

ENVIRONMENTAL MANAGEMENT PROGRAMME

Bosveld Phosphates (Pty) Ltd – Magnetite Waste Site Disposal



DECEMBER 2022



Purpose of Report

Bosveld Phosphates (Pty) Ltd requires a suitable waste disposal facility for the storage of magnetite waste for future use. Magnetite tailings are produced by two magnetite beneficiation plants on the Bosveld Phosphates (Pty) Ltd premises, where the beneficiation process entails the upgrading of magnetite (Fe_3O_4) from an average input feed to a concentrate. The upgraded magnetite concentrate is transported to clients off site. Non-magnetite tailings will be stored temporarily until it is processed through a copper flotation plant where copper mineral will be extracted. The waste produced from the copper extraction process needs to be disposed onto an authorised waste disposal facility.

Current value adding projects such as the pelletising of upgraded magnetite and developing of a Dense Medium Separation (DMS) product for the coal washing market is under investigation. If feasible, upgraded magnetite will be processed through these facilities before being transported off site.

This proposed project requires Environmental Authorisation (EA) in terms of the provisions of the National Environmental Management Act (NEMA) Act No. 107 of 1998, the National Environmental Management: Waste Act (NEMWA) Act No. 59 of 2008 as well as the National Water Act (NWA) Act No. 36 of 1998. Based on the nature of the proposed activities associated with this project, the necessary applications have to be supported *inter alia* by a Scoping and Environmental Impact Assessment and Reporting Process (S&EIR) as provided for in the Environmental Impact Assessment (EIA) Regulations of December 2014 (as amended). In this regard an application for an EA in terms of the NEMA and an application for a Waste Management Licence (WML) in terms of the NEMWA was made to the Limpopo Department of Economic Development, Environment and Tourism (LEDET) as the Competent Authority (CA). An application for the new water uses associated with this project (Water Use Licence (WUL)) will be submitted to the Department of Water and Sanitation (DWS). This report represents the Environmental Management Programme (EMPr) compiled in support of the S&EIR Process as provided for in the EIA Regulations. The content of this EMPr gives full compliance with the requirements for an EMPr as detailed in Appendix 4 of the EIA Regulations.

Report Reference Numbers

LEDET (NEMA) Ref: 12/1/9/2-M68
LEDET (NEMWA) Ref: 12/4/10/8-B/M5
JMA Project: JMA/10533
JMA Report: Prj6522
Date: December 2022

Report Status

Draft for I&AP Review

Compiled for

BOSVELD PHOSPHATES (PTY) LTD
Private Bag X01022
Ba-Phalaborwa
1390
(t): 015 780 6100
(f): 015 780 6103

Compiled by

JMA CONSULTING (PTY) LTD
15 Vickers Street
Delmas
2210
(t): 013 665 1788
(f): 013 665 2364
Mrs René van Greunen (EAP; Pr.Sci.Nat.)
rene@jmaconsult.co.za

TABLE OF CONTENTS

	Page
EXECUTIVE SUMMARY	i
1. DETAILS OF ENVIRONMENTAL PRACTITIONER (EAP).....	1
1.1. DETAILS OF THE EAP WHO PREPARED THE REPORT	1
1.2. EXPERTISE OF THE EAP.....	1
1.2.1. Qualifications of the EAP	1
1.2.2. Past Experience of the EAP	2
1.3. CV OF THE EAP.....	2
2. DESCRIPTION OF THE ASPECTS OF THE ACTIVITY	3
3. SITE MAP.....	4
4. IMPACT MANAGEMENT OBJECTIVES/OUTCOMES.....	6
5. DESCRIPTION OF IMPACT MANAGEMENT MEASURES/ ACTIONS.....	9
5.1. CONSTRUCTION PHASE IMPACT MANAGEMENT MEASURES TABLES	10
5.2. OPERATIONAL PHASE IMPACT MANAGEMENT MEASURES TABLES	33
5.3. DECOMMISSIONING AND CLOSURE PHASE IMPACT MANAGEMENT MEASURES TABLES	47
5.4. POST CLOSURE PHASE IMPACT MANAGEMENT MEASURES TABLES.....	59
6. COMPLIANCE MONITORING AND PERFORMANCE ASSESSMENT	67
7. ENVIRONMENTAL AWARENESS PLAN	72
8. INFORMATION REQUIRED BY COMPETENT AUTHORITY	73
9. UNDERTAKING BY EAP	75
9.1. CORRECTNESS OF INFORMATION IN REPORTS	75
9.2. INCLUSION OF COMMENTS AND INPUTS FROM I&AP'S.....	75
9.3. INCLUSION OF INPUTS AND RECOMMENDATIONS FROM SPECIALIST REPORTS	75
9.4. INFORMATION PROVIDED AND RESPONSES TO I&AP'S	75

LIST OF APPENDICES

APPENDIX 1(A): CV OF THE EAP



LIST OF ABBREVIATIONS AND ACRONYMS

AEL	:	Air Emission Licence
BPEO	:	Best Practice Environmental Option
BPM	:	Ba-Phalaborwa Municipality
CA	:	Competent Authority
CV	:	Curriculum Vitae
DWS	:	Department of Water and Sanitation
EA	:	Environmental Authorisation
EAP	:	Environmental Assessment Practitioner
EAPASA	:	Environmental Assessment Practitioners Association of South Africa
EIA	:	Environmental Impact Assessment
EIAR	:	Environmental Impact Assessment Report
EMP	:	Environmental Management Plan
EMPR	:	Environmental Management Programme Report
GISTM	:	Global Industry Standard on Tailings Management
GN	:	Government Notice
GNR	:	Government Notice Report
I&AP's	:	Interested and Affected Parties
IWWMP	:	Integrated Water and Waste Management Plan
LEDET	:	Limpopo Department of Economic Development, Environment and Tourism
LEMA	:	Limpopo Environmental Management Act (Act No. 7 of 2003)
MOL	:	Maximum Operating Level
MWSDF	:	Magnetite Waste Site Disposal Facility
NEMA	:	National Environmental Management Act (Act No. 107 of 1998)
NEMBA	:	National Environmental Management: Biodiversity Act (Act No. 10 of 2004)
NEMWA	:	National Environmental Management: Waste Act (Act No. 59 of 2008)
NFA	:	National Forests Act (Act No. 84 of 1998)
NWA	:	National Water Act (Act No. 36 of 1998)
PCD	:	Pollution Control Dam
PES	:	Present Ecological State
RQO	:	Resource Quality Objective
SACNASP	:	South African Council for Natural Scientific Professions
SANAS	:	South African National Accreditation System
S&EIR	:	Scoping and Environmental Impact Reporting
SHEQ	:	Safety, Health, Environment and Quality
WML	:	Waste Management Licence
WUL	:	Water Use Licence
WULA	:	Water Use Licence Application

EXECUTIVE SUMMARY

To be compiled after the EIA Phase Public Meeting





1. DETAILS OF ENVIRONMENTAL PRACTITIONER (EAP)

1.1. DETAILS OF THE EAP WHO PREPARED THE REPORT

Table 1.1(a): Details of the Environmental Assessment Practitioner (EAP)

Project Consultancy	JMA Consulting (Pty) Ltd
Company Registration	2005/039663/07
Professional Affiliation	Environmental Assessment Practitioners Association of South Africa (EAPASA - EAP 2019/943); South African Council for Natural Scientific Professions (SACNASP – Pr.Sci.Nat. 400291/12)
Contact Person	Mrs René van Greunen (Pr. Sci. Nat.)
Physical Address	15 Vickers Street DELMAS 2210
Postal Address	P O Box 883 DELMAS 2210
Telephone Number	+27 13 665 1788
Fax Number	+27 13 665 2364
E-mail	rene@jmaconsult.co.za

1.2. EXPERTISE OF THE EAP

The Environmental Assessment Practitioner (EAP) for this project was Mrs René van Greunen (Pr. Sci. Nat.).

1.2.1. Qualifications of the EAP

René van Greunen holds the following degrees:

- B.Sc. from the University of Pretoria (2006) with major subjects in Ecology.
- B.Sc. (Hons) from the University of Pretoria (2007) with field of specialisation Ecology (Invasion Biology).
- M.Sc. (cum laude) from the University of Pretoria (2010) with field of specialisation Ecology (Invasion Biology).

René van Greunen is registered as an Environmental Assessment Practitioner (EAP 2019/943) with the Environmental Assessment Practitioners Association of South Africa (EAPASA) in accordance with the prescribed criteria of Regulation 15(1) of the Section 24H Registration Authority Regulations (Regulation No. 849, Gazette No. 40154 of 22 July 2016, of the NEMA, Act No. 107 of 1998, as amended).

In addition, René holds a Professional Registration with South African Council for Natural Scientific Professions (SACNASP) since 2012 – 400291/12. René is registered as a professional scientist in the following category:

- Ecological Science

1.2.2. Past Experience of the EAP

René van Greunen started her working career as an Intern at the South African National Biodiversity Institute (SANBI) Threatened Biodiversity Research Programme followed by being employed as an Environmental Practitioner at Clean Stream Scientific Services.

René was appointed as a Scientist at JMA Consulting (Pty) Ltd in 2012 and has been responsible for the compilation of Basic Assessment Reports (BAR), Scoping and Plan of Study Reports, Environmental Impact Assessment Reports (EIAR) and Environmental Management Programme (EMPr) Reports.

Subsequently, René is also assisting with the development of Integrated Water and Waste Management Plans (IWWMP) and External Audit Reports on Water Use Licences (WUL) and Waste Management Licences (WML). In addition, René facilitates the Stakeholder Engagement Programmes as required by Environmental Management Legislation.

1.3. CV OF THE EAP

A Synoptic CV of the EAP is attached as **APPENDIX 1(A)** to this report.

2. DESCRIPTION OF THE ASPECTS OF THE ACTIVITY

A description of the aspects of the activities that are addressed in the EMPr as identified by the project description is provided below.

The details pertaining to the development and operation of the activities associated with the proposed project is relayed in section 4.3 of the EIAR and were perused to determine what particular aspect/action associated with the activity could potentially cause an impact.

Table 2(a) provides the aspects assessed for each activity for a specific life cycle phase.

Table 2(a): Aspect associated with the Project Activity per life cycle phase of the Project.

Activity	Activity Aspect			
	Construction Phase	Operational Phase	Decommissioning Phase	Post Closure Phase
Magnetite Waste Site Disposal Facility (MWSDF)	Clearance of Vegetation	Disposal of magnetite waste on top of facility	Decommissioning of Facility (Flatten and Shape Side Slopes, Install Suitable Capping Liner, Resoil, Re-Vegetate)	
		General disturbances		
	Topsoil Stripping and Stockpiling	Reticulation of Return Water from MWSDF		
	Construction of Facility			
Access Road to MWSDF	Clearance of Vegetation	Transport of Material	Decommissioning of Road (Flatten and Shape, Resoil, Re-Vegetate)	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner
	Topsoil Stripping and Stockpiling	Dust suppression		
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Clearance of Vegetation	Reticulation of contaminated Storm Water Runoff	Decommissioning of Dam (Dewatering of the dam, Removal of contaminated sediment on basin, Removal of liner, contaminated sediment and underlying layers, Flatten and Shape Dam Walls, Resoil, Re-Vegetate)	
	Topsoil Stripping and Stockpiling	Storage of contaminated Storm Water Runoff		
	Construction of Facility			
Copper Flotation Plant	Construction of Facility	Extraction of Copper	Decommissioning of Plant (Demolish and remove infrastructure, Flatten and Shape, Resoil, Re-Vegetate)	

3. SITE MAP

The site map compiled consists of the following:

- The localities and layouts of the proposed new activities including the structures and infrastructure as per the civil engineering designs.
- The environmental features (site sensitivities including buffers) associated with the project area of the preferred site.

A large-scale version of the site map is attached as **APPENDIX 12(A)** to the EIAR. A small-scale copy of the map is provided as Figure 3(a) below.

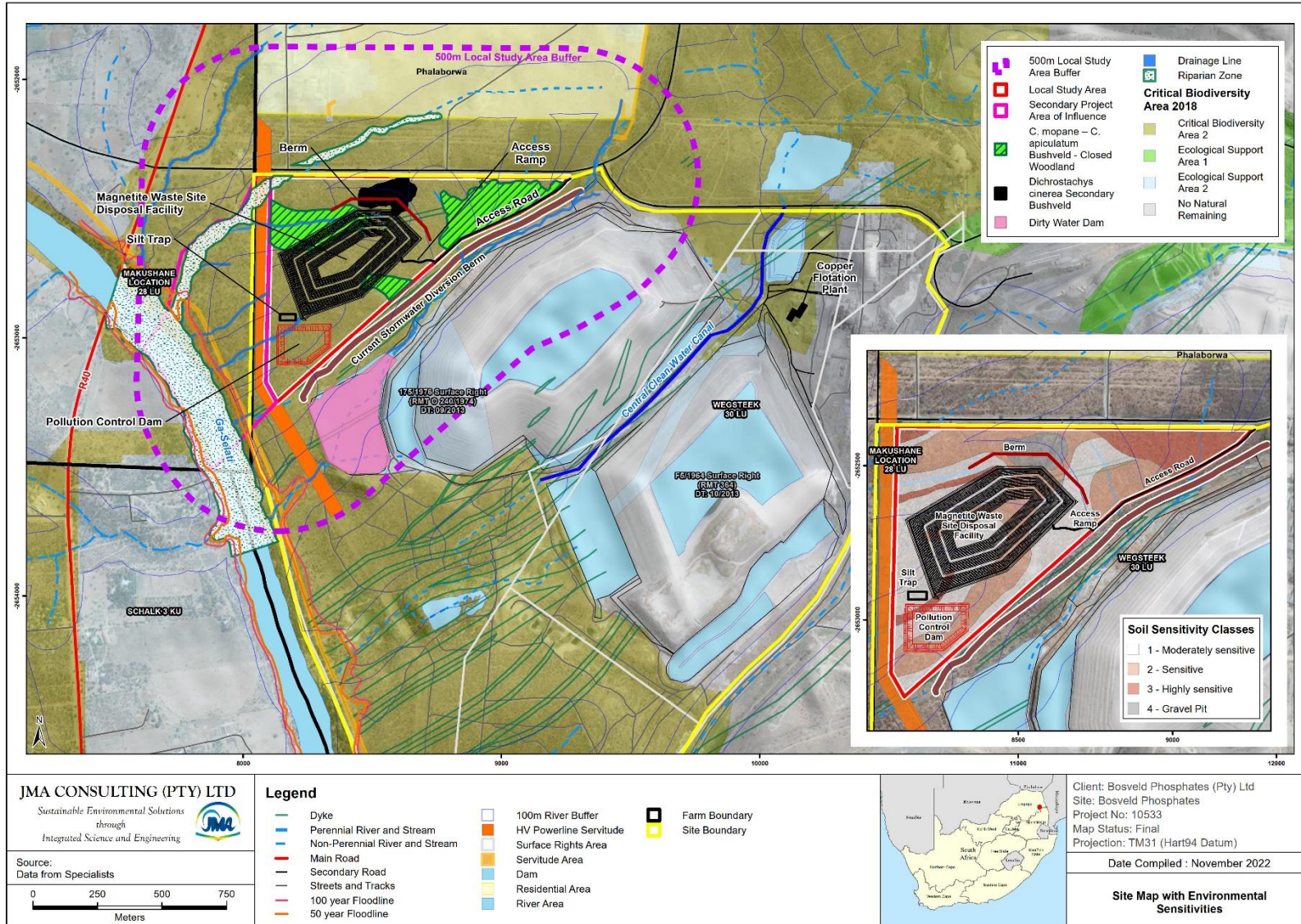


Figure 3(a): Site Map showing the Project Activities and Environmental Features

4. IMPACT MANAGEMENT OBJECTIVES/OUTCOMES

The section below provides a description of the impact management objectives and outcomes for each environmental component considered to be potentially impacted upon, during all the life - cycle phases of the proposed project.

The following environmental components were considered:

- Socio-Cultural and Socio-Economic
- Archaeology, Heritage and Palaeontology
- Soils, Land Capability and Land Use
- Geology and Groundwater
- Surface Water
- Terrestrial Ecology (Plant Life and Animal Life)
- Aquatic Ecosystems
- Wetlands
- Air Quality

Table 4(a): Management and Closure Objectives and Outcomes as per Environmental Component

Environmental Component	Management Objective	Construction Phase Management Outcomes	Operational Phase Management Outcomes	Decommissioning and Closure Phase Management Outcomes	Post Closure Phase Management Outcomes
Socio-Cultural/ Socio-Economic Environment	Positive community liaisons.	Optimise transparent and fair local recruitment processes. Minimise nuisance factors (dust and noise) of local communities.	Support local economic development objectives. Minimise nuisance factors (dust and noise) of local communities.	Mitigate local job losses. Minimise impact on land use.	Positive community liaisons.
Archaeological and Heritage Environment	Mitigate impact on the heritage resources.	Implement chance find procedures if any heritage resources are uncovered during construction activities.	Implement chance find procedures if any heritage resources are uncovered during operational activities.	Implement chance find procedures if any heritage resources are uncovered during decommissioning activities.	None.
Palaeontological Environment	Mitigate impact on the palaeontological resources (fossils).	Implement chance find procedures if any fossils are uncovered during construction activities.	Implement chance find procedures if any fossils are uncovered during operational activities.	Implement chance find procedures if any fossils are uncovered during decommissioning activities.	None.
Soils, Land Capability & Land Use	Soil fertility that allows for stable, self-sustaining vegetation cover.	Optimise stripping and storage of soils to ensure future utilisation.	Manage and control of footprint area to prevent further loss and contamination of the resource.	Replacement of utilisable soils and morphology, soil fertility and residual contamination.	Soil fertility that supports end land use.
Groundwater Environment	Prevent contamination of the groundwater resource.	Control and manage contamination of the resource (source control measure).	Groundwater quality to be compliant with the background groundwater quality profile / WUL conditions.	Groundwater quality to be compliant with the background groundwater quality profile / WUL conditions.	Groundwater quality to be compliant with the background groundwater quality profile / WUL conditions.
Surface Water Environment	Prevent contamination of receiving environment. Prevent erosion.	Prevent contamination of receiving environment. Ensure that clean storm water run-off is free-draining.	Dirty water to be contained in PCD's. Clean water to be diverted past contaminated areas. Water contained must comply with WUL conditions.	Prevent contamination of receiving environment. Ensure that clean storm water run-off is free-draining.	Surface water quality to be compliant with resource quality objectives / WUL conditions.
Terrestrial Ecology (Plant and Animal Life)	Ensure facilities are operated /rehabilitated as per approved designs and closure plans. Survivorship of replaced protected trees. Absence of invasive alien species.	Apply for protected trees licence (clearing permits). Restrict vegetation clearance to development footprint area. Develop and implement a suitable and approved rehabilitation programme. Actively manage fauna-human interactions.	Ensure optimal operation and maintenance of facilities. Implement an invasive species programme. Implement a suitable and approved rehabilitation programme. Actively manage fauna-human interactions.	Ensure optimal operation and maintenance of facilities. Implement an invasive species programme. Implement a suitable and approved rehabilitation programme. Actively manage fauna-human interactions.	Ensure facilities are rehabilitated as per approved closure plan. Ensure survivorship of replaced protected trees. Absence of invasive alien species.

Environmental Component	Management Objective	Construction Phase Management Outcomes	Operational Phase Management Outcomes	Decommissioning and Closure Phase Management Outcomes	Post Closure Phase Management Outcomes
Aquatic Ecosystems Environment	Prevent further degradation of the aquatic ecosystem health.	Minimise footprint of vegetation clearing. Ensure suitable bufferzone around watercourses. Minimise sediment mobilisation and runoff towards the Ga-Selati.	Maintain suitable bufferzone around watercourses. Prevent potential impacts on surface water quality. Monitor water quality and remedy appropriately.	Maintain suitable bufferzone around watercourses. Prevent potential impacts on surface water quality. Monitor water quality and remedy appropriately.	Ensure no further degradation of the aquatic ecosystem health by implementing on-going maintenance, aftercare and monitoring.
Wetland Environment	Maintain PES of the Ga-Selati riparian zone and other affected watercourses.	Minimise footprint of disturbance and vegetation clearing. Limit sediment transport from the project area. Prevent degradation of habitat due to water quality contamination. Minimise fragmentation of riparian and watercourse habitat. Prevent spread of alien invasive plant species.	Limit water quality impact by isolating contaminants from water resources and controlling contaminants at source.	Prevent further disturbance and degradation of watercourse habitats on site.	Maintain PES of the Ga-Selati riparian zone and other affected watercourses.
Air Quality Environment	Conditions and targets as per Bosveld Phosphates Air Quality Management Plan, the Atmospheric Emission License and National Standards.	Control through implementing appropriate dust suppression methods and administrative measures. Control through ensuring mobile and stationary internal combustion equipment is properly serviced and operated.	Control through implementing appropriate dust suppression methods and administrative measures. Control through ensuring mobile and stationary internal combustion equipment is properly serviced and operated.	Control through implementing appropriate dust suppression methods and administrative measures. Control through ensuring mobile and stationary internal combustion equipment is properly serviced and operated.	Control through implementing appropriate dust suppression methods and administrative measures. Control through ensuring mobile and stationary internal combustion equipment is properly serviced and operated.

5. DESCRIPTION OF IMPACT MANAGEMENT MEASURES/ ACTIONS

Tables relating the impacts and impact management associated with all the life cycle phases of the proposed project are provided below. In these tables, a description of the impact management objectives/ outcomes, a description of the proposed management actions, the standards to be achieved and compliance with prescribed and applicable environmental management standards or practices are provided.

The Impact Management Measures Tables follow from the Impact Significance Rating Tables provided in Chapter 10 of the EIAR. Each Table comprises of eight columns:

- Column 1: Project Activity
- Column 2: Activity Aspect
- Column 3: Environmental Aspect (Component) Affected
- Column 4: Potential Impact Description

These columns are followed by **the actual Management Measures** which comprises the following columns:

- Column 5: Management Objective/Outcome (Avoid, Modify, Remedy, Control, Stop)
- Column 6: Management Measures (Actions)
- Column 7: Standard to be Achieved
- Column 8: Compliance with Standards (Legal Requirements)

Impact Management Measures Tables compiled for the Construction Phase for each environmental component considered are relayed in Tables 5.1(a)-(h).

Impact Management Measures Tables compiled for the Operational Phase for each environmental component considered are relayed in Tables 5.2(a)-(h).

Impact Management Measures Tables compiled for the Decommissioning Phase for each environmental component considered are relayed in Tables 5.3(a)-(h).

Impact Management Measures Tables compiled for the Post Closure Phase for each environmental component considered are relayed in Tables 5.4(a)-(h).

5.1. CONSTRUCTION PHASE IMPACT MANAGEMENT MEASURES TABLES

Table 5.1(a): Construction Phase Impact Management Measures Table – Socio-Economic/Cultural

CONSTRUCTION PHASE IMPACT MANAGEMENT MEASURES TABLE – SOCIO-ECONOMIC/CULTURAL							
Activity	Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Proposed Activities	Construction of proposed activities	Socio-Economic	Employment and income.	Optimise recruitment of unskilled labour from local communities.	Recruit unskilled labour from local area.	100% unskilled from local BPM	None
Proposed Activities	Construction of proposed activities	Socio-Economic	Safety and security.	Follow a transparent and fair local recruitment process.	Work with local leaders (local business chamber, municipal and traditional authorities) in the procurement of local labour.	No conflict/issues raised in the local community related to the procurement process	None
					Develop and implement a clear communication strategy with local communities in terms of recruitment period and process.	No conflict/issues raised in the local community related to the procurement process	None
Proposed Activities	Construction of proposed activities	Socio-Economic	Nuisance factors.	Minimise nuisance factors (dust and noise) for local communities.	Establish communication channels with local landowners through which they can voice complaints during construction of activities.	Minimum complaints from local community	None
					Implement air quality management measures.	Complaints from local community resolved within acceptable time (e.g. month)	None
Proposed Activities	Construction of proposed activities	Socio-Economic	Informal and formal population influx.	Follow a transparent and fair local recruitment process.	Recruit unskilled labour from local area.	100% unskilled from local BPM	None
					Verify local status of applicants for unskilled labour through community representatives and reference letters.	100% unskilled from local BPM	None

Table 5.1(b): Construction Phase Impact Management Measures Table – Soils, Land Use and Land Capability

CONSTRUCTION PHASE IMPACT MANAGEMENT MEASURES TABLE – SOILS, LAND USE AND LAND CAPABILITY							
Activity	Construction Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF)	Clearance of Vegetation	Soil Fertility and change in Land Use Capability	Change in land use, loss of vegetative cover and the possible loss of the resource, sterilisation of the footprint and increased potential for erosion and impact of sedimentary load on downstream receptors.	Manage and control size of footprint of disturbance. Avoid excessive vehicle movement over unprotected soils. Control and manage storm water runoff and erosion. Manage contamination from hydrocarbon spillage.	Restrict vegetative clearing to design footprint.	International Best Practice Standards	Chamber of Mines Guidelines and International Best Practice Guidelines
					Limit vehicle movement to demarcated areas.		
					Strip and stockpile utilisable soils in berms as close as possible to area of re-use.		
					Clad and protect from wind and water erosion and ingress of dirty water.		
	Topsoil Stripping and Stockpiling	Change in Ecosystem Services and the potential Land Capability	Loss of ecosystem service and resource, de-nutrition and reduction in nutrient status and potential for compaction and erosion of unprotected materials.	Delineate area for storage of utilisable soils, protect from dirty water and dust ingress from windblown and storm water runoff from dirty areas. Control and manage erosion by wind and/or water. Avoid excessive vehicle movement over unprotected soils. Manage contamination from hydrocarbon spillage.	Any leaks and spillages are to be reported to the relevant personnel, after which the area is to be cleaned up accordingly.		
					Strip and stockpile utilisable soils in berms as close as possible to area of re-use.		
					Clad and protect from wind and water erosion and ingress of dirty water.		
					Include soil management as part of routine auditable housekeeping.		
	Construction of Facility	Loss of Ecosystem Services and Resource	Permanent loss and sterilisation of resource, potential for salinisation and contamination by dirty water runoff, reagent and hydrocarbon spills and the consequences for downstream receptors.	Manage and control size of footprint of disturbance. Avoid excessive vehicle movement over unprotected soils. Control and manage storm water runoff and erosion. Manage contamination from hydrocarbon spillage.	Limit vehicle movement to demarcated areas.		
					Strip and stockpile utilisable soils in berms as close as possible to area of re-use.		
					Clad and protect from wind and water erosion and ingress of dirty water.		
					Any leaks and spillages are to be reported to the relevant personnel, after which the area is to be cleaned up accordingly.		
Access Road to MWSDF	Clearance of Vegetation	Soil Fertility and change in Land Use Capability	Change in land use, loss of vegetative cover and the possible loss of the resource, sterilisation of the footprint and increased potential for erosion and impact of sedimentary load on downstream receptors.	Manage and control size of footprint of disturbance. Minimise erosion and compaction. Avoid excessive vehicle movement over unprotected soils. Control and manage storm water runoff and erosion. Manage contamination from hydrocarbon spillage.	Restrict vegetative clearing to design footprint.	International Best Practice Standards	Chamber of Mines Guidelines and International Best Practice Guidelines
					Limit vehicle movement to demarcated areas.		
					Stockpile soils as berms upslope along access road for use at closure.		
					Clad and protect from wind and water erosion and ingress of dirty water.		

CONSTRUCTION PHASE IMPACT MANAGEMENT MEASURES TABLE – SOILS, LAND USE AND LAND CAPABILITY

Activity	Construction Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Access Road to MWSDF	Topsoil Stripping and Stockpiling	Change in Ecosystem Services and the potential Land Capability	Loss of ecosystem service and resource, de-nutrition and reduction in nutrient status and potential for compaction and erosion of unprotected materials.	Delineate area for storage of utilisable soils, protect from dirty water and dust ingress from windblown and storm water runoff from dirty areas. Control and manage erosion by wind and/or water. Avoid excessive vehicle movement over unprotected soils. Manage contamination from hydrocarbon spillage.	Any leaks and spillages are to be reported to the relevant personnel, after which the area is to be cleaned up accordingly.	International Best Practice Standards	Chamber of Mines Guidelines and International Best Practice Guidelines
					Strip and stockpile utilisable soils in berms as close as possible to area of re-use. Strip soils with vegetative cover in tacked (inclusive of seed pool and organic matter).		
					Clad and protect from wind and water erosion and ingress of dirty water.		
					Include soil management as part of routine auditable housekeeping.		
					Limit vehicle movement to demarcated areas.		
Any leaks and spillages are to be reported to the relevant personnel, after which the area is to be cleaned up accordingly.							
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Clearance of Vegetation	Soil Fertility and change in Land Use Capability	Change in land use, loss of vegetative cover and the possible loss of the resource, sterilisation of the footprint and increased potential for erosion and impact of sedimentary load on downstream receptors.	Manage and control size of footprint of disturbance. Avoid excessive vehicle movement over unprotected soils. Control and manage storm water runoff and erosion. Manage contamination from hydrocarbon spillage.	Restrict vegetative clearing to design footprint.	International Best Practice Standards	Chamber of Mines Guidelines and International Best Practice Guidelines
					Limit vehicle movement to demarcated areas.		
					Strip and stockpile utilisable soils in berms as close as possible to area of re-use.		
					Clad and protect from wind and water erosion and ingress of dirty water.		
					Any leaks and spillages are to be reported to the relevant personnel, after which the area is to be cleaned up accordingly.		
	Topsoil Stripping and Stockpiling	Change in Ecosystem Services and the potential Land Capability	Loss of ecosystem service and resource, de-nutrition and reduction in nutrient status and potential for compaction and erosion of unprotected materials.	Delineate area for storage of utilisable soils, protect from dirty water and dust ingress from windblown and storm water runoff from dirty areas. Control and manage erosion by wind and/or water. Avoid excessive vehicle movement over unprotected soils. Manage contamination from hydrocarbon spillage.	Strip and stockpile utilisable soils in berms as close as possible to area of re-use.		
					Clad and protect from wind and water erosion and ingress of dirty water.		
					Include soil management as part of routine auditable housekeeping.		
					Limit vehicle movement to demarcated areas.		
	Construction of Facility	Loss of Ecosystem Services and Resource	Permanent loss and sterilisation of resource, potential for salinisation and contamination by dirty water runoff,	Manage and control size of footprint of disturbance. Avoid excessive vehicle movement over unprotected soils.	Any leaks and spillages are to be reported to the relevant personnel, after which the area is to be cleaned up accordingly.		
					Restrict vegetative clearing to design footprint.		
					Limit vehicle movement to demarcated areas.		
					Strip and stockpile utilisable soils in berms as close as possible to area of re-use.		

CONSTRUCTION PHASE IMPACT MANAGEMENT MEASURES TABLE – SOILS, LAND USE AND LAND CAPABILITY							
Activity	Construction Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
			reagent and hydrocarbon spills and the consequences for downstream receptors.	Control and manage storm water runoff and erosion. Manage contamination from hydrocarbon spillage.	Clad and protect from wind and water erosion and ingress of dirty water. Any leaks and spillages are to be reported to the relevant personnel, after which the area is to be cleaned up accordingly.		
Copper Flotation Plant	Construction of Facility	Loss of Ecosystem Services and Resource	Loss and sterilisation of resource, potential for salinisation and contamination by dirty water runoff, reagent and hydrocarbon spills and the consequences for downstream receptors.	Manage and control size of footprint of disturbance. Avoid excessive vehicle movement over unprotected soils. Control and manage storm water runoff and erosion. Manage contamination from hydrocarbon spillage.	Restrict vegetative clearing to design footprint.	International Best Practice Standards	Chamber of Mines Guidelines and International Best Practice Guidelines
					Limit vehicle movement to demarcated areas.		
					Strip and stockpile utilisable soils in berms as close as possible to area of re-use.		
					Clad and protect from wind and water erosion and ingress of dirty water. Any leaks and spillages are to be reported to the relevant personnel, after which the area is to be cleaned up accordingly.		

Table 5.1(c): Construction Phase Impact Management Measures Table – Groundwater

CONSTRUCTION PHASE IMPACT MANAGEMENT MEASURES TABLE – GROUNDWATER							
Activity	Construction Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF)	Construction of Facility	Groundwater: Quality	Deterioration of the groundwater resource quality due to spillages and infiltration of fuel (hydrocarbons) from the fuel tanks of construction vehicles.	Control and manage hydrocarbon spillage and contamination of resource (source control measure).	Responsible personnel to inspect the construction vehicles for potential fuel leaks. (Source Control Measure)	No spillages and subsequent seepage into the groundwater	Quality/ Conditions as per WUL
					Any leaks and spillages are to be reported to the relevant personnel, after which the area is to be cleaned up accordingly. (Source Control Measure)		Quality/ Conditions as per WUL
Access Road to MWSDF	Construction of Facility	Groundwater: Quality	Deterioration of the groundwater resource quality due to spillages and infiltration of fuel (hydrocarbons) from the fuel tanks of construction vehicles.	Control and manage hydrocarbon spillage and contamination of resource (source control measure).	Responsible personnel to inspect the construction vehicles for potential fuel leaks. (Source Control Measure)	No spillages and subsequent seepage into the groundwater	Quality/ Conditions as per WUL
					Any leaks and spillages are to be reported to the relevant personnel, after which the area is to be cleaned up accordingly. (Source Control Measure)		Quality/ Conditions as per WUL
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Construction of Facility	Groundwater: Quality	Deterioration of the groundwater resource quality due to spillages and infiltration of fuel (hydrocarbons) from the fuel tanks of construction vehicles.	Control and manage hydrocarbon spillage and contamination of resource (source control measure).	Responsible personnel to inspect the construction vehicles for potential fuel leaks. (Source Control Measure)	No spillages and subsequent seepage into the groundwater	Quality/ Conditions as per WUL
					Any leaks and spillages are to be reported to the relevant personnel, after which the area is to be cleaned up accordingly. (Source Control Measure)		Quality/ Conditions as per WUL
Copper Flotation Plant	Construction of Facility	Groundwater: Quality	Deterioration of the groundwater resource quality due to spillages and infiltration of fuel (hydrocarbons) from the fuel tanks of construction vehicles.	Control and manage hydrocarbon spillage and contamination of resource (source control measure).	Responsible personnel to inspect the construction vehicles for potential fuel leaks. (Source Control Measure)	No spillages and subsequent seepage into the groundwater	Quality/ Conditions as per WUL
					Any leaks and spillages are to be reported to the relevant personnel, after which the area is to be cleaned up accordingly. (Source Control Measure)		Quality/ Conditions as per WUL

Table 5.1(d): Construction Phase Impact Management Measures Table – Surface Water

CONSTRUCTION PHASE IMPACT MANAGEMENT MEASURES TABLE – SURFACE WATER							
Activity	Construction Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF)	Clearance of Vegetation	Surface Water: Quality	Contamination of the surface water resource due to increased sediment load from cleared area directly into the surface water resource.	Control by maintaining suitable bufferzones (temporary berms) around activity footprint.	Construct an earth berm around the proposed development footprint prior to vegetation clearance.	Surface water quality to be compliant with resource quality objectives	Quality/ Conditions as per WUL
	Topsoil Stripping and Stockpiling	Surface Water: Quality	Contamination of the surface water resource due to increased sediment load from cleared area directly into the surface water resource.	Control by maintaining suitable bufferzones (temporary berms) around activity footprint.	Construct an earth berm around the proposed development footprint prior to topsoil stripping.	Surface water quality to be compliant with resource quality objectives	Quality/ Conditions as per WUL
	Construction of Facility	Surface Water: Quality	Contamination of the surface water resource due to contamination from construction activities/ material/ vehicles.	Control potential migration of construction activities (diesel and oil) into the surface run-off through a spillages control and clean-up procedure.	Prevent spillage of fuel and oils by using drip trays and storing hazardous substances and vehicles in bunded areas.	Surface water quality to be compliant with resource quality objectives	Quality/ Conditions as per WUL
Access Road to MWSDF	Topsoil Stripping and Stockpiling	Surface Water: Quality	Contamination of the surface water resource due to contaminated run-off from “dirty areas” directly into the surface water resources.	Control by maintaining suitable bufferzones around watercourses.	Ensure contaminated run-off from stripped area are contained not to pollute surface water.	Surface water quality to be compliant with resource quality objectives	Project site water balance
Pollution Control Dam (PCD) and associated infrastructure (including the silt trap)	Clearance of Vegetation	Surface Water: Quality	Contamination of the surface water resource due to increased sediment load from cleared area directly into the surface water resource.	Control by maintaining suitable bufferzones (temporary berms) around activity footprint.	Construct an earth berm around the proposed development footprint prior to vegetation clearance.	Surface water quality to be compliant with resource quality objectives	Quality/ Conditions as per WUL
	Topsoil Stripping and Stockpiling	Surface Water: Quality	Contamination of the surface water resource due to increased sediment load from cleared area directly into the surface water resource.	Control by maintaining suitable bufferzones (temporary berms) around activity footprint.	Construct an earth berm around the proposed development footprint prior to topsoil stripping.	Surface water quality to be compliant with resource quality objectives	Quality/ Conditions as per WUL
	Construction of Facility	Surface Water: Quality	Contamination of the surface water resource due to contamination from construction activities/ material/ vehicles.	Control potential migration of construction activities (diesel and oil) into the surface run-off through a spillages control and clean-up procedure.	Prevent spillage of fuel and oils by using drip trays and storing hazardous substances and vehicles in bunded areas.	Surface water quality to be compliant with resource quality objectives	Quality/ Conditions as per WUL
Copper Flotation Plant	Construction of Facility	Surface Water: Quality	Contamination of the surface water resource due to contamination from construction activities/ material/ vehicles.	Control potential migration of construction activities (diesel and oil) into the surface run-off through a spillages control and clean-up procedure.	Prevent spillage of fuel and oils by using drip trays and storing hazardous substances and vehicles in bunded areas.	Surface water quality to be compliant with resource quality objectives	Quality/ Conditions as per WUL

Table 5.1(e): Construction Phase Impact Management Measures Table – Terrestrial Ecology

CONSTRUCTION PHASE IMPACT MANAGEMENT MEASURES TABLE – TERRESTRIAL ECOLOGY							
Activity	Construction Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF)	Clearance of Vegetation	Flora & Fauna: Habitat and Diversity	Loss and disturbance of habitat due to site clearance. Estimated extent of habitat loss/disturbance is 16.7 ha of <i>C. mopane</i> – <i>C. apiculatum</i> Bushveld & 0.8 ha of <i>D. cinerea</i> Secondary Bushveld.	Control by restricting vegetation clearance to development footprint area. Control by re-establishing indigenous vegetation on rehabilitated areas.	Vegetation clearing should be restricted to the proposed development (MWSDF & Berm) footprints only, with no clearing permitted outside of these areas.	No unnecessary clearance/loss of natural habitat	Footprint Area as per Design Report
					The areas to be cleared should be clearly demarcated to prevent any unnecessary clearing outside of these areas.	No unnecessary clearance/loss of natural habitat	Footprint Area as per Design Report
					Remove and stockpile topsoil to actively rehabilitate all disturbed areas.	No loss of topsoil	Best Practise Guidelines
					Develop and implement a suitable rehabilitation programme. The programme should include stabilisation and active revegetation of all disturbed areas using locally occurring indigenous grass and tree species.	Minimise exposed soil surfaces through active revegetation	Best Practise Guidelines
	Clearance of Vegetation	Fauna: Habitat and Diversity	Fragmentation of habitat causing disruption of fauna movement/dispersal corridors.	Control by restricting vegetation clearance to development footprint area. Control by re-establishing indigenous vegetation on rehabilitated areas.	Vegetation clearing should be restricted to the proposed development footprints only, with no clearing permitted outside of these areas.	No unnecessary clearance/loss of natural habitat	Footprint Area as per Design Report
					The areas to be cleared should be clearly demarcated to prevent any unnecessary clearing outside of these areas.	No unnecessary clearance/loss of natural habitat	Footprint Area as per Design Report
					Remove and stockpile topsoil to actively rehabilitate all disturbed areas.	No loss of topsoil	Best Practise Guidelines
					Develop and implement a suitable rehabilitation programme. The programme should include stabilisation and active revegetation of all disturbed areas using locally occurring indigenous grass and tree species.	Minimise exposed soil surfaces through active revegetation	Best Practise Guidelines
	Clearance of Vegetation & Topsoil Stripping	Flora: Habitat and Diversity	Establishment and spread of alien invasive species resulting from the removal of indigenous vegetation and soil disturbances.	Control potential impacts by implementing an invasive species programme. Remedy by rehabilitating disturbed areas.	Develop and implement an alien invasive species control programme that includes a combined approach using both chemical and mechanical control methods, and periodic follow-up treatments that are informed by regular monitoring.	Minimise on-site populations of alien invasive species	Alien and Invasive Species Regulations
					Revegetate all disturbed areas using locally occurring indigenous grass and tree species.	Minimise exposed soil surfaces	Best Practise Guidelines
	Clearance of Vegetation	Flora: Species of conservation concern (Protected Trees)	Loss of protected tree species located in construction footprints.	Control potential impacts by limiting the number of protected trees that require clearing to a minimum. Apply for the correct clearing permits.	Wherever possible, avoid clearing protected trees by positioning infrastructure around individual trees/tree groupings.	No unnecessary clearing of protected trees	Best Practise Guidelines
					Apply for and obtain clearing permits from the relevant national and/or provincial authority to clear protected trees that occur within the development footprint.	Only clear protected trees under the correct permit	National Forest Act (1998) & Limpopo Environmental Management Act (2003)

CONSTRUCTION PHASE IMPACT MANAGEMENT MEASURES TABLE - TERRESTRIAL ECOLOGY							
Activity	Construction Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF)	Clearance of Vegetation	Flora: Species of conservation concern (Protected Trees)	Loss of protected tree species located in construction footprints.	Implement a conservation plan that includes the planting of juvenile protected trees during rehabilitation.	Protected tree species should be included in the mix of woody species used during rehabilitation at a ratio of 2:1 (i.e., 2 juvenile replacement protected trees per 1 mature tree lost during vegetation clearing).	Successful recruitment of protected tree	N/A
					Replacement protected trees should be sourced from local nurseries, or a permit to collect and germinate seeds on-site should be obtained from the relevant authorities. Propagation and out-planting should be optimally timed and accompanied by correct post-planting care to ensure tree survival and recruitment.	Successful recruitment of protected trees	N/A
	Clearance of Vegetation Topsoil Stripping & Construction of Facility	Fauna: Diversity	Direct mortality and disturbance of fauna as a consequence of construction activities, including vehicle collisions, trapping in excavations, hunting/ snaring and sensory disturbance.	Control potential impacts by actively managing fauna-human interactions, and implementing minimisation measures and awareness training for all on-site workers.	An ECO should be on-site during vegetation clearing to monitor and manage any wildlife-human interactions. The ECO should be trained in inter alia, fauna species identification and snake handling.	Minimise human-wildlife interactions	Best Practise
					As appropriate, barriers should be erected to prevent fauna gaining access to construction trenches and voids where they may become trapped.	Minimise potential for trapping of wildlife in infrastructure	Best Practise
					A low-speed limit (recommended 20-40 km/h) should be enforced on-site to reduce wildlife-collisions.	On-site Health and Safety	Best Practise
					The handling, poisoning and killing of on-site fauna by workers and contractors must be strictly prohibited. Employees and contractors should be made aware of the presence of, and rules regarding fauna, through suitable induction training and on-site signage.	Minimise incidents of hunting/snaring by on-site workers	Best Practise
					General noise abatement equipment should be fitted to any excessively noisy machinery and vehicles.	Minimise excessive noise from machinery	Norms and Standards
					Ensure that all proposed project infrastructure is correctly designed to prevent any potential spills/seepage of waste material and other pollutants from entering into drainage lines and the Ga-Selati River.	Minimise potential incidents of seepage/spills	Engineering design specifications
	Construction of Facility	Flora & Fauna: Habitat and Diversity	Contamination of downstream riparian habitat resulting from pollution spills or leaks from construction equipment and waste containers.	Control impact by ensuring all built facilities are correctly designed.	Implement additional safety measures, such as storm water infrastructure to separate clean/dirty water, pollution traps, to further prevent any contamination/ pollution entering drainage lines and the Ga-Selati River.	Minimise risk of potential pollution seepage/spills entering into the environment	Approved Design Drawings and Report
					Regularly inspect and maintain all facilities and infrastructure associated with waste storage and conveyance to ensure operational effectiveness.	Minimise potential incidents of seepage/spills	Norms and Standards
					Ensure that all construction waste and chemicals used on-site are correctly stored.	Minimise potential incidents of seepage/spills	Norms and Standards

CONSTRUCTION PHASE IMPACT MANAGEMENT MEASURES TABLE - TERRESTRIAL ECOLOGY							
Activity	Construction Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF)	Construction of Facility	Flora & Fauna: Habitat and Diversity	Contamination of downstream riparian habitat.	Minimise and remedy impacts through effective emergency response planning and implementation.	Develop and implement an emergency response and clean-up plan for any waste/pollution leakages and spills.	Minimise risk of potential pollution seepage/spills entering into the environment	Norms and Standards
Access Road to MWSDF	Clearance of Vegetation	Flora & Fauna: Habitat and Diversity	Loss and disturbance of habitat due to site clearance. Estimated extent of habitat loss/disturbance is 0.5 ha of <i>C. mopane</i> – <i>C. apiculatum</i> Bushveld.	Control by restricting vegetation clearance to development footprint area. Remedy by fully re-establishing indigenous vegetation on rehabilitated areas during decommissioning and closure.	Vegetation clearing should be restricted to the proposed development footprints only, with no clearing permitted outside of these areas.	No unnecessary clearance/loss of natural habitat	Footprint Area as per Design Report
					The areas to be cleared should be clearly demarcated to prevent any unnecessary clearing outside of these areas.	No unnecessary clearance/loss of natural habitat	Footprint Area as per Design Report
					Remove and stockpile topsoil to actively rehabilitate all disturbed areas.	No loss of topsoil	Best Practise Guidelines
					Develop and implement a suitable rehabilitation programme. The programme should include stabilisation and active revegetation of all disturbed areas using locally occurring indigenous grass and tree species.	Minimise exposed soil surfaces through active revegetation	Best Practise Guidelines
	Clearance of Vegetation & Topsoil Stripping	Flora: Habitat and Diversity	Establishment and spread of alien invasive species resulting from the removal of indigenous vegetation and soil disturbances.	Control potential impacts by implementing an invasive species programme. Remedy by rehabilitating disturbed areas.	Develop and implement an alien invasive species control programme that includes a combined approach using both chemical and mechanical control methods, and periodic follow-up treatments that are informed by regular monitoring.	Minimise on-site populations of on-site alien invasive species	Alien and Invasive Species Regulations
					Revegetate all disturbed areas using locally occurring indigenous grass and tree species.	Minimise exposed soil surfaces	Best Practise Guidelines
	Clearance of Vegetation	Flora: Species of conservation concern (Protected Trees)	Loss of protected tree species located in construction footprints.	Control potential impacts by limiting the number of protected trees that require clearing to a minimum. Apply for the correct clearing permits. Implement a conservation plan that includes the planting of juvenile protected trees during rehabilitation.	Wherever possible, avoid clearing protected trees by positioning infrastructure around individual trees/tree groupings.	No unnecessary clearing of protected trees	Best Practise Guidelines
					Apply for and obtain clearing permits from the relevant national and/or provincial authority to clear protected trees that occur within the development footprint.	Only clear protected trees under the correct permit	National Forest Act (1998) & Limpopo Environmental Management Act (2003)
					Protected tree species should be included in the mix of woody species used during rehabilitation at a ratio of 2:1 (i.e., 2 juvenile replacement protected trees per 1 mature tree lost during vegetation clearing).	Successful recruitment of protected trees	N/A
					Replacement protected trees should be sourced from local nurseries, or a permit to collect and germinate seeds on-site should be obtained from the relevant authorities. Propagation and out-planting should be optimally timed and accompanied by correct post-planting care to ensure tree survival and recruitment.	Successful recruitment of protected trees	N/A

CONSTRUCTION PHASE IMPACT MANAGEMENT MEASURES TABLE - TERRESTRIAL ECOLOGY							
Activity	Construction Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Access Road to MWSDF	Clearance of Vegetation Topsoil Stripping & Construction of Facility	Fauna: Diversity	Direct mortality and disturbance of fauna as a consequence of construction activities, including vehicle collisions, trapping in excavations, hunting/ snaring and sensory disturbance.	Control potential impacts by actively managing fauna-human interactions, and implementing minimisation measures and awareness training for all on-site workers.	An ECO should be on-site during vegetation clearing to monitor and manage any wildlife-human interactions. The ECO should be trained in inter alia, fauna species identification and snake handling.	Minimise human-wildlife interactions	Best Practise
					As appropriate, barriers should be erected to prevent fauna gaining access to construction trenches and voids where they may become trapped.	Minimise potential for trapping of wildlife in infrastructure	Best Practise
					A low-speed limit (recommended 20-40 km/h) should be enforced on-site to reduce wildlife-collisions.	On-site Health and Safety	Best Practise
					The handling, poisoning and killing of on-site fauna by workers and contractors must be strictly prohibited. Employees and contractors should be made aware of the presence of, and rules regarding fauna, through suitable induction training and on-site signage.	Minimise incidents of hunting/snaring by on-site workers	Best Practise
					General noise abatement equipment should be fitted to any excessively noisy machinery and vehicles.	Minimise excessive noise from machinery	Norms and Standards
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Clearance of Vegetation	Flora & Fauna: Habitat and Diversity	Loss and disturbance of habitat due to site clearance. Estimated extent of habitat loss/ disturbance is 3.9 ha of <i>C. mopane</i> – <i>C. apiculatum</i> Bushveld.	Control by restricting vegetation clearance to development footprint area. Remedy by fully re-establishing indigenous vegetation on rehabilitated areas during decommissioning and closure.	Vegetation clearing should be restricted to the proposed development footprints (PCD and associated infrastructure) only, with no clearing permitted outside of these areas.	No unnecessary clearance/loss of natural habitat	Footprint Area as per Design Report
					The areas to be cleared should be clearly demarcated to prevent any unnecessary clearing outside of these areas.	No unnecessary clearance/loss of natural habitat	Footprint Area as per Design Report
					Remove and stockpile topsoil to actively rehabilitate all disturbed areas.	No loss of topsoil	Best Practise Guidelines
					Develop and implement a suitable rehabilitation programme. The programme should include stabilisation and active revegetation of all disturbed areas using locally occurring indigenous grass and tree species.	Minimise exposed soil surfaces through active revegetation	Best Practise Guidelines
	Clearance of Vegetation	Fauna: Habitat and Diversity	Fragmentation of habitat causing disruption of fauna movement/ dispersal corridors.	Control by restricting vegetation clearance to development footprint area. Remedy by re-establishing indigenous vegetation on rehabilitated areas.	Vegetation clearing should be restricted to the proposed development footprints only, with no clearing permitted outside of these areas.	No unnecessary clearance/loss of natural habitat	Footprint Area as per Design Report
					The areas to be cleared should be clearly demarcated to prevent any unnecessary clearing outside of these areas.	No unnecessary clearance/loss of natural habitat	Footprint Area as per Design Report
					Remove and stockpile topsoil to actively rehabilitate all disturbed areas.	No loss of topsoil	Best Practise Guidelines
					Develop and implement a suitable rehabilitation programme. The programme should include stabilisation and active revegetation of all disturbed areas using locally occurring indigenous grass and tree species.	Minimise exposed soil surfaces through active revegetation	Best Practise Guidelines

CONSTRUCTION PHASE IMPACT MANAGEMENT MEASURES TABLE - TERRESTRIAL ECOLOGY							
Activity	Construction Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Clearance of Vegetation & Topsoil Stripping	Flora: Habitat and Diversity	Establishment and spread of alien invasive species resulting from the removal of indigenous vegetation and soil disturbances.	Control potential impacts by implementing an invasive species programme. Remedy by rehabilitating disturbed areas.	Develop and implement an alien invasive species control programme that includes a combined approach using both chemical and mechanical control methods, and periodic follow-up treatments that are informed by regular monitoring.	Minimise on-site populations of on-site alien invasive species	Alien and Invasive Species Regulations
					Revegetate all disturbed areas using locally occurring indigenous grass and tree species.	Minimise exposed soil surfaces	Best Practise Guidelines
	Clearance of Vegetation	Flora: Species of conservation concern (Protected Trees)	Loss of protected tree species located in construction footprints.	Control potential impacts by limiting the number of protected trees that require clearing to a minimum. Apply for the correct clearing permits. Implement a conservation plan that includes the planting of juvenile protected trees during rehabilitation.	Wherever possible, avoid clearing protected trees by positioning infrastructure around individual trees/tree groupings.	No unnecessary clearing of protected trees	Best Practise Guidelines
					Apply for and obtain clearing permits from the relevant national and/or provincial authority to clear protected trees that occur within the development footprint.	Only clear protected trees under the correct permit	National Forest Act (1998) & Limpopo Environmental Management Act (2003)
					Protected tree species should be included in the mix of woody species used during rehabilitation at a ratio of 2:1 (i.e., 2 juvenile replacement protected trees per 1 mature tree lost during vegetation clearing).	Successful recruitment of protected trees	N/A
					Replacement protected trees should be sourced from local nurseries, or a permit to collect and germinate seeds on-site should be obtained from the relevant authorities. Propagation and out-planting should be optimally timed and accompanied by correct post-planting care to ensure tree survival and recruitment.	Successful recruitment of protected trees	N/A
					An ECO should be on-site during vegetation clearing to monitor and manage any wildlife-human interactions. The ECO should be trained in inter alia, fauna species identification and snake handling.	Minimise human-wildlife interactions	Best Practise
	Clearance of Vegetation Topsoil Stripping & Construction of Facility	Fauna: Diversity	Direct mortality and disturbance of fauna as a consequence of construction activities, including vehicle collisions, trapping in excavations, hunting/ snaring and sensory disturbance.	Control potential impacts by actively managing fauna-human interactions, and implementing minimisation measures and awareness training for all on-site workers.	As appropriate, barriers should be erected to prevent fauna gaining access to construction trenches and voids where they may become trapped.	Minimise potential for trapping of wildlife in infrastructure	Best Practise
					A low-speed limit (recommended 20-40 km/h) should be enforced on-site to reduce wildlife-collisions.	On-site Health and Safety	Best Practise
					The handling, poisoning and killing of on-site fauna by workers and contractors must be strictly prohibited. Employees and contractors should be made aware of the presence of, and rules regarding fauna, through suitable induction training and on-site signage.	Minimise incidents of hunting/snaring by on-site workers	Best Practise
					General noise abatement equipment should be fitted to any excessively noisy machinery and vehicles.	Minimise excessive noise from machinery	Norms and Standards

CONSTRUCTION PHASE IMPACT MANAGEMENT MEASURES TABLE - TERRESTRIAL ECOLOGY							
Activity	Construction Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Construction of Facility	Flora & Fauna: Habitat and Diversity	Contamination of downstream riparian habitat resulting from pollution spills or leaks from construction equipment and waste containers.	Control impact by ensuring all built facilities are correctly designed. Remedy impacts through effective emergency response planning and implementation.	Ensure that all proposed Project infrastructure are correctly designed to prevent any potential spills/seepage of waste material and other pollutants from entering into drainage lines and the Ga-Selati River.	Minimise potential incidents of seepage/spills	Approved Design Drawings and Report
					Implement additional safety measures, such as storm water infrastructure to separate clean/dirty water, pollution traps, to further prevent any contamination/ pollution entering drainage lines and the Ga-Selati River.	Minimise risk of potential pollution seepage/spills entering into the environment	Approved Design Drawings and Report
					Regularly inspect and maintain all facilities and infrastructure associated with waste storage and conveyance to ensure operational effectiveness.	Minimise potential incidents of seepage/spills	Norms and Standards
					Ensure that all construction waste and chemicals used on-site are correctly stored.	Minimise potential incidents of seepage/spills	Norms and Standards
					Develop and implement an emergency response and clean-up plan for any waste/pollution leakages and spills.	Minimise risk of potential pollution seepage/spills entering into the environment	Norms and Standards

Table 5.1(f): Construction Phase Impact Management Measures Table – Aquatic Ecosystems

CONSTRUCTION PHASE IMPACT MANAGEMENT MEASURES TABLE – AQUATIC ECOSYSTEMS							
Activity	Construction Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF)	Clearance of Vegetation	Surface Water: Quality	Degradation of aquatic ecosystems due to sediment mobilisation, run-off from site and potential erosion.	Minimise footprint of vegetation clearing and ensure limited sediment mobilisation and run-off towards the Ga-Selati.	Restrict vegetation clearing to the proposed development footprints, no clearing permitted outside of these areas. Silt traps should be placed down-slope of vegetation stripping will to minimise siltation in rivers. Maintain silt traps regularly to ensure effective drainage.	Restrict impact to development footprint area and appropriate buffer zone	Approved Design Drawings and Report
					Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	No decline in current PES compared to DWS, 2014 and the baseline conditions	Conditions/ quality as per WUL
					Develop suitable rehabilitation programme as per terrestrial ecologist findings and implement in all disturbed areas. Programme should include active re-vegetation, using locally occurring indigenous grass and tree species.	No visible signs of erosion or of alien invasive plant species	Best Practise Guidelines
					Earth mobilisation activities should preferably be conducted during the dry season (limit the intensity of impact, particularly in terms of runoff of sediments).	No visible signs of erosion or run-off	Best Practise Guidelines
	Topsoil Stripping and Stockpiling	Surface Water: Quality	Degradation of aquatic ecosystems due to sediment mobilisation, run-off from site and potential erosion. Changes/ deterioration of water quality (within the Ga-Selati River).	Ensure suitable bufferzone around watercourses. No stockpiling within bufferzone or riparian zone of the Ga-Selati (36m from the watercourse). Minimise footprint and residence time of topsoil stockpiles.	Restrict vegetation clearing to the proposed development footprints, no clearing permitted outside of these areas.	Restrict impact to development footprint area and appropriate buffer zone	Approved Design Drawings and Report
					Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	No decline in current PES compared to DWS, 2014 and the baseline conditions	Conditions/ quality as per WUL
					Develop suitable rehabilitation programme as per terrestrial ecologist findings and implement in all disturbed areas. Programme should include active re-vegetation, using locally occurring indigenous grass and tree species.	No visible signs of erosion or of alien invasive plant species	Best Practise Guidelines
					Earth mobilisation activities should preferably be conducted during the dry season (limit the intensity of impact, particularly in terms of runoff of sediments).	No visible signs of erosion or run-off	Best Practise Guidelines
		Aquatic habitats	Loss/ or alteration of habitat: mainly in-stream channel habitat - limited riparian habitat. Increase in erosion within the riparian zone. Increased sedimentation smothering in-stream habitats and reducing availability of biotopes.	Ensure suitable bufferzone around watercourses. No stockpiling within bufferzone or riparian zone of the Ga-Selati (36m from the watercourse). Minimise footprint and residence time of topsoil stockpiles.	Restrict vegetation clearing to the proposed development footprints, no clearing permitted outside of these areas.	Restrict impact to development footprint area and appropriate buffer zone	Approved Design Drawings and Report
					Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	No decline in current PES compared to DWS, 2014 and the baseline conditions	Conditions/ quality as per WUL
				Develop suitable rehabilitation programme as per terrestrial ecologist findings and implement in all disturbed areas. Programme should include active re-vegetation, using locally occurring indigenous grass and tree species.	No visible signs of erosion or of alien invasive plant species	Best Practise Guidelines	

CONSTRUCTION PHASE IMPACT MANAGEMENT MEASURES TABLE – AQUATIC ECOSYSTEMS

Activity	Construction Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF)	Topsoil Stripping and Stockpiling	Aquatic biota	Loss of ecological communities.	Ensure suitable bufferzone around watercourses. No stockpiling within bufferzone or riparian zone of the Ga-Selati (36m from the watercourse). Minimise footprint and residence time of topsoil stockpiles.	Restrict vegetation clearing to the proposed development footprints, no clearing permitted outside of these areas.	Restrict impact to development footprint area and appropriate buffer zone	Approved Design Drawings and Report
					Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	No decline in current PES compared to DWS, 2014 and the baseline conditions	Conditions/ quality as per WUL
					Develop suitable rehabilitation programme as per terrestrial ecologist findings and implement in all disturbed areas. Programme should include active re-vegetation, using locally occurring indigenous grass and tree species.	No visible signs of erosion or of alien invasive plant species	Best Practise Guidelines
	Construction of Facility	Surface Water: Quality	Alteration of drainage patterns of cleared area and area immediate adjacent to it.	Ensure a suitable bufferzone around watercourses. No construction activities or storage of infrastructure within bufferzone or riparian zone of the Ga-Selati (36m from the watercourse). Implement dust control measures on all dirt roads.	Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	No decline in current PES compared to DWS, 2014 and the baseline conditions	Conditions/ quality as per WUL
					Earth mobilisation activities should preferably be conducted during the dry season (limit the intensity of impact, particularly in terms of runoff of sediments).	No visible signs of erosion or run-off	Best Practise Guidelines
		Aquatic habitats	Loss/ or alteration of habitat: mainly in-stream channel habitat - limited riparian habitat. Increase in erosion within the riparian zone. Increased sedimentation smothering in-stream habitats and reducing availability of biotopes.	Minimise sediment mobilisation and run-off towards the Ga-Selati.	Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	No decline in current PES compared to DWS, 2014 and the baseline conditions	Conditions/ quality as per WUL
					Ensure suitable bufferzone around watercourses and minimise sediment mobilisation and run-off towards the Ga-Selati.	Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	No decline in current PES compared to DWS, 2014 and the baseline conditions

CONSTRUCTION PHASE IMPACT MANAGEMENT MEASURES TABLE – AQUATIC ECOSYSTEMS							
Activity	Construction Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Access Road to MWSDF	Clearance of Vegetation	Surface Water: Quality	Degradation of aquatic ecosystems due to sediment mobilisation, run-off from site and potential erosion.	Minimise the footprint of vegetation clearing and ensure limited sediment mobilisation and run-off towards the Ga-Selati.	Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	No decline in current PES compared to DWS, 2014 and the baseline conditions	Conditions/ quality as per WUL
					Develop suitable rehabilitation programme as per terrestrial ecologist findings and implement in all disturbed areas. Programme should include active re-vegetation, using locally-occurring indigenous grass and tree species.	No visible signs of erosion or of alien invasive plant species	Best Practise Guidelines
					Earth mobilisation activities should preferably be conducted during the dry season (limit the intensity of impact, particularly in terms of runoff of sediments).	No visible signs of erosion or run-off	Best Practise Guidelines
	Topsoil Stripping and Stockpiling	Surface Water: Quality	Degradation of aquatic ecosystems due to sediment mobilisation, run-off from site and potential erosion. Changes/ deterioration of water quality (within the Ga-Selati River).	Minimise footprint and residence time of topsoil stockpiles.	Restrict vegetation clearing to the proposed development footprints, no clearing permitted outside of these areas.	Restrict impact to development footprint area and appropriate buffer zone	Approved Design Drawings and Report
					Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	No decline in current PES compared to DWS, 2014 and the baseline conditions	Conditions/ quality as per WUL
					Develop suitable rehabilitation programme as per terrestrial ecologist findings and implement in all disturbed areas. Programme should include active re-vegetation, using locally-occurring indigenous grass and tree species.	No visible signs of erosion or of alien invasive plant species	Best Practise Guidelines
					Earth mobilisation activities should preferably be conducted during the dry season (limit the intensity of impact, particularly in terms of runoff of sediments).	No visible signs of erosion or run-off	Best Practise Guidelines
	Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Clearance of Vegetation	Surface Water: Quality	Degradation of aquatic ecosystems due to sediment mobilisation, run-off from site and potential erosion.	Minimise footprint of vegetation clearing.	Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	No decline in current PES compared to DWS, 2014 and the baseline conditions
Develop suitable rehabilitation programme as per terrestrial ecologist findings and implement in all disturbed areas. Programme should include active re-vegetation, using locally-occurring indigenous grass and tree species.						No visible signs of erosion or of alien invasive plant species	Best Practise Guidelines
Earth mobilisation activities should preferably be conducted during the dry season (limit the intensity of impact, particularly in terms of runoff of sediments).						No visible signs of erosion or run-off	Best Practise Guidelines
Topsoil Stripping and Stockpiling		Surface Water: Quality	Degradation of aquatic ecosystems due to sediment mobilisation, run-off from site and potential erosion.	Maintain suitable bufferzones around watercourses. Minimise footprint and residence time of topsoil stockpiles.	Restrict vegetation clearing to the proposed development footprints, no clearing permitted outside of these areas.	Restrict impact to development footprint area and appropriate buffer zone	Approved Design Drawings and Report
					Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	No decline in current PES compared to DWS, 2014 and the baseline conditions	Conditions/ quality as per WUL

CONSTRUCTION PHASE IMPACT MANAGEMENT MEASURES TABLE – AQUATIC ECOSYSTEMS							
Activity	Construction Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Topsoil Stripping and Stockpiling	Surface Water: Quality	Degradation of aquatic ecosystems.	Maintain suitable bufferzones around watercourses.	Earth mobilisation activities should preferably be conducted during the dry season (limit the intensity of impact, particularly in terms of runoff of sediments).	No visible signs of erosion or run-off	Best Practise Guidelines
		Aquatic habitats	Loss/ or alteration of habitat: mainly in-stream channel habitat - limited riparian habitat. Increase in erosion within the riparian zone. Increased sedimentation smothering in-stream habitats and reducing availability of biotopes.	Maintain suitable bufferzones around watercourses.	Restrict vegetation clearing to the proposed development footprints, no clearing permitted outside of these areas.	Restrict impact to development footprint area and appropriate buffer zone	Approved Design Drawings and Report
					Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	No decline in current PES compared to DWS, 2014 and the baseline conditions	Conditions/ quality as per WUL
					Develop suitable rehabilitation programme as per terrestrial ecologist findings and implement in all disturbed areas. Programme should include active re-vegetation, using locally-occurring indigenous grass and tree species.	No visible signs of erosion or of alien invasive plant species	Best Practise Guidelines
	Aquatic biota	Loss of ecological communities.	Maintain suitable bufferzones around watercourses. Minimise footprint and residence time of topsoil stockpiles.	Restrict vegetation clearing to the proposed development footprints, no clearing permitted outside of these areas.	Restrict impact to development footprint area and appropriate buffer zone	Approved Design Drawings and Report	
				Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	No decline in current PES compared to DWS, 2014 and the baseline conditions	Conditions/ quality as per WUL	
	Construction of Facility	Surface Water: Quality	Alteration of drainage patterns of the cleared area and the area immediate adjacent to it.	Ensure suitable bufferzone around watercourses, including drainage lines on site. No construction activities or storage of infrastructure within bufferzone or within the riparian zone of the Ga-Selati (36m from the watercourse). Implement dust control measures on all dirt roads.	Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	No decline in current PES compared to DWS, 2014 and the baseline conditions.	Conditions/ quality as per WUL
					Earth mobilisation activities should preferably be conducted during the dry season (limit the intensity of impact, particularly in terms of runoff of sediments).	No visible signs of erosion or run-off.	Best Practise Guidelines

CONSTRUCTION PHASE IMPACT MANAGEMENT MEASURES TABLE – AQUATIC ECOSYSTEMS							
Activity	Construction Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Construction of Facility	Aquatic habitats	Loss/ or alteration of habitat: mainly in-stream channel habitat - limited riparian habitat. Increase in erosion within the riparian zone. Increased sedimentation smothering in-stream habitats and reducing availability of biotopes.	Minimise sediment mobilisation and run-off towards the Ga-Selati.	Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	No decline in current PES compared to DWS, 2014 and the baseline conditions	Conditions/ quality as per WUL
		Aquatic habitats	Loss of ecological communities.	Ensure suitable bufferzone around watercourses. Minimise sediment mobilisation and run-off towards the Ga-Selati.	Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	No decline in current PES compared to DWS, 2014 and the baseline conditions	Conditions/ quality as per WUL
		Aquatic biota	Degradation of aquatic ecosystems due to sediment mobilisation, run-off from the site and potential erosion.	Ensure suitable bufferzone around watercourses including drainage lines on site. No construction activities or storage of infrastructure within bufferzone or the riparian zone of the Ga-Selati (36m from the watercourse). Implement dust control measures on all dirt roads.	Earth mobilisation activities should preferably be conducted during the dry season (limit the intensity of impact, particularly in terms of runoff of sediments).	No visible signs of erosion or run-off	Best Practise Guidelines
Copper Flotation Plant	Construction of Facility	Surface Water: Quality	Loss/ or alteration of habitat: mainly in-stream channel habitat - limited riparian habitat. Increase in erosion within the riparian zone. Increased sedimentation smothering in-stream habitats and reducing availability of biotopes.	Minimise sediment mobilisation and run-off towards the Ga-Selati.	Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	No decline in current PES compared to DWS, 2014 and the baseline conditions	Conditions/ quality as per WUL
		Aquatic habitats	Loss of ecological communities.	Ensure suitable bufferzone around watercourses. Minimise sediment	Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with	No decline in current PES compared to DWS, 2014	Conditions/ quality as per WUL
		Aquatic biota	Loss of ecological communities.	Ensure suitable bufferzone around watercourses. Minimise sediment	Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with	No decline in current PES compared to DWS, 2014	Conditions/ quality as per WUL

CONSTRUCTION PHASE IMPACT MANAGEMENT MEASURES TABLE – AQUATIC ECOSYSTEMS							
Activity	Construction Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
				mobilisation and run-off towards the Ga-Selati.	Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	and the baseline conditions	

Table 5.1(g): Construction Phase Impact Management Measures Table – Wetlands

CONSTRUCTION PHASE IMPACT MANAGEMENT MEASURES TABLE – WETLANDS							
Activity	Construction Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF)	Clearance of Vegetation. Topsoil stripping and stockpiling. Construction of MWSDF.	Wetlands, riparian habitats and watercourses	Loss of watercourse habitat due to clearance of vegetation. Disturbance of adjacent watercourse habitat.	Limit disturbance to direct development footprint.	Minimise loss of riparian and watercourse habitat on site by locating the proposed MWSDF and associated infrastructure to reduce overlap with delineated watercourse habitats. All riparian habitats and associated 32m bufferzones must be excluded from the development footprint.	Maintain PES of the Ga-Selati riparian zone and other affected watercourses	Approved Design Drawings and Report
					Prior to vegetation clearing the required construction footprint should be fenced off/demarcated and all activities, including all laydown areas and vehicle parking areas, should be located within the fenced off/demarcated area. No vegetation disturbance to take place outside the fenced off area.		
					Minimise the extent of vegetation clearing to the smallest footprint possible.		
					All topsoil removed during site preparation must be carefully stockpiled and conserved for future rehabilitation as per soil scientist recommendations.		
					No hunting or collection of firewood should be allowed within the natural habitats surrounding the construction site.		
					Design and implement a site-specific construction storm water management plan prior to vegetation clearing that aims to minimise the concentration of flow and increase in flow velocity, as well as minimising sediment transport off site.		
		Wetlands, riparian habitats and watercourses	Increased sedimentation in adjacent watercourses resulting in habitat degradation.	Limit extent of vegetation clearance and limit sediment transport off the development site.	Minimise area of vegetation clearing.	Maintain PES of the Ga-Selati riparian zone and other affected watercourses	Approved Design Drawings and Report
					Phase vegetation clearing activities to limit the area exposed at any one time.		
					Major earthworks should preferably be undertaken during the dry season (roughly from April to November) to limit erosion due to rainfall runoff.		
					Install sediment barriers and/or low berms along the downslope edge of cleared areas to trap sediments on site. Design of sediment barriers should be such that expected flow velocities will not damage the barriers or impair their function. Regular cleaning and maintenance of the barriers should be undertaken.		
					Discharge storm water into well vegetated areas outside riparian habitat, ideally with a minimum 32 m buffer area between riparian		

CONSTRUCTION PHASE IMPACT MANAGEMENT MEASURES TABLE – WETLANDS							
Activity	Construction Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/ Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF)	Clearance of Vegetation. Topsoil stripping and stockpiling. Construction of MWSDF.				habitat and the point of discharge. Install energy dissipaters and erosion protection at points of discharge.		
					Cleared areas outside direct development footprint should be re-vegetated and seeded (where necessary) as soon as possible following disturbance. Locally occurring, indigenous species should be used for revegetation. Regular monitoring and inspections at rehabilitated sites should be undertaken to ensure successful rehabilitation.		
		Wetlands, riparian habitats and watercourses	Fragmentation of habitat.	Minimise fragmentation of riparian and watercourse habitat.	Prior to vegetation clearing the required construction footprint should be fenced off/demarcated and all activities, including all laydown areas and vehicle parking areas, should be located within the fenced off/demarcated area. No vegetation disturbance to take place outside the fenced off area.	Maintain PES of the Ga-Selati riparian zone and other affected watercourses	Approved Design Drawings and Report
					Minimise the extent of vegetation clearing to the smallest footprint possible.		
					All topsoil removed during site preparation must be carefully stockpiled and conserved for future rehabilitation as per soil scientist recommendations.		
					No hunting or collection of firewood should be allowed within the natural habitats surrounding the construction site.		
	Wetlands, riparian habitats and watercourses	Establishment and Spread of Alien Invasive Species.	Prevent spread of alien invasive plant species.	Develop and implement an alien invasive species management plan on site during all phases of the proposed project. The plan should follow a combined approach using both chemical and mechanical control methods. Monitoring should take place in disturbed areas, as well as adjacent undisturbed areas. Periodic follow-up treatments, informed by regular monitoring.	Maintain PES of the Ga-Selati riparian zone and other affected watercourses	Best Practise Guidelines	
	Wetlands, riparian habitats and watercourses	Contamination of Downstream Water Courses.	Prevent degradation of habitat due to water quality contamination.	All potentially harmful substances used on site should be stored in bunded areas so that spills and leaks can be contained and no contamination of soils or surface runoff occurs.	Maintain PES of the Ga-Selati riparian zone and other affected watercourses	Conditions/ quality as per WUL	
				Servicing and cleaning of vehicles to take place off site at designated facilities off site.			
				Limit storage of fuel and diesel on site to the minimum. Management plan for waste collection, storage and handling on site must be drawn up. All waste to be disposed of offsite in designated facilities.			
Clearance of Vegetation.	Wetlands, riparian habitats and watercourses	Disturbance of adjacent watercourse habitat.	Limit disturbance to direct development footprint.	Prior to vegetation clearing the required construction footprint should be fenced off/demarcated and all activities, including all laydown areas and vehicle parking areas, should be located within the fenced off/demarcated area. No vegetation disturbance to take place outside the fenced off area.	Maintain PES of the Ga-Selati riparian zone and other affected watercourses	Approved Design Drawings and Report	
				Minimise the extent of vegetation clearing to the smallest footprint possible.			

CONSTRUCTION PHASE IMPACT MANAGEMENT MEASURES TABLE – WETLANDS							
Activity	Construction Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/ Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Access Road to MWSDF	Topsoil stripping and stockpiling. Construction of Access Road.				All topsoil removed during site preparation must be carefully stockpiled and conserved for future rehabilitation as per soil scientist recommendations.		
					No hunting or collection of firewood should be allowed within the natural habitats surrounding the construction site.		
	Clearance of Vegetation. Topsoil stripping and stockpiling. Construction of Access Road.	Wetlands, riparian habitats and watercourses	Increased sedimentation in adjacent watercourses resulting in habitat degradation.	Limit extent of vegetation clearance and limit sediment transport off the development site.	Limit extent of vegetation clearing.	Maintain PES of the Ga-Selati riparian zone and other affected watercourses	Approved Design Drawings and Report
					Prevent concentration of flow along the access road by providing regular opportunities for surface water flow to be discharged into adjacent vegetated areas.		
Discharge storm water into well vegetated areas outside riparian habitat, ideally with a minimum 32 m buffer area between riparian habitat and the point of discharge. Install energy dissipaters and erosion protection at points of discharge if necessary to prevent erosion.							
Cleared areas outside direct development footprint should be re-vegetated and seeded (where necessary) as soon as possible following disturbance. Locally occurring, indigenous species should be used for revegetation.							
Access Road to MWSDF	Clearance of Vegetation. Topsoil stripping and stockpiling. Construction of Access Road.	Wetlands, riparian habitats and watercourses	Establishment and Spread of Alien Invasive Species.	Prevent spread of alien invasive plant species.	Develop and implement an alien invasive species management plan on site during all phases of the proposed project. The plan should follow a combined approach using both chemical and mechanical control methods. Monitoring should take place in disturbed areas, as well as adjacent undisturbed areas. Periodic follow-up treatments, informed by regular monitoring.	Maintain PES of the Ga-Selati riparian zone and other affected watercourses	Best Practise Guidelines
		Wetlands, riparian habitats and watercourses	Contamination of Downstream Water Courses.	Prevent degradation of habitat due to water quality contamination.	All potentially harmful substances used on site should be stored in bunded areas so that spills and leaks can be contained and no contamination of soils or surface runoff occurs.	Maintain PES of the Ga-Selati riparian zone and other affected watercourses	Conditions/ quality as per WUL
					Servicing and cleaning of vehicles to take place off site at designated facilities off site.		
Limit storage of fuel and diesel on site to the minimum.							
					Management plan for waste collection, storage and handling on site must be drawn up. All waste to be disposed of offsite in designated facilities.		
Pollution Control Dam	Clearance of Vegetation. Topsoil	Wetlands, riparian habitats and watercourses	Loss of watercourse habitat due to clearance of vegetation.	Limit disturbance to direct development footprint.	Prior to vegetation clearing the required construction footprint should be fenced off/demarcated and all activities, including all laydown areas and vehicle parking areas, should be located within the fenced off/demarcated area. No vegetation disturbance to take place outside the fenced off area.	Maintain PES of the Ga-Selati riparian zone and other	Approved Design Drawings and Report

CONSTRUCTION PHASE IMPACT MANAGEMENT MEASURES TABLE – WETLANDS							
Activity	Construction Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/ Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
(PCD) and associated infrastructure (including silt trap)	stripping and stockpiling. Construction of PCD and associated infrastructures.		Disturbance of adjacent watercourse habitat.		Minimise the extent of vegetation clearing to the smallest footprint possible.	affected watercourses	
					All topsoil removed during site preparation must be carefully stockpiled and conserved for future rehabilitation as per soil scientist recommendations.		
					No hunting or collection of firewood should be allowed within the natural habitats surrounding the construction site.		
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Clearance of Vegetation. Topsoil stripping and stockpiling. Construction of PCD and associated infrastructures.	Wetlands, riparian habitats and watercourses	Increased sedimentation in adjacent watercourses resulting in habitat degradation.	Limit extent of vegetation clearance and limit sediment transport off the development site.	Design and implement a site-specific construction storm water management plan prior to vegetation clearing that aims to minimise the concentration of flow and increase in flow velocity, as well as minimising sediment transport off site.	Maintain PES of the Ga-Selati riparian zone and other affected watercourses	Approved Design Drawings and Report
					Minimise area of vegetation clearing.		
					Phase vegetation clearing activities to limit the area exposed at any one time.		
					Major earthworks should preferably be undertaken during the dry season (roughly from April to November) to limit erosion due to rainfall runoff.		
					Install sediment barriers and/or low berms along the downslope edge of cleared areas to trap sediments on site. Design of sediment barriers should be such that expected flow velocities will not damage the barriers or impair their function. Regular cleaning and maintenance of the barriers should be undertaken.		
					Discharge storm water into well vegetated areas outside riparian habitat, ideally with a minimum 32 m buffer area between riparian habitat and the point of discharge. Install energy dissipaters and erosion protection at points of discharge.		
					Cleared areas outside direct development footprint should be re-vegetated and seeded (where necessary) as soon as possible following disturbance. Locally occurring, indigenous species should be used for revegetation. Regular monitoring and inspections at rehabilitated sites should be undertaken to ensure successful rehabilitation.		
	Wetlands, riparian habitats and watercourses	Fragmentation of habitat.	Minimise fragmentation of riparian and watercourse habitat	Prior to vegetation clearing the required construction footprint should be fenced off/demarcated and all activities, including all laydown areas and vehicle parking areas, should be located within the fenced off/demarcated area. No vegetation disturbance to take place outside the fenced off area.	Maintain PES of the Ga-Selati riparian zone and other affected watercourses	Approved Design Drawings and Report	
				Minimise the extent of vegetation clearing to the smallest footprint possible.			
				All topsoil removed during site preparation must be carefully stockpiled and conserved for future rehabilitation as per soil scientist recommendations.			

CONSTRUCTION PHASE IMPACT MANAGEMENT MEASURES TABLE – WETLANDS							
Activity	Construction Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/ Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Clearance of Vegetation. Topsoil stripping and stockpiling. Construction of PCD and associated infrastructures.				No hunting or collection of firewood should be allowed within the natural habitats surrounding the construction site.		
		Wetlands, riparian habitats and watercourses	Establishment and Spread of Alien Invasive Species.	Prevent spread of alien invasive plant species.	Develop and implement an alien invasive species management plan on site during all phases of the proposed project. The plan should follow a combined approach using both chemical and mechanical control methods. Monitoring should take place in disturbed areas, as well as adjacent undisturbed areas. Periodic follow-up treatments, informed by regular monitoring.	Maintain PES of the Ga-Selati riparian zone and other affected watercourses	Best Practise Guidelines
		Wetlands, riparian habitats and watercourses	Contamination of Downstream Water Courses.	Prevent degradation of habitat due to water quality contamination.	All potentially harmful substances used on site should be stored in banded areas so that spills and leaks can be contained and no contamination of soils or surface runoff occurs.	Maintain PES of the Ga-Selati riparian zone and other affected watercourses	Conditions/ quality as per WUL
					Servicing and cleaning of vehicles to take place off site at designated facilities off site.		
Limit storage of fuel and diesel on site to the minimum.							
				Management plan for waste collection, storage and handling on site must be drawn up. All waste to be disposed of offsite in designated facilities.			

Table 5.1(h): Construction Phase Impact Management Measures Table – Air Quality

CONSTRUCTION PHASE IMPACT MANAGEMENT MEASURES TABLE – AIR QUALITY							
Activity	Construction Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF); Access Road to MWSDF; Pollution Control Dam (PCD) and associated infrastructure (including silt trap); Copper Flotation Plant	Land clearing, excavation, earth moving & engineering	Air Quality: Dust Fallout	Increased dust deposition rate at Foskor Mine, at Phalaborwa Town, at PMC Mine, at Schalk Small Holdings, at Namakgale/ Makhushane and at Phalaborwa Industrial Area.	Control through implementing appropriate dust suppression methods and administrative measures.	Monitor ambient dust deposition rates.	A change of more than 10% from the pre-construction conditions should result in an applicable adjustment	Conditions and targets as per Bosveld Phosphates Air Quality Management Plan, the Atmospheric Emission License and National Standards
		Air Quality: Particulate Matter	Increased particulate concentration at Foskor Mine, at Phalaborwa Town, at PMC Mine, at Schalk Small Holdings, at Namakgale/ Makhushane and at Phalaborwa Industrial Area.	Control through implementing appropriate dust suppression methods and administrative measures.	Monitor ambient PM ₁₀ concentrations.	A change of more than 10% from the pre-construction conditions should result in an applicable adjustment	Conditions and targets as per Bosveld Phosphates Air Quality Management Plan, the Atmospheric Emission License and National Standards
		Air Quality: Gaseous Emissions	Increased gaseous concentration at Foskor Mine, at Phalaborwa Town, at PMC Mine, at Schalk Small Holdings, at Namakgale/ Makhushane and at Phalaborwa Industrial Area.	Control through ensuring mobile and stationary internal combustion equipment is properly serviced and operated.	Maintain service records for all mobile and stationary internal combustion equipment.	No visibly abnormal tailpipe emissions in accordance with supplier specifications	Auditing and <i>ad hoc</i> emission testing

5.2. OPERATIONAL PHASE IMPACT MANAGEMENT MEASURES TABLES

Table 5.2(a): Operational Phase Impact Management Measures Table – Socio-Economic/Cultural

OPERATIONAL PHASE IMPACT MANAGEMENT MEASURES TABLE – SOCIO-ECONOMIC/CULTURAL							
Activity	Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Proposed Activities	Operation of proposed activities	Socio-Economic	Potential increase in employment and income opportunities.	Optimise recruitment of labour and inputs from local area.	Recruit workers of MWSDF from the local area.	Targeted % local recruitment	None
					Maximise procurement of operational inputs from the local BPM area.	Targeted % of inputs (excluding water and electricity) procured (and manufactured) in the local area	None
Proposed Activities	Operation of proposed activities	Socio-Economic	Support of local economic development objectives.	Support local economic development objectives.	Facilitate the further beneficiation of materials.	None	None
Proposed Activities	Operation of proposed activities	Socio-Economic	Potential increase in nuisance factors (dust and noise).	Minimise nuisance factors (dust and noise) for local communities.	Strict adherence air quality management measures.	Limited grievances received from local community; grievances resolved within a month	National Air Quality Standards
					Establish and utilise a local forum that represents the interests of adjacent communities.	Limited grievances received from local community; grievances resolved within a month	None
					Register any complaints from the local community through forum meetings (twice a year) and through a complaints register managed by the community liaison / SHEQ office.	Limited grievances received from local community; grievances resolved within a month	None
Proposed Activities	Operation of proposed activities	Socio-Economic	Increased economic concentration.	Contribute to diversification of the local economy.	Focus the local procurement programme on non-core (non-mining related) inputs (e.g. maintenance, electrical).	Targeted % of non-core inputs procured from the local economy	None
Proposed Activities	Operation of proposed activities	Socio-Economic	Increased local water use.	Minimise water consumptions.	Develop a plan to minimise water consumption on the MWSDF, e.g. through water recycling.	Targeted % of water use reduction	None

Table 5.2(b): Operational Phase Impact Management Measures Table – Soils, Land Use and Land Capability

OPERATIONAL PHASE IMPACT MANAGEMENT MEASURES TABLE – SOILS, LAND USE AND LAND CAPABILITY							
Activity	Operational Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF)	Disposal of Magnetite Waste on top of facility	Continued loss of in-situ soil utilisation potential/sterilisation of resource, possible contamination of in-situ and stored soils. Change of Land capability and Land Use.	On-going sterilisation of in-situ and stripped/stored (berms) soil, loss of ecosystem services and potential for salinisation and/or contamination of in-situ and stored soils due to product ingress and/or storm water runoff.	Manage and control footprint area, storm water controls (berms, channels) and potential for contamination from dirty water runoff and spillage of material.	Maintain footprint area to minimum.	Best Practice Environmental Option (BPEO)	Chamber of Mines Guidelines and Best Practice Environmental Option (BPEO)
					Manage erosion by promoting re-vegetation of soil stockpiles.		
					Maintain storm water berms to prevent contamination/ run-off.		
					Include soil management as part of routine auditable housekeeping.		
					No waste materials to be placed on stockpiles.		
	Reticulation of Return Water from MWSDF	Sterilisation, loss of in-situ soil utilisation potential along reticulation line, de-nitrification and loss of fertility on stored materials. Possible contamination from dirty water runoff on stored and in-situ soils along linear infrastructure.	On-going sterilisation of in-situ and stripped/stored (berms) soil over footprint servitude of pipeline and associated infrastructure. Possible erosion (wind and water) and compaction of unprotected soils.	Manage and control footprint area, storm water controls (berms, channels) erosion (water), and compaction along water servitudes (pipeline and service road).	Limit vehicle movement on stockpiles and rehabilitated areas.		
					Manage erosion by promoting re-vegetation of soil stockpiles.		
					Maintain storm water berms to prevent contamination/ run-off.		
					Include soil management as part of routine auditable housekeeping.		
					Limit vehicle movement on water servitudes.		
Maintain linear infrastructure (pipelines).							
Access Road to MWSDF	Transport of Material	Sterilisation and loss of soils utilisation potential on disturbed footprint, de-nitrification (loss of fertility), change of Land Capability and possible contamination.	Continued loss of soil (ecosystem services), land capability due to uncontrolled erosion, compaction and the potential for salinisation and/or contamination by vehicle movement.	Manage and control/prevent further loss and contamination of resource. Minimise and maintain footprint of impact and monitor and audit soil stockpiles and berms as part of management plan.	Maintain footprint area to minimum.	Best Practice Environmental Option (BPEO)	Chamber of Mines Guidelines and Best Practice Environmental Option (BPEO)
					Manage erosion by promoting re-vegetation of soil stockpiles.		
					Maintain storm water berms to prevent contamination/ run-off.		
					Limit vehicle movement to access road.		
Pollution Control Dam (PCD) and associated infrastructure	Reticulation of contaminated Storm Water Runoff	Sterilisation and loss of in-situ soil utilisation potential, de-nitrification and possible contamination of stored and in-situ soils. Permanent change of Land Use.	On-going sterilisation of in-situ and stored (berms) soil associated with PCD footprint and surrounds. Ingress and erosion (water leakage) of unprotected soils.	Manage and control footprint area, storm water controls (berms, channels) and potential for contamination from spillage and dirty water runoff and overflow.	Any leaks and spillages are to be reported to the relevant personnel, after which the area is to be cleaned up accordingly.	Best Practice Environmental Option (BPEO)	Chamber of Mines Guidelines and Best Practice Environmental Option (BPEO)
					Maintain footprint area to minimum.		
					Maintain storm water berms to prevent contamination/ run-off.		
					Manage erosion by promoting re-vegetation of soil stockpiles.		

OPERATIONAL PHASE IMPACT MANAGEMENT MEASURES TABLE – SOILS, LAND USE AND LAND CAPABILITY

Activity	Operational Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
(including silt trap) Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Storage of contaminated Storm Water Runoff	Sterilisation and loss of in-situ soil utilisation potential, de-nitrification and contamination of in-situ soils. Permanent change in Land Use.	On-going sterilisation of in-situ and stored materials associated with PCD footprint and surrounds. Ingress and erosion (water leakage) of unprotected soils.	Manage and control of footprint area, storm water controls (berms, channels), erosion (water) and compaction associated with PCD.	Limit vehicle movement on stockpiles and rehabilitated areas.	Best Practice Environmental Option (BPEO)	Chamber of Mines Guidelines and Best Practice Environmental Option (BPEO)
					Maintain footprint area to minimum.		
					Maintain storm water berms to prevent <u>contamination/ run-off</u> .		
					Manage erosion by promoting re-vegetation of soil stockpiles.		
Copper Flotation Plant	Extraction of Copper	Sterilisation and loss of in-situ soil utilisation potential, de-nitrification/loss of stored soil fertility and contamination. Change of Land Capability and Land Use.	Continued loss of soil resource and utilization potential, contamination of footprint soils by operational activities.	Manage and control footprint area, storm water controls (berms, dams and channels) and potential for contamination.	Limit vehicle movement on stockpiles and rehabilitated areas.	Best Practice Environmental Option (BPEO)	Chamber of Mines Guidelines and Best Practice Environmental Option (BPEO)
					Maintain footprint area to minimum.		
					Any leaks and spillages are to be reported to the relevant personnel, after which the area is to be cleaned up accordingly.		

Table 5.2(c): Operational Phase Impact Management Measures Table – Groundwater

OPERATIONAL PHASE IMPACT MANAGEMENT MEASURES TABLE – GROUNDWATER							
Activity	Operational Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/ Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF)	Disposal of magnetite waste on top of facility	Groundwater: Quality	Deterioration of the groundwater resource quality due to the infiltration of soluble contaminants into the subsurface through the footprint of the facility.	Control by monitoring groundwater quality adjacent to the facility.	Monitor groundwater resource quality at dedicated weathered zone monitoring boreholes adjacent to the MWSDF. (Resource Directed Measure)	No deterioration in groundwater resource quality from leaching of the facility materials	Conditions/ quality as per WUL
					Any adverse trends in the groundwater quality recorded from the dedicated groundwater monitoring boreholes are to be reported and assessed, followed by the development of a site specific groundwater remediation plan. (Resource Directed Measure)		National Water Act
Magnetite Waste Site Disposal Facility (MWSDF)	Reticulation of contaminated Storm Water Runoff	Groundwater: Quality	Deterioration of the groundwater resource quality due to the infiltration of contaminated storm water runoff.	Avoid by diverting and capturing contaminated storm water runoff to the PCD.	Responsible engineer to inspect and record the status / integrity of the storm water canals. (Source Control Measure)	No deterioration in groundwater resource quality from infiltration of contaminated storm water	Conditions/ quality as per WUL
					Monitor groundwater resource quality and quantity (water levels) at dedicated weathered zone monitoring boreholes adjacent to the MWSDF (Resource Directed Measure)		Conditions/ quality as per WUL
Access Road to MWSDF	Transport of Material	Groundwater: Quality	Deterioration of the groundwater resource quality due to seepage or leaching of material spilled during transport.	Avoid by preventing spillages of material during transport.	Responsible personnel to inspect the transport vehicles for potential spillage risks. (Source Control Measure)	No deterioration in groundwater resource quality from seeping of the facility materials	N/A
					Any spillages are to be reported to the relevant personnel, after which the area is to be cleaned up accordingly. (Source Control Measure)		N/A
Internal Roads	Dust Suppression	Groundwater: Quality	Deterioration of the groundwater resource quality due to the infiltration of contaminated water used for dust suppression on internal road surface.	Avoid by not using contaminated water for dust suppression.	No contaminated water should be used for dust suppression on internal roads unless authorised in the WUL.	No deterioration in groundwater resource quality from seeping of contaminated water	Conditions/ quality as per WUL
					Monitor and report the quality (quarterly) and quantity (monthly) of water used for dust suppression. (Source Control Measure)		Conditions/ quality as per WUL
					Continue monitoring the groundwater resource quality. (Resource Directed Measure)		Conditions/ quality as per WUL
Pollution Control Dam (PCD) and associated infrastructure including silt trap	Reticulation of contaminated Storm Water Runoff	Groundwater: Quality	Deterioration of the groundwater resource quality due to the infiltration of spilled contaminated water or seepage from cracks or breaks of canals.	Avoid by diverting and capturing contaminated storm water runoff to the PCD.	Responsible engineer to inspect and record the status / integrity of the storm water canals. (Source Control Measure)	No deterioration in groundwater resource quality from infiltration of contaminated storm water	Conditions/ quality as per WUL
					Monitor groundwater resource quality and quantity (water levels) at dedicated weathered zone monitoring boreholes adjacent to the PCD. (Resource Directed Measure)		Conditions/ quality as per WUL
Pollution Control Dam (PCD) and associated infrastructure including silt trap	Reticulation of PCD water from PCD to Plant	Groundwater: Quality	Deterioration of the groundwater resource quality due to the infiltration of spilled contaminated water from cracks or breaks in the pipeline.	Avoid by preventing spills from pipeline.	Responsible engineer to inspect and record the status / integrity of the pipeline. (Source Control Measure)	No deterioration in groundwater resource quality from infiltration of spilled PCD water	N/A
					Any leaks and spillages are to be reported to the relevant personnel, after which it should be repaired accordingly. (Source Control Measure)		N/A

OPERATIONAL PHASE IMPACT MANAGEMENT MEASURES TABLE – GROUNDWATER							
Activity	Operational Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/ Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Pollution Control Dam (PCD) and associated infrastructure including silt trap	Storage of contaminated Storm Water Runoff	Groundwater: Quality	Deterioration of the groundwater resource quality due to spillages and infiltration of contaminated water from and/or the infiltration of soluble contaminants into the subsurface through the footprint of the dam.	Avoid by lining the PCD to prevent any seepage of contaminated water.	Responsible engineer to inspect and record the status / integrity of the dam. (Source Control Measure)	No deterioration in groundwater resource quality from infiltration of PCD water.	Conditions/ quality as per WUL
					The water level in the dam is to be operated below the calculated Maximum Operating Level (MOL) at all times. (Source Control Measure)		National Water Act
					Implement groundwater monitoring plan adjacent to the PCD. (Resource Directed Measure)		National Water Act
					Monitor groundwater resource quality and quantity (water levels) at dedicated boreholes adjacent to the PCD. (Resource Directed Measure)		National Water Act
Copper Flotation Plant	Extraction of Copper	Groundwater: Quality	Contamination of groundwater due to seepage of spillages of chemicals used in the plant.	Avoid by preventing spills in the plant.	Any spillages are to be reported to the relevant personnel, after which the area is to be cleaned up accordingly. (Source Control Measure)	No deterioration in groundwater resource quality from infiltration of plant process water.	Conditions/ quality as per WUL
					Implement groundwater monitoring plan adjacent to the plant. (Resource Directed Measure)		Conditions/ quality as per WUL

Table 5.2(d): Operational Phase Impact Management Measures Table – Surface Water

OPERATIONAL PHASE IMPACT MANAGEMENT MEASURES TABLE – SURFACE WATER							
Activity	Operational Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF)	Disposal of Magnetite Waste on top of facility	Surface Water: Quality	Deterioration in surface water resource quality due to spillages and subsequent runoff containing soluble contaminants from the MWSDF across the surface into the receiving surface draining features.	Prevent spillages from the MWSDF by implementing approved design and sound operational plan.	Construct and operate the MWSDF as per approved design.	Construct as per approved design. Provide as-built drawings upon completion of construction.	Approved Design Drawings and Report. GISTM Standards.
	Collection of contaminated runoff water from MWSDF	Surface Water: Quantity	Reduction in the quantity of the surface water resource due to the capturing of rainfall on the MWSDF.	Avoid by minimising the footprint of the facility.	Construct and operate the dirty water containment system as per the approved design.	Construct as per approved design. Provide as-built drawings upon completion of construction.	Approved Design Drawings and Report. GISTM Standards.
Access Road to MWSDF	Transport of Material	Surface Water: Quality	Deterioration in surface water resource quality due to spillages and subsequent runoff of water containing soluble contaminants across the surface into the receiving surface drainage features.	Prevent spillages onto soil through a spillages control and clean-up procedure.	Activate prompt spillage clean-up procedure.	No residual magnetite on surface.	Bosveld WUL surface water quality objectives as well as NEMWA Norms and Standards GN 331 Remediation of Contaminated Land and Soil Quality.
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Reticulation of contaminated Storm Water Runoff	Surface Water: Quality	Deterioration in surface water resource quality due to spillages from the PCD and subsequent runoff of PCD return water containing soluble contaminants across the surface into the receiving surface drainage features.	Prevent spillages from the PCD by implementing approved design and sound operational plan.	Construct and operate the PCD as per approved design.	Construct as per approved design. Provide as-built drawings upon completion of construction.	Approved Design Drawings and Report. GISTM Standards.
	Storage of contaminated Storm Water Runoff	Surface Water: Quality	Contamination of the surface water resource due to spillages of contaminated water from dam.	Prevent by maintaining PCD water level at an elevation below peak storage volume.	Keep PCD levels low by return pumping to the plant.	Construct as per approved design. Provide as-built drawings upon completion of construction.	Approved Design Drawings and Report. GISTM Standards. NWA GN704.
Copper Flotation Plant	Extraction of Copper	Surface Water: Quality	Contamination of the surface water resource due to spillages of contaminated water from dirty water systems.	Prevent by maintaining clearance of vegetation and obstructions from conveyance systems.	Clean and maintain storm water conveyance channels and systems regularly and keep free of obstructions.	Construct as per approved design. Provide as-built drawings upon completion of construction.	Approved Design Drawings and Report. GISTM Standards. NWA GN704.

Table 5.2(e): Operational Phase Impact Management Measures Table – Terrestrial Ecology

OPERATIONAL PHASE IMPACT MANAGEMENT MEASURES TABLE – TERRESTRIAL ECOLOGY							
Activity	Operational Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF)	Disposal of magnetite waste on top of facility & Reticulation of Return Water from MWSDF	Flora & Fauna: Habitat and Diversity	Contamination of downstream riparian habitats resulting from spills or seepage of waste and/or contaminated water from MWSDF and/or water infrastructure.	Control impact through continuing facility maintenance. Minimise and remedy impacts through effective response planning and implementation.	Regularly inspect and maintain all facilities and infrastructure associated with waste storage and conveyance.	Minimise potential incidents of seepage/spills	Norms and Standards
					Develop and implement an emergency pollution response and clean-up plan for any waste/pollution leakages and spills.	Minimise risk of potential pollution seepage/spills entering into the environment	Norms and Standards
	General disturbances	Flora: Habitat and Diversity	Establishment and spread of alien invasive species resulting from general disturbances associated with MWSDF.	Control potential impacts by implementing an invasive species programme.	Develop and implement an alien invasive species control programme that includes a combined approach using both chemical and mechanical control methods, and periodic follow-up treatments that are informed by regular monitoring.	Minimise populations of on-site alien invasive species	Alien and Invasive Species Regulations
					Revegetate disturbed areas using locally occurring indigenous grass and tree species.	Minimise exposed soil surfaces	Best Practise Guidelines
Access Road to MWSDF	Transport of Material	Fauna: Diversity	Direct mortality and disturbance of fauna as a consequence of vehicle collisions.	Control potential impacts by actively managing fauna-human interactions, and implementing minimisation measures and awareness training for all on-site workers.	The environmental manager should be trained and available to manage any wildlife-human interactions.	Minimise human-wildlife interactions	Best Practise
					As appropriate, barriers should be erected to prevent fauna gaining access to infrastructure/facilities where they may be injured or trapped.	Minimise potential for trapping of wildlife in infrastructure/facilities	Best Practise
					A low-speed limit (recommended 20-40 km/h) should be enforced on-site to reduce wildlife-collisions.	On-site Health and Safety	Best Practise
					The handling, poisoning and killing of on-site fauna by workers and contractors must be strictly prohibited. Employees and contractors should be made aware of the presence of, and rules regarding fauna, through suitable induction training and on-site signage.	Minimise incidents of hunting/snaring by on-site workers	Best Practise
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Reticulation of contaminated Storm Water Runoff & Storage of contaminated Storm Water Runoff	Flora & Fauna: Habitat and Diversity	Contamination of downstream riparian habitats resulting from spills or seepage of waste and/or contaminated water from PCD and/or water infrastructure.	Control impact through continuing facility maintenance. Minimise and remedy impacts through effective response planning and implementation.	Regularly inspect and maintain all facilities and infrastructure associated with waste storage and conveyance.	Minimise potential incidents of seepage/spills	Norms and Standards
					Develop and implement an emergency pollution response and clean-up plan for any waste/pollution leakages and spills.	Minimise risk of potential pollution seepage/spills entering into the environment	Norms and Standards
	Storage of contaminated Storm Water Runoff	Flora: Habitat and Diversity	Establishment and spread of alien invasive species resulting from general disturbances associated with PCD and	Control potential impacts by implementing an invasive species programme.	Develop and implement an alien invasive species control programme that includes a combined approach using both chemical and mechanical control methods, and periodic follow-up treatments that are informed by regular monitoring.	Minimise populations of on-site alien invasive species	Alien and Invasive Species Regulations

OPERATIONAL PHASE IMPACT MANAGEMENT MEASURES TABLE – TERRESTRIAL ECOLOGY							
Activity	Operational Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
			associated infrastructure.		Revegetate disturbed areas using locally occurring indigenous grass and tree species.	Minimise exposed soil surfaces	Best Practise Guidelines

Table 5.2(f): Operational Phase Impact Management Measures Table – Aquatic Ecosystems

OPERATIONAL PHASE IMPACT MANAGEMENT MEASURES TABLE – AQUATIC ECOSYSTEMS									
Activity	Operational Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)		
Magnetite Waste Site Disposal Facility (MWSDF)	Disposal of Magnetite Waste on top of facility	Surface Water: Quality	Changes/ deterioration of water quality (i.e. within the Ga-Selati River).	Remedy by monitoring restored surface run-off patterns and erosion gulleys. Maintain suitable bufferzones around watercourses.	Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	Ensure no decline current PES compared to DWS, 2014 and the baseline conditions. Surface water quality to be complaint with resource quality objectives.	Conditions/ quality as per WUL		
					Should significant elevated EC/TDS concentrations be recorded within the Ga-Selati and/or major discrepancies between the up and downstream sites be noted, these should be flagged immediately and Bosveld Phosphates should be notified immediately.	Ensure data is within baseline conditions. Surface water quality to be complaint with resource quality objectives.	Conditions/ quality as per WUL		
					Avoid non-perennial bodies of water such as artificial drainage lines on site, artificial wetlands and floodplain depressions on the Bosveld Phosphates property where possible.	Ensure data is within baseline conditions. Surface water quality to be complaint with resource quality objectives.	Conditions/ quality as per WUL		
	Reticulation of Return Water from MWSDF	Aquatic biota	Loss of ecological communities.	Maintain suitable bufferzones around watercourses.	Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	Ensure no decline current PES compared to DWS, 2014 and the baseline conditions. Surface water quality to be complaint with resource quality objectives.	Conditions/ quality as per WUL		
					Potential spillage/leakage of contaminated water from reticulation/ pipes and subsequently contamination directly into the adjacent surface water resources.	Remedy by monitoring restored surface run-off patterns and erosion gulleys. Maintain suitable bufferzones around watercourses.	Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	Ensure no decline current PES compared to DWS, 2014 and the baseline conditions. Surface water quality to be complaint with resource quality objectives.	Conditions/ quality as per WUL
					Loss of ecological communities.		Continue current bi-annual aquatic biomonitoring programme for Bosveld	Ensure no decline current PES compared to DWS, 2014	Conditions/ quality as per WUL

OPERATIONAL PHASE IMPACT MANAGEMENT MEASURES TABLE – AQUATIC ECOSYSTEMS

Activity	Operational Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
				Maintain suitable bufferzones around watercourses.	Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	and the baseline conditions. Surface water quality to be complaint with resource quality objectives.	
Access Road to MWSDF	Transport of Material	Surface Water: Quality	Degradation of the aquatic ecosystems due to sediment mobilisation, run-off from the site and potential erosion.	Maintain suitable bufferzones around watercourses. Control by cleaning spillage from haulage ways and vehicles regularly.	Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	Ensure no decline current PES compared to DWS, 2014 and the baseline conditions. Surface water quality to be complaint with resource quality objectives.	Conditions/ quality as per WUL
Access Road to MWSDF	Transport of Material	Surface Water: Quality	Degradation of the aquatic ecosystems due to sediment mobilisation, run-off from the site and potential erosion.	Control potential impacts by implementing dust control measures on all dirt roads.	Routine checks for signs of erosion. Maintain service roads to avoid erosion and excessive dust formation.	No visible signs of erosion	Best Practise Guidelines
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Reticulation of contaminated Storm Water Runoff	Surface Water: Quality	Changes/deterioration of water quality (within the Ga-Selati River) as well as a decrease in general water quality parameters.	Remedy by monitoring restored surface run-off patterns and erosion gulleys. Maintain suitable bufferzones around watercourses.	Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	Ensure no decline current PES compared to DWS, 2014 and the baseline conditions. Surface water quality to be complaint with resource quality objectives.	Conditions/ quality as per WUL
					Should significant elevated EC/TDS concentrations be recorded within the Ga-Selati and/or major discrepancies between the up and downstream sites be noted, these should be flagged immediately and Bosveld Phosphates should be notified immediately.	Ensure no decline current PES compared to DWS, 2014 and the baseline conditions. Surface water quality to be complaint with resource quality objectives.	Conditions/ quality as per WUL
					Runoff into the PCD should be routinely monitored for acidity/alkalinity and TDS as an early warning for potential increases in discharge water.	No visible signs of leakages, seepage	Conditions/ quality as per WUL
					Repair damaged structures immediately to avoid excessive spills.	No visible signs of leakages, seepage	Conditions/ quality as per WUL
		Aquatic biota	Loss of ecological communities.	Maintain suitable bufferzones around watercourses.	Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	Ensure no decline current PES compared to DWS, 2014 and the baseline conditions. Surface water quality to be complaint with resource quality objectives.	Conditions/ quality as per WUL
					Avoid non-perennial bodies of water such as artificial drainage lines on site, artificial wetlands and floodplain depressions on the Bosveld Phosphates property where possible.	No visible signs of surface water ponding	Best Practise Guidelines

OPERATIONAL PHASE IMPACT MANAGEMENT MEASURES TABLE – AQUATIC ECOSYSTEMS

Activity	Operational Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Storage of contaminated Storm Water Runoff	Surface Water: Quality	Potential spillage/leakage from storage and subsequently contamination directly into the adjacent surface water resources.	Remedy by monitoring restored surface run-off patterns and erosion gulleys. Maintain suitable bufferzones around watercourses. Prevent by maintaining PCD water levels as to avoid overflow during high rainfall events.	Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	Ensure no decline current PES compared to DWS, 2014 and the baseline conditions. Surface water quality to be complaint with resource quality objectives.	Conditions/ quality as per WUL
		Surface Water: Quality	Potential spillage/leakage from storage and subsequently contamination directly into the adjacent surface water resources.	Remedy by monitoring restored surface run-off patterns and erosion gulleys. Maintain suitable bufferzones around watercourses. Prevent by maintaining PCD water levels as to avoid overflow during high rainfall events.	Avoid non-perennial bodies of water such as artificial drainage lines on site, artificial wetlands and floodplain depressions on the Bosveld Phosphates property where possible.	No visible signs of surface water ponding	Best Practise Guidelines
	Storage of contaminated Storm Water Runoff	Surface Water: Quality	Potential spillage/leakage from storage and subsequently contamination directly into the adjacent surface water resources.	Remedy by monitoring restored surface run-off patterns and erosion gulleys. Maintain suitable bufferzones around watercourses. Prevent by maintaining PCD water levels as to avoid overflow during high rainfall events.	Repair damaged structures immediately to avoid excessive spills	No visible signs of leakages, seepage	Conditions/ quality as per WUL
	Storage of contaminated Storm Water Runoff	Aquatic biota	Loss of ecological communities.	Maintain suitable bufferzones around watercourses.	Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	Ensure no decline current PES compared to DWS, 2014 and the baseline conditions. Surface water quality to be complaint with resource quality objectives.	Conditions/ quality as per WUL

Table 5.2(g): Operational Phase Impact Management Measures Table – Wetlands

OPERATIONAL PHASE IMPACT MANAGEMENT MEASURES TABLE – WETLANDS							
Activity	Operational Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF)	Disposal of magnetite waste on top of facility	Wetlands, riparian habitats and watercourses	Water quality deterioration in adjacent watercourses.	Limit water quality impact by isolating contaminants from water resources and controlling contaminants at source.	<p>Focus mitigation measures on the successful isolation of dirty water areas and the separation of clean and dirty water areas. The MWSDF, PCD and any other areas exposed to contaminants must be designated dirty water areas and isolated from the surrounding catchment.</p> <p>Develop and implement a detailed water management plan. Ensure all contaminated surface runoff from the MWSDF facility is captured on site. Install seepage interception measures to prevent seepage of contaminated water into downslope watercourses. No dirty water may be discharged on site unless meeting the RQO requirement of the Ga-Selati and/or Olifants River, as applicable.</p> <p>Develop and implement a water quality and biomonitoring plan. Such a monitoring plan must detail the process to be followed in responding to any contamination of adjacent watercourses being observed.</p> <p>Develop a groundwater monitoring plan to investigate potential groundwater contamination plumes. Develop suitable mitigation measures to prevent such pollution plumes from reaching the Ga-Selati River.</p>	Maintain PES of the Ga-Selati riparian zone and other affected watercourses	Conditions/ quality as per WUL
	Reticulation of Return Water from MWSDF	Wetlands, riparian habitats and watercourses	Water quality deterioration in adjacent watercourses.	Limit water quality impact by isolating contaminants from water resources and controlling contaminants at source.	<p>Undertake monthly visual inspections of the reticulation infrastructure.</p> <p>Reticulation infrastructure must include flow monitoring technology that will allow for leaks and pipe bursts to be identified immediately. Pumping must be stopped immediately following identification of a leak or burst. Relevant authorities must be notified within 24 hours of any pipe burst or significant leak.</p> <p>Immediate clean-up and repair of any erosion damage or water resource contamination caused by pipe bursts.</p> <p>Undertake monthly visual inspections of the pipelines to ensure optimal operation and to check for any erosion damage along the route. Inspections to be undertaken as walkdown surveys within watercourse areas.</p> <p>Develop and implement a water quality and biomonitoring plan. Such a monitoring plan must detail the process to be followed in responding to any contamination of adjacent watercourses being observed.</p>	Maintain PES of the Ga-Selati riparian zone and other affected watercourses	Conditions/ quality as per WUL
Access Road to MWSDF	Transport of Material	Wetlands, riparian habitats and watercourses	Water quality deterioration in adjacent watercourses.	Limit water quality impact by isolating contaminants from water resources and controlling contaminants at source.	<p>Undertake monthly visual inspections of the access road and any spills or litter must be cleaned-up.</p> <p>Immediate clean-up and rehabilitation of any larger spills or accidents.</p> <p>Develop a Standard Operating Procedure (SOP) for the loading of trucks and transport of material. Such an SOP must include measures that reduce risk of spillage (e.g. by setting limits on loading capacity, use of tarpaulins etc, as applicable).</p>	Maintain PES of the Ga-Selati riparian zone and other affected watercourses	Conditions/ quality as per WUL

OPERATIONAL PHASE IMPACT MANAGEMENT MEASURES TABLE – WETLANDS

Activity	Operational Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
					Develop and implement a water quality and biomonitoring plan. Such a monitoring plan must detail the process to be followed in responding to any contamination of adjacent watercourses being observed.		
Pollution Control Dam (PCD) and associated infrastructure (including the silt trap)	Reticulation of contaminated Storm Water Runoff	Wetlands, riparian habitats and watercourses	Water quality deterioration in adjacent watercourses.	Limit water quality impact by isolating contaminants from water resources and controlling contaminants at source.	Monthly visual inspections of the reticulation infrastructure must be undertaken.	Maintain PES of the Ga-Selati riparian zone and other affected watercourse	Conditions/ quality as per WUL
					Reticulation infrastructure must include flow monitoring technology that will allow for leaks and pipe bursts to be identified immediately. Pumping must be stopped immediately following identification of a leak or burst. Relevant authorities must be notified within 24 hours of any pipe burst or significant leak.		
					Immediate clean-up and repair of any erosion damage or water resource contamination caused by pipe bursts.		
					Undertake monthly visual inspections of the pipelines to ensure optimal operation and to check for any erosion damage along the route. Inspections to be undertaken as walkdown surveys within watercourse areas.		
	Storage of contaminated Storm Water Runoff	Wetlands, riparian habitats and watercourses	Water quality deterioration in adjacent watercourses.	Limit water quality impact by isolating contaminants from water resources and controlling contaminants at source.	Develop and implement a water quality and biomonitoring plan. Such a monitoring plan must detail the process to be followed in responding to any contamination of adjacent watercourses being observed.	Maintain PES of the Ga-Selati riparian zone and other affected watercourses	Conditions/ quality as per WUL
					Focus mitigation measures on the successful isolation of dirty water areas and the separation of clean and dirty water areas. The MWSDP, PCD and any other areas exposed to contaminants must be designated dirty water areas and isolated from the surrounding catchment.		
					Develop and implement a detailed water management plan. Install seepage interception measures to prevent seepage of contaminated water into downslope watercourses. No dirty water may be discharged on site unless meeting the RQO requirement of the Ga-Selati and/or Olifants River, as applicable.		
					Develop and implement a water quality and biomonitoring plan. Such a monitoring plan must detail the process to be followed in responding to any contamination of adjacent watercourses being observed.		
Copper Flotation Plant	Extraction of Copper	Wetlands, riparian habitats and watercourses	Water quality deterioration in adjacent watercourses.	Limit water quality impact by isolating contaminants from water resources and controlling	Focus mitigation measures on the successful isolation of dirty water areas and the separation of clean and dirty water areas. The Copper Flotation Plant and any other areas exposed to contaminants must be designated dirty water areas and isolated from the surrounding catchment.	Maintain PES of the Ga-Selati riparian zone and other	
					Develop and implement a detailed water management plan. Plan must ensure all contaminated surface runoff from the Copper Flotation		

OPERATIONAL PHASE IMPACT MANAGEMENT MEASURES TABLE – WETLANDS

Activity	Operational Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Copper Flotation Plant	Extraction of Copper	Wetlands, riparian habitats and watercourses	Water quality deterioration in adjacent watercourses.	Limit water quality impact by isolating contaminants from water resources and controlling contaminants at source.	Plant is captured on site. Install seepage interception measures to prevent seepage of contaminated water into downslope watercourses. No dirty water may be discharged on site unless meeting the RQO requirement of the Ga-Selati and/or Olifants River, as applicable.	affected watercourses	Conditions/ quality as per WUL
					Develop and implement a water quality and biomonitoring plan. Such a monitoring plan must detail the process to be followed in responding to any contamination of adjacent watercourses being observed.	Maintain PES of the Ga-Selati riparian zone and other affected watercourses	Conditions/ quality as per WUL
					Develop a groundwater monitoring plan to investigate potential groundwater contamination plumes. Develop suitable mitigation measures to prevent such pollution plumes from reaching the Ga-Selati River.		

Table 5.2(h): Operational Phase Impact Management Measures Table – Air Quality

OPERATIONAL PHASE IMPACT MANAGEMENT MEASURES TABLE – AIR QUALITY							
Activity	Operational Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF); Access Road to MWSDF; Pollution Control Dam (PCD) and associated infrastructure (including the silt trap); Copper Flotation Plant	Extraction of copper; transport and disposal of magnetite waste	Air Quality: Dust Fallout	Increased dust deposition rate at Foskor Mine.	Control through implementing appropriate dust suppression methods and administrative measures.	Monitor ambient dust deposition rates.	A change of more than 10% from the pre-construction conditions should result in an applicable adjustment	Conditions and targets as per Bosveld Phosphates Air Quality Management Plan, the Atmospheric Emission License and National Standards
			Increased dust deposition rate at Phalaborwa Town.				
			Increased dust deposition rate at PMC Mine.				
			Increased dust deposition rate at Schalk Small Holdings.				
			Increased dust deposition rate at Namakgale/ Makhushane.				
			Increased dust deposition rate at Phalaborwa Industrial Area.				
Magnetite Waste Site Disposal Facility (MWSDF); Access Road to MWSDF; Pollution Control Dam (PCD) and associated infrastructure (including the silt trap); Copper Flotation Plant	Extraction of copper; transport and disposal of magnetite waste	Air Quality: Particulate Matter	Increased particulate concentration at Foskor Mine.	Control through implementing appropriate dust suppression methods and administrative measures.	Monitor ambient PM ₁₀ concentrations.	A change of more than 10% from the pre-construction conditions should result in an applicable adjustment	Conditions and targets as per Bosveld Phosphates Air Quality Management Plan, the Atmospheric Emission License and National Standards
			Increased particulate concentration at Phalaborwa Town.				
			Increased particulate concentration at PMC Mine.				
			Increased particulate concentration at Schalk Small Holdings.				
			Increased particulate concentration at Namakgale/ Makhushane.				
			Increased particulate concentration at Phalaborwa Industrial Area.				
Magnetite Waste Site Disposal Facility (MWSDF); Access Road to MWSDF; Pollution Control Dam (PCD) and associated infrastructure (including the silt trap); Copper Flotation Plant	Extraction of copper; transport and disposal of magnetite waste	Air Quality: Gaseous Emissions	Increased gaseous concentration at Foskor Mine.	Control through ensuring mobile and stationary internal combustion equipment is properly serviced and operated.	Maintain service records for all mobile and stationary internal combustion equipment.	No visibly abnormal tailpipe emissions in accordance with supplier specifications	Auditing and <i>ad hoc</i> emission testing
			Increased gaseous concentration at Phalaborwa Town.				
			Increased gaseous concentration at PMC Mine.				
			Increased gaseous concentration at Schalk Small Holdings.				
			Increased gaseous concentration at Namakgale/ Makhushane.				
			Increased gaseous concentration at Phalaborwa Industrial Area.				

5.3. DECOMMISSIONING AND CLOSURE PHASE IMPACT MANAGEMENT MEASURES TABLES

Table 5.3(a): Decommissioning and Closure Phase Impact Management Measures Table – Socio-Economic/Cultural

DECOMMISSIONING AND CLOSURE PHASE IMPACT MANAGEMENT MEASURES TABLE – SOCIO-ECONOMIC/CULTURAL							
Activity	Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Proposed Activities	Decommissioning and closure of proposed activities	Socio-Economic	Job and income losses.	Minimise local job losses.	Prepare the workforce at least a year in advance of the imminent closure of facilities.	Targeted % of workers placed in jobs after closure	None
					Make use, as far possible, of workers at the plant and the local labour force to assist with the dismantling of the facilities.	Targeted % of workers placed in jobs after closure	None
					Develop mechanisms to assist employees, prior to retrenchment date in the transition phase after closure of the operations e.g. providing assistance in accessing available and suitable jobs with associated companies or plants in the reclamation group, providing reference letters, assist with CV preparation.	70% of workers placed in jobs after closure	None
Proposed Activities	Decommissioning and closure of proposed activities	Socio-Economic	Potential increase in nuisance factors (dust and noise).	Minimise nuisance factors (dust and noise) for local communities.	Liaise on a regular basis with the relevant community forum during the decommissioning phase.	Limited grievances received from local community; grievances resolved within a month.	National air quality standards
					Maintain grievances register.	Limited grievances received from local community; grievances resolved within a month.	None
Proposed Activities	Decommissioning and closure of proposed activities	Socio-Economic	Permanent loss of land.	Minimise loss of local land.	Formulate and implement an alternative land-use and rehabilitation plan.	Visual restoration of the project area.	Closure and Rehabilitation Plan

Table 5.3(b): Decommissioning and Closure Phase Impact Management Measures Table – Soils, Land Use and Land Capability

DECOMMISSIONING AND CLOSURE PHASE IMPACT MANAGEMENT MEASURES TABLE – SOILS, LAND USE AND LAND CAPABILITY							
Activity	Decommissioning Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF)	Decommissioning of Facility (Flatten and Shape Side Slopes, Install Suitable Capping Liner, Resoil, Re-Vegetate)	Land Capability and Land Use	Loss of soil nutrients while in storage, contamination by dirty water used for rehabilitated/re-vegetation, hydrocarbon spills from vehicles, compaction and dust.	Cap and close facility as per approved closure and rehabilitation plan.	Landscape facility to be free draining, cap with saprolitic sub-base and cover with utilisable (stockpiled soils) soil.	Best Practice Environmental Option (BPEO)	Chamber of Mines Guidelines and Best Practice Environmental Option (BPEO)
					Stockpiled utilisable soil must be redistributed in a manner that achieves an approximate uniform stable thickness consistent with the approved post development end land use and to attain a free draining surface profile.		
					Determine the nutrient status and chemistry of the utilisable materials and based on the analysis, fertilisers must be applied if necessary.		
					Revegetate disturbed areas using locally occurring indigenous grass and tree species.		
					Implement erosion control measures (rock cladding/ vegetative cover) to ensure that the soil is not washed away and that erosion gulleys do not develop prior to vegetation establishment.		
					Manage movement of people, animals and traffic over rehabilitated land.		
Access Road to MWSDF	Decommissioning of Road (Flatten and Shape, Resoil, Re-Vegetate)	Land Capability and Land Use	Loss of soil nutrients while in storage, contamination by dirty water used for rehabilitated/re-vegetation, hydrocarbon spills from vehicles, compaction and dust.	Replacement of soils, morphology, soil fertility and rectification of residual contamination. Monitor and manage erosion.	Perform a contaminated land assessment to determine if soils are polluted.	Best Practice Environmental Option (BPEO)	Chamber of Mines Guidelines and Best Practice Environmental Option (BPEO)
					Determine and implement suitable remediation options.		
					Stockpiled utilisable soil must be redistributed in a manner that achieves an approximate uniform stable thickness consistent with the approved post development end land use and will attain a free draining surface profile.		
					Determine the nutrient status and chemistry of the utilisable materials and based on the analysis, fertilisers must be applied if necessary.		
					Revegetate disturbed areas using locally occurring indigenous grass and tree species.		
					Rectify erosion promptly to ensure that the soil is not washed away and that erosion gulleys do not develop prior to vegetation establishment.		
Manage movement of people, animals and traffic over rehabilitated land.							

DECOMMISSIONING AND CLOSURE PHASE IMPACT MANAGEMENT MEASURES TABLE – SOILS, LAND USE AND LAND CAPABILITY

Activity	Decommissioning Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Decommissioning of Dam (Dewatering of the dam, Removal of contaminated sediment on basin, Removal of liner, contaminated sediment and underlying layers, Flatten and Shape Dam Walls, Resoil, Re-Vegetate)	Land Capability and Land Use	Loss of soil nutrients while in storage, contamination by dirty water used for rehabilitated/re-vegetation, hydrocarbon spills from vehicles, compaction and dust.	Decommission and close facility per approved closure and rehabilitation plan.	Perform a contaminated land assessment to determine if soils are polluted.	Best Practice Environmental Option (BPEO)	Chamber of Mines Guidelines and Best Practice Environmental Option (BPEO)
					Determine and implement suitable remediation options.		
					Where possible backfill and compact dam footprint, landscape facility to be free draining.		
					Stockpiled utilisable soil must be redistributed in a manner that achieves an approximate uniform stable thickness consistent with the approved post development end land use and will attain a <u>free draining surface profile</u> .		
					Determine the nutrient status and chemistry of the utilisable materials and based on the analysis, fertilisers must be applied if necessary.		
					Revegetate disturbed areas using locally occurring indigenous grass and tree species.		
					Implement erosion control measures (rock cladding/ vegetative cover) to ensure that the soil is not washed away and that erosion gulleys do not develop prior to vegetation establishment.		
					Manage movement of people, animals and traffic over rehabilitated land.		
Copper Flotation Plant	Decommissioning of Plant (Demolish and remove infrastructure, Flatten and Shape, Resoil, Re-Vegetate)	Land Capability and Land Use	Loss of soil nutrients while in storage, contamination by dirty water used for rehabilitated/re-vegetation, hydrocarbon spills from vehicles, compaction and dust.	Decommission and close facility per approved closure and rehabilitation plan.	Perform a contaminated land assessment to determine if soils are polluted.	Best Practice Environmental Option (BPEO)	Chamber of Mines Guidelines and Best Practice Environmental Option (BPEO)
					Determine and implement suitable remediation options.		
					Stockpiled utilisable soil must be redistributed in a manner that achieves an approximate uniform stable thickness consistent with the approved post development end land use and will attain a <u>free draining surface profile</u> .		
					Determine the nutrient status and chemistry of the utilisable materials and based on the analysis, fertilisers must be applied if necessary.		
					Revegetate disturbed areas using locally occurring indigenous grass and tree species.		
					Implement erosion control measures (rock cladding/ vegetative cover) to ensure that the soil is not washed away and that erosion gulleys do not develop prior to vegetation establishment.		

Table 5.3(c): Decommissioning and Closure Phase Impact Management Measures Table – Groundwater

DECOMMISSIONING AND CLOSURE PHASE IMPACT MANAGEMENT MEASURES TABLE – GROUNDWATER							
Activity	Decommissioning Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF)	Decommissioning of Facility (Flatten and Shape Side Slopes, Install Suitable Capping Liner, Resoil, Re-Vegetate)	Groundwater: Quality	Deterioration of the groundwater resource quality due to the leaching of residual materials during decommissioning.	Control by monitoring groundwater quality adjacent facility.	Monitor groundwater resource quality at dedicated weathered zone monitoring boreholes adjacent to the facility. (Resource Directed Measure)	No deterioration in groundwater resource quality from leaching of the facility materials	Conditions/ quality as per WUL
					Any adverse trends in the groundwater quality recorded from the dedicated groundwater monitoring boreholes are to be reported and assessed, followed by the development of a site specific groundwater remediation plan. (Resource Directed Measure)		Conditions/ quality as per WUL
Access Road to MWSDF	Decommissioning of Road (Flatten and Shape, Resoil, Re-Vegetate)	Groundwater: Quality	Deterioration of the groundwater resource quality due to spillages and infiltration of fuel (hydrocarbons) from the fuel tanks of construction vehicles.	Stop and control by inspecting construction vehicles regularly and also cleaning spillage from vehicles regularly.	Responsible personnel to inspect the construction vehicles for potential fuel leaks. (Source Control Measure)	No spillages and subsequent seepage into the groundwater	No
					Any leaks and spillages are to be reported to the relevant personnel, after which the area is to be cleaned up accordingly. (Source Control Measure)		No
Internal Roads	Dust Suppression	Groundwater: Quality	Deterioration of the groundwater resource quality due to the infiltration of contaminated water used for dust suppression on internal road surface.	Avoid by not using contaminated water for dust suppression.	No contaminated water should be used for dust suppression on internal roads unless authorised in the WUL.	No deterioration in groundwater resource quality from leaching of the facility materials	Conditions/ quality as per WUL
					Monitor and report the quality (quarterly) and quantity (monthly) of water used for dust suppression. (Source Control Measure)		Conditions/ quality as per WUL
					Continue monitoring the groundwater resource quality. (Resource Directed Measure)		
Pollution Control Dam (PCD) and associated infrastructure	Decommissioning of Dam (Dewatering of the dam, Removal of contaminated sediment on basin, Removal of liner, contaminated sediment and underlying layers, Flatten and Shape Dam Walls, Resoil, Re-Vegetate)	Groundwater: Quality	Deterioration of the groundwater resource quality due to the leaching of residual materials during decommissioning.	Control by monitoring groundwater quality adjacent facility.	Monitor groundwater resource quality at dedicated weathered zone monitoring boreholes adjacent to the facility. (Resource Directed Measure)	No deterioration in groundwater resource quality from leaching of the facility materials	Conditions/ quality as per WUL
					Any adverse trends in the groundwater quality recorded from the dedicated groundwater monitoring boreholes are to be reported and assessed, followed by the development of a site specific groundwater remediation plan. (Resource Directed Measure)		Conditions/ quality as per WUL
Copper Flotation Plant	Decommissioning of Plant (Demolish and remove infrastructure, Flatten and Shape, Resoil, Re-Vegetate)	Groundwater: Quality	Deterioration of the groundwater resource quality due to the leaching of residual materials during decommissioning.	Control by monitoring groundwater quality adjacent facility.	Monitor groundwater resource quality at dedicated weathered zone monitoring boreholes adjacent to the plant area. (Resource Directed Measure)	No deterioration in groundwater resource quality from leaching of the facility materials	Conditions/ quality as per WUL
					Any adverse trends in the groundwater quality recorded from the dedicated groundwater monitoring boreholes are to be reported and assessed, followed by the development of a site specific groundwater remediation plan. (Resource Directed Measure)		Conditions/ quality as per WUL

Table 5.3(d): Decommissioning and Closure Phase Impact Management Measures Table – Surface Water

DECOMMISSIONING AND CLOSURE PHASE IMPACT MANAGEMENT MEASURES TABLE – SURFACE WATER							
Activity	Decommissioning Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF)	Decommissioning of Facility (Flatten and Shape Side Slopes, Install Suitable Capping Liner, Resoil, Re-Vegetate)	Surface Water: Quality	Contamination of the surface water resource due to increased sediment load from MWSDF covered slopes directly into the surface water resource.	Control impact on surface water resource quality through sediment load control plan.	Decommission and close the MWSDF during the dry season. Cap and close facility as per approved closure and rehabilitation plan.	Surface water quality to be compliant with resource quality objectives	Bosveld WUL decommissioning and closure procedures. Surface Water quality Standards as per WUL.
Access Road to MWSDF	Decommissioning of haul road	Surface Water: Quality	Deterioration of the surface water resource quality as a result of increased erosion introducing elevated sediment load into the surface drainage features and as a result of diesel and oil spillages into storm water flowing into the surface drainage features.	Control impact on surface water resource quality through sediment load control plan as well as a spillages control and clean-up procedure.	Implement dust control measures on all dirt roads.	Surface water quality to be compliant with resource quality objectives	Bosveld WUL decommissioning and closure procedures. Surface Water quality Standards as per WUL.
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Decommissioning of Dam (Dewatering of the dam, Removal of contaminated sediment on basin, Removal of liner, contaminated sediment and underlying layers, Flatten and Shape Dam Walls, Resoil, Re-Vegetate)	Surface Water: Quality	Deterioration of the surface water resource quality as a result of increased erosion introducing elevated sediment load into the surface drainage features.	Control impact on surface water resource quality through sediment load control plan.	Ensure that demolition and removal of infrastructure does not encroach upon remaining natural vegetation. Sediment trap netting to be established during revegetation of area.	Surface water quality to be compliant with resource quality objectives	Bosveld WUL decommissioning and closure procedures. Surface Water quality Standards as per WUL.
Copper Flotation Plant	Decommissioning of Plant (Demolish and remove infrastructure, Flatten and Shape, Resoil, Re-Vegetate)	Surface Water: Quality	Deterioration of the surface water resource quality as a result of increased erosion introducing elevated sediment load into the surface drainage features.	Control impact on surface water resource quality through sediment load control plan.	Ensure that demolition and removal of infrastructure does not encroach upon remaining natural vegetation. Sediment trap netting to be established during revegetation of area.	Surface water quality to be compliant with resource quality objectives	Bosveld WUL decommissioning and closure procedures. Surface Water quality Standards as per WUL.

Table 5.3(e): Decommissioning and Closure Phase Impact Management Measures Table – Terrestrial Ecology

DECOMMISSIONING AND CLOSURE PHASE IMPACT MANAGEMENT MEASURES TABLE – TERRESTRIAL ECOLOGY							
Activity	Decommissioning Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF)	Decommissioning of Facility (Flatten and Shape Side Slopes, Install Suitable Capping Liner, Resoil, Re-Vegetate)	Flora & Fauna: Habitat and Diversity	Contamination of downstream riparian habitats resulting from seepage of waste and/or contaminated water from MWSDF.	Stop and control impact through continuing facility maintenance, and minimise and remedy impacts through effective response planning and implementation.	Regularly inspect and maintain all facilities and infrastructure associated with waste storage and conveyance.	Minimise potential incidents of seepage/spills	Norms and Standards
					Develop and implement an emergency pollution response and clean-up plan for any waste/pollution leakages and spills.	Minimise risk of potential pollution seepage/spills entering into the environment	Norms and Standards
		Flora: Habitat and Diversity	Establishment and spread of alien invasive species resulting from disturbances caused by decommissioning activities.	Modify, control and stop potential impacts by implementing an invasive species programme.	Develop and implement an alien invasive species control programme that includes a combined approach using both chemical and mechanical control methods, and periodic follow-up treatments that are informed by regular monitoring.	Minimise populations of on-site alien invasive species	Alien and Invasive Species Regulations
					Revegetate disturbed areas using locally occurring indigenous grass and tree species.	Minimise exposed soil surfaces	Best Practise Guidelines
Access Road to MWSDF	Decommissioning of Road (Flatten and Shape, Resoil, Re-Vegetate)	Flora: Habitat and Diversity	Establishment and spread of alien invasive species resulting from disturbances caused by decommissioning activities.	Modify, control and stop potential impacts by implementing an invasive species programme.	Develop and implement an alien invasive species control programme that includes a combined approach using both chemical and mechanical control methods, and periodic follow-up treatments that are informed by regular monitoring.	Minimise populations of on-site alien invasive species	Alien and Invasive Species Regulations
					Revegetate disturbed areas using locally occurring indigenous grass and tree species.	Minimise exposed soil surfaces	Best Practise Guidelines
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Decommissioning of Dam (Dewatering of the dam, Removal of contaminated sediment on basin, Removal of liner, contaminated sediment and underlying layers, Flatten and Shape Dam Walls, Resoil, Re-Vegetate)	Flora & Fauna: Habitat and Diversity	Contamination of downstream riparian habitats resulting from seepage of waste and/or contaminated water from PCD and associated water infrastructure.	Stop and control impact through continuing facility maintenance, and minimise and remedy impacts through effective response planning and implementation.	Regularly inspect and maintain all facilities and infrastructure associated with waste storage and conveyance.	Minimise potential incidents of seepage/spills	Norms and Standards
					Develop and implement an emergency pollution response and clean-up plan for any waste/pollution leakages and spills.	Minimise risk of potential pollution seepage/spills entering into the environment	Norms and Standards
		Flora: Habitat and Diversity	Establishment and spread of alien invasive species resulting from disturbances caused by decommissioning activities.	Modify, control and stop potential impacts by implementing an invasive species programme.	Develop and implement an alien invasive species control programme that includes a combined approach using both chemical and mechanical control methods, and periodic follow-up treatments that are informed by regular monitoring.	Minimise populations of on-site alien invasive species	Alien and Invasive Species Regulations
					Revegetate disturbed areas using locally occurring indigenous grass and tree species.	Minimise exposed soil surfaces	Best Practise Guidelines

DECOMMISSIONING AND CLOSURE PHASE IMPACT MANAGEMENT MEASURES TABLE – TERRESTRIAL ECOLOGY

Activity	Decommissioning Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Copper Flotation Plant	Decommissioning of Plant (Demolish and remove infrastructure, Flatten and Shape, Resoil, Re-Vegetate)	Flora: Habitat and Diversity	Establishment and spread of alien invasive species resulting from disturbances caused by decommissioning activities.	Modify, control and stop potential impacts by implementing an invasive species programme.	Develop and implement an alien invasive species control programme that includes: a combined approach using both chemical and mechanical control methods, and periodic follow-up treatments, informed by regular monitoring.	Minimise populations of on-site alien invasive species	Alien and Invasive Species Regulations
					Revegetate disturbed areas using locally occurring indigenous grass and tree species.	Minimise exposed soil surfaces	Best Practise Guidelines

Table 5.3(f): Decommissioning and Closure Phase Impact Management Measures Table – Aquatic Ecosystems

DECOMMISSIONING AND CLOSURE PHASE IMPACT MANAGEMENT MEASURES TABLE – AQUATIC ECOSYSTEMS							
Activity	Decommissioning Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF)	Decommissioning of Facility (Flatten and Shape Side Slopes, Install Suitable Capping Liner, Resoil, Re-Vegetate)	Surface Water: Quality	Potential spillage/leakage from demolished facility.	Control by maintaining suitable bufferzones around watercourses.	Maintain service roads to avoid erosion and excessive dust formation.	No visible signs of erosion	Best Practise Guidelines
					Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	Ensure no decline current PES compared to DWS, 2014 and the baseline conditions	Conditions/ quality as per WUL
Access Road to MWSDF	Decommissioning of Road (Flatten and Shape, Resoil, Re-Vegetate)	Surface Water: Quality	Degradation of the aquatic ecosystems due to sediment mobilisation, run-off from the site and potential erosion.	Control by maintaining suitable bufferzones around watercourses. Avoid by minimising the footprint.	Maintain service roads to avoid erosion and excessive dust formation.	Routine checks for erosion	Best Practise Guidelines
					Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	Ensure no decline current PES compared to DWS, 2014 and the baseline conditions	Conditions/ quality as per WUL
		Aquatic habitat	Loss/ or alteration of habitat: mainly in-stream channel habitat - limited riparian habitat. Increase in erosion within the riparian zone. Increased sedimentation smothering in-stream habitats and reducing availability of biotopes.	Control by maintaining suitable bufferzones around watercourses.	Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	Ensure no decline current PES compared to DWS, 2014 and the baseline conditions	Conditions/ quality as per WUL
Pollution Control Dam (PCD) and associated infrastructure (including the silt trap)	Decommissioning of Dam (Dewatering of the dam, Removal of contaminated sediment on basin, Removal of liner, contaminated sediment and underlying layers, Flatten and Shape Dam Walls, Resoil, Re-Vegetate)	Surface Water: Quality	Potential spillage/leakage from decommissioning of dam, dewatering, leakage of contaminated sediments in adjacent Ga-Selati.	Remedy by monitoring any surface run-off patterns and erosion gulleys. Control by maintaining suitable bufferzones around watercourses.	Maintain service roads to avoid erosion and excessive dust formation.	No visible signs of erosion	Best Practise Guidelines
					Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	Ensure no decline current PES compared to DWS, 2014 and the baseline conditions	Conditions/ quality as per WUL
		Aquatic biota	Loss of ecological communities.	Control by maintaining suitable bufferzones around watercourses.	Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	Ensure no decline current PES compared to DWS, 2014 and the baseline conditions	Conditions/ quality as per WUL

DECOMMISSIONING AND CLOSURE PHASE IMPACT MANAGEMENT MEASURES TABLE - AQUATIC ECOSYSTEMS							
Activity	Decommissioning Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Copper Flotation Plant	Decommissioning of Plant (Demolish and remove infrastructure, Flatten and Shape, Resoil, Re-Vegetate)	Surface Water: Quality	Potential spillage/leakage from demolished facility.	Control by maintaining suitable bufferzones around watercourses.	Maintain service roads to avoid erosion and excessive dust formation.	No visible signs of erosion	Best Practise Guidelines
					Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	Ensure no decline current PES compared to DWS, 2014 and the baseline conditions	Conditions/ quality as per WUL

Table 5.3(g): Decommissioning and Closure Phase Impact Management Measures Table – Wetlands

DECOMMISSIONING AND CLOSURE PHASE IMPACT MANAGEMENT MEASURES TABLE – WETLANDS							
Activity	Decommissioning Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF), Access Road to MWSDF, Pollution Control Dam (PCD) and associated infrastructure (including the silt trap) and Copper Flotation Plant	Decommissioning of Facility (Flatten and Shape Side Slopes, Install Suitable Capping Liner, Resoil, Re-Vegetate)	Wetlands, riparian habitats and watercourses	Destruction and disturbance of watercourse habitat. Increased sedimentation within watercourses. Water quality deterioration. Increase in alien vegetation.	Prevent further disturbance and degradation of watercourse habitats on site.	Limit the disturbance footprint resulting from decommissioning activities to the already disturbed footprint.	Maintain PES of the Ga-Selati riparian zone and other affected watercourses	Conditions/ quality as per WUL and EMP Industry Best Practice
					Ensure all decommissioning activities avoid the delineated riparian habitats on site as well as the associated 32m buffer zones.		
					Clearly demarcate all watercourses in close proximity to decommissioning activities and prevent any direct disturbances to these areas.		
					Revegetate disturbed/ cleared areas as soon as possible following completion of decommissioning activities with locally occurring indigenous species.		
					Remove all redundant infrastructure from site as well as all solid waste.		
					Minimise extent of exposed, bare soils at any one time, i.e. phase activities.		
					Where practically possible, the major earthworks should be undertaken during the dry season (roughly from April to November) to limit erosion due to rainfall runoff.		
					Install sediment barriers and/or low berms along the downslope edge of earthworks to trap sediments on site. Design of sediment barriers should be such that expected flow velocities will not damage the barriers or impair their function. Regular cleaning and maintenance of the barriers should be undertaken.		
					Maintain the stormwater management system as long into the decommissioning phase as possible.		
					Discharge stormwater into well vegetated areas outside riparian habitat, ideally with a minimum 32 m buffer area between riparian habitat and the point of discharge.		
					Install energy dissipaters and erosion protection at points of discharge.		
					Regular monitoring and inspections at rehabilitated sites should be undertaken to ensure successful rehabilitation.		
					To prevent water quality deterioration, all potentially harmful substances used on site should be stored in bunded areas so that spills and leaks can be contained and no contamination of soils or surface runoff occurs.		
					Servicing and cleaning of vehicles to take place off site at designated facilities off site.		
Limit storage of fuel and diesel on site to the minimum.							
Management plan for waste collection, storage and handling on site must be implemented. All waste to be disposed of offsite in designated facilities.							

DECOMMISSIONING AND CLOSURE PHASE IMPACT MANAGEMENT MEASURES TABLE – WETLANDS							
Activity	Decommissioning Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
					Any areas of contaminated soils should be appropriately remediated under guidance of a suitable contaminated land specialist.		
					An alien invasive species management plan must be developed and implemented on-site during all phases of the proposed project. It is recommended that the programme include a combined approach using both chemical and mechanical control methods with periodic follow-up treatments, informed by regular monitoring.		
					Monitoring should take place in disturbed areas, as well as adjacent undisturbed areas.		

Table 5.3(h): Decommissioning and Closure Phase Impact Management Measures Table – Air Quality

DECOMMISSIONING AND CLOSURE PHASE IMPACT MANAGEMENT MEASURES TABLE – AIR QUALITY							
Activity	Decommissioning Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF); Access Road to MWSDF; Pollution Control Dam (PCD) and associated infrastructure (including silt trap); Copper Flotation Plant	Decommissioning of Facility (Flatten and Shape Side Slopes, Install Suitable Capping Liner, Resoil, Re-Vegetate); Decommissioning of Road (Flatten and Shape, Resoil, Re-Vegetate); Decommissioning of Dam (Dewatering of the dam, Removal of contaminated sediment on basin, Removal of liner, contaminated sediment and underlying layers, Flatten and Shape Dam Walls, Resoil, Re-Vegetate); Decommissioning of Plant (Demolish and remove infrastructure, Flatten and Shape, Resoil, Re-Vegetate)	Air Quality: Dust Fallout	Increased dust deposition rate at Foskor Mine, at Phalaborwa Town, at PMC Mine, at Schalk Small Holdings, at Namakgale/ Makhushane and at Phalaborwa Industrial Area	Control through implementing appropriate dust suppression methods and administrative measures	Monitor ambient dust deposition rates	A change of more than 10% from the pre-construction conditions should result in an applicable adjustment	Conditions and targets as per Bosveld Phosphates Air Quality Management Plan, the Atmospheric Emission License and National Standards
Magnetite Waste Site Disposal Facility (MWSDF); Access Road to MWSDF; Pollution Control Dam (PCD) and associated infrastructure (including silt trap); Copper Flotation Plant	Decommissioning of Facility (Flatten and Shape Side Slopes, Install Suitable Capping Liner, Resoil, Re-Vegetate); Decommissioning of Road (Flatten and Shape, Resoil, Re-Vegetate); Decommissioning of Dam (Dewatering of the dam, Removal of contaminated sediment on basin, Removal of liner, contaminated sediment and underlying layers, Flatten and Shape Dam Walls, Resoil, Re-Vegetate); Decommissioning of Plant (Demolish and remove infrastructure, Flatten and Shape, Resoil, Re-Vegetate)	Air Quality: Particulate Matter	Increased dust deposition rate at Foskor Mine, at Phalaborwa Town, at PMC Mine, at Schalk Small Holdings, at Namakgale/ Makhushane and at Phalaborwa Industrial Area	Control through implementing appropriate dust suppression methods and administrative measures	Monitor ambient PM ₁₀ concentrations	A change of more than 10% from the pre-construction conditions should result in an applicable adjustment	Conditions and targets as per Bosveld Phosphates Air Quality Management Plan, the Atmospheric Emission License and National Standards
Magnetite Waste Site Disposal Facility (MWSDF); Access Road to MWSDF; Pollution Control Dam (PCD) and associated infrastructure (including silt trap); Copper Flotation Plant	Decommissioning of Facility (Flatten and Shape Side Slopes, Install Suitable Capping Liner, Resoil, Re-Vegetate); Decommissioning of Road (Flatten and Shape, Resoil, Re-Vegetate); Decommissioning of Dam (Dewatering of the dam, Removal of contaminated sediment on basin, Removal of liner, contaminated sediment and underlying layers, Flatten and Shape Dam Walls, Resoil, Re-Vegetate); Decommissioning of Plant (Demolish and remove infrastructure, Flatten and Shape, Resoil, Re-Vegetate)	Air Quality: Gaseous Emissions	Increased dust deposition rate at Foskor Mine, at Phalaborwa Town, at PMC Mine, at Schalk Small Holdings, at Namakgale/ Makhushane and at Phalaborwa Industrial Area	Control through ensuring mobile and stationary internal combustion equipment is properly serviced and operated	Maintain service records for all mobile and stationary internal combustion equipment	No visibly abnormal tailpipe emissions in accordance with supplier specifications	Auditing and <i>ad hoc</i> emission testing

5.4. POST CLOSURE PHASE IMPACT MANAGEMENT MEASURES TABLES

Table 5.4(a): Post Closure Phase Impact Management Measures Table – Socio-Economic/Cultural

Refer to Table 5.3(a) - Decommissioning Phase Impact Significance Rating Table – Socio-Economic/Cultural.

Table 5.4(b): Post Closure Phase Impact Management Measures Table – Soils, Land Use and Land Capability

POST CLOSURE PHASE IMPACT MANAGEMENT MEASURES TABLE – SOILS, LAND USE AND LAND CAPABILITY							
Activity	Post Closure Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF)	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner	Soil fertility and vegetative cover	Addition of fertilizers is a possible pollutant/contaminant in excessive quantities. Vehicle, animal and human movement impact on soil compaction, erosion, generation of dust and stormwater runoff and sedimentary load on receiving environment.	Facilitate end Land Use. Monitor and remediate where necessary.	Fence off rehabilitated sites if required.	Best Practice Environmental Option (BPEO)	Chamber of Mines Guidelines and Best Practice Environmental Option (BPEO)
					Reduce animal, people and vehicle movement over rehabilitated sites.		
					Use clean water for irrigation of rehabilitated sites if necessary.		
					Monitor and manage affected areas, fertilize and re-vegetate if necessary.		
Access Road to MWSDF	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner	Soil fertility and vegetative cover	Addition of fertilizers is a possible pollutant/contaminant in excess quantities. Movement of vehicle, animal and human impact on soil compaction, erosion, generation of dust and possible contamination (hydrocarbons).	Facilitate end Land Use. Monitor and remediate where necessary.	Fence off rehabilitated sites if required.	Best Practice Environmental Option (BPEO)	Chamber of Mines Guidelines and Best Practice Environmental Option (BPEO)
					Reduce animal, people and vehicle movement over rehabilitated sites.		
					Use clean water for irrigation of rehabilitated sites if necessary.		
					Monitor and manage affected areas, fertilize and re-vegetate if necessary.		
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner	Soil fertility and vegetative cover	Addition of fertilizers is a possible pollutant/contaminant in excessive quantities. Movement of vehicle, animal and human impact on soil compaction, erosion, generation of dust and stormwater runoff and sedimentary load on receiving environment.	Facilitate end Land Use. Monitor and remediate where necessary.	Fence off rehabilitated sites if required.	Best Practice Environmental Option (BPEO)	Chamber of Mines Guidelines and Best Practice Environmental Option (BPEO)
					Reduce animal, people and vehicle movement over rehabilitated sites.		
					Use clean water for irrigation of rehabilitated sites if necessary.		
					Monitor and manage affected areas, fertilize and re-vegetate if necessary.		
Copper Flotation Plant	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner	Soil fertility and vegetative cover	Addition of fertilizers is a possible pollutant/contaminant in excessive quantities. Movement of vehicle, animal and human impact on soil compaction, erosion, generation of dust and stormwater runoff and sedimentary load on receiving environment.	Facilitate end Land Use. Monitor and remediate where necessary.	Fence off rehabilitated sites if required.	Best Practice Environmental Option (BPEO)	Chamber of Mines Guidelines and Best Practice Environmental Option (BPEO)
					Reduce animal, people and vehicle movement over rehabilitated sites.		
					Use clean water for irrigation of rehabilitated sites if necessary.		
					Monitor and manage affected areas, fertilize and re-vegetate if necessary.		

Table 5.4(c): Post Closure Phase Impact Management Measures Table – Groundwater

POST CLOSURE PHASE IMPACT MANAGEMENT MEASURES TABLE – GROUNDWATER							
Activity	Post Closure Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF), Pollution Control Dam (PCD) and associated infrastructure and Copper Flotation Plant	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner	Groundwater Quality	Residual impact on the groundwater resource quality due to the previous infiltration of soluble contaminants into the subsurface through the footprints of the facility.	Control by monitoring groundwater quality adjacent to facility.	Use the groundwater monitoring data to identify the areas in which groundwater remediation is required and in which groundwater abstraction for remediation is required post closure (if required). (Resource Directed Measure)	No deterioration in groundwater resource quality from leaching of the facility materials	No
					Monitor the groundwater quality in selected areas, to assess the efficiency of the proposed post closure groundwater remediation plan (if required) and to verify whether any trends in the groundwater quality exist. (Resource Directed Measure)		Conditions/ quality as per WUL

Table 5.4(d): Post Closure Phase Impact Management Measures Table – Surface Water

POST CLOSURE PHASE IMPACT MANAGEMENT MEASURES TABLE - SURFACE WATER							
Activity	Post Closure Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF), Access Road to MWSDF, Pollution Control Dam (PCD) and associated infrastructure (including the silt trap) and Copper Flotation Plant	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner.	Surface Water: Quality	Impact on surface water resource quality if erosion occurs due to run-off from poorly rehabilitated and re-vegetated surface areas.	Maintain rehabilitated surfaces in good condition (no erosion with stable vegetative cover).	Maintain and monitor vegetative cover. Continue surface water quality monitoring.	Stable vegetative cover	NEMBA Regulation 864 of July 2016 - Alien and Invasive species Lists

Table 5.4(e): Post Closure Phase Impact Management Measures Table – Terrestrial Ecology

POST CLOSURE PHASE IMPACT MANAGEMENT MEASURES TABLE – TERRESTRIAL ECOLOGY							
Activity	Post Closure Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF)	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner	Flora: Habitat and Diversity	Contamination of downstream riparian habitats resulting from seepage of waste and/or contaminated water from MWSDF.	Stop and control impact through continuing facility maintenance, and minimise and remedy impacts through effective response planning and implementation.	Regularly inspect and maintain all facilities and infrastructure associated with waste storage and conveyance.	Minimise potential incidents of seepage/spills	Norms and Standards
					Implement an emergency response and clean-up plan for any waste/pollution leakages and spills.	Minimise risk of potential pollution seepage/spills entering into the environment	Norms and Standards
	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner	Flora & Fauna: Habitat and Diversity	Establishment and spread of alien invasive species resulting from any disturbances caused by maintenance and aftercare.	Modify, control and stop potential impacts by implementing an invasive species programme.	Develop and implement an alien invasive species control programme that includes a combined approach using both chemical and mechanical control methods, and periodic follow-up treatments that are informed by regular monitoring.	Minimise populations of on-site alien invasive specie	Alien and Invasive Species Regulations
					Revegetate disturbed areas using locally occurring indigenous grass and tree species.	Minimise exposed soil surfaces	Best Practise Guidelines
Access Road to MWSDF	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner	Flora: Habitat and Diversity	Establishment and spread of alien invasive species resulting from any disturbances caused by maintenance and aftercare.	Modify, control and stop potential impacts by implementing an invasive species programme.	Develop and implement an alien invasive species control programme that includes: a combined approach using both chemical and mechanical control methods, and periodic follow-up treatments, informed by regular monitoring.	Minimise populations of on-site alien invasive species	Alien and Invasive Species Regulations
					Wherever possible, disturbed areas using locally occurring indigenous grass and tree species.	Minimise exposed soil surfaces	Best Practise Guidelines
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner	Flora: Habitat and Diversity	Establishment and spread of alien invasive species resulting from any disturbances caused by maintenance and aftercare.	Modify, control and stop potential impacts by implementing an invasive species programme.	Develop and implement an alien invasive species control programme that includes a combined approach using both chemical and mechanical control methods, and periodic follow-up treatments that are informed by regular monitoring.	Minimise populations of on-site alien invasive species	Alien and Invasive Species Regulations
					Revegetate disturbed areas using locally occurring indigenous grass and tree species.	Minimise exposed soil surfaces	Best Practise Guidelines
Copper Flotation Plant	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner	Flora: Habitat and Diversity	Establishment and spread of alien invasive species resulting from any disturbances caused by maintenance and aftercare.	Modify, control and stop potential impacts by implementing an invasive species programme.	Develop and implement an alien invasive species control programme that includes a combined approach using both chemical and mechanical control methods, and periodic follow-up treatments that are informed by regular monitoring.	Minimise populations of on-site alien invasive specie	Alien and Invasive Species Regulations
					Revegetate disturbed areas using locally occurring indigenous grass and tree species.	Minimise exposed soil surfaces	Best Practise Guidelines

Table 5.4(f): Post Closure Phase Impact Management Measures Table – Aquatic Ecosystems

POST CLOSURE PHASE IMPACT MANAGEMENT MEASURES TABLE – AQUATIC ECOSYSTEMS							
Activity	Post Closure Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF), Access Road to MWSDF, Pollution Control Dam (PCD) and associated infrastructure (including silt trap) and Copper Flotation Plant	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner.	Surface Water: Quality, habitats, biota	Further degradation of the aquatic ecosystem health should on-going maintenance, aftercare and monitoring not be undertaken.	Continued maintenance and monitoring to ensure closure objectives have been met.	Continue current bi-annual aquatic biomonitoring programme for Bosveld Phosphates, in collaboration with Palabora Copper and Foskor and implement updates as per monitoring plan proposed for project.	Ensure no decline current PES compared to DWS, 2014 and the baseline conditions	Conditions/ quality as per WUL

Table 5.4(g): Post Closure Phase Impact Management Measures Table – Wetlands

POST CLOSURE PHASE IMPACT MANAGEMENT MEASURES TABLE – WETLANDS							
Activity	Post Closure Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF), Access Road to MWSDF, Pollution Control Dam (PCD) and associated infrastructure (including silt trap) and Copper Flotation Plant	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner.	Wetlands, riparian habitats and watercourses	Contamination of Downstream Water Courses. Establishment and Spread of Alien Invasive Species.	Maintain PES of the Ga-Selati riparian zone and other affected watercourses.	Develop and implement an alien invasive species management plan on-site during all phases of the proposed project. It is recommended that the programme include a combined approach using both chemical and mechanical control methods with periodic follow-up treatments, informed by regular monitoring.	Maintain PES of the Ga-Selati riparian zone and other affected watercourses	Conditions/ quality as per WUL and EMP Industry best practice
					Monitoring should take place in disturbed areas, as well as adjacent undisturbed areas.		
					Isolate dirty water areas and separate clean and dirty water areas.		
					The MWSDF must be capped with suitable material to ensure surface runoff from the MWSDF remains clean and can be discharged to the environment. Capping material should further aim to reduce infiltration into the MWSDF so as to reduce seepage out of the MWSDF. Once capped, the MWSDF should be vegetated.		
					Implement detailed water management plan and adjust to post-closure requirements. The plan must ensure all contaminated surface runoff from the MWSDF facility are captured on site.		
					Implement seepage interception measures to prevent seepage of contaminated water into downslope watercourses.		
					No dirty water may be discharged from site unless meeting the RQO requirement of the Ga-Selati and/or Olifants River, as applicable.		
					Develop and implement a water quality and biomonitoring plan. Such a monitoring plan must detail the process to be followed in responding to any contamination of adjacent watercourses being observed.		
					Implement a groundwater monitoring strategy as per recommendations of the groundwater specialist.		

Table 5.4(h): Post Closure Phase Impact Management Measures Table – Air Quality

POST CLOSURE PHASE IMPACT MANAGEMENT MEASURES TABLE – AIR QUALITY							
Activity	Post Closure Activity Aspect	Environmental Component Affected	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)	Standard to be Achieved	Compliance with Standards (Legal Requirements)
Magnetite Waste Site Disposal Facility (MWSDF); Access Road to MWSDF; Pollution Control Dam (PCD) and associated infrastructure (including the silt trap); Copper Flotation Plant	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner	Air Quality: Dust Fallout	Increased dust deposition rate at Foskor Mine, at Phalaborwa Town, at PMC Mine, at Schalk Small Holdings, at Namakgale/ Makhushane and at Phalaborwa Industrial Area.	Control through implementing appropriate dust suppression methods and administrative measures.	Monitor ambient dust deposition rates	A change of more than 10% from the pre-construction conditions should result in an applicable adjustment	Conditions and targets as per Bosveld Phosphates Air Quality Management Plan, the Atmospheric Emission License and National Standards
Magnetite Waste Site Disposal Facility (MWSDF); Access Road to MWSDF; Pollution Control Dam (PCD) and associated infrastructure (including the silt trap); Copper Flotation Plant	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner	Air Quality: Particulate Matter	Increased dust deposition rate at Foskor Mine, at Phalaborwa Town, at PMC Mine, at Schalk Small Holdings, at Namakgale/ Makhushane and at Phalaborwa Industrial Area.	Control through implementing appropriate dust suppression methods and administrative measures.	Monitor ambient PM ₁₀ concentrations	A change of more than 10% from the pre-construction conditions should result in an applicable adjustment	Conditions and targets as per Bosveld Phosphates Air Quality Management Plan, the Atmospheric Emission License and National Standards
Magnetite Waste Site Disposal Facility (MWSDF); Access Road to MWSDF; Pollution Control Dam (PCD) and associated infrastructure (including the silt trap); Copper Flotation Plant	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner	Air Quality: Gaseous Emissions	Increased dust deposition rate at Foskor Mine, at Phalaborwa Town, at PMC Mine, at Schalk Small Holdings, at Namakgale/ Makhushane and at Phalaborwa Industrial Area.	Control through ensuring mobile and stationary internal combustion equipment is properly serviced and operated.	Maintain service records for all mobile and stationary internal combustion equipment	No visibly abnormal tailpipe emissions in accordance with supplier specifications	Auditing and <i>ad hoc</i> emission testing

6. COMPLIANCE MONITORING AND PERFORMANCE ASSESSMENT

This section relays a compliance monitoring and performance assessment programme developed to assess compliance with the management actions and measures proposed in the EMPr. This programme is provided in Table 6(a).

The requirements for this programme are as follows:

- The method of monitoring the implementation of the impact management actions
- The frequency of monitoring the implementation of the impact management actions
- An indication of the persons who will be responsible for the implementation of the impact management actions
- The time periods within which the impact management actions must be implemented
- The mechanism for monitoring compliance with the impact management actions
- A programme for reporting on compliance, taking into consideration the requirements as prescribed in the regulations

The above-mentioned programme considered the following environmental components:

- Socio-Cultural and Socio-Economic
- Archaeology, Heritage and Palaeontology
- Soils, Land Capability and Land Use
- Geology and Groundwater
- Surface Water
- Terrestrial Ecology (Plant Life and Animal Life)
- Aquatic Ecosystems
- Wetlands
- Air Quality

The programme was developed by summarising information provided in the comprehensive monitoring plans developed for each of the environmental component considered. These monitoring plans are provided in the specialist reports compiled in support of this project; attached to the EIAR and provide details proposed to monitor the impacts associated with the project and efficiency of management measures proposed. Each monitoring plan typically contain details and information related to the following aspects:

- Monitoring localities
- Monitoring procedures
- Relevant standards for monitoring
- Monitoring frequencies
- Data capture protocols
- Reporting
- Standard operating procedures for non-compliance

It should be noted further that the monitoring plans developed for the Surface Water, Groundwater and Aquatic Ecosystems environmental components will also be provided in the Integrated Water and Waste Management Plan (IWWMP) to be submitted to the DWS in support of the Water Use Licence Application (WULA) associated with this proposed project.

Table 6(a) consists of the following Columns:

- Environmental Component
- Source Activity (ies)
- Reference to Potential Impact
- Functional Requirements for Monitoring
- Frequency of Monitoring Implementation
- Reporting Frequency
- Responsible Person
- Time period for implementation

Auditing of compliance with the environmental authorisation/ EMPr must adhere to regulation 34 of the EIA Regulations of 2014 (as amended).

Table 7(a): Formal Compliance Monitoring and Performance Assessment Programme

Environmental Component	Source Activity (ies)	Impacts Requiring Monitoring	Functional Requirements for Monitoring	Frequency of Monitoring Implementation	Reporting Frequency	Responsible Person	Time Period for Implementation
Socio-Economic Aspects	Construction of proposed activities	Procurement Process and Actions	Establishment and maintenance of a Grievance Register. Establishment and maintenance of a Database to capture minutes during meetings with local communities.	Register and Database: Continuous	Monthly Reporting		Construction Phase
	Operation of proposed activities	Procurement Process and Actions	Maintenance/ update of Grievance Register. Maintenance/ update of Database of minutes captured during meetings with local communities and procurement actions taken for project.	Register and Database: Continuous	Annual Reporting		Operational Phase
	Decommissioning and Closure of proposed activities	Job losses/ Retrenchment	Maintenance/ update of Grievance Register. Maintenance/ update of Database of minutes captured during meetings with local communities and retrenchment (rehabilitations) actions taken for project.	Register and Database: Continuous	Monthly Reporting		Decommissioning and Closure Phase
Archaeology, Heritage and Palaeontology	Construction, Operation and Decommissioning activities	Chance Findings of Heritage Resources and/or Fossils	Establishment and maintenance of a Chance Find register. Implementation of Chance Find Procedure if and when required.	Register: Continuous	During/ after each chance find opportunity		Construction Phase, Operational Phase and Decommissioning Phase
Soils, Land Capability and Land Use	Topsoil Stockpiles	Soil Quality/ Fertility	Soils should be sampled and analysed for at least the following parameters: pH (H ₂ O), Phosphorus (Bray I), Electrical Conductivity, Calcium mg/kg, Cation exchange capacity, Sodium mg/kg, Magnesium mg/kg, Potassium mg/kg, Zinc mg/kg, Clay (soil texture) and Organic matter content (C %)	Annually during operational phase (during the same time of the year)	Annual Report		Operational Phase
	Re-instated Soils	Soil Quality/ Fertility	Preliminary Soil Quality monitoring should be carried out before rehabilitation to accurately determine the fertiliser requirements that will be needed. Additional soil sampling should be carried out on the re-instated soils as required until the levels of nutrients are at the required levels for sustainable growth.	During the decommissioning/ rehabilitation phase	Before rehabilitation and quarterly during rehabilitation		Decommissioning and Post Closure Phase
Groundwater	Proposed Activities	Groundwater Quality	Groundwater Quality at proposed weathered zone monitoring boreholes upstream of and adjacent to new facilities (source control measure) as per groundwater monitoring plan.	Biannually	Biannual Data Report & Annual Water Quality Report		Construction Phase, Operational Phase, Decommissioning Phase and Post Closure Phase
Surface Water	Proposed Activities	Sedimentation	Inspect construction and decommissioning sites for traces of erosion to ensure no sediment load into nearby watercourses.	After rainfall event/ As per WUL conditions	As per WUL conditions		Construction Phase and Decommissioning Phase
	Proposed Activities	Surface Water Quality	Surface Water Quality up and downstream of project area as per surface water monitoring plan and WUL.	As per WUL conditions	As per WUL conditions		Construction Phase, Operational Phase and Decommissioning Phase

Environmental Component	Source Activity (ies)	Impacts Requiring Monitoring	Functional Requirements for Monitoring	Frequency of Monitoring Implementation	Reporting Frequency	Responsible Person	Time Period for Implementation
Surface Water	Proposed Activities	Surface Water Quality	Surface Water Quality of PCD as per surface water monitoring plan and WUL to monitor concentration levels in case of overflow or need for discharge.	As per WUL conditions	As per WUL conditions		Operational Phase
Terrestrial Ecology (Plant and Animal Life)	Vegetation Clearing and Earth Works	Alien invasive species colonisation	Visual inspection to identify sites of alien invasive species establishment and to verify alien species control effectiveness.	Annually (during the mid to late wet/growing season)	Annual Report		Construction Phase, Operational Phase and Decommissioning Phase
	Vegetation Clearing	Protected tree survival and recruitment following replacement planting during rehabilitation	Visual inspection to assess tree survivorship of out-planted <i>Boscia albitrunca</i> , <i>Combretum imberbe</i> , <i>Diospyros mespiliformis</i> , <i>Philenoptera violacea</i> , and <i>Sclerocarya birrea</i> subsp. <i>caffra</i> trees.	Biannually (during the mid to late wet/growing season)	Biannual Report		Post Closure Phase
Aquatic Ecosystems	Proposed Activities	Ga-Selati and Olifants Rivers	Health and Integrity of the Aquatic Ecosystem as per aquatic ecosystem monitoring report.	As required by rehabilitation/revegetation implementation programme	Annual Report		As soon as possible after disturbance
				Biannually (post wet and post dry season)	Post wet/ post dry season report – whichever survey is undertaken first followed by annual report consisting of both wet and dry season results and trends		Construction Phase, Operational Phase, Decommissioning Phase and Post Closure Phase
Wetlands	No natural wetland habitat was identified within the project study area or the 500m buffer. Monitoring as per Surface Water, Terrestrial Ecology and Aquatic Ecosystems environmental components.						
Air Quality	Current operations and proposed development (MWSDF, PCD and Copper Flotation Plant). Operational components: <ul style="list-style-type: none"> Construction processes. Haul roads. Raw material delivery. Material stockpiles. Operational processes. 	Air Quality: Dustfall	Single bucket dust gauges measure the fallout of windblown settleable dust in accordance with ASTM D1739-98. Assessment of compliance with dustfall limits within the main impact zone of the operation. Facilitate the measurement of progress against environmental targets within the main impact zone of the operation. Temporal trend analysis to determine the potential for nuisance impacts within the main impact zone of the operation. Tracking of progress due to pollution control measure implementation within the main impact zone of the operation. Informing the public of the extent of localised dust nuisance impacts occurring in the vicinity of the operations.	Samples are collected at the end of each sampling period (30-day period)	Monthly Reports & Annual Reports to be submitted to Licensing Authority.		Construction Phase, Operational Phase, Decommissioning Phase and Post Closure Phase - facilitating data collection over 30-day averaging period.

Environmental Component	Source Activity (ies)	Impacts Requiring Monitoring	Functional Requirements for Monitoring	Frequency of Monitoring Implementation	Reporting Frequency	Responsible Person	Time Period for Implementation
Air Quality	<ul style="list-style-type: none"> Product stockpiles. Waste disposal facility. Product dispatch. Waste dispatch. 	Air Quality: Dustfall					
	Current operations. Operational component: Operational processes.	Air Quality: Particulate Matter	AeroQual AQM65 ambient air quality monitoring system. Assessment of compliance with national standards for ambient fine particulate matter, sulphur dioxide and nitrogen dioxide over various reference intervals within the main impact zone of the operation. Facilitate the measurement of progress against environmental targets within the main impact zone of the operation. Temporal trend analysis to determine the potential for impacts within the main impact zone of the operation. Tracking of progress due to pollution control measure implementation within the main impact zone of the operation. Informing the public of the extent of localised criteria pollutant impacts in the impact zone of the operation.	Internet based AeroQual data management system. All records of raw data, data adjustments and schedules of maintenance, services and calibrations to be kept for a minimum period of five years. All results to be included in the annual emissions inventory.	Quarterly reports. Annual reports to be submitted to Licensing Authority.		Continuous monitoring over the operational lifetime of the project. SANAS valid data standard of 90% for all continuous monitoring equipment.

7. ENVIRONMENTAL AWARENESS PLAN

In order to adhere to the EIA Regulations, an EMPr must also contain an Environmental Awareness Plan. This Plan should provide details of the following:

- Describe how the applicant intends to inform his or her employees of any environmental risk which may result from their work.
- Describe the manner in which the risk must be dealt with in order to avoid pollution or degradation of the environment.

All staff and contractors are required to attend an Induction session annually at Bosveld Phosphates. Environmental issues and aspects related to the plant are addressed in these Induction sessions.

Examples of aspects covered:

- Awareness of storm water trenches and function thereof on site.
- Awareness of groundwater monitoring boreholes around the site and the function thereof.
- Awareness of domestic water supply and conservation thereof when performing duties on site.
- Awareness of the temperatures encountered on the site during the summer season and to keep hydrated by drinking enough water when performing duties on site.
- Awareness of dust generated by activities on site especially during the windy season and the importance of wearing a dust mask when performing duties on site.
- Awareness that the plant falls within a malaria area and that wearing long sleeve shirts and trousers when performing duties on site during sunset and sunrise when the mosquitoes are most active.

8. INFORMATION REQUIRED BY COMPETENT AUTHORITY

Table 8(a) serves to show that section 24(4)(a) and (b) of the Act have been adhered to when compiling the EIAR and EMPR for this project. The chapter which relays the specific information required as per the regulation is given in the second column of the Table.

In addition, an Environmental Management Programme Checklist Table (Table 8(b)) has been compiled in accordance with the guideline as set out in the EIA Regulations (GNR 982) of December 2014 (as amended); Appendix 4. Table 8(b) serves to show that the Appendix guideline has been adhered to when compiling this report. The chapter which relays the specific information required as per the guideline is given in the second column of the Table.

Confirmation of the monitoring results, performance assessments, internal and external audits and the annual review of the closure plan and financial provisioning are also provided below.

Table 8(a): Section 24(4)(a) and (b) of the Act Checklist Table

24 (4) Procedures for the investigation, assessment and communication of the potential consequences or impacts of activities on the environment -	
(a) must ensure, with respect to every application for an environmental authorisation -	Section
(i) coordination and cooperation between organs of state in the consideration of assessments where an activity falls under the jurisdiction of more than one organ of state;	N/A
(ii) that the findings and recommendations flowing from an investigation, the general objectives of integrated environmental management laid down in this Act and the principles of environmental management set out in section 2 are taken into account in any decision made by an organ of state in relation to any proposed policy, programme, process, plan or project;	5 of EIAR
(iii) that a description of the environment likely to be significantly affected by the proposed activity is contained in such application;	8 of EIAR
(iv) investigation of the potential consequences for or impacts on the environment of the activity and assessment of the significance of those potential consequences or impacts; and	9 & 10 of EIAR
(b) must include, with respect to every application for an environmental authorisation and where applicable-	Section
(i) investigation of the potential consequences or impacts of the alternatives to the activity on the environment and assessment of the significance of those potential consequences or impacts, including the option of not implementing the activity;	8 of EIAR
(ii) investigation of mitigation measures to keep adverse consequences or impacts to a minimum;	8, 13 of EIAR & 5 of EMPR
(iii) investigation, assessment and evaluation of the impact of any proposed listed or specified activity on any national estate referred to in section 3(2) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999), excluding the national estate contemplated in section 3(2)(i)(vi) and (vii) of that Act;	10, 21 of EIAR
(iv) reporting on gaps in knowledge, the adequacy of predictive methods and underlying assumptions, and uncertainties encountered in compiling the required information;	16 of EIAR
(v) investigation and formulation of arrangements for the monitoring and management of consequences for or impacts on the environment, and the assessment of the effectiveness of such arrangements after their implementation;	6 of EMPR
(vi) consideration of environmental attributes identified in the compilation of information and maps contemplated in subsection (3); and	8 of EIAR
(vii) provision for the adherence to requirements that are pre scribed in a specific environmental management Act relevant to the listed or specified activity in question	5 of EIAR

Table 8(b): Environmental Management Programme Checklist Table

Environmental Management Programme Guideline - Appendix 4 GNR 326 EIA Regulations 07 April 2017 (as amended)	
Headings	Section in Report
Environmental Practitioner (EAP)	
Details of the EAP who prepared the report	1
Expertise of the EAP	1
CV of the EAP	1
Detailed description of the Aspects of the Activity that are covered by the EMPr as identified by the Project Description	2
Map which superimposes the Proposed Activity, its associated Structures, and Infrastructure on the environmental sensitivities of the preferred site, indicating any areas that should be avoided including buffers	3
Description of the Impact Management Outcomes, including Management Statements, identifying the impacts and risks that need to be avoided, managed and mitigated as identified through the environmental impact assessment process for all phases of the developing including	
Pre-construction activities	5
Construction activities	5
Rehabilitation of the environment after construction and where applicable post closure	5
Where relevant operation activities	5
Description of Proposed Impact Management Actions, identifying the manner in which the impact management objectives and outcomes contemplated in above will be achieved and must where applicable include actions to	
Avoid, modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation	5
Comply with any prescribed environmental management standards and practices	5
Comply with any applicable provisions of the Act regarding closure, where applicable	5
The Method of Monitoring the implementation of the impact management actions contemplated in the above	6
The Frequency of Monitoring the implementation of the impact management actions in the above	6
An indication of the Persons who will be Responsible for the implementation of the impact management actions	6
The Time Periods within which the impact management actions contemplated in the above must be implemented	6
The Mechanism for Monitoring Compliance with the impact management actions contemplated in the above	6
A program for Reporting on Compliance taking into account the requirements as prescribed by the Regulations	7
An Environmental Awareness Plan describing the manner in which	7
The applicant intends to inform his or her employees of any environmental risk which may result from their work	7
Risks must be dealt with in order to avoid pollution or the degradation of the environment	7
Any specific Information that may be required by the CA	8

9. UNDERTAKING BY EAP

9.1. CORRECTNESS OF INFORMATION IN REPORTS

I, **René van Greunen**, duly appointed by Bosveld Phosphates (Pty) Ltd, in terms of the provisions of the National Environmental Management Act, Act No.107 of 1998, and the EIA Regulations, GNR 982 of 4 December 2014 (as amended), as the EAP managing this application, hereby confirms that as far as my knowledge goes, the information provided in the EIAR, the EMP, as well as the supporting Specialist Reports are correct.

9.2. INCLUSION OF COMMENTS AND INPUTS FROM I&AP'S

I, **René van Greunen**, duly appointed by Bosveld Phosphates (Pty) Ltd, in terms of the provisions of the National Environmental Management Act, Act No.107 of 1998, and the EIA Regulations, GNR 982 of 4 December 2014 (as amended), as the EAP managing this application, hereby confirms that all comments and inputs from Stakeholders and I&AP's were included in the Issues and Comments Register of this project and were duly considered throughout the S&EIR process.

9.3. INCLUSION OF INPUTS AND RECOMMENDATIONS FROM SPECIALIST REPORTS

I, **René van Greunen**, duly appointed by Bosveld Phosphates (Pty) Ltd, in terms of the provisions of the National Environmental Management Act, Act No.107 of 1998, and the EIA Regulations, GNR 982 of 4 December 2014 (as amended), as the EAP managing this application, hereby confirms that all inputs and recommendations from Specialist Reports, including but not restricted to baseline descriptions, impact significance ratings, proposed impact management measures, as well as monitoring proposals, were duly, where practicable, included in the EIAR and EMP.

9.4. INFORMATION PROVIDED AND RESPONSES TO I&AP'S

I, **René van Greunen**, duly appointed by Bosveld Phosphates (Pty) Ltd, in terms of the provisions of the National Environmental Management Act, Act No.107 of 1998, and the EIA Regulations, GNR 982 of 4 December 2014 (as amended), as the EAP managing this application, hereby confirms the correctness of all information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested and affected parties, and as duly recorded in the formal Public Participation Programme Report and also in the Issues and Comments Register of this project presented in section 8.3 of this EIAR.

Respectfully submitted

René van Greunen (EAP; Pr.Sci.Nat.)

on behalf of

JMA Consulting (Pty) Ltd

END OF EMPr



APPENDIX 1(A)

CV OF THE EAP

RENE VAN GREUNEN (EAP/Pr.Sci.Nat.)

Environmental Assessment Practitioner



Position: Scientist

SACNASP: 400291/12

Contact Details:

Phone: +27 13 665 1788
Mobile: +27 82 556 8287
E-mail: rene@jmaconsult.co.za

Overview:

René van Greunen is an EAP and Scientist at JMA Consulting (Pty) Ltd specialising in environmental authorisation processes.

René graduated with a B.Sc. Degree in Ecology from the University of Pretoria in 2005. René furthermore graduated with a B.Sc. Honours Degree in Zoology (Invasion Biology) in 2006, and a M.Sc. in Zoology (Invasion Biology) in 2009 both at the University of Pretoria.

René started her working career as an Intern at the South African National Biodiversity Institute (SANBI) Threatened Biodiversity Research Programme followed by being employed as an Environmental Practitioner at Clean Stream Scientific Services.

René was appointed as a Scientist at JMA Consulting in 2012 and has been responsible for the compilation of basic assessment reports, scoping and plan of study reports, environmental impact assessment reports and environmental management programme reports.

Subsequently, René assists with the development of integrated water and waste management plans and external audit reports on water use licences and waste management licences. In addition, René facilitates the stakeholder engagement programmes as required by environmental management legislation.

René is registered as an Environmental Assessment Practitioner (EAP) with the Environmental Assessment Practitioners Association of South Africa (EAPASA) in accordance with the prescribed criteria of Regulation 15(1) of the Section 24H Registration Authority Regulations (Regulation No. 849, Gazette No. 40154 of 22 July 2016, of the NEMA, Act No. 107 of 1998, as amended), and holds a Professional Registration with the South African Council for Natural Scientific Professions (SACNASP).

Career:

- May 2012 – Present : Environmental Assessment Practitioner, JMA Consulting.
- July 2009 – April 2012 : Environmental Practitioner, Clean Stream Scientific Services.
- January 2009 – June 2009 : Intern with the Protea Mensural Project, South African National Biodiversity Institute (SANBI).

Key Performance Areas:

Environmental Authorisation Applications and Processes; Environmental Authorisation Audits; EIA and EMP Project Management; Specialist Plant Life, Animal Life, Topography and Meteorology inputs; and Public Participation.

Professional Associations:

- Environmental Assessment Practitioners Association of South Africa (2019/943).
- International Association for Impact Assessment South Africa (5782).
- South African Council for Natural Scientific Professions – Professional: Ecological Science (400291/12).

Academic Qualifications:

- M. Sc. Zoology, University of Pretoria, 2009.
- B. Sc. (Hons) Zoology, University of Pretoria, 2006.
- B. Sc. Ecology, University of Pretoria, 2005.

Short Courses and Training:

- DFFE Waste Management Licensing Workshop (2022).
 - IAIAsa GP: Understanding ECA (2021), Hydropedology (2020), Impact Significance Rating (2020), Wetland Rehabilitation Workshop (2020) and Biodiversity Offsets Workshop (2019).
 - Environmental Law Update Workshop. Imbewu Sustainability Legal Specialists (Pty) Ltd. (November 2018).
 - One Environmental System Workshop in terms of the National Environmental Management Act (NEMA), Act No 107 of 1998. Imbewu Sustainability Legal Specialists (Pty) Ltd. (February 2016).
 - Surface and groundwater sampling techniques according to the SABS standards. Clean Stream Scientific Services Workshop (June 2011).
 - Biomonitoring and Toxicity analyses. Clean Stream Biological Services Workshop (May 2011).
 - 35th Annual Weeds Workshop hosted by the ARC-PPRI Cedara at Natalia KZN (June 2007).
 - Using Microsoft Access: A gentle introduction to relational databases for biologists (2007).
 - Learning ArcGIS Desktop. ESRI: My Virtual Campus Courses (2007).
 - An Introduction to R. The R Project for statistical computing (2007).
-