consolidation report (SLR, 2011), and surface water study (SLR, 2013) included in Appendix E.

Introduction and link to impact

As a whole, the various aspects of the climate that are discussed influence the potential for environmental impacts and related mine design. Specific issues are listed below:

- Rainfall could influence erosion, evaporation, vegetation growth, rehabilitation planning, dust suppression, and surface water management planning.
- Temperature could influence air dispersion through impacts on atmospheric stability and mixing layers, vegetation growth, and evaporation which could influence rehabilitation planning; and
- Wind could influence erosion, the dispersion of potential atmospheric pollutants, and rehabilitation planning.

To understand the basis of these potential impacts, a baseline situational analysis is described below.

Data collection

Rainfall and evaporation data for the site was considered from various sources including weather stations managed by both the South African Weather Services (SAWS) and the Department of Water Affairs (DWA). These include the Rustenburg-POL station (0511400 W).

Results

Regional climate

The Impala converted mining rights area falls within the Highveld Climatic Zone. 85 % of the mean annual precipitation falls during summer as thunderstorms. The thunderstorms generally occur every 3 to 4 days in summer and are of short duration and high intensity. Temperatures in this climatic zone are generally mild, but low minima can be experienced in winter due to clear night skies. Frost characteristically occurs in the winter months. Generally winds are light, but south-westerly winds associated with thunderstorms are typically strong and gusty (Metago, September 2007).

Rainfall

Rainfall data for the shaft sites was considered from various sources including weather stations managed by both the South African Weather Services (SAWS) and the Department of Water Affairs (DWA). Mean annual precipitation (MAP) for the site was sourced from the Rustenburg-POL weather station (511400W), 7 km south of the Impala Rustenburg site. The Boschpoort weather station (A2E024) is 16 km east of the Impala site, and 18 km south east of the proposed No 18 Shaft complex. The Rustenburg-POL weather station has been used in past Impala Rustenburg environmental investigations and provides a reliable daily record length of 87 years, with an average MAP of 665 mm. The Boschpoort weather station is, however, closer to the site and provides a record length of 30 years, with an average MAP of 604 mm. Table 14 presents the monthly rainfall and evaporation of the Boschpoort weather station. Table 15 presents the 24-hour storm rainfall depths for various return periods.

TABLE 14: MONTHLY RAINFALL AND EVAPORATIVE ESTIMATES (SLR, 2013)

Month	Mean Monthly Rainfall (mm)	Mean Monthly Evaporation - Lake (mm)
Jan	62	162
Feb	91	143
Mar	98	130
Apr	107	99
May	99	83
Jun	73	64
Jul	40	70
Aug	13	95
Sep	6	129
Oct	2	155
Nov	4	158
Dec	11	163
Total	604	1453

TABLE 15: 24-HOUR STORM DEPTHS (SLR, 2013)

Return Period (Years)	24-hour Rainfall Depth (mm)	
	Smithers & Schulze (2002)	Hydrological Response Unit

Return Period (Years)	24-hour Rainfall Depth (mm)	
	Smithers & Schulze (2002)	Hydrological Response Unit
1 in 2	67	49
1 in 5	91	64
1 in 10	108	79
1 in 20	125	97
1 in 50	150	127
1 in 100	170	157
1 in 200	191	193

Temperature

Temperatures in the region tend to be warm to mild with average temperatures ranging between highs of 32 °C in the warmer summer months and lows of 3 °C in the colder winter months. The annual average temperature is approximately 19 °C. The recorded average range of extreme temperatures is between 39 °C and -6 °C (SLR, 2011).

Wind

Wind roses comprise 16 spokes which represent the directions from which winds blew during the period (Airshed, May 2011). The colours reflected the different categories of wind speeds, the orange area, for example, representing winds of 3 m/s to 6 m/s. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories. The frequency, at which calms occurred, i.e. periods during which the wind speed was below 1 m/s, is also indicated.

Diurnal and seasonal wind roses generated from data recorded at the ambient meteorological monitoring station located at Luka Primary School between January 2009 and December 2010 are presented in Figure 6. During the day, winds occurred most frequently from the east and west-northwest with very little airflow from the north. During the night, the wind shifted, blowing from the south. Calm conditions increased to 41 % during the night. The most distinct shift in the seasonal wind field was observed during spring with when southerly winds occurred most frequently. 36% of the winds recorded during 2009 and 2010 were below 1 m/s (SLR, 2011).

Evaporation

Evaporation figures recorded for the area are high. The average annual evaporation is approximately 1 453 mm (SLR, 2011).

FIGURE 6: DAY-TIME, NIGHT-TIME AND SEASON WIND ROSES FOR LUKA WEATHER STATION (SLR, 2011)

Conclusion

The project area is characterised by dry seasons with heavy thunderstorms that last for short periods at a time. High evaporation rates reduce infiltration rates, while the high rainfall levels can increase the erosion potential and the formation of erosion gullies. The presence of vegetation does however allow for surface infiltration thereby reducing the effects of erosion. The mixing of layers resulting in the formation of temperature inversion and the presence of cloud cover limits the dispersion of pollutants into the atmosphere. In general wind speeds are below 5.4 m/s and not able to carry dust particles, however this is dependent on the material type, as fine dust can be carried by winds speeds less than 5.4m/s. These climatic aspects need to be taken into consideration during rehabilitation and surface water management planning.

1.1.3 TOPOGRAPHY BASELINE

Introduction and link to anticipated impact

The topography of a particular area will determine the following factors:

- The flow of surface, and in many cases, also groundwater
- The depth of soils and the potential for soil erosion, for example, in the case of steep slopes
- The type of land use for example flat plains are more conducive to crop farming
- The aesthetic appearance of the area
- Topography can also influence climatic factors such as wind speeds and direction, for example, wind will be channelled in between mountains along the valley.

Changes in the topography caused by the project could therefore alter all of the above-mentioned aspects of the environment. Project-related activities have the potential to alter the topography of the site through the establishment of both temporary (such as the shafts and support facilities) and permanent infrastructure (such as the waste rock dumps).

This section provides an understanding of the topographical features relevant to the project site and surrounding area from which to measure potential change.

Data collection

Data on topography was sourced by SLR through the studying of 1:50 000 topographical maps and observations made by the SLR team and various specialists during site visits.

Results

The Impala converted mining rights area is characterised by koppies, hills and gentle undulating plains at an altitude of approximately 1 130 meters above mean sea level (mamsl), approximately 10 km north-

east of the northern most section of the Magaliesberg Range. Peaks in this section of the Magalies rise to heights of between 1 400 and 1 500 mamsl. The Pilanesberg occurs to the north-west of the area.

The Thlatlhane (1 126 mamsl) and Sefakwe koppies (1 139 mamsl) lie directly north and east of the No 18 Shaft bank area respectively. The Pilwane (1 165 mamsl) koppie lies to the east of the No 18 Shaft linear infrastructure, while the Ga Nape (1 256 mamsl) and Mammanthane (1 180 mamsl) koppies occur further to the east of this infrastructure as well as lying to the north of the existing No 17 Shaft .

Conclusion

The baseline topographical information has mainly been used to develop the stormwater management plan to ensure that clean water will be diverted away from the site and dirty water will be contained. In addition, linear infrastructure corridors used this information to avoid koppies. The baseline topographical information has also been used in developing a conceptual closure plan to ensure that any final landforms will be stable topographic features which do not pose significant risk to third parties and emulate the natural landscape as far as practically possible.

1.1.4 SOIL AND LAND CAPABILITY BASELINE

Information in this section was sourced from the soil and land capability study conducted by Earth Science Solutions (ESS) in the Impala EMP consolidation report (SLR, 2011) for the whole Impala converted mine rights area.

Introduction and link to anticipated impact

Soil is an important natural resource and provides ecosystem services that are critical for life, such as:

- Water filtering
- Providing growth medium for plants, which in turn provide food for plant-eating animals
- Providing habitat for a wide variety of life forms.

Soil forms rather slowly by the breaking down of rock material and is therefore viewed as a non-renewable resource. Soil determines the type of land use the area is suitable for, for example, soil with low nutrients may not be able to support crop farming.

Soil resources are vulnerable to pollution, erosion and compaction, which could be caused by project-related activities.

The baseline soil information has been used to identify sensitive soil types, to guide the project planning in order to avoid sensitive soil types where possible, to determine how best to conserve the soil resources in the area and allow for proper rehabilitation of the site once mining ceases.

Data collection

Data was obtained through the review of existing geological information, previous studies conducted for the Impala mining operations. The 2010 field survey involved the mapping and classification of different soil types. In addition to this soil samples were taken in order to investigate/log and classify the different soil profiles. The procedure adopted in field when classifying the soil profiles is as follows:

- Demarcate master horizons
- Identify applicable diagnostic horizons by visually noting the physical properties such as:
 - Depth (below surface)
 - Texture (Grain size, roundness etc.)
 - Structure (Controlling clay types)
 - Mottling (Alterations due to continued exposure to wetness)
 - Visible pores (Spacing and packing of peds)
 - Concretions (cohesion of minerals and/or peds)
 - Compaction (from surface)
- Determine from i) and ii) the appropriate Soil Form
- Establishing provisionally the most likely Soil Family.

Terrain information, topography and any other infield data of significance were also recorded, with the objective of identifying and classifying the area in terms of:

- The soil types disturbed or that might be disturbed/rehabilitated
- The soil physical and chemical properties
- The soil effective rooting depths
- The erodibility of the soils
- The soil utilisation potential
- The soil nutrient status.

The identification and classification of soil profiles were carried out using the Taxonomic Soil Classification System.

Results

Soil forms and characteristics

No 18 Shaft complex footprint intersects Rensburg/Sepane and Arcadia/Mayo soils (refer to Figure 7). The linear infrastructure corridor associated with the No 18 Shaft complex intersects the following soil types (refer to Figure 7):

- Mayo
- Arcadia
- Sterkspruit/Arcadia
- Rensburg/Sepane
- Arcadia/Mayo
- Arcadia/Sterkspruit
- Rock outcrops.

The existing No 17 Shaft complex intersects Arcadia, Mayo and rock outcrops, while the proposed associated linear infrastructure intersects:

- Mayo/Glenrosa
- Sterkspruit/Arcadia
- Mayo
- Rock outcrops
- Swartland/Sterkspruit
- Sepane/Kroonstad.

The proposed central STP lies within Sepane soils. The proposed STP for the No 17 and 18 Shaft complexes will be positioned within the shaft bank areas.

Arcadia, Mayo and Sterkspruit are of the more structured soil forms, while Sepane and Rensburg are hydromorphic forms. The heavy structured black and dark brown Vertic and/or Gleycutanic and prismatic soils include the Arcadia, Sterkspruit and Mayo soil forms generally known as black-turf. The different soils forms (including their effective rooting depths (ERD)) identified within the project area are illustrated in Figure 7 and discussed in further detail below (ESS, 2010):

- Arcadia: Arcadia is a highly structured soil on an unspecified base. It exhibits extremely strong vertical columns of structure from surface (ESS, 2010). In general, these soils are high in transported clay topsoil and subsoil layers. The nutrient status is generally low, and these soils will be more difficult to work with. Compaction is a problem to contend with if these soils are to be worked during the wet months of the year.

Stockpiling of these soils should be done separately from the less structured and wet based soils, and greater care is needed with the management of erosion problems during storage. Any strong structure that develops during the stockpiling stage will need to be managed prior to the use of this material for rehabilitation.

- **Mayo:** Mayo is characterised by effective rooting depths of between 100 mm and 500 mm. The major constraint envisaged with these soils will be tillage, sub-surface hindrance and erosion. The restrictive layer associated with these soils is a hard lithocutanic layer in the form of weathered parent material, or rock. The effective soil depth is restricted; resulting in reduced soil volumes and as a result, depletion in the water holding capacity as well as nutrient availability.

Physical characteristics of these soils include moderate to high clay percentages (25 % to 45 %), moderate to low internal drainage and low water holding capabilities. These are of the poorer land capability units mapped. It is imperative that good management of these soils is implemented, both from the, erosion as well as the compaction perspectives and a good vegetative cover should be maintained where possible.

- **Sterkspruit (Ss) Swartland (Sw):** These soils are generally grey to dark brown or black in colour and blocky to prismatic (prismacutanic) in structure. These soils are generally found associated with the intrusive and more basic geological host material. Although the Swartland form is less intensely structured their land capability, irrigation potential and general workability are of a lower order than the Valsrivier Forms, and although agriculturally these soils have been cultivated they require a far greater degree of management to obtain good economic results.

Chemically, both soil forms are similar, returning moderate to low levels of most nutrients, the Swartland returning higher levels across the spectrum. The high levels of sodium and potassium result in a moderate to high potential for salinity/sodicity problems, if the water management is not maintained.

Structurally these soils classify as moderate blocky (pedocutanic) to prismatic or prismacutanic, have low intake rates, moderate water holding capabilities, and in most places returned evidence of expansive clays, with a fair range in depths noted (200mm - 600mm).

These soils will be more difficult to work, and they are generally more widely distributed. The expansive nature of the clays (2:1 swelling) will make for difficult water management and compaction control.

- **Rensburg:** The Rensburg soils are characterised by high clay contents, often of a swelling variety that produce strongly structured and blocky fabric, are generally pale in colour (grey to grey brown), highly leached, and are, in almost all cases associated with the bottomland areas where accumulations of transported soils make up the majority of the soil pedogenesis (ESS, 2010).

The gleyed structure is the distinctive feature of these soils, the Rensburg Form comprises a vertic "A" horizon on a gleyed G-horizon. With its distinctive greyish background colour and yellow/red mottling, these soils are distinctive of semi-permanent saturation.

Chemically, Rensburg has moderate to poor levels of most nutrients (aluminium, phosphorus and nitrate mineralisation capacity). Conversely the salts (potassium and zinc) return as higher levels, resulting in a greater potential for salinity and/or sodicity problems (moderate to severe).

- Sepane: The Sepane Forms mapped fall within the “hydromorphic” category of soils as classified. These soils are generally found associated with and down slope of the dry soils. Chemically, these soils are moderate to highly leached returning significantly lower amounts of potassium, phosphorus, zinc with a low nitrate and sulphur mineralisation capacity and organic matter content. The leaching of the nutrients from these soils is significant and the pale colours are evidence of the movement of water within the profile (ESS, 2010).

By definition, these soils vary in the degrees of wetness at the base of their profile i.e. the soils are influenced by a rising and falling water table, hence the mottling within the lower portion of the profile and the pale background colours. Depths of utilizable agricultural soil (to top of mottled horizon) vary from 200 mm to 400 mm. The rooting depths that are less than 400 mm, classified as having a wetland capability. In general, these soils are high in transported clay in the lower “B” horizon with highly leached topsoils and pale denuded horizons at shallow depths. The nutrient status is generally low.

These soils will be more difficult to work due to the wetness factor and the high clay percentage, low internal drainage and moderate to high water holding capabilities. Compaction is a problem to contend with if these soils are to be worked during the wet months of the year. Stockpiling of these soils should be done separately from the dry soils and greater care is needed with the management of erosion problems during storage. Any strong structure that develops during the storage of these soils will need to be dealt with prior to their use as rehabilitation materials.

- Kroonstad (Kd): These soils are associated exclusively with the wetland and vlei areas alongside the rivers and around the prominent pan features. The hydromorphic nature of these soils renders them highly susceptible to compaction and erosion.
- Glenrosa (Gs): These soils have an effective rooting depth of between 150 and 400mm. The major constraint envisaged with these soils will be tillage, sub surface hindrance and erosion. The restrictive layer associated with the soil is a hard lithocutanic layer in the form of weathered parent material, or rock. The effective soil depth is restricted, resulting in reduced soil volumes and as a result, depletion in the water holding capacity as well as nutrient availability.

Geophysical characteristics of the soil include moderate to high clay percentages (20 to 32%), moderate internal drainage and low water holding capabilities. These are of the poorer land capability units mapped.

FIGURE 7: SOIL FORMS WITHIN THE PROJECT AREA (SLR, 2011)

Chemical characteristics

Soil salinity/alkalinity

In general, it is accepted that the pH of a soil has a direct influence on plant growth. This may occur in a number of different ways, which include:

- The direct effect of the hydrogen ion concentration on nutrient uptake
- Indirectly through the effect on major trace nutrient availability
- Mobilizing toxic ions such as aluminum and manganese, which restrict plant growth.

A pH range of between 6 and 7 most readily promotes the availability of plant nutrients to the plant. However, pH values below 3 or above 9, will seriously affect, and reduce the nutrient uptake by a plant.

Soil forms located within the project area are neutral to slightly alkaline (7.0 to 8.3). It should however be noted that some of the soils derived from intrusive material will tend to be more alkaline than indicated by these results due to the potential buffering capacity of the moderately high levels of calcium carbonate. This may affect the pH of the soils to some extent. It is unlikely however, that they will be dramatically impaired.

Soil salinity/sodicity

Salinity and/or sodicity are important as it influences the soils potential to sustain growth. Highly saline soils will result in the reduction of plant growth caused by the diversion of plant energy from normal physiological processes, to those involved in the acquisition of water under highly stressed conditions.

The sodium adsorption ratio (SAR) is an indication of the effect of sodium on the soils. At high levels of exchangeable sodium, certain clay minerals, when saturated with sodium, swell markedly. With the swelling and dispersion of a sodic soil, pore spaces become blocked and infiltration rates and permeability are greatly reduced. The critical SAR for poorly drained (grey coloured) soils is 6, for slowly draining clays it is 10 and for well drained, (red and yellow) soils and recent sands, 15.

Generally, the soils forms located within the project area are saline in character, and may become susceptible to an increase in salinity if their water regime is not well managed. In addition these soil forms are slow draining.

Soil fertility

The soils identified in the converted mining rights area returned moderate to high levels of some of the nutrients required for good plant growth, although zinc, phosphorus and potassium are generally lower than the optimum required, and the soil depths are inhibiting due to the extreme soil structure. Significantly large areas of soil with an acceptable level of plant nutrition are not generally considered to be of an arable land capability rating (strongly structured black tuffs).

There are no indications of any toxic elements that are likely to limit natural plant growth in the soil forms located within the project area although the nitrate levels are generally higher than the average and at exceptionally high values could pose a problem. Fairly standard fertilizer treatments will be needed for optimum agricultural production of crops on areas that have previously been planted, with exceptionally good water management being of paramount importance on both dryland as well as irrigated lands.

Nutrient Storage and Cation Exchange Capacity (CEC)

The potential for a soil to retain and supply nutrients can be assessed by measuring the cation exchange capacity (CEC) of the soils. The low organic carbon content is balanced to some extent by the high clay content which naturally provides exchange sites that serve as nutrient stores. These conditions will result in a moderate retention and supply of nutrients for plant growth. Low CEC values are an indication of soils lacking organic matter and clay minerals. Typically a soil rich in humus will have a CEC of 300 me/100g (>30 me/%), while a soil low in organic matter and clay may have a CEC of 1-5 me/100g (<5 me/%). Generally, the CEC values for the soils forms located within the project area are high, due to the high clay content.

Soil physical characteristics

Soil distribution

The distribution of the soils (refer to Figure 7) is closely linked to the topography and parent materials from which they are derived. The better drained soils are generally associated with a less basic parent material; while the more structured and more clay rich (less easily drained) soils are associated with the intrusive, basic parent material which underlay the majority of the study area.

Soil erodability

The majority of the soils identified in the mining lease area can be classified as having a moderate erodibility index (Table 16). This is largely ascribed to the generally low organic carbon content and the sensitivity of the soils (solubility of calcium). These factors are offset by the generally gentle to flat topography and the high clay contents. The vulnerability of the "B" horizon to erosion once/if the topsoil is removed must not be underestimated.

The wet and highly structured soils are susceptible to compaction due to the swelling clays that are common in the majority of the materials classified. These soils will need to be managed extremely well, both, during the stripping operation, as well as during the stockpiling/storage and rehabilitation stages.

The concerns around erosion and compaction are directly related to the fact that the protective vegetation cover and topsoil will be disturbed during any mining or construction operation. Once disturbed, the actions of wind and water are increased. Loss of soil (topsoil and subsoil) is extremely costly to any operation, and is generally only evident at closure or when rehabilitation operations are compromised.

Well planned management actions during the construction and operational phases will save time and money in the long run, and will have an impact on the ability to successfully “close” an operation once completed.

TABLE 16: ERODIBILITY OF DIFFERENT SOIL TYPES (SLR, 2011)

Soil Form	Erodibility Index	Index of Erosion (I.O.E.)
Sterkspruit	Moderate	1.40 – 1.60
Mayo	Moderate to High	1.40 – 1.65
Arcadia	Moderate	1.40 – 1.65
Sepane	Moderate	1.40 – 1.65
Rensburg	Moderate	1.40 – 1.65
Outcrop	Very Low	<0.15
Swartland	Moderate to High	1.40 – 1.65
Sterkspruit	Moderate	1.40 – 1.60
Glenrosa	Moderate to High	1.40 – 1.65
Kroonstad	Moderate	1.40 – 1.65
Sepane	Moderate	1.40 – 1.65

Dry land production potential

At the extreme of poor quality shallow soils the dryland production potential of the shallow Sterkspruit and Mayo Form soils are poor to very poor. These soils rate as moderate to poor quality grazing land capability under dryland conditions.

Irrigation potential

The irrigation potential for the soils is at best “poor” in terms of the soil structure and drainage capability. Irrigation is practiced within the project area. However, the spatial distribution of the soils with adequate soil rooting depths will limit the size of the areas that can be cultivated, thereby limiting the potential for economic irrigation farming.

Soil utilisation potential

In general, the soils will require rehabilitation, are moderate to shallow, (ERD = 400 mm to 600 mm), generally poorly drained, with a susceptibility to erosion and compaction. The wet based and structured soils will be difficult to work, both from a trafficability, workability, storage and rehabilitation point of view.

Compaction must be considered carefully as the working of the wet based and structured soils when wet (rainy season), will be detrimental and compaction will occur. The structure of the soil will affect their workability, and provision will need to be made for the timing of the stripping and rehabilitation works to be undertaken if the structural integrity of the soils are to be maintained.

The potential of the use of the hydromorphic soils for economic crop production and/or market gardening is at best poor, and should not be considered for anything other than as wilderness lands (preferred option). The potential for economic farming of the structured soils is considered at best to be “low

intensity grazing land”, while the production of high intensity market gardening or annual cropping that generates high returns is possible on these soils with good water and drainage management (high input costs).

Conclusion

Soil forms found within the converted mining rights area are predominately highly structured, relatively shallow soils with a high clay content which allows for high water retention. These soil forms are therefore not highly erodible but are susceptible to compaction as a result of water retention and swelling clays. Poor drainage capacity of these soil forms reduces the dry production potential as well as the irrigation potential. These soil forms are difficult to work and have a limited utilization potential. In addition, even though these soils are slightly alkaline in character and therefore promote good nutrient mobility, their soil fertility is low as a result of a deficit of key nutrients.

These soils will require appropriate management measures during construction and operation to prevent the loss of soil resources through pollution and erosion as soil resources form a crucial role during rehabilitation.

Land capabilities

Information in this section was sourced from the Impala consolation EMP report (SLR, 2011) for the Impala converted mining rights area.

Introduction and link to impact

The land capability classification is based on the soil properties and related potential to support various land use activities. Mining operations have the potential to significantly transform the land capability. To understand the basis of this potential impact, a baseline situational analysis is described below.

Data collection

Land capability within the project area was classified into different classes namely, wetland, arable land, grazing and wilderness by applying the classification system in terms of the South African Chamber of Mines Land Capability Rating System.

Results

The table provides the land capability for each infrastructure component footprint. Wilderness comprises 6 % of the total area to be affected, while only 15 % has a grazing capability. Land capability is mapped in Figure 8. The central STP is not material in this discussion because of its small size.

TABLE 17: LAND CAPABILITY IN THE PROJECT AREA

Land capability	Hectares
Shaft 18 complex (including STP)	
River	10.283
Wilderness	103.794
Wetland	14.952
Grazing	13.957
Linear infrastructure corridors	
Wilderness	44.990
Wetland	11.146
River	5.642
Grazing	19.688
Dam	0.497
Total	224.958

Conclusion

The current land capability within the project area is a mixture of grazing, wilderness, wetland and rivers. The land capability is dominated by wilderness use, with only 15 % suitable for grazing. The land capability within the project area will be changed with the establishment of surface infrastructure. Therefore, impact management and rehabilitation planning are required to achieve acceptable post rehabilitation land capabilities.

FIGURE 8: LAND CAPABILITY IN THE PROJECT AREA (SLR, 2011)

1.1.5 BIODIVERSITY BASELINE

Information in this section was sourced from the biodiversity specialist study (SAS, 2013).

Introduction and link to anticipated impact

Biodiversity refers to the fauna (animals) and flora (plants) on earth. According to the International Union for Conservation of Nature (IUCN) (2011), biodiversity is crucial for the functioning of ecosystems which provide us with products and services which sustain human life. Healthy ecosystems provide us with oxygen, food, fresh water, fertile soil, medicines, shelter, protection from storms and floods, stable climate and recreation. Biodiversity therefore has a direct impact on human health when considering (IUCN, 2011):

- Biodiversity is essential to global food security and nutrition and also serves as a safety-net to poor households during times of crisis
- Increased diversity of genes within species e.g. as represented by livestock breeds or strains of plants, reduces risk from diseases and increases potential to adapt to changing climates
- More than 70,000 plant species are used in traditional and modern medicine
- The value of global ecosystem services is estimated at \$16-\$64 trillion.

The establishment of project infrastructure as well as project-related activities have the potential to result in a loss of habitat through the destruction/disturbance of vegetation and/or contamination of soil and/or water resources, thereby reducing the occurrence of fauna and flora on site and in the surrounding areas.

The baseline information on biodiversity in the project area has been used to identify sensitive areas, to guide the project planning in order to avoid sensitive areas where possible, to determine how best to conserve the fauna and flora in the area and allow for proper rehabilitation of the site once mining ceases.

Data collection

SAS conducted a desktop survey to identify the fauna and flora potentially occurring in the project area. This was followed by field work:

- Field assessments were undertaken during March 2013, in order to determine the ecological status of the study area. A reconnaissance 'walkabout' was initially undertaken to determine the general habitat types found throughout the study area and, following this, specific study sites were chosen that were representative of the habitats found within the area
- Emphasis was placed on areas that may potentially support Red Data Listed (RDL) species
- Sites were investigated on foot in order to identify the occurrence of the dominant plant species and habitat diversities

- A Vegetation Index Score (VIS) was determined and the ecological state of each habitat unit defined within each assessment site. This enabled an accurate and consistent description of the Present Ecological State (PES) in the project area. The information gathered during these assessments also contributed to sensitivity mapping. The presence of any faunal inhabitants assessed through direct visual observation or identifying them through calls, tracks, scats and burrows, with emphasis being placed on determining if any RDL species occur within the project area.
- The Probability of Occurrence (POC) for each floral species of concern (2527AC, 2527CA and 2527CB) was determined using criteria such as habitat requirements and habitat disturbance
- A one day field assessment was conducted in October 2013 to assess the route of the proposed No 17 Shaft tailings pipeline corridor.

Results – Flora

National Guidelines

There are two recently developed national guidelines that have an impact on the project area. These are described below.

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 (SAS, 2013). 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 majority of the proposed linear and sewage infrastructure associated with the development, as well as the proposed No 18 Shaft, falls within an area earmarked for expansion of a National Protected Area. This mapping is shown in the biodiversity specialist reports provided in Appendix D.

The DEA, DMR, Chamber of Mines, South African Mining and Biodiversity Forum, and SANBI published the Mining and Biodiversity Guideline in 2013. This guideline provides explicit direction in terms of where mining-related impacts are legally prohibited, where biodiversity priority areas may present high risks for mining projects and where biodiversity may limit the potential for mining. The guideline distinguishes between four categories of biodiversity priority areas in relation to their importance from a biodiversity and ecosystem service point of view, as well as the implications for mining. These categories include (DEA *et al*, 2013):

- Legally Protected Areas
- Highest Biodiversity Importance
- High Biodiversity Importance
- Moderate Biodiversity Importance.

The project area covers some of the extent of High and Moderate Biodiversity Importance areas as follows (mapping provided in specialist report):

- The No 18 Shaft complex is located in a moderate biodiversity area with the eastern shaft block border touching on a high biodiversity area
- No 18 Shaft linear infrastructure is located in a moderate biodiversity area
- No 17 Shaft and proposed linear infrastructure is located in a high biodiversity area
- The central STP is not located in an area of biodiversity importance.

It should however be noted that these areas of biodiversity importance are surrounded by large areas of degraded land with low biodiversity importance.

High Biodiversity Importance areas include (DEA *et al*, 2013):

- Protected area buffer (including buffers around National Parks, World Heritage Sites and Nature Reserves)
- Trans frontier conservation Areas (remaining areas outside of formally proclaimed protected areas),
- Other identified priorities from provincial spatial biodiversity plans and high water yield areas, amongst others.

These areas are deemed to be important for conserving biodiversity, supporting or buffering other biodiversity priority areas, maintaining important ecosystem services for particular communities or the country as a whole. An environmental impact assessment should include an assessment of optimum, sustainable land use for a particular area and will determine the significance of the impact on biodiversity. Mining options may be limited in these areas, and red flags for mining projects are possible. Authorisations may set limits and specify biodiversity offsets that would be written into licence agreements and/or authorisations (SAS, 2013).

Moderate Biodiversity Importance areas include (DEA *et al*, 2013):

- Ecological Support Areas
- Vulnerable ecosystems and focus areas for protected area expansion.

Areas of Moderate Biodiversity Importance are considered to be at moderate risk from mining. EIAs and their associated specialist studies should focus on confirming the presence and significance of these biodiversity features, identifying features (e.g. threatened species) not included in the existing datasets, and on providing site-specific information to guide the application of the mitigation hierarchy. Authorisations may set limits and specify biodiversity offsets that would be written into licence agreements and/or authorisations (SAS, 2013).

National Vegetation Types

The proposed site for the No 18 Shaft and associated linear infrastructure routes, as well as the central STP is situated in Zeerust Thornveld. The proposed No 18 Shaft STP will be situated within the shaft bank. Zeerust Thornveld is recognised as Least Threatened, with less than four percent of this vegetation type statutorily conserved. Over 16 % is transformed mainly through cultivation. The distribution of this vegetation types extends along the plains of the North West province from the Lobatsi River in the west via Zeerust, Groot Marico and Mabaalstad to the flats between the Pilanesberg and the western end of the Magaliesberg in the east. This is a deciduous region that is open to short thorny woodland dominated species such as the *Acacia* species with a grassy herbaceous layer.

Sections of the proposed the proposed No 17 Shaft linear infrastructure, the shaft itself and proposed STP is situated in Marikana Thornveld, which is regionally considered to be a more sensitive vegetation type than the Zeerust Thornveld. This vegetation type is more open to the *Acacia karroo* woodlands.

The National Environmental Management: Biodiversity Act (Act 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. According to the National List of Threatened Terrestrial Ecosystems (2011) Marikana Thornveld Ecosystem is listed as vulnerable (SAS, 2013).

Habitat in the Project Area

According to SAS, there are four main habitat or units within the project area – refer to Figure 9 for a map showing these habitats. Table 18 provides a description of these habitats and lists common species, conservation species and describes the current state of these habitats.

TABLE 18: DESCRIPTION OF HABITAT TYPES WITHIN THE PROJECT AREA (SAS, 2013)

Habitat	Condition	Dominant species (amongst others)	Red Data or Protected Species
Impacted Bushveld	<p>Decrease in floral diversity as result of edge effects from mining to the south, urbanisation to the west and ploughing, crop cultivation, overgrazing, livestock trampling and timber harvesting.</p> <p>Low ecological sensitivity and low conservation value.</p> <p>Rocky areas have moderate ecological sensitivity and have slightly higher present ecological status because these areas have not been previously cultivated.</p> <p>Class D – largely modified.</p>	<p><i>Acacia karoo</i></p> <p><i>Acacia caffra</i></p> <p><i>Acacia tortilis</i></p> <p><i>Acacia melifera</i></p> <p><i>Acacia nilotica</i></p> <p><i>Grewia flava</i></p> <p><i>Dichrostachys cinerea</i></p> <p><i>Aristida bipartite</i></p> <p><i>Eragrostis lehmanniana</i></p> <p><i>Cucumis zeyheri</i></p> <p><i>Tubina elongate</i></p> <p><i>Crabbea hisuta</i></p> <p><i>Hibiscus trionum*</i></p> <p><i>Zinnia pervuviana*</i></p> <p><i>Schkuria pinnata*</i></p> <p><i>Sesbania bisponosa*</i></p>	<p><i>Sclerocarya birrea</i> subsp. <i>africana</i> – protected under Nationals Forests Act (Act 84 of 1998)</p>
Rocky Outcrop	<p>High ecological functionality and intact habitat integrity.</p> <p>Provides habitat for high faunal diversity, which may include red data avifauna and reptile species.</p> <p>Contributes to provide migratory habitat within the</p>	<p><i>Sclerocarya birrea</i> subsp. <i>Africana</i></p> <p><i>Pappea capensis</i></p> <p><i>Combretum molle</i></p> <p><i>Peltophorum africanum</i></p> <p><i>Rhus leptodictya</i></p>	<p><i>Sclerocarya birrea</i> subsp. <i>africana</i> – protected under Nationals Forests Act (Act 84 of 1998).</p> <p>Other possible species include:</p> <p><i>Aloe peglerae</i></p>

Habitat	Condition	Dominant species (amongst others)	Red Data or Protected Species
	area. High ecological sensitivity. Class B – largely natural with few modifications.	<i>Vangueria infausta</i> <i>Faurea saligna</i> <i>Croton gratissimus</i> <i>Ziziphus mucronata</i> <i>Rhoicissus tridentate</i> <i>Pallea calamelanos</i> <i>Grewsia flanscens</i> <i>Heteropogon contortus</i> <i>Cymbopogon plurinoides</i> <i>Elionurus muticus</i> <i>Panicum maximum</i>	<i>Frithia pulchra</i> <i>Andromischus umbraticola</i> subsp. <i>umbraticola</i>
Wetland	Contributes to faunal migratory connectivity. Provides ecosystem services. Provides unique habitat for faun and flora. High ecological sensitivity. Class C – moderately modified.	<i>Datura stramonium</i> * <i>Datura stramonium</i> * <i>Sesbania bispinosa</i> * <i>Tagetes minuta</i> * <i>Setaria pallide-fusca</i> <i>Setaria schinzii</i>	Possible species: <i>Boophane disticha</i> – IUCN orange listed
Transformed habitat	Completely transformed by mining and agricultural activities. Low ecological sensitivity and conservation value. Class F – modified completely.	n/a	n/a

* Alien species

FIGURE 9: HABITATS WITHIN THE PROJECT AREA (SAS, 2013)

Conservation Important Plant Species

SAS conducted an assessment considering the presence of any plant species of concern, as well as suitable habitat to support such species. No red data species were identified in the project area during fieldwork. However all possibly occurring Red Data Listed species were identified using the Pretoria Computer Information System (PRECIS) for the quarter degrees 2527AC, SAS then determined the actual probability of occurrence using a set of criteria such as presence of suitable habitat – refer to the specialist report in Appendix D for more information on this determination. SAS determined that only *Boophane distichia* has a probability of occurring within the study area, and if present, these would be found in the less disturbed portions of the Impacted Bushveld and Wetland Habitat units.

The tree species, *Sclerocarya birrea* subsp. *africana* (Marula), is protected under the National Forests Act of 1998 (Act 84 of 1998) and was found in the study area within the Rocky Outcrop Habitat unit and in the rocky bushveld areas within the Impacts Bushveld Habitat unit.

In addition, *Spirostachys africana* (Tamboti) trees are known to occur in the area and are provincially protected under the Transvaal Nature Conservation Ordinance of 1983. However, it is unclear whether this act is still applicable. The North West Province Biodiversity Conservation Bill, which was published for comments under Notice Nr. 394, Provincial Gazette 6719, dated 23 December 2009, incorporates the old Transvaal Nature Conservation Ordinance of 1983, but the status of this Bill is also currently unclear (SAS, 2013).

FIGURE 10: SENSITIVITY MAP FOR THE STUDY AREA (SAS, 2013)

Plant Species with Medicinal or Cultural Value

SAS identified plant species with medicinal and/or cultural value and these are listed in the table below. It should be noted that medicinal plants are not necessarily indigenous species; in fact many are regarded as alien invasive species.

TABLE 19: COMMONLY KNOWN MEDICINAL/CULTURAL USE PLANTS IN THE PROJECT AREA (SAS, 2013)

Scientific Name	Common Name
<i>Sclerocarya birrea</i> subs. <i>africana</i> (P)	Marula
<i>Vernonia oligocephala</i>	Vernonia
<i>Tagetes minuta</i> **	Khaki Weed
<i>Acacia karroo</i>	Sweet - thorn
<i>Acacia fruticosa</i>	Milk weed
<i>Pallea calomelanos</i>	Hard fern
<i>Scabiosa columbaria</i>	Wild scabious
<i>Ziziphus mucronata</i>	Buffalow thorn
<i>Datura stramonium</i>	Thornapple
<i>Dichrostachys cinerea</i>	Sickle bush
<i>Dombeya rotundiflora</i>	Wild pear
<i>Elephantorrhiza elephantine</i>	Elandsbean
<i>Rhoicissus tridentata</i> subsp. <i>cuneifolia</i>	Bushman's Grape

** indicate weeds; P = protected

Results – Vertebrate fauna

Mammals

Six mammal species were directly observed during fieldwork and included the Cape spiny mouse, Swamp musk shrew, Yellow mongoose, Steenbok, Single-striped mouse and Scrub hare. However, common livestock were also observed. Other mammals which may utilise the project area include the Slender mongoose, Common duiker, While-tailed mongoose, Caracal, Serval, South African Porcupine and Black backed jackal. All of these mammals are considered Least Concern by the International Union for Conservation of Nature (IUCN). The study area is situated relatively close to the Pilanesburg National Park and therefore other animals may utilise the project area for foraging and as a migration corridor.

No Red Data or threatened mammals were identified in the project area, nor are any likely to occur due to the high levels of anthropogenic activity, historic and current mining activity and human settlements to the south and east of the project area, as well as use of the land for communal grazing (SAS, 2013).

Birds

According to SAS (2013), the project area is situated between two Important Bird Areas, namely the Pilanesburg National Park in the north and the Magaliesburg/Witwatersrand in the South. The project area falls outside these areas, however it should be noted that birds from these areas may utilise the project area as foraging habitat. 43 bird species were observed during fieldwork; however all of these have a Least Concern status in terms of the IUCN. It is however considered likely that some Red Data species may utilise the project area for foraging or for migration. Threatened species likely to utilise the

project area include the African grass owl, Peregrine falcon, Martial eagle, Secretary bird, Cape vulture, Kori bustard and Red winged pratincole (SAS, 2013).

Reptiles

Two reptiles were observed during fieldwork, namely the Variable skink and Southern rock agama. Other common species known to occur in the vicinity include the Flap necked chameleon, Puff adder, Cape cobra, Southern Rock agama, African striped skink and Boomslang (SAS, 2013). None of these species are considered to be threatened by the IUCN. One Red Data species, the South African python, is likely to occur on the project area, and if present this snake will be restricted to areas within the vicinity of the Rocky Outcrop and Wetland Habitat units.

Frogs

No amphibians were encountered during fieldwork. Common species which may occur along drainage lines in the project area include the Plain grass frog, Common river frog, Common caco, Red toad, Tremolo sand frog, Bubbling kassina, Guttural toad, Natal sand frog, Knocking sand frog and the Striped grass frog. None of these species are considered to be threatened. There is a low possibility of the African bullfrog (listed as being of concern in North West Province but Least Concern by IUCN), and other Red Data species in the project area (SAS, 2013).

Invertebrates

SAS conducted a general assessment with the purpose of identifying common species and taxa in the project area. Various butterflies, moths, grass hoppers, crickets, bees, wasps, beetles and stick insects were observed, however none of these invertebrates are Red Data listed.

With regard to spiders, only the Band legged golden orb-web spider and the Funnel web spider were observed on site. No scorpions were encountered. No evidence was found of the South African National Biodiversity Institute (SANBI) endangered or threatened Mygalomorphae arachnids which includes Baboon and Trapdoor spiders, however it is noted that these species are difficult to detect.

Results - Wetlands

A wetland is defined by the NWA as an area including physical structure and associated vegetation of areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation species with a composition and physical structure distinct from those adjacent areas (SAS, 2013).

SAS consulted the SANBI Wetland Inventory (2006) and the National Freshwater Ecosystem Priority Areas (NFEPA) (2011) database to define the aquatic ecology of the rivers systems in the project area that may be of ecological importance. The following points are noteworthy (SAS, 2013):

- The project areas falls within the Crocodile (West) and Marico Water Management Area (WMA) and the Elands sub-WMA
- The Elands sub-WMA is not listed as a fish Freshwater Ecosystem Priority Area (FEPA) and is not regarded as important in terms of fish sanctuaries, rehabilitation or corridors, nor in terms of relocation zones for fish
- The Leragane River is perennial and classified as Class D (largely modified), nor is it classified as a flagship river or as a FEPA river
- The Molapongwamongana River is non-perennial and classified as Class D (largely modified), nor is it classified as a flagship river or as a FEPA river
- No wetland features as indicated by the NFEPA database (2011) are crossed or contained within the project area.

SAS identified eight (watercourse associated) wetlands with low ecological significance within the project area – refer to Figure 11. This figure also shows appropriate buffer zones. According to SAS, most of the drainage lines present in the project area are considered to be non-perennial drainage lines that are poorly defined and may be classified as unchanneled valley bottom wetlands. All wetland features present have been significantly impacted upon by surrounding historical agricultural activities (SAS, 2013). The wetlands are discussed below with reference to the levels of ecosystem services they provide, condition and Present Ecological State (PES). Ecosystem services offered by wetlands include (SAS, 2013):

- Flood attenuation
- Stream flow regulation
- Sediment trapping
- Phosphate, nitrate and toxicant assimilation
- Erosion control
- Biodiversity maintenance
- Carbon storage
- Water supply

- Harvestable resources
- Cultivated foods
- Cultural significance
- Tourism and recreation
- Education and research.

SAS assessed the wetland vegetation components as part of the wetland study. Refer to Appendix D for the list of plant species identified, which included terrestrial species.

An Ecological Management Class (EMC) of Class C – moderately modified, was determined as both the current status and the aim for all the wetland features identified to enhance and maintain current ecology and functionality. It is however noted that catchment wide impacts on the drainage system may hamper the attainment of this EMC objective (SAS, 2013).

TABLE 20: LOW ECOLOGICAL SIGNIFICANCE WETLAND FEATURES (SAS, 2013)

Wetland	Type	Description	Ecoservice provision	Condition
Wetland 1	Channelled valley bottom	Poorly developed, weakly channelled wetland associated with an unnamed tributary of the Leragane River.	Moderately low. Most important services include flood attenuation and sediment trapping.	Class C – moderately modified. Main modifiers are cattle grazing, terrestrial floral encroachment and historical agricultural activities in the immediate vicinity.
Wetland crossing A	Unchanneled valley bottom	Forms part of a tributary of the Leragane River.	Intermediate. Most important services include erosion and sediment control, flood attenuation during wet and dry seasons and stream flow regulation.	Class C – moderately modified. Main modifiers include encroachment by terrestrial floral species, and mining activities in the vicinity.
Wetland crossing B	Channelled valley bottom	Forms part of a tributary of the Leragane River.	Moderately low. Most important services include flood attenuation, sediment trapping and provides potential habitat for fauna and flora.	Class C – moderately modified. Main modifiers are cattle grazing and trampling and historical agricultural activities in the immediate vicinity.
Wetland crossings C, D, E, F, G	Unchanneled valley bottom	Wetland crossings C, D, E and F are unnamed tributaries of the Leragane River. Wetland crossing G comprises a tributary of the Molapongwamongana River.	Moderately low. Most important services are flood attenuation, sediment trapping and erosion control.	Class C – moderately modified. Main modifier is agricultural activities.

FIGURE 11: LOW ECOLOGICAL SIGNIFICANCE WATERCOURSE ASSOCIATED WETLANDS IDENTIFIED IN THE PROJECT AREA (SAS, 2013)

Results – Biodiversity Sensitivity

SAS has mapped sensitive areas (refer to Figure 10) using the floral integrity and diversity encountered during the assessment of the project area. The assessment shows (SAS, 2013):

- Portions of the project area consist of Rocky Outcrop Habitat Unit with intact habitat structure and good ecological functioning
- A number of watercourse associated wetlands are present throughout the project area. In general, wetland areas are regarded as being of higher ecological sensitivity due to their contribution to faunal migratory connectivity, wetland eco-services provision and the unique habitat provided for faunal and floral species. It should however be noted that these wetlands have been determined to be of low ecological significance
- The rocky bushveld areas that have seen fewer disturbances than the surrounding historical agricultural fields, comprising the Impacted Bushveld Habitat Unit, are deemed to be of moderate ecological sensitivity, due to habitat structure being largely intact. Protected *Sclerocarya birrea* subsp. *africana* trees associated with these areas (as well as within the Rocky Outcrop Habitat Unit) were noted within and adjacent to the project area during the field assessment
- The Impacted Bushveld Habitat Unit, covering the largest portion of the project area and the Transformed Habitat Unit has a low ecological sensitivity.

In addition, the Mining Biodiversity Guidelines and NPAES areas relevant to the project area were also taken into account in developing the sensitivity mapping.

Potchefstroom University conducted a study covering the entire surface area used by Impala in order to understand the current status of the biodiversity in these areas. This study identified six core conservation areas of high biodiversity on the basis of the occurrence of Red data species and species density and diversity. Agreenco Environmental subsequently conducted a new biodiversity study which takes into account the Mining and Biodiversity Guidelines. This study revised the core conservation areas by considering the SANBI priority areas identified in the Mining and Biodiversity Guidelines, as well as other factors such as habitat irreplaceability and ecosystem services. These core conservation areas are shown in Figure 12, in relation to the proposed project infrastructure. As shown in Figure 12, a portion of the proposed No 18 Shaft complex and one component of associated linear infrastructure extending to the north-west do encroach on an identified core conservation area. In addition, the existing No 17 Shaft touches on the boundary of a core conservation area, as does the proposed sewage pipeline to No 17 Shaft. Development within these areas must be aimed at minimising the area of surface disturbance as far as practically possible.

FIGURE 12: HIGH BIODIVERSITY AREAS (AGREENCO, 2013)

Conclusion

The project area includes threatened ecosystem, NPAES areas as well as High and Moderate Biodiversity areas in terms of the recently published Mining Biodiversity Guidelines. In addition, some of the project components encroach slightly on core conservation areas identified by the Agreeco study (2013). There are a number of conservation important faunal and floral species within the project area. In addition, various areas of high ecosystem function and significance as well as several watercourse associated wetlands have been identified within the project area. It should however be noted that the wetlands associated with the watercourses identified in the project area have been determined to have low ecological significance. This information was provided to the project team in an effort to avoid areas of high significance, or where this was not possible, to minimize the impact on these areas.

1.1.6 HYDROLOGY BASELINE

The information in this section was sourced from the specialist hydrology study conducted by SLR in August 2013 (Appendix E).

Introduction and link to anticipated impact

Surface water resources include drainage lines and paths of preferential flow of stormwater runoff. Project-related activities have the potential to alter the drainage of surface water through the establishment of both temporary (such as shaft infrastructure and support facilities) and permanent infrastructure (such as waste rock dumps) and/or result in the contamination of the surface water resources through seepage and/or spillage of potentially polluting materials, non-mineralised waste (general and hazardous) and mineralised wastes. Key to understanding the hydrology of the site is the climatic conditions of the site. As a baseline, this section provides an understanding of the hydrological catchments that could be affected by the project and the status of surface water resources in the project area.

Data collection

Data used in determining the hydrological characteristics include climatic data (section 1.1.2) and topographical data (section 1.1.3). Rainfall and evaporation data for the shaft sites was considered from various sources including weather stations managed by both the South African Weather Services (SAWS) and the Department of Water Affairs (DWA). The Boschpoort weather station was used for both rainfall and evaporative data and is situated approximately 16 km east of the Impala site, and 18 km south-east of the proposed No 18 shaft complex..

Design rainfall depths for various return periods and storm durations were sourced from the Design Rainfall Estimation Software for South Africa, developed by the University of Natal in 2002 as part of a WRC project K5/1060 (Smithers and Schulze, 2002 as cited in SLR, 2013). This method uses a Regional L-Moment Algorithm in conjunction with a Scale Invariance (RLMA&SI) approach to provide site

specific estimates of depth-duration-frequency (DDF) rainfall, based on surrounding observed records. This method of DDF rainfall estimation is considered more robust than previous single site methods.

Natural sub catchments were delineated for the shaft site. For this purpose, site survey data as well as ASTER elevation data were used. ASTER data is a product of Japan's Ministry of Economy, Trade and industry (METI) and America's National Aeronautics and Space Administration (NASA). The Rational Method was then applied in order to calculate flood peaks for the delineated sub catchments. This method was selected to be appropriate since by using it, a combined approach could be implemented whereby flow in the headwaters of the sub catchment could be calculated assuming dominant overland flow regime, while in the lower reaches, flow could be calculated with channel flow as the dominant regime. Furthermore, a spread sheet based implementation of the Rational method allows for the inclusion of RLMA&SI depth-duration-frequency (DDF) estimates. The spreadsheet implementation of the rational method as applied in this project, is based upon the approach adopted in the Drainage Manual (SANRAL, 2006). While the Rational method is a simplistic method of peak flow estimation, a modification to the method, which includes a composite estimation of the runoff coefficient, allows for the influence of slope, soil permeability, vegetation and land cover (e.g. residential houses or heavy industry) to be considered. Furthermore, the time of concentration is explicitly calculated, enabling a more realistic estimation of the DDF design rainfall event.

Results

Surface drainage and mean annual runoff

The Impala converted mining rights area is located in the Limpopo Basin, in the catchment of the Crocodile River. Drainage into the Crocodile River is along two routes, via the Elands and Hex Rivers. The proposed project area falls within the A22F quaternary catchment.

A tributary of the non-perennial Leragane stream has the start of its reach in the footprint of the No 18 Shaft complex. The Leragane stream flows into the Elands River, which ultimately flows into the Vaalkop Dam, which is situated on the Crocodile River. No 18 Shaft linear infrastructure crosses tributaries of the Leragane Stream in various locations. Water quality in the Leragane Stream at a point close to the proposed shaft showed exceedance of the relevant guidelines of Electrical conductivity, Chloride, sulphate, Fluoride, Nitrate, Calcium, Magnesium, Sodium, Lead, Iron and Manganese.

A tributary of the Rasekanyane stream has the start of its reach to the east of the No 17 Shaft complex. The proposed No 17 Shaft linear infrastructure crosses tributaries in various locations.

There are no watercourses in the immediate vicinity of the proposed central STP.

The No 18 Shaft site lies within the headwaters of the sub-catchment and consequently, the nearby non-perennial watercourses as defined by the 1:50,000 topographical map can be considered to have limited flow even during heavy rainfall (due to the absence of large upstream contributing areas). Natural sub catchments were delineated for the shaft site according to Figure 13. The characteristics of these catchments are provided in the table below.

TABLE 21: SUBCATCHMENT CHARACTERISTICS (SLR, 2013)

Description	A	B	C
Sub catchment Area (km ²)	5.1	2.3	8.5
Runoff Coefficient for the 1 in 100 year event	0.34	0.34	0.34
Time of Concentration (min)	103	62	110
Rainfall Intensity (mm/h) for the 1 in 100 year event	135	130	138

The Mean Annual Runoff (MAR) for the total catchment area associated with the anticipated area of containment for the No 18 Shaft complex (linear infrastructure is not considered relevant to this discussion due to the limited surface area) was estimated using rainfall-runoff response parameters from WR2005. The rainfall-runoff response of the catchment was assumed to be the same as the regional rainfall-runoff response as determined for the quaternary catchment in which the mine falls. Using the WR2005 quaternary catchments dataset, and an estimated 0.79km² of runoff being contained, it is expected that approximately 0.0067 million m³ of the quaternary catchments 14.4 million m³ Mean Annual Runoff (MAR), will be held back. This accounts for 0.047 % of the MAR for quaternary catchment A22F.

FIGURE 13: HYDROLOGY AND TOPOGRAPHY (SLR, 2013)

Catchment peak flow estimates

Design rainfall depths associated with each catchment were required to be determined through a depth-duration-frequency approach. This approach requires that both *duration* and *frequency* of rainfall be determined in order to arrive at a design rainfall *depth*. Frequency directly relates to the return periods of the event. *Duration* is defined through the estimation of the critical storm duration for each subcatchment, estimated by calculating the time of concentration for individual subcatchments. The time of concentration was calculated through the application of the TR-55 methodology. This methodology improves on other empirical estimates of the time of concentration, through the division of a catchment into three primary flow processes of sheet flow, shallow concentrated flow and open channel flow. This subdivision enables the application of an empirical method particular to a specific flow process, in contrast to the single primary flow approaches which have traditionally been used in the past.

With the time of concentration, and thereby the design rainfall duration calculated, subcatchment specific critical storm depths for return periods of interest were derived from the output of the RLMA&SI method as implemented in the Design Rainfall for South Africa software (Smithers and Schulze, 2002). The RLMA&SI methodology provides an average estimate, lower estimate and upper estimate. The application of the average estimates are most easy to validate (in that they are neither of the two extremes) and that the average RLMA&SI estimates exceeded the Hydrological Response Unit (HRU) estimates (up to the 1 in 50 year event), it was decided that the average RLMA&SI estimate would be used.

The calculated rainfall depths were subsequently converted into rainfall intensities (mm/hr.), which through the inclusion of a sub catchment specific runoff coefficient, and sub catchment area (km²) enabled the application of the Rational Method in order to calculate the design peak flows provided in Table 22.

TABLE 22: DESIGN PEAK FLOWS (SLR, 2013)

Culvert	Peak Flow (m ³ /s) associated with RP						
	1in2	1in5	1in10	1in20	1in50	1in100	1in200
Sub- A	20.46	30.01	38.32	48.27	65.41	83.23	112.22
Sub-B	9.02	13.22	16.88	21.28	28.83	36.69	49.44
Sub- C	35.03	51.40	65.63	82.63	111.99	142.50	192.18

It should be noted that the development of the No 18 Shaft complex will change the baseline conditions presented in Table 22 since the area of the sub catchments will be reduced due to the containment of dirty water generating areas. This change is primarily associated with sub catchments B and C.

Floodlines

The floodlines were determined for the entire Impala converted mining rights by SLR in 2010 as cited in SLR 2013 (Appendix E). This information has been used for the current shafts project. The floodlines

are presented in relation to the proposed infrastructure in Figure 14. Every effort has been made to prevent the placement of infrastructure within the 1:100 year floodlines and the 100 m offset. However No 18 Shaft complex is positioned at the upstream end of the non-perennial watercourse located there. The relevant authorisations will be applied for in terms of the National Water Act of 1998.

Proposed linear infrastructure corridors cross streams in various locations – refer to Figure 14.

Water quality

Impala has an on-going monitoring programme for surface water for the current mining operations. The purpose of this monitoring programme is to assess the potential impact of specific mining related activities, as well as the cumulative impact of the operation on receiving water resources. The monitoring locations are presented in Figure 36.

15 surface water monitoring locations make up the surface water monitoring network. The majority of these points are located on the Legadigadi, Leragane and Eland rivers and the smaller tributaries thereof with and including the Rockwall dam. 18 years of monitoring data has been statistically analysed. From the statistical summary of the water quality results, the following parameters were elevated at times based on their mean values to exceed the DWA Domestic Use (DU) guideline (note that spikes of higher concentrations were recorded periodically): pH, Electrical conductivity and total dissolved solids, Chloride, Sulphate, Fluoride, Nitrate, Calcium, Magnesium, Sodium, Iron, Manganese and Ammonium. In terms of the monitored water qualities, the indications are that mining activities do have an impact on surface water quality. The water quality in the Leragane River, including the Rockwall Dam is noticeably worse than the other streams monitored (SLR, 2011).

A monitoring point is located in the Leragane Stream up-stream and to the west of the No 18 Shaft (point number 29) and a point further downstream of the No 18 Shaft (point number 52) – refer to Figure 36 for the location of these monitoring points. Monitoring results for these points for various parameters from 1994 was statistically analysed and the mean values were compared to the relevant guidelines. The results are shown in Table 23, with exceedance of the relevant guideline shown in red. This table shows exceedance of the relevant guidelines for the mean values of Electrical conductivity, Chloride, sulphate, Fluoride, Nitrate, Calcium, Magnesium, Sodium, Lead, Iron and Manganese for both monitoring points.

FIGURE 14: FLOODLINES IN THE PROJECT AREA (SLR, 2013)

TABLE 23: WATER QUALITY AT SELECTED SURFACE WATER MONITORING POINTS

Monitoring Point	Description of sample		pH	EC	Cl	SO4	F	PO4	NO3	TDS	SS	Alk	Hard	Ca	Mg	Na	K	NH4	Pb	Fe	Ni	Zn	Cu	Mn	AL	COD	
				mS/m	mg/l	mg/l	mg/l	mg/l as P	mg/l as N	mg/l	mg/l	mg/l as CaCO3	mg/l as CaCO3	mg/l	mg/l	mg/l	mg/l	mg/l as N	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	
		Domestic WQ Guidelines	6-9	<70	<100	<200	<1		<6						<32	<30	<100		<1	<0.01	<0.1		<3	<1	<0.05		
		WHO Drinking water (2008)			250		1.5		11.3						300		200			0.0		0.07		2.00	0.40		
		IFC Mining Effluent																	0.2	2.0	0.50	0.50	0.30				
		SANS class I		<150	<200	<0.02	<0.1		<10	<1000				<150	<70	<200	<50		<0.02	<0.2	<150	<5	<1	<0.1	<300		
		SANS class II		150 - 370	200-600	0.02-0.05	1.0-1.5		10-20.	100-2400				150-300	70-100	200-400	50-100		0.02-0.05	0.2-2	0.15-0.35	5-10.	1-2.	0.1-1	3 - 500		
		Livestock watering			0-3000	0-0.1			0-1000	0-2000				0-1000	0-500	0-2000			0-0.1	0-10	0-1	0-20	0-1	0-10	0-5		
29	LER.OUT	Mean	8.26	208.0	284.3	382.3	1.4	0.3	39.4	1676.7	46.3	219.0	842.1	123.5	128.4	129.4	14.7	0.143	0.116	0.241	0.058	0.052	0.055	0.113	0.700	33.00	
		Max	9.20	441.0	945.0	1125.0	10.7	3.7	135.5	5150.0	265.0	420.0	1635.0	400.0	250.0	295.0	90.0	1.300	0.500	2.300	0.100	0.100	0.100	2.210	1.890	60.00	
		Min	4.40	41.0	30.0	30.0	0.1	0.1	1.4	330.0	5.0	5.0	155.0	5.0	20.0	15.0	5.0	0.100	0.100	0.050	0.050	0.050	0.050	0.010	0.020	30.00	
		Standard Deviation	0.5	84.8	149.8	244.5	1.6	0.5	27.2	836.3	48.9	74.5	338.4	75.4	50.6	71.1	14.6	0.2	0.1	0.4	0.0	0.0	0.0	0.3	0.8	9.5	
		Count	108.0	108.0	108.0	108.0	108.0	108.0	107.0	63.0	62.0	106.0	106.0	108.0	108.0	107.0	102.0	67.0	63.0	43.0	43.0	43.0	43.0	43.0	5.0	10.0	
52	LER.ELANDS	Mean	8.18	242.7	399.3	589.9	2.5	0.2	22.4	1789.3	84.0	140.0	946.1	172.1	132.1	180.8	22.4	0.156	0.101	0.175	0.063	0.057	0.055	0.101	1.543	-	
		Max	8.60	388.0	1715.0	1180.0	13.3	1.3	125.0	3070.0	710.0	245.0	2645.0	485.0	350.0	325.0	50.0	0.500	0.120	0.900	0.160	0.160	0.110	0.200	4.980	0.00	
		Min	7.40	17.0	10.0	5.0	0.4	0.1	0.4	180.0	5.0	65.0	95.0	20.0	10.0	5.0	5.0	0.100	0.100	0.050	0.050	0.050	0.050	0.010	0.100	0.00	
		Standard Deviation	0.3	102.5	276.7	337.2	2.5	0.2	23.0	866.1	179.0	44.5	493.7	98.2	65.9	91.9	12.2	0.1	0.0	0.2	0.0	0.0	0.0	0.1	2.3	-	
		Count	36.0	36.0	36.0	36.0	36.0	36.0	36.0	15.0	15.0	36.0	36.0	36.0	36.0	36.0	36.0	16.0	15.0	15.0	15.0	15.0	15.0	15.0	4.0	0.00	

Surface water use

Water could be abstracted both up and downstream of the mine for domestic purposes and livestock watering. The precise quantities of abstraction are unknown. It is unlikely that there is significant reliance for community consumption because of the fact that many of the watercourses are dry for most of the year and many of the communities receive reticulated water.

Conclusion

The nature of the Impala infrastructure and activities are such that they present real potential for pollution of water resources that in some cases may be used by third parties for domestic, recreation and/or agricultural purposes. Therefore mine operations and new projects must be managed/implemented in a way that pollution of water resources is prevented. Moreover, care is required to ensure that surface run-off patterns are disturbed as little as possible to promote the continued flows of water and nutrients.

The information regarding catchment characteristics and floodlines has been provided to the project team to develop the stormwater management plan and for planning the surface layout in order to avoid streams and floodlines as far as practically possible.

1.1.7 GROUNDWATER BASELINE

The information in this section was sourced from the groundwater study conducted by SLR (Appendix F).

Introduction and link to impacts

Groundwater is a valuable resource and is defined as water which is located beneath the ground surface in rock pore spaces and in the fractures of lithologic formations. Understanding the geology of the area provides a basis from which to understand the occurrence of groundwater resources. Project-related activities such as the development of the underground mining areas (to a depth of almost 2 km), the handling and storage of materials and handling and storage of mineralised and non-mineralised wastes have the potential to result in the loss of groundwater resources, both to the environment and third party users, through dewatering and pollution. As a baseline, this section provides an understanding of the current groundwater conditions (quality, quantity and use) and the potential for dewatering cones of depression and pollution plumes to occur as a result of project-related activities.

Data collection

Sources of data include the following:

- Review of existing reports, databases (Impala's monitoring database and the National Groundwater database) and maps
- A geophysical investigation conducted at the shaft site

- Hydrocensus studies of boreholes both within and outside of the project area
- Water quality sampling conducted during the hydrocensus
- Six new monitoring boreholes were drilled at the shaft site and these boreholes were pump tested to gain useful information with respect to characterising the aquifers – refer to Table 24 below.

TABLE 24: BOREHOLE INFORMATION INDICATING POSITION, STATIC WATER LEVEL AND WATER STRIKES (SLR, 2013)

BH_ID	Coordinates		Depth (m)	Water strike (m)	Water level (before pumping test) (mbgl)	Sampled
MWG 18-4	S 25°27'10.8"	E 27°14'00.5"	46	18	17.15	Yes
MWG 18-5	S 25°26'37.0"	E 27°13'04.1"	50	Dry	n.m	No
MWG 18-6	S 25°27'12.3"	E 27°13'14.5"	50	28	23.88	Yes
MWG 18-01	S 25°26'02.1"	E 27°13'33.5"	101	Dry	>60	No
MWG 18-02	S 25°25'54.6"	E 27°13'23.8"	101	36	31.40	Yes
MWG 18-03	S 25°26'06.4"	E 27°13'29.7"	101	Seepage	47.12	No

Results

Groundwater zones (aquifers) on site

The following two-layer aquifer model was used to conceptualise the Bushveld Complex aquifers at a regional scale (SLR, 2013):

- A shallow weathered aquifer system (i.e. intergranular water table aquifer) that may be laterally connected to alluvial aquifers associated with river systems
- A deeper, fractured bedrock aquifer system.

The shallow unconfined, phreatic (or water table) aquifer comprises of the saprolite (that formed as a result of intensive and in-situ weathering processes) to saprock (differentially weathered and fractured upper bedrock underlying the saprolite) zones. The soil and saprolite are collectively termed the regolith. The saprolite and saprock (classified as part of the bedrock) are generally treated as a single weathered aquifer unit, referred to as the weathered overburden, which varies in thickness from 12 to 50 m and is derived from the in-situ decomposition of the underlying noritic rocks. The weathered overburden is considered to have low to moderate transmissivity but high storativity.

The unweathered and fractured semi-confined bedrock aquifer consists of fractured norites, anorthosites and pyroxenites underlying the upper weathered aquifer. The intact bedrock matrix has a very low matrix hydraulic conductivity and its effective hydraulic conductivity is determined by fractures and mine voids. Water is generally stored and transmitted in fractures and fissures within a relatively impermeable matrix.

Groundwater occurrence in the Rustenburg Layered Suite of the Bushveld Igneous Complex (BIC) is associated mainly with deeply weathered and fractured mafic rocks. The groundwater yield potential is

classified as poor since most of the boreholes produce less than 2 l/s. Mafic rocks of the BIC tend to weather to a clay rich soil, which has low permeability and reduces the recharge to underlying aquifers. The aquifer system underlying Impala Platinum's mine lease area is described as an intergranular and fractured aquifer with borehole yields varying between 0.5 to 2 l/s.

Aquifer classification

The classification of the aquifer system underlying Impala's converted mine rights area is based on the following modified aquifer system management classes (Parsons and Conrad, 1998 as cited in SLR, 2013):

- Sole Aquifer System: An aquifer used to supply 50 % or more of urban domestic water for a given area and for which there are no reasonably available alternative sources of water. Major Aquifer System: A high-yielding aquifer system of good quality water.
- Minor Aquifer System: A moderately-yielding aquifer system of variable water quality (Although these aquifers seldom produce large quantities of water, they are important for local supplies and in supplying base flow to rivers).
- Poor Groundwater Region: A low to negligible yielding aquifer system of moderate to poor water quality.

Special Aquifer Region: An aquifer designated as such by the Minister of Water Affairs and Environment, after due process.

In terms of the Aquifer Classification Map of South Africa (Parsons and Conrad, 1998), the intergranular and fractured aquifer underlying Impala is classified as a minor aquifer region. However, this classification is only applicable to the heterogeneous and shallow, weathered and unconfined aquifer system. High yielding boreholes are found on occasion associated with zones of deep weathering or along geological features such as faults. However the classification as a minor aquifer system, particularly in the vicinity of proposed project components, is justified due to the low yields of the aquifer.

Groundwater flow

Vertical groundwater flow

The infiltration of water from the shallow weathered aquifer system to the deeper fractured bedrock aquifer system is strongly heterogeneous and requires permeable soils, or permeable horizons (i.e. 'infiltration routes'), as well as 'open' and interconnected fracture systems in the bedrock. If present, these fracture zones act as conduits for deeper flows from groundwater reservoirs located in upper permeable soils or the weathered overburden. The general fact that the weathered and alluvial aquifers along the river courses support most irrigation and domestic water-supply boreholes despite being undermined by existing mines indicates limited interaction between the shallow and deep aquifer systems. Moreover, even where there is vertical leakage the shallow aquifer has the potential to be

replenished relatively quickly during sustained rainfall periods. It follows that the dewatering impacts on the shallow weathered aquifer system are expected to be negligible away from the immediate vicinity of the mining areas, given the hydrogeological characteristics of the weathered aquifer and the spatial heterogeneity in hydraulic connectivity between the shallow weathered aquifer and the deeper fractured aquifer.

Horizontal groundwater flow

It can be assumed that the groundwater table follows the surface topography based on a very good correlation between the measured head and topography. In addition, horizontal groundwater flow is generally in accordance with surface water flow such that the regional groundwater flow is generally northwest and northwards towards the Elands River as well as south and southeast in the direction of the Bospoort Dam and Hex River. However, due to mine dewatering the local groundwater flow directions in the deeper fractured aquifer are generally re-directed towards the underground and open pit mines. This results in spatially different groundwater flow directions for the shallow and deeper aquifer systems.

Groundwater levels

Impala's Groundwater Database indicates that groundwater levels in the shallow weathered aquifer vary between 3.7 and 19.3 mbgl with an average depth of 6.8 mbgl. The groundwater level for the deeper fractured aquifer varies between 9.3 and 48.6 mbgl with an average depth of 21.8 mbgl.

Current groundwater quality

Impala has an on-going groundwater monitoring programme that consists of more than 80 sampling boreholes. The majority of these sampling boreholes are located within the converted mining rights area; however a few are located outside this area (Figure 35). Groundwater monitoring frequencies range from monthly to annually for groundwater, depending on the chemical analysis requirements. The majority of water samples are analyzed to determine the concentrations of major cations/anions as well as metals. The borehole water levels are recorded when groundwater samples are taken.

Approximately 18 years of data has been statistical analysed, and the following parameters were elevated at times based on their mean values to exceed the relevant DWA guideline (note that spikes of higher concentrations were recorded periodically): pH, Electrical conductivity and total dissolved solids, Chloride, Sulphate, Fluoride, Phosphate, Nitrate, Calcium, Magnesium, Sodium, Iron, Zinc, Copper, Manganese and Ammonium. It should however be noted that Aluminium was recorded at exactly 30mg/l in a few boreholes, therefore further monitoring is required to verify these values as it appears to be an error. The worst groundwater quality was recorded in the boreholes RGC1 – 3 and RGC10 – 16.2 which are located in the regions of Shaft 12, Shaft 14, Central concentrator-Smelter Complex, and Shaft 16.

The groundwater quality in project area presented a combination of water types (refer to Table 25):

- A Mg-Na-Ca-HCO₃ water facies that represents an evolved, ambient groundwater quality associated with the weathering of silicate and ferromagnesian minerals as a major source of mineralization.
- A Na-SO₄-HCO₃ water type that suggests an impact on the shallow groundwater due to mining activities.

TABLE 25: TDS AND SO₄ VALUES AND WATER TYPE FOR GROUNDWATER IN THE PROJECT AREA (SLR, 2013)

BH_ID	TDS (mg/l)	SO ₄ (mg/l)	Water Type	E.N.
MWG 18-04	810	409	Na-SO ₄ -Cl	-6.65
MWG 18-06	962	68	Mg-Ca-HCO ₃ -Cl	-5.63
MWG 18-02	362	26	Na-HCO ₃	0.67
Hand pump 1	676	52	Mg-Na-Ca-HCO ₃	6.01
Hand pump	762	129	Mg-Na-Ca-HCO ₃	1.67
New	596	38	Ca-Mg-Na-Cl-NO ₃	5.17
New 2	174	6	Ca-Mg-Na-HCO ₃ -Cl	-12.5

Note: hand pump points are community boreholes equipped with a hand pump

New 1 and 2 – unlabelled boreholes discovered during the hydrocensus.

FIGURE 15: HYDROCENSUS POINTS (SLR, 2013)

Groundwater users

More than half (52 %) of the boreholes within the Impala mining rights use area are used for groundwater monitoring while approximately 27 % of boreholes are used for domestic, irrigation or livestock watering. Use of groundwater for domestic purposes is generally limited because communities within and outside the Impala area generally have access to reticulated water supply.

From an ecological perspective, site investigations and modelling indicate that most of the recharge that enters the shallow weathered aquifer exits as outflow to rivers, indicating significant but temporal limited surface and groundwater interaction, especially after major rainfall events. The streams are generally non-perennial which means that they are generally only active during and after rain events.

Conclusion

The nature of the Impala infrastructure and activities are such that they present real potential for pollution of groundwater resources that in some cases may be used by third parties for domestic and/or agricultural uses. Depletion of groundwater levels within the converted mining rights area is limited. Therefore mine operations and new projects must be implemented/ managed in a way that pollution and reduction of groundwater resources is prevented.

1.1.8 AIR QUALITY BASELINE

Information in this section was sourced from the Impala consolidation EMP report (SLR, 2011).

Introduction and link to anticipated impact

Identification of 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 to nearby receptors. Potential receptor sites include the surrounding communities discussed in section 1.3.1 and the farm workers living in informal dwellings in the project area discussed in section 1.3.1.

Data collection

Data was obtained from the review of existing literature, available studies and monitoring data. In this regard the three data types are meteorological data (weather data), dust fallout data, and ambient pollution concentration data (PM 10). This data was obtained from various stations in and around Impala.

Results

Regional air quality

Rustenburg Local Municipality developed an Air Quality Management Plan for the municipal area in 2005. According to the main findings from the plan, major air pollution sources within Rustenburg include emissions from manufacturing and mining industries, townships and informal settlements and vehicle

activity. Primary atmospheric emissions released from these sources include sulphur dioxide (SO₂) nitrogen oxides (NO_x), carbon monoxide (CO), particulate matter (PM_{2.5} and PM₁₀) and Volatile Organic Compounds (VOCs). Secondary pollutants such as ozone (O₃) are formed in the atmosphere through the chemical transformation of precursors such as VOCs and NO_x. Heavy metals such as lead (Pb), chromium (Cr) and nickel (Ni) do also occur in the Rustenburg area due to mining and smelting activities.

The contribution of various sources of emission to ambient particulate and gaseous concentrations within the Rustenburg region is of interest given that elevated concentrations have been recorded. The most significant sources located within the Rustenburg region include (APP, 2011):

- Stack, vent and fugitive emissions from *industrial* operations - industrial emissions include various criteria pollutants (as SO₂, NO_x, CO and particulates), greenhouse gases (CO₂ and CH₄), volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), various heavy metals and other toxins such as dioxins and furans. Industries in the region include three platinum smelter operations: Anglo Platinum Smelter Operation (Waterval Smelter), Impala Platinum Smelter Plant and Lonmin (Western Platinum). Sources of emission at these operations typically include stack emissions, including main stack releases which comprise furnace and converter off gases, acid plant stack emissions and releases from flash dryer stacks. The furnace and converter operations are also associated with significant fugitive emissions. A number of ferrochrome smelter operations occur in the region. These include: International Ferro-metals near Mooi-nooi and Xstrata-Merafe Ferrochrome in Boshhoek, Rustenburg, and Wonderkop. Furnace stack emissions, furnace fugitives and baghouse stack releases represent the main sources at these operations. The induction furnaces at Joerg Foundry (Trek Engineering) represent a smaller source of industry-related emissions.
- Stack emissions from boiler operations - boiler stack emissions include particulates, NO_x, SO₂, CO, VOCs and CO₂. In addition to various smelter plants, boiler operations are also undertaken at Rainbow Chickens, Rustenburg Abattoir, MKTV Tobacco Limited, Rustenburg Provincial Hospital, British American Tobacco Products, Mageu Number One and Anglo Platinum Base Metals Refinery (BMR).
- Stack emissions from incineration operations - emissions include criteria gases (SO₂, NO_x, CO, lead and particulates), acid gases (hydrogen chloride, hydrogen bromide, hydrogen fluoride) metal gases (chromium, arsenic, cadmium, mercury, manganese, etc.) and dioxins and furans. Incineration operations are undertaken at Anglo Platinum Precious Metals Refinery (PMR), with medical waste incineration occurring at Ferncrest Hospital.
- Fugitive emissions from quarrying and mining operations - comprising mainly dust releases, with small amounts of NO_x, CO, SO₂, methane, CO₂ being released during blasting operations.
- Fugitive dust emissions from tailings impoundments which are associated with Anglo Platinum, Impala Platinum, Lonmin, Aquarius, Xstrata-Merafe, International Ferro-metals, Tharisa Minerals and Bafokeng Rasimone Platinum Mine.

- Vehicle tailpipe emissions - significant primary pollutants emitted by motor vehicles include CO₂, CO, hydrocarbons (HCs), SO₂, NO_x, particulate matter and lead.
- Household fuel combustion (coal, wood) - coal burning emits a large amount of gaseous and particulate pollutants including SO₂, heavy metals, total and respirable particulates including heavy metals and inorganic ash, CO, polycyclic aromatic hydrocarbons (PAHs), NO₂ and various toxins such as benzo(a)pyrene. Pollutants from wood burning include respirable particulates, NO₂, CO, PAHs, particulate benzo(a)pyrene and formaldehyde. Particulate emissions from wood burning have been found to contain about 50 % elemental carbon and about 50 % condensed hydrocarbons.
- Biomass burning - major pollutants from veld fires are particulates, CO and VOCs. The extent of NO_x emissions depend on combustion temperatures, with minor sulphur oxides being released.
- Various miscellaneous fugitive dust sources, including: agricultural activities, wind erosion of open areas, vehicle-entrainment of dust along paved and unpaved roads.

Ambient air pollutant concentrations within the Rustenburg region occur not only due to local source but also as a result of emissions from various remote sources. Regionally- transported air masses comprising well mixed concentrations of 'aged' (secondary) pollutants are known to represent a significant component of ambient fine particulate concentrations within the South African interior. Such air masses contain pollutants released from various remote sources including elevated releases from distant industrial operations and power generation facilities and large scale biomass burning in neighbouring countries. Typical pollutants which circulate within such regionally-transported polluted air masses include nitrates, ammonium nitrate and sulphates. The quantification of background particulate concentration, which is of particular importance given the nature of the proposed development, is complicated due to the large number of sources of this pollutant. Sources of particulates also include a significant proportion of fugitive emissions from diffuse sources (e.g. vehicle-entrained dust from roadways, wind-blown dust from stockpiles and open areas, dust generated by materials handling) which are more difficult to quantify than are emissions from a point source.

Local air quality

Impala has various monitoring stations, however the nearest monitoring station is situated at Ga-Luka. The operations and activities that currently contribute to the air pollution within the Impala converted mining rights area include:

- Point source emissions from listed activities at the smelter operations (stack and fugitive emissions)
- Ventilation emissions from underground mine workings (NO_x, CO and particulates)
- Materials handling operations (e.g. tipping of waste rock and ore and conveying of ore)
- Vehicle activity on paved and unpaved roads (during construction, operation and decommissioning)
- Wind erosion from exposed working surfaces
- Open cast operations

- Diesel generators
- Vehicle tail pipe emissions
- Crushing
- Dust generated from the tailings dams and spills along the delivery pipelines.

Project area

Monitoring data from the Luka monitoring station indicates that the existing PM10 concentrations are in exceedance of the relevant ambient standards.

Potential receptor sites

Potential receptor sites include the surrounding communities discussed in section 1.3.1 and the farm workers living in farm dwellings in the project area discussed in section 1.3.1.

Conclusion

This baseline information will be used to assess the impact of the proposed project. Given that ambient concentrations of PM10 are already elevated above the relevant ambient standards, the design of the project and air mitigation measures must be focussed on limiting any addition to the current ambient situation.

1.1.9 NOISE BASELINE

Information in this section was sourced from the noise specialist study (Acusolv 2013) (Appendix G).

Introduction and link to anticipated impact

Some of the noise generating activities associated with the project may cause an increase in ambient noise levels in and around the site. This may cause a disturbance to nearby receptors. Potential receptor sites identified by the noise specialist include:

- Serutube and Mafika
- Luka and Mogono (Ga-Luka)
- Tsitsing
- Diepkuil
- Maile
- Ga-Nape Cultural Landscape
- People residing in informal farm dwellings next to the proposed linear infrastructure (refer to section 1.3.1 for more information. The dwelling locations are shown on Figure 19).

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 collection

To quantify the current day and night ambient noise levels, noise monitoring was undertaken at six sampling sites close to the proposed No 18 Shaft. These sampling points were identified to provide a representation of current or ambient noise levels. Since no facilities suitable for long-duration unattended recordings were available, ambient noise levels were probed and samples taken in which the level was averaged over sufficiently long time durations to obtain good estimates of the average ambient level. This involved time-integrated averaging for a period long enough for the running average to converge to a constant level with less than 1 dB variance. A-weighted, equivalent continuous sound pressure levels LAeq (dBA) were measured, using an integrating sound analyser. Meteorological conditions and the location of sampling points were taken into consideration when determining ambient noise levels.

Results

The proposed project is located in an area where, in most areas, the ambient noise still has a rural village character. With the exception of Ga-Luka, villages nearest to the proposed development are still outside audible reach of noise emanating from existing Impala Mine operations, such as the plant and shaft complexes, as well as noise from other existing mines and industries in the district. Ambient noise comprises mainly of relatively low levels of road traffic and community activity noise. On the whole, the area in its current state (in terms of SANS 10103 guidelines) rates as a “Suburban District – With little road traffic” with typical daytime and night-time ambient levels of 50 dBA and 40 dBA, respectively (refer to Figure 16). These levels are just 5 dB above typical ambient levels in Rural Districts, the lowest noise category. The people living in the farm dwellings adjacent to the linear infrastructure route notably have very low ambient noise levels currently, with 35 dB nighttime level expected (Acusolv, 2013).

Conclusion

The proposed project area is located in an area where, in most areas, the ambient noise still has a rural village character. With the exception of Mogono (Luka North) and villages closest to the existing No 17 Shaft, villages nearest to the proposed development components are still outside audible reach of noise emanating from existing Impala Mine operations, such as the plant and shaft complexes, as well as noise from other existing mines and industries in the district. Ambient noise comprises mainly of relatively low levels of road traffic and community activity noise. This baseline information will be used to compare the predicted increase in noise levels due to the current project

FIGURE 16: DAY/NIGHT AMBIENT NOISE LEVELS (ACOSOLV, 2013)

1.1.10 VISUAL ASPECTS

Information sourced from the visual specialist study conducted by Newtown Landscape Architects (NLA, 2013) (Appendix H).

Introduction and link to anticipated impact

Project-related activities have the potential to alter the landscape character of the site and surrounding area through the establishment of both temporary (such as support facilities) and permanent infrastructure (such as waste dumps). 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 project area against which to measure potential change as a result of project infrastructure and activities.

Data collection

Data collection was sourced from a field survey and the review of relevant maps.

Results

In describing the visual landscape, a number of factors were considered, including landscape character, sense of place, scenic quality, and sensitive views. It is important to note that the study area defined for the visual study is a 12.5 km radius around the proposed project area (refer to Figure 17). Beyond this distance, the proposed project infrastructure would be 'absorbed' into the landscape setting and would therefore have an insignificant impact on sensitive views. This section therefore refers to the "study area" and should not be confused with the "project area" which refers to the area in which infrastructure will be established. The main findings of the baseline study are summarised below, with further detail provided in the specialist report (NLA, 2013).

Landscape character:

The study area is situated in an area of gently undulating plains at an average altitude of 1 130 metres above mean sea level (mamsl). The topography in the study area is mostly flat, gently sloping to the drainage lines, which eventually feed the Elands River system. Hills, rising up to 250 m above the plain, occur along the eastern edge of the project area. The hills in the project area tend to have a dense cover with rocky outcrops prevalent. Tall shrubs can also be found on the hills along with dense grass cover.

Current land use within the study area comprises settlements in the east (Serube, Mafika and Kanana) and western portions of the site (Luka North and Luka South) and Freedom Park in the south. The south western section of the study area is dominated by Impala's existing mining activities.

Sense of place and aesthetic value

The south western section of the study area leaves an overriding impression (sense of place) of a flat and relatively featureless natural landscape, dominated by mining, utility and township land uses. These

areas are considered to have a low visual quality i.e. the landscape generally is negative in character with few, if any, valued features.

The hills and koppies, which occur along the eastern side of the study area create a contained, complex yet coherent spatial dimension, which invites the visitor into a scene dominated by these natural edges and which add 'wildness' to the scene. These factors combine to evoke a strong emotional response in the visitor, created by a landscape that is somewhat unique and has a distinct character of its own. This landscape type has a visual quality that is rated high i.e. a landscape that exhibits a very positive character with valued features that combine to give the experience of unity, richness and harmony. It is a landscape that may be considered to be of particular importance to conserve. It may be sensitive to change in general and may be detrimentally affected if change is inappropriately dealt with.

A moderate value is placed on the grasslands, which occur in the northern and middle sections of the study area. The proposed new project infrastructure occur within this landscape type.

FIGURE 17: VISUAL STUDY AREA AND VIEWS (NLA, 2013)

Visual Context - Views

The project area is visually exposed primarily due to the relatively flat nature of the landscape and the lack of tall vegetation (NLA, 2013). Public views (sensitive viewing areas) to the project area would be experienced by people living in and visiting the adjacent settlements as outlined in section 1.1

All these public views are however from a relatively low vantage point. The result of this is that the sites would only be visible from the periphery of the residential areas and from the roads that service these settlements and the mining area (NLA, 2013).

Views from R510 would mostly be obscured and blocked by township developments and the hills that run along the south-eastern side of the project area. Views from the R556 would be open and orientated towards the proposed development sites, but would mostly be distant i.e. over 5 km from the sites. Views towards proposed No 18 Shaft along the access road, D513, would be open (refer to Figure 17).

Views from the proposed heritage area on Welbekend would be in the background of views to the north-west (i.e. towards the project site) (refer to Figure 17).

Conclusion

The eastern sector of the study area comprises hills and associated grasslands and has been assigned a high value with respect to visual resource. The grasslands in the central and northern sector of the study area have been assigned a moderate value, while the mining and township areas in the western sector of the study area have a low value. This information has been used in an effort to try to minimise the visual impact of the project components.

1.2 ENVIRONMENTAL ASPECTS WHICH MAY REQUIRE PROTECTION OR REMEDIATION

Environmental aspects both on the site applied for and in the surrounding area which may require protection or remediation during the life of the project are listed below. This list is based on the concise descriptions provided in Sections 1.1 and 1.3.

- Drainage patterns on site after closure
- Stripped and stockpiled soils
- In-situ soils and land capabilities (not disturbed by project infrastructure)
- Biodiversity (not disturbed by project infrastructure)
- Ground and surface water resources
- Ambient air qualities
- Noise environment
- Visual and landscape quality
- Surrounding land uses, socio-economic conditions and economic activity
- Heritage (and cultural) resources (not disturbed by project infrastructure).

1.3 LAND USES, CULTURAL AND HERITAGE ASPECTS AND INFRASTRUCTURE

A description of the specific land uses, cultural and heritage aspects and infrastructure on site and on neighbouring properties/farms is provided in this section. This section identifies whether or not there is potential for the socio-economic conditions of other parties to be affected by the proposed operations.

1.3.1 LAND USES

Information was sourced from information compiled by the SLR EIA team and with consultation with the RBA who have allocated certain areas to some people for surface use.

Introduction and link to impacts

Projects of this nature have the potential to influence current land uses both on the site (through land development) and in the surrounding areas (through direct or secondary positive and/or negative impacts). As a baseline, this section outlines existing 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 may be experienced.

Data collection

Surface right information was sourced by SLR through a deed search conducted in May 2011. Information on existing prospecting/mineral rights was compiled with input from Impala and SLR's knowledge of the area.

Information on the context of the area and the presence of infrastructure was compiled by SLR using information provided by the various specialist studies, observations during site visits and studying of aerial and satellite images.

Results –Land Ownership

The surface use area is an area of land that Impala may utilise for mining activities subject to obtaining all necessary authorisations in terms of mining and environmental legislation. Impala does not own any portion of land in the surface use area or current project area (Figure 18). The surface use area is made up of surface right permit areas, notarial mineral mining lease areas between individuals and the state, and a mineral lease agreement with the Royal Bafokeng Administration. The table below provides a list of land owners in and surrounding the project area.

TABLE 26: SURFACE RIGHTS IN AND SURROUNDING THE PROJECT SITE

Property Description	Title Deed number	Surface Owner
Project area		
Klein Doornspruit 108 JQ	T3788/1907BP	Royal Bafokeng
Toulon 111 JQ	T134/1935BP	Royal Bafokeng
Goedgedacht 114 JQ	T3786/1907BP	August Mokhatler Tribe
Vaalkop 275 JQ	T9495/1904BP	Royal Bafokeng
Welbekend 117 JQ	T9311/1922BP	August Mokhatler Tribe
Vlakfontein 276 JQ	T3781/1907BP	Republic of Bophuthatswana
Surrounding the project area		
Doornspruit Annex 109 J.Q.	T110/1935BP	August Mokhatler Tribe
Goedgedacht 110 JQ	T14/1980BP	Ptn 0: August Mokhatler Tribe
	T2249/1930BP	Ptn 1: Republic of Bophuthatswana
Hartbeestspruit 88 JQ	T3789/1907BP	August Mokhatler Tribe
Elandsheuwel 282 JQ	T164/1990BP	Ptn 5: Bafokeng Stam Tribe
Reinkoyalskraal 278 JQ	T373/1992BP	Ptn 3: Royal Bafokeng
	T6749/1909BP	Ptn 0: Republic of Bophuthatswana
	T7134/1978	Ptn 1: Evangelical Lutheran Church in South Africa - Tswana
	T9673/1933	Ptn 2: Republic of South Africa
Rhenosterfontein 86-JQ	T447/1979BP	Ptn 0: Republic of Bophuthatswana
	T142857/2007	Ptn 1: Mokgatle Prop Trust
	T33/1994BP	Ptn 2: Mafuta Petros Maraume
	T121178/2003	Ptn 4: Mareume Lydia Liza
	T142857/2007	Ptn 5: Mokgatle Prop Trust
	T22977/1938BP	Ptn 7: National Government Republic of South Africa

Property Description	Title Deed number	Surface Owner
	T6881/1925BP	Ptn 8: Republic of Bophuthatswana
Klipgatkop 115 JQ	T6461/1937BP	Ptn 0: Republic of Bophuthatswana
	T5398/1963BP	Ptn 1: Republic of Bophuthatswana
Rietspruit 83-JQ	T11354/1937BP	Ptn 0: Republic of Bophuthatswana
	T13173/1937BP	Ptn 1: Republic of Bophuthatswana
Doornspruit 84-JQ	T11180/1928BP	Ptn 0: Republic of Bophuthatswana
Roodekraalspruit 113-JQ	T40105/1965BP	Ptn 0: Andrew Maito
	T5054/1934BP	Ptn 2: Cornelius Maito
	T11788/1941BP	Ptn 6: Reuben Mosito
	T10618/1959BP	Ptn 8: Jakonia Mofoeke
Diepkuil 116-JQ	T1099/1923BP	Ptn 0: Bafokeng Tribe
Bierkraal 120-JQ	T1217/1887BP	Ptn 0: Republic of Bophuthatswana
Wilbeesfontein 274-JQ	T10990/1937BP	Ptn 1: Republic of Bophuthatswana
	T41109/1970BP	Ptn 3: Jonas Motsuenyane
	T143/1982BP	Ptn 4: Priscilla Motsuenyane
	T48446/2001	Ptn 5: Bojanala Platinum District Municipality
	T75818/2000	Ptn 6: Bojanala Platinum District Municipality
	T27708/1971BP	Ptn 7: Eliphas Motsuenyane
	T35556/2009	Ptn 8: Impala Platinum Ltd
	T99143/2003	Ptn 9: Rustenburg Local Municipality
	T27711/1971BP	Ptn 10: Aaron Motsuenyane
	T169772/2003	Ptn 12: Rustenburg Local Municipality
	T16767/2010	Ptn 21: Sasol Chemical Industries Ltd
Doornspruit 106-JQ	T745/1890BP	Ptn 0: Bafokeng Tribe
Boschkoppie 104-JQ	T12173/1937BP	Ptn 0: Republic of Bophuthatswana
	T1712/1929BP	Ptn 1: Bafokeng Tribe
	T29329/1968BP	Ptn 2: Rakgokong Edbaal
Styltdrift 90-JQ	T955/1894BP	Ptn 0: Republic of Bophuthatswana
Waagfontein 89-JQ	T30718/1965BP	Ptn 0: National Government Republic of South Africa
	T8188/2009	Ptn 2: Kingdom Development Company Pty Ltd
	T95145/2002	Ptn 3: Aqua Terra Pty Ltd
	T95145/2002	Ptn 4: Aqua Terra Pty Ltd

Results – Mineral / Prospecting rights

Impala was granted a new order Converted Mining Right Protocol Number 599/2008 under DMR ref no NW30/5/1/2/2/131MR to mine the bulk of the No 18 Shaft area. The Impala Platinum Limited/Royal Bafokeng Resources Platinum (Pty) Limited unincorporated joint venture (“the JV”) has acquired the right to prospect for platinum group metals and certain other associated minerals in respect of the farm Klipgatkop 115JQ by virtue of Prospecting Right no 638/2007 (the notarial execution of a section 11 transfer for this prospecting right from Western Platinum Limited to the JV is pending) under DMR ref no NW30/5/1/1/2/519PR. Furthermore, the JV holds the right to prospect for platinum group metals and

certain other associated minerals on certain portions of the farm Roodekraalspruit 113 JQ by virtue of Prospecting Right no 497/2007 under DMR ref no NW30/5/1/1/2/878PR.

A portion of the proposed No 17 Shaft linear infrastructure will be located on portions of the farm Welbekend 117 JQ. Welbekend and Portion 1 of Reinkoyalskraal 278 JQ (25 ha in extent that is not part of this mining right area) has recently been incorporated by way of Notarial Amendment / Variation of Mining Right in terms of Section 102 of the MPRDA into the adjacent Converted Mining Rights Area 599/2008 under DMR ref no NW30/5/1/2/2/131MR.

The underground mining area associated with the No 18 shaft will take place on portions of Klipgatkop 115JQ and Roodekraalspruit 113JQ. A section 102 application was lodged on 6 June 2013 to include the following farms in the Impala mining rights area in terms of the MPRDA:

- Roodekraalspruit 113JQ
- Klipgatkop 115JQ
- Diepkuil 116JQ.

The current mining rights area is shown in Figure 18.

FIGURE 18: IMPALA CONVERTED MINING RIGHTS AND PROSPECTING RIGHTS AREAS

Results - Land uses

This section should be read in conjunction with the following maps:

- Figure 1 which shows the regional and local setting as well as the Ga-Nape koppie around which the proposed heritage park will be established
- Figure 21 which shows the existing Impala infrastructure
- Figure 18 which shows the Impala mining rights and prospecting right areas
- Figure 19 which shows the dwellings in the project area.

Land uses

The sites for the proposed No 18 Shaft and associated linear infrastructure corridor are currently used for grazing, wood harvesting and wilderness. The No 18 Shaft site shows evidence of cattle grazing, wood harvesting and there are various excavations that may be the result of mining exploration activities in the area. The central STP is located immediately north of existing TSF and proposed TSF 5 and 6, while the proposed No 17 Shaft sewage pipeline will follow the servitude on the eastern boundary of the TSF 5, which has recently been approved by DEDECT and approval is pending from DMR. The proposed No 17 Shaft tailings pipeline follows an existing railway servitude, however a small section does traverse a small piece of land used for cultivation. Impala will negotiate a servitude for this small section with the land owners. The proposed No 17 Shaft STP will be located within the existing shaft bank.

The RBA, as land owners, allocate some of the project area to Bafokeng people for agricultural use. As such, some of the farm workers live in dwellings in the project area. Several dwellings were found within and close to the project area.

Impala has a lease agreement in place with the RBN for the use of various portions of the project area, except for the farm Welbekend. Impala is in negotiations with the RBN to obtain the right to use part of the Welbekend farm for surface infrastructure as per the project requirements. Adjacent land use is that of mining activities in the form of existing Impala mining activities and infrastructure and community land use for suburban areas and agriculture.

An Eskom powerline servitude runs through the No 18 Shaft complex and this powerline will need to be re-routed (refer to Figure 22). Impala will deal with this issue directly with Eskom.

Existing Impala Infrastructure

The key existing mine related infrastructure includes (refer to Figure 21):

- Opencast and underground workings
- Mining and ventilation shafts
- Processing plants for the concentration of both UG2 and Merensky ore

- Mine residue facilities for sludge, waste rock, tailings dams and slag
- A smelter complex
- A significant range of support infrastructure and services for transport, water supply, power supply, cooling, maintenance, repairs, and management of non-mineralised waste.

Existing non-mining infrastructure in or adjacent to the project area

The table below lists the existing infrastructure in or adjacent to the project area.

TABLE 27: INFRASTRUCTURE IN AND SURROUNDING THE PROJECT AREA

Structure	Description	
Dwellings	The RBA, as land owners, lease some of the project area to Bafokeng people for agricultural use. As such, some of the farm workers live in dwellings in the project area. Figure 19 shows the location of six dwellings found within and close to the proposed No 18 Shaft linear infrastructure. These include:	
	Dwelling number)	Description
	Dwelling 1 Land leased by Theetso	<ul style="list-style-type: none"> • Two tin houses • Five small cattle kraals made from a mixture of fencing and wood • One cattle crush • One farm worker lives there permanently, his wife occasionally visits him • Small herd of livestock comprising goats, cattle, chickens and a dog • Water is brought in on a daily basis, for domestic use and cattle watering.
	Dwelling 2 Land leased by Seloko	<ul style="list-style-type: none"> • One tin house • One large cattle kraal made from Acacia tree branches • One worker living of the property permanently • Significant herd of livestock comprising cattle (64), Calves (24), a few goats (3) and dogs (4) • Sunflower cultivation (this cropped area is shown in Figure 9) • Numerous water troughs for the animals • A defunct water tank is not used because it leaks • Water is brought in on a daily basis, for domestic use and cattle watering.
	Dwelling 3 Land leased by Chipaa Khono	<ul style="list-style-type: none"> • A single shed • One single worker living there permanently.
	Dwelling 4 Land leased by Zero Magano	<ul style="list-style-type: none"> • Single house • 2 large cattle kraals, made from a mixture of wood, rusted metal and Acacia tree branches • Two people living on the property permanently (worker and his wife)

Structure	Description	
		<ul style="list-style-type: none"> Significant livestock herd comprising cattle (132), chickens (14), one cat and four dogs Water is brought in on a daily basis, for domestic use and cattle watering.
	Dwelling 5 Land leased by Justice	<ul style="list-style-type: none"> One person lives there permanently A single house Water is brought in on a daily basis, for domestic use and cattle watering.
	Dwelling 6	<ul style="list-style-type: none"> One single house Two kraals made from Acacia tree branches. Water is brought in on a daily basis, for domestic use and cattle watering.
Provincial road	The D513 provincial road traverses the farms Goedgedacht 110 JQ, Doornspruit Annex 109 JQ, Hartebeespruit 88JQ and Klein Doornspruit 108 JQ (Figure 1).	
Regional powerline	A regional powerline traverses the No 18 Shaft site and may need to be moved by Eskom. This is however dependent on the shaft infrastructure alignment and every effort will be made to stay out of the powerline servitude.	

Particular attention must be paid to dwellings situated close to the No 18 Shaft linear infrastructure route with respect to potential impacts such as noise, dust and safety aspects. Impala is engaged in discussions with Eskom regarding the possible relocation of the regional powerline. Every effort will be made to avoid any other structures or infrastructure within the project area.

Closest non Impala Mining Operations in the region

The closest non Impala mining and industrial operations in the region include:

- Xstrata Merafe Boshoeck operation – approximately 10 km from Impala's mineral processing complex (MINPRO)
- Anglo Platinum, Rustenburg division - approximately 5.5 km from the existing UG2 plant
- Anglo Platinum – Bafokeng Rasimone Platinum Mine (BRPM) – approximately 11 km from MINPRO
- Omnia Fertilizers – adjacent to MINPRO.

Recreational Facilities

Sun City lies approximately 16 km to the north-west of the proposed No 18 Shaft site and is bordered by the Pilanesberg National Park.

As indicated previously, part of the farm Welbekend 117 JQ (in the hills and Koppies) has been identified by the RBA as a possible protected heritage area. This planning is however in the very early stages and no further information is available at this stage.

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:

- The regional Transnet railway line is located to the west of the converted mining rights area between Impala and Phokeng
- The existing road network at Impala consists of gravel and tar roads (these include public roads as well as internal Impala roads). Gravel roads are located throughout Impala converted mining rights area, and are utilised by community members as well as Impala staff mainly for prospecting and maintenance purposes. Public and internal Impala roads are utilized mainly by community members as well as mining related traffic. Public roads are maintained by the North West Roads Department. The main access road to Impala is the Z523 that links between the R565 near Phokeng and the R510 near Kanana. Other provincial and access roads include the D513 which runs through Luka, and the D1813.
- There are numerous pipelines within the Impala converted mining rights area that transport air, clean water, sewage, process water, and slurry (amongst other substances). These pipelines are either located above ground or underground and are maintained by Impala except for the Rand Water pipeline
- Power lines located within the Impala converted mining rights area comprise internal Impala power lines, municipal power lines and regional Eskom power lines
- There are numerous telephone lines within the Impala converted mining rights area that are maintained by Telkom.

Conclusion

The powerline, agricultural and wilderness land uses in the proposed project area will be affected by the proposed project. The information regarding current land uses has been used by the project team in an effort to minimise impacts on these land uses.

FIGURE 19: PROXIMITY OF COMMUNITIES AND FARM DWELLINGS TO THE PROJECT AREA

1.3.2 CULTURAL ASPECTS

Cultural aspects of the project area are discussed below as part of the heritage discussion.

1.3.3 HERITAGE (INCLUDING CULTURAL AND PALEONTOLOGICAL) ASPECTS

Information in this section was sourced from the specialist heritage study conducted by Dr Julius Pistorius (Appendix I) and specialist paleontological study conducted by Prof. Bruce Rubidge (Appendix J).

Introduction and link to impacts

Various natural and cultural assets collectively form the heritage. Heritage resources (including 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. Paleontological resources are fossils, the remains or traces of prehistoric life preserved in the geological (rock stratigraphic) record. They range from the well-known and well publicized (such as dinosaur and mammoth bones) to the more obscure but nevertheless scientifically important fossils (such as paleobotanical remains, trace fossils, and microfossils). Paleontological resources include the casts or impressions of ancient animals and plants, their trace remains (for example, burrows and trackways), microfossils (for example, fossil pollen, ostracodes, and diatoms), and unmineralized remains (for example, bones of Ice Age mammals).

The project has 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 and underground mining). In this regard, heritage and paleontological resources could be disturbed or destroyed. As a baseline, this section identifies the presence of heritage and paleontological resources and their conservation significance.

Data collection

Data collection for the heritage survey was done by an accredited specialist through review of available databases, published reports and maps; previous studies done in the region; and site specific field work via a survey with a vehicle and on foot. Further detail on the methodologies used is provided in the specialist report.

Data collection for the Paleontological survey was conducted by an accredited specialist through the review of geological information and relevant paleontological research.

Results: Heritage (including cultural) resources

Heritage resources include sites of archaeological, cultural or historical importance. The Phase I heritage study identified various types of resources within the project area and immediate surrounds. These heritage resources mainly consist of stone walled sites, stone structures and archaeological deposits which date from the Late Iron Age. No heritage resources were observed in the proposed linear corridors. Table 28 describes the heritage resources found. These resources are mapped in Figure 20.

TABLE 28: HERITAGE RESOURCES IDENTIFIED IN THE PROJECT AREA (PISTORIUS, 2013)

Resource number	Coordinates	Description
LIA01	25° 26.379' 27° 13.411'	Archaeological deposit on the northern foot of Tlathane (no stone walls but holds extensive middens)
LIA02	25° 26.601' 27° 13.599'	Site with stone walls but not as prominent as most other stone walled sites on the northern foot of Tlathane
LIA03	25° 26.762' 27° 13.791'	Extensive stone walled site along northern foot of Sefakwe
LIA04	25° 26.823' 27° 13.777'	Simple stone walled site with outer boundary on eastern foot of Sefakwe

Only two of the identified heritage resources are likely to be directly affected by the proposed project, namely LIA03 and LIA04 along the base lines of Tlathane and Sefakwe due to the current positioning of a power sub-station.

The significance of these heritage resources was determined according to the following criteria (Pistorius, 2011):

- Stipulations derived from the National Heritage Resources Act (NHRA) (No 25 of 1999)
- Rating criteria specifically devised for heritage resources.

The significance of these stone walled sites can be described as medium to high when considering the following (Pistorius, 2013):

- The sites represent a cultural landscape. Each site is unique as it contributes to the significance of the cultural landscape which served as cultural and historic unit representing the customs and cultures of pre-historical and historical Tswana and other indigenous groups who lived in the Bankeveld three to four hundred years ago
- The investigation cultural landscape can contribute to a better understanding of the regions pre-history and history as the landscape falls within the sphere of Bafokeng influence, who was subjugated by Mazilikazi's Ndebele during 1827 to 1832
- The settlements have educational and research value which should be unlocked by a Phase II study should these resources be impacted upon.

It should be noted that large numbers of stone walled sites occur outside the project area, mainly at Ga-Nape and Mamanthane hills. These sites and clusters of sites occur along the base of these kopjes as

well as on higher altitudes on Ga-Nape itself, where they reveal a different settlement pattern than those on level ground. These stone walled sites represent a cultural landscape of high significance which will not be directly (physically) affected by the proposed project. For this reason, part of the farm Welbekend 117 JQ (in the hills and Koppies) has been identified by the Royal Bafokeng Administration as a possible protected heritage area. This planning is however in the very early stages and no further information is available at this stage. We will refer to this site as the “Ga-Nape cultural landscape” in this report.

A site of cultural importance, the hill Mallaphiri, close to the village of Maile, is used for religious purposes by members of the local community. This site is however more than five kilometres from the proposed infrastructure and will therefore not be directly affected by the proposed project.

FIGURE 20: HERITAGE RESOURCES WITHIN THE PROJECT AREA (PISTORIUS, 2013)

Results: Paleontological resources

The main findings of the specialist study conducted by Professor Bruce Rubidge are provided below.

The entire project area is underlain by igneous rocks of the Rustenburg Layered Suite of the Bushveld Igneous Complex as discussed in section 1.1.1. This complex is an intrusive igneous body comprising a series of ultramafic-mafic layers and a suite of associated granitoid rocks. As these rocks are Precambrian in age and are of igneous origin it is highly unlikely that fossils will be affected by the proposed subsurface mining development (Rubidge, 2011). A very small portion of the southern side of the farm Klein Doornspruit 108 JQ is covered by Quaternary alluvial deposits. Although highly unlikely, there is a possibility that the Quaternary deposits could contain fossils.

Conclusion

It is unlikely that paleontological resources will be found on site. There are two heritage sites that may be directly affected by the proposed project, namely LIA03 and LIA04. Both sites are protected in terms of the NHRA. If it is not possible to avoid these sites, the mitigation measures proposed by Dr Pistorius will be followed.

1.3.4 SOCIO-ECONOMIC ENVIRONMENT/PROFILE

Information in this section was sourced from the socio-economic specialist study (Strategy4Good 2013) (Appendix K). This information broadly corresponds to the baseline information provided in Impala's Social and Labour Plan (SLP); however the information provided below is more focussed, comprehensive and up to date with regard to the current project area.

Introduction and link to anticipated impact

Projects of this nature have the potential to influence various aspects of the socio-economic profile of a community. This baseline section describes the current socio-economic status of the region and project area thereby providing the context within which the operations' potential impacts will occur.

Data collection

Data was collected through review of available databases, communication with district and local authorities, field observations and consultation with stakeholders (through telephonic discussions). Further detail on the methodologies used is included in the specialist report.

Results

This section was compiled using data from the following sources (Strategy4Good, 2013):

- 2009/2010 Quantec Data (Quantec Research (Pty) Ltd)
- 2007 Community Survey (Statistics South Africa)
- 2010/2011 Integrated Development Plan for the Bojanala Platinum District Municipality (BPDM)
- 2010/2011 Integrated Development Plan for the Rustenburg Local Municipality (RLM).

Provincial Level – North West Province

The socio-economic environment in the province can be summarised as follows:

- **Population** – The North West Province has a population of approximately 3.2 million residents (Community Survey, 2007; Quantec, 2010), with an average household size of 3.6.
- **Economic Activity** – Provincially it was estimated that, in 2009, the most dominant sector contributing to the North West Province's economy was the Mining industry. This was demonstrated by 25 % of the economically active population¹ being employed in this industry. The sectors with the smallest contributions to the province's Gross Geographic Product (GGP) were Electricity and Water, as well as the Transportation industry.

¹ *Economically active population*: consists of both those who are employed and those who are unemployed (as defined by Statistics South Africa) within the *working age population* (includes all those aged between 15 and 65)

- **Unemployment** – It was estimated that the unemployment rate of the North West Province in 2009 was 26 % (presenting a similar profile to South Africa as a whole – with an unemployment rate of 25 % in the same year).
- **Education** – Ten percent of the working age population has had no formal education. Furthermore, only 18 % of the total population in the province obtained a grade 12/matric education.
- **Basic Services** – The majority of the population's households have access to piped water, with only eight percent using alternate water sources (for example, boreholes, water vendors, wells, tankers, dams, rivers, streams). Approximately 46 % of households with toilet facilities utilise pit or bucket latrines. Eight percent have no toilet facilities. In terms of households' dominant energy source, 86 % use electricity as the primary means for lighting. Refuse removal services are provided to most households, with a small percentage of the population (an estimated nine percent) not having any refuse disposal facilities.
- **Housing** – Within the North West Province, it is estimated that 22 % of the population reside in farm dwellings (with 15 % of the population living in informal settlements and seven percent in backyards).
- **HIV Status** – Those with a tested HIV positive status account for approximately 13 % of the North West Province population. In 2010, 1 percent of the entire province's residents died of AIDS related illness.

District and Local Municipal Level – Bojanala Platinum District Municipality (BPDM) and Rustenburg Local Municipality (RLM)

The socio-economic environment at municipal level can be summarised as follows:

- **Population** – The population residing within the Bojanala Platinum District Municipality constitutes approximately 39 % of the total population of the North West province. Rustenburg local municipality is the largest municipality within the district, with a population concentration of approximately 32 % of the total population of BPDM. The average household size in BPDM is estimated to be with an average household size of 3.4, with RLM's average household size at 2.9.
- **Economic Activity** – Mining plays an important role in the region's economy and is the district's major source of employment. It was estimated that in 2009 33 % of the district's economically active population was employed in the mining sector. Fifty percent (50 %) of Rustenburg Local Municipality's economically active population was employed by this industry. As reflected at a provincial level, the sectors with the smallest contributions to the province's Gross Geographic Product (GGP) were Electricity and Water, along with Transportation, Agriculture and Construction – all within the range of a 2 to 4 % contribution.
- **Unemployment** – An unemployment rate of 25 % and 20 % has been estimated for 2009 at the district and local municipal levels respectively.
- **Education** – In 2010, approximately 66 % of the BPDM residents constituted the working age population. Of these individuals, 19 % have completed matric and seven percent have received no

formal education in line with the South African schooling system. This is a similar depiction of the RLM, with 18 % obtaining a matric certificate and 6% of the population with no schooling. Within the Rustenburg Local Municipality, 71 % of the population is of working age.

- **Basic Services** – As far as access to piped water is concerned, Bojanala Platinum District Municipality and its Rustenburg Local Municipality displays a similar profile to that of the province at large. Nine percent and 11 % of the district and local municipality households', respectively, use alternate water sources. The remainder of each population has access to piped water. Higher than the provincial average, 56 % of households with toilet facilities utilise pit or bucket latrines in BPDM. In RLM, pit or bucket latrines are used by 38 % of households. As depicted at a provincial level, between eight and nine percent have no toilet facilities. Electricity is used as a primary source of energy for lighting in 87 % of the homes within BPDM and 81 % in RLM. Refuse removal services are provided to the majority of all households at the district and local municipal levels, with 11 % not having any refuse disposal facilities.
- **Housing** – It is estimated that 33 % of the BPDM homes are informal dwellings. Approximately 38% of the RLM homes are informal dwellings, of which 20 % are in informal settlements and 18% can be found in backyards.
- **HIV Status** – Between 14 and 15 % of the BPDM and RLM, respectively, have tested positive for HIV. Similar to the provincial level one percent of both the district and local municipalities' residents died of AIDS related illness.

Local Level

As previously indicated, Mogono (Luka North), Diepkuil, Maile, Chaneng, Robega and Rasimone all lie within a 6-km radius of the proposed No 18 Shaft site, while Tstitsing, Tlaseng, Ga-Mogajane, Serutube, Mogono (Luka North), Luka South and Diepkuil lie within a 6-km radius of the No 19 Shaft site. Figure 19 shows the proximity of the project area to surrounding communities.

These communities form part of the wider Bafokeng Municipal Place (note this is a municipal demarcation and does not mean that all of the communities are regarded as part of the RBN) and the demographics of these communities as well as those situated within six kilometers of the proposed area as discussed above, is discussed below (Strategy 4 Good, 2011):

- **Population** – The Bafokeng has a relatively large population, estimated at 300 000 (2009) and it is assumed that this growth rate corresponds to the rest of Rustenburg's growth rate of 2.2 %. The communities within a six kilometer radius of the project area have a population of 39 625 as at the same period above. This translates to an estimated 150 people per square kilometer, as opposed to the SA average of around 40 people per square kilometer. This means that the local areas are high populated. In addition to this, there has been a tremendous influx of people into the Rustenburg Municipality and this is also evidenced in the Bafokeng area

- **Economic Activity** – The mining sector accounts for the most jobs in the affected area, being 58 % for of Bafokeng and 43 % in communities within a six kilometer radius of the project area. The tertiary sector (services and government), makes up 26 % of the jobs in the communities within a six kilometer radius of the project area. The percentage households on or below the poverty line is still high, and due to the increase in informal settlements as a result of in-migration, this proportion has steadily risen to 33 % for the Bafokeng area in 2009.
- **Employment** – An unemployment rate of 25 % and 20 % has been estimated for 2009 at the district and local municipal levels respectively. For communities within a six kilometer radius of the project area, employment ranged between 64 % and 25 % in 2009. On average, the estimated Bafokeng unemployment rate was 23 % in 2009. Of equal significance is the under-employment rate (people not looking for jobs), which amounts to 40 %. This means that 37 % (3.7 adults out of all adults), have formal jobs. Only 25 % of the workforce is in elementary jobs, which is relatively little compared to other rural areas, which have as much as 50 % of the workforce in elementary jobs.
- **Education** – It is estimated that there are approximately 18 schools in communities within a six kilometer radius of the project area, which equates to an estimated 530 pupils per school, which should be sufficient for the area. The total amount of adults that have no schooling (illiterate or semi-illiterate) is still high – 25 % for the Bafokeng area, even though this has improved marginally since 2001. The percentage population that matriculated has also increased marginally and stands at 25 % for the Bafokeng area in 2009.
- **Basic Services** – There has been a strong improvement in the electrification of houses (66 % of the houses in communities within a six kilometer radius of the project area have been electrified), but water piping into the dwelling (as opposed to the yard), is still inadequate (an estimated two percent of these communities had water linked to the dwelling). The number of dwellings where water was provided to the household yard was 37 % in 2009. Most houses have a pit latrine and very few had flush toilets. However, well over 90 % of communities within a six kilometer radius of the project area had access to a telephone (mobile, landline or public) in 2009.
- **Housing** – In 2001 the whole of the Bafokeng area had under 17 000 brick houses and just under 19 000 informal dwellings. The affected communities (this is a section of the Bafokeng area), which are much closer to mines, had 65 % formal to only 25 % informal dwellings, which shows that people in mining communities in the Bafokeng area are better off than those who are not. In as short as nine years, the total dwellings for Rustenburg as a whole grew by 31 %, and for every new dwelling, only one was a formal dwelling. Thus the housing stock is increasing and the informal dwellings are increasing disproportionately in Rustenburg.
- **Health and HIV Status** – In the communities within a six kilometer radius of the project area, four clinics were identified (these would be excluding other medical facilities), which amounts to approximately 9 000 people per clinic. If we assume a clinic would have “three hospital beds”, this equates to 3 000 per bed, which is much more than the average of 1 000 people per hospital bed in developed countries. HIV/Aids statistics are unfortunately not available on a Ward level, but as

previously indicated between 14 and 15 percent of the BPDM and RLM, respectively, have tested positive for HIV. This is more than the country's average of 12 %. Of the infected, 7.2 % of the people die of AIDS, and this statistic is also higher than the national average.

The actual data, upon which the above discussion is based, is provided in the Table 29.

As outlined above in section 1.3.1, various farm dwellings have been established in the project area. The RBA, as land owners, lease some of the project area to Bafokeng people for agricultural use. As such, some of the farm workers live in farm dwellings in the project area. In most cases, a single person lives in each of the six dwellings identified in close proximity to planned infrastructure. These dwellings are typically constructed out of tin, with associated structures such as cattle kraals often made out of tree branches.

TABLE 29: SOCIO-ECONOMIC DATA FOR THE BAFOKENG MUNICIPAL AREA (STRATEGY 4 GOOD, 2013)

Estimated 2009	Total population	% male	% Dependent Children	% pensioners	Dependency Ratio	% Setswana	% no schooling + some primary	% Matric and higher	% Underemployed	% Unemployed	% Elementary jobs and others	% Mining jobs	% Government jobs	% house or brick structure separate dwelling	% below/on poverty line	% water on dwelling	% Electricity	% water pipe on yard	% Flush Toilet and Septic Tank	% Pit Latrine	% no Rubbish disposal	% no access to any phone
Bafokeng total	158,887	56%	23%	6%	415%	76%	30%	23%	29%	28%	23%	63%	8%	66%	21%	8%	56%	42%	12%	75%	14%	3%
Bafokeng North Mines	5,656	99%	0%	0%	1.21	51%	39%	13%	16%	1%	14%	100%	0%	66%	0%	0%	76%	57%	0%	85%	46%	0%
Bafokeng South Mines	1,853	100%	0%	0%	1.30	8%	41%	9%	22%	2%	23%	100%	0%	na	na	na	na	na	na	na	na	na
Beestekraal	479	54%	31%	6%	4.90	55%	34%	16%	27%	35%	25%	96%	0%	92%	23%	7%	26%	14%	27%	66%	32%	25%
Bleskop Mines	2,580	81%	9%	0%	1.47	27%	32%	25%	12%	11%	15%	100%	2%	59%	9%	100%	100%	0%	100%	0%	na	1%
Chachalaza	3,240	55%	22%	1%	3.61	35%	44%	8%	33%	27%	23%	62%	4%	4%	34%	1%	1%	2%	4%	82%	24%	4%
Chaneng	9,183	52%	27%	5%	4.14	91%	22%	32%	41%	21%	29%	46%	10%	50%	21%	2%	84%	53%	9%	78%	47%	2%
Diepkuil	608	50%	22%	16%	9.99	99%	24%	25%	49%	33%	26%	28%	18%	71%	29%	0%	47%	33%	6%	81%	0%	0%
Dithabane	2,190	53%	24%	8%	4.35	96%	37%	19%	23%	37%	33%	54%	10%	54%	26%	6%	86%	89%	15%	74%	3%	12%
Entabeni	4,359	49%	24%	0%	4.70	4%	49%	7%	30%	36%	18%	100%	1%	1%	51%	0%	0%	0%	100%	16%	0%	0%
Freedom Park	7,984	53%	16%	0%	2.89	24%	41%	7%	22%	31%	13%	100%	1%	1%	32%	0%	0%	0%	1%	84%	24%	0%
Frischgewaagd	1,136	52%	31%	4%	4.27	95%	17%	31%	36%	25%	19%	83%	8%	61%	20%	71%	100%	43%	3%	52%	2%	2%
Ga-Luka	13,058	54%	22%	5%	3.25	82%	28%	24%	31%	24%	16%	98%	5%	59%	15%	1%	67%	91%	5%	81%	17%	1%
Ga-Mogajane	2,125	50%	28%	7%	5.07	99%	31%	28%	19%	42%	28%	41%	14%	58%	24%	4%	67%	15%	6%	81%	9%	0%
Kanana	13,589	54%	24%	5%	3.43	80%	32%	19%	28%	27%	27%	61%	7%	44%	17%	2%	43%	13%	1%	84%	7%	1%
Kgale	4,817	51%	25%	6%	3.91	96%	20%	28%	42%	20%	25%	63%	8%	49%	21%	6%	72%	81%	14%	73%	2%	0%
Kopman	712	47%	27%	7%	6.22	100%	28%	17%	35%	36%	41%	28%	3%	69%	25%	7%	49%	88%	5%	82%	0%	1%
Lefaragatlha	9,057	52%	26%	3%	3.84	89%	25%	25%	37%	23%	28%	39%	8%	38%	23%	6%	37%	67%	5%	81%	4%	4%
Lekgalong	414	52%	29%	10%	5.51	90%	34%	12%	30%	35%	11%	57%	8%	94%	20%	0%	26%	0%	0%	85%	4%	3%
Lemenong	1,665	53%	26%	4%	3.55	95%	16%	39%	37%	20%	27%	55%	15%	79%	19%	77%	81%	12%	31%	63%	2%	0%
Lesung	476	52%	24%	11%	5.24	98%	26%	29%	41%	27%	24%	53%	15%	94%	14%	0%	100%	60%	0%	83%	0%	0%
Mabitse	485	49%	26%	10%	4.52	91%	27%	28%	39%	24%	18%	38%	7%	92%	17%	0%	58%	2%	0%	85%	0%	0%
Mafika	741	53%	30%	6%	3.79	97%	21%	25%	23%	31%	27%	35%	19%	94%	19%	0%	39%	0%	0%	85%	16%	0%
Magokgwane	613	52%	30%	4%	3.86	100%	14%	35%	29%	27%	11%	49%	12%	44%	17%	3%	67%	95%	19%	72%	0%	2%
Maile	1,202	49%	25%	11%	6.95	99%	27%	22%	38%	35%	30%	21%	10%	84%	25%	1%	64%	19%	0%	85%	19%	1%
Malejane	802	67%	19%	2%	2.27	13%	52%	6%	19%	21%	10%	100%	1%	0%	14%	0%	95%	0%	na	na	0%	0%
Mamerotse	1,619	50%	27%	9%	7.29	98%	29%	21%	15%	53%	31%	21%	13%	70%	29%	6%	69%	1%	2%	84%	0%	0%
Masosobane	3,601	50%	27%	6%	4.35	96%	23%	30%	28%	33%	23%	51%	14%	65%	22%	5%	75%	57%	10%	75%	5%	1%
Mfidikoe	4,884	57%	19%	2%	2.55	42%	34%	16%	25%	22%	23%	87%	2%	11%	20%	0%	3%	85%	30%	64%	1%	0%
Mogokgwane	90	54%	21%	4%	4.72	96%	26%	24%	24%	41%	23%	99%	0%	57%	16%	0%	0%	74%	0%	85%	0%	0%
Mogono	4,156	51%	25%	7%	4.11	91%	23%	27%	31%	29%	19%	89%	9%	80%	14%	0%	75%	95%	6%	81%	5%	5%
Mosonthal-Marubithi	5,253	50%	28%	4%	4.51	79%	41%	16%	32%	31%	35%	45%	5%	22%	31%	1%	28%	2%	2%	83%	13%	2%
Nkaneng	6,506	54%	19%	0%	3.04	3%	47%	6%	33%	23%	12%	100%	1%	1%	30%	0%	0%	0%	7%	79%	0%	0%
Other	3,542	58%	22%	2%	2.67	58%	32%	13%	21%	25%	24%	55%	3%	16%	28%	3%	8%	8%	15%	73%	49%	6%
Phokeng	2,541	51%	25%	6%	4.37	94%	27%	21%	42%	23%	27%	54%	11%	56%	21%	0%	10%	76%	3%	82%	0%	0%
Photshaneng	4,163	56%	20%	3%	2.60	60%	31%	22%	17%	27%	21%	100%	4%	23%	14%	2%	35%	96%	7%	79%	27%	0%

Estimated 2009	Total population	% male	% Dependent Children	% pensioners	Dependency Ratio	% Setswana	% no schooling + some primary	% Matric and higher	% Underemployed	% Unemployed	% Elementary jobs and others	% Mining jobs	% Government jobs	% house or brick structure separate dwelling	% below/on poverty line	% water on dwelling	% Electricity	% water pipe on yard	% Flush Toilet and Septic Tank	% Pit Latrine	% no Rubbish disposal	% no access to any phone
Pudunong	3,743	51%	23%	9%	3.90	96%	18%	37%	34%	25%	30%	41%	16%	77%	19%	3%	78%	87%	21%	70%	72%	6%
Rasimone	1,781	52%	23%	7%	3.81	76%	26%	43%	4%	48%	22%	91%	4%	30%	19%	1%	63%	41%	5%	82%	2%	11%
Robega	2,668	51%	26%	6%	4.06	85%	27%	30%	25%	33%	27%	61%	12%	58%	16%	4%	100%	90%	5%	79%	0%	0%
Saron	4,521	53%	21%	9%	3.71	94%	20%	31%	35%	24%	23%	55%	10%	78%	15%	3%	79%	85%	15%	74%	2%	1%
Seritube	536	53%	23%	9%	4.12	95%	17%	37%	35%	26%	23%	41%	11%	89%	18%	0%	89%	33%	7%	80%	0%	0%
Tantanana	2,062	49%	32%	8%	6.97	95%	35%	17%	26%	42%	31%	22%	12%	54%	31%	1%	60%	8%	0%	85%	58%	17%
Thekwane	3,844	58%	23%	4%	2.83	71%	26%	24%	27%	21%	15%	93%	5%	36%	11%	0%	47%	97%	2%	83%	2%	0%
Tlapa	1,486	49%	32%	9%	6.73	66%	46%	9%	15%	50%	33%	56%	6%	79%	21%	3%	43%	13%	4%	82%	41%	33%
Tlaseng	1,957	47%	27%	9%	5.21	99%	35%	29%	37%	30%	26%	37%	16%	53%	22%	3%	71%	14%	4%	83%	0%	0%
Tshwara	843	52%	23%	8%	3.46	87%	29%	36%	41%	17%	33%	47%	8%	77%	12%	2%	96%	84%	11%	77%	0%	0%
Tsitsing	3,367	48%	29%	7%	5.13	97%	26%	26%	34%	31%	24%	34%	13%	62%	25%	1%	63%	4%	10%	78%	20%	1%
Wildebeesfontein	5,594	97%	1%	0%	1.23	47%	41%	14%	14%	4%	13%	100%	0%	31%	13%	20%	47%	40%	0%	85%	0%	0%
Windsor	1,103	50%	24%	7%	3.62	93%	16%	49%	37%	20%	21%	60%	13%	94%	15%	29%	98%	68%	27%	67%	100%	0%

Conclusion

The baseline information shows that there is a measure of inward migration of people with the resultant pressure on basic infrastructure and services, informal settlement development, increased crime, introduction of diseases and disruption to the existing social structures within established communities, and pressure of deliver of basic services (health, education, sanitation, water etc.). These factors have been considered with regarding to assessing impacts on the current socio-economic situation.

1.4 MAPS SHOWING THE SPATIAL LOCALITY AND AERIAL EXTENT OF ENVIRONMENTAL FEATURES

Maps showing the spatial locality and aerial extent of all environmental, cultural/heritage, infrastructure and land use features identified on site and on the neighbouring properties and farms are included in the baseline description. These include:

- Geological maps (Figure 2 to Figure 5)
- Wind roses for ambient monitoring station located at Luka Primary School (Figure 6)
- Soil forms identified on the project site (Figure 7)
- Land capability of soils forms identified on the project site (Figure 8)
- Vegetation communities identified on the project site (Figure 9)
- Areas of significance from a biodiversity perspective (Figure 12)
- Hydrology and topography map (Figure 13)
- Floodlines in the project area (Figure 14)
- Ambient noise levels (Figure 16)
- Views from surrounding areas Figure 17)
- Heritage resources in the project area (Figure 20)
- Dwellings in the project area (Figure 19).

1.5 SUPPORTING DOCUMENTS

The following specialist studies are attached as appendices to this report:

- Biodiversity studies (Appendix D)
- Hydrological assessment and stormwater management plan (Appendix E)
- Groundwater study (Appendix F)
- Noise study (Appendix G)
- Visual study (Appendix H)
- Phase 1 Heritage (and cultural) study (Appendix I)
- Phase 1 Paleontological study (Appendix J)
- Socio-economic study (Appendix K).

2 PROPOSED MINING OPERATION

OVERVIEW AND INTRODUCTION

The main aim of the proposed No 18 Shaft project is to replace production from older shafts that are reaching the end of their life. This will be achieved by developing a new vertical shaft complex. In addition, new sewage treatment plants are needed to provide sewage treatment capacity in this part of the Impala converted mining rights (CMR) area and to ensure that grey water produced can be used for mining. The backfilling of mine residue into mine voids will assist with more effective ventilation and safer mining.

The proposed project therefore includes the establishment of a new vertical shaft complex (No. 18 Shaft) with associated infrastructure, underground mining section, residue facility, water management facilities and various support infrastructure and services, new sewage treatment plants (and associated pipelines) and tailings plants and associated pipelines for preparation of tailings for use as support and ventilation barriers at the No 17 and 18 Shafts.

Estimated project timelines are detailed below (Table 30).

TABLE 30: ESTIMATED SHAFT PROJECT TIMELINES

Aspect	Mining activities	Processing activities
Start construction	If the decisions are positive, start date between 2015 and 2018	n/a
Duration of construction phase	Approximately ten years.	n/a
Start operation	Actual mining of ore reserves should start between 2025 and 2028	Ore will be processed at the existing Impala concentrators. If the decisions are positive, target date is between 2025 and 2028
Life of operation	Approximately 25-35 years	Approximately 25-35 years

2.1 MINERAL TO BE MINED

Impala has four converted mining rights and the minerals to be mined are covered below:

- **NW30/5/1/2/2/130 MR**

The notarially executed converted mining right covered: **Platinum Group Metals, Nickel Ore, Gold Ore, Silver Ore and Copper Ore**. The section 102 application to include **Chrome Ore, Cobalt, Sulphur, Sand (manufactured) from waste rock and Iron Ore** was approved by DMR.

- **NW30/1/2/2/131 MR**

The notarially executed converted mining right covers: **Platinum Group Metals, Nickel Ore, Gold Ore, Cobalt, Chrome Ore, Silver Ore, Copper Ore, Sulphur, Sand (manufactured) from waste rock and Iron Ore.**

- **NW30/1/2/2/132 MR**

The notarially executed converted mining right covers: **Platinum Group Metals, Nickel Ore, Gold Ore, Silver Ore, Cobalt, Copper Ore, Sulphur, Sand (manufactured) from waste rock and Iron Ore.** The section 102 application to include **Chrome Ore** was approved by DMR.

- **NW30/1/2/2/133 MR**

The notarially executed converted mining right covers: **Platinum Group Metals, Nickel Ore, Gold Ore, Silver Ore, Cobalt, Copper Ore, Sulphur, Sand (manufactured) from waste rock and Iron Ore.** The section 102 application to include **Chrome Ore** was approved by DMR.

2.2 MINING METHOD TO BE EMPLOYED

This section should be read with reference to the site layout drawings (Figure 22 - overall site layout, Figure 23 – shaft complex).

2.2.1 MINING OPERATIONS – UNDERGROUND MINING AT NO 18 SHAFT

The Merensky Reef and UG2 Chromitite Layer are the two reef horizons exploited economically within the Impala CMR area and will both be mined. The Merensky Reef and UG2 Chromitite Layer dip in a north-north-east direction in the No. 18 Shaft mining block with an average dip in the region of 12° for both mineralised horizons. The average strike-length is approximately 6 km while the dip is 3 km in No. 18 Shaft block. The vertical separation between the Merensky and UG2 reef horizons varies from 30 m to 60 m, which allow the mine design and scheduling for the horizons to be done independently.

The mining footprint is significantly deeper than the existing Impala operations. The mining method to be employed will be conventional, double-sided breast mining. For this mining method, stopeing operations take place in narrow panels with hand drilling and scraper cleaning. Panels will be supported by a combination of pillars or backfill, mat packs, in-panel elongates and tendons. Scraper winches and scoops will be used for the stope cleaning operation. Ore broken in the panels will be scraped out of the panel, down the strike gully and into the centre gully or raise line, where it will be dumped into ore-passes developed from the off-reef crosscuts or lay-byes. Large rocks will be broken at the grizzlies covering the ore-pass in the stoping area (Rock breakers will only be used at the main tips and specifically the waste tips on each level). The ore will then be loaded into rail-bound hoppers pulled by battery-powered locomotives and trammed back to the Main Shaft system. After being dumped into the shaft ore-pass system, the ore will gravitate to the shaft loading boxes, before being hoisted out of the mine by skip.

No crushing will take place at the shaft. Instead, primary and secondary crushing will be done at the existing concentrator.

Information on the magnitude of the mining operations is presented in Table 31.

TABLE 31: DATA THAT PROVIDES PERSPECTIVE ON THE MAGNITUDE OF THE MINING OPERATIONS

Features		No 18 Shaft
Group	Specific	
Main vertical shaft	Depth	1 940 m
	Diameter	10 m internal diameter lined
Mining	Target minerals	Platinum Group Metals, Nickel Ore, Gold Ore, Silver Ore, Cobalt, Copper Ore, Sulphur, Chrome, Iron Ore and Sand (manufactured from waste rock)
	Mineable area	12 897 567 m ²
	Resource estimation	72,671,603 tons
	Rate	225 kilo tons per month (ktpm) of reef plus 35 ktpm of waste rock
	Life of mine per shaft	Approximately 25 – 35 years
	Mine-related surface area and associated surface infrastructure	Approximately two square kilometres Additional linear infrastructure corridor of approximately 14 km long and a width of between 30 m and 90 m.
	Blasting	Construction of the shaft portal will typically require 1 blast per day. Operations blasting will be as required, but is also normally one blast per day.
Mine residues	Waste rock	Approximately 300 0000 m ³ in total
Resource use	Water demand	Approximately 150 000 m ³ per month
	Power maximum demand	51.5 MVA
Employment	Staff: construction	Approximately 1 200
	Staff: operational	Workforce to be moved from other shafts therefore no jobs to be created. Approximately 4 800 people will be required at the new shaft complex.
	Operating times	Continuous operations are possible once steady state mining is reached.

2.3 LIST OF MAIN ACTIONS/ACTIVITIES/PROCESSES ON SITE

Key activities that will take place on site during each phase (construction, operational, decommissioning, closure) of the project are listed in Table 32 below. For the purposes of this report, in broad terms, construction is the phase in which the mine infrastructure is established and the sinking of the shafts until ore is reached, operational covers the production phase of the underground mining sections associated with each shaft complex, decommissioning is when mining has ceased, infrastructure is being removed and the site rehabilitated in line with a closure plan and the closure phase refers to the period of time when maintenance and aftercare of rehabilitated areas and facilities is required to ensure closure objectives are met.

This table reflects the chosen preferred alternative. Further design details for components of the project plan, where required, are either included in the specialist reports or included in the project-specific management plans in Section 19.

TABLE 32: LIST OF PROJECT ACTIONS / ACTIVITIES / PROCESSES

Main activity/process	Sub-activities	Construction	Operation	Decommissioning	Closure
Site preparation	Selective bush clearing in line with biodiversity management plan	On-going	Occasionally, if required		
	Removal of existing structures such as fencing (if present).	On-going			
	Establishing the construction contractor's area	At start of phase			
Geotechnical investigations	Geotechnical drilling for the site preparations and shaft sinking and geochemical characterisation of material.	On-going			
Earthworks Earthworks on surface relate mainly to the moving of soil and rock.	Stripping and stockpiling of soil resources in line with the soil management programme	On-going	Occasionally, if required		
	Bulldozing activities	On-going	Occasionally, if required		
	Establishing gravel roads	On-going	Occasionally, if required		
	Digging trenches	On-going	For maintenance		
	Foundation excavations and compaction	On-going			
	Bulk earthworks including preparing dump footprints	On-going			
	Establishing stormwater controls (channels, berms) as per stormwater management plan	At start of phase	Occasionally, if required		
	Grading of roads	On-going	For maintenance	For maintenance	
Civil works Civil works on surface relate mainly to any steel and concrete work.	General building activities and erection of structures	On-going	For maintenance		
	Use of scaffolding and cranes	On-going	For maintenance		
	Concrete work including culverts	On-going	For maintenance		
	Steel work (including grinding and welding)	On-going	For maintenance		
	Installation of cables/lines and pipelines (process)	On-going	For maintenance		
Underground mining	Initial establishment and sinking of shafts	At start of phase	On-going		
	Drilling and blasting	On-going	On-going		
	Loading and hauling	On-going	On-going		
	Dewatering of the shafts and underground mine sections	On-going	On-going		
Overburden and waste rock management	Storage on overburden and waste dumps (on-site, on surface)	On-going	On-going		
	Final disposal / rehabilitation of waste dumps (on-site, on surface)			Permanent	Permanent

Main activity/process	Sub-activities	Construction	Operation	Decommissioning	Closure
Tailings backfilling	Construction of backfill plants and associated tailings pipelines at No 17 and 18 Shafts		Will be constructed before stoping operations start on levels 33, 34 and 35.		
	Tailings backfilling		On-going for stoping operations of last 3 levels (33 to 35)	As required for ventilation control	
Power supply and use <i>* continue until infrastructure can be removed or alternative end use identified</i>	Delivery of power to site via Eskom powerlines	On-going	On-going	On-going*	
	Temporary / Back-up power generation on site (using diesel generators with total supply of 12.5 MW)	At start of phase	As back-up*	As back-up*	
Water supply <i>* continue until infrastructure can be removed</i>	Delivery of clean water to site (water to be tanked in during construction, permanent supply from Magalies Water)	On-going	On-going	On-going*	
	Storage of clean water on site (Potable water 600 m ³)	On-going	On-going	On-going*	
Stormwater management <i>* continue until infrastructure can be removed or successfully rehabilitated</i>	Diversion of clean water	On-going	On-going	On-going*	
	Collection of dirty water using channels, berms	On-going	On-going	On-going*	
	Storage of dirty water in dams for re-use	On-going	On-going	On-going*	
Transport systems <i>* continue until infrastructure can be removed or alternative end use identified</i>	Temporary (gravel) service road	At start of phase			
	Permanent (tarred) road access will be provided from the D513 tarred road	At start of phase			
	Use of access points to the site	On-going	On-going	On-going	On-going but limited
	Transport of staff to and from site (using buses and private cars via surfaced and gravel roads) using R556, D513 and site roads	On-going	On-going	On-going	Limited
	Transport of supplies, services and waste removal (using trucks and vans via surfaced and gravel roads) using R556, D513 and site roads	On-going	On-going	On-going	Limited
	Vehicles/machinery movement within site boundary (via gravel roads)	On-going	On-going	On-going – tapering down	Limited

Main activity/process	Sub-activities	Construction	Operation	Decommissioning	Closure
	Pumping of materials (water, sewage) (via pipelines, diameter of 0.5 meters)		On-going	On-going*	
	Conveying materials within the site boundary (conveyor with wind protection sides, 1.2m above ground and wide)		On-going		
	Taxi and bus on-and off-loading areas for employees	On-going	On-going	On-going*	
Non-mineralised (general and industrial hazardous) waste management	Collection of general and hazardous waste on site	On-going	On-going	On-going	
	Separation of oil and water at wash bays	On-going	On-going	On-going	
	Temporary storage of general (capacity of less than 100 m ³) and hazardous waste (capacity of less than 80 m ³) within dedicated demarcated containers/areas	On-going	On-going	On-going	
	Sorting of general and hazardous waste for re-use and/or recycling purposes	On-going	On-going	On-going	
	Removal of waste by contractor for recycling, re-use and/or final disposal at permitted waste disposal facilities	On-going	On-going	On-going	On-going
	Use of portable sanitation and change houses	On-going		On-going	
	Treatment of sewage at a dedicated sewage treatment plant/s (± 840 365m ³ annual throughput capacity)		On-going		
	Re-use of treated sewage sludge in the rehabilitation of disturbed areas (if permitted)		On-going	On-going	
Site support services <i>* continue until infrastructure can be removed or alternative end use identified</i>	Operating office(s)	On-going	On-going	On-going*	
	Operating clinic / medical station(s)	On-going	On-going	On-going*	
	Parking of vehicles and security facilities	On-going	On-going	On-going*	Limited
Storage and maintenance services/facilities <i>* continue until infrastructure can be removed or alternative end use identified</i>	Washing of machinery and vehicles (wash bays)	On-going	On-going	On-going	
	Servicing machinery and vehicles (workshops)	On-going	On-going	On-going	
	Storage (stores, tanks) and handling of non-process materials (consumables), including sand, rock, equipment, steel, paints, gas (welding), fuel, lubricants, oil, hydraulic fluid, cement, chemical additives for cement and explosives emulsion; chemical additives for the production of tailings backfill	On-going	On-going		
Housing	No on-site housing planned.	Not applicable	Not applicable	Not applicable	Not applicable
Site/contract management	Appointment of contractors and workers (if required)	At start of phase and on-going	At start of phase and on-going	At start of phase	
	Site management (monitoring, inspections, maintenance)	On-going	On-going	On-going	On-going

Main activity/process	Sub-activities	Construction	Operation	Decommissioning	Closure
	of facilities, security, access control)				
	Environmental awareness training and emergency response	On-going	On-going	On-going	
	On-going rehabilitation of facilities/disturbed areas (where possible)	On-going	On-going	On-going	
	Implementing and maintaining management plans	On-going	On-going	On-going	
Demolition \$ unless alternative end land or infrastructure use is identified during the detailed closure planning	Removing construction contractor's area	At end of phase			
	Dismantling and demolition of infrastructure using scaffolding and cranes		For maintenance	On-going ^{\$}	
	Removal of equipment		For maintenance	On-going ^{\$}	
	Removal of foundations and access roads (no longer needed)			On-going ^{\$}	
Rehabilitation \$ unless alternative end land or infrastructure use is identified during the detailed closure planning	Rehabilitating construction borrow pits	At end of phase			
	Replacing soil resources		As required	On-going	
	Slope stabilisation and landscaping	On-going	On-going	On-going	On-going
	Sealing of shafts with engineered plugs	As required	As required	On-going	
	Re-vegetation of disturbed areas and where infrastructure was removed in line with biodiversity management plan	Where possible	Where possible	On-going	For maintenance
	Restoration of natural drainage patterns as far as practically possible			On-going	
	Rehabilitation of waste dumps		On-going	On-going	
	Initiation of aftercare and maintenance			At end of phase	
Maintenance and aftercare	Monitoring, maintenance and repair of facilities and rehabilitated areas				On-going until rehabilitation measures are successful and a closure certificate is obtained

2.4 PLAN SHOWING LOCATION AND EXTENT OF OPERATIONS

2.4.1 SITE LAYOUT PLANS

The location of the proposed infrastructure in relation to existing Impala infrastructure is provided in Figure 21. Site layouts for the project include an overall site layout showing the full extent of the current application area (Figure 22) and a zoomed-in plan of a typical shaft complex (Figure 23).

2.4.2 SITE FACILITIES DURING CONSTRUCTION

It is envisaged that construction related infrastructure for all No 18 Shaft project components will be placed at the No 18 Shaft complex footprint. The following facilities are expected during construction:

- Contractors lay down areas
- Workshops, stores, wash bays, lay-down areas, fuel handling and storage area, offices, ablution facilities such as chemical toilets or conservancy tanks
- Handling and storage area for construction materials (paints, solvents, oils, grease) and waste
- Generators for temporary power supply
- Stockpiles
- Water management infrastructure
- Explosive magazines
- Run of mine (ROM) pads
- Haul roads
- Temporary access roads
- Temporary services (water, electricity)
- Ventilation infrastructure including fans
- Drill rigs for geotechnical drilling
- Portable air compressors for the sinking operations
- Settling ponds for the sinking operations.
- Sewage treatment plant.

These facilities would either be removed at the end of the construction phase or incorporated into the layout of the operational mine.

The existing No 17 Shaft laydown area and other facilities will be used during the construction of the proposed No 17 Shaft STP and linear infrastructure, while the facilities at No 11C Shaft will be used during the construction of the proposed central STP.

It should be noted that the site layout plan in Figure 23 does not show all of these construction infrastructure components.

2.4.3 SITE FACILITIES DURING THE OPERATIONAL PHASE

The bulk of the No 18 Shaft surface infrastructure will be accommodated in approximately two square kilometres for the shaft. Shaft infrastructure will typically include (refer to Figure 22 and Figure 23):

- A Main Shaft intended for personnel, material and rock hoisting with an internal lined diameter of 10 m and depth of 1 940 m. This shaft will be equipped with headgear, hoisting facilities and winder houses
- An upcast Ventilation Shaft with an internal lined diameter of 9 m and depth of 1 680 m and equipped with five surface fans
- Downcast shaft for chilled air (Fridge Shaft), with a diameter of 8 m and depth of 1 380 m
- A separate short bulk air cooler (BAC) duct with a short feeder shaft of approximately 60 0 m into the Main Shaft.
- Air compressors housed in a building
- Ore, fuel, chemical, material and explosive storage facilities
- Topsoil stockpile/s
- Silo storage for mined ore
- A waste rock dump
- An overburden stockpile
- A cementation/grout plant
- Conveyors
- Road access and internal roads
- Change houses
- Lamp rooms
- A medical first aid facility
- Offices
- Shaft access and security offices
- Parking areas
- Fire detection and fighting facilities
- Water storage facilities and surface water control measures: in compliance with R704
- Lighting and communication infrastructure
- Provision is made for modular sewage treatment plants at the No 18 and 17 shafts as well as a conventional central sewage treatment facility close to the existing No 11C Shaft
- Waste handling stationA complete reticulation system for all services to No 18 Shaft.

Other project components include:

- The following services will be run in approved servitudes:
 - Incoming water supply from water board mains via No14 Shaft
 - Compressed air connection into the Impala compressed air circuit
 - Tailings pipelines between the No 18 Shaft and the existing tailings scavenger plant
 - Sewerage reticulation for the central sewage plant option and pipeline to the tailings dams area for any excess water from the shaft to be utilised in the processing plant
 - Sewage and tailings reticulation from central STP and existing tailings scavenger plant respectively to No 17 shaft (this servitude still requires approval).
 - Overhead 33 kV Electrical power lines
 - Rail lines
 - Access roads.
- Once mining reaches 1 600 m below ground level at No 17 and 18 Shafts, a tailings treatment plant will be established at each shaft. These plants will be required to prepare the tailings for usage as support and ventilation barriers in mined out areas. These plants will be located on the shaft bank area and sized as described in above. As indicated above, tailings pipelines will be required to convey tailings to these plants. There will in fact be three pipelines, one conveying tailings slurry to the tailings treatment plant; one from the plant to the tailings dam; and one will be kept empty to provide for emergency situations.

It should be noted that the site layout plan in Figure 23 shows only the main infrastructure components.

FIGURE 21: LOCATION OF NEW SHAFT WITHIN EXISTING IMPALA OPERATIONS

FIGURE 22: SURFACE INFRASTRUCTURE LAYOUT (OVERALL SITE LAYOUT)

FIGURE 23: TYPICAL SHAFT COMPLEX

2.5 LISTED ACTIVITIES IN TERMS OF EIA REGULATIONS (NEMA AND NEM:WA)

The list of activities applied for under NEMA is included in Table 33. The list of waste-related activities applied for is presented in Table 34. These activities have been incorporated into the list of project activities as presented in Table 32.

TABLE 33: NEMA LISTED ACTIVITIES APPLIED FOR (AS PER APPLICATION DATED AUGUST 2013)

Activity Number	Listed Activity	Description of activity
Notice 544, 18 June 2010		
1	The construction of facilities or infrastructure for the generation of electricity where: <ul style="list-style-type: none"> (i) i. the electricity output is more than 10 megawatts but less than 20 megawatts; or (ii) ii. the output is 10 megawatts or less but the total extent of the facility covers an area in excess of 1 hectare. 	Preliminary design information allows for the temporary use of back up diesel generators during emergency situations to generate 15 MW of electricity.
9	The construction of facilities or infrastructure exceeding 1 000 metres in length for the bulk transportation of water, sewage or storm water – <ul style="list-style-type: none"> (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: <ul style="list-style-type: none"> a. such facilities or infrastructure are for bulk transportation of water, sewage or storm water or storm water drainage inside a road reserve; or b. where such construction will occur within urban areas but further than 32 metres from a watercourse, measured from the edge of the watercourse. 	Preliminary design information allows for the transportation of water, sewerage and storm water to the No 18 and 17 Shafts in pipeline sizes with a diameter greater than 0.36 meters.
11	The construction of: <ul style="list-style-type: none"> (i) canals (ii) channels; (iii) bridges; (iv) dams; (v) weirs; (vi) bulk storm water outlet structures; (vii) marinas; (viii) jetties exceeding 50 square metres in size; (ix) slipways exceeding 50 square metres in size; or 	The proposed No 18 Shaft complex will be in close proximity to a watercourse. In addition, linear infrastructure proposed for No 18 and No 17 Shafts such as roads and pipelines, will cross perennial and non-perennial water courses in various locations.

Activity Number	Listed Activity	Description of activity
	(x) buildings exceeding 50 square metres in size; or (xi) infrastructure or structures covering 50 square metres or more; where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.	
12	The construction of facilities or infrastructure for the off-stream storage of water, including dams and reservoirs, with a combined capacity of 50 000 cubic metres or more, unless such storage falls within the ambit of activity 19 of Notice 545 of 2010	Preliminary design information indicates that No 18 shaft will have a stormwater dam capacity of 85 ML.
22	The construction of a road, outside urban areas, (i) with a reserve wider than 13,5 metres or, (ii) where no reserve exists where the road is wider than 8 metres, or (iii) for which an environmental authorisation was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Notice 545 of 2010.	Preliminary design information indicates that the main No 18 Shaft access roads will be 9.4 m asphalt covered roads with 1 m gravel shoulder, and will not be in a national road reserve.
37	The expansion of facilities or infrastructure for the bulk transportation of water, sewage or storm water where: (a) the facility or infrastructure is expanded by more than 1 000 metres in length; or (b) where the throughput capacity of the facility or infrastructure will be increased by 10 % or more- excluding where such expansion: (i) relates to transportation of water, sewage or storm water within a road reserve; or (ii) where such expansion will occur within urban areas but further than 32 metres from a watercourse, measured from the edge of the watercourse.	Preliminary design information allows for new water, sewerage and storm water handling facilities to be constructed at the shaft sites which will be approximately 16 km long.
53	The expansion of railway lines, stations or shunting yards where there will be an increased development footprint – excluding: (i) railway lines, shunting yards and railway stations in industrial complexes or zones; (ii) underground railway lines in mines; and (iii) additional railway lines within the reserve of an existing railway line.	Preliminary design information indicates that a new railway line will be built to the No 18 Shaft area and will be approximately 12.5 km long.
Notice 545, 18 June 2010		
5	The construction of facilities or infrastructure for any process or activity which requires a permit or license in terms of national or provincial legislation governing the generation or release of emissions,	Various activities will require an amendment of the Impala Water Use

Activity Number	Listed Activity	Description of activity
	pollution or effluent and which is not identified in Notice No. 544 of 2010 or 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 that Act will apply.	<p>Licence. At this stage these water uses are anticipated:</p> <ul style="list-style-type: none"> • The use of tailings as support in mined out areas at the No 17 and 18 Shaft mining blocks • The waste rock dump and dirty water storage dams at the No 18 shaft will require authorisation in terms of section 21(g) of the National Water Act: Disposing of waste in a manner which could detrimentally impact upon a water resource. • The dewatering of the underground mine area will require authorisation in terms of section 21 (a): Taking water from a water resource and (j): Removing water from underground for the safe continuation of an activity
6	<p>The construction of facilities or infrastructure for the bulk transportation of dangerous goods</p> <ul style="list-style-type: none"> (i) in gas form, outside an industrial complex, using pipelines, exceeding 1000 metres in length, with a throughput capacity of more than 700 tons per day; (ii) in liquid form, outside an industrial complex, using pipelines, exceeding 1000 metres in length, with a throughput capacity of more than 50 cubic metres per day; or (iii) in solid form, outside an industrial complex, using funiculars or conveyors with a throughput capacity of more than 50 tons per day. 	<p>Preliminary design information indicates that tailings will be pumped via pipelines to the No 17 and 18 Shaft site where it will be blended with cement and placed in geosocks for deposition in mined out areas. The flow rate is expected to be 50 m³/hr.</p>

Activity Number	Listed Activity	Description of activity
15	Physical alteration of undeveloped, vacant or derelict land for residential, retail, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 hectares or more; except where such physical alteration takes place for: (i) linear development activities; or (ii) agriculture or afforestation where activity 16 in this schedule will apply.	Preliminary design information indicates the total site area that will be transformed will exceed an area of 150 hectares.
Notice 546, 18 June 2010		
4	The construction of a road wider than 4 metres with a reserve less than 13,5 metres. (c) In North West : i. Outside urban areas, in: (aa) A protected area identified in terms of NEMPAA, excluding conservancies; (bb) National Protected Area Expansion Strategy Focus areas; (cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; (dd) Sites or areas identified in terms of an International Convention; (ee) Critical biodiversity areas (Terrestrial Type 1 and 2 and Aquatic Type 1) as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; (ff) Core areas in biosphere reserves; (gg) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from a biosphere reserve. ii. In urban areas: (aa) Areas zoned for use as public open space; (bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority or zoned for a conservation purpose; (cc) Natural heritage sites.	Preliminary design information indicates that the main No 18 Shaft access roads will be 9.4 m asphalt covered roads with 1 m gravel shoulder, and will not be in a national road reserve.
12	The clearance of an area of 300 square metres or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation. (a) Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004; (b) Within critical biodiversity areas identified in bioregional plans; (c) Within the littoral active zone or 100 metres inland from high water mark of the sea or an estuary, whichever distance is the greater, excluding where such removal will occur behind the development setback line on erven in urban areas.	The existing No 17 Shaft as well as its proposed linear infrastructure will traverse a threatened ecosystem (Marikana Thornveld).

Activity Number	Listed Activity	Description of activity
13	<p>The clearance of an area of 1 hectare or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, except where such removal of vegetation is required for:</p> <p>(1) the undertaking of a process or activity 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 activity is regarded to be excluded from this list.</p> <p>(2) the undertaking of a linear activity falling below the thresholds mentioned in Listing Notice 1 in terms of GN No. 544 of 2010.</p> <p>(a) Critical biodiversity areas and ecological support areas as identified in systematic biodiversity plans adopted by the competent authority.</p> <p>(b) National Protected Area Expansion Strategy Focus areas.</p> <p>(e) In North West:</p> <p>i. Outside urban areas, in:</p> <p>(aa) A protected area identified in terms of NEMPAA, excluding conservancies;</p> <p>(bb) National Protected Area Expansion Strategy Focus areas;</p> <p>(cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;</p> <p>(dd) Sites or areas identified in terms of an International Convention;</p> <p>(ee) Critical biodiversity areas (Type 1 only) and ecological support areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;</p> <p>(ff) Core areas in biosphere reserves;</p> <p>(gg) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve.</p>	<p>The majority of proposed infrastructure falls with a National Protected Area Expansion Strategy Focus area.</p>
14	<p>The clearance of an area of 5 hectares or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, except where such removal of vegetation is required for:</p> <p>(1) purposes of agriculture or areas identified in spatial instruments adopted by the Competent authority for agriculture or afforestation purposes;</p> <p>(2) the undertaking of a process or activity 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 activity is regarded to be excluded from this list;</p> <p>(3) the undertaking of a linear activity falling below the thresholds in Notice 544 of</p>	<p>Preliminary design information indicates that more than 5 ha of vegetation will be removed for the establishment of surface infrastructure.</p>

Activity Number	Listed Activity	Description of activity
	2010. (a) In Eastern Cape, Free State, KwaZulu-Natal, Gauteng, Limpopo, Mpumalanga, Northern Cape, Northwest and Western Cape: i. All areas outside urban areas.	
16	The construction of: (i) jetties exceeding 10 square metres in size; (ii) slipways exceeding 10 square metres in size; (iii) buildings with a footprint exceeding 10 square metres in size; or (iv) infrastructure covering 10 square metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line. (c) In North West: i. Outside urban areas, in: (aa) A protected area identified in terms of NEMPAA, excluding conservancies; (bb) National Protected Area Expansion Strategy Focus areas; (cc) World Heritage Sites; (dd) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; (ee) Sites or areas identified in terms of an International Convention; (ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; (gg) Core areas in biosphere reserves; (hh) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve.	<p>The proposed shaft 18 complex will be constructed in close proximity to watercourses.</p> <p>In addition, the majority of proposed infrastructure falls with a National Protected Area Expansion Strategy Focus area and the proposed No 17 Shaft linear infrastructure will traverse a threatened ecosystem (Marikana Thornveld).</p>

TABLE 34: NEM:WA LISTED ACTIVITIES RELEVANT TO THE PROJECT (GN32368, OF 3 JULY 2009)

Activity number	Listed Activity	Description of Activity
B4 (7) Category B	The treatment of effluent, wastewater or sewage with an annual throughput capacity of 15 000 cubic meters or more.	Treatment of sewage in various sewage treatment plants.
B4(11) Category B	The construction of activities listed in Category B of the schedule.	Construction of the various sewage treatment plants.

2.6 INDICATION OF PHASES AND TIMEFRAMES ASSOCIATED WITH THE MAIN ACTIONS / ACTIVITIES / PROCESSES

An indication of the phases and estimated timeframes in relation to the main actions, activities or processes and infrastructure is provided in Table 32 above.

2.7 ADDITIONAL INFORMATION

2.7.1 CONSTRUCTION PHASE

2.7.1.1 Workforce and housing

At this stage it is expected that the construction workforce will peak at 1 200 people. The construction contractors will be responsible for housing their workers off site and providing the required facilities and services.

2.7.1.2 Transport Systems

Temporary (gravel) road access will be provided to the project area from No 14B Shaft, along the same servitude corridor as the temporary power and water supply, which will be sourced from No 14 Shaft. The No 18 Shaft temporary access roads will be extended from the existing No 14 Shaft. It is planned that these temporary access / service roads will be rehabilitated and surfaced with asphalt to form the permanent access roads.

The Central STP site will be accessed via existing Impala roads at the TSF site, and the No 17 Shaft site is accessed by the Phokeng Kanana Road.

The linear infrastructure corridors will have maintenance access tracks associated with them and will extend from No 17 and 18 Shafts as required.

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Approximately 25 buses per day are expected to transport staff to and from site during the construction phase, and approximately 10 trucks per day for transport of materials along the R556, D513 and site roads.

2.7.1.3 Water Supply and Management

Water will be brought in by tankers until permanent water supply is established.

Impala plans to contain and re-use contaminated water generated at the shafts.

2.7.1.4 Power Supply

Temporary power of 8 MVA will be supplied directly by Eskom from the Millennium substation at 6,6 kV from 2x10 MVA transformers. The new twin 33 kV overhead lines which will be used for construction and permanent conditions will initially be operated at 6,6 kV with an initial demand of around 2 MVA until the main sinking operations commence. The twin 33 kV lines will follow the mechanical services corridor. The power supply will be adequate to address the construction of all proposed project infrastructure.

Any new power lines and distribution yards will be authorized by Eskom and will not form part of this EIA.

2.7.1.5 Waste management

2.7.1.5.1 Sewage

During the early construction phase, sewage will be collected in conservancy tanks and transported by truck to existing sewage treatment facilities at Impala. The existing system is capable of handling the additional load for the interim period.

2.7.1.5.2 Non-mineralised wastes

The types of waste that could be generated during construction include:

- General waste:
 - Domestic waste
 - Uncontaminated PPE
 - Garden waste
 - Food waste
 - Building rubble
 - Paper
 - Plastics
 - Glass
 - Metals
 - Rubber
 - Wood
- Hazardous waste:
 - Gaseous waste (ammonia)
 - Batteries
 - POP wastes (PCB transformers etc.)
 - Inorganic chemical waste (laboratory chemicals, vanadium pentoxide etc.)
 - Waste oils
 - Organic compounds and solvents (reagents, chemicals etc.)
 - WEEE waste (electrical and electronic equipment, cartridges etc.)
 - Health care risk waste (clinics and hospital waste)

- Sewage sludge (sewage plants).
- Explosives waste
- Contaminated metals, plastic, rubber and wood.

These wastes will be temporarily handled and stored on site before being removed for recycling by suppliers, reuse by scrap dealers or final disposal at permitted waste disposal facilities.

Impala has developed and implements a waste management procedure that considers the waste management hierarchy and sound environmental practices for the handling and temporary storage of wastes on site.

2.7.1.6 Timing

The bulk of construction activities to enable the build up to full production should take ten years, starting between 2015 and 2018, pending the EIA authorisation process and Impala Platinum project approval processes. The start date is furthermore dependant on the global economic environment and the company financial situation. The central and No 17 Shaft STPs will be constructed at the end of 2016, along with the associated pipelines.

2.7.2 OPERATIONAL PHASE

2.7.2.1 Workforce and Housing

The No 18 Shaft project is an ore replacement project and therefore Impala will move workers from other areas of their operations to the new mine area during the operational phase. Therefore no significant additional jobs will be created or additional housing will be required for the operation of all proposed project components. However, a marginal number of additional staff will be required to operate the new STPs.

2.7.2.2 Transport Systems

Permanent (tarred) road access to the No 18 Shaft will be provided from the D513 tarred road linking Luka village to the R556 (Sun City road) with a ring linking existing road infrastructure on the No. 14 Shaft. Linear infrastructure will have maintenance tracks.

Approximately 30 buses per day are expected to transport staff to and from No 18 Shaft during the operational phase, and approximately 10 trucks per day for transport of materials along the R556, D513 and site roads. No significant additional transport is expected to the other project components.

Ore will be trammed by locomotive and hopper on the Impala surface rail system, linking the No 18 Shaft into the rail network at the No 11 Shaft.

2.7.2.3 Water Supply and Management

Water will be supplied directly by Magalies Water from the Vaalkop Dam. Any new bulk water pipelines will be authorised by Magalies Water. The internal Impala water distribution circuit will be in the linear corridors shown in Figure 22 and have been included in this EIA.

At this stage it is estimated that 150 000 m³ of water will be required per month at No 18 Shaft for makeup to cooling towers, change houses, drinking water, washing facilities, grout and underground works at the shaft complex.

Impala plans to contain and re-use contaminated water generated at the shafts. The site complies with the National Water Act 36 of 1998 and Regulations 704 in terms of clean and dirty water separation and management. The best environmental solution is firstly to re-use excess dirty water. Treatment of water may be required in order to re-use this water, and clean water will only be taken in for make-up water over and above this. Discharge is only considered as a last option.

2.7.2.4 Power Supply

The initial strategy to supply power to No. 18 Shaft shall be to utilise the spare capacity on the 6,6 kV network at Millennium sub-station situated approximately 4 km south west of No. 18 Shaft via 6,6 kV overhead lines. This setup shall supply No. 18 Shaft for approximately four years before being switched over to the permanent supply, however, in order to achieve this two existing 10 MVA transformers at Millennium sub-station will need to be replaced with two 20 MVA transformers.

The permanent supply shall be derived from a new ESKOM distribution sub-station which shall be established approximately 500 m away from No. 18 Shaft. This sub-station shall receive a premium supply via 2 No's kingbird overhead lines, one from the new Ngwedi Main Transmission Station (MTS) envisaged to be completed by 2016 and the other from SA Chrome sub-station. From the new distribution sub-station, No. 18 Shaft shall receive power at 33 kV via 2 x 33 kV twin circuit Panther overhead lines designed for full redundancy of the envisaged maximum demand of 51.5 MVA.

At the No. 18 Shaft Complex, 33 kV and 6, 6 kV will be used as the primary distribution voltages to supply all surface and underground load centres. The temporary 6, 6 kV supply will feed into temporary, modular switchrooms, which will distribute power to all surface infrastructure and contractors. These modular switchrooms shall be designed for easy relocation and it is the intention that these modular switchrooms be uplifted, relocated and installed on the next Impala sinking project, once the sinking phase of No. 18 Shaft is completed.

Power for the operation of the STP and associated infrastructure, as well as water pipeline will be sourced from No 11c shaft, No 17 and 18 Shafts as well as the operating TSF power supply point as relevant.

Any new power lines and distribution yards will be authorized by Eskom and will not form part of this EIA.

2.7.2.5 Waste management

2.7.2.5.1 Sewage

Impala plans to develop three separate sewage treatment plants, with associated pipelines:

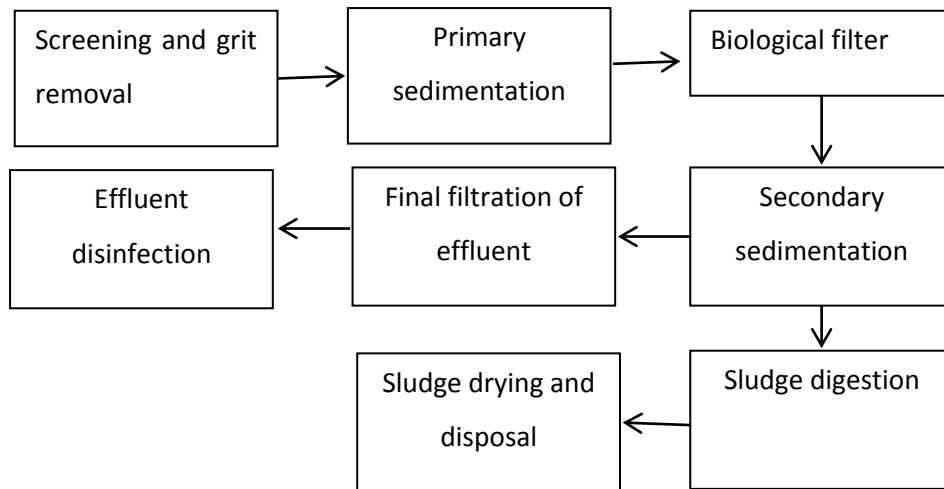
- Modular sewage plants at each shaft complex (17 and 18) to cater for 4 800 personnel each generating 150 litres of waste per person per day
- A central sewage treatment plant at No 11C Shaft will treat sewage from other parts of the mine.

The sewage treatment plants will potentially have following treatment stages:

- Screening and grit removal to remove large objects mechanically
- Primary sedimentation to remove coarser suspended solids
- Biological filter in which sewage trickles over pebbles in anaerobic conditions. The organic substance resident on the pebble medium works on the incoming effluent via carboneous oxidation. Alternatively an activated sludge process may be used
- Secondary sedimentation (humus tank) to remove any microorganisms that may have passed through the biological filter. A portion of the settled effluent is returned to primary sedimentation
- Sludge is rendered harmless by an aerobic digester and then dried for disposal
- Final filtration to remove any remaining suspended solids using gravity or sand filters
- Chlorination or the use of ozone gas to kill any remaining bacteria (disinfection)
- Treated sewage effluent will be fed back into the mine or mineral processing water circuit or active return water dam for reuse
- Sewage sludge from drying beds will be used for composting or land rehabilitation as is currently the practice at Impala. Alternatively it will be managed according to Impala's waste management procedure which could include disposal at a registered landfill site.

Emergency storage is incorporated into the sewage treatment plant design. In addition, the design allows for high peak inflows occurring at shift changes and low flows between shift changes.

Figure 24 provides a flow diagram of the treatment process.

**FIGURE 24: SEWAGE TREATMENT FLOW DIAGRAM**

2.7.2.5.2 Non-mineralised wastes

The types of waste that could be generated at the vertical shaft operations are as described above (see section 2.7.1.5.2). These wastes will be temporarily handled and stored on site before being removed for recycling by suppliers/contractors, reuse by scrap dealers or final disposal at permitted waste disposal facilities.

Impala has developed and implements a waste management procedure that considers the waste management hierarchy and sound environmental practices for the handling and temporary storage of wastes on site.

2.7.2.5.3 Mineralised Waste Disposal at No 18 Shaft

Overburden Disposal

Overburden, which includes soil and material that can be removed by excavation (without blasting) will not contain blast residues and will be accommodated in specific overburden stockpile at the shaft complex. Overburden may be used during construction for various uses such as fill material, and it is expected that limited overburden will remain on surface after closure. Key information on the design principles is provided in the table below.

TABLE 35: OVERBURDEN DISPOSAL

Feature	Detail			
Safety and environmental classification				
Safety classification	TWP has determined the safety classification as Low in accordance with the South African Code of Practice for Mine Residue Deposits (SANS 10286:1998) and the requirements of Mineral Regulation 527 of 23 April 2004).			
	Criteria No.	Criteria	Comment	Safety Classification
	1	No. of Residents in Zone of Influence	No formal or informal settlements were noted within the zone of influence. Specialist studies indicated that the general land use in this area is for grazing. The design allows for fencing of the general site area and therefore the exposure to any danger will be minimal.	Low Hazard
	2	No. of Workers in Zone of Influence	The topography dictates the zone of influence to be to the North and North West. Minimal workers will be exposed in this area since the only site activity in this area is the storm water collection dam and pump station. Workers responsible for the day-to-day waste handling who will be working at and on the waste dump is also minimal	Low Hazard
	3	Value of third party property in zone of influence	No formal assessment of the value of property has been done in the zone of influence. The characteristics of the overburden dumps are such that catastrophic failures will be localised and no extended flow will be experienced. The dump design has been completed by professional engineers and the construction will be	Low Hazard

Feature	Detail			
			supervised by competent persons. Life of mine quality inspections of the installations will be conducted by the appointed engineer.	
	4	Depth to underground mine workings	The No 18 Shaft mine is a deep level mine with the first working areas only starting at around 1 500 m below ground level. Therefore no influence on surface storage stockpile is expected.	Low Hazard
Environmental classification	Low risk classification due to limited dust and seepage potential.			
Preliminary design principles				
Area	Approximately 162 000 m ² (16.2 ha)			
Overburden Transport and Deposition	Overburden will be loaded selectively onto mine dump trucks and transported to stockpile. Stockpile access ramps will be constructed with a maximum gradient of 1:7 for mine dump trucks. Overburden will be dumped and spread and flattened with a bulldozer. The acid generating potential of the overburden is expected to be limited, but as part of on-going rehabilitation and pollution control, the practice will be to reinstate the original profile comprising topsoil, with soft subsoil material.			
Topsoil Stripping	Topsoil in the overburden footprint area will be stripped and stockpiled in accordance with the topsoil conservation guide. Some of this material may be used for the construction of noise barriers such as berms. A stripping depth of 500 mm is recommended where possible or until hard rock is encountered.			
Lining	No lining will be provided.			
Under Drains	No under drainage will be provided.			
Access and Access Control	Mining haul roads will typically have a minimum width of 7.4 m plus 1 m wide shoulders and will be constructed using waste rock. A perimeter fence around the overburden stockpile is not planned. Rather a perimeter fence around the whole of shaft complex will be installed.			
Waste Minimisation	Overburden will be used for the construction of internal mine access and haul roads during the construction phase and for the maintenance of roads during the operational phase if the material is appropriate.			
Monitoring	No monitoring is planned, as this material will not contain blast residues.			
Dust Control	Operational Phase: Watering of roads for dust suppression. Post Operational Phase: No measures necessary due to the coarse particle size distribution.			
Rehabilitation of overburden dumps (within 12 months on the dumps being inactive)	Once no more material is being added to or removed from the stockpile, it will be properly rehabilitated: <ul style="list-style-type: none">• Access ramps and berms will be eliminated prior to rehabilitation to reduce erosion risks• The side slopes will be flattened to a gradient that will support the re-establishment of sustainable land functionality• The overburden dumps will be covered with subsoil and stockpiled topsoil and re-vegetated with a combination of indigenous trees, shrubs, grasses to mimic the vegetation cover of natural topographical features in the area• Topsoil stripped prior to development will be used to provide the growth medium• The vegetation will be monitored for one year to determine if land functionality has been established• No active groundwater protection measures are envisaged given the relatively low pollution of the residual spoil material• Rehabilitation success will be determined by monitoring vegetation cover and land function.			

Waste Rock Disposal

Material that must be blasted and any waste rock from underground mining will be disposed of onto a dedicated waste rock dump at the complex. The waste rock dump is expected to remain on surface after closure; however some material may be used during construction. Key information on the design principles is provided in the table below.

TABLE 36: WASTE ROCK DUMP DISPOSAL

Feature	Detail			
Safety and environmental classification				
Safety classification	TWP has determined the safety classification as Low in accordance with the South African Code of Practice for Mine Residue Deposits (SANS 10286:1998) and the requirements of Mineral Regulation 527 of 23 April 2004).			
	Criteria No.	Criteria	Comment	Safety Classification
	1	No. of Residents in Zone of Influence	No formal or informal settlements were noted within the zone of influence. Specialist studies indicated that the general land use in this area is for grazing. The design allows for fencing of the general site area and therefore the exposure to any danger will be minimal.	Low Hazard
	2	No. of Workers in Zone of Influence	The topography dictates the zone of influence to be to the North and North West. Minimal workers will be exposed in this area since the only site activity in this area is the storm water collection dam and pump station. Workers responsible for the day-to-day waste handling who will be working at and on the waste dump is also minimal	Low Hazard
	3	Value of third party property in zone of influence	No formal assessment of the value of property has been done in the zone of influence. The characteristics of the waste rock dumps are such that catastrophic failures will be localised and no extended flow will be experienced. The dump design has been completed by professional engineers and the construction will be supervised by competent persons. Life of mine quality inspections of the installations will be conducted by the appointed engineer.	Low Hazard
	4	Depth to underground mine workings	The No 18 Shaft mine is a deep level mine with the first working areas only starting at around 1 500 m below ground level. Therefore no influence on surface storage dump is expected.	Low Hazard
Environmental classification	Medium classification			
Chemical characteristics	The chemical characteristics of waste rock samples are discussed in section 1.1.1. These show no significant acid generating characteristics but the potential for contamination through seepage/leachate does exist.			
Preliminary design principles				
Dimensions	Footprint area for the WRD will be a minimum of 16 ha with a height of approximately 40 m with side slopes of approximately 1:3.			
Waste Rock Transport and Deposition	Waste rock from the establishment of the shaft boxcut will be loaded onto mine dump trucks and transported to the waste rock dumpsite. During the operational phase, waste rock will be conveyed from underground to the waste rock dump at the shaft complex. The sides of the dump slope will initially be 1:1,5. During the course of operations, the dump will be spread at a slope of 1:3 to minimize erosion and allow for topsoil capping.			
Diversion / Stormwater management	Stormwater trenches / berms around the upstream boundaries of the waste rock dump that direct clean stormwater run-off around and away from the waste rock dump.			
Topsoil Stripping	Topsoil in waste rock dump footprint area will be stripped and stockpiled in accordance with the topsoil conservation guide in close proximity to the final toe of each waste rock dump. A stripping depth of 500mm is recommended, however this will depend on the actual depth of topsoil, because enough material must remain available for compaction to serve as lining.			

Feature	Detail
Lining	<p>After topsoil stripping the underlying black turf will be moisture conditioned and compacted to provide a liner of approximately 0.5 m depth. However, the black turf is highly expansive, and if allowed to dry out after compaction, shrinkage cracking will occur. It is therefore imperative that immediately after compaction a protective layer of suitable material is placed over the prepared layer to maintain moisture content and prevent desiccation. Waste rock can then be dumped over the cover.</p> <p>The cover layer will comprise a layer of high permeability coarse sand or gravel sized material approximately 500 mm thick, which will act as a capillary break layer and cover. Screened and washed crusher sand will be used for this purpose.</p>
Embankments	The outer slopes of the facility will have an overall slope no steeper than 1:3 to prevent erosion of any capping material placed over the waste rock and to facilitate vegetation growth.
Under Drains	<p>A network of agricultural type drains will be constructed over the compacted clay layer to reduce the hydraulic head on the liner and intercept seepage from the overlying waste rock before it enters the ground.</p> <p>The drains will divert leachate to a collection sump or series of sumps outside the footprint of the WRD, from where it will be recycled or treated.</p>
Access and Access Control	<p>The haul roads will typically have a minimum width of 7.5 m and will be constructed using waste rock. A perimeter fence around each waste rock dump is not planned. Rather a perimeter fence around the whole of the shaft complex will be installed.</p>
Waste Minimisation	Waste rock may be used for the construction of internal mine access and haul roads, used as rail balast as well as the shaft terrace during the construction phase and for the maintenance of roads during the operational phase for the current project as well as in other areas of the Impala operation. The opportunity also exists to crush and sell waste rock as building aggregate.
Monitoring	Monitoring of boreholes around the perimeter of the waste rock dump to determine pH, EC, TDS, NO ₃ , Ca, Mg, Fe, Mn, Na, Cl, K, SO ₄ , F, Zn, Cu, Ni.
Dust Control	<p>Operational Phase: Watering of roads for dust suppression and concurrent rehabilitation to establish vegetative cover</p> <p>Post Operational Phase: No measures necessary due to the coarse particle size distribution and vegetative cover.</p>
Concurrent shaping and capping	<p>The capping should cover as much of the dump as possible at all times, leaving only a 20 m wide strip along the face of the dump, although the width of the active face may be amended once the waste rock deposition begins in order to suit operating requirements.</p> <p>Capping will be placed annually, keeping pace with the advance of the dump and the base preparation.</p> <p>Prior to capping, the top of the dump will be sloped towards the perimeter (minimum slope 2 %) to prevent ponding and the side slopes of the WRD will be shaped to a maximum gradient of 1:3.</p> <p>The capping layer will be placed over the WRD to reduce ingress of rainwater into the dump. Criteria for capping are that it:</p> <ul style="list-style-type: none"> • Should reduce infiltration to less than 5% of incident rainfall • Should be free draining to ensure that ponding does not occur • Should support a vegetative cover • Must be resistant to erosion before vegetation becomes established • Must be sufficiently robust to remain in place indefinitely after decommissioning and closure. <p>Capping will be carried out with materials that exist naturally in the vicinity of the dump. 0.5 m of capping material is considered sufficient to prevent the infiltration of rainfall into the final landform.</p> <p>The cap will be an engineered cover/drain system consisting of layers (installed bottom to top) as follows:</p> <ul style="list-style-type: none"> • A selected layer of single sized finer (<50 mm) waste rock 300 mm thick to be spread over the general waste-rock fill to act as a capillary break layer • A 300 mm thick layer of compacted black turf placed over the capillary break layer • 200 mm of topsoil with local grass roots, seed etc. spread over the compacted black turf. Seeding the topsoil would be advantageous to encourage rapid growth of vegetation and minimise erosion of the topsoil.
Closure	<p>Decommissioning of the WRD will include:</p> <ul style="list-style-type: none"> • Protecting the sides and top surfaces of the WRD against wind and water erosion • Upgrading and securing water drainage on the WRD to ensure that the capping layer is not subject

Feature	Detail
	<ul style="list-style-type: none"> to erosion Providing permanent stormwater management to avoid ingress of water into the WRD

2.7.2.6 Mineral processing

The ore from the No 18 Shaft complex will be processed at the existing Impala concentrator. The ore will be trammed by locomotive and hopper on the Impala surface rail system. The No 18 Shaft will be linked into the rail network at No 11 Shaft.

2.7.2.7 Tailings Backfilling (support and ventilation)

Murray and Roberts conducted a design cost study in 2007 on tailings backfilling at the No 17 Shaft mining area. The information in this section was sourced from this report.

Tailings will be mixed with cement and other binding and stabilising additives which will be used as backfill material. The backfill will be placed in panels of approximately 70 m³ in size in the lower three levels of the mining areas at the No 17 and 18 Shafts. As previously indicated, this backfill will provide support during mine development and will be used as ventilation barriers.

The backfill system will conceptually operate as follows (Murray & Roberts, 2007):

- The tailings will be delivered from the tailings dam delivery pipeline and fed under pressure and gravity to the backfill plant at each shaft. It is estimated that 2.2 m³ of tailings slurry will be required for every cubic metre of backfill
- Excess water will be removed from the tailings by cycloning to the required solids concentration, essentially a tailings paste, and the supernatant water used for pipeline flushing and binder production, after which the remainder will be returned either to the tailings dam or the concentrators or re-used at the shaft if practical
- The thickened tailings will then be transferred and stored in flat bottomed, mechanically agitated tanks
- A pumped delivery system will deliver the thickened tailings to the required pipelines for distributing underground
- A binder system will blend and deliver binder to the backfill pipelines for distributing underground. The binder system will require a silo to feed material to a mixer, and an intermediate storage tank to act as a buffer for the mixer.
- A flushing system will clear each of the backfill pipelines. The decant water from the thickener will be retained in a flush water tank for pre and post flushing of the backfill and binder pipelines.

It may be that the tailings cannot be settled to the required solids concentration and therefore provision has been made for a vacuum filter press that produces a filter cake of the tailings at a high solids

concentration, which can be used to increase the solids concentration of the backfill in the flat bottomed mechanically agitated tanks.

Figure 25 provides a conceptual flow diagram of a typical backfill plant.

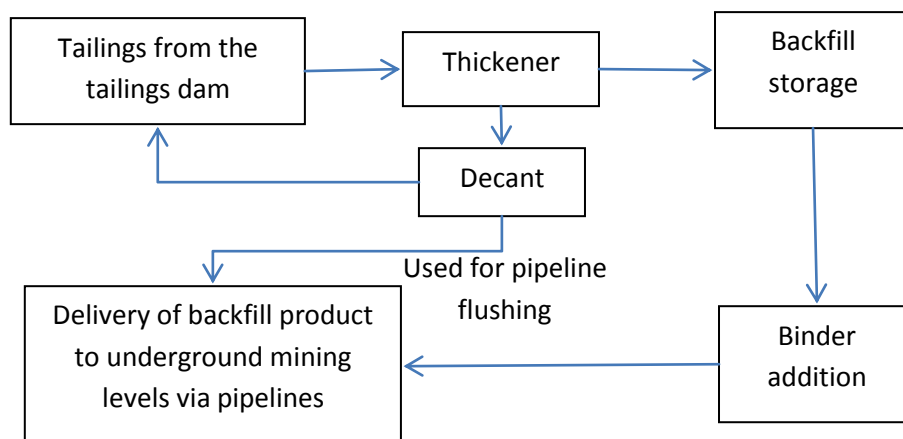


FIGURE 25: BACKFILL PLANT FLOW DIAGRAM (MURRAY & ROBERTS, 2007)

2.7.2.8 No 18 Shaft Stormwater Management Plan

The aim of this stormwater management plan (SWMP) is to fulfil the requirements of the Regulation 704, 4 June 1998 (hereafter referred to as R704) promulgated in terms of the NWA of 1998, which deals with the separation and management of clean and dirty water. This SWMP and associated conceptual designs were developed by TWP Consulting (now known as Worley Parsons TWP).

Clean and dirty areas have been delineated for No 18 Shaft complex in Figure 28. This will be achieved by the construction of clean and dirty water diversion infrastructure, as well as stormwater management dams at the shaft complex. These dams will be lined with a synthetic liner. Information on the TWP conceptual design is summarised below. These designs, as well as the actual sizing of berms and channels, will be determined and revised during the detailed design phase as required.

Concrete lined settling dams will be constructed to settle out sludge from water removed from underground. The sludge will be cleared out periodically and sent with ROM for processing at the existing Impala concentrator plants during operations. However, during the sinking phase, the sludge will be disposed of onto the waste rock dump. Water will be pumped from the settling dams to the storm water dams for reuse.

It should be noted that No 17 Shaft (which incorporates proposed sewage and tailings plants) has already been constructed with stormwater management plans.

No dirty water will be contained in linear infrastructure components and clean water will be allowed to flow naturally past these structures

Clean water diversion

Clean water diversion berms have been designed to divert clean water around dirty water generating areas (i.e. intercepting clean water runoff and diverting this water around mining activities). These diversions are required to be sized so as not to spill more than once in 50 years in terms of R704. The proposed clean water diversions do not include any lining.

The typical berm layout of the various structures are provided below.

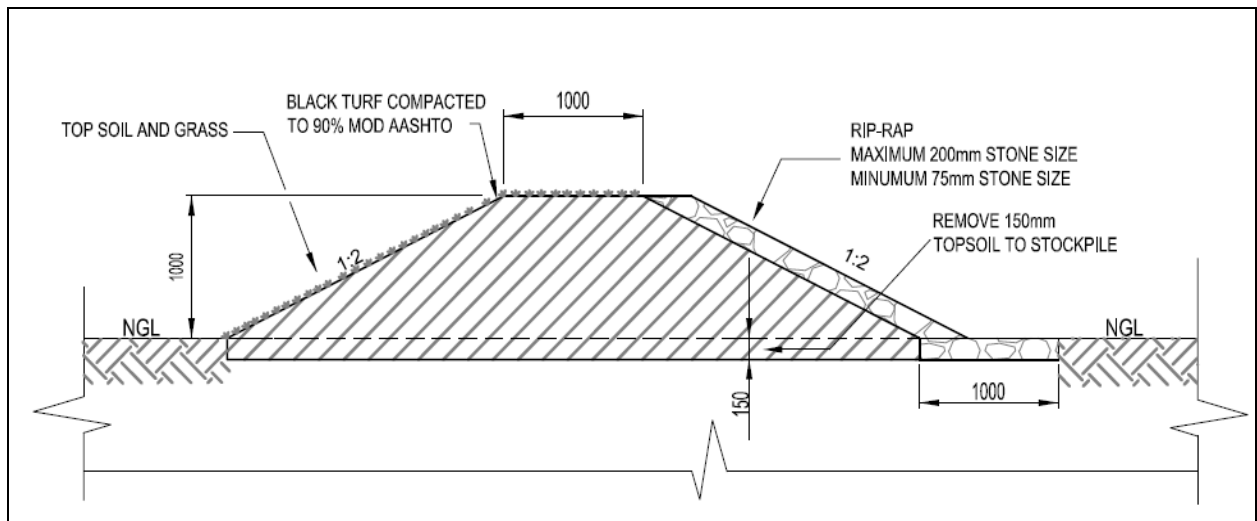


FIGURE 26: TYPICAL BERM FOR CLEAN STORMWATER DIVERSION SYSTEM (TWP)

Dirty water containment

Dirty water containment systems have been designed to ensure dirty water is contained. These systems will also contain a channel component. Lining of the dirty water channels has been included to prevent seepage of any pollutants into the soil profile and subsequent percolation into groundwater. These systems are required to be sized so as not to spill more than once in 50 years in terms of R704.

The typical channel design is provided below.

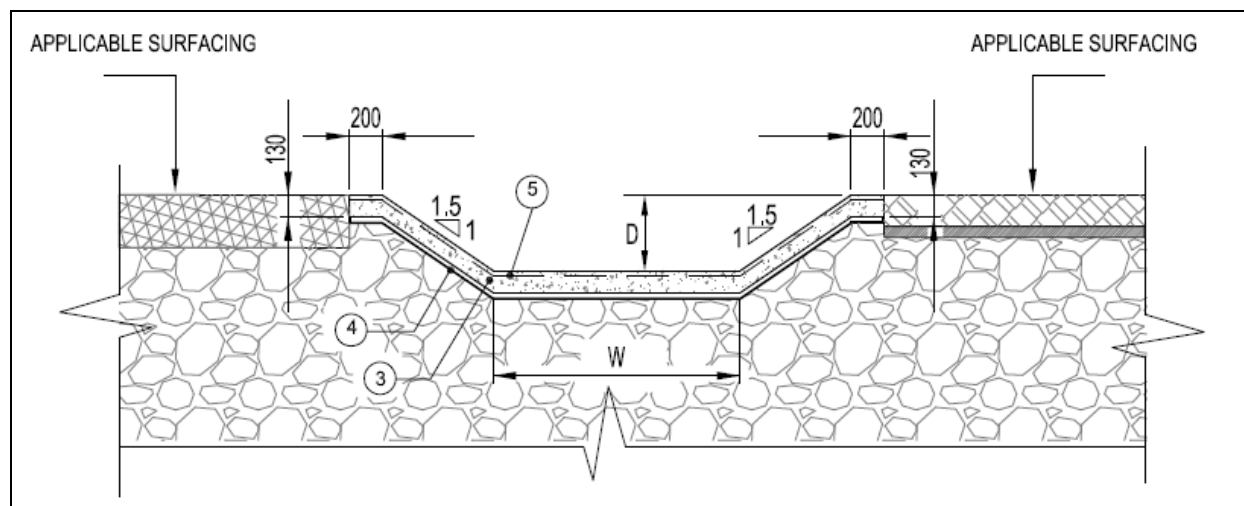


FIGURE 27: TYPICAL CHANNEL FOR DIRTY STORMWATER DIVERSION SYSTEM (TWP)

Dirty water containment

The stormwater management dams at No 18 Shaft will accommodate water from:

- Refrigeration cooling towers (1,728 m³/day)
- Precooling tower from cold well (8.64 m³/day)
- Compressor cooling (25 m³/day)
- Hot well blow-down including underground excess or seepage water (2,160 m³/day)
- Sewage for 4,800 people at 120 litres per person (576 m³/day).

Dirty runoff water generated from dirty areas will also be accommodated in the dam and the volume of water from a 1:50 year rainfall event has been calculated to be 40,270 m³.

The sizing of the containment facilities has been based upon a minimum pumping capacity of 6,000 m³/day operating at 95 % availability. Given the required availability, a backup secondary pumping system will be provided, in the event of a primary pumping failure.

All dirty water dams will have a synthetic liner system.

TABLE 37: STORMWATER DAM VOLUME REQUIREMENT

	Total Volume (m³)	Depth (m)
Stormwater containment dams	85,000	4

Water accumulated in the containment facility will be re-used at the shaft. The facility will be operated empty as a general operating principle.

FIGURE 28: CLEAN AND DIRTY WATER SEPARATION AT NO 18 SHAFT COMPLEX (SLR, 2013)

2.7.2.9 Water Balance

A site wide climatic water balance model has been developed by SLR for the proposed No 18 Shaft. It covers water consumption and reticulation of the following components of the project:

- Potable water supply to the shaft and underground mining operations
- Shaft operation including cooling towers, blow down towers, change houses, sewage plant
- Underground dewatering
- Stormwater dam.

This water balance represents typical wet and dry seasons based on monthly flows for the No 18 Shaft operations. The wet season was calculated using the six wettest months (October to March) with the dry season calculated using the six driest months (April to September).

It should be noted that sewage effluent generated at the central and No 17 Shaft STPs will be reused in the relevant Impala water circuits. No return water is expected to be generated at the tailings treatment plants since no additional water will be required or released.

Input Data

Various climatic data and specialist information was required as inputs to the water balance model as discussed below.

Climate:

Monthly rainfall and evaporation data for the water balance were sourced from the appropriate monitoring gauges as presented in the specialist surface water report for the project.

Specialist input

Input from a number of specialists was required for the development of this water balance. This input included the following:

- Abstraction volumes of water from underground (groundwater specialist)
- Potable water requirements for both the shaft and underground operations and the seasonal variability thereof (TWP design engineers)
- Capacities of the stormwater dam (TWP design engineers)

Model Summary

The water balance model schematic for the average wet and average dry seasons at the No 18 shaft operation are presented in Figure 29 and Figure 30 respectively. These figures show that no excess water will be produced during the wet or dry seasons. However, should there be excess water produced

at the shaft, this water will be pumped to the proposed return water dam associated with the proposed No 5 tailings dam, which is currently being authorised through a separate EIA process.

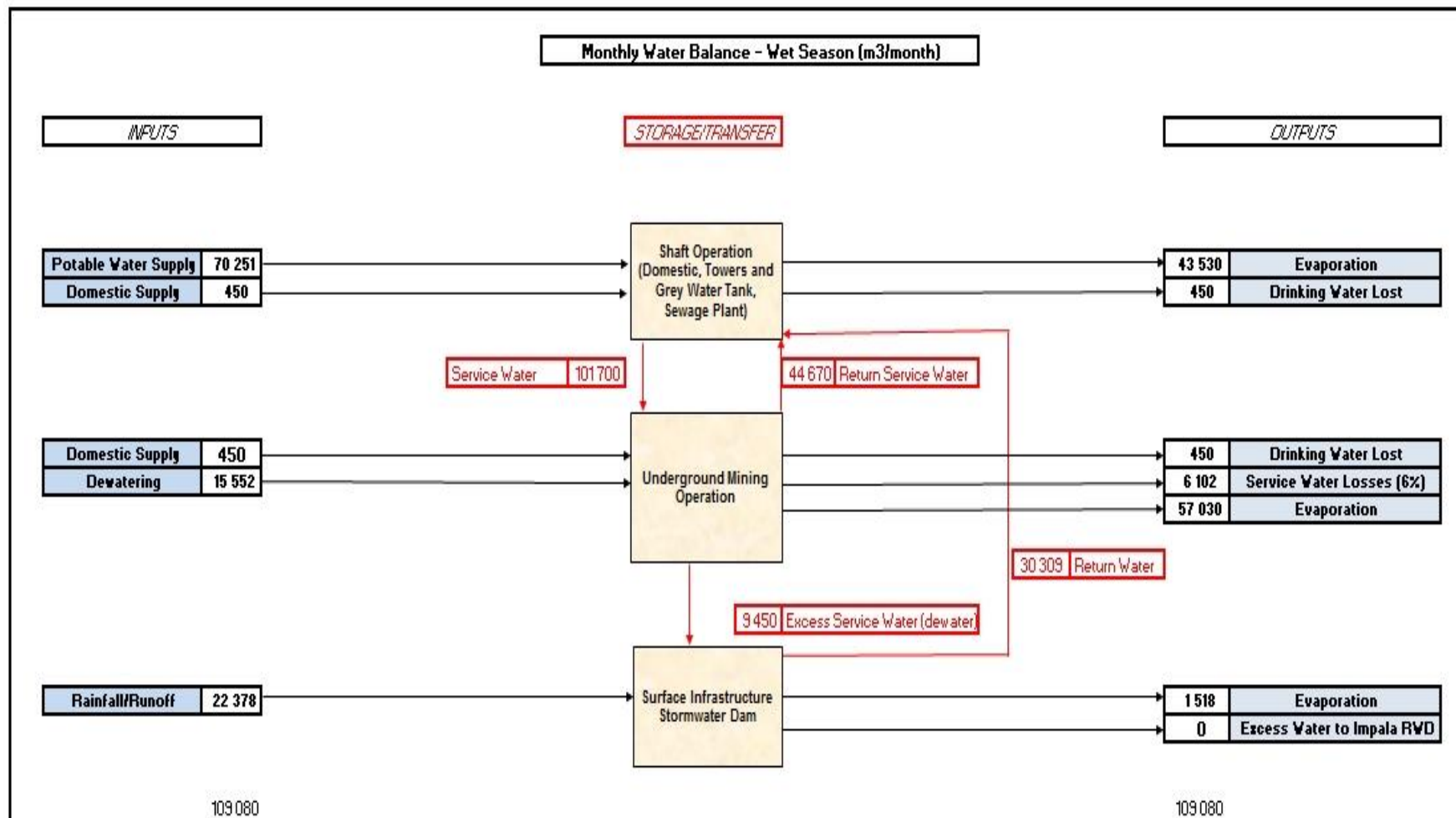


FIGURE 29: PROCESS STATIC WATER BALANCE MODEL FOR AVERAGE WET SEASON

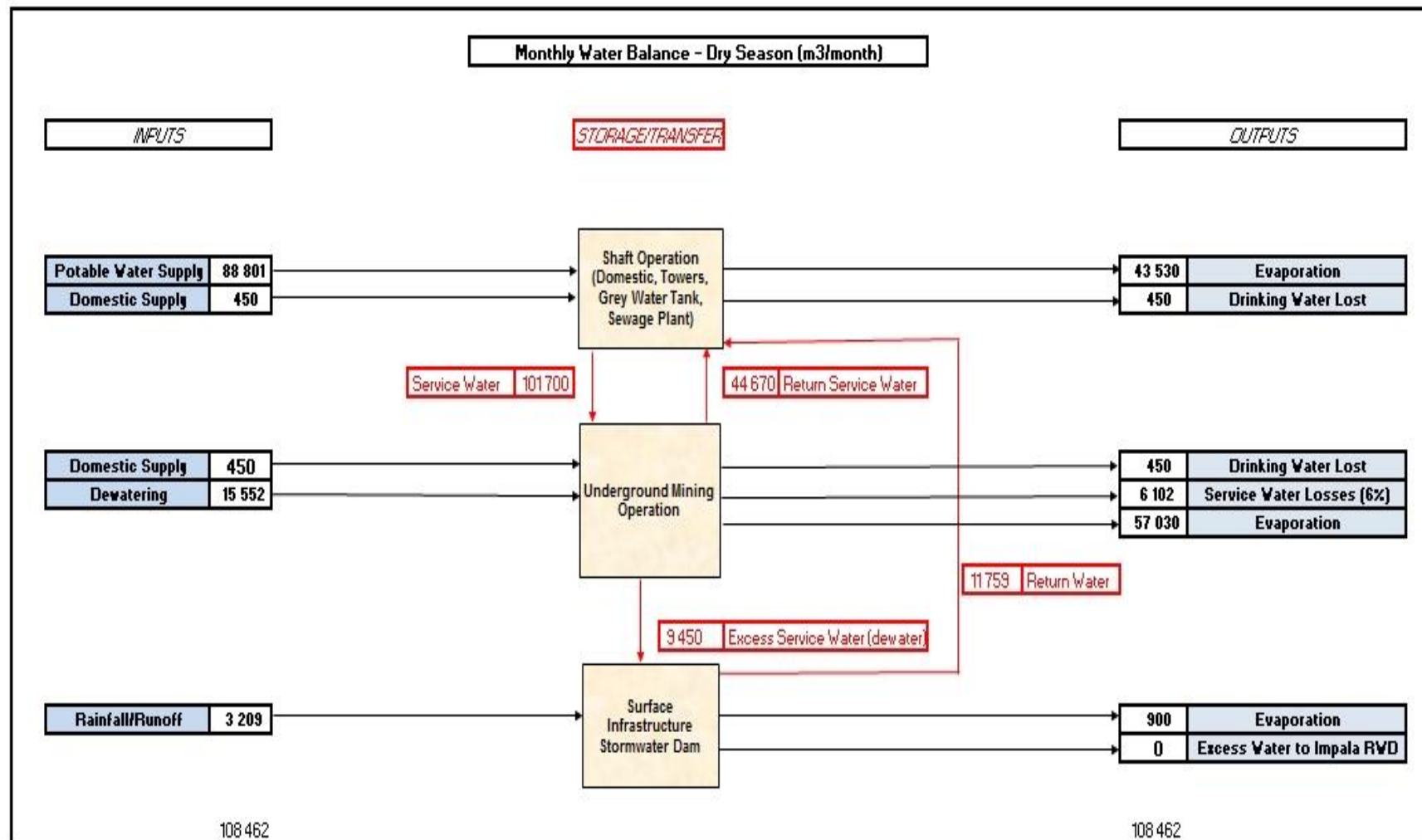


FIGURE 30: PROCESS WATER BALANCE MODEL FOR AVERAGE DRY SEASON

Model Assumptions

Model assumptions include:

- Potable water supply volumes at the proposed shaft and underground operations are based on the TWP water requirements (including seasonal variability of water required at the cooling/blow down towers)
- There is no seasonal distinction between evaporation losses at the shaft and underground operation as per TWP approach. There is however a seasonal distinction at the stormwater dam. This water balance may be updated when seasonal data becomes available.
- Excess water pumped from underground (excess service water) will be recycled into the process
- During the summer months, stormwater runoff together with surplus underground water is anticipated to dilute return process water to sufficiently good quality for reuse
- During the winter months however, the limited availability of stormwater may not allow for sufficient dilution of the return process water. If the salt concentrations in the return process water are too high, the water will need to be routed to the Impala return water dam
- Evaporation from the stormwater dam has been calculated based on an assumed average operating surface area of 1 hectare (100 m x 100 m)
- Seepage losses from the stormwater dams have been neglected as they are assumed to be lined
- Underground service water losses have been calculated at 6 %
- Sewage water will be treated and recycled into the process
- The water balance represents average wet and dry season conditions and does not take into account water required at the start-up of the operations
- The proposed new Impala return water dam associated with the proposed Tailings Dam No 5. has capacity to incorporate excess water produced (potentially high salt concentration) at the No 18 shaft operation.

2.7.2.10 Life of Mine

The mine design allows for approximately 25 to 35 years life of mine.

2.8 DECOMMISSIONING AND CLOSURE

The closure objective will be to return the land to pre-mining potential or as agreed with the land owner and the relevant authorities. At a conceptual level, decommissioning is a reverse of the construction phase with infrastructure and activities very similar to those described for the construction phase. The conceptual decommissioning plan is as follows:

- Surface infrastructure will be demolished and removed, with the exception of the mineralised waste facilities which will remain in perpetuity

- Areas where infrastructure has been removed will be levelled and topsoil restored
- Remove all waste and contaminated soil and water from the project area and dispose of appropriately.

Mineralised waste facility decommissioning:

- The No 18 Shaft waste rock dump will be shaped to prevent ponding and to create slopes that allow vegetation to establish on the facility
- Runoff and eroded material from the dump surface will be captured behind a perimeter bund and allowed to evaporate until vegetation has been properly established
- Aftercare and maintenance will be designed and implemented for the post closure phase
- Surface and groundwater quality will be monitored regularly for a period to be agreed upon with the relevant authorities.

All other surface components:

- Vertical shafts will be capped and sealed
- All other surface infrastructure will be broken down and reused or disposed of as waste
- Contaminated soils underlying the structures will be excavated and disposed of appropriately
- The soil and vegetation function of the land will be restored to be free draining as far as practically possible. Hard surface may need to be ripped
- Any residual excavations will be backfilled and levelled with selected overburden material and covered with between 300 mm and 500 mm of topsoil.

3 POTENTIAL IMPACTS ON THE BIO-PHYSICAL ENVIRONMENT

3.1 LIST OF POTENTIAL IMPACTS ON ENVIRONMENTAL ASPECTS

This section provides a list of potential impacts on environmental aspects (excluding social and cultural aspects – see Section 6) separately in respect of each of the main project actions / activities and processes including activities listed in the NEMA and NEM:WA EIA regulations. The potential impacts are presented for each of the project phases in tabular format (Table 38).

TABLE 38: LIST OF POTENTIAL IMPACTS AS THEY RELATE TO PROJECT ACTIONS / ACTIVITIES / PROCESSES (EXCLUDING SOCIAL AND CULTURAL)

Activity	Phase	Impacts (unmitigated)
Site preparation Bush clearing, removal of infrastructure, establishing construction area	Construction Operation	Physical destruction and disturbance of biodiversity Alteration of drainage patterns Air pollution Blasting hazards Disturbing noise Negative landscape and visual impact
Earthworks (for all surface infrastructure) Stripping and stockpiling soils, bulldozing, temporary gravel roads, trenches, foundation excavation and compaction, construction borrow pits, establishing stormwater controls, road grading	Construction Operation	Hazardous excavations Loss of soil resources and land capability Physical destruction and disturbance of biodiversity Alteration of drainage patterns Pollution of surface water Air pollution Disturbing noise Blasting hazards Negative landscape and visual impact
Civil works Building activities, erection of structures, concrete work, steel work, electrical installation, establishing pipelines	Construction Operation Decommissioning	Hazardous excavations Loss of soil resources and land capability Pollution of surface water resources Contamination of groundwater Air pollution Disturbing noise Blasting hazards Negative landscape and visual impact
Underground mining Drilling, blasting, load, hauling, dewatering	Operation Decommissioning and closure	Hazardous excavations Pollution of surface water resources Dewatering impacts Disturbing noise Negative visual impact from shaft infrastructure
Waste rock management Storage, final disposal	Operation Decommissioning and closure (final land form)	Hazardous excavations Loss of soil resources and land capability Disturbance of biodiversity Pollution of surface water resources Contamination of groundwater Air pollution Disturbing noise Negative landscape and visual impact

Activity	Phase	Impacts (unmitigated)
Power supply and use Internal site distribution, temporary generation	Construction Operation Decommissioning	Physical destruction and disturbance of biodiversity Air pollution Negative landscape and visual impact
Water supply Delivery on site, storage of clean water	Construction Operation Decommissioning	Hazardous excavations and structures Disturbing noise
Dirty water management Collection, storage of dirty for re-use, recycling	Construction Operation Decommissioning	Hazardous excavations Loss of soil resources and land capability Pollution of surface water resources Contamination of groundwater Disturbing noise
Sewage treatment	Construction Operation Decommissioning	Hazardous excavations Loss of soil resources and land capability Pollution of surface water resources Contamination of groundwater Disturbing noise
Stormwater management Stormwater channels and berms, collection of dirty, storage for re-use	Construction Operation Decommissioning	Hazardous excavations Loss of soil resources and land capability Alteration of drainage patterns Pollution of surface water resources Contamination of groundwater Disturbing noise
Transport systems Use of access points, road transport to and from site for employees and supplies, movement within site boundary (haul roads, conveyors, pipelines), taxi and bus areas. Use of linear infrastructure.	Construction Operation Decommissioning Closure (limited road)	Physical destruction and disturbance of biodiversity Pollution of surface water resources Air pollution Disturbing noise Negative landscape and visual impact
Non-mineralised (general and industrial hazardous) waste management Collection, separation, temporary storage, sorting, removal for recycling or final disposal off site, temporary facilities, ablutions on site, sewage treatment plant on site, re-use sludge in rehabilitation	Construction Operation Decommissioning Closure (limited)	Loss of soil resources and land capability Pollution of surface water resources Contamination of groundwater Disturbing noise Negative landscape and visual impact
Site support services Operating offices, parking vehicles	Construction Operation Decommissioning Closure (limited)	Loss of soil resources and land capability Disturbance of biodiversity Air pollution Negative landscape and visual impact
Storage and maintenance services/facilities Washing and servicing vehicles and machinery, storage and handling non-process materials	Construction Operation Decommissioning	Loss of soil resources and land capability Pollution of surface water resources Contamination of groundwater Disturbing noise
Site/contract management Appointment of workers/contractors, site management (monitoring, inspections, maintenance, security, access control), awareness training, emergency response, implementing and maintaining programmes	Construction Operation Decommissioning Closure	Management of the site plays a significant role in all identified impacts
Demolition	Operation (as part	Loss of soil resources and land capability

Activity	Phase	Impacts (unmitigated)
Dismantling, demolition, removal of equipment	of maintenance) Decommissioning	Disturbance of biodiversity Air pollution Disturbing noise Negative landscape and visual impact
Rehabilitation Replacing soil, slope stabilisation, landscaping, re-vegetation, restoration	Construction Operation Decommissioning Closure	Hazardous excavations Loss of soil resources and land capability Disturbance of biodiversity Alteration of drainage patterns Pollution of surface water resources Contamination of groundwater Air pollution Disturbing noise Negative landscape and visual impact
Maintenance and aftercare Inspection and maintenance of remaining facilities and rehabilitated areas	Closure	Loss of soil resources and land capability Disturbance of biodiversity Pollution of surface water Air pollution Negative landscape and visual impact

3.2 LIST OF POTENTIAL CUMULATIVE IMPACTS

Potential cumulative impacts associated with the project, were identified by considering the existing land uses together with the proposed mine development, and include increased pressure on water resources, disturbance to biodiversity, contamination of groundwater resources and increased air pollution.

3.3 POTENTIAL FOR ACID MINE DRAINAGE OR GROUNDWATER CONTAMINATION

Detailed information on these issues is provided in Section 1.1.1. The conclusions of the study are summarised as follows:

- The tailings material from the chrome beneficiation plant and waste rock samples from No 11 Shaft indicated no risk of acid generation and a net neutral to alkaline leachate composition. The ABA results for the sludge samples from No 5 and 11 Shaft are regarded as inconclusive. The samples are flagged as short-term acid generating as precaution.
- The potential leachate quality from the chrome beneficiation tailings material does not exceed applicable drinking water limits (WHO and SANS 241 guidelines) and / or mining effluent limits (i.e. IFC guidelines) for all pH ranges tested. However, leachate from one No 11 Shaft waste rock sample exceeds acceptable drinking water (SANS 241 Class II) and / or mining effluent limits (IFC guidelines) for iron (only at pH 4) and nitrate (entire pH range). Leachate qualities from the other waste rock and the majority of sludge samples fall generally within the class II drinking water limits (SANS 241). An exception is the leachate from sludge sample No 11 Shaft, which exceeds acceptable drinking (SANS 241 Class II) and / or mining effluent limits (IFC guidelines) for iron and nickel under acidic leach conditions. However, no long-term acidic leachate conditions are expected.

The following recommendations made by SLR are highlighted:

- A pilot study will need to be conducted with a representative sample of the final backfill material (with the correct proportions of tailings and binding agents) in both the consolidated (dried) and unconsolidated (wet) state, in order to determine if the tailings liquid will leach out. The results of this pilot study may require additional management measures to be implemented in order to prevent and minimise pollution from backfilling

4 ALTERNATIVE LAND USE OR DEVELOPMENT

4.1 DESCRIPTION OF ALTERNATIVE LAND USE OF THE AREA

In accordance with the current land use in the vicinity of the proposed project sites, the sites proposed for the No 18 Shaft complex and other proposed infrastructure could, as an alternative to the project, continue to be used for grazing or limited cultivation.

The proposed Ga-Nape cultural landscape area is planned to be developed on the farm Welbekend in approximately 25 to 30 years as per the RBA Master Plan. No borders to this planned park are available yet. The proposed infrastructure is not located close to this planned park.

4.2 ALTERNATIVES FOR SEWAGE TREATMENT

Impala is proposing to treat sewage through biological means using modular package plants at the shafts, and a more conventional system at the central sewage treatment plant. The modular systems can be built up over time as the workforce at the shafts is increased, and this option is therefore preferred for the shaft sewage treatment plants. However the central sewage treatment plant will need to be established at its full capacity at the start of the project. Both types of plants will treat sewage biologically, however there are two treatment methods being considered: biological trickling filter or activated sludge system.

Trickling filters are the oldest and most stable forms of fixed film reactors that exist. Growth on the fixed film becomes a biological slime that allows attached bacteria to remove soluble biological oxygen demand (BOD) from either primary effluent or finely screened wastewater. The trickling filter (fixed film) processes is distinctly different from an activated sludge (suspended growth) process. The activated sludge process uses slurry of suspended bacteria or other organisms to remove BOD. The biological slurry is called mixed liquor suspended solids (MLSS) and is maintained at high concentration by recycling bacteria from the secondary clarifier. Treated MLSS is contained in a reactor called an aeration basin.

Table 39 shows advantages and disadvantages of each type of system. Impala will only decide on the preferred option in the detailed design phase.

TABLE 39: TRICKLING FILTER VERSUS ACTIVATED SLUDGE SEWAGE TREATMENT

Trickling filter		Activated sludge	
Advantages	Disadvantages	Advantages	Disadvantages
<ul style="list-style-type: none"> - Simple and reliable process that is suitable in areas where space is limited - Effective in treating high concentrations of organic material depending on the type of media used - Very efficient in removal of ammonia from wastewater - Appropriate for small- to medium-sized communities - Ability to handle and recover from shock loads - Relatively low power requirements – they require power for pumping only and do not need large power-hungry aeration blowers - Produce less sludge than suspended-growth systems. The sludge tends to settle well because it is compact and heavy - Level of skill and technical expertise needed to manage and operate the system is moderate - Low operating cost. 	<ul style="list-style-type: none"> - Additional treatment may be needed for the effluent to meet strict discharge standards - Generates sludge that must be treated and disposed of - Regular operators attention is needed - Relatively high incidence of clogging - Relatively low loadings required depending on the media - Limited flexibility and control in comparison with activated sludge processes - Require high maintenance costs of rotary distributor center mechanisms. Any maintenance service for the rotary distribution mechanism would require a crane and complete removal of the rotary distributor mechanism, guy rods, and arms - Potential for vector and odor problems. 	<ul style="list-style-type: none"> - Low installation cost - Produces good quality effluent - Little space needed for the plant - No vector of odour problems as it is a sealed system. 	<ul style="list-style-type: none"> - Not very flexible - High operational cost - Produces large quantities of sludge that requires disposal - Process sensitive to certain industrial wastes - Skilled supervision is required

4.3 MAIN FEATURES AND INFRASTRUCTURE RELATED TO ALTERNATIVE LAND USE / DEVELOPMENT

Potential features and infrastructure that could be associated with the alternative land use/development are listed below and fall within the type of infrastructure found in the surrounding area (see Section 1.3):

- Farm dwellings associated with grazing and limited crop farming
- No information is available yet as to what infrastructure the Ga-Nape heritage park will include. It is anticipated that the area would be fenced-off; a small building may be established to serve as an administration centre with basic services such as water, power and sanitation.

4.4 PLAN SHOWING LOCATION AND EXTENT OF ALTERNATIVE LAND USE / DEVELOPMENT

A plan showing the location and extent of the alternative land use / development is not possible to present at this stage as no information is available at this stage as to the area to be used for the Ga-Nape heritage park.

5 POTENTIAL IMPACTS OF ALTERNATIVE LAND USE OR DEVELOPMENT

5.1 LIST OF POTENTIAL IMPACTS

Potential impacts, expected to occur as a result of the alternative land use / development described in Section 4 above, are listed below.

Impacts currently associated with the existing agricultural activities in the project area include:

- Soil erosion due to excessive grazing
- Loss of sensitive biodiversity areas and conservation important species due to livestock grazing, cropping and illegal harvesting of fauna and flora for food, firewood, medicinal purposes, sport etc.
- Dust generation due to excessive grazing and clearing of land for cropping
- Contamination of surface water due to a lack of sanitation facilities at the farm dwellings
- Damage to heritage resources
- Noise levels associated with these activities are generally low
- Visual impact in the case of croplands.

Depending on the plans for the Ga-Nape heritage park, the following impacts could occur:

- Loss of biodiversity if any land is cleared for the establishment of surface infrastructure
- Loss of soil resources through erosion, compaction of contamination during construction of surface infrastructure
- Dust generation due to site clearing
- Contamination of surface water and soil during construction of surface infrastructure due to accidental spills of materials or leaks from vehicles and equipment
- Surface and groundwater contamination if sanitation facilities are very basic, such as the case of pit latrines, or inadequate, or if the system requires a discharge of treated sewage effluent
- It is assumed that no heritage resources would be damaged or disturbed
- Noise levels associated with these activities are expected to be low
- Visual impact of surface infrastructure.

5.2 LIST OF POTENTIAL CUMULATIVE IMPACTS

Potential cumulative impacts associated with the alternative land use, when compared to the existing land use on site and in the surrounding area, are expected to include:

- Air pollution with respect to dust
- Surface and groundwater contamination
- Loss of soil resources
- Loss of biodiversity
- Disturbance of heritage resources.

6 POTENTIAL SOCIAL AND CULTURAL IMPACTS

6.1 LIST OF POTENTIAL IMPACTS ON SOCIO-ECONOMIC CONDITIONS OF THIRD PARTY LAND USE ACTIVITIES

Potential impacts on the socio-economic conditions of other parties land use activities both on site and in the surrounding area are discussed in detail in Section 7 and listed below. This list includes potential impacts on cultural and heritage resources (Section 6.3):

- Loss of current land uses through impacts on the bio-physical environment
- Dust
- Blasting hazards
- Noise
- Project-related road use and traffic
- Destruction and indirect disturbance of heritage resources
- Contamination of soil and water
- Economic impacts (positive and negative)
- Inward migration.

6.2 CULTURAL ASPECTS AND POTENTIAL IMPACTS THEREON

Cultural aspects are discussed as part of heritage discussion below.

6.3 HERITAGE FEATURES AND POTENTIAL IMPACTS THEREON

6.3.1 HERITAGE (AND CULTURAL) FEATURES

A detailed description of heritage (including cultural resources) in and around the project area is provided in section 1.3.3 and Figure 20. Only two of the identified heritage resources may be directly affected by the proposed project:

- LIA3 - a large settlement located on a plateau along the north-eastern slope of Sefakwe. It comprises a level area in the east which merely consists of an archaeological deposit without any stone walls and a dense concentration of stone walls in the west. These stone walls include enclosures with relatively high walls. The settlement style of the site does not reveal a typical Tswana pattern
- LIA4 - comprises a simple stone walled site against the south-eastern foot of Sefakwe. This settlement is composed of a half-circular wall. The site is partly covered with trees and other vegetation which does not allow for the detection of archaeological remains.

The significance of both of these resources has been determined to be medium to high. Refer to section 1.3.3 for more detailed information. The potential impact on these resources has been assessed in section 7.2.17 as having a high significance in the unmitigated scenario. However this can be reduced to low if the No 18 Shaft infrastructure (specifically, the electrical substation) can be adjusted to avoid these heritage resources and provide a suitable buffer, thereby reducing the severity, duration and probability of the impact occurring. Refer to section 7.2.17 for more information.

6.3.2 PALEONTOLOGICAL FEATURES

As outlined in section 1.3.3, it is unlikely that paleontological resources will be found on site. This is because the project area is mostly underlain by an intrusive igneous body. As these rocks are Precambrian in age and are of igneous origin it is highly unlikely that fossils will be found on site. Refer to section 1.3.3 for more information.

6.4 QUANTIFICATION OF IMPACT ON SOCIO-ECONOMIC CONDITIONS

Socio-economic impacts have been assessed in sections 7.2.18 (economic impacts) and 7.2.19 (inward migration impacts). The main findings are as follows:

- The proposed project will have a highly significant and positive economic impacts by ensuring the continuation of the Impala operation (since this is a shaft replacement project), the retention of jobs at the mine and creation of jobs in support services (downstream effect)
- The significance of Inward migration has been rated as high for all phases. This can however be mitigated to moderate by reducing the severity and probability.

Refer to sections 7.2.18 (economic impacts) and 7.2.19 (inward migration impacts) for more information.

7 ASSESSMENT AND EVALUATION OF POTENTIAL IMPACTS

7.1 LIST OF EACH POTENTIAL IMPACT

Potential environmental impacts were identified by SLR in consultation with IAPs, regulatory authorities, specialist consultants and Impala. 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 and those potentially associated with the project are discussed and assessed together.

Potential impacts identified for the project include:

- Sterilization of a mineral resource (Section 7.2.1)
- Hazardous excavations/structures/surface subsidence (Section 7.2.2)
- Loss of soil resources and land capability through contamination (Section 7.2.3)
- Loss of soil resources and land capability through physical disturbance (Section 7.2.4)
- Physical destruction of biodiversity (Section 7.2.5)
- General disturbance of biodiversity (Section 7.2.6)
- Alteration of drainage patterns (Section 7.2.7)
- Pollution of surface water resources (Section 7.2.8)
- Dewatering (Section 7.2.9)
- Contamination of groundwater (Section 7.2.10)
- Air pollution (Section 7.2.11)
- Noise pollution (Section 7.2.12)
- Negative landscape and visual impacts (Section 7.2.13)
- Loss of current land uses (Section 7.2.14)
- Blasting hazards (Section 7.2.15)
- Project-related road use and traffic (Section 7.2.16)
- Destruction and disturbance of heritage (including cultural) and paleontological resources (Section 7.2.17)
- Economic impact (Section 7.2.18)
- Inward migration impact (Section 7.2.19)
- Relocation of farm dwellers (section 7.2.20).

The assessment focusses on the following project components:

- No 18 Shaft complex and associated linear infrastructure
- No 17 Shaft linear infrastructure

- Central STP
- Use of a tailings mixture as support in No 17 and 18 mine voids.

The proposed No 18 STP and tailings treatment plant will be located within the shaft block and is therefore not assessed separately.

The proposed No 17 STP and tailings treatment plant will be located within the shaft block and because this shaft has already been established, no new surface disturbance will occur.

7.2 IMPACT RATING FOR EACH POTENTIAL IMPACT

The impact rating for each potential impact listed above (Section 7.1) is provided in the section below. The criteria used to rate each impact is outlined in Section 7.3. 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 is provided below and summarised in Section 7.4 together with the estimated timeframes for each rated impact.

GEOLOGY

7.2.1 ISSUE: LOSS AND STERILIZATION OF MINERAL RESOURCES

Introduction

Mineral resources can be sterilized and/or lost through the placement of infrastructure and activities in close proximity to mineral resources, by preventing access to potential mining areas, and through the disposal of mineral resources onto waste facilities.

In this project there are various factors that make this an insignificant issue. These factors are listed as follows:

- The No 18 shaft surface infrastructure has been specifically designed for the purpose of accessing the mineral resource in a manner that will ensure maximum extraction
- Most of the waste rock and tailings associated with the ore that is extracted from No 18 Shaft will be available on waste rock dumps and the operational tailings dam for future processing as is currently the practice at Impala. Limited amounts of waste rock will be used for construction and limited amounts of tailings will be used for backfill, but this is not material in the context of the Impala waste rock and tailings production rates
- At the proposed infrastructure development areas, the underlying mineral resource is located up to two kilometres below surface; therefore the establishment of surface infrastructure will not result in any sterilisation of mineral resources.

TOPOGRAPHY**7.2.2 ISSUE: HAZARDOUS STRUCTURES / EXCAVATIONS / SURFACE SUBSIDENCE****Introduction**

Hazardous structures include all excavations, infrastructure 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 water storage dams). 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 (such as waste rock dumps).

Activities and infrastructure - link to mine phases

Construction	Operational	Decommissioning	Closure
Earthworks Civil works Rehabilitation	Earthworks Civil works Shafts Waste rock dumps Water supply infrastructure Power supply infrastructure Rehabilitation	Earthworks Civil works Demolition Rehabilitation	Maintenance and aftercare of final land forms and rehabilitated areas

Rating of impactSeverity / nature

Mining will be far below surface (approximately 1.9 km), and therefore there is no significant risk of subsidence. Hazardous excavations will be dug for foundations for all relevant surface infrastructure components during the construction phase, and scaffolding and other such temporary hazardous structures will be used during construction. During the operational phase the shaft sinking will present a hazardous excavation, and hazardous structures could include scaffolding and shaft headgear, waste rock dumps, water storage dams. The decommissioning phase will be similar to the construction phase and hazardous structures and excavations will be present during the demolition and site rehabilitation process. The waste rock dumps will remain in perpetuity and represent residual hazardous structures. In the unmitigated scenario, most of the identified hazardous excavations and infrastructure present a potential risk of injury and/or death to both animals and third parties. This is a potential high severity. With mitigation, the severity reduces to medium.

Duration

Should death or permanent injury to third parties occur, this is considered a long-term, permanent impact.

Spatial scale / extent

The spatial scale may extend beyond the project site to the communities to which the injured people or animals belong. This applies to the unmitigated and mitigated scenarios.

Consequence

In both the unmitigated and mitigated scenario, the consequence of this potential impact is high.

Probability

In the unmitigated scenario the probability is considered to be moderate because the sites are remote and the existing Impala safety data indicates limited incidents. This can however be reduced to unlikely with the implementation of proper management and mitigation measures which restrict access.

Significance

In the unmitigated scenario, the significance of this potential impact is high. In the mitigated scenario, the significance of this potential impact is medium because there will be a reduction in the probability that the impact occurs.

Summary of the rated hazardous excavations and structures impact per phase of the project

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

Conceptual description of proposed mitigation measures

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19).

Objective

The objective of the management and mitigation measures is to prevent physical harm to third parties and animals from hazardous excavations and infrastructure.

Actions

The proposed No 18 Shaft waste rock dump and all dams/ponds associated with the proposed project will be designed, constructed, operated and closed in a manner that the stability related safety risks to third parties and animals are addressed and that this issue is monitored according to a schedule that is deemed relevant to the type of facility by a professional engineer.

During construction and operation, the safety risks associated with identified hazardous excavations, subsidence and infrastructure will be addressed as follows:

- Fencing, berms, barriers and/or security personnel will be established around hazardous structures and excavations to prevent access to third parties and animals
- Language appropriate warning signs will be provided at hazardous structures and excavations. Warning pictures can be used as an alternative.

At closure the hazardous structures and excavations and risk of subsidence will be dealt with as follows:

- Any remaining land forms such as the waste rock dumps, will be decommissioned and rehabilitated in a manner that they do not present long-term safety and/or stability risks
- Shaft openings will be properly sealed with an engineered plug and rehabilitated
- The potential for surface subsidence will have been addressed by providing underground support in mined out areas
- Monitoring and maintenance will take place to observe whether the relevant long-term safety objectives have been achieved and to identify the need for additional intervention where the objectives have not been met.

Where Impala has caused injury or death to third parties and/or animals, appropriate compensation will be provided.

Emergency situations

If people or animals fall off or into hazardous excavations or infrastructure causing injury, or if any mineralised waste or water facilities fail causing injury to people or animals, the Impala emergency response procedure will be initiated.

SOIL AND LAND CAPABILITY

7.2.3 ISSUE: LOSS OF SOIL RESOURCES THROUGH CONTAMINATION

Information based on Impala consolidation EMP report (SLR, 2011).

Introduction

Soil is a valuable resource that supports a variety of ecological systems. The project has the potential to damage soil resources through physical disturbance and/or contamination. Contamination of soils also has the potential to enter both surface and groundwater resources (see Sections 7.2.8 and 7.2.10, respectively). The loss of soil resources has a direct impact on the potential loss of the natural capability of the land. Any potential direct impacts on soil will potentially have secondary impacts on the ecological systems that make use of the soil for survival.

Activities and infrastructure - link to mine phases

Construction	Operational	Decommissioning	Closure
Earthworks Civil works Site management Transport systems Non-mineralised waste management Support services and amenities Rehabilitation	Earthworks Civil works Site management Transport systems Non-mineralised waste management Mineralised waste management Support services and amenities Shaft infrastructure Water supply infrastructure Power supply infrastructure Rehabilitation	Demolition Earthworks Civil works Site management Transport systems Non-mineralised waste management Mineralised waste management Support services and amenities Shaft infrastructure Water supply infrastructure Power supply infrastructure Rehabilitation	Maintenance and aftercare of final land forms and rehabilitated areas

Rating of impactSeverity / nature

Contamination of soils due to accidental spills and leaks from equipment can occur during all project phases. Pollution of soil through accidental spills and/or leaks is expected to have a high severity. This is because plants and animals rely on this valuable resource for sustenance and shelter such as in the case of insects. If such spills are prevented and/or contained and minimised through the implementation of management and mitigation measures, the severity could be reduced to moderate. This applies to all project phases.

Duration

The impact of soil pollution could be long-term; however with the implementation of management and mitigation measures the impact on the soil could be avoided or at least limited to the short-term.

Spatial scale / extent

The spatial scale will be limited to the project site where infrastructure is established. This applies to the unmitigated and mitigated scenarios. This applies to all project phases.

Consequence

The consequence of this potential impact is high in the unmitigated scenario. However, this can be reduced to moderate with the implementation of management and mitigation measures by reducing severity and duration. This applies to all project phases.

Probability

The probability of soil pollution is considered to be high in the unmitigated scenario because without adequate controls, polluting spills do occur frequently. This can however be reduced to low with the

implementation of management and mitigation measures which focus on pollution prevention and remediation where necessary. This applies to all project phases.

Significance

The significance of soil pollution is rated as high in the unmitigated scenario. This can however be reduced to low with the implementation of management and mitigation measures by reducing the severity, duration and probability of the impact occurring. This applies to all project phases.

Summary of the rated soil contamination impact per phase of the project

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

Conceptual description of proposed mitigation measures

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19).

Objective

The objective of the measures is to prevent pollution of soils through accidental spills and/or leaks from equipment.

Actions

In the construction, operation and decommissioning phases, all potentially polluting materials (new and used), dirty water, mineralised wastes and non-mineralised wastes will be handled and managed in a manner that they do not pollute soils. This will be implemented through a procedure(s) covering the following:

- Pollution prevention through basic infrastructure design that is adequate to contain polluting substances. In this respect all potentially polluting liquids will be stored in bunded areas capable of containing sufficient excess capacity of the stored contents within the bunded area
- Pollution prevention through maintenance of equipment that can spill polluting substances, such as containers and bund walls
- Pollution prevention through education and training of workers (permanent and temporary)
- Adequate waste bins will be provided in work areas with lids and littering will be prohibited
- Pollution prevention through appropriate handling, storage, use and overall management of potentially polluting substances, materials and non-mineralised waste
- Spills will be contained and cleaned up immediately. Sorp kits will be kept on hand and personnel trained in its use. Used sorp material will be disposed of as hazardous

- Soil will be remediated in situ or contaminated soil will be disposed of as hazardous waste. In situ remediation is preferred because 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 replaced
- Specifications for post rehabilitation audit criteria 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.

The designs of any permanent and potentially polluting structures (waste rock dumps) will take account of the requirements for long-term soil pollution prevention, land function and confirmatory monitoring.

Emergency situations

Major spillage incidents will be handled in accordance with the Impala emergency response procedure.

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

Introduction

There are a number of activities/infrastructure in all phases of the project that have the potential to disturb soils and related land capability through removal, compaction and/or erosion. 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 activities and the closure phase will present final land forms that may be susceptible to erosion.

Activities and infrastructure - link to mine phases

Construction	Operational	Decommissioning	Closure
Earthworks - for all surface infrastructure Site management Transport systems Support services and amenities Rehabilitation	Earthworks - for all surface infrastructure Site management Transport systems Non-mineralised waste management Mineralise waste management Support services and amenities Water supply infrastructure Power supply infrastructure Rehabilitation	Demolition Earthworks Site management Transport systems Non-mineralised waste management Mineralise waste management Support services and amenities Water supply infrastructure Power supply infrastructure Rehabilitation	Maintenance and aftercare of final land forms and rehabilitated areas

Rating of impact

Severity / nature

The loss of soil through erosion and compaction could occur during all project phases and is considered to have a high severity. This is because of the important role soil plays in the ecosystem and the flora and fauna that it supports. This could also affect the capability of the land by reducing its potential. The soils underneath the No 18 waste rock dump will be permanently lost because this facility will remain in perpetuity. If utilisable soil is stripped from other areas designated for surface infrastructure, this valuable resource can be stockpiled and used in the rehabilitation of the site. With the implementation of this and other management and mitigation measures, the significance can be reduced to moderate.

Duration

The loss of soil through erosion and compaction is long-term in the unmitigated scenario; however this duration can be reduced to the life of the project with the implementation of management and mitigation measures.

Spatial scale / extent

Soils will only be disturbed in areas designated for surface infrastructure and therefore a low spatial scale. This applied to both the unmitigated and mitigated scenarios for all project phases.

Consequence

The consequence of this potential impact is high in the unmitigated scenario; however this can be reduced to moderate with the implementation of management and mitigation measures because the severity and duration will be reduced. This applies to all project phases.

Probability

The probability of losing soil through erosion and compaction is high in the unmitigated scenario because without soil conservation interventions this resource will be lost. This can however be reduced to moderate with the implementation of soil conservation management and mitigation measures. This applies to all project phases.

Significance

The significance of this potential impact is rated as high in the unmitigated scenario; however this can be reduced to moderate with the implementation of management and mitigation measured by reducing the severity, duration and probability. This applies to all project phases.

Summary of the rated soil disturbance and land capability impact per phase of the project

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

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

Conceptual description of proposed mitigation measures

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19).

Objective

The objective of the measures is to minimise the loss of soil resources and related functionality through physical disturbance, erosion and compaction.

Actions

In the construction, operation and decommissioning phases a soil management plan will be implemented. The key components are:

- Limit the infrastructure footprint as far as practically possible and thereby minimise the disturbance of soils
- Utilisable soil will be stripped in areas designated for surface infrastructure, stockpiled, managed and used for site rehabilitation in accordance with Impala's soil conservation plan, the main components of which are outlined in Table 40
- During any rehabilitation conducted, soil sampling will be carried out to determine any fertilizer requirements before using the soil for rehabilitation
- As part of closure planning, the designs of any permanent landforms (mineralised waste facilities) will take into consideration the requirements for land function, long-term erosion prevention and confirmatory monitoring

TABLE 40: 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 and infrastructure that are described in the EIA/EMP report, and where a clearly defined end rehabilitation use for the stripped soil has been identified.
Reference to biodiversity mitigation		All requirements for moving and preserving fauna and flora according to the biodiversity mitigation measures will be adhered to.
Stripping	Topsoil	A minimum of 50 cm topsoil will be stripped unless a soils expert advises otherwise.
	Subsoil	If present, subsoil will be removed and stockpiled separately to the topsoil.
Delineation of stockpiling areas	Location	Stockpiling areas will be identified in close proximity to the source of the soil to limit handling and to promote reuse of soils in the correct areas.
	Designation of the areas	Soil stockpiles will be clearly identifiable in terms of soil type and the intended areas of rehabilitation.

Steps	Factors to consider	Detail
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.
	Storm water controls	Stockpiles will be established with storm water diversion berms to prevent run off erosion.
	Height and slope	Soil stockpiles height will be controlled to avoid compaction and damage to the underlying soils. The stockpile side slopes should be flat enough to promote vegetation growth and reduce run-off related erosion.
	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.
Rehabilitation of disturbed land: restoration of land capability	Placement of soil	A minimum layer of 50 cm of topsoil will be replaced unless a soils expert advises otherwise.
	Fertilisation	Samples of stripped soils will be analysed to determine the nutrient status of the soil before rehabilitation commences. 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, fertilisers will be applied if necessary.
	Erosion control	Erosion control measures will be implemented to ensure that the topsoil is not washed away and that erosion gulley's do not develop prior to vegetation establishment.
	Restore land function and capability	Apply landscape function analysis and restoration interventions to areas where soil has been replaced as part of rehabilitation, but the land function and capability has not been effectively restored.

Emergency situations

None identified.

BIODIVERSITY

Information in this section is based on the biodiversity study conducted by SAS (Appendix D).

7.2.5 ISSUE: PHYSICAL DESTRUCTION OF BIODIVERSITY

Information based on biodiversity specialist study (SAS, 2013) (Appendix D).

Introduction

There are a number of activities/infrastructure in all phases that have the potential to destroy biodiversity through loss and/or transformation of habitat, increased pressures from harvesting and poaching, alien plant invasion, loss of plant and animal species of conservation importance and disruption of animal movements. This will then impact upon ecosystem functionality that the biodiversity supports. The value of biodiversity is outlined in section 1.1.5. It is in this context that impacts on biodiversity are assessed below.

Activities and infrastructure - link to mine phases

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks for all surface infrastructure Site management Transport systems Support services and amenities Site management Rehabilitation	Site preparation Earthworks - for all surface infrastructure Site management Transport systems Non-mineralised waste management Mineralised waste management Support services and amenities Site management Shaft infrastructure Water supply infrastructure Power supply infrastructure Rehabilitation	Site preparation Demolition Earthworks Site management Transport systems Non-mineralised waste management Mineralise waste management Support services and amenities Site management Water supply infrastructure Rehabilitation	Maintenance and aftercare of final land forms and rehabilitated areas

Rating of impactSeverity / nature

The main infrastructure components will impact directly on biodiversity in the following ways:

- Loss of biodiversity (fauna and flora) within the surface infrastructure footprint areas
- Habitat fragmentation and associated reduced capacity for species movements
- Destruction of breeding and nesting sites
- Increase in alien invasive plant species.

The following is relevant with respect to biodiversity in the No 18 Shaft complex:

- The No 18 Shaft complex is located in a moderate biodiversity area with the eastern shaft block border touching on a High Biodiversity area in terms of the Mining Biodiversity Guideline
- The majority of the proposed infrastructure falls within an area earmarked for expansion of a National Protected Area in terms of the National Protected Area Expansion Strategy developed by SANBI
- A portion of the proposed shaft complex encroaches on a core conservation area identified by Agreenco (2013)
- Protected Marula trees were found towards the north-eastern boundary of the proposed No 18 Shaft area in rocky Bushveld areas
- Impacted Bushveld Habitat unit dominates, with a significant portion of the area impacted upon by agricultural activities (refer to Figure 9)

- Rocky Outcrop and Wetland Habitat units, which occur in the proposed complex footprint, could provide habitat for vulnerable Red Data Listed South African Rock Python, however the remainder of the project area is not believed to be important in terms of Red Data Listed species conservation
- The footprint lies over mostly medium sensitivity areas, however with some hotspots rated as having a high sensitivity associated with rocky outcrop areas. In addition a wetland was identified that is associated with the stream that traverses the proposed No 18 Shaft area. This wetland was found to provide a moderately low level of ecological functioning and service provision, and was determined to be a Class C feature, which is moderately modified. This wetland therefore has a relatively low ecological significance.

The following is relevant with respect to biodiversity in the linear services corridors:

- No 18 Shaft linear infrastructure is located in a Moderate Biodiversity area in terms of the Mining Biodiversity Guideline
- No 17 Shaft and proposed linear infrastructure is located in a High Biodiversity area in terms of the Mining Biodiversity Guideline
- The majority of the proposed infrastructure falls within an area earmarked for expansion of a National Protected Area in terms of the National Protected Area Expansion Strategy developed by SANBI
- The existing No 17 Shaft and sections of the proposed linear infrastructure lies within Marikana Thornveld, a threatened ecosystem
- One linear infrastructure component associated with the No 18 Shaft complex encroaches on a core conservation area identified by Agreenco (2013). The existing No 17 Shaft complex as well as the proposed linear infrastructure component touches on the boundary of one of these core conservation areas
- Linear infrastructure corridors transect a diverse variety of habitat units including Impacted Bushveld with rocky Bushveld Rocky Outcrops, ephemeral watercourses with associated wetlands of low ecological significance, dams and rock pools (refer to Figure 9)
- Erosion and incision of adjacent streams may occur where river crossings are constructed due to vehicle movement and the use of construction equipment
- Protected Marula trees were found along the corridor extending to the south of the proposed No 18 Shaft complex (Refer to Figure 10)
- Rocky Outcrop and Wetland Habitat units could provide habitat for vulnerable Red Data Listed South African Rock Python, however the remainder of the corridor area is not believed to be important in terms of Red Data Listed species conservation
- The corridors traverse predominately medium sensitivity areas; however there are points of high sensitivity associated rocky outcrop areas (refer to Figure 10). In addition, wetlands have been identified where the linear infrastructure will cross various streams. These wetlands were found to provide a moderately low level of ecological functioning and service provision, and were determined

to be a Class C feature, which is moderately modified. These wetlands therefore have a low ecological significance

- Any disruption of the natural stream network would interfere with or destroy natural flow patterns and sediment-transport functions, resulting in downstream flooding and changes to the water quality of the downstream flows
- The stream and associated wetland crossings could cause reduced access to water resource within a semi-arid environment if not carefully constructed to avoid stream flow interference.

The proposed central STP is located in Zeerust Thornveld, and in an area already significantly impacted by mining activities and does not lie within an area of biodiversity importance in terms of the Mining Biodiversity Guideline.

This impact has been rated as having a high severity, which cannot be significantly mitigated during construction. During the operational phase, provided the footprints of the infrastructure components are not expanded, biodiversity will be impacted to a lesser extent. This also applies to the decommissioning phase. With mitigation, this impact could be mitigated to moderate severity. Upon closure, the No 18 Shaft waste rock dump will remain in perpetuity and represent a residual impact on biodiversity of moderate severity. With mitigation, this impact could be mitigated to a low severity.

Duration

The destruction of biodiversity could have a long-term effect if unmitigated. This cannot be significantly mitigated.

Spatial scale / extent

The destruction 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. This spatial scale cannot be significantly reduced with mitigation.

Consequence

The consequence has been rated as high for all project phases in the unmitigated and mitigated scenarios.

Probability

The probability is considered to be high for all project phases. The destruction of biodiversity in the construction and decommissioning phase remains high with mitigation, since the footprint areas will impact upon sensitive biodiversity. The probability can be reduced during the operations and closure phases with the implementation of management and mitigation measures.

Significance

The significance has been rated as high for all project phases; however this can be mitigated to moderate for operations and closure.

Summary of the rated physical destruction of biodiversity impact per phase of the project

Mitigation	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction						
Unmitigated	H	H	M	H	H	H
Mitigated	H	H	M	H	H	H
Operations and decommissioning						
Unmitigated	H	H	M	H	H	H
Mitigated	M	H	M	H	L	M
Closure						
Unmitigated	M	H	M	H	H	H
Mitigated	L	H	M	H	L	M

Conceptual description of proposed mitigation measures

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19).

Objective

The objective of the mitigation measures is to prevent the unacceptable loss of biodiversity and related ecosystem functionality through physical destruction.

Actions

In the project planning phase prior to construction, the project team will re-assess the finer detail of the infrastructure layout in an effort to avoid highly sensitive and localised biodiversity areas. Particularly with respect to the sensitive rocky outcrops which support protected Marula tree species and island-hopping animals such as dassies, rock-rabbits and baboons, the project team will determine the feasibility of leaving these intact, although these would still be surrounded by shaft infrastructure.

The following management and mitigation measures will be implemented during the construction, operation and decommissioning phases:

- The areas to be disturbed will be limited and avoid sensitive biodiversity areas (such as wetlands, watercourse and rocky outcrops) as far as practically possible
- Should any Red Data Listed fauna species be noted in the project area during construction, these will be relocated to similar habitat in the vicinity with the assistance of a suitably qualified specialist. Faunal migratory connectivity will be maintained especially with respect to Wetland Habitat Units. In this regard, stream crossings will be constructed in such a manner that these do not impede the flow of water. In addition, pipelines will either be buried or crossings will be constructed at key locations to

allow livestock to cross. The positions and type of crossing will be determined with the input of a biodiversity specialist

- Stream and wetland crossings will be constructed in the dry season if at all possible in order to avoid sedimentation of wetlands in the area
- Should any sensitive flora species be noted in the project area during construction, these will be relocated to similar habitat in the vicinity with the assistance of a suitably qualified specialist. This may include *Boophane distichia*. It is however noted that it is difficult to relocate Marula trees, therefore two new Marula trees will be planted in suitable habitat for every tree removed, after obtaining the relevant permit
- The overall footprint areas should not need to be expanded during the operational phase, however if this is required a biodiversity specialist will be consulted to limit further impacts
- Activities within 100 m or within the 1:100 year floodline watercourses will be limited as far as practically possible
- The following process will be implemented when the footprint areas are to be cleared and if new areas must be disturbed at a later stage in the life of the project:
 - Delineation of proposed area to be cleared or disturbed
 - Obtain any relevant permits for the removal of protected plant species and trees
 - Relocation of species that can effectively be relocated especially protected species and species of conservation concern. Relocation of faunal species should also focus on reptiles, arachnids and amphibians, particularly lizards, chameleons, tortoises, scorpions and adult frogs. Relevant specialists will be consulted to get advice on species to focus on and appropriate relocation techniques
 - Cordon off any areas that are to be preserved within the overall area to be disturbed. This may be applicable to the rocky outcrops situated within all infrastructure components
 - Restoration of the ecosystem functionality, as far as is possible, in areas that have been physically rehabilitated. Restoration efforts must specifically consider re-creating rocky and wetland habitats similar to the smaller naturally occurring in the area
 - Follow up audits and monitoring, in the short and long-term, to determine the success of the relocation, rehabilitation and restoration activities in terms of a range of species and ecosystem function performance indicators
- Rehabilitate any areas no longer required for mining activities
- During decommissioning, wetland crossing areas will be rehabilitated in an effort to re-instate wetland functioning. It should however be noted that these wetlands were found to have limited ecological functioning and are of low ecological significance
- If irreplaceable species and/or associated ecosystem functionality associated with core conservation or linkage areas will be permanently lost and restoration is not possible, a biodiversity offset project will be investigated. Issues that will be considered in the investigation are as follows:

- the size of the potentially affected area;
 - the conservation/sensitivity status of the potentially affected area;
 - the offset ratio (in terms of the required size of the offset site) to be applied;
 - evaluation of alternative offset sites on the basis of: no net biodiversity loss, compensation for the mine's negative impact on biodiversity, long term functionality, long term viability, contribution to biodiversity conservation including linkages to areas of conservation importance, acceptability to key stakeholders, distances from other mines and development activities in relation to cumulative impacts, and biodiversity condition scores as compared to that at the mine site;
 - land ownership now and in the future;
 - status/security of the offset site, i.e. will it receive conservation status;
 - measures to guarantee the security, management, monitoring and auditing of the offset;
 - capacity of the mine to implement and manage the offset;
 - identification of unacceptable risks associated with the offset;
 - the start-up and on-going costs associated with the offset for the life of the project; and
 - Implementation of an alien/invasive/weed management programme to control the spread of these plants onto and from disturbed areas through active eradication, establishment of natural species and through on-going monitoring and assessment. In this regard, the use of herbicides will be controlled by only allowing registered Pest Control Operators (PCO) to administer any such chemical or biological agent.
- Workers (permanent and temporary) will be trained on the value of biodiversity and the need to conserve the species and ecosystems. This will be included in induction training as well as relevant follow-up training. Information will be provided to workers with basic information such as locally occurring fauna and flora, the importance of conserving biodiversity, how best to conserve biodiversity etc.
 - Concurrent and final rehabilitation of the waste rock dumps as outlined in Table 36
 - As part of closure planning, the designs of any permanent structures (waste rock dumps) will take into consideration the requirements for the establishment of long-term species diversity, ecosystem functionality, aftercare and confirmatory monitoring.

Emergency situations

None identified.

7.2.6 ISSUE: GENERAL DISTURBANCE OF BIODIVERSITY

Introduction

There is a number of activities/infrastructure in all phases (see Section 1, Table 38 for further detail) that have the potential to disturb biodiversity, 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, such as waste rock dumps, which may have pollution potential through long term seepage and/or run-off.

Activities and infrastructure - link to mine phases

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks for all surface infrastructure Site management Transport systems Support services and amenities Site management Rehabilitation	Site preparation Earthworks - for all surface infrastructure Site management Transport systems Non-mineralised waste management Mineralised waste management Support services and amenities Site management Underground mining Water supply infrastructure Power supply infrastructure Rehabilitation	Site preparation Demolition Earthworks Site management Transport systems Non-mineralised waste management Mineralised waste management Support services and amenities Site management Water supply infrastructure Rehabilitation	Maintenance and aftercare of final land forms and rehabilitated areas

Rating of impact

Severity / nature

Biodiversity will be disturbed in the following ways during all project phases:

- Lighting at the shaft will attract insects at night. White light in particular attracts large numbers of invertebrates which become easy prey for predators. This can upset the invertebrate population balance. Lighting can also affect the foraging patterns of nocturnal species such as owls and bats
- Harvesting and killing of plant and animal species for medicinal use, food, fire wood, for sport, persecution of predators such as jackal and hyenas etc. This could reduce populations of smaller ungulates e.g. Dassies, Duiker, Steenbok and Porcupine, and cause the loss of non-target species from indiscriminate trapping methods, e.g. Brown Hyaena caught in snares. Increased wood harvesting could cause a loss of cover for faunal species and tree nesting habitat for birds, particularly for hole-nesting bird species, e.g. woodpeckers, oxpeckers and other arboreal faunal species
- Excessive dust fallout may have adverse effects on the growth of some vegetation, and it may cause varying stress on the teeth of vertebrates that have to graze soiled vegetation
- Noise and vibration 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

- Road kills
- Blasting could harm species in the fly rock zone
- The presence of mine water and sewage impoundments and pipelines may lead to drowning of fauna
- Increased presence of alien animal species such as dogs and cats could cause increased predation on small fauna and genetic contamination of wild cat populations
- Contamination of water and soil and general litter may directly impact on the survival of individual plants, vertebrates and invertebrates.

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.

Duration

In the event of death of a fauna or flora species, the duration of this impact would be long-term. This cannot be significantly mitigated.

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. This spatial scale cannot be significantly reduced with mitigation.

Consequence

The consequence has been rated as high during all project phases; however this can be reduced to moderate with the implementation of management and mitigation measures.

Probability

The probability has been rated as high for all project phases because by nature mining operations are intrusive. This can however be mitigated to moderate for construction, operations and decommissioning. The probability after closure can be mitigated to low because only the waste rock dumps will remain and the seepage and runoff contamination risk can be managed.

Significance

The significance has been rated as high for all project phases. This can however be mitigated to moderate for construction, operations and decommissioning by reducing the severity and probability.

The significance can be mitigated to low at closure because only the waste rock dumps will remain and the seepage and runoff contamination risk can be managed.

Summary of the rated general disturbance of biodiversity impact per phase of the project

Mitigation	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operations and decommissioning						
Unmitigated	H	H	M	H	H	H
Mitigated	L	H	M	M	M	M
Closure						
Unmitigated	H	H	M	H	H	H
Mitigated	L	H	M	M	L	L

Conceptual description of proposed mitigation measures

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19).

Objective

The objective of the management measures is to prevent unacceptable disturbance of biodiversity and related ecosystem functionality.

Actions

The following management and mitigation measures will be implemented during the construction, operation and decommissioning phases:

- The use of light will be kept to a minimum, and where it is required, yellow lighting will be used where possible. In addition to this vertebrates should be kept away from the illuminated areas with appropriate fencing where feasible
- Internal powerlines may be equipped with bird deterrent measures to prevent bird kills where deemed necessary
- 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. This will be included in induction training as well as relevant follow-up training. Information will be provided to workers with basic information such as locally occurring fauna and flora, the importance of conserving biodiversity, how best to conserve biodiversity etc.
- There will be zero tolerance with respect to the killing or collecting of any biodiversity by anybody working for or on behalf of Impala
- 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

- Soil erosion, which may affect floral and faunal diversity, will be controlled using berms, hessian curtains, soil traps and ensuring good vegetation cover
- Erosion berms will be installed in areas where soil disturbance will occur in the vicinity of watercourse crossings in order to prevent gully formation and siltation of the watercourses as follows:
 - Slope of less than 2 % construct berms every 50 m
 - Slope 2 % to 10 % construct berms every 25 m
 - Slope 10 % to 15 % construct berms every 20 m
 - Slope greater than 15 % construct berms every 10 m.
- Noisy and/or vibrating equipment will be well maintained to control noise and vibration emission levels
- All permanent water dams (excluding Rock-wall dam) will be fenced off to prevent access by larger animals
- Dust control measures will be implemented as outlined in section 7.2.11
- Surface and groundwater management measures will be implemented as outlined in sections 7.2.8 and 7.2.10
- Soil pollution will be prevented and managed as outlined in section 7.2.3
- Blasting hazards will be managed as outlined in section 7.2.15
- Road safety measures will be implemented as outlined in section 7.2.16. A record of road kills and injuries will be kept in an effort to identify road safety hotspots. Additional management measures will be implemented at these hotspots if deemed necessary
- Concurrent and final rehabilitation of the waste rock dumps as outlined in Table 36
- 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 (No 18 Shaft waste rock dump) will take consideration of the requirements for long-term ecosystem functionality, pollution prevention and confirmatory monitoring.

Emergency situations

Major spillage incidents will be handled in accordance with the Impala emergency response procedure.

Certain instances of injury to animals may be considered emergency situations. These will be managed in accordance with the Impala emergency response procedure.

SURFACE WATER**7.2.7 ISSUE: ALTERATION OF DRAINAGE PATTERNS**

Information in this section is based on the hydrology study conducted by SLR (Appendix E) and the biodiversity specialist study (SAS, 2013) (Appendix D).

Introduction

There are a number of activities/ infrastructures which could alter drainage patterns and result in the reduction of surface runoff in the catchment to downstream water users throughout all phases of the project.

Activities and infrastructure - link to mine phases

Construction	Operational	Decommissioning	Closure
Earthworks Civil works Site management Transport systems Non-mineralised waste management Support services and amenities Rehabilitation	Earthworks Civil works Site management Transport systems Non-mineralised waste management Mineralised waste management Support services and amenities Shaft infrastructure Water supply infrastructure Power supply infrastructure Rehabilitation	Demolition Earthworks Civil works Site management Transport systems Non-mineralised waste management Mineralised waste management Shaft infrastructure Support services and amenities Water supply infrastructure Power supply infrastructure Rehabilitation	Maintenance and aftercare of final land forms and rehabilitated areas

Rating of impactSeverity / nature

Every effort has been made to keep all infrastructure out of the 1:100 year floodline or 100 m buffer zone from watercourses, whichever is greatest, in line with R704 requirements. The following infrastructure will however be placed within the buffer zones:

- A non-perennial watercourse traverses the proposed No 18 Shaft complex footprint and a second non-perennial passes nearby the footprint to the west
- The underground mining operations will undermine watercourses at depth of more than 1600 m. The linear infrastructure corridor will cross non-perennial streams at seven points as per the 1:50 000 topography maps, however an additional two preferential flow paths were identified in the field – refer to Figure 31.

These are however small non-perennial streams. Stream crossings will be designed so as not to interfere with the natural flow of the relevant streams. All relevant water uses and exemptions from R704 will be applied for in this respect.

The establishment of the No 18 Shaft complex terrace will result in a loss of water falling in this containment area to the natural environment. This loss of mean annual runoff (MAR) has been estimated using rainfall-runoff response parameters from WR2005. An estimated 0.79 km² of area will be contained for the establishment of the shaft complex. This equates to a loss of approximately 0.0067 million m³ of MAR. This is however only 0.047 % of the total MAR for the quaternary catchment A22F. No material loss in runoff to the environment is expected from the establishment of other project components.

The alteration of drainage patterns as described above will be relevant to the construction, operational and decommissioning phases, as well as to the closure phase due to the No 18 Shaft waste rock dump that will remain in perpetuity and the fact that site rehabilitation could never truly restore topography and surface drainage to its pre-disturbed state. Due to the small percentage of the MAR that will be lost, and the fact that the placement of surface infrastructure will only affect the headwaters of a non-perennial stream, this impact has been rated as having a moderate severity in both the unmitigated and mitigated scenarios. This applies to all project phases.

Changes to surface flow patterns at the No 17 Shaft complex have not been assessed since this shaft has already been constructed.

FIGURE 31: STREAM CROSSINGS (SLR, 2013)

Duration

The alteration of drainage patterns will be long-term and extend beyond the life of the project due to remaining No 18 Shaft waste rock dump and the fact that site rehabilitation could never truly restore the topography and surface drainage to its pre-disturbed state. The duration cannot be significantly reduced with mitigation.

Spatial scale / extent

The alteration of drainage patterns is expected to have a limited scale just beyond the current project area, but well within the Impala converted mining rights area. This applies to all project phases in both the unmitigated and mitigated scenarios.

Consequence

The consequence has been rated as moderate for all project phases in both the unmitigated and mitigated scenarios.

Probability

The probability of a reduction of water within the catchment is definite. However due to the limited nature of the reduction of water in the catchment, the probability of impacting downstream users is low for all project phases in both the unmitigated and mitigated scenarios.

Significance

The significance has been rated as low for all project phases in both the unmitigated and mitigated scenarios.

Summary of the rated alteration of drainage patterns impact per phase of the project

Mitigation	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operations and decommissioning						
Unmitigated	M	H	L	M	L	L
Mitigated	M	H	L	M	L	L

Conceptual description of proposed mitigation measures

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19).

Objective

The objective of the mitigation measures is to minimise the disturbance of streams and surface drainage patterns and a reduction in flow to downstream users.

Actions

The following management and mitigation measures will be implemented during all project phases:

- An amendment to the Impala water use licence will be applied for with respect to all relevant water uses and R704 exemptions required for this project and will address all project components
- The requirements of any water use licence issued by DWA, R704 (unless exemptions are issued by DWA) and the NWA of 1998 will be complied with
- The project infrastructure footprint and associated area of disturbance will be minimised as far as practically possible
- 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 as outlined in the stormwater management plan (refer to 2.7.2.8)
- Site rehabilitation will aim to restore surface drainage patterns as far as practically and economically feasible.

Emergency situations

None identified.

7.2.8 ISSUE: POLLUTION OF SURFACE WATER RESOURCES

Information in this section is based on the hydrology study conducted by SLR (SLR, 2013) (Appendix E).

Introduction

There are a number of pollution sources in all phases that have the potential to pollute surface water and impact on downstream water users. In the construction and decommissioning phases these potential pollution sources are temporary in nature. 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.

Activities and infrastructure - link to mine phases

Construction	Operational	Decommissioning	Closure
Earthworks Civil works Site management Transport systems Non-mineralised waste management Support services and amenities Rehabilitation	Earthworks Civil works Site management Transport systems Non-mineralised waste management Mineralised waste management Underground mining Support services and amenities Water supply infrastructure	Demolition Earthworks Civil works Site management Transport systems Non-mineralised waste management Mineralised waste management Support services and amenities Water supply infrastructure	Maintenance and aftercare of final land forms and rehabilitated areas

Construction	Operational	Decommissioning	Closure
	Power supply infrastructure Rehabilitation	Power supply infrastructure Rehabilitation	

Rating of impact

Severity / nature

Surface water resources downstream of the proposed project infrastructure and activities could be polluted if there are discharges of contaminated substances into these resources. Potential construction and decommissioning phase pollution sources include:

- Sedimentation from erosion
- Spillage of sewage, construction solvents, paint, fuel, lubricants, cement or leaks from vehicles and equipment.

Potential operational phase pollution sources include:

- Spills of potentially polluting materials such as chemicals, fuel and lubricant
- Contaminated discharges from the dirty water systems including: sewage treatment and conveyance infrastructure, dewatering settling ponds, dirty water containment facilities, stockpile areas, tailings pipelines, workshops etc.
- Contaminated runoff and seepage from the No 18 Shaft waste rock dump
- Sedimentation from erosion.

In the normal course all contaminated water, including water removed from underground, will be contained in the dirty water system and re-used. In addition, treated sewage effluent will be reused.

After closure the No 18 Shaft waste rock dump will remain in perpetuity and represent a potential residual water quality impact. Current understanding is that there is connectivity between the shallow groundwater aquifer and surface streams. However no contaminated decant is expected to impact on surface water streams because the tailings backfill is not expected to be a significant pollution source. This is outlined in the section below.

In the unmitigated scenario, the uncontrolled discharge of contaminated water could impact the health of ecosystems, biodiversity, livestock and any human users. The severity of the pollution of surface water resources is high during all project phases. With mitigation, the severity can be reduced to moderate for all project phases.

Duration

The impact of surface water could have long-term effects on the flora and fauna it supports during all project phases. The implementation of management and mitigation measures could reduce the duration.

Spatial scale / extent

The contamination of surface water is expected to have a limited scale, just beyond the current project area, but well within the Impala converted mining rights area. This applies to all project phases in both the unmitigated and mitigated scenarios.

Consequence

The consequence has been rated as high for all project phases. This can however be mitigated to moderate by reducing the severity of the impact.

Probability

In the unmitigated scenario it is likely that there will be significant pollution incidents that have a real possibility of impacting downstream ecosystems and users. The probability is therefore rated as high in all project phases. This can however be reduced to low with the implementation of management and mitigation measures that contain pollution at source or enable fast remediation.

Significance

The significance has been rated as high for all unmitigated project phases. This can however be mitigated to low by reducing the severity and probability of occurrence.

Summary of the rated pollution of surface water impact per phase of the project

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

Conceptual description of proposed mitigation measures

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19).

Objective

The objective of the mitigation measures is to prevent pollution of surface water resources and impacts on other surface water users.

Actions

The following management and mitigation measures will be implemented during all project phases:

- An amendment to the Impala water use licence will be applied for with respect to all relevant water uses and R704 exemptions required for this project and will address all project components
- The requirements of any water use licence issued by DWA, R704 (unless exemptions are issued by DWA) and the NWA of 1998 will be complied with
- The project footprint and associated area of disturbance will be minimised as far as practically possible
- Erosion and stormwater management measures will be implemented to prevent the loss of topsoil and resultant sedimentation of watercourses
- The stormwater management plan will be implemented as outlined in section 2.7.2.8
- All contaminated water, including water removed from underground during dewatering, will be contained and reused
- Adequate sanitation facilities, such as chemical toilets, will be installed and maintained during the construction and decommissioning phases. However, no sanitation facilities may be located within 100 m of a watercourse. During the operational phase flush toilets will be provided and a sewage treatment plants will treat this waste. It should be noted that the treated sewage effluent will not be discharged to the environment, but will instead be fed into the mine's dirty water system for reuse
- All hazardous chemicals (new and used), mineralised wastes and non-mineralised wastes will be handled in a manner that they do not pollute surface water. This will be implemented through a procedure(s) covering the following pollution prevention aspects:
 - Basic infrastructure design that is adequate to contain polluting substances. Part of this requirement will be that area where hazardous and/or polluting substances can be spilled will be minimised and contained. The storage method of all these substances is to contain them in sealed containers within impermeable, bunded areas with sufficient excess capacity. All spilled materials must drain to sumps with oil traps that must also be equipped to allow collection and removal of spilled substances. Concrete will not be mixed directly on the ground. Plastic liners and mixing trays will be used at all times. Waste concrete will be scraped off the site of the batching plant daily and removed to an approved landfill site in order to prevent pollution during times of rain. Cement contaminated water will be collected, stored and disposed of at a site approved by the site engineer (approved disposal method and location)
 - Maintenance of equipment that can spill polluting substances. This includes the maintenance of vehicles and equipment and oil or fuel leaks will be fixed immediately upon detection in designated wash bays that are fitted with impermeable dirty water collection sumps and separators
 - Education and training of workers (permanent and temporary)
 - Implementation of 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.

- Activities on the banks of watercourses will be minimised as far as possible
- Polluted soils will be treated in accordance with Section 7.2.3
- The designs of any permanent and potentially polluting structures (e.g. waste rock dumps) will take account of the requirements for long-term surface water pollution prevention
- Impala will monitor the water quality in all potentially affected surface water resources (refer to 1) and use the results of the monitoring to implement any other surface water quality related interventions as deemed appropriate to achieve the mitigation objectives
- Where monitoring identifies that third party water supply has been polluted by Impala, an alternative equivalent water supply will be provided by Impala.

Emergency situations

Pollution incidents will be reported to the relevant authorities within the specified time frames and will be handled in accordance with the Impala emergency response procedure.

GROUNDWATER

7.2.9 ISSUE: DEWATERING IMPACTS ON THIRD PARTY USERS

Information based on groundwater specialist study (SLR 2013) Appendix F).

Introduction

It is necessary to dewater the underground mining sections at the No 18 Shaft to create a safe working environment. With dewatering the concern is that third party groundwater users may be negatively affected. This activity will commence during shaft sinking operations and will cease in the decommissioning phase. Upon closure, the groundwater levels will be allowed to rebound naturally.

Activities and infrastructure - link to mine phases

Construction	Operational	Decommissioning	Closure
			N/A
Shafts- sinking	Underground mining	Dewatering ceases	

Rating of impact

Severity / nature

Dewatering activities will commence in the construction phase with the sinking of the shafts, and will continue throughout the operational phase to enable a safe working environment during steady-state mining.

The groundwater modelling estimates the combined dewatering rate (i.e. mine inflows) for all Impala underground mine voids to be approximately 1.4 M m³/a. Applying this value to dewatering from No 18

Shaft related underground void represents the upper limit for dewatering volumes (and impacts) across the modelled domain.

The modelled groundwater contours and flow directions are influenced by the existing underground mine dewatering. The effect on the groundwater levels, although minor over the operational mining phase, is enhanced by the dykes that act as barriers to groundwater flow. In addition, the groundwater mound below TSF Dam No. 3 and 4 has divergent groundwater flow away from the TSF site.

The predicted cone of depression is shown in Figure 32. The shallow aquifer changes essentially into a perched aquifer system, although it retains its saturated conditions due to limited leakage to the deeper, fractured aquifer. Figure 29 shows that drawdown of the regional groundwater level in the shallow aquifer due to underground mine dewatering ranges from 0.5 m to an approximate maximum of 4 m east of the No 18 Shaft. The effect on the groundwater level is more pronounced in this topographically higher lying ground as it represents a local groundwater divide with only limited vertical replenishment of groundwater by recharge. As a result, the predicted cone of depression extends beyond the Impala converted mining rights area boundary. It is important to note that no third party water supply boreholes have been identified within the cone of depression. Only DWA and Impala monitoring boreholes have been identified within the affected area.

**FIGURE 32: PREDICTED CONE OF DEPRESSION (AREA OF INFLUENCE) FOR SHALLOW
AQUIFER SYSTEM (SLR, 2013)**

Dewatering activities will cease at the end of the operational phase, and groundwater levels will be allowed to rebound naturally. Current modeling shows that it is likely to take more than 100 years for the groundwater levels to recover to pre-mining conditions.

Given that no other water users are expected to be impacted upon by dewatering activities, this impact has been rated as having a low severity during all phases. This impact does not require mitigation.

Duration

This impact will have a long-term duration given the fact that it is expected to take more than 100 years for the groundwater levels to recover.

Spatial scale / extent

The dewatering cone of depression will extend beyond the mining rights area.

Consequence

The consequence has been rated as medium during all project phases in both the unmitigated and mitigated scenarios.

Probability

Given the fact that no third party water supply boreholes were identified within the affected area, this impact has a low probability of occurring in all project phases in both the unmitigated and mitigated scenarios.

Significance

The significance has been rated as low in all project phases in both the unmitigated and mitigated scenarios.

Summary of the rated dewatering impact per phase of the project

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

Conceptual description of proposed mitigation measures

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19).

Objective

The objective of the mitigation measures is to prevent water losses to third party water users.

Actions

Any future third party boreholes that are situated within the cone of depression will be included in the Impala groundwater monitoring programme where possible to ensure that changes in water depths can be identified.

If dewatering causes a loss of water supply to third parties, an alternative equivalent water supply will be provided by Impala until such time as the dewatering impacts cease.

Emergency situations

None identified.

7.2.10 ISSUE: CONTAMINATION OF GROUNDWATER

Information based on groundwater specialist study (SLR 2013) (Appendix F).

Introduction

There are a number of sources in all phases that have the potential to pollute groundwater particularly in the unmitigated scenario. In the construction and decommissioning phases these potential pollution sources are temporary and diffuse in nature. The operational phase will present more long-term potential sources such as the waste rock dump and the closure phase will present final land forms that may have the potential to pollute water resources through long-term seepage.

Activities and infrastructure - link to mine phases

Construction	Operational	Decommissioning	Closure
Earthworks Civil works Site management Transport systems Non-mineralised waste management Support services and amenities Rehabilitation	Earthworks Civil works Site management Transport systems Non-mineralised waste management Mineralised waste management Support services and amenities Underground mining Backfilling with tailings Water supply infrastructure Power supply infrastructure Rehabilitation	Demolition Earthworks Civil works Site management Transport systems Non-mineralised waste management Mineralised waste management Backfilling with tailings Support services and amenities Water supply infrastructure Power supply infrastructure Rehabilitation	Maintenance and aftercare of final land forms and rehabilitated areas Tailings backfilled areas

Rating of impactSeverity / nature

The following sources have the potential to pollute groundwater for this project:

- Accidental spills and leaks from vehicles and equipment as well as sewage treatment facilities have the potential to reach shallow groundwater during the construction, operational and decommissioning phases
- Sludge removed from the dewatering settling dams have the potential to pollute groundwater through seepage, depending on the disposal option selected for this material. However it should be noted that common practice is to periodically remove this sludge and send it through the processing plant during operations. However, this sludge will be disposed of onto the waste rock dump during the sinking phase
- The waste rock dump has the potential to impact upon groundwater during all project phases, as well as after closure through seepage
- The backfilling of mined out areas in the underground mining sections associated with the No 17 and 18 Shafts have the potential to pollute groundwater from the operational phase when this material is deposited, and beyond closure.

Each of these impacts will be assessed separately.

Accidental spills and leaks:

Contamination from spills on surface could involve a range of contaminants such as hydrocarbons or hazardous chemicals, raw sewage, tailings, dirty water or sludge. It is not anticipated that a large quantity of contaminants would reach the groundwater level before it is contained and cleaned up on surface. This impact has therefore been rated as having a moderate severity, which can be mitigated to low.

Waste rock disposal:

Geochemical analysis has been conducted on analogue samples of waste rock to determine the potential for acid generation and the leaching of contaminants from the waste rock dump (WRD). The acid based accounting (ABA) analysis shows no to low risk of acid generation and a neutral to alkaline leachate quality is predicted. Leachate tests show that nitrates may exceed water quality guidelines and that trace elements such as iron, manganese and nickel may exceed water quality limits in acidic conditions. However, acidic conditions are not expected. This impact has therefore been rated as having a moderate severity in all project phases, and this can be mitigated to low with the implementation of the Impala design standard which includes the combination of a clay lining system (with runoff collection trenches) and concurrent rehabilitation. This standard also requires that the WRD footprint be progressively developed ahead of deposition i.e. only the area to be used for dumping in one year will be prepared at a time, and a layer of waste rock will be used as cover to prevent the clay liner from drying out and cracking. The WRD will also be rehabilitated concurrently with the operation of the WRD, and this will minimise ingress of rainwater into the WRD.

Tailings backfilling:

Geochemical analysis has also been conducted on tailings, which will be mixed with stabilisers and additives and used as backfill in the mined out areas associated with the No 17 and 18 Shafts. The solid tailings fraction and tailings liquid were tested separately. The ABA analysis shows no to low risk of acid generation and leachate tests shows that major and trace element concentrations are below drinking water guideline limits and mining effluent limits for the tailings solid fraction. The leachate likely to be generated from the tailing solids therefore passes through a tier one risk assessment (direct linkage between source and receptor) and no further risk modelling is required. However, tests on tailings liquid from the tailings shows saline seepage with elevated electrical conductivity and sulphate which exceed water quality guideline limits.

The severity of groundwater contamination has therefore been rated as high for operations. This can however be mitigated to moderate if the tailings liquid is removed from the tailings material before it is prepared for use as backfill, should the need for this be determined by pilot testing.

This rating also applies to the post-closure phase because the rebounding groundwater influenced by the proposed backfill (tailings) material is unlikely to negatively impact the groundwater quality of the shallow weathered aquifer during the decommissioning phase (i.e. rebounding of groundwater levels) based on current results. This is because shallow weathered aquifer has been shown to have marginal to poor water quality and the expected impact of backfill material is not expected to reduce this quality further.

Duration

The duration of groundwater impacts could be long-term for all of the impacts described above. This can however be reduced to the life of the project with implementation of management and mitigation measures.

Spatial scale / extent

The spatial scale could be regional in the unmitigated scenario, however this should be mitigated to moderate.

Consequence

The consequence has been rated as high for accidental spills and this can be mitigated to moderate by reducing the severity and duration. The consequence has been rated as high for the No 18 Shaft waste rock dump and this can be mitigated to moderate by reducing the severity and duration. The consequence of tailings backfill is high, but this can be mitigated to moderate by reducing the severity and duration.

Probability

The probability of occurrence has been rated as moderate in the unmitigated scenario, reducing to low with mitigation. .

Significance

The significance of contamination due to accidental spills and leaks and from waste rock disposal at No 18 Shaft has been rated as high and this can be mitigated to low by reducing the severity, duration and probability. The significance of tailings backfill has been rated as high, but this can be mitigated to moderate by reducing the severity and probability.

Summary of the rated groundwater pollution impact per phase of the project

Mitigation	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Accidental spills and leaks						
Construction, operations and decommissioning						
Unmitigated	M	H	H	H	M	H
Mitigated	L	M	M	M	L	L
Waste rock disposal						
All phases						
Unmitigated	M	H	H	H	M	H
Mitigated	L	H	M	M	L	L
Tailings backfilling						
Operations to closure						
Unmitigated	H	H	H	H	M	H
Mitigated	M	H	M	H	L	M

Conceptual description of proposed mitigation measures

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19).

Objective

The objective of the mitigation measures is to prevent pollution of groundwater resources and impacts on other groundwater users.

Actions

The following management and mitigation measures will be implemented during all project phases:

- All relevant water uses will be licenced
- The No 18 Shaft waste rock dump will be constructed, operated (including concurrent rehabilitation) and rehabilitated as outlined in section Table 36
- A pilot study will be conducted with a representative sample of the final backfill material (with the correct proportions of tailings and binding agents) in both the consolidated (dried) and unconsolidated (wet) state, in order to determine if the tailings liquid will leach out. The results of this pilot study may require additional management measures to be implemented in order to prevent and minimise pollution from backfilling in No 17 and 18 Shaft mine voids
- Monitor groundwater quality as outlined in section 21.1.1
- All of the geochemical tests will be repeated when final tailings backfill mixture, sludge samples from the dewatering system and waste rock samples are available. The waste rock testing will include samples from various lithological units (i.e. norites, anorthosites, pyroxenites) and mineralised zones.

Implement additional management measures if warranted by the testwork in consultation with an appropriate specialist

- Should the monitoring show a deterioration in groundwater quality as result of the project activities, this will be investigated further and mitigation measures developed for implementation in consultation with an appropriate specialist
- Stormwater management dams will be equipped with appropriate liners
- All hazardous chemicals (new and used), mineralised wastes and non-mineralised wastes will be handled in a manner that they do not pollute groundwater. This will be implemented through a procedure(s) covering the following:
 - Pollution prevention through basic infrastructure design that is adequate to contain polluting substances
 - Pollution prevention through maintenance of equipment that can spill polluting substances
 - Pollution prevention through education and training of workers (permanent and temporary)
 - Pollution prevention through appropriate management of hazardous chemicals, materials and non-mineralised waste
 - 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.
- Where pollution caused by Impala negatively impacts third party water supply an alternative equivalent supply will be provided by Impala.

Emergency situations

Discharge incidents that result in pollution of groundwater resources will be handled in accordance with the Impala emergency response procedure.

AIR QUALITY

7.2.11 ISSUE: INCREASE IN AIR POLLUTION

The information in this section is based on the specialist opinion input (Appendix L).

Introduction

There are a number of sources in all phases that have the potential to cause air pollution in the unmitigated scenario. In the construction and decommissioning phases these potential pollution sources are temporary in nature, usually existing for a few weeks to a few months. 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 pollute the air through long-term wind erosion. This section focuses on human health impacts.

With projects of this nature, the main emissions include: inhalable particulate matter less than 10 microns in size (PM10), larger total suspended particulates (TSP), and limited gas emissions. Gaseous pollutants (such as sulphur dioxide, oxides of nitrogen, carbon monoxide, etc.) derived from vehicle exhausts and blasting are regarded as negligible in comparison to particulate emissions. At certain concentrations, each of these contaminants can have health and/or nuisance impacts.

Activities and infrastructure - link to mine phases

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks Civil works Site management Transport systems Non-mineralised waste management Support services and amenities Rehabilitation	Site preparation Earthworks Civil works Site management Transport systems Non-mineralised waste management Mineralised waste management Support services and amenities Rehabilitation	Site preparation Demolition Earthworks Civil works Site management Transport systems Non-mineralised waste management Mineralised waste management Support services and amenities Rehabilitation	Maintenance and aftercare of final land forms and rehabilitated areas

Rating of impact

Severity / nature

Gaseous emissions from vehicles and equipment are expected to be minimal, and this impact is therefore considered to have a low severity. In a previous study conducted by APP for the No 17 Shaft (as cited in the APP specialist input for the current project in Appendix L), it was shown that receptors within 500 m of the shaft would not be significantly impacted by PM10. Therefore, dust generated at the proposed No 18 Shaft is not expected to impact significantly on nearby communities or the farm dwellers residing adjacent to the linear infrastructure route because they are more than 500 m away from the shaft. However, dust generated along the No 18 Shaft linear route could have an unacceptable impact on the informal dwellers. This impact has therefore been rated as having a high severity in the unmitigated scenario. However, with the implementation of management and mitigation measures, such as applying a chemical dust suppressant on the unpaved road and paving the road as soon as possible, this can be reduced to low.

Dust is already managed at the existing No 17 Shaft. No significant dust is expected at the central STP or the No 17 Shaft linear infrastructure routes.

Duration

Health effects resulting from the inhalation of particulates could be long-term, and this applies to the unmitigated and mitigated scenarios for all project phases.

Spatial scale / extent

As shown in the study conducted for the No 17 Shaft, dust impacts are not expected to extend more than 500 m away from the shaft. The impact is therefore expected to be limited to the project site boundary for all project phases, in both the unmitigated and mitigated scenarios.

Consequence

The consequence has been rated as high in the unmitigated and mitigated scenarios for all project phases.

Probability

The probability that there will be elevated dust emissions is high for all project phases in the unmitigated scenario. Moreover, given the proximity of the farm dwellers, this could result in a human health impact because without mitigation measures the dwellers will be exposed to elevated dust concentrations that are above the ambient standards along the linear route over the long term. This can be reduced to low with the implementation of management and mitigation measures.

Significance

The significance has been rated as high for all project phases; however this can be mitigated to moderate through a reduction in the severity and probability.

Summary of the rated air quality impact per phase of the project

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

Conceptual description of proposed mitigation measures

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19).

Objective

The objective of the mitigation measures is to reduce dust and gaseous impacts during all project phases.

Actions

In the construction, operational and decommissioning phases, the following management and mitigation measures will be implemented for the main emission sources: roads, materials handling (tipping points), soil stockpiles:

- The area of disturbance will be limited as far as practically possible

- The permanent access road to No 18 Shaft will be tarred and spillages of material on these roads will be routinely cleaned
- Dust will be suppressed on unpaved roads (temporary gravel service roads) through the use of chemical binding agents and/or water sprays combined with vehicle speed controls
- Dust controls at material handling points (loading and offloading) by water sprays
- Rehabilitation and re-vegetation of all decommissioned areas and concurrent rehabilitation of the side slopes of the operational waste rock dumps
- Maintenance of all vehicles and equipment to achieve optimal exhaust emissions
- Dust will be monitored at the closest sensitive receptors – the informal dwellers (refer to section 21.1) or the dwellers will be relocated
- As part of closure planning the designs of any permanent and potentially polluting structures (waste rock dumps) will incorporate measures to address long-term pollution prevention and confirmatory monitoring.

Emergency situations

None identified.

AMBIENT NOISE

7.2.12 ISSUE: INCREASE IN DISTURBING NOISE LEVELS

Information based on the noise specialist study (Acusolv 2013) (Appendix G).

Introduction

There are limited activities at the No 18 Shaft site that contribute to current ambient noise levels because site is situated away from current mining activities and current land use is that of agriculture and wilderness. There are a range of construction, operation and decommissioning project activities that have the potential to generate noise (disturbance and nuisance) and cause related noise impacts at sensitive receptors. No noise-related impacts are expected at closure. It should however be noted that the sites for other project components such as the central STP and proposed No 17 Shaft linear infrastructure are already affected by noise generated by mining activities.

General noise disturbance can be defined as an increase in ambient noise levels and can be quantified and assessed based on estimated or measured sound levels, expressed in decibels (dB), which is compared to baseline noise levels. The South African Noise Regulations indicates that the legal limit for an increase in ambient noise is 7 dB. However it should be noted that this is not necessarily the upper limit of acceptability. SANS 10103 identified that an increase of 5 dB is considered a significant impact,

and that an increase of 5 dB will cause widespread complaints from the community. For the purposes of this assessment, an increase of 5 dB is considered a significant impact.

The Noise Regulations also prohibit the creation of noise nuisance, which is defined as any sound which disturbs, or impairs the convenience or peace of any person. The intent of this prohibition clause is to control the types of noise that are not satisfactorily covered by means of measurement and assessment criteria applicable to disturbing noise. These noises are either difficult to capture, or are noises for which the readings registered on sound level meters do not correlate satisfactorily with the annoyance it causes when assessed against standard criteria. Noise nuisance is difficult to quantify and is not confirmed or assessed by measurement. Noise nuisance sources presented by the proposed project consist of blasting, reverse alarms and hooters.

For on-site activities, the assessment below focuses on night-time conditions when ambient noise levels are lower (generally night-time ambient noise levels are 10 dB lower than day-time levels) and the sensitivity of the environment increases. It is expected that if the night-time impact is contained within acceptable levels, then the daytime impact will also fall within acceptable limits.

Activities and infrastructure - link to mine phases

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks for all surface infrastructure Site management Transport systems Support services and amenities Non-mineralised waste management Site management Rehabilitation	Site preparation Earthworks - for all surface infrastructure Site management Transport systems Non-mineralised waste management Mineralised waste management Support services and amenities Site management Water supply infrastructure Power supply infrastructure Rehabilitation	Site preparation Demolition Earthworks Site management Transport systems Non-mineralised waste management Mineralised waste management Support services and amenities Site management Water supply infrastructure Rehabilitation	Maintenance and aftercare of final land forms and rehabilitated areas

Rating of impact

Severity / nature

There will be a difference in noise levels in the different phases of the proposed project. During the construction and decommissioning of all surface infrastructure, the increase in noise levels caused by building and demolition activities, reverse hooters, and diesel generators is expected to be low. Blasting noise from the No 18 Shaft development may be audible and occasionally cause significant impact at the nearest receptors described in section 1.1.9, particularly those living in farm dwellings described in section 1.3.1.

Nearest communities

The potential increase in ambient noise levels during the operational phase has been modelled for the proposed No 18 Shaft and associated linear infrastructure, the only significant noise generating project components. The model shows that the widest reach of the significant noise impact footprint extends approximately 2,7km in a down-wind direction from the centre of the No 18 Shaft complex – refer to Figure 33. This noise map shows that the nearest communities are located well outside of the 45 dBA significant impact area.

Farm dwellers

However, the people living in the farm dwellings adjacent to the No 18 Shaft linear infrastructure route are located within this significant impact zone – refer to Figure 33. The relevant baseline level for people living in these dwellings has been determined to be 35 dBA, the night-time level for Rural Districts. The maximum predicted increase in night-time ambient noise has been calculated for these dwellings at 13 dB. The increase in ambient noise levels at the dwellings could therefore exceed both the significance limit of 5 dB and the legal limit of 7 dB significantly.

This impact assessment will be based on the most sensitive receptors, which are the farm dwellers. This impact therefore has a high severity. This can be reduced to low if the people in the dwellings are relocated for safety reasons as discussed in section 7.2.16.

Duration

The duration of the construction and decommissioning phase impacts is short-term in both the unmitigated and mitigated scenarios. The duration of the operational phase impact is medium-term, for the life of the project. This applies to the unmitigated and mitigated scenarios.

Spatial scale / extent

The spatial scale is high in the unmitigated scenario and low in the mitigated scenario.

Consequence

The impact consequence is rated as high in the unmitigated scenario for all phases but could be reduced to low if the informal dwellers are relocated for safety reasons as discussed in section 7.2.16.

Probability

The probability of occurrence is high in all phases but can be mitigated to low if the informal dwellers are relocated for safety reasons as discussed in section 7.2.16.

FIGURE 33: NOISE MAP (ACUSOLV, 2013)

Significance

The impact significance for all phases has been rated as moderate and low in the unmitigated and mitigated scenarios respectively because the implementation of management and mitigation measures can reduce the severity and impact probability.

Summary of the rated noise impact per phase of the project

Mitigation	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction and decommissioning						
Unmitigated	H	L	H	H	H	H
Mitigated	L	L	L	L	L	L
Operations						
Unmitigated	H	M	H	H	H	H
Mitigated	L	M	L	L	L	L

Conceptual description of proposed mitigation measures

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19).

Objectives

The objectives of the management and mitigation measures are to prevent an unacceptable increase in disturbing noise and limit nuisance noise at sensitive receptors as far as practically possible.

Actions

It is noted that noise modelling shows an unacceptable increase in noise levels at the farm dwellings situated next to the No 18 Shaft linear infrastructure corridor. These farm dwellers should however be relocated due to safety factors which are discussed in section 7.2.16. The RBA will need to provide alternative land for these farmers to move to. This will be done according to the lease agreement between the RBA and the relevant farmers, and the farmer will take his workers with him. It should however be noted that the dwellers may refuse to be relocated. In this case, Impala will ensure that they are properly informed about the potential risks and reach an alternative agreement with these people. This process will be clearly documented and kept as proof.

During the construction and decommissioning phases, blasting will be scheduled to take place in the afternoons and be limited to week days if possible.

During all project phases, disturbing noise can be limited as follows:

- All vehicles and equipment will be maintained in good working order to restrict noise emissions
- All noise complaints will be documented, investigated and reasonable efforts made to address the area of concern. This may include consulting a noise specialist for mitigation advice

- Where necessary, noise monitoring will be used as part of the investigatory process into noise complaints and as part of the assessment of the impact of mitigation and, if required, the alteration thereof

VISUAL ASPECTS

7.2.13 ISSUE: NEGATIVE LANDSCAPE AND VISUAL IMPACTS

Information in this section is based on the visual specialist study conducted by Newtown Landscape Architects (NLA) (Appendix H).

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 project site. During construction, this will be influenced by the increase in activities and removal of vegetation on site. During operation this will be influenced by the presence of shaft infrastructure and development of the waste dumps in particular; and during decommissioning and closure by the closure objectives and effectiveness of rehabilitation measures. The more significant activities and structures are considered to be construction activities, the presence of the shafts, the waste dumps and night lighting needed for safety purposes. The project components associated with the tailings backfill and sewage management are not considered to be significant from a visual impact perspective.

Activities and infrastructure - link to mine phases

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks Civil works Site management Transport systems Non-mineralised waste management Support services and amenities Rehabilitation	Site preparation Earthworks Civil works Site management Transport systems Non-mineralised waste management Mineralised waste management Support services and amenities Shaft infrastructure Water supply infrastructure Power supply infrastructure Rehabilitation	Site preparation Demolition Earthworks Civil works Site management Transport systems Non-mineralised waste management Mineralised waste management Support services and amenities Water supply infrastructure Power supply infrastructure Rehabilitation	Maintenance and aftercare of final land forms and rehabilitated areas

Rating of impact

Severity / nature

The severity of visual impact has been assessed using the parameters of landscape impact, visual exposure and visual intrusion. Each parameter is discussed below.

- Landscape impact: The landscape impact is the change to the character of the landscape caused by the physical presence of infrastructure and associated infrastructure. This impact has been rated as high for all phases of the project. This is because of the initial scarring and disturbance of the landscape through the removal of vegetation and extensive earthworks during the construction phase, the presence of project infrastructure during the operational phase, and the extensive earthworks and disturbance caused during rehabilitation. After closure, the No 18 Shaft waste rock dump will remain in perpetuity and will represent a permanent visual impact. All other infrastructure will however be removed and the site rehabilitated.
- Visual exposure: Visual exposure relates directly to the distance. The impact of an object diminishes at an exponential rate as the distance between the observer and the object increases. The project infrastructure and activities are potentially visible from over half of the zone of potential influence – this is shown in the viewshed analysis (refer to Figure 31). Exposure from the surrounding communities vary as follows (NLA, 2013):
 - Low exposure (viewed in the background of a scene) to people living in and visiting the residences along the peripheries of all the larger communities. With the exception of the north-eastern edges of Mogono which borders on the moderate exposure range
 - Due to topographic relief, project components would not be visible from Kanana and Freedom Park located to the south of the proposed No 18 Shaft
 - Although views towards the proposed No 18 Shaft complex from the R510 and R556 would be open and unobstructed, visual exposure would be low as the project would appear in the background for travellers along these routes
 - Views from the D513 would appear in the middle ground of travellers along this route resulting in a moderate exposure.
 - High for people living in the farm dwellings along the No 18 Shaft linear infrastructure corridor. It should however be noted that these people should be relocated due to safety, dust and noise impacts.
 - Low from the Ga Nape cultural landscape.

It should be noted that views of the proposed infrastructure may be blocked by existing vegetation because of the nature of the landscape and the scale of the project components relative to the viewer and viewpoint.

Visual intrusion: Visual intrusion is the extent to which the infrastructure and activities contrast with the visual landscape and can or cannot be absorbed by the landscape. The proposed new infrastructure would be viewed against a backdrop of existing mining infrastructure and absorbed into the scene. Existing vegetation would also aid in reducing visual intrusion by blocking some views. Public views (sensitive viewing areas) to the project sites would be experienced by people living in and visiting the adjacent settlements as outlined in section 1.1.10. Although visibility is high, virtually every public view to the project sites would be from a low perspective and have mining infrastructure as a backdrop or at least

within the view (NLA, 2013). This is because the residential areas and public roads are not elevated above the grassland plains. The proposed infrastructure would be viewed against the backdrop of the existing mining infrastructure and be 'absorbed' into the scene. This ultimately makes it difficult to see.

NLA has therefore determined that the proposed infrastructure would result in a moderate visual intrusion for receptors due to it having a moderate negative effect on the visual quality of the landscape and being partially compatible with land use patterns within the visual study area. From key views, the structures of the project would be partially 'absorbed' into the landscape resulting in a moderate negative effect on the visual quality of the landscape.

The severity of the visual impact is expected to vary as follows (NLA, 2013):

- High for the people living in farm dwellings adjacent to the No 18 Shaft linear infrastructure routes
- Moderate for proposed Ga-Nape Cultural landscape, Maile, Diepkuil and sections of the D513
- Low for Tsitsing, Ga-Luka and sections of local roads and the proposed Ga Nape Cultural Landscape
- Negligible for Serutube, Marika, Kanana, Freedom Park, Rasimone, Robega, Chaneng, sections of the R556 south of Pilanesberg Nature Reserve.

Mitigation should decrease these severity ratings for all phases.

Duration

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 No 18 Shaft waste rock dump will remain after closure, which, if correctly rehabilitated, will not be associated with negative visual impacts.

Spatial scale / extent

The spatial scale will extend beyond the site boundary. This applies to both the unmitigated and mitigated scenarios.

Consequence

The consequence varies according to the viewers. The viewers with the highest visual exposure will be the farm dwellers. In the unmitigated scenario for all project phases, the consequence is high. This can be mitigated to low by reducing the severity and duration.

Probability

Without mitigation, the probability of visual impact is high. This can be mitigated to low.

FIGURE 34: VIEWSHED (NLA, 2013)

Significance

The significance varies according to the viewers. The viewers with the highest visual exposure will be the informal dwellers. In the unmitigated scenario for all project phases, the significance is high. This can be mitigated to low by reducing the severity and duration.

Summary of the rated visual impact per phase of the project

Mitigation	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operations and decommissioning						
Farm dwellings						
Unmitigated	H	H	M	H	H	H
Mitigated	M	M	M	M	L	L
Ga-Nape cultural landscape, Maile, Diepkuil and sections of the D513						
Unmitigated	M	H	M	H	H	H
Mitigated	L	M	M	M	L	L
Tsitsing, Ga-Luka and sections of local roads						
Unmitigated	L	H	M	M	H	M
Mitigated	L	M	M	L	L	L
Closure						
Farm dwellings						
Unmitigated	H	H	M	H	H	H
Mitigated	L	M	M	M	L	L
Ga-Nape cultural landscape, Maile, Diepkuil and sections of the D513						
Unmitigated	M	H	M	H	H	H
Mitigated	L	M	M	L	L	L
Tsitsing, Ga-Luka and sections of local roads						
Unmitigated	L	H	M	M	H	H
Mitigated	L	M	M	L	L	L

Conceptual description of proposed mitigation measures

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19).

Objective

The objective of the mitigation measures is to limit negative visual impact.

Actions

During construction, operations and decommissioning, the following visual mitigation measures will be implemented:

- Limit the clearing of vegetation
- Suppress dust to prevent a visual dust cloud
- The establishment of visual screening berms to screen views from sensitive visual receptors. This could include indigenous trees and shrubs planted in clumps
- Where possible paving materials will be used that have earthy tones that complement the red/brown colours and textures of the soils in the area
- On-going vegetation establishment on rehabilitated areas and the No 18 Shaft waste rock dump side slopes

- Limit lighting as far as practically possible and use light fixtures that precisely direct illumination. High top pole lighting will be avoided where possible
- Painting infrastructure with colours that blend in with the surrounding environment where possible.

In the decommissioning phase Impala will implement its closure plan which involves the removal of infrastructure, and the rehabilitation and re-vegetation of cleared areas and any final landforms (No 18 Shaft waste rock dump) that will remain post closure. These final landforms should be rehabilitated in a manner that achieves landscape functionality and limits and/or enhances the long term visual impact. In addition, Impala will develop the rehabilitation and closure plan in conjunction with the RBA to ensure that visual impacts on the Ga-Nape Cultural Landscape are minimised as far as possible.

At closure, the No 18 Shaft waste rock dump will be managed through an aftercare and maintenance programme to limit and/or enhance the long-term post closure visual impacts.

Emergency situations

None identified.

LAND USES

7.2.14 ISSUE: LOSS OF CURRENT LAND USES

Introduction

The establishment of infrastructure and mining activities will change the land use on surface. As indicated in section 1.3.1, the current land use is that of grazing, limited cropping and wilderness. In addition, farm dwellers currently reside adjacent to the No 18 Shaft linear infrastructure corridor.

Activities and infrastructure - link to mine phases

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks Civil works Site management Transport systems Non-mineralised waste management Support services and amenities Rehabilitation	Site preparation Earthworks Civil works Site management Transport systems Non-mineralised waste management Mineralised waste management Support services and amenities Shaft infrastructure Water supply infrastructure Power supply infrastructure Rehabilitation	Site preparation Demolition Earthworks Civil works Site management Transport systems Non-mineralised waste management Mineralised waste management Support services and amenities Water supply infrastructure Power supply infrastructure Rehabilitation	Maintenance and aftercare of final land forms and rehabilitated areas

Rating of impactSeverity / nature

The dwellers located adjacent to the No 18 Shaft linear infrastructure may be significantly affected by noise from the linear infrastructure corridor and from the shaft complex itself as described in section 7.2.12. These farm dwellers and their livestock may also be affected by the cumulative impact of:

- Dust generation on unpaved roads
- Surface and groundwater quality and quantity impacts
- Blasting hazards
- Traffic safety impacts on the roads linking the shaft to e existing Impala operations
- Inward migration
- Visual impacts.

These farm workers should therefore be relocated. The main factor motivating this relocation is safety, although additional factors include potential noise and dust (pre-tarring) impacts expected from the proposed project.

The proposed Ga-Nape heritage park on Welbekend may also be affected by the above-mentioned impacts. At this stage the RBA have indicated that the park is likely to be established in five to ten years' time. This park will therefore be affected by the construction, operational, decommissioning and closure phases of the proposed project. In this respect the heritage park and associated tourism activities could be impacted upon by the proposed project as follows:

- Traffic safety impacts on the roads linking the shaft to existing Impala infrastructure
- Inward migration
- Visual impacts although these will be low as discussed in section 7.2.13
- Noise impacts are not expected to be significant.

This impact has been rated as having a high severity in all project phases. This can be mitigated to moderate if suitable management and mitigation measures are implemented during the construction, operations and decommissioning phases. Upon closure, all surface infrastructure will be removed and the site rehabilitated, with the exception of the No 18 Shaft waste rock dump which will remain in perpetuity. This waste rock dump is however only planned to be 16 ha in extent. Once successfully rehabilitated, the remainder of the project area could therefore be used for agriculture and dwelling once again. The remaining No 18 Shaft waste rock dump is not expected to have a significant visual impact on the heritage park once properly rehabilitated. The mitigated impact has therefore been rated as having a low severity after closure.

The proposed No 17 Shaft and central sewage plants will have no significant impact on land use because they will be located in areas already used for mining infrastructure. The majority of No 17 Shaft linear infrastructure will be located in existing servitudes, with only a small section of the proposed tailings pipeline traversing a piece of land used for cultivation. Impala will negotiate a servitude with the land owner for this section of the pipeline. This impact has therefore been rated as having a low severity. The severity rating in the table below is however based on the previously mentioned impacts which have a high severity.

Duration

The impact on agricultural land use will be long-term. Although some of the land use should be able to resume after decommissioning and closure, the 16 ha taken up by the No 18 Shaft waste rock dump cannot be used for agricultural use. The Ga-Nape heritage park is not expected to be significantly affected in the long term, except for the visual impact of the remaining No 18 Shaft waste rock dump which is assessed in section 7.2.13 and considered to have a low impact post mitigated closure.

Spatial scale / extent

The loss of agricultural land use will be limited to the project infrastructure footprint. However the spatial extent will extend beyond project area for all phases for both the unmitigated and mitigated scenarios because of the impact on the Ga-Nape heritage area.

Consequence

The unmitigated consequence has been rated as high for all phases. This can however be mitigated to moderate during the construction, operations and decommissioning phases and low after closure due to a reduction in the severity.

Probability

In the unmitigated scenario, the probability is considered to be high for all project phases. This can be mitigated to moderate with the relocation of the farm dwellers and other management and mitigation measures.

Significance

The significance of the unmitigated scenario has been rated as high for all project phases. This can however be mitigated to moderate for all phases due to a reduction in the severity and probability.

Summary of the rated land use impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operations and decommissioning						
Unmitigated	H	H	M	H	H	H
Mitigated	M	H	M	M	M	M

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

Conceptual description of proposed mitigation measures

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19).

Objective

The objective of the mitigation measures is to prevent unacceptable negative impacts on surrounding land uses.

Actions

The farm dwellers located close proximity to the No 18 Shaft linear infrastructure corridor should be relocated for safety and other reasons. Should the relevant dwellers agree to relocation, the RBA will need to provide alternative land for both grazing and dweller location. This will be done according to the lease agreement between the RBA and the relevant farmers, and the farmer will take his workers with him.

During all phases, the mitigation measures outlined for the following impacts will be implemented:

- Noise (section 7.2.12)
- Dust generation (section 7.2.11)
- Surface and groundwater quality and quantity impacts (sections 7.2.7 to 7.2.10)
- Blasting hazards (section 7.2.15)
- Traffic safety impacts on the roads linking the shafts to each other and the existing Impala operations (section 7.2.16)
- Inward migration (section 7.2.19)
- Visual impacts (section 7.2.13).

Any areas no longer required will be rehabilitated during all phases, and the No 18 Shaft waste rock dump will be concurrently rehabilitated.

During decommissioning, all surface infrastructure will be removed, with the exception of the No 18 Shaft waste rock dump. The whole site will be properly rehabilitated to as close as possible to the pre-disturbed land capabilities as outlined in section 1.1.4. In addition, Impala will develop the rehabilitation and closure plan in close partnership with the RBA to ensure that impacts on the proposed Ga-Nape heritage park are minimised as far as possible and the proposed future land use is not inhibited.

7.2.15 ISSUE: BLASTING HAZARDS

Introduction

The main activity that has the potential to cause a blasting hazard is the establishment of the No 18 Shaft portal. This activity will occur during the initial blasting of the shaft portal and during the operational phase. Some blasting may occur during the construction phase, for foundation establishment for various infrastructure components, but this will be limited (if needed). Blasting will take place during underground mining, but at depth (almost 2 km below ground), and therefore this is not expected to have a significant impact. Blasting is likely to be required during demolition during the decommissioning phase.

Blasting activities have the potential to impact on people, animals and structures located in the vicinity of the operation. Blast hazards include ground vibration, airblast, fly rock, blast fumes and dust. Ground vibrations travel directly through the ground and have the potential to cause damage to surrounding structures. Airblasts result from the pressure released during the blast resulting in an air pressure pulse (wave), which travels away from the source and has the potential to damage surrounding structures. Fly rock is the release of pieces of rock over a distance and can be harmful to people and animals and damage structures and property. Blast fumes and dust, caused by the explosion, can be considered significant nuisance factors. Ground vibrations and airblasts have the potential to cause nuisance to people and animals even if blasts occur within legal limits.

The impacts on air quality have been assessed in Section 7.2.11. This section focuses on the impacts of ground vibration, airblast and flyrock, collectively, as they relate to people.

Activities and infrastructure - link to mine phases

Construction	Operational	Decommissioning	Closure
			N/A
Earthworks	Establishment of shaft portals	Demolition	

Rating of impact

Severity / nature

Surface blasting will be limited to the development of the No 18 Shaft portal and once surface and near-surface blasting is completed early in the construction phase and during demolition during the decommissioning phase, blasting that takes place underground is not expected to impact surface users during the operational phase. Should injury to people or damage to third party infrastructure occur as a result of blasting, this has a high severity during the construction and decommissioning phases. The livestock and livestock herders wandering within the project area could be particularly vulnerable to injury. This severity cannot be mitigated to a lower level of severity.

Duration

Should injury to people occur as a result of blasting during the construction, operational and decommissioning phases, this could have a long-term duration. This cannot be significantly mitigated.

Spatial scale / extent

Blast impacts may extend beyond the project site boundary in the unmitigated scenario during the construction and decommissioning phases. This should however be limited to within the site boundary with the implementation of management and mitigation measures.

Consequence

The consequence is high for the construction and decommissioning phases in the unmitigated and mitigated scenarios.

Probability

The probability of injury to third party or damage to third party infrastructure is considered to be moderate in the unmitigated scenario. This can be reduced to low with the implementation of management and mitigation measures.

Significance

The significance has been rated as high in the unmitigated scenario. This can be mitigated to moderate by reducing the spatial scale and probability.

Summary of the rated blasting impact per phase of the project

Mitigation	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction and decommissioning phases						
Unmitigated	H	H	M	H	M	H
Mitigated	H	H	L	H	L	M

Conceptual description of proposed mitigation measures

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19).

Objective

The objective of the mitigation measures is to prevent injury to third parties and damage to third party infrastructure through blasting.

Actions

A blast management plan will be implemented for surface and near surface blasts which will include:

- As a general rule, no blasting will take place within 500 m of third party structures. Where Impala would like to blast in areas within this 500 m distance, a project specific risk assessment will be completed and additional project specific mitigation measures will be implemented, subject to approval by the relevant stakeholders and/or authority (ies).
- Pre-mining crack surveys of any structures within the potential impact zone
- Design of blasts to prevent injury to people and livestock and to prevent damage to structures. As a minimum the blast design will achieve:
 - A fly rock impact zone limit of 500 m
 - A peak particle velocity limit of less than 12 mm/s at third party structures that are built according to building industry standards and which is further reduced in the case of third party structures that are not built according to building industry standards (such as the farm dwellings)
 - An air blast limit of 125 dB at third party structures.
- Communication of the planned blast programme to interested and affected parties
- Pre-blast warning and evacuation to clear people, traffic, moveable property and livestock from the potential fly rock impact zone
- Blast monitoring to verify the effectiveness of the blast design and blast execution
- Audit and review to adjust the blast design where necessary to achieve the stated objectives
- Formal documented investigation and response for all third party blast related complaints
- Remediation of all impacts caused by blasting.

Emergency situations

If a person or animal is injured by blasting activities this must be handled in accordance with the Impala emergency response procedure.

7.2.16 ISSUE: PROJECT-RELATED ROAD USE AND TRAFFIC

Introduction

Traffic impacts are expected from construction through to the end of the decommissioning phase when trains, trucks, buses, taxis and smaller vehicles will make use of the public and private transport network in and adjacent to the project area. The key potential traffic related impacts are on road capacity and public safety.

Activities and infrastructure - link to mine phases

Construction	Operational	Decommissioning	Closure
			N/A
Transport systems	Transport systems	Transport systems	

Rating of impact

Severity / nature

Approximately 25 bus and ten truck trips per day are expected during the construction phase and 30 bus and 10 truck trips per day for the operational phase as a result of this project on the D556, D513 and smaller site roads. Insignificant increases are expected on roads used to access the central STP, No 17 Shaft STP and linear infrastructure corridors. The decommissioning phase traffic is expected to be less than that of the construction phase. It should however be noted that vehicles from the existing Impala operations already make use of most of these access routes. This increase in traffic is therefore not expected to be significant. However, traffic accidents have the potential to injure people and animals. The dwellers adjacent to the No 18 Shaft linear infrastructure route could be particularly vulnerable in this respect. This impact has been rated as having a high severity during construction, operations and decommissioning. This severity can be mitigated by relocating the farm dwellers and implementing road safety measures such as speed limit control and training of drivers.

Duration

Should serious injury or death occur this would have a long-term duration, and this cannot be mitigated.

Spatial scale / extent

The spatial scale could extend beyond the site boundary during construction, operations and decommissioning. This cannot be significantly mitigated.

Consequence

The consequence has been rated as high during construction, operations and decommissioning, and cannot be significantly mitigated.

Probability

The probability is considered to be moderate in the unmitigated scenario since road accidents can occur without management measures being implemented; however this could be mitigated to a low probability and this is supported by the Impala records which show a low frequency of road accidents.

Significance

The significance has been rated as high during construction, operations and decommissioning, however this could be mitigated to moderate by reducing the probability.

Summary of the rated road use and traffic impact per phase of the project

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

Conceptual description of proposed mitigation measures

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19).

Objective

The objective of the mitigation measures is to prevent injury to third parties or animals as a result of traffic accidents.

Actions

The following management and mitigation measures will be implemented during the construction, operations and decommissioning phases:

- Educate employees (temporary and permanent) about road safety
- The informal farm dwellers that are situated adjacent to the No 18 Shaft road should be relocated
- Enforce strict vehicle speeds along the linear services corridors
- Implement speed allaying measures along the linear services corridors Road markings and road surfacing to assist with the above measures
- Impala will facilitate communication between the North West Roads Department, municipal engineers (where relevant) and community leadership with a view to improving the safety of pedestrians on the private Impala roads. Options to consider in these discussions are:
 - Channelling of pedestrians (especially school children) to selected pedestrian crossings
 - Provision of signage to create awareness of pedestrian crossings
 - Road safety education and awareness for the pedestrians.

Emergency situations

If a person or animal is injured by transport activities this will be handled in accordance with the Impala emergency response procedure.

HERITAGE (AND CULTURAL)

7.2.17 ISSUE: DESTRUCTION AND DISTURBANCE OF HERITAGE (INCLUDING CULTURAL) AND PALEONTOLOGICAL RESOURCES

Information based on heritage specialist study conducted by Dr Pistorius (Appendix I) and the paleontological specialist study conducted by Prof Rubidge (Appendix J).

Introduction

There are a number of activities/infrastructure in all phases that have the potential to damage heritage and/or paleontological 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 (refer to Section 1, Table 38 for further detail).

Activities and infrastructure - link to mine phases

Construction	Operational	Decommissioning	Closure
Earthworks - for all surface infrastructure Site management Transport systems Support services and amenities Rehabilitation	Earthworks - for all surface infrastructure Site management Transport systems Non-mineralised waste management Mineralised waste management Support services and amenities Underground mining Water supply infrastructure Power supply infrastructure Rehabilitation	Demolition Earthworks Site management Transport systems Non-mineralised waste management Mineralised waste management Support services and amenities Water supply infrastructure Power supply infrastructure Rehabilitation	N/A

Rating of impact

Severity / nature

Two heritage resources (LIA03 and LIA04) with a heritage rating of medium to high may be affected by the establishment of an electrical substation at the No 18 Shaft site. Both of these resources are protected in terms of the NHRA. Other heritage resources are situated further away from the proposed infrastructure sites for the No 18 Shaft and the linear infrastructure corridors. The severity of potentially damaging or disturbing these heritage resources has been rated as high, given the moderate to high heritage significance of LIA03. However, if the substation position can be adjusted to avoid these heritage resources and provide a minimum buffer of 50 m between these heritage resources and electrical infrastructure, the severity could be reduced to low. It would be unlikely that additional resources would be found during the operational or decommissioning phases, and no impacts are therefore expected after construction.

No paleontological resources are expected to be found in the Impala concerted mining rights area, therefore this impact is not assessed further.

Duration

If LIA03 and LIA04 are damaged, destroyed or have to be removed for the establishment of infrastructure at the No 18 Shaft, this would be permanent. However, if the electrical substation can be adjusted to avoid these heritage resources, the duration could be reduced.

Spatial scale / extent

The spatial scale is limited to the project area in both the unmitigated and mitigated scenarios.

Consequence

The consequence would be high in the unmitigated scenario and moderate if the electrical substation can be adjusted to avoid these heritage resources and provide a buffer of 50 m or more, thereby reducing the severity and duration of the impact.

Probability

The probability is considered to be high in the unmitigated scenario given the position of the electrical substation in relation to LIA03 and LIA04; however this can be mitigated to low if the substation can be adjusted to avoid these heritage resources and provide a buffer of 50 m or more.

Significance

The significance of this impact has been rated as high in the unmitigated scenario, however this can be reduced to low if the electrical substation can be adjusted to avoid these heritage resources and provide a buffer of 50 m or more, thereby reducing the severity, duration and probability of the impact occurring.

Summary of the rated heritage (including cultural) impact per phase of the project

Mitigation	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction						
Unmitigated	H	H	L	H	H	H
Mitigated	H	L	L	M	L	L

Conceptual description of proposed mitigation measures

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19).

Objective

The objective of the mitigation measures is to prevent the loss of heritage (including cultural) resources that may be caused by the proposed mining activities.

Actions

During the project planning phase, the electrical substation will be adjusted to avoid LIA02 and SS01 if at all possible and provide a minimum buffer of 50 m. If these heritage resources cannot be avoided, a Phase II heritage study will be conducted by an archaeologist accredited with the Association for Southern African Professional Archaeologists. This will involve documentation and mapping of the sites and possibly small test excavations. Upon conclusion of the Phase II study, a permit must be obtained from the South African Heritage Resources Agency prior to the removal, alteration or destruction of these

heritage resources. The following management and mitigation measures will be implemented during all phases:

- The area of disturbance will be limited as far as practically possible
- All workers (temporary and permanent) will be educated about the heritage and cultural sites that may be encountered and about the need to conserve these.
- In the event that new heritage and/or cultural and/or paleontological resources are discovered, the mine will follow a chance find emergency procedure, which includes the following:
 - Mine related work at the find will be stopped to prevent damage.
 - An appropriate heritage specialist will be appointed to assess the find and related impacts.
 - Permitting applications will be made to SAHRA, if required.

In the event that any graves are discovered during the construction, operational or decommissioning phases, prior to damaging or destroying any identified graves, permission for the exhumation and relocation of graves must be obtained from the relevant descendants (if known) and the relevant local and provincial authorities.

Emergency situations

If there are any chance finds of heritage and/or cultural sites, Impala will follow its emergency response procedure.

SOCIO-ECONOMIC

Mining projects generally have positive impacts such as job and income creation and negative socio-economic impacts such as unwanted inward migration during all project phases. The assessment below assesses the economic and social impacts separately.

7.2.18 ISSUE: ECONOMIC IMPACT (POSITIVE AND NEGATIVE)

Information in this section is based on SLR's observations and experience with other Impala developments. Specialist input was also obtained from Strategy4Good (Appendix K).

Introduction

The development of the mine as a whole has the potential to impact on the economy both positively through potential growth in the mining sector and negatively through the potential loss of existing economic activities.

Activities and infrastructure - link to mine phases

Construction	Operational	Decommissioning	Closure
Earthworks - for all surface infrastructure Site management Transport systems Support services and amenities Rehabilitation	Earthworks - for all surface infrastructure Site management Transport systems Non-mineralised waste management Mineralised waste management Support services and amenities Underground mining and beneficiation of ore resources Water supply infrastructure Power supply infrastructure Rehabilitation	Demolition Earthworks Site management Transport systems Non-mineralised waste management Mineralised waste management Support services and amenities Water supply infrastructure Power supply infrastructure Rehabilitation	N/A

Rating of impactSeverity / nature

For this project, the amount of farm land potentially lost for the establishment of surface infrastructure is less than 200 hectares. The specialist used a conservative estimate of 800 hectares to cover the potential development of more than one shaft complex. This is no longer part of this project brief but the conclusions of the specialist remain valid. The anticipated investment of approximately R8 billion and job retention of just over 9 000 jobs per annum on average associated with the proposed project is significant. However, Strategy4Good compared the economic benefits of the proposed project to that of the current agricultural activities over the full life of the project. This was achieved as follows (Strategy4Good, 2013):

- Comparison of the new mining investment with the potential loss of agricultural property values
- Comparing the present value of the net economic value added of the mining project relative to impacted farmland yields
- Comparison of the continuation of mining employment with that potentially lost to agriculture.

Values for the proposed project were obtained from Impala and values for the agricultural industry were imputed based on macro-economic databases.

The comparison determined the following (Strategy4Good, 2013):

- The proposed mining projects' net present value exceeds that of the current agricultural activities by R 23 billion (over 24 years of mining and 32 years of agriculture)
- The new or retained investment is a net positive R3,7 billion with respect to existing and new mining investments compared to potential farm property values lost.

The development of the proposed project will therefore have a highly significant, positive economic impact 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 (limited grazing and wood harvesting) can resume in appropriate areas. It should however be noted that as per the baseline land capability findings (refer to section 1.1.4, only a small percentage of the project area is suitable for grazing).

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. However it should be noted that Impala plans to continue operating well beyond the life of the proposed project, and the overall mine will therefore continue to impact positively on the region and the country as a whole long after the closure of the No 18 Shaft and associated infrastructure. The continued operation of Impala as a whole does of course depend on a variety of factors, such as consumer demand for platinum group metals, which affect the price for these metals. These factors cannot be predicted and have a direct influence on the long-term prospects for Impala.

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 consequence has been rated as high in both the unmitigated and mitigated scenarios for all project phases until closure.

Probability

The probability is considered to be high in both the unmitigated and mitigated scenarios for all project phases until closure.

Significance

The significance has been rated as high in both the unmitigated and mitigated scenarios for all project phases until closure.

Summary of the rated economic impact per phase of the project

Mitigation	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operations and decommissioning						
Unmitigated	H+	M+	H+	H+	H+	H+
Mitigated	H+	M+	H+	H+	H+	H+

Conceptual description of proposed mitigation measures

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19).

Objective

The objective of the mitigation measures is to enhance positive and minimise negative economic impacts.

Actions

The following management and mitigation measures will be implemented during all phases of the project:

- Impala will continue to:
 - Offer employment opportunities to local people from the closest communities where possible
 - Operate the formal bursary and skills development programmes, ensuring that the closest communities are included in order to increase the number of local skilled people and thereby increase the potential local employee base
 - Procure local goods and services from the closest communities where possible
 - Support a procurement mentorship programme which provides support to local business from the enquiry to project delivery stages
 - Incorporates economic considerations into its closure planning from the outset
 - Ensure that closure planning considerations address the re-skilling of employees for the downscaling, early closure and long-term closure scenarios
 - Ensure that closure planning considerations address the needs of future farming for the downscaling, early closure and long-term closure scenarios.
- Where farming land is lost to mining, the affected farmers will be provided with alternative suitable land by facilitating discussions with the Royal Bafokeng Administration (RBA) and if this is not feasible alternative compensation will be provided.
- Once the No 18 Shaft area is mined-out, as many workers as possible will be moved to other areas of the Impala operation
- At closure, the site will be properly rehabilitated in order to be suitable for pre-mining activities to resume over most of the land, with the exception of the areas of residue facilities which will remain in perpetuity.

Emergency situations

None identified.

7.2.19 ISSUE: INWARD MIGRATION

Introduction

Mining projects often cause an influx of people in search of employment. This inward migration causes a range of secondary impacts such as increased pressure on infrastructure and services such as hospitals and water supply, housing etc., as well as the potential development of informal settlements. Other secondary impacts include social ills such as an increase in crime and the spread of diseases such as HIV/Aids.

Activities and infrastructure - link to mine phases

Construction	Operational	Decommissioning	Closure
Earthworks - for all surface infrastructure Site management Transport systems Support services and amenities Rehabilitation	Earthworks - for all surface infrastructure Site management Transport systems Non-mineralised waste management Mineralised waste management Support services and amenities Underground mining and beneficiation of ore resources Water supply infrastructure Power supply infrastructure Rehabilitation	Demolition Earthworks Site management Transport systems Non-mineralised waste management Mineralised waste management Support services and amenities Water supply infrastructure Power supply infrastructure Rehabilitation	N/A

Rating of impact

Severity / nature

The effects of inward migration can be significant. These effects could include, but not be limited to:

- Potential establishment or expansion of informal settlements
- Increased pressure on housing, water supply infrastructure, sanitation and waste management systems and infrastructure, health care and community services and infrastructure
- Potentially for increased pressure on natural resources such as water, fauna, flora and soils
- Increase in crime
- Spread of disease, most notably HIV/Aids and tuberculosis.

It is not possible to predict how significant the inward migration may be, however this impact severity has been rated as high in line with the precautionary approach. It may be possible to mitigate this impact by managing expectations with regard to employment and by limiting inward migration through the RBA.

Duration

The impacts of inward migration can extend beyond the life of the project. However, the duration should be limited to the life of the project with the implementation of management and mitigation measures.

Spatial scale / extent

The impacts of inward migration could extend beyond the project boundary into nearby communities in both the unmitigated and mitigated scenarios.

Consequence

The consequence has been rated as high in the unmitigated scenario for all project phases. This cannot be significantly mitigated.

Probability

The probability is considered to be moderate since Impala is an existing operation and the RBA own and control the surrounding land. The RBA will not generally inward migration onto their land. In addition, the consultation process for this project has provided information regarding employment opportunities for this project, and clearly states that no significant new opportunities will be available. This probability could be reduced to low through mitigation.

Significance

The significance has been rated as high for all phases. This can however be mitigated to moderate by reducing the severity and probability.

Summary of the rated inward migration impact per phase of the project

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

Conceptual description of proposed mitigation measures

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19).

Objective

The objective of the mitigation measures is to minimise inward migration and the associated secondary impacts.

Actions

It is crucial that employment expectation be effectively managed. This has been started through the public consultation process for the EIA in that the information distributed to IAPs clearly states that no

significant new employment opportunities will be available for this project. Impala will continue to manage expectations by communicating the exact number of new job opportunities (permanent and temporary) and procurement opportunities to the public together with the required skills and qualifications. The duration of temporary work will be clearly indicated and the relevant employees/contractors provided with regular reminders and revisions throughout the temporary employment period.

In terms of recruitment, procurement and training, Impala will continue to:

- Maintain good communication with all job and procurement opportunity seekers throughout the recruitment process. The process must be seen and understood to be fair and impartial by all involved. The personnel in charge of resolving recruitment and procurement concerns must be clearly identified and accessible to potential applicants
- Recruitment and procurement, by Impala and its contractors, will be preferentially provided to people in the communities, where possible, that are closest to Impala. In order to be in a position to achieve this, a skills register of people within the closest communities will be maintained. Impala will also preferentially provide bursaries and training to people that reside in these closest communities
- There will be no recruitment or procurement at the gates of the mine or at the shaft offices. All recruitment will take place off site, at designated offices in the closest communities or at a centralised office set up by the mine. All procurement will be through existing, established procurement and tendering processes and preference will be given to service providers from the closest communities.

Impala aims to prevent the establishment of informal settlements by actively encouraging employees to live in formal houses by:

- Allocating an accommodation allowance to all employees that can demonstrate that they live in formal housing
- Maintaining an employee profile (for Impala employees) that can be used as a tool to identify socio-economic concerns and plan long term mitigation interventions.

Impala will continue to work with its neighbours, local authorities and law enforcement officials to monitor and prevent the development of informal settlements near the mine and to assist where possible with crime prevention within the Impala area.

With respect to health issues, Impala will continue to implement a health policy on HIV/ADS and tuberculosis in particular. This policy will promote education, awareness and disease management both in the workplace and in the home so that the initiatives of the workplace have a positive impact on the communities from which employees are recruited. Partnerships will be formed with local and provincial authorities to maximise the off-site benefits of the policy.

Impala will continue to work closely with the local and regional authorities, the RBA and other mines/industry in the area to be part of the problem solving process that needs to address social service constraints.

Emergency situations

The establishment of any informal settlements is considered to be an emergency situation that will be handled in accordance with the Impala emergency response procedure.

7.2.20 ISSUE: RELOCATION OF FARM DWELLERS

Introduction

The development of mining projects can displace people living in the project area. It is important that relocation is managed in a fair and transparent manner.

Activities and infrastructure - link to mine phases

Construction	Operational	Decommissioning	Closure
Construction of No 19 Shaft and development of linear infrastructure corridor	Operation of No 18 and 19 Shafts and use of linear infrastructure corridor	Decommissioning of No 18 and 19 Shafts and linear infrastructure corridor	N/A

Rating of impact

Severity / nature

Noise modelling has shown that the dwellers located adjacent to the No 18 Shaft linear infrastructure may be significantly affected by noise from the linear infrastructure corridor. Safety impacts related to traffic on this linear infrastructure route is another significant factor, along with the dust that would be generated along the access road before it is tarred. Additional cumulative impacts that may impact on these dwellers include of surface water pollution, groundwater pollution and dewatering, blasting hazards although this will be limited to the shaft site which is situated further away from the dwellers, inward migration and visual impacts. These farm workers should therefore to be relocated out of the zone of impact. The main factors motivating this relocation are noise, dust (pre tarring) and safety impacts expected from the proposed project. This impact has a high severity; however this can be mitigated to low if the relocation process is carefully planned and is fair and transparent.

Duration

The relocation of these farm dwellers will be permanent. However, the effect of the relocation can be reduced if the relocation is handled fairly and these dwellers have the same or better standard of living after the relocation.

Spatial scale / extent

The spatial scale may extend beyond the project area, depending on where the farm dwellers are relocated to.

Consequence

The consequence has been rated as high in the unmitigated scenario for all project phases. This can be mitigated to low by reducing the severity and duration.

Probability

The probability is high because the farm dwellers could be disadvantaged if the relocation process is not handled properly. However, by ensuring a fair and transparent relocation process this can be reduced to low if the dwellers will have the same standard of living after the relocation process.

Significance

The significance has been rated as high for all phases. This can however be mitigated to low by reducing the severity, duration and probability.

Summary of the rated relocation impact per phase of the project

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

Conceptual description of proposed mitigation measures

Conceptual mitigation measures are provided below and tabulated in the EMP (Section 19).

Objective

The objective of the mitigation measures is to manage the relocation process to ensure that it is fair and transparent.

Actions

The farm dwellers should be relocated in a fair and equitable manner. The RBA will need to provide alternative land for the farmers, who lease the land, to move to. This will be done according to the lease agreement between the RBA and the relevant farmers, and the farmer will take his workers with him. In this respect the farm dwellers should have the same standard of living with the same or better access to amenities as they have currently. It should however be noted that the dwellers may refuse to be relocated. In this case, Impala will ensure that they are properly informed about the potential risks and reach an alternative agreement with these people. This process will be clearly documented and kept as proof.

If the project is approved and the affected farm dwellers are willing to be relocated, but the RBA does not implement this relocation, then Impala will appoint a team of professionals to design and implement a resettlement plan. The resettlement must take place prior to the components of the operational phase that will necessitate resettlement and the plan must cover the relevant components from the World Bank Operational Handbook for Resettlement Action Plans.

Emergency situations

None identified.

7.3 DEFINITION OF CRITERIA USED

Both the criteria used to assess the impacts and the method of determining the significance of the impacts is outlined in Table 41. This method complies with the method provided in the EIA guideline document. Part A provides the approach for determining impact consequence (combining severity / nature, spatial scale and duration) and impact significance (the overall rating of the impact). Impact consequence and significance are determined from Part B and C. The interpretation of the impact significance is given in Part D. Unmitigated scenario is considered for each impact.

TABLE 41: 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 / nature, spatial extent and duration			
Criteria for ranking of the SEVERITY/NATURE of environmental impacts	H	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action. Irreplaceable loss of resources.			
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints. Noticeable loss of resources.			
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints. Limited loss of resources.			
	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/ EXTENT 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 / NATURE = L					
DURATION	Long term	H	Medium	Medium	Medium

	Medium term	M	Low	Low	Medium
	Short term	L	Low	Low	Medium

SEVERITY / NATURE = M

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

SEVERITY / NATURE = H

DURATION	Long term	H	High	High	High
	Medium term	M	Medium	Medium	High
	Short term	L	Medium	Medium	High

L	M	H
SPATIAL SCALE / EXTENT		

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.

7.4 PHASES AND TIMEFRAMES OF POTENTIAL IMPACTS

An indication of the phases in which impacts could occur is included in Section 7.2. This section also provides an indication of the duration of potential impacts. Potential impacts associated with the project have the potential to occur in almost all project phases and on a continuous basis if unmitigated. With the implementation of the mitigation as presented in Section 19, the monitoring programmes as presented in Section 21 and the emergency response procedures as presented in Section 20 the timeframe of potential impacts will be reduced significantly.

8 COMPARATIVE ASSESSMENT OF IDENTIFIED LAND AND DEVELOPMENT ALTERNATIVES

8.1 ALTERNATIVE LAND USES WHICH COULD BE IMPACTED ON

In accordance with the current land use in the vicinity of the proposed project sites, the sites proposed for surface infrastructure could, as an alternative to the project, be used for grazing or limited cultivation.

The Ga-Nape cultural landscape proposed by the RBA will be located on the Welbekend Farm. At this stage the RBA have indicated that the park is likely to be established in five to ten years' time. The project infrastructure will however not be established in close proximity to the proposed park area.

8.2 RESULTS OF SPECIALIST COMPARATIVE LAND USE ASSESSMENT

A comparative land use assessment was undertaken by the socio-economic specialist in order to meet the requirements of Regulation 50 of the MPRDA Guideline for the Compilation of an Environmental Impact Assessment and an Environmental Management Programme to be Submitted with Applications for a Mining Right in terms of the Mineral and Petroleum Resources Development Act, 2002, (Act no. 28 of 2002) (the Act)". The specialist report is included in Appendix K. Regulation 50 has two distinct components, the first being a straight analysis of the economic value of land between a mining project and the alternative land-use, and the second being an opinion on the sustainable development quality of the project relative to the alternative land-use. The latter requires the integration of all the social, environmental and economic impacts on a cost-benefit basis.

The results of the economic analysis of current agriculture versus the proposed mining activities is provided in section 7.2.18, and shows that mining far outweighs the current agricultural activities from an economic perspective.

This section therefore addresses the comparison of the alternative land uses from a social, environmental and economic perspective. In arriving at the best sustainability option of land-use, Strategy4Good have made use of the Analytical Hierarchical Process, which is a structured technique for organizing and analysing complex decisions. The Analytical Hierarchical Process was designed and executed in the following manner:

- The SLR socio-economic and environment impact assessment was used as a basis for the severity of risks and opportunities (costs and benefits)
- Only the mitigated impact significance was used as it is assumed that mitigation will take place
- The impact significance was converted into numerical scales +90 % for very positive, e.g. Income generation and -90 % for severely negative (e.g. the physical destruction of biodiversity)

- A weighting was assigned to each aspect under the main categories Social, Environment and Economic. For example, land values and income generation fall under the Economics category; whereas surface and groundwater, biodiversity, air quality etc. fall under the Environment category. Refer to the specialist report attached in Appendix K for more detail
- A weighted average was then calculated for each aspect under the categories Social, Environment and Economics
- The weighted averages were then summed by category, and each category given an equal weighting i.e. Social, Environment and Economics

The study found that mining is considered the best sustainable use of the land in that the positive social and economic benefits outweigh the negative social, economic and environmental impacts. Refer to the specialist report attached in Appendix K for more detail

9 LIST OF SIGNIFICANT IMPACTS

A list of significant impacts as identified in the assessment conducted in Section 7 is provided below.

TABLE 42: SIGNIFICANT IMPACTS AND SIGNIFICANCE RATINGS

Impact	Significance	
	Unmitigated	Mitigated
Hazardous excavations/structures/surface subsidence	High	Medium
Loss of soil resources and land capability through contamination	High	Low
Loss of soil resources and land capability through physical disturbance	Medium	Medium
Physical destruction of biodiversity	High	High – construction Medium – other phases
General disturbance of biodiversity	High	Medium – construction to decommissioning Low - closure
Alteration of drainage patterns	Medium	Medium
Pollution of surface water resources	High	Low
Dewatering	Low	Low
Contamination of groundwater	High	Low/Medium
Air pollution	High	Medium
Noise pollution	High	Low
Negative landscape and visual impacts	High	Low
Loss of current land uses	High	Medium
Blasting hazards	High	Medium
Project-related road use and traffic	High	Medium
Destruction and disturbance of heritage (including cultural) and paleontological resources	High	Low
Economic impact (positive impact)	High +	High +
Inward migration impact	High	Medium

10 STAKEHOLDER ENGAGEMENT PROCESS

This section provides a description of the engagement process with interested and affected persons (IAPs) followed during the course of the environmental assessment process. It outlines how IAPs were identified, confirms the details of the engagement process (with supporting documentation included as appendices), and how issues raised have been addressed.

10.1 IDENTIFICATION OF INTERESTED AND AFFECTED PARTIES

The stakeholder engagement process commenced with a stakeholder analysis that was aimed at identifying parties to be involved during the environmental assessment process and associated communication structures. This was done through a deeds search of the relevant properties within the project site and immediately adjacent portions of land, social scans including site visits in the surrounding areas, networking and direct discussions with IAPs. Key stakeholders identified for the project include:

- **IAPs:**
 - Landowners, land occupiers and communities on and surrounding the project areas
 - The Royal Bafokeng traditional authority
 - The Royal Bafokeng Stock and Crop Farmers Union and related farmers and farm workers
 - Mines and industries in the area
 - Non-governmental Organisation (NGO): North West Ecoforum
 - Parastatals: Eskom and Magalies Water.
- **Regulatory authorities:**
 - North West Department of Economic Development, Environment, Conservation and Tourism (DEDECT)
 - Department of Water and Environment Affairs (DWEA)
 - Department of Mineral Resources (DMR)
 - South Africa Heritage Resource Agency (SAHRA)
 - North-West Heritage Resource Agency (NWHRA)
 - Department of Agriculture (DA)
 - Department of Land Affairs (DLA)
 - North West Parks and Tourism (NWDPT)
 - North West Department of Transport Roads and Community Safety (NWDTRCS).
 - Bojanala Platinum District Municipality (BPDM)
 - Rustenburg Local Municipality (RLM)
 - Ward councillors.

A full list of landowner names, local communities, other IAPs and non-government organisations consulted is provided in the IAPs and regulatory authorities' database included in Appendix A. The database is updated on an ongoing basis throughout the environmental process.

10.2 DETAILS OF ENGAGEMENT PROCESS

Stakeholder engagement is an integral component of any development process. The goal of stakeholder engagement is to facilitate and improve communication between stakeholders (including the applicant) in the interest of facilitating better decision-making and more sustainable development (DEAT, 2002). In accordance with the requirement of Chapter 6 of the EIA Regulations, 2006, a stakeholder engagement programme has been developed to set out a coordinated process through which IAPs are informed of the proposed development and environmental assessment process and provided with an opportunity to provide input into the project plan and proposed mitigation measures. By consulting with authorities and IAPs, the range of environmental issues to be considered in the EIA has been given specific context and focus. Included below is an outline of the process followed, and the people engaged. Refer to Section 10.3 for a list of issues that were identified during the engagement process.

10.2.1 STEPS IN THE PUBLIC PARTICIPATION PROCESS

Steps in the process that have been conducted to date are set out in Table 43 below.

TABLE 43: PARTICIPATION PROCESS WITH IAPS AND AUTHORITIES

Task	Description	Date
Notification - regulatory authorities and IAPs		
Application to DEDECT and DEA	Formal applications were submitted to the relevant departments. The DMR was informed of Impala's intention to amend the mine EMP.	
Consultation with land claims commissioner	The land claims commissioner was consulted in order to verify if any land claims had been lodged on any of the proposed farms. Refer to Appendix B for a copy of the response received from the land claims commissioner.	
Updating of the IAP database	The Impala IAP database was updated where relevant.	
Distribution of background information document (BID)	A background information document (BID) was compiled by SLR for information-sharing purposes. The purpose of the BID was to inform IAPs and authorities about the project, the environmental assessment process, possible environmental impacts and means of inputting into the environmental assessment process. Attached to the BID was a registration and response form, which provided IAPs with an opportunity to submit their names, contact details and comments on the project. BIDs were distributed to IAPs by email, post and fax using contact details obtained from the Impala IAP database, at the scoping meetings and by fax and/or e-mail to authorities on the project's public involvement database. Copies of the BID in English Setswana are attached in Appendix B.	
Site notices	Laminated A2 site notices in English and Setswana were placed at key conspicuous positions in and around the project sites. Copies of the site notices are included in Appendix B together with photos of where the site notices were placed.	May 2011
Newspaper	Block advertisements were placed in English in the Daily Sun and	May 2011

Task	Description	Date
advertisements	Rustenburg Herald newspapers on 27 May 2011. Copies of the advertisements are included in Appendix B.	
Scoping stage meetings and comments received		
Public scoping meetings	Community	Date
	Macharora	6 June
	Mogono	6 June
	Phokeng	7 June
	Luka South	7 June
	Kanana	8 June
	Serutube and Mafika	8 June
	Tsitsing/Maile/Diepkuil	10 June
	Minutes of the meetings are included in Appendix B. Issues raised are included in the comments and response report in Appendix C.	
		June 2011
Focussed meeting	A focussed meeting and site visit was held with the RBA on 20 June 2011. Minutes of the meeting are included in Appendix B. Issues raised are included in the comments and response report in Appendix C.	June 2011
Authorities meeting	An authorities meeting and site visit was held on 22 August 2011. Minutes of the meeting are included in Appendix B. Issues raised are included in the comments and response report in Appendix C.	August 2011
Written comments	Written comments were received by SLR during the scoping process. Copies of the comments are included in Appendix B and a summary is included in the comments and response report in Appendix C.	May to November 2011
Distribution of draft scoping report for review		
Authority review of draft scoping report	The following authorities were involved in the review process: DMR, SAHRA, DWEA, NWHRA, DA, DLA, NWDPT, NWDTRCS, BPDM and RLM.	July to August 2011
Public review of scoping report	<p>Copies of the scoping report and summary were made available for public review at:</p> <ul style="list-style-type: none"> • Kanana: headman's office, ward councillor's office, the clinic and the post office • Luka South: ward councillor's office and the headman's houses • Macharora: headman's office, Mafanya Middle School, Changeng Post Office, Rasimone Primary School and the community police station • Mogono: ward councillor's office and the headman's houses • Phokeng: Civic Centre and the community library • Serutube: ward councillor's office and the school • Mafika: headman's office and the mosque • Maile Extension: headman's office, the tuck-shop, the learning centre and the ward councillor's office • Maile: headman's office, the general dealer shop and the ward councillor's office • Diepkuil: headman's office, the general dealer shop, Desto College and the ward councillor's office • Tsitsing: headman's office, the college/school, the post office and the ward councillor's office • Tlaseng: headman's office, the clinic, the primary school and the ward councillor's office • Ga mogajane: headman's office, the primary school and the ward councillor's office • Kopman: headman's office, the general dealer shop and the ward councillor's office. 	July to August 2011

Task	Description	Date
	The report was also provided to the RBA Mining Committee and Land Administration Committee, as well as the NW Ecoforum.	
Distribution of final scoping report for review		
Authority review of final scoping report	The final scoping report was submitted to the DEDECT and DEA for review and consideration. Since there were no material changes to the draft report subjected to public review, this report was not sent out for a second round of public review. All IAPs were informed accordingly.	October 2011

The consultation process going forward will include:

- Public and authority review of the draft EIA/EMP amendment report
- EIA feedback meetings to discuss the findings of the EIA
- Updating of the Issues Report for inclusion into the EIA/EMP amendment report
- Finalisation of the EIA/EMP amendment and public review if there are material changes from the draft document
- Inform all IAPs of the relevant authorities' decisions.

10.3 MANNER IN WHICH ISSUES RAISED WERE ADDRESSED

Stakeholder meetings and public review of the scoping reports provided IAPs an opportunity to comment on the baseline environment and potential impacts of the project (including social and cultural impacts). All views, issues and concerns raised have been captured into the comments and response report (Appendix C). The comments and response report provides responses to issues raised and identifies where the issues have been addressed in the EIA and EMP report.

10.3.1 MANNER IN WHICH ISSUES AND CONCERNS WILL BE ADDRESSED GOING FORWARD

The Impala Stakeholder Engagement Department is responsible for handling all community related issues. In this regard bi-annual meetings are held with all the communities located within the surface use area. These bi-annual meetings address the following:

- Employment related issues
- Procurement related issues
- Skills development (bursaries and internal training programmes)
- Environmental related issues
- Health and safety related issues.

In addition to this regular meetings are held with the Royal Bofokeng Administration, Municipal ward councillors, Theba (the employment agency for the lower skilled) as well as various Impala departments in order to address the issues and concerns that have been raised by community members.

11 ADEQUACY OF PREDICTIVE METHODS AND ASSUMPTIONS, AND UNCERTAINTIES

This section identifies knowledge gaps and reports on the adequacy of predictive methods, underlying assumptions and uncertainties encountered in the compilation of specialist reports and this EIA/EMP amendment report. Information is based on the specialist reports and findings of the SLR EIA team.

11.1 ENVIRONMENTAL ASSESSMENT LIMIT

The assessment 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 Impala will adhere to these.

11.2 TECHNICAL PROJECT INFORMATION

The EIA is being completed in parallel with the completion of the feasibility study. The level of detail for the technical information was therefore limited. Any significant changes to the project description will, however, require potential revision of this EIA/EMP amendment.

11.3 SPECIALIST STUDIES

Soils and land capability study

Limitations to the accuracy of the pedological mapping (as recognised within the pedological industry) are accepted at between 50 % (reconnaissance mapping) and 80 % (detailed mapping), while the degree of certainty for the soils physical and chemical (analytical data) results are based on “composite” samples taken from the dominant soil types mapped in the study area.

No specific study was undertaken for the proposed project. However, ESS conducted a study over the entire Impala converted mining rights area, 32,736ha in total. Information was abstracted from this report relevant to the current project area. The reconnaissance pedological study of the site was performed based on a variable grid base of between 50 m² and 500 m².

Biodiversity

Vegetation surveys

Vegetation mapping was based on field investigations and using Google Earth Georeferenced Images. Limitations to this could include the accuracy of the georeferencing by Google Earth.

Fauna survey

The limited time available to conduct field investigations and the instinctive nature of many faunal species to avoid human encounters makes it difficult to conduct a complete census of faunal species within a specific habitat. Surveying faunal diversity over a short time period has severe limitations; nevertheless sampling within different habitats under such restriction does provide data of sufficient quality to assess the relative sensitivities of habitats in a manner that can be used to predict impacts.

Hydrology

The Boschpoort weather station (A2E024), situated approximately 16 km east of the Impala site, and 18 km south-east of the proposed Shaft 18 complex, was used for rainfall data. This station has a record length of 30 years.

Standard methods for the calculation of flood peaks for specific return periods were used based on inputs using as much site specific information as possible. The calculation of flood peaks remains estimation with uncertainties increasing with higher return periods.

Assumptions are based on inputs into flood hydrology modelling being as representative as possible. Where uncertainties are prevalent, a degree of conservatism was used.

Groundwater

A numerical groundwater flow and transport model is a representation of some or all characteristics of a real system on an appropriate scale. It is a management tool that is typically used to understand why a system is behaving in a particular observed manner or to predict how it will behave in the future. Its precision depends on chosen simplifications (in a conceptual model) as well as on the completeness and accuracy of input parameters. In particular, data on input parameters like water levels and aquifer properties is often scarce and limits the precision and confidence of numerical groundwater models. Impact predictions are based on numerical model results, the precision of which depends obviously on the chosen simplifications as well as the accuracy of input parameters like hydraulic conductivities, porosities or source concentrations.

The estimated average mine inflow/dewatering rates are annually averaged steady-state groundwater inflows into the underground mine workings. Any steady-state groundwater model is likely to overestimate groundwater inflows (viz. dewatering rates), as it does not account for increasing dewatering of the host aquifer resulting in reducing mine inflows and hence reduced shaft dewatering rates. However, the chosen approach is conservative. Similarly mine inflows may vary over a hydrological year, with higher inflow rates in the rainy season and lower inflow rates during the dry season. Such variability was not addressed with the current steady-state groundwater flow model.

It should also be noted that the mine inflow/dewatering rates are based on the conceptual understanding that only a minor proportion of the direct (average) rainfall recharge to the shallow weathered aquifer leaks to the deeper fractured aquifer and eventually reports as mine (fissure) inflows. No regional inflows

from adjacent aquifer systems beyond the extended model domain were considered due to a lack of data.

Noise

The baseline ambient noise levels were measured and estimated based on a physical inspection, aided by sampling and probing measurements. Since no facilities suitable for long-duration unattended recordings were available, ambient noise levels were probed and samples taken in which the level was averaged over sufficiently long time durations to obtain good estimates of the average ambient level. This involved time-integrated averaging for a period long enough for the running average to converge to a constant level with less than 1 dB variance. A-weighted, equivalent continuous sound pressure levels LAeq (dBA) were measured, using an integrating sound analyser.

According to Acusolv (2013), confidence in the predictions, which are based on appropriately scaled data obtained in measurements at various existing shaft complexes, ventilation fans and railway lines, is high. It should nevertheless be cautioned that predicted noise levels and contours are not to be taken as absolute. Noise maps must be interpreted with caution. Although the confidence level in the acoustic model is high, predicted levels are valid for the assumptions made in respect of meteorological and other conditions. Since meteorological conditions in particular are highly variable, levels produced at a distance by a source at a constant acoustic output will vary considerably, even during the course of a single day-time or night-time period. Variance in noise level due to changes in atmospheric conditions increases with distance from the source.

Heritage and cultural aspects

Heritage and cultural

It is possible that the study may have missed heritage resources in the project area as heritage sites may occur in thick clumps of vegetation while others may lie below the surface of the earth and may only be exposed once development commences. If any heritage resources of significance are exposed during the project the South African Heritage Resources Authority (SAHRA) will be notified immediately, all construction activities will be stopped and an archaeologist accredited with the Association for Southern African Professional Archaeologist (ASAPA) will be notified in order to determine appropriate mitigation measures for the discovered finds.

The methods used and underlying assumptions are based on human effort (search and observe, outcomes of earlier/previous surveys in wider area) and as such is subject to human error.

Paleontological

The methods used and assumptions made are considered adequate for this study area as most of the rocks of the area are Precambrian in age and thus have almost no chance of delivering fossils.

Socio-economic

This study required significant input of information pertaining to the project description. The information used in the study is included in the specialist report. This information was provided by the technical project team and it is assumed that this information is correct.

Geochemistry

No waste rock or sludge samples are obviously yet available from the proposed shaft, therefore analogue samples were collected at an existing waste rock dump and sludge pond at the No 11 Shaft and an older sludge deposit at the No 5 Shaft. Based on the uniform lithologies of the Bushveld Igneous Complex underlying the site and mineralised horizons mined, the samples are considered representative of the mine residues (waste rock and sludge) generated by the proposed No 18 Shaft development. A critical success factor for any geochemical characterisation program is the selection of representative samples considering material type (e.g. lithology), spatial (e.g. vertical and horizontal area to be mined) and compositional (e.g. all material types based on sulphur content) representation as well as sample storage and handling (e.g. fresh or weathered samples). Additional testing should therefore be conducted once the actual samples are available.

Closure cost calculations

The closure cost calculations are based on the technical information and site layout as provided by the technical project team, and are assumed accurate at the time of compiling this report.

12 ARRANGEMENTS FOR MONITORING AND MANAGEMENT OF IMPACTS

This section describes the arrangements for monitoring and management of environmental impacts. It identifies the impacts that require monitoring programmes and outlines the functional requirements, roles and responsibilities and timeframes for the monitoring programmes. Further detail on each monitoring programme is included in Section 21.

12.1 IMPACTS THAT REQUIRE MONITORING PROGRAMMES

Impacts that require monitoring include:

- Hazardous excavations and structures (failure of water dams)
- Physical destruction and general disturbance of biodiversity
- Dewatering impacts on third party users
- Contamination of groundwater
- Contamination of surface water
- Increase in dust
- Increase in disturbing noise levels
- Blasting hazards.

In addition to the above, the commitments as included in the EMP report will require monitoring to a) ensure that they are being implemented and b) that they are effective in mitigating potential impacts on the environment, socio-economic conditions of third parties and heritage/cultural aspects. This will be done through regular internal auditing by mine personnel.

12.2 FUNCTIONAL REQUIREMENTS OF MONITORING PROGRAMMES

The purpose of the monitoring programmes is to review the mine's impact on various aspects of the environment and to report on changes needed to the management programme as proposed in this report.

As a general approach, the mine will ensure that the monitoring programmes comprise the following:

- A formal procedure
- Appropriately calibrated equipment
- Where samples require analysis they will be preserved according to laboratory specifications
- An independent, accredited laboratory will undertake sample analyses and/or internal laboratory results will periodically be checked by independent and accredited
- Parameters to be monitored will be identified in consultation with a specialist in the field and/or the relevant authority

- If necessary, following the initial monitoring results, certain parameters may be removed from the monitoring programme in consultation with a specialist and/or the relevant authority
- Monitoring data will be stored in a structured database
- Data will be interpreted and reports on trends in the data will be compiled by an appropriately qualified person on an ongoing basis or as required
- Both the data and the reports will be kept on record for the life of mine.

12.3 ROLES AND RESPONSIBILITIES

The roles and responsibilities for the execution of the monitoring programmes are defined below.

- Senior Operational Manager and Environmental Department manager:
 - Ensure that the monitoring programmes are scoped and included in the annual mine budget
 - Identify and appoint appropriately qualified specialists/engineers to undertake the programmes
 - Appoint specialists in a timely manner to ensure work can be carried out to acceptable standards.

12.4 TIMEFRAMES FOR MONITORING AND REPORTING

The timeframes for monitoring and reporting thereof are detailed in the monitoring programme (see Section 21). A summary is provided below:

Programme	Timeframe and frequency	Reporting
Waste dumps and water dams	All project phases On-going by dam operators and quarterly by professional engineer	On-going internally and quarterly by professional engineer
Biodiversity	All project phases	As required by specialist
Groundwater and process water	All project phases As per requirements of water use license	As per requirements of water use license
Surface water	All project phases As per requirements of water use license	As per requirements of water use license
Air	All project phases As per requirements of the Atmospheric Emissions Licence As required (dependant on stakeholder complaints)	As per requirements of the Atmospheric Emissions Licence As required (dependant on stakeholder complaints)
Noise	As required (dependant on stakeholder complaints)	As required (dependant on stakeholder complaints)
Blasting	Every blast	Monthly by specialist
Internal auditing	From start of construction to end of closure On-going	As required
External auditing	From start of construction to end of closure Every two years	Every two years to DMR

13 TECHNICAL SUPPORTING INFORMATION

Technical and supporting information included as appendices to this report are listed below.

- Stakeholder database (Appendix A)
- Information-sharing with IAPs (Appendix B)
- Issues and response report (Appendix C)
- Biodiversity specialist reports (Appendix D)
- Hydrological specialist report (Appendix E)
- Geo-hydrological specialist report (Appendix F)
- Noise specialist report (Appendix G)
- Visual specialist report (Appendix H)
- Heritage specialist report (Appendix I)
- Paleontological specialist report (Appendix J)
- Socio-economic specialist report (Appendix K)
- Air quality specialist input (Appendix L)
- Closure cost calculation specialist report (Appendix M).

SECTION 2 – ENVIRONMENTAL MANAGEMENT PROGRAMME

It should be noted that this section addresses the existing Impala operations and the proposed project .i.e. consolidated operation.

14 ENVIRONMENTAL OBJECTIVES AND SPECIFIC GOALS FOR CLOSURE

14.1 ENVIRONMENTAL ASPECTS THAT DESCRIBE THE PRE-MINING ENVIRONMENT

Environmental aspects that describe the pre-mining environment as informed by the baseline description (Section 1.1) are listed below. This list serves to guide the setting of environmental objectives for mine closure.

- Relatively flat topography
- Pre-mining soils supported arable, grazing and wilderness land capabilities and/or uses. Closure objectives around land capability and use must be informed by consensus with relevant stakeholders
- A functioning ecosystem
- Perennial and non-perennial drainage patterns
- Moderate to good groundwater quality
- Stable water table providing groundwater as a water supply source
- Quite rural/urban environment.

14.2 MEASURES REQUIRED FOR CONTAINMENT OR REMEDIATION

Measures required to contain or remedy any causes of pollution or degradation or migration of pollutants, both for closure of the mine and post-closure are listed below:

- Implement a waste management procedure for general and hazardous waste on site
- Ensure immediate clean-up of any spills as per the emergency response procedures (see section 20.2)
- Establish and maintain dirty stormwater control measures in line with regulatory requirements, until such time as potentially polluting areas are rehabilitated
- Contain pollutants at source by storing and handling potentially polluting substances on impermeable substrates, within bunded areas and with the capacity to contain spills
- Design, construct and operate all tailings dams with decant and drainage systems and runoff control measures
- Design, construct and operate existing and future waste dumps with runoff control measures
- Control air emissions through the implementation of the air quality management plan
- Rehabilitate the site in line with a detailed closure plan to be developed at least five years prior to decommissioning.

Further detail on the proposed action plans and mitigation measures is included in Section 19.

15 ENVIRONMENTAL OBJECTIVES AND SPECIFIC GOALS FOR MANAGEMENT OF IDENTIFIED ENVIRONMENTAL IMPACTS

The environmental objectives and specific goals for the management of identified environmental impacts are detailed in this section.

15.1 IMPACTS THAT REQUIRE MONITORING PROGRAMMES

Impacts that require monitoring at the overall Impala site include:

- Hazardous excavations and structures
- Physical destruction and general disturbance of biodiversity
- Pollution of surface water resources
- Pollution of groundwater
- Dewatering
- Pollution of soil resources
- Loss of soil resources and land capability
- Increase in air pollution
- Increase in noise levels
- Blasting impacts
- Traffic increase and road use.

15.2 SOURCE ACTIVITIES

The source activities of potential impacts which require management at Impala are listed below:

- | | |
|-------------------------------|---|
| • Earthworks | • Power supply infrastructure |
| • Civil works | • Demolition |
| • Prospecting | • Maintenance and aftercare |
| • Rehabilitation | • Site preparation |
| • Open pit mining | • Prospecting and survey |
| • Shafts | • Transportation system |
| • Waste rock dumps | • Support services and amenities |
| • Concentrators | • Site management |
| • Chrome processing | • Non-mineralised waste management |
| • Smelter complex | • Slag plant and dump |
| • Water supply infrastructure | • Use of tailings mixed with stabilisers as support in mine voids |

15.3 MANAGEMENT ACTIVITIES

Management activities which will be conducted to control the project actions, activities or processes which have the potential to pollute or result in environmental degradation are detailed in Section 19.

15.4 ROLES AND RESPONSIBILITIES

The key personnel to ensure compliance to this EMP report will be the operations executive, the environmental manager and the stakeholder development 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:
 - Liaise with the relevant structures in terms of the commitments in the SLP
 - Ensure that commitments in the SLP are developed and implemented in a timeously fashion
 - Establish and maintain good working relations with surrounding communities and landowners
 - Facilitate stakeholder communication, information sharing and grievance mechanism.

16 ENVIRONMENTAL OBJECTIVES AND SPECIFIC GOALS FOR SOCIO-ECONOMIC CONDITIONS

16.1 ASPECTS OF THE SOCIO-ECONOMIC CONDITIONS

The socio-economic conditions in the vicinity of the mine are described in Section 1.3.4.

16.2 OBJECTIVES AND GOALS

Specific environmental objectives and goals to control, remedy or stop potential impacts emanating from the mine which may impact on communities and IAPs are described below. The information is presented in tabular format (Table 44).

TABLE 44: ENVIRONMENTAL OBJECTIVES AND GOALS – SOCIO-ECONOMIC CONDITIONS

Aspect	Environmental objective	Goals
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
Blasting	To minimise the potential for third party damage and/or loss	To protect third party property from mine-related activities, where possible Where damage is unavoidable, to work together with the third parties to achieve a favourable outcome To ensure public safety
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
Socio-economic	To enhance the positive economic impacts and limit the negative economic impacts	To work together with existing structures and organisations
Informal settlements	To limit the impacts associated with inward migration	To establish and maintain a good working relationship with surrounding communities, local authorities and land owners
Relocation	To prevent the risk of harm and injury to people and animals and the damage of any associated buildings, or unacceptable noise or dust impacts.	To work together with existing structures and organisations To establish and maintain a good working relationship with surrounding communities and land owners

17 ENVIRONMENTAL OBJECTIVES AND SPECIFIC GOALS FOR HISTORICAL AND CULTURAL ASPECTS

Environmental objectives and goals in respect of historical and cultural aspects are listed in the table below (Table 45).

TABLE 45: ENVIRONMENTAL OBJECTIVES AND GOALS – HISTORICAL AND CULTURAL ASPECTS

Aspect	Environmental objective	Goals
Heritage and cultural	To prevent unacceptable loss of heritage (including cultural) resources and related information	To protect heritage (including cultural) resources where possible If disturbance is unavoidable, then mitigate impact in consultation with a specialist and the SAHRA and in line with regulatory requirements

18 APPROPRIATE TECHNICAL AND MANAGEMENT OPTIONS

18.1 PROJECT ACTIONS, ACTIVITIES AND PROCESSES

All activities associated with the project have the potential to cause pollution or environmental degradation. These are described in Section 2 of this EIA and EMP report.

18.2 TECHNICAL AND MANAGEMENT OPTIONS

Appropriate technical and management options chosen to modify, remedy, control or stop any action, activity or process associated with the project which will cause significant impacts on the environment, socio-economic conditions and historical and cultural aspects are listed in the table below (Table 46). In addition to these, the mine has implemented an environmental management system to assist in the implementing and monitoring of commitments included in this EIA and EMP report.

TABLE 46: TECHNICAL AND MANAGEMENT OPTIONS

Potential impact	Technical and management options
Mineral sterilisation	Mine workings will be developed and designed taking cognisance of potential ore reserves Extraction of all possible minerals prior to final disposal
Hazardous structures	Construction of berms, fencing, barriers and access control Warning signs Sealing and backfilling shafts and pits Implement monitoring programme Implement an emergency response
Loss of soil resources and land capability through pollution	Implement hazardous waste, dirty water and mineralised and non-mineralised waste management procedures Permanent infrastructure designs to take long-term soil prevention, land function and confirmatory monitoring into account
Loss of soil and land capability through physical disturbance	Implementation of a soil management plan Limiting disturbance of soil to what is necessary Stripping, storing, maintenance and replacement of topsoil in accordance with soil management procedures
Physical destruction of biodiversity	Implementation of the biodiversity management plan Restrict project footprint Limit disturbance on high biodiversity areas Investigation of a biodiversity offset if required Implementation of monitoring programmes Rehabilitate disturbed areas
General disturbance of biodiversity	Prevention of the killing of animal species and harvesting of plant species Implementation of dust control measures Pollution prevention measures (water, soil) Prevention of the disturbance of ecosystems

Potential impact	Technical and management options
Pollution of surface water resources	<p>Appropriate design of polluting facilities and pollution prevention facilities (by qualified person)</p> <p>Implement and maintain storm water controls that meet regulatory requirements</p> <p>Implement site-specific soil management plan</p> <p>Implement a monitoring programme (water use, surface water quality, process water quality, rainfall-related discharge quality)</p> <p>Implement emergency response procedure</p> <p>Implementation and maintenance of licence requirements</p>
Alteration of natural drainage lines	<p>Avoid alteration of watercourses as far as practically possible</p> <p>Implement and maintain storm water controls that meet regulatory requirements</p>
Contamination of groundwater	<p>Appropriate design of pollution facilities</p> <p>Correct handling of hazardous wastes, mineralised and non-mineralised wastes</p> <p>Compensation for loss</p> <p>Implement and maintain terms and conditions of regulatory and license requirements</p> <p>Implementation of a monitoring programme</p> <p>Implement emergency response</p>
Dewatering	<p>Compensation for loss</p> <p>Implementation of monitoring programme</p> <p>Implement and maintain terms and conditions of regulatory and license requirements</p>
Air pollution	<p>Implementation of air quality management plan</p> <p>Implementation of an air quality monitoring programme</p> <p>Control dust plumes</p> <p>Implementation of an air complaints procedure</p> <p>Maintenance of abatement equipment</p> <p>Implement an emergency response</p> <p>Authorise all scheduled processes</p> <p>Compliance with relevant licence requirements</p>
Noise pollution	<p>Maintenance of vehicles and equipment in good working order</p> <p>Implementation of a noise complaints procedure</p> <p>Reducing operational hours</p> <p>Education and awareness training of workers</p> <p>Equip machinery with silencers</p> <p>Construction of noise attenuation measures</p> <p>Relocate people experiencing unacceptable increase in ambient noise if the relevant people agree to be relocated</p>
Blasting damage	<p>Implementation of a blast management plan</p> <p>Pre-mining crack survey</p> <p>Communication of planned blasting times with stakeholders</p> <p>Pre-blast warning</p> <p>Monitoring blasts</p> <p>Audit and review to adjust blast design where necessary</p> <p>Rectify damage to third party structures</p> <p>Implementation of a blasting complaints procedure</p> <p>Investigate blast related complaints</p> <p>Implement emergency response</p>

Potential impact	Technical and management options
Traffic increase	<p>Implementation of a traffic safety programme</p> <p>Implement speed allaying measures where appropriate e.g. speed humps, such as in areas where the people reside in close proximity to mine access roads</p> <p>Education and awareness training of workers</p> <p>Enforce strict speed limits on mine access roads</p> <p>Ensure dust is effectively controlled on unpaved road so as not to reduce visibility</p> <p>Use of pedestrian crossing by pedestrians and school children</p> <p>Placement of signage to create awareness</p> <p>Maintenance of the transport systems</p> <p>Implementation of a traffic complaints procedure</p> <p>Implement emergency response</p>
Visual impacts	<p>Limit the clearing of vegetation</p> <p>Limit the emission of visual air plumes</p> <p>Use of screening berms</p> <p>Concurrent rehabilitation</p> <p>Painting infrastructure to compliment the surrounding environment where possible</p> <p>Implementation of a closure plan</p> <p>Management through care and aftercare</p>
Heritage and cultural	<p>Limit project infrastructure, activities and related disturbances as far as practically possible</p> <p>Avoid disturbance of heritage and cultural resources as far as practically possible</p> <p>Project specific heritage studies will be conducted to identify any resources should the project footprint change</p> <p>Education and awareness training of workers</p> <p>Apply for the relevant permits to remove or destroy heritage resources</p> <p>Exhumation and relocation of graves where required according to legal requirements</p> <p>Implement emergency response with respect to the chance find procedure for heritage, cultural and paleontological resources</p> <p>Maintain communication channels with the RBA regarding the proposed Welbekend Heritage Park and align the mine's future planning accordingly. This specifically includes development of the decommissioning and closure plan for the No 19 Shaft in close consultation with the RBA.</p>
Economic impact	<p>Hire people from closest communities as far as practically possible</p> <p>Extend the formal bursary and skills development to closest communities</p> <p>Implement a procurement mentorship programme</p> <p>Local procurement of goods and services as far as practically possible</p> <p>Compensation for loss of land use</p> <p>Closure planning to make consideration for skills, economic consideration and the needs of future farming</p>
Inward migration	<p>Good communication in terms of recruitment, procurement and training</p> <p>Number of temporary and permanent new job opportunities and procurement will be made public</p> <p>Employment and procurement opportunities provided to closest communities as far as practically possible</p> <p>No recruitment at the mine</p> <p>Notify unsuccessful job seekers</p> <p>Encourage formal housing of employees and implement contractual requirement for contractors to ensure formal housing for workers, both temporary and permanent)</p> <p>Maintain a skills profile for the nearest communities</p> <p>Monitor and prevent the development of informal settlements through the interaction with neighbours, local authorities and law enforcement officials</p> <p>Implement a health policy on HIV/AIDs and tuberculosis to promote awareness and training</p> <p>Continue to work closely with the local and regional authorities, the RBA and other mines/industry in the area to be part of the problem solving process that needs to address social service constraints</p> <p>Implement emergency response</p>

Potential impact	Technical and management options
Relocation	Conduct any required relocation in accordance with the principles and requirements of the World Bank International Finance Corporation Resettlement Action Plan guideline Ensure transparent communication with the affected people and the RBA
Land use	Implementation of EMP commitments that focus on environmental and social impacts Take necessary steps to prevent negative impact on surrounding land Closure planning to incorporate measures to achieve future land use plans

19 ACTION PLAN TO ACHIEVE OBJECTIVES AND GOALS

Action plans to achieve the objectives and goals set out in Section 7.2 re listed in tabular format together with timeframes for each action. The action plans include the timeframes and frequency for implementing the mitigation measures as well identifies the responsible party. Many of these action plans make reference to Impala's procedures, a list of which is provided in Appendix O. These procedures are dynamic documents that are regularly updated by Impala.

TABLE 47: ACTION PLAN – LOSS AND STERILISATION OF MINERAL RESOURCES

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Civil works – related to infrastructure establishment	M	L	<ul style="list-style-type: none">Impala will continue to incorporate cross discipline planning structures for all new mining and infrastructure developments to avoid mineral sterilization. A key component of the cross cutting function is the Mine resource managerMine workings will be developed and designed so as not to limit the potential to exploit deeper minerals Provision will be made to extract all minerals possible prior to final disposal onto the mineralised waste facilities. This requires additional extraction processes downstream of the UG2 and Central Concentrators in particular. Where a lack of technological processes has caused minerals to be disposed onto the mineralised waste facilities, the option of reprocessing the facilities will be considered and implemented where feasible and technological possible	At start	Once off	Mine resource manager
Operation	Civil works – related to infrastructure establishment Tailings dam, slag dump and waste rock dump components of shafts Open pit mining – above mineable underground resources	M	L		On-going	On-going	Mine Resource manager
					On-going	On-going	Mine Resource manager
Decommission	Rehabilitation – related to mineralised waste facilities and backfilling pits, closing voids and sealing shafts	M	L				
Closure	Maintenance and aftercare of final land forms and rehabilitated areas	M	L				

TABLE 48: ACTION PLAN – HAZARDOUS STRUCTURES / EXCAVATIONS/SURFACE SUBSIDENCE

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Earthworks Civil works Prospecting –sumps Rehabilitation	H	M	<ul style="list-style-type: none"> All existing and proposed mineralised waste facilities and water dams will be designed and constructed in a manner to ensure stability 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. Erection of fencing, berms, barriers and/or security personnel to prevent unauthorised access related to proposed and current projects Placement of language appropriate warning signs at all hazardous excavations and structures. Warning pictures can be used as an alternative Educate third parties on potential risks Existing and proposed mineral waste facilities and water dams will be constructed that the stability related safety risks to third parties are addressed and monitored Sealing of surface holdings in accordance with Impala's procedures In case of injury or death due to hazardous excavations, the emergency response procedure in Section 20.2 will be followed. 	On-going	On-going	Professional engineer where required
					As required	Once off	Senior Operational Manager
					On-going	As required	Senior Operational Manager
					As required As required	As required As required	Senior Operational Manager Senior Operational Manager
					On-going	On-going	Professional engineer
					As required	As required	Environmental site officer
Operation	Earthworks Civil works Prospecting - sumps Open pit mining Shafts & waste rock dumps Concentrator plants Chrome processing plants Smelter complex Tailings dams Slag dump Water storage and supply infrastructure Transport infrastructure, in particular rail network Power supply infrastructure Rehabilitation	H	M	<ul style="list-style-type: none"> All existing and proposed mineralised waste facilities and water dams will be designed and constructed in a manner to ensure stability 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. Erection of fencing, berms, barriers and/or security personnel to prevent unauthorised access related to proposed and current projects Placement of language appropriate warning signs at all hazardous excavations and structures. Warning pictures can be used as an alternative Maintain safety control measures Educate third parties on potential risks In case of injury or death due to hazardous excavations, the emergency response procedure in Section 20.2 will be followed. Sealing of surface holdings in accordance with Impala's procedures Existing and proposed mineral waste facilities and water dams will be operated that the stability related safety risks to third 	On-going	On-going	Professional engineer where required
					On-going	On-going	Senior Operational Manager
					On-going	On-going	Environmental site manger
					On-going On-going As required	On-going As required As required	Senior Operational Manager Environmental site manager Senior Operational Manager
					As required	As required	Senior Operational Manager
					On-going	On-going	Professional engineer

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Decommission	Earthworks Civil works Demolition Rehabilitation	H	M	<ul style="list-style-type: none"> All existing and proposed mineralised waste facilities and water dams will be closed in a manner to ensure stability 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 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. Sealing of surface holdings in accordance with Impala's procedures In case of injury or death due to hazardous excavations, the emergency response procedure in Section 20.2 will be followed. 	On-going	On-going	Professional engineer
					As required	As required	Senior Operational Manager
					On-going	On-going	Professional engineer
					As required	As required	Senior Operational Manager
Closure	Maintenance and aftercare	H	M	<ul style="list-style-type: none"> 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 presents a long term safety and/or stability risk. At closure of any port of the mine the hazardous excavations and subsidence will have been dealt with as follows: <ul style="list-style-type: none"> All shaft openings will have been sealed and rehabilitated All pits will have been backfilled and rehabilitated The potential for surface subsidence will have been addressed by providing underground support in mined out areas and by providing a bulking factor for backfilled pits 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. In case of injury or death due to hazardous excavations, the emergency response procedure in 20.2 will be followed. 	As required	As required	Senior Operational Manager
					As required	As required	As required
					As required	As required	Environmental manager

TABLE 49: ACTION PLAN – LOSS OF SOIL RESOURCES AND LAND CAPABILITY THROUGH POLLUTION

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Earthworks Civil works Prospecting and survey Site management Transport system Non-mineralised waste management Support services and amenities Rehabilitation	H	L	<ul style="list-style-type: none">• The design of any permanent and potentially polluting structures (mineralised waste facilities) will take account of the requirements for long-term soil pollution prevention, land function and confirmatory monitoring• Prevention of pollution through basic infrastructure design• Pollution prevention through maintenance of equipment• Pollution prevention through education and training of workers (temporary and permanent)• Pollution prevention through appropriate management of hazardous and materials and 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 resourced will be retained in the correct place. The in situ options include bioremediation at the point of pollution, or removal of souls for washing and/or bio remediation at a designated area after which the soils are returned• Specifications for post rehabilitation audit to ascertain where the remediation of any polluted soils and re-establishment of soil functionality has been achieved• Implementation of Impalas soil management procedures, spillage control guideline and rehabilitation procedures• Implementation of Impalas management procedures for the handling and disposal of hazardous and non-hazardous materials• In case of major spillage incidents the emergency response procedure in Section 20.2 will be followed.	As required	As required	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
Operation	Earthworks Civil works Prospecting and survey Site management Transport systems Non-mineralised waste management Support services and amenities Open pit mining Shafts Concentrators Chrome processing Smelter complex Slag plant and dump Tailings dam Water supply infrastructure Power supply infrastructure	H	L		As required	As required	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
Decommission	Demolition Earthworks Civil works Site management Transport systems Transport systems Non-mineralised waste management Support services and amenities Shaft waste rock dumps Tailings dams Slag dump Water supply infrastructure Power supply infrastructure Rehabilitation	H	L		On-going	On-going	Senior Operational Manager
					As required	As required	Senior Operational Manager

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Closure	Maintenance and aftercare of final land forms and rehabilitated areas	H	L	<ul style="list-style-type: none"> Implementation of Impalas soil management procedures, spillage control guideline and rehabilitation procedures Implementation of Impalas management procedures for the handling and disposal of hazardous and non-hazardous materials In case of major spillage incidents the emergency response procedure in Section 20.2 will be followed. 	As required	As required	Senior Operational Manager
					As required	As required	Senior Operational Manager
					As required	As required	Senior Operational Manager

TABLE 50: ACTION PLAN - LOSS OF SOIL RESOURCES AND LAND CAPABILITY THROUGH PHYSICAL DISTURBANCE

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Earthworks for all surface infrastructure Prospecting and survey Site management Transport systems Support services and amenities Rehabilitation	H	M	<ul style="list-style-type: none"> Limit the disturbance of soils to what is absolutely necessary for earthworks on-going activities, infrastructure footprints and use of vehicles Stripping, storage and maintenance of soil in accordance with soil management procedure included in Table 40. As part of closure planning, the designs of any permanent landforms (egg. mineralized waste facilities) will take into consideration the requirements for land function, long-term erosion prevention and confirmatory monitoring. In case of a major incident the emergency response procedure in Section 20.2 will be followed. 	On-going	On-going	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
					As required	As required	Senior Operational Manager
					As required	As required	Senior Operational Manager
Operation	Earthworks - for all surface infrastructure Prospecting and survey Site management Transport systems Non-mineralised waste management Support services and amenities Open pit mining Shaft waste rock dumps Chrome processing stockpiles Tailings dams Slag dump Rehabilitation	H	M				
Decommission	Demolition Earthworks Site management	H	M	<ul style="list-style-type: none"> Limit the disturbance of soils to what is absolutely necessary for decommissioning activities, and on-going activities, infrastructure footprints and use of vehicles Maintenance and replacement of soil in accordance with 	On-going	On-going	Senior Operational Manager
					On-going	On-going	Senior Operational Manager

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
	Transport systems Non-mineralised waste management Support services and amenities Shaft waste rock dumps Tailings dams Slag dump Rehabilitation			soil management procedures included in Table 40. • In case of a major incident the emergency response procedure in Section 20.2 will be followed.	As required	As required	Senior Operational Manager
Closure	Maintenance and aftercare of final land forms and rehabilitated areas	H	M	• Maintenance and replacement of soil in accordance with soil management procedures included in Table 40. • In case of a major incident the emergency response procedure in Section 20.2 will be followed.	At start of phase As required	At start of phase As required	Senior Operational Manager Senior Operational Manager

TABLE 51: ACTION PLAN – PHYSICAL DESTRUCTION OF BIODIVERSITY

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Site preparation Earthworks for all surface infrastructure Prospecting and survey Site management Transport systems Support services and amenities Site management Rehabilitation	H	M	<ul style="list-style-type: none">Limit infrastructure, activities and related disturbance to those specifically identified and described in this report.Prevent the disturbance of core conservation areas, ecologically sensitive areas and important linkages between these areas so that the species composition and ecosystem functionality remain intactIn the No 18 shaft project planning phase prior to construction, the project team will re-assess the finer detail of the infrastructure layout in an effort to avoid the sensitive rocky outcrops which support protected Marula tree species and island-hopping animalsFaunal migratory connectivity will be maintained especially with respect to Wetland Habitat Units. In this regard, stream crossings will be constructed in such a manner that these do not impede the flow of water. In addition, pipelines will either be buried or crossings will be constructed at key locations to allow livestock to cross. The positions and type of crossing will be determined with the input of a biodiversity specialist. Stream and wetland crossings will be constructed in the dry season if at all possible in order to avoid sedimentation of wetlands in the area<ul style="list-style-type: none">During the construction, operation and decommissioning phases Impala will implement biodiversity management plan. The key components are:Delineation of any proposed areas that will be disturbedMaintaining linkages between sensitive areasObtain relevant permits for the relocation or removal of protected speciesRelocation of fauna and flora species were possible (especially protected species and species of core concern). In this regard it is noted that Marula trees are difficult to transplant. If relocation is unsuccessful, two Marula trees will be planted for every tree removedRestoration of the ecosystem functionality, as far as is possible, in	As required	As required	Senior Operational Manager
					As required	As required	Senior Operational Manager
					As required Planning phase	As required Planning phase	Senior Operational Manager Senior Operational Manager
					Operation	Site preparation Earthworks - for all surface infrastructure Prospecting and survey Site management Transport systems Non-mineralised waste management Support services and amenities Site management Open pit mining shafts Concentrators Chrome processing Smelter complex Slag plant and ump Tailings dams Water supply infrastructure Power supply infrastructure Rehabilitation	H
On-going	On-going	Senior Operational Manager					
Decommission	Site preparation Demolition Earthworks Site management Transport systems Non-mineralised waste management	H	M				

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
	Support services and amenities Site management Shaft waste rock dumps Tailings dams Slag dump Water supply infrastructure Rehabilitation			<p>areas that have been physically rehabilitated</p> <ul style="list-style-type: none"> ○ Follow up audits and monitoring, in the short and long-term to determine the success of the relocation, rehabilitation and restoration activities in terms of a range of species and ecosystem function performance indicators ○ Investigation of biodiversity offset project if irreplaceable species and/or associated ecosystem functionality associated with core conservation, sensitive areas or linkage areas will be permanently lost and restoration is not possible. The biodiversity offset will investigate: <ul style="list-style-type: none"> ▪ the size of the affected area, ▪ the conservation/sensitivity status, ▪ the offset ration, evaluation of alternative offset sites of the basis of: no net biodiversity loss compensation for the mines negative impact on biodiversity, long term functionality, long term viability, contribution to biodiversity conservation including linkages to areas of conservation importance, acceptability to key stakeholders, distances from other mines and development activities in relation to cumulative impacts, and biodiversity condition scores as compared to that at the mine site. ▪ land ownership now and in the future ▪ status/security/sustainability of the offset site i.e. will it receive conservation status 			

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
				<ul style="list-style-type: none"> measures to guarantee the security, management, monitoring and auditing of the offset capacity of the mine to implement and manage the offset identification of unacceptable risks associated with the offset start-up and on-going costs associated with the offset for the life of the project 			
				<ul style="list-style-type: none"> Implementation of an alien/invasive/weed management programme to control the spread of these plants onto and from disturbed areas through active eradication, establishment of natural species and through on-going monitoring and assessment. In this regard, the use of herbicides will be controlled by only allowing registered Pest Control Operators (PCO) to administer any such chemical or biological agent. Education and training of workers (temporary and permanent) Implementation of vegetation management in accordance to Impala's vegetation procedures In case of a major incident the emergency response procedure in Section 20.2 will be followed. 	On-going	On-going	Senior Operational Manager
					As required	As required	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
					As required	As required	Senior Operational Manager
Closure	Maintenance and aftercare of final land forms and rehabilitated areas	H	M	<ul style="list-style-type: none"> The designs of any permanent structures will take into consideration the requirement for the establishment of long term species diversity, ecosystem functionality, aftercare and confirmatory monitoring Education and training of workers (temporary and permanent) Implementation of vegetation management in accordance with Impala's vegetation procedures Watercourse crossing areas will be rehabilitated in an effort to re-instate wetland functioning. In case of a major incident the emergency response procedure in Section 20.2 will be followed. 	As required	As required	Senior Operational Manager
					As required	As required	Senior Operational Manager
					As required	As required	Senior Operational Manager
					Decommissioning	Decommissioning	Senior Operational Manager
					As required	As required	Senior Operational Manager

TABLE 52: ACTION PLAN – GENERAL DISTURBANCE OF BIODIVERSITY

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Site preparation Earthworks for all surface infrastructure Prospecting and survey Site management Transport systems Support services and amenities Site management Rehabilitation	H	M	<ul style="list-style-type: none">• The use of light is kept to a minimum, and where it is required, yellow lighting is used where possible;• Vertebrates should be kept away from the illuminated areas with appropriate fencing where feasible;• Internal power lines may be equipped with bird deterrent measures to prevent bird kills where deemed necessary;• There is training for workers on the value of biodiversity, the need to conserve the species and systems that occur within the surface use area as well as on fire control;• There is zero tolerance of the killing or collecting of any biodiversity by anybody working for or on behalf of Impala;• Strict speed control measures are used for any vehicles driving within the surface use area and vehicles are restricted to designated roads;• Noisy and/or vibrating equipment will be well maintained to control noise and vibration emission levels;• All permanent water dams (excluding Rock-wall dam) will be fenced off to prevent access by larger animals;• Dust control measures will be implemented• Pollution and litter prevention measures will be implemented• As part of closure planning, the designs of any permanent and potentially polluting structures (mineralised waste facilities) will take consideration of the requirements for long-term pollution prevention and confirmatory monitoring.• Impala will monitor the aquatic habitat of all potentially affected surface water resources and use the results of the monitoring to implement any other surface water related interventions as deemed appropriate to achieve the mitigation objectives. This is will be out sourced as part of the Impala biomonitoring in accordance to acceptable practice.• In case of a major incident the emergency response procedure in Section 20.2 will be followed.	On-going	On-going	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
					As required	As required	Senior Operational Manager
Operation	Site preparation Earthworks - for all surface infrastructure Prospecting and survey Site management Transport systems Non-mineralised waste management Support services and amenities Site management Open pit mining shafts Concentrators Chrome processing Smelter complex Slag plant and ump Tailings dams Water supply infrastructure Power supply infrastructure Rehabilitation	H	M		On-going	On-going	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
					As required	As required	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
					As required	As required	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
Decommission	Site preparation Demolition Earthworks Site management Transport systems	H	M		As required	As required	Senior Operational Manager

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
	Non-mineralised waste management Support services and amenities Site management Shaft waste rock dumps Tailings dams Slag dump Water supply infrastructure Rehabilitation						
Closure	Maintenance and aftercare of final land forms and rehabilitated areas	H	M	<ul style="list-style-type: none"> In case of a major incident the emergency response procedure in Section 20.2 will be followed. 	As required	As required	Senior Operational Manager

TABLE 53: ACTION PLAN – POLLUTION OF SURFACE WATER RESOURCES

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Earthworks Civil works Prospecting and survey Site management Transport system Non-mineralised waste management Support services and amenities Rehabilitation	H	M	<ul style="list-style-type: none"> Compliance to the National Water Act (36 of 1998) and Regulation 704 (4 June 1999): <ul style="list-style-type: none"> Keep clean water and dirty water system separate Clean run-off and rainfall water is diverted around dirty areas and back into its normal flow in the environment Location of all activities and infrastructure should be outside of the specified zones and /or floodlines of watercourses. If this is unavoidable the necessary exemptions/approvals will be obtained. Size of dirty water areas are minimized and dirty water is contained in systems that allow the reuse and/or recycling of this dirty water Discharges of dirty water may only occur in accordance with authorisations that are issued in terms of the relevant legislation specifications and they must not result in negative health impacts for downstream surface water users. The relevant legislation specifications comprises any applicable authorisation/exemption, the National Water Act (36 of 1998) and Regulation 704, or any future amendment thereto; and 	On-going	On-going	Senior Operational Manager
Operation	Earthworks Civil works Prospecting and survey Site management Transport system Non-mineralised waste management Support services and amenities Open pit mining Shafts Backfilling with tailings Concentrators Chrome processing	H	M				

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
	Smelter complex Slag plant and dump Tailings dam Water supply infrastructure Power supply infrastructure Rehabilitation			<ul style="list-style-type: none"> The site wide water balance is refined on an on-going basis with the input of actual flow volumes and used as a decision making tool for water management and impact mitigation (Section 21.1.1). All hazardous chemicals, mineralized waste and non-mineralised waste must be handled in a manner that they do not pollute surface water. This will be implemented by means of the following <ul style="list-style-type: none"> 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 equipment 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. 	On-going	On-going	Senior Operational Manager
Decommission	Demolition Earthworks Civil works Site management Transport systems Non-mineralised waste management Support services and amenities Shaft waste rock dumps Tailings dams Slag dump Water supply infrastructure Power supply infrastructure Backfilling with tailings Rehabilitation	H	M	<ul style="list-style-type: none"> The designs of any permanent and potentially polluting structures (e.g. mineralised waste facilities) will take account of the requirements for long term surface water pollution prevention. Moreover, where these facilities are associated with groundwater plumes that have or will impact the quality of surface water resources, Impala will implement mitigation measures for as long as is needed to eliminate the risk and achieve the stated mitigation objectives. An example of such a solution is to pump and treat the polluted groundwater so that it does not impact surface water resources. A pilot study will be conducted with a representative sample of the final backfill material (with the correct proportions of tailings and binding agents) in both the consolidated (dried) and unconsolidated (wet) state, in order to determine if the tailings liquid will leach out. The results of this pilot study may require additional management measures to be implemented in order to prevent and minimise pollution from backfilling in No 17 and 18 Shaft mine voids Impala will monitor the water quality (Section 21.1.1) in all 	As required	As required	Senior Operational Manager
					Planning	Planning	Senior Operational Manager
					On-going	On-going	Senior Operational Manager

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
				<p>potentially affected surface water resources and use the monitoring results to implement appropriate prevention and mitigation measures to achieve surface water quality objectives.</p> <ul style="list-style-type: none"> Where monitoring results indicate that third party water supply has been polluted by Impala, an alternative equivalent water supply will be provided by Impala. Authorise all relevant water uses Comply with relevant license conditions In case of a major incident the emergency response procedure in Section 20.2 will be followed. 	On-going	On-going	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
					As required	As required	Senior Operational Manager
Closure	Maintenance and aftercare of final land forms and rehabilitation areas	H	M	<ul style="list-style-type: none"> Keep clean water and dirty water system separate Clean run-off and rainfall water is diverted around dirty areas and back into its normal flow in the environment Location of all activities and infrastructure should be outside of the specified zones and /or floodlines of water courses. If this is unavoidable the necessary exemptions/approvals will be obtained. Size of dirty water areas are minimized and dirty water is contained in systems that allow the reuse and/or recycling of this dirty water Discharges of dirty water may only occur in accordance with authorisations that are issued in terms of the relevant legislation specifications and they must not result in negative health impacts for downstream surface water users. The relevant legislation specifications comprises any applicable authorisation/exemption, the National Water Act (36 of 1998) and Regulation 704, or any future amendment thereto Authorise all relevant water uses Comply with relevant license conditions In case of a major incident the emergency response procedure in Section 20.2 will be followed. 	On-going	On-going	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
					As required	As required	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
					As required	As required	Senior Operational Manager

TABLE 54: ACTION PLAN – ALTERATION OF NATURAL DRAINAGE PATTERNS

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Earthworks Civil works Prospecting and survey Site management Transport systems Non-mineralised waste management Support services and amenities Rehabilitation	M-H	M-H	<ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> Clean water systems are separated from dirty water systems The size of dirty water areas are minimized and clean run-off and rainfall water is diverted around dirty areas and back into the normal flow in the environment The location of all activities and infrastructure should be outside of the specified zones and/or flood lines of watercourses. If this is unavoidable the necessary exemptions/approvals will be obtained. Comply with relevant license conditions Subject to water quality constraints, Impala will implement a system to control the release of water from Rockwall Dam with the objective of limiting downstream quantity impacts Stream and wetland crossings will be constructed in a manner so as not to impede the flow of water 	On-going	On-going	Senior Operational Manager
Operation	Earthworks Civil works Prospecting and survey Site management Transport systems Non-mineralised waste management Support services and amenities Open pit mining shafts Concentrators Chrome processing Smelter complex Slag plant and ump Tailings dams Water supply infrastructure Power supply infrastructure Rehabilitation	M-H	M-H		On-going On-going Construction Planning	On-going On-going Construction Planning	Senior Operational Manager Senior Operational Manager Senior Operational Manager Senior Operational Manager

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Decommission	Demolition Earthworks Civil works Site management Transport systems Non-mineralised waste management Support services and amenities Shaft waste rock dumps Tailings dams Slag dump Water supply infrastructure Power supply infrastructure Rehabilitation	M-H	M-H				
Closure	Maintenance and aftercare of final land forms and rehabilitated areas	M-H	M-L				

TABLE 55: ACTION PLAN – CONTAMINATION OF GROUNDWATER RESOURCES

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Earthworks Civil works Prospecting and survey Site management Transport systems Non-mineralised waste management Support services and amenities Rehabilitation	H	M-L	<ul style="list-style-type: none"> Impala will comply with both the National Water Act (36 of 1998) and Regulation 704 (4 June 1999) All hazardous chemicals (new and used), mineralized wastes and non-mineralised waste are handled in a manner that they do not pollute groundwater. This will be implemented by covering the following: <ul style="list-style-type: none"> Pollution prevention through basic infrastructure design Pollution prevention through maintenance of equipment 	On-going On-going	On-going On-going	Senior Operational Manager Senior Operational Manager

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Operation	Earthworks Civil works Prospecting and survey Site management Transport systems Non-mineralised waste management Support services and amenities Open pit mining Shafts Backfilling with tailings Concentrators Chrome processing Smelter complex Slag plant and ump Tailings dams Water supply infrastructure Power supply infrastructure Rehabilitation	H	M-L	<ul style="list-style-type: none"> Pollution prevention through education and training of workers (permanent and temporary) Pollution prevention through appropriate management of hazardous chemicals, materials and non-mineralised waste Required steps to enable containment and remediation of pollution incidents Specification for post rehabilitation audit criteria to ascertain whether the remediation has been successful and if not, to recommend and implement further measures Future infrastructure will be designed and implemented in a manner that pollution is prevented in all mine phases <ul style="list-style-type: none"> Existing infrastructure that has the potential to pollute groundwater will be identified and included into the groundwater management plan which will be implemented as part of the operational phase. The plan includes: <ul style="list-style-type: none"> The determining potential pollution sources, determining the extent of the pollution plume, Design and implement intervention measures to prevent, eliminate and/or control the pollution plume, Monitoring existing and potential impact zones to track pollution and mitigation impacts and Where pollution has negatively impacted on third parties, to supply an alternative equivalent supply 	On-going	On-going	Senior Operational Manager
Decommission	Demolition Earthworks Civil works Site management Transport systems Non-mineralised waste management Support services and amenities Shaft waste rock dumps Slag dump Tailings dams Water supply infrastructure Power supply infrastructure Rehabilitation	H	M-L	<ul style="list-style-type: none"> A pilot study will be conducted with a representative sample of the final backfill material (with the correct proportions of tailings and binding agents) in both the consolidated (dried) and unconsolidated (wet) state, in order to determine if the tailings liquid will leach out. The results of this pilot study may require additional management measures to be implemented in order to prevent and minimise pollution from backfilling in the No 17 and 18 Shaft mine voids Impala will implement a groundwater monitoring programme (Section 21.1.1) in order to monitor groundwater quality within the surface use area In case of a major incident the emergency response procedure in Section 20.2 will be followed. 	Planning	Planning	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
					As required	As required	Senior Operational Manager
Closure	Maintenance and aftercare of final land forms and rehabilitated	H	M-L	<ul style="list-style-type: none"> Future infrastructure will be designed and implemented in a manner that pollution is prevented in all mine phases 	As required	As required	Senior Operational Manager

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
	areas			<ul style="list-style-type: none"> In case of a major incident the emergency response procedure in Section 20.2 will be followed. 	As required	As required	Senior Operational Manager

TABLE 56: ACTION PLAN – DEPLETION OF GROUNDWATER THROUGH DEWATERING

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Shafts-sinking	L	L	<ul style="list-style-type: none"> All potentially affected third party boreholes will be included in the Impala groundwater monitoring program to ensure that changes in water depths can be identified. Where Impala's dewatering causes a loss of water supply to third parties an alternative equivalent water supply will be provided by Impala until such time as the dewatering impacts cease Impala will implement a groundwater monitoring programme (Section 21.1.1) in order to monitor groundwater quantity within the surface use area Comply with relevant license conditions. 	On-going	On-going	Senior Operational Manager
Operation	Open pit mining	L	L		As required	As required	Senior Operational Manager
Decommission	Shafts	L	L		On-going	On-going	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
Closure	IN/A	L		N/A	N/A	N/A	N/Q

TABLE 57: ACTION PLAN – AIR POLLUTION

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Site preparation	H	H	<ul style="list-style-type: none"> Impala will comply with the terms and conditions of air pollution authorisations/licenses. Impala will implement a dynamic air quality management plan that covers: the identification of sources and emissions inventory, the implementation of source based controls, the use of source and receptor based performance indicators and monitoring strategies, the use of source and receptor based mitigation measures, the use of internal and external auditing; and review and plan adjustment as required. Limit the disturbance of land to what is absolutely necessary Where possible roads will be paved and spillages of material on these paved roads must be routinely cleaned. Alternatively, Impala will apply dust suppression on 	On-going	On-going	Senior Operational Manager
	Earthworks				On-going	On-going	Senior Operational Manager
	Civil works						
	Prospecting and survey						
Operation	Site management						
	Transport systems						
	Non-mineralised waste management				On-going	On-going	Senior Operational Manager
	Support services and amenities				On-going	On-going	Senior Operational Manager
	Rehabilitation						
	Earthworks	H	H				
	Civil works						
	Prospecting and survey						

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
	Site management Transport systems Non-mineralised waste management Support services and amenities Open pit mining shafts Concentrators Chrome processing Smelter complex Slag plant and ump Tailings dams Water supply infrastructure Power supply infrastructure Rehabilitation			unpaved roads through chemical binding agents and/or water sprays combined with vehicle speed controls • Dust controls at the crushing and screening operation by water sprays and/or installing extraction hoods with filters or scrubbers • Dust controls at material handling points (loading and offloading) • Collection of spilled material and rehabilitation of areas where tailings spills occur along the pipe lines • Rehabilitation and re-vegetation of all decommissioned areas and of the side slopes of the operational tailings dams and new waste rock dumps • Maintenance of the SO ² and dust control infrastructure and systems that have been implemented at the smelter complex • Minimise dust emissions from operational tailings dam (e.g. by controlling deposition methodology and slag capping of exposed crests) • Maintenance of all vehicles to achieve optimal exhaust emissions.	On-going	On-going	Senior Operational Manager
Decommission	Site preparation Demolition Earthworks Civil works Site management Transport systems Non-mineralised waste management Support services and amenities Shafts waste rock dump Tailings dams Slag dump Rehabilitation	H	H	• The ambient and dust fallout monitoring programme will continue and the results thereof will be used to determine appropriate emission controls and other relevant mitigation interventions. • Impala will play an active role in regional organisations that exist for the purpose of addressing regional cumulative air impact concerns. • Impala will install non-ozone depleting substances in the refrigeration plants. • Implementation of an air complaints procedure • Impala will comply with its air quality monitoring procedures and air quality management procedures • In case of a major incident the emergency response procedure in Section 20.2 will be followed.	On-going	On-going	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
Closure	Maintenance and aftercare of final land forms and rehabilitated areas	H	M	• As part of closure planning the designs of any permanent and potentially polluting structures (particularly the mineralized waste facilities) will, on the basis of impact modeling, incorporate measures to address long-term pollution prevention and confirmatory monitoring. • In case of a major incident the emergency response procedure in Section 20.2 will be followed.	As required	As required	Senior Operational Manager
					As required	As required	Senior Operational Manager

TABLE 58: ACTION PLAN – INCREASE IN NOISE DISTURBANCE

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Site preparation Earthworks Civil works Prospecting and survey Transport system Rehabilitation	M	M	<ul style="list-style-type: none">All vehicles and equipment will be maintained to limit noise emissionsDocumentation of all noise complaints. Complaints need to be addressed and reasonable efforts made to address the area of concernReducing operation hours were possibleEquipping noise sources with silencersConstruction of noise attenuation measures such as noise berms and placing noise sources sub surfaceConsulting a noise specialist for mitigation adviceWhere necessary noise monitoring will be used as part of the investigatory process into noise complaints and as part of the assessment of the impact of mitigation and, if required, the alteration thereofImpala will monitor noise levels at ventilation shafts and at nearby receptorsEducation of workersRelocate farm workers shown in Figure 19 should the dwellers agree to this. Should the dwellers refuse an alternative agreement will be achieved and clearly documented.	On-going	On-going	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
Operation	Earthworks Civil works Prospecting and survey Transport system Open pit mining shafts Concentrators Chrome processing Smelter complex Slag plant Rehabilitation	M	M		As required	As required	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
					On-going	On-going	Senior Operational Manager
					As required	As required	Senior Operational Manager
					As required	As required	Senior Operational Manager
					As required	As required	Senior Operational Manager
Decommission	Demolition Earthworks Civil works Transport system Shaft waste rock dumps - crushing Rehabilitation	M	M		As required	As required	Senior Operational Manager
					As required	As required	Senior Operational Manager
Closure	N/A	-	-	-	-	-	

TABLE 59: ACTION PLAN – BLASTING IMPACTS

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Earthworks		M-L	<ul style="list-style-type: none"> Implementation of a blast management programme Conduct a pre-crack survey of structures within the potential impact zone Design of blasts to prevent injury to people and livestock and to prevent damage to structures. As a minimum the blast design will achieve: <ul style="list-style-type: none"> Fly rock zone limit of less than 500 m A peak particle velocity limit of less than 12 mm/s 	On-going	On-going	Senior Operational Manager
Operation	Open pit mining Shafts	H	M-L		As required	As required	Senior Operational Manager
Decommission	Demolition	H	M-L		On-going	On-going	Senior Operational Manager

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
				<p>at third party structures that are built according to building industry standards and which is further reduced in the case of third party structures that are not built according to building industry standards (such as the farm dwellings)</p> <ul style="list-style-type: none"> ○ An air blast limit of less than 125 dB at third party structures • Communication of the planned blast programme to interested and affected parties • Pre-blast warning and evacuation to clear people, traffic, moveable property and livestock from the potential impact zone • Blast monitoring to verify the effectiveness of the blast design and blast execution • Audit and review to adjust the blast design where necessary to achieve the stated objectives • Formal documented investigation and response for all third party blast related complaints • Remediation of all impacts caused by blasting • As a general rule, no blasting will take place within 500m of third party structures. Where Impala would like to blast in areas within this 500m distance, a project specific risk assessment will be completed and additional project specific mitigation measures will be implemented, subject to approval by the relevant stakeholders and/or authority(ies). • In case of a major incident the emergency response procedure in Section 20.2 will be followed. 	On-going	On-going	Senior Operational Manager
					As required	As required	Senior Operational Manager
					As required	As required	Senior Operational Manager
					As required	As required	Senior Operational Manager
					As required	As required	Senior Operational Manager
					As required	On-going	Senior Operational Manager Senior Operational Manager
					As required on-going	As required On-going	Senior Operational Manager
					As required	As required	Senior Operational Manager
Closure	N/A	-	-	-	-	-	-

TABLE 60: ACTION PLAN – TRAFFIC IMPACT

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Transport systems	H	M	<ul style="list-style-type: none"> • Education and awareness training • Maintenance of the transport system • Transnet will be contacted by Impala to evaluate the safety aspects associated with the intersection of the Transnet railway line and the Z532 and to implement the required intersection upgrades • Impala will facilitate communication between the North 	On-going	On-going	Senior Operational Manager
Operation	Transport systems	H	M		On-going	On-going	Senior Operational Manager
Decommission	Transport systems	H	M		On-going	On-going	Senior Operational Manager
					On going	On going	Senior Operational Manager

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
				<p>West Roads Department, municipal engineers (where relevant) and community leadership with a view to improving the safety of pedestrians on the private Impala roads. Options to consider in these discussions are:</p> <ul style="list-style-type: none"> Channelizing of pedestrians (especially school children) to selected pedestrian crossings Provision of signage to create awareness of pedestrian crossings Road safety education and awareness for pedestrians <ul style="list-style-type: none"> Implementation of traffic complaints procedure Implement speed allaying measures where required on Impala access roads Enforce strict speed limits on Impala access roads In case of a major incident the emergency response procedure in Section 20.2 will be followed. 	On-going As required	On-going As required	Senior Operational Manager Senior Operational Manager
					On-going As required	On-going As required	Senior Operational Manager Senior Operational Manager
Closure	N/A	-	-	-	-	-	-

TABLE 61: ACTION PLAN – VISUAL IMPACTS

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Site preparation	H	M	<ul style="list-style-type: none"> Limit the clearing of vegetation Limit the emission of visual air emission plumes (dust and stack fugitive emissions) Use of visual screening berms in areas where there are sensitive visual receptors On-going vegetation establishment on rehabilitated areas and the tailings dam and waste rock dump side slopes Painting infrastructure with colours that blend in with the surrounding environment where possible 	On-going	On-going	Senior Operational Manager
	Earthworks				On-going	On-going	Senior Operational Manager
	Civil works				On-going	On-going	Senior Operational Manager
	Prospecting and survey				On-going	On-going	Senior Operational Manager
	Site management				As required	As required	Senior Operational Manager
Operation	Transport systems						
	Non-mineralised waste management						
	Support services and amenities						
	Rehabilitation						
	Site preparation	H	M				
	Earthworks						
	Civil works						
	Prospecting and survey						
	Site management						
	Transport systems						

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
	Non-mineralised waste management Support services and amenities Open pit mining shafts Concentrators Chrome processing Smelter complex Slag plant and dump Tailings dams Water supply infrastructure Power supply infrastructure Rehabilitation						
Decommission	Site preparation Demolition Earthworks Civil works Site management Transport systems Non-mineralised waste management Support services and amenities Shafts waste rock dumps Concentrators Chrome processing Tailings dams Slag dump Water supply infrastructure Power supply infrastructure Rehabilitation	H	M	<ul style="list-style-type: none"> Implementation of the Impala closure plan which involves the removal of infrastructure, and the rehabilitation and re-vegetation of cleared areas and any final land forms that will remain post closure. 	As required	As required	Senior Operational Manager
Closure	Maintenance and aftercare of final land forms and rehabilitated areas	H	L	<ul style="list-style-type: none"> Final land forms will be managed through a care and maintenance programme to limit and/or enhance the long-term post closure visual impacts 	As required	As required	Senior Operational Manager

TABLE 62: ACTION PLAN – HERITAGE , PALEONTOLOGICAL AND CULTURAL RESOURCES

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Earthworks - for all surface infrastructure Site management Prospecting and survey Transport systems Support services and amenities Rehabilitation	M	L	<ul style="list-style-type: none"> Project infrastructure, activities and related disturbances will be limited as far as practically possible. Where future plans require a change in mine footprint, a project specific heritage study will be done to identify any project specific heritage and cultural resources that may be affected and to detail the mitigation plan where required All workers (temporary and permanent) will be educated about the heritage and cultural sites that may be encountered in their area of work and about the need to conserve these 	On-going	On-going	Senior Operational Manager
					As required	As required	Senior Operational Manager
Operation	Earthworks - for all surface infrastructure Prospecting and survey Site management Transport systems Non-mineralised waste management Support services and amenities Open pit mining Shafts waste rock dumps Chrome processing stockpiles Tailings dams Slag dump Water supply infrastructure Power supply infrastructure Rehabilitation	M	L	<ul style="list-style-type: none"> In the event that new heritage and/or cultural and/or paleontological resources are discovered, the mine will follow an emergency procedure, which includes the following: <ul style="list-style-type: none"> Work at the find will be stopped to prevent damage An appropriate heritage specialist will be appointed to assess the find and related impacts Permitting applications will be made to SAHRA, if required In the event that any graves are discovered, prior to damaging or destroying any identified graves, permission for exhumation and relocation of graves must be obtained from the relevant descendants (if known) and the relevant local and provincial authorities Refine the No 18 Shaft infrastructure layout by moving the electrical substation to avoid heritage sites LIA03 and LIA04 and provide a minimum of 50 m buffer In case of a major incident the emergency response procedure in Section 20 will be followed. Maintain communication with the RBA regarding the proposed Welbekend Heritage park and align the mine's future planning accordingly. 	As required	As required	Senior Operational Manager
					As required	As required	Senior Operational Manager
					Planning	Planning	Senior Operational Manager
					As required	As required	Senior Operational Manager
					As required	As required	Senior Operational Manager
Decommission	Demolition Earthworks - for all surface infrastructure Site management Transport systems Non-mineralised waste management Support services and amenities	M	L	<ul style="list-style-type: none"> In the event that any graves are discovered, prior to damaging or destroying any identified graves, permission for exhumation and relocation of graves must be obtained from the relevant descendants (if known) and the relevant local and provincial authorities In case of a major incident the emergency response procedure in Section 20 will be followed. Maintain communication with the RBA regarding the proposed Welbekend Heritage park and align the mine's future planning accordingly. 	As required	As required	Senior Operational Manager
					As required	As required	Senior Operational Manager
					As required	As required	Senior Operational Manager

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
	Shafts waste rock dumps Tailings dams Slag dump Water supply infrastructure Power supply infrastructure Rehabilitation						
Closure	N/A	-	-	-	-	-	-

TABLE 63: ACTION PLAN – ECONOMIC IMPACT (POSITIVE AND NEGATIVE)

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	All activities	H	H	<ul style="list-style-type: none"> • Impala (and its contractors) will hire local people from the closest communities where possible • Impala will extend its formal bursary and skills development programmes to the closest communities to increase the number of local skilled people and thereby increase the potential local employee base • Impala will ensure it procures local goods and services from the closest communities where possible • Impala will implement a procurement mentorship programme which provides support to local businesses from the enquiry to project delivery stages • Where farming land is lost to mining, the affected farmer(s) will be provided with alternative suitable land by facilitating discussions with the Royal Bafokeng Administration (RBA) and if this is not feasible alternative compensation will be provided • It identified and develops sustainable business opportunities and skills, independent from mining for members of the local communities to ensure continued economic prosperity beyond the life of mine. 	As required	As required	Stakeholder engagement department
Operation	All activities	H	H		On-going	On-going	Stakeholder engagement department
Decommission	All activities	H	H		On-going	On-going	Stakeholder engagement department
					On-going	On-going	Stakeholder engagement department
					As required	As required	Stakeholder engagement department
					As required	As required	Stakeholder engagement department
Closure	All activities	H	H	<ul style="list-style-type: none"> • Incorporation of economic consideration into its closure planning from the outset • Closure planning will consider the skilling of employees for the downscaling, early closure and long-term closure scenarios • Closure planning considerations cover the needs of future farming for the downscaling, early closure and long-term closure scenarios. 	As required	As required	Stakeholder engagement department
					As required	As required	Stakeholder engagement department
					As required	As required	Stakeholder engagement department

TABLE 64: ACTION PLAN – INWARD MIGRATION

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	All activities	H	H-M	<ul style="list-style-type: none"> In terms of recruitment, procurement and training: <ul style="list-style-type: none"> Good communication with all job and procurement opportunity seekers will be maintained throughout the recruitment process. The process must be seen and understood to be fair and impartial by all involved. The personnel in charge of resolving recruitment and procurement concerns must be clearly identified and accessible to potential applicants; The precise number of new job opportunities (permanent and temporary) and procurement opportunities will be made public together with the required skills and qualifications. The duration of temporary work will be clearly indicated and the relevant employees/contractors provided with regular reminders and revisions throughout the temporary period; Recruitment and procurement, by Impala and its contractors, will be preferentially provided to people in the communities where possible, which are closest to Impala. In order to be in a position to achieve this Impala will maintain a skills register of people within the closest communities. Impala will also preferentially provide bursaries and training to people that reside in these closest communities; There will be no recruitment or procurement at the gates of the mine. All recruitment will take place off site, at designated locations in the closest communities. All procurement will be through existing, established procurement and tendering processes that will include mechanisms for empowering service providers from the closest communities; Impala acknowledges that it is responsible for ensuring that its employees and contractors are housed in formal serviced housing. This will be achieved by: <ul style="list-style-type: none"> Allocating an accommodation or an allowance to all employees that can demonstrate that they live in formal housing; and By maintaining an employee profile (for Impala and contractor employees) that can be used as a tool to identify socio-economic concerns and plan long-term mitigation interventions 	On-going	On-going	Stakeholder engagement department
Operation	All activities	H	H-M		On-going	On-going	Stakeholder engagement department
Decommission	All activities	H	H-M		On-going	On-going	Stakeholder engagement department

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
				<ul style="list-style-type: none"> • Impala will work with its neighbours, local authorities and law enforcement officials to monitor and prevent the development of informal settlements near the mine and to assist where possible with crime prevention within the surface use area. • Impala will implement a health policy on HIV/ADS and tuberculosis. This policy will promote education, awareness and disease management both in the workplace and in the home so that the initiatives of the workplace have a positive impact on the communities from which employees are recruited. Partnerships will be formed with local and provincial authorities to maximise the off-site benefits of the policy. • Impala will work closely with the local and regional authorities, the Royal Bafokeng Administration and other mines/industry in the area to be part of the problem solving process that needs to address social service constraints. • Impala will implement a stakeholder communication, information sharing and grievance mechanism to enable all stakeholders to engage with Impala on both socio-economic and environmental issues. • The establishment of any informal settlements is considered to be an emergency situation that will be handled in accordance with the Impala emergency response procedure (Section 20.2) 	On-going	On-going	Stakeholder engagement department
					On-going	On-going	Stakeholder engagement department
					On-going	On-going	Stakeholder engagement department
					On-going	On-going	Stakeholder engagement department
					As required	As required	Stakeholder engagement department
Closure	N/A	-	-	-	-	-	-

TABLE 65: ACTION PLAN – LAND USE

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Site preparation	H	M	<ul style="list-style-type: none"> Impala will implement the EMP commitments with a view not only to prevent and/or mitigate the various environmental and social impacts, but also to prevent negative impacts on surrounding land uses. If a situation arises where any surrounding land use is negatively affected by the mine, Impala will take steps to prevent the impact. If the land use impact cannot be prevented, Impala will work with landowners in the area to provide alternative land that is acceptable to the affected land user for the land use. Alternatively, Impala will provide compensation for mine-related loss of land use. 	As required	As required	Senior Operational Manager
	Earthworks Civil works Prospecting and survey Site management Transport systems Non-mineralised waste management Support services and amenities Rehabilitation				As required	As required	Senior Operational Manager
Operation	Site preparation Earthworks Civil works Prospecting and survey Site management Transport systems Non-mineralised waste management Support services and amenities Open pit mining Shafts Concentrator Chrome processing Smelter complex Slag plant and dump Tailings dams Water supply infrastructure Power supply infrastructure Rehabilitation	H	M				
Decommission	Site preparation Demolition Earthworks Civil works Site management	H	M				

Phase of operation	Activities (see Table 32)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
	Transport systems Non-mineralised waste management Support services and amenities Tailings dams Slag dump Water supply infrastructure Power supply infrastructure Rehabilitation						
Closure	Maintenance and aftercare of final land forms and rehabilitated areas	H	L	<ul style="list-style-type: none"> Closure planning will incorporate measures to achieve the future land use plans for the land within the impala surface use area Impala will specifically liaise with the RBA regarding the closure of the tailings dam (No. 5) in order to minimise long-term land use impacts on the proposed heritage park 	As required	As required	Senior Operational Manager

20 PROCEDURES FOR ENVIRONMENTAL EMERGENCIES AND REMEDIATION

20.1 ONGOING MONITORING AND MANAGEMENT MEASURES

The on-going monitoring as described in Section 21 will be undertaken to provide early warning systems necessary to avoid environmental emergencies.

20.2 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 66).

20.2.1 GENERAL EMERGENCY PROCEDURE

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

- Applicable operational managers must be notified of an incident upon discovery
- Area to be cordoned off to prevent unauthorised access and tampering of evidence
- If residue facilities/dams, stormwater 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 safety 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 (DWA and DEA, DMR and Inspectorate of Mines as appropriate), the South African Police Services, the relevant fire prevention service, the provincial head of DEDECT, the head of the local municipality, the head of the regional DWA 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
- Assess the immediate and long term effects of the incident (environment and public health)
- Within 14 days the Environment department must report to the DWA and DEA, the provincial head of DEDECT, the regional manager of the DMR, the head of the local and district municipality, the head of the regional DWA office or any other relevant authority 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.

20.2.2 IDENTIFICATION OF EMERGENCY SITUATIONS

The site wide emergency situations that have been identified together with specific emergency response procedures are outlined in Table 66.

20.3 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 operations 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 66: EMERGENCY RESPONSE PROCEDURES

Item	Emergency Situation	Response in addition to general procedures
1	Spillage of chemicals, engineering substances and waste	<p>Where there is a risk that contamination will contaminate the land (leading to a loss of resource), surface water and/or groundwater, Impala will:</p> <ul style="list-style-type: none"> • Notify residents/users downstream of the pollution incident. • Identify and provide alternative resources should contamination impact adversely on the existing environment. • Cut off the source if the spill is originating from a pump, pipeline or valve (e.g. Tailings delivery pipeline, refuelling tanker) and the infrastructure 'made safe'. • Contain the spill (e.g. construct temporary earth bund around source such as road tanker). • Pump excess hazardous liquids on the surface to temporary containers (e.g. 210 litre drums, mobile tanker, etc.) for appropriate disposal. • Remove hazardous substances from damaged infrastructure to an appropriate storage area before it is removed/repared.
2	Discharge of dirty water to the environment	<p>Apply the principals listed for Item 1 above.</p> <p>To stop spillage from the dirty water system the mine will:</p> <ul style="list-style-type: none"> • Redirect excess water to other dirty water facilities where possible; • Pump dirty water to available containment in the clean water system, where there is no capacity in the dirty water system; and • Carry out an emergency discharge of clean water and redirect the spillage to the emptied facility. • Apply for emergency discharge as a last resort.
3	Pollution of surface water	<p>Personnel discovering the incident must inform the Environment department of the location and contaminant source.</p> <p>Apply the principals listed for Item 1 above.</p> <p>Absorbent booms will be used to absorb surface plumes of hydrocarbon contaminants.</p> <p>Contamination entering the surface water drainage system should be redirected into the dirty water system.</p> <p>The Environment department will collect in-stream water samples downstream of the incident to assess the immediate risk posed by contamination.</p>
4	Groundwater contamination	<p>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).</p> <p>Investigate the source of contamination and implement control/mitigation measures.</p>
5	Burst water pipes (loss of resource and erosion)	<p>Notify authority responsible for the pipeline (if not mine responsibility).</p> <p>Shut off the water flowing through the damaged area and repair the damage.</p> <p>Apply the principals listed for Item 1 above if spill is from the dirty/process water circuit.</p>
6	Flooding from failure of surface water control infrastructure	<p>Evacuate the area downstream of the failure.</p> <p>Using the emergency response team, rescue/recover and medically treat any injured personnel.</p> <p>Temporarily reinstate/repair stormwater diversions during the storm event (e.g. emergency supply of sandbags).</p>

Item	Emergency Situation	Response in addition to general procedures
		Close the roads affected by localised flooding or where a stormwater surge has destroyed crossings/bridges.
7	Risk of drowning from falling into water dams	Attempt rescue of individuals from land by throwing lifeline/lifesaving ring. Get assistance of emergency response team whilst attempting rescue or to carry out rescue of animals and or people as relevant. Ensure medical assistance is available to recovered individual.
8	Veld fire	Evacuate mine employees from areas at risk. Notify downwind residents and industries of the danger. Assist those in imminent danger/less able individuals to evacuate until danger has passed. Provide emergency fire fighting assistance with available trained mine personnel and equipment.
9	Overtopping or failure of the tailings dam	Sound the alarm to evacuate danger area. Pump water from top of dam and follow redirection of water as indicated in Item 2 above. Stop pumping tailings to the tailings facility. Recover casualties resulting from dam failure using the emergency response team. Make the remaining structure safe. Apply the principles of Item 1 above.
10	Falling into hazardous excavations	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.). The injured party should be recovered by trained professionals such as the mine emergency response team. 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)	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. Access to the area should be restricted and access roads cleared for the emergency response team. Vehicles must be made safe first by trained professionals (e.g. crushed or overturned vehicles). Casualties will be moved to safety by trained professionals and provided with medical assistance. Medical centres in the vicinity with appropriate medical capabilities will be notified if multiple seriously injured casualties are expected. A nearby vet should be consulted in the case of animal injury
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	Injury from fly rock	The person discovering the incident will contact the mine emergency response personnel to recover the injured person or animal and provide medical assistance.

Item	Emergency Situation	Response in addition to general procedures
		Whilst awaiting arrival of the emergency response personnel, first aid should be administered to the injured person by a qualified first aider if it is safe to do so.
14	Uncovering of graves and sites	Personnel discovering the grave or site must inform the Environment 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.
15	Uncovering of fossils	Personnel discovering the fossil or potential site must inform the Environment department immediately. Should any fossils be uncovered during the development of the site, a palaeontologist or paleoanthropologist will be consulted to identify the possibility for research.

21 PLANNED MONITORING AND EMP PERFORMANCE ASSESSMENT

21.1 PLANNED MONITORING OF ENVIRONMENTAL ASPECTS

Environmental aspects requiring monitoring are listed below:

- Water resources – see Section 21.1.1 for details
- Air – see Section 21.1.2 for details
- Biodiversity – see Section 21.1.3 for details
- Blasting – see Section 21.1.4 for details
- Tailings dam, waste dumps and other water dams – see Section 21.1.5 for details.

21.1.1 WATER RESOURCES

Impala has an existing extensive surface and groundwater monitoring programme that was developed in consultation with qualified specialists. Figure 35 sets out Impala's existing groundwater monitoring points within the surface use area as well as the frequency which water quality and quantity are measured, in addition to the new points related to the proposed project. Figure 36 sets out the existing and new surface water monitoring points. Surface water monitoring is conducted on a monthly basis. Table 67 sets out the parameters that are monitored. Water quality analysis results are classified in terms of the DWAF Guidelines Domestic Water Supply (1999), the DWAF Guidelines for livestock watering, IFC mining Effluent limits and the SANS guideline limits.

TABLE 67: MONITORING PARAMETERS FOR ANALYSIS AND REPORTING

In field measurements		
pH	Electrical conductivity	Water level
Laboratory analysis		
pH	Ammonium	Calcium
Electrical conductivity	Iron	Magnesium
Temperature	Lead	Sodium
Sulphate	Nickel	potassium
Total dissolved salts (TDS)	Zinc	Nitrate
Total alkalinity as CaCO ₃	Copper	Sodium absorption rate
Fluoride	Manganese	Total hardness as CaCO ₃
Phosphate	Chemical oxygen demand	Aluminium

Any boreholes that are not currently part of Impala's existing monitoring programme but may be required or any current boreholes affected during future projects will be incorporated and/or replaced in the groundwater monitoring programme.

If monitoring indicates a mine-related decrease in groundwater supply to third parties or groundwater quality at third party boreholes, appropriate measures will be taken to prevent the decrease from

occurring or rectify the contamination situation, to provide the affected third parties with an alternative water supply, and/or to possibly purchase affected farms.

FIGURE 35: GROUNDWATER MONITORING POINTS AND FREQUENCY

FIGURE 36: SURFACE WATER MONITORING POINTS

Process water

Process water quality from dirty water dams is monitored. The parameters to be monitored are outlined in Table 67 above.

Rainfall related discharges are monitored as required according to the parameters in Table 67. If the quality of the monitored discharge is above acceptable levels, additional measures will be identified and implemented to prevent the future potential for surface water related pollution.

Water balance

The water balance is updated on a monthly basis from recorded flow measurements and production figures.

21.1.2 AIR QUALITY

Impala has an existing monitoring programme aimed at monitoring selected ambient parameters, including dust fall-out as well as selected operational parameters at identified sources. This monitoring programme was developed in consultation with an appropriately qualified air specialist and monitors both source and receptor site. The air monitoring programme includes:

- The identification of sources
- The implementation of source based controls
- The use of source and receptor based performance indicators and monitoring strategies
- The use of source and receptor based mitigation measures
- The use of internal and external auditing
- Review and plan adjustment as required.

Impala Platinum operates various ambient monitoring stations which provide a good indication of ambient concentrations attributed to various activities and sources in and around our area of operation. Various meteorological parameters as well as PM₁₀ and SO₂ are measured at three stations located in Boshoeck, Luka, and at Impala Central Services Offices. In addition to selected meteorological parameters, SO₂ is also monitored at stations located at the old schools grounds of Lebone College and at Impala Shaft 7A. Refer to Figure 37 for the location of the ambient monitoring stations within and surrounding the surface use area.

Impala's existing dust fallout network comprises 36 monitoring points and is monitored on a monthly basis. Refer to Figure 37 for location of the existing and new dust fallout monitoring points. It should be noted that the precise location of the new dust monitoring points will be determined by a specialist.

FIGURE 37: AIR QUALITY MONITORING POINTS

21.1.3 BIODIVERSITY MONITORING PROGRAMME

On-going monitoring

Prior to the construction of any future project, detailed baseline studies of selected fauna and flora groups within the impact zone will be undertaken. During operation and decommissioning, Impala will implement a monitoring programme which will be aimed at monitoring selected indicator species. This monitoring, which will include the species selection and determination of monitoring intervals, will be performed by a specialist.

Alien invasive species programme

During operation, decommissioning and closure Impala will implement an alien/invasive /weed management programme to control the spread of these plants onto and from disturbed areas. This will be achieved by active eradication and the establishment of natural species and through on-going monitoring and assessment. The use of herbicides will be limited and focussed and will only be used under strict controls. Herbicides will be selected to ensure least residual harm. Herbicides will be administered by suitably qualified people.

Continued monitoring will be undertaken to ensure that the alien invasive species have been eradicated and are controlled for both controlled sites as well as rehabilitated areas. Repeat surveys should be carried out annually for at least the first three years post-rehabilitation.

Rehabilitation

For each area requiring rehabilitation specific landscape functionality objectives will be set with expert input and the associated targets and monitoring program will follow accordingly.

21.1.4 BLASTING

Prior to the construction phase of future projects, Impala will undertake a pre-blast baseline survey as detailed in the action plan (refer to Table 59).

Monitoring of each surface blast will take place for the duration of blasting activities. Points for off-site vibration and airblast monitoring will be identified in consultation with surrounding landowners and a blast monitoring specialist. The monitoring results will be documented and maintained for record-keeping and auditing purposes.

21.1.5 MINERALISED WASTE FACILITIES AND WATER DAMS

In addition to the abovementioned environmental monitoring programmes, all mineralised waste facilities and water dams will be monitored to ensure stability, safety and prevention of environmental impacts. The frequency of the monitoring and the qualification of the monitoring personnel will be determined on an infrastructure specific basis.

The findings will be documented for record-keeping and auditing purposes and addressed where relevant to achieve the stated objectives.

21.2 AUDITING AND PERFORMANCE ASSESSMENTS

The environmental consultant will ensure that internal management 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, an independent professional will conduct an EMP performance assessment every 2 years. The site's compliance with the provisions of the EMP and the adequacy EMP report relative to the on-site activities will be assessed in the performance assessment.

21.3 FREQUENCY FOR REPORTING

As a minimum, the following documents will be submitted to the relevant authorities from the start of construction until mine closure:

- EMP performance assessment, submitted every two years to DMR, or as specified by DMR
- Updated closure and rehabilitation cost estimate, submitted to the DMR in accordance with DMR requirements
- Water monitoring reports, submitted to DWA in accordance with the water use license
- Air quality monitoring reports, submitted to the relevant authority (currently under review) in accordance with the air emissions license
- Detailed plan for decommissioning/closure, submitted to DMR in accordance with DMR requirements.

22 FINANCIAL PROVISION

The information in this section was sourced from the closure cost calculation study completed by Etek (Appendix M).

22.1 PLAN SHOWING LOCATION AND AERIAL EXTENT OF PROPOSED OPERATION

A series of plans showing the location and aerial extent of the entire Impala operation, including the proposed new shafts, is provided in Figure 38.

22.2 ANNUAL FORECASTED FINANCIAL PROVISION

Should the proposed new tailings dam and open pit project currently being applied for under a separate EIA/EMP amendment process and this proposed project be approved, the consolidated scheduled liability will be **R 920 161 681.72** and the unscheduled liability will be **R 872 034 422.26**. The annual forecasted financial provision for the first 10 years of this proposed project, as well as the scheduled closure amount is provided in Table 68 below for the No 18 Shaft complex (which included the sewage treatment plant), as well as the No 17 STP and the central STP. This amount has been included in the total liability amounts calculated for scheduled and unscheduled closure provided above.

TABLE 68: SHAFT FINANCIAL PROVISION (ETEK, 2013)

Year	Financial provision (ZAR)		
	No 18 Shaft and linear infrastructure	No 17 Shaft STP and sewage pipeline	Central STP
1 (mid 2012)	26 822 097.19	602,416.57	1,974,406.15
2	58 511 602.87	602,416.57	1,974,406.15
3	58 511 602.87	602,416.57	1,974,406.15
4	58 511 602.87	602,416.57	1,974,406.15
5	58 511 602.87	602,416.57	1,974,406.15
6	58 511 602.87	602,416.57	1,974,406.15
7	58 511 602.87	602,416.57	1,974,406.15
8	58 511 602.87	602,416.57	1,974,406.15
9	58 511 602.87	602,416.57	1,974,406.15
10	58 511 602.87	602,416.57	1,974,406.15
Life of project (scheduled closure)	58 511 602.87	602,416.57	1,974,406.15

22.3 CONFIRMATION OF AMOUNT TO BE PROVIDED

Impala will liaise with DMR to determine the amount to be provided for.

22.4 METHOD OF PROVIDING FINANCIAL PROVISION

The funding method will be in accordance with the DMR methods.

FIGURE 38: SURFACE LAYOUT OF THE ENTIRE IMPALA OPERATION WITH THE NEW SHAFT

23 ENVIRONMENTAL AWARENESS PLAN

This section includes an environmental awareness plan for the 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 Impala are bound by the content of the EMP 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 EMP will remain with Impala.

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 Impala to achieve the objectives of the environmental policy.

23.1 ENVIRONMENTAL POLICY

Impala will display the environmental policy. To achieve world class environmental performance in a sustainable manner Impala is 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 Impala 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.

23.2 STEPS TO ACHIEVE THE ENVIRONMENTAL POLICY OBJECTIVES

Impala'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:
 - Impala 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 with the assistance of the appointed EMS Area Coordinator and the Area Waste Coordinator
 - 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 Impala 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 Department of Minerals Resources
 - 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:
 - Impala 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-Impala 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
 - Topography (hazardous excavations)
 - Soil and land capability management (loss of soil resource)
 - Management of biodiversity
 - Surface water management (alteration of surface drainage and pollution of surface water);
 - Groundwater management (reduction 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)
 - Surrounding land use (traffic management, blast management, land use loss)
 - Heritage resources (management of sites)
 - Socio-economic impacts (management of positive and negative impacts);
- All mine projects will be designed to minimise impact on the environment and to accomplish closure/rehabilitation objectives.
- Impala will maintain records of all environmental training, monitoring, incidents, corrective actions and reports.

23.3 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.

23.3.1 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 3 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
 - Impala'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
 - 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 in the open pits
 - 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 (including paleontological 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
 - Dust impacts on local communities (nuisance and health implications).
 - Impala's duty of care (specifically with respect to waste management); and
 - Purpose and function of Impala'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 Impala 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 Department Manager to ensure relevance
- Participate and organise events which promote environmental awareness, some of which will be tied to national initiatives e.g. National Labour Week, World Environment Day and National Water Week.

24 TECHNICAL SUPPORTING INFORMATION

Technical and supporting information included as appendices to this report, not already attached in terms of the EIA, are listed below:

- Calculation of financial closure liability report (Appendix M).

25 CAPACITY TO MANAGE AND REHABILITATE THE ENVIRONMENT

This section outlines the applicant's capacity to rehabilitate and manage negative impacts on the environment.

25.1 AMOUNT REQUIRED TO MANAGE AND REHABILITATE THE ENVIRONMENT

The mine manages the environmental impacts throughout the value chain and puts preventative and mitigating measures in place to achieve this. It is the mines policy to always adopt best practice and the capital budget provided by the mine to manage all identified environmental aspects for five year period from the 2012 financial year is R410 million.

25.2 AMOUNT PROVIDED FOR

The amount as outlined above has been provided for in the current mine budget.

26 UNDERTAKING SIGNED BY APPLICANT**COMMITMENT/UNDERTAKING BY APPLICANT**

I,.....

the undersigned and duly authorised thereto by

.....

undertake to adhere to the requirements and to the conditions set out in the approved EMP with the exception of the exemption(s) and amendment(s) agreed to be relevant by the Regional Manager: _____ (include relevant province).

Signed at:

On:

Signature:

Designation:

REGIONAL MANAGER: _____ REGION

In terms of the Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002) this document of is approved subject to the conditions as set out in the letter of approval.

Signed at:

On:

Signature:

Designation:

REGIONAL MANAGER: _____

27 ENVIRONMENTAL IMPACT STATEMENT & CONCLUSION

This document presents the proposed project plan as defined by Impala, presents findings of specialist studies, identifies and assesses potential impacts on the receiving environment in both the unmitigated and mitigated scenarios, including cumulative impacts, and identifies measures together with monitoring programmes to monitor and mitigate potential impacts.

A summary of the potential impacts (as per Section 7) associated with the proposed project, in the unmitigated and mitigated scenarios for all project phases is included in Table 69 below. The assessment of the proposed project presents the potential for significant impacts to occur on the bio-physical, cultural and socio-economic environments both on the site and in the surrounding area.

The project is expected to benefit nearby communities both directly and indirectly by allowing the mine to continue operating. Direct economic benefits will be derived from wages, taxes and profits. Indirect economic benefits will be derived from the procurement of goods and services and the increased spending power of employees. Some local negative socio-economic impacts are expected in the immediate vicinity of the mine if the mitigation as presented in Section 19 is not effectively implemented. The challenge facing Impala is to contribute to the positive benefits while at the same time preventing and/or mitigating potential negative social and environmental impacts as discussed in detail in Section 7.

TABLE 69: TABULATED SUMMARY OF POTENTIAL IMPACTS

Impact	Significance	
	Unmitigated	Mitigated
Hazardous excavations/structures/surface subsidence	High	Medium
Loss of soil resources and land capability through contamination	High	Low
Loss of soil resources and land capability through physical disturbance	Medium	Medium
Physical destruction of biodiversity	High	High – construction Medium – other phases
General disturbance of biodiversity	High	Medium – construction to decommissioning Low - closure
Alteration of drainage patterns	Medium	Medium
Pollution of surface water resources	High	Low
Dewatering	Low	Low
Contamination of groundwater	High	Low/Medium
Air pollution	High	Medium
Noise pollution	High	Low
Negative landscape and visual impacts	High	Low
Loss of current land uses	High	Medium
Blasting hazards	High	Medium
Project-related road use and traffic	High	Medium

Impact	Significance	
	Unmitigated	Mitigated
Destruction and disturbance of heritage (including cultural) and paleontological resources	High	Low
Economic impact (positive impact)	High +	High +
Inward migration impact	High	Medium
Relocation of farm dwellers	High	Low

Linda Munro (PrSciNat)
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Brandon Stobart (EAPSA)
(Project Reviewer)

SLR Africa (Pty) Ltd

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Steffan Robertson and Kirsten (SRK), 1997: Impala Bafokeng Mining Complex (IBMC) Environmental Management Programme Report, Report number 206741.

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Transvaal Nature Conservation Ordinance, No. 12 of 1983, Gauteng, November 1983

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APPENDIX A: STAKEHOLDER DATABASE

APPENDIX B: INFORMATION-SHARING WITH IAPS AND REGULATORY AUTHORITIES

- Landowner notification letter and proof of notification
- NEMA application form
- NEM:WA application form
- Background information document (in English and Setswana) for information-sharing purposes
- Site notice (in English and Setswana) and photos showing where site notices were displayed
- Advertisements in newspapers
- Correspondence from IAPs
- Focussed and public meeting minutes
- Meeting attendance registers
- Regulatory authorities meeting minutes
- Correspondence with relevant authorities
- Proof of submission of the scoping report
- Scoping report summary in English and Setswana
- Comments on the scoping report

APPENDIX C: ISSUES AND CONCERNS REPORT

APPENDIX D: BIODIVERSITY STUDIES

Specialist reports prepared by Scientific Aquatic Services, 2013.

APPENDIX E: HYDROLOGICAL STUDY

Specialist report prepared by SLR, 2013.

APPENDIX F: GEOHYDROLOGICAL STUDY

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APPENDIX G: NOISE STUDY

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APPENDIX H: VISUAL STUDY

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APPENDIX I: HERITAGE (INCLUDING CULTURAL ASPECTS) STUDY

Specialist report prepared by Dr Julius Pistorius, 2013

APPENDIX J: PALAEONTOLOGICAL STUDY

Specialist report prepared by BPI for Paleontological Research, June 2011

APPENDIX K: ALTERNATIVE LAND USE SUSTAINABILITY ASSESSMENT

Specialist report prepared by Strategy4Good, 2013.

APPENDIX L: SPECIALIST AIR QUALITY INPUT

APPENDIX M: CLOSURE COST CALCULATION STUDY

Specialist report prepared by Etek, 2013.

APPENDIX N: LIST OF IMPALA PROCEDURES

Procedure type	Description
Rehabilitation	To ensure that the required rehabilitation is undertaken.
Soil management	The consolidation of all procedures relating to soil and its associated groundwater management in order to effectively manage Impala's impact on soil and groundwater quality.
Water management	The consolidation of all procedures relating to water management and related issues in order to effectively manage the impact that Impala has on the local water resources
Air quality management	The consolidation of all procedures relating to air quality management and related issues in order to effectively manage the impact that Impala has on air quality.
Identification of environmental impacts and aspects	The procedures for the identification of all the environmental aspects of Impala's activities, products or services in order to control and over which to have an effluence of all possible operating conditions
Risk assessment	The methodology for the evaluation of the significance of resultant environmental impacts from Impala's activities, products and services
Air quality monitoring	To ensure that air quality monitoring at Impala conforms to all legal requirements and accepted guidelines. This includes various methods (continuous stack monitoring, random compliance sampling, ambient monitoring, dust fallout monitoring, ISO-Kinetic sampling, visual stack monitoring, electrostatic precipitator performance, acid plant and sulfacid plant performance), reporting, EMPR monitoring requirements and general requirements for monitoring, sampling and compliance assessment as specified in permit.
Water monitoring	To ensure that water monitoring conforms to all legal requirements and accepted guidelines. This includes various sampling methods, the general requirements of the water permit, monitoring requirements as set out in the approved EMP, reporting, and sampling positions and frequencies
Updating environmental management plan progress on database	Outlines the sequence that is followed for updating the progress towards achieving the EMP plans on the EMS database
Waste management	Provides an description of each waste type to ensure the correct management of all waste types generated is conducted in a responsible manner, the method of storage, handling and disposal method (re-cycling, re-use, treatment and or disposal) and the interaction with relevant departments were applicable

Procedure type	Description
Environmental incident formal root cause analysis	To define the method for undertaking the technique of a formal systematic root cause analysis to determine the root cause of an environmental incident to ensure that the adequate and effective remedial actions are taken
Sealing of surface holdings	Provides guidelines for the protection of workers and the public during the sealing of surface holdings on the sub-outcrop. In addition it takes cognisance of the protection and rehabilitation of the environment in the immediate surroundings of the surface holdings.
Spillage control guidelines	Outlines the current and proposed clean up procedures for all types of contamination resulting from all spillage incidents on site
Engineering operations and hazardous substance management	To ensure the engineering operation at the operating units does not result in significant pollution of water and soil.
Reporting and controlling of environmental incidents on the database	To define the sequence that is followed for the reporting, entering of audit action plans and updating the action plan progress on the EMS Database
Sulphuric acid and sulphuric acid plant break down and maintenance escalation procedure	Outlines the effective management of the air quality of the Impala Smelter operations in order to achieve: <ul style="list-style-type: none"> - SO₂ emissions as stipulated in the permit - Minimise impact of unplanned extraordinary events or breakdowns - Assign responsibilities to management personnel - Clarify escalation procedures and responsibilities - Effectively communicate any abnormal situations to all relevant parties
Unplanned main electrostatic precipitator failure – escalating procedure	To ensure the personnel and management know what and how to communicate in the event of all the main (furnace) electrostatic precipitators (ESP's) failing.
Acid plant spillage controls	The correct management of any spillages at the acid plant
Reporting and controlling of low pH effluent from acid plant and Omnia area	To define the sequence of events which have to be followed when low pH effluent has been detected at the inflow to the central sewage plant
Penstock discharge control	Regulating the control and response strategy to minimise the discharge of penstock return water to the Rockwall dam
Bottom dam overflow control	The control, monitoring and distribution of all Plant water within the Central concentrator
Environmental requirements for on-site contractors	To ensure that on site contractors are made aware of Impala's operations requirements to ensure that the Impala Policy requirements of legal compliance, prevention of pollution and continual improvement are met.
Vegetation management	To ensure the effective management of vegetation



RECORD OF REPORT DISTRIBUTION

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Proponent:	Impala Platinum Limited

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