



**RVM 1 HYDROELECTRIC POWER (PTY) LTD**

**RIEMVASMAAK HYDROPOWER PROJECT, ORANGE RIVER,  
NORTHERN CAPE PROVINCE, SOUTH AFRICA**

**ENVIRONMENTAL IMPACT ASSESSMENT  
VOLUME 4: ENVIRONMENTAL MANAGEMENT PROGRAMME**

DEA Reference Number: 14/12/16/3/3/2/600

<p>Prepared for:</p>  <p><b>RVM1</b> HYDRO ELECTRIC POWER (Pty) Ltd <small>Registration No. 2011/135598/07</small></p> <p>RVM1 Hydro Electric Power</p> <p>Loft Office No. 6 The Woodmill Lifestyle Centre Vredenburg Road Stellenbosch</p> <p>South Africa</p>	<p>Prepared by:</p>  <p><b>EOH</b></p> <p>EOH Coastal &amp; Environmental Services</p> <p>Grahamstown P.O. Box 934, Grahamstown, 6140</p> <p>South Africa</p>
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**FINAL REPORT**

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### **REPORTS PRODUCED AS PART OF THIS EIA:**

Volume 1:	Environmental Scoping Report
Volume 2:	Specialist Reports
Volume 3:	Environmental Impact Assessment Report
Volume 3a:	Appendices to Environmental Impact Assessment Report
<b>Volume 4:</b>	<b>Environmental Management Programme</b>
Volume 5	Comment and Response Report

#### **Notes:**

- (i) The Environmental Scoping Report was produced by Aurecon and accepted by DEA in October 2013
- (ii) Volume 2 was compiled by EOH Coastal & Environmental Services
- (iii) Volumes 3, 4 and 5 were prepared by EOH Coastal & Environmental Services






Coastal & Environmental Services

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Name	Responsibility	Signature	Date
Dr Eric Igbinigie	Author		April, 2015
Bill Rowston	Reviewer		September, 2015
Dr Ted Avis	EAP; Reviewer		September, 2015

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## DECLARATION OF INDEPENDENCE

I **ERIC IGBINIGIE** declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed project, in application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.



I **Bill ROWLSTON** declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed project, in application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.



I **TED AVIS** declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed project, in application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.



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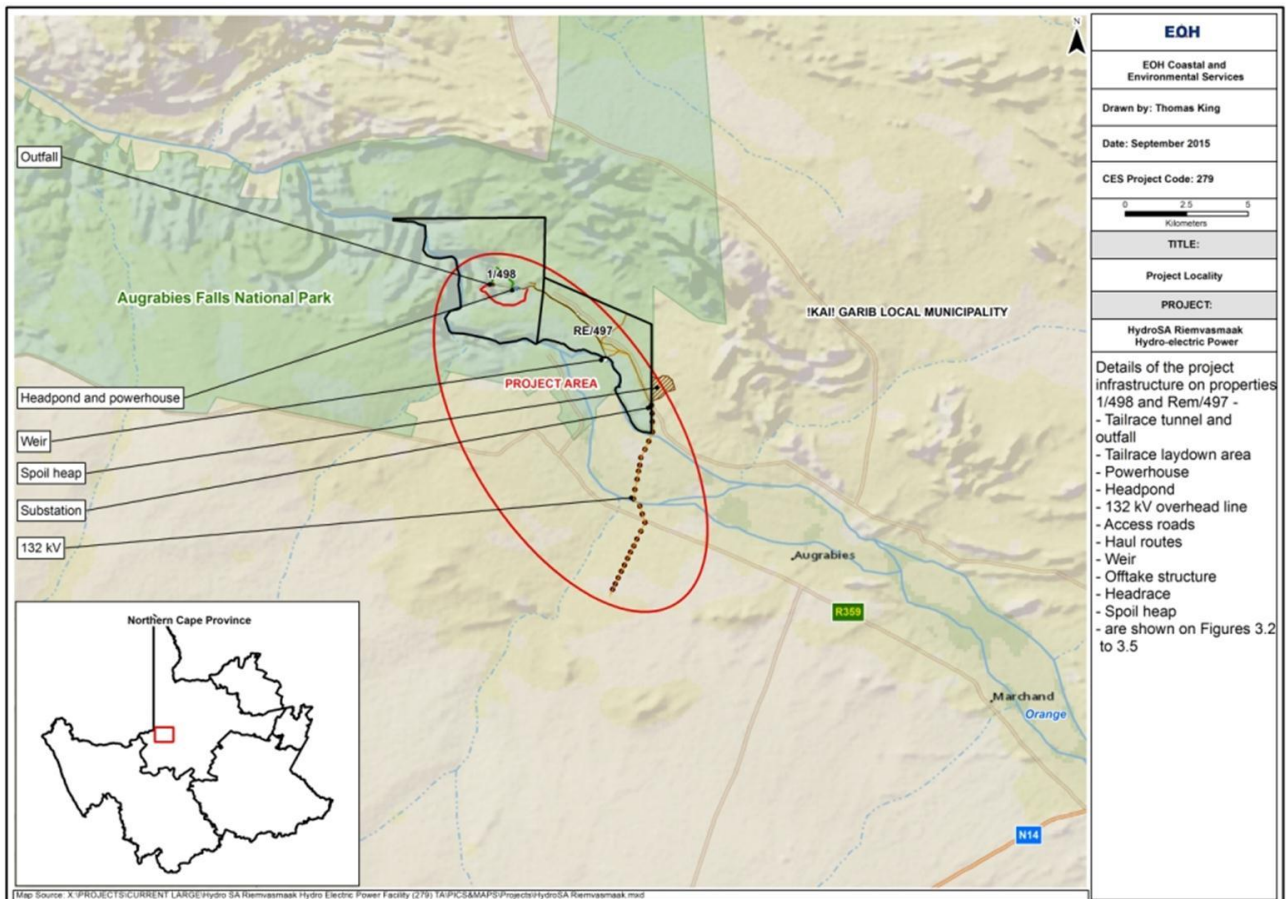
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## 1. INTRODUCTION

### 1.1 Project background

RVM1 Hydro Electric Power (Pty) Ltd (RVM1) intends to construct a run-of-river hydroelectric power station on the Orange River on the farm Riemvasmaak (Remainder of Farm no. 497) and Portion 1 of Farm no. 498, north of the Augrabies Falls, approximately 32km North West of the town of Kakamas in the Northern Cape Province of South Africa. The power station will have an installed generating capacity of 40 megawatts (MW), and the annual energy output from the facility is anticipated to be approximately 235 gigawatt-hours (GWh).

The general location of the project is shown on Figure 1.1.



**Figure 1.1: General location of the RVM1 Hydro Electric Power Project**

As the map indicates, Remainder 497 is within the boundaries of the Augrabies Falls National Park, but Portion 1 of 498 is owned by the Riemvasmaak Community Development Trust.

RVM1 aims to be the leader in socially and environmentally responsible hydroelectric power generation in the region and, as such, will seek compliance with both national and international requirements. According to the Equator Principles III (2013), the primary tool for implementing sound environmental and social management throughout the lifetime of a project is a series of Environmental and Social Management Plans (ESMP) that include plans for the Design and Planning Phase, the Construction Phase, the Operation Phase and, where appropriate, the Decommissioning / Closure Phase. For the purpose of this report, which will be submitted to the Department of Environmental Affairs (DEA), these documents are jointly referred to as the Environmental Management Programme (EMPr). The EMPr (*this document*) has been standardised and adapted to the requirements stipulated in section 33 of the National Environmental Management Act (NEMA No. 107 of 1998) Environmental Impact Assessment (EIA) Regulations 543 of 2010 in compliance with section 24N of the Act. In addition, the EMPr is drafted

to comply with Equator Principles (EP III 2013), the International Finance Corporations (IFC) Performance Standards on Environmental and Social Sustainability (2012) and all relevant World Bank Group Environmental, Health and Safety (EHS) Guidelines.

This report is structured as follows:

- Chapter 1 provides an overview of the RVM1 Hydro Electric Power project, and details of the team members who were involved with drafting this report.
- Chapter 2 provides background to the EMPr and details of relevant management plans required in each phase of the project lifetime to ensure compliance with relevant standards.
- Chapter 3 provides a summary of the project description.
- Chapter 4 provides an overview of the applicable legislation, and relevant local and international policies, standards and guidelines.
- Chapter 5 identifies the training needs that will be required to implement the EMPr, which include staff training, and community training and partnerships.
- Chapter 6 describes the organisational capacity and human resources requirements to implement the EMPr.
- Chapter 7 presents the structure of the project's life cycle EMPs and specific mitigation measures that will be required to manage the identified environmental and social impacts.
- Chapter 8 describes the environmental and social monitoring requirements.
- Chapter 9 sets out the applicant's responsibilities for managing the implementation of the EMPr, and for undertaking regular reviews of the EMPr to determine the need for revisions.

## **1.2 Objectives of the Environmental Management Programme**

This document is intended for the implementation of a sound environmental and social management at the RVM1. It represents the company's commitment to addressing and managing the potential negative and positive impacts associated with the planning, construction, operation and decommissioning phases of the RVM1 project in a systematic, efficient and effective manner.

The objectives of the EMPr are to:

1. Ensure that the project complies with applicable national and international environmental and social regulatory instruments.
2. Identify the mitigation measures that are required to reduce negative environmental and social impacts and enhance positive ones.
3. Ensure that all mitigation measures and recommendations identified during the EIA process are captured, referenced and incorporated into relevant documentation, and can be expanded as necessary during the various phases of the project.
4. Outline management structures to ensure that the implementation of the EMPr is possible for all phases of the project.
5. Identify relevant documents and procedures to be developed that will facilitate the implementation of the EMPr.

## **1.3 Environmental Impact Assessment Process to Date**

This project was initially the subject of Basic (Environmental Impact) Assessments for two 10MW hydroelectric power stations fed by water diversion infrastructure common to both stations. A Draft Basic Assessment Report was released for public review in January 2013. The project was subsequently increased in size, and the environmental assessment upgraded to a full Scoping and EIA process during the first half of 2013. A Draft Scoping Report was released for public review in July 2013. The Final Scoping Report was submitted to the DEA in September 2013 and accepted in October 2013. The Environmental Assessment Practitioner (EAP) for the project until the end of the Scoping Phase was Aurecon. The EAP for the EIA phase is EOH Coastal & Environmental Services. All documents prepared as part of the EIA process are in accordance with required national and international standards and are listed below.



Table 1.1: Reports produced for the EIA process to date

Report produced	Date	Author
<b>Basic Assessment Phase</b>		
Draft Basic Assessment Reports	December 2012	Aurecon South Africa
<b>Scoping Phase</b>		
Draft Scoping Report	July 2013	Aurecon South Africa
Final Scoping Report	September 2013	Aurecon South Africa
<b>Specialist Studies</b>		
Agricultural Impact Assessment	January 2014	Johann Lanz
Aquatic Ecology Report	April 2015	EnviRoss CC (Mathew Ross)
Botanical Assessment	April 2015	Bergwind Botanical Surveys (David J. McDonald)
Faunal Impact Assessment	March 2015	William Roy Branch
Geotechnical Assessment	February 2015	Council for Geoscience (FDJ Stapelberg)
Heritage Impact Assessment	December 2012	ACO Associates (Jayson Orton and Lita Webley)
Noise Impact Assessment	November 2012	M <sup>2</sup> Environmental Connections CC (Johan Maré)
Socio-Economic and Tourism Impact Assessment	January 2014	ACER (Africa) (Duncan Keale)
Visual Impact Assessment	February 2014	MetroGIS (Lourens du Plessis)
<b>Environmental and Social Impact Assessment</b>		
Environmental Impact Assessment Report	September 2015	EOH Coastal & Environmental Services
<b>Environmental Management Programme</b>		
Environmental Management Programme ( <i>this report</i> )	September 2015	Eric Igbinigie, Bill Rowlston & Ted Avis

#### 1.4 Study team

The following team members contributed to the development of this document:

##### Dr Eric E Igbinigie

(EOH Coastal & Environmental Services: Senior Environmental Consultant: Author)

Eric holds a PhD in Environmental Biotechnology, a registered Professional Natural Scientist (Pr.Sci.Nat.) and a certified EMS ISO 14001:2004 Auditor (IRCA). He is a seasoned environmental consultant with project experience in different industry sectors across Africa including mining, oil and gas, agro-industry and water/effluent treatment facilities in developing countries financed by Equator Principles Financial Institutions such as the IFC, AFC, FMO, SWEDFUND, DEG and AfDB. Eric's areas of expertise include Scoping and EIA, Integrated Waste Management Plans, IFC Performance Standards on E&S Sustainability (2012) compliance assessment, EMS ISO 14001:2004, Waste and Wastewater Impact/Quality Assessment, Bioremediation and Environmental Site Assessment (Phases I, II & III). Apart from his considerable of experience as an environmental consultant, he has an outstanding record in research and academic scholarship with Rhodes University, yielding sound scholarly publications and a patented technology for the rehabilitation and re-vegetation of coal mined land, which is currently in use in South Africa.

##### Bill Rowlston

(EOH Coastal & Environmental Services; Executive; Reviewer)

Bill holds a First Class Honours degree in civil engineering from the University of Salford, England (1971). He worked for 25 years for the South African Department of Water Affairs and Forestry,

where he contributed to the development of the National Water Policy and the National Water Act, and compiled and edited the National Water Resource Strategy, First Edition (2004), much of which he wrote. Bill joined CES as a Director in 2007. In addition to working as project manager and water resources specialist on a number of large ESIA and ESHIA in South Africa and in other African countries, he has undertaken environmental and social due diligence studies, compliance reviews and audits for a range of proposed and operational projects, including three hydroelectric power projects in Zambia and Zimbabwe, copper and heavy mineral mines in Zambia and Mozambique, solar projects and agri-industrial projects in South Africa, and a railway rehabilitation project in Kenya and Uganda. All reviews were conducted against the requirements of relevant national legislation, the Equator Principles, the International Finance Corporation Performance Standards on Environmental and Social Sustainability, and the IFC Environmental, Health and Safety Guidelines.

### **Dr Ted Avis**

*(EOH Coastal & Environmental Services; Managing Director; EAP; Reviewer)*

Ted, CES's Managing Director is a leading expert in the field of Environmental Impact Assessments, having project-managed numerous large-scale EIAs to international standards (e.g. World Bank and International Finance Corporation). Dr Avis was principle consultant to Corridor Sands Limited for the development of all environment aspects for the US\$1billion Corridor Sands Project. This involved the completion of five Environmental Impact Assessments, as well as Environmental Management Plans for the entire project. Dr Avis has also managed EIA studies of similar scope in Kenya and South Africa. Dr Avis was instrumental in developing a professional course in Environmental Impact Assessments, based on his past experience running an honours module in EIA practice at Rhodes University. He is a Visiting Fellow in the Environmental Science Department at Rhodes University, and a certified Environmental Assessment Practitioner. He has delivered papers and published in the field of EIA, SEA and ICZM and has been a principal of CES since its inception 18 years ago, and managing director for the past 10 years, during which time the company has grown rapidly.

## 2. BACKGROUND TO THE ENVIRONMENTAL MANAGEMENT PROGRAMME

### 2.1 Introduction

This Environmental Management Programme (EMPr) summarises RVM Hydro1's commitments to address and mitigate risks and impacts identified as part of the EIA process, through avoidance, minimisation, and compensation, followed by the development of offsets if necessary (Equator Principles III, 2013). It establishes mitigation measures that define actions and desired outcomes address the impacts and issues identified during the EIA process. To the extent possible the actions and outcomes are measurable processes or events, with elements such as performance indicators, targets, or acceptance criteria, that can be tracked over defined time periods, and with estimates of the resources and responsibilities for implementation. More specifically, the EMPr includes the following components:

- **Mitigation:** Feasible and cost-effective measures are identified that are intended to reduce potentially significant adverse environmental impacts to acceptable levels.
- **Monitoring:** Environmental and social monitoring during project implementation provides information about key environmental and social aspects of the project, particularly the environmental and social impacts of the project and the effectiveness of mitigation measures.
- **Organisational Capacity Development and Training:** To support timely and effective implementation of mitigation measures the EMPr provides a description of institutional / organisational arrangements necessary for implementation, an indication of who in the organisation is responsible for carrying out the mitigation and monitoring measures, and the training and capacity development requirements for doing so..
- **Implementation Schedule:** For all three aspects - mitigation, monitoring, and capacity development - the EMPr provides a conceptual n implementation schedule for measures that must be carried out as part of the project.

The EMPr is intended to ensure that:

1. **During project planning and design,** all environmental and social constraints and restrictions identified during the EIA, and measures to address them, are accounted for in the design and layout of the project.
2. **During construction,** all mitigation measures identified during the EIA that are required to minimise environmental and social impacts are implemented. The responsibility for implementing many of the mitigation measures will fall to the contractors and sub-contractors appointed by RVM1 to construct the civil works, and install and commission the electro-mechanical equipment. Nevertheless, the ultimate responsibility for ensuring compliance with the requirements and objectives of the EMPr remains with RVM1. It is good practice to facilitate legal enforceability of the EMPr by integrating its requirements into the tender and contractual documents as a set of environmental specifications
3. **During commissioning and operation,** detailed operating procedures are developed so that all measures and activities required to minimise impacts caused by commissioning and operation are developed, implemented and monitored for all aspects of the project. It is important that monitoring activities continue for the entire operational lifetime of the project, since the results of monitoring contribute to the continuous development and improvement of measures to enhance the benefits of the facility and minimise the effects of negative impacts.
4. **During decommissioning,** detailed procedures are developed to ensure that the project area is rehabilitated to an acceptable and previously agreed condition.

### 2.2 Framework Environmental Management Plans

The EIA process is normally conducted prior to or during the preparation of the final design and operational details of the development. While it is possible to identify and assess potential environmental and social impacts at this early stage, in many cases the outcome of the EIA process will result in modifications to the original conceptual plans. Thus, while it is possible to

identify a number of specific mitigation measures applicable to each phase of the project's life cycle at the time of completing the EIA, it is necessary to allow for modification of these mitigation measures after environmental authorisation has been secured, and as the detailed plans for the construction and operation of the development are developed and refined.

Framework Environmental Management Plans (EMPs) allow for this flexibility, and are set out in detail for each phase of the project in Chapter 7. All identified mitigation measures will be continuously implemented, and their implementation must be continuously monitored, periodically audited and reviewed, and if necessary revised and amended to ensure that the procedures continue to be relevant, efficient and serve their intended purpose.

A Framework EMP does not present technical details and specifications for managing impacts associated with each phase of the project's life cycle, since many of these details have not yet been finalised. Rather, it maps out broad management principles and initiatives, and establishes a framework within which environmental and social issues are managed at various stages in the project. The framework and principles do not deal with the specific project specifications of construction or operational impacts, and usually reflect the company's commitment and responsibility to manage project impacts. Although much of this responsibility is passed on to third parties such as contractors and sub-contractors the ultimate responsibility for ensuring compliance with the objectives of the Framework EMPs remains with RVM1 and its project managers.

In large and complex projects it is usually necessary to expand and add to the environmental framework, management principles and initiatives developed in the Framework EMP for the different phases of a project as the project progresses through its life cycle. This is required in order to update the Framework EMPs using specific project details regarding the various actions that will take place once the project is implemented. These specific details are used to develop activity-specific environmental management plans, but these will be guided overall by the framework and principles detailed in the Framework EMP.

Further details on the EMPs for each phase of the project's life cycle are provided below.

### ***2.2.1 Design and Planning EMP***

The purpose of the Design and Planning EMP (D/PEMP) is to ensure that the project designers are aware of the environmental and social constraints associated with the project, and the aspects of the project design that will contribute to addressing these constraints. Since part of the project is on land that is within the boundaries of the AFNP, and part is on land immediately adjacent to the park, it will be necessary for the designers to have in-depth discussions with DEA and SANParks to ensure that design specifications and operational parameters are satisfactory to all parties.

For this project it will, for instance, be necessary to ensure that the design of the diversion weir and the control system for the control gates is such that the agreed minimum flow rate in the Orange River at which diversion of flow to the power station may commence is strictly adhered to. It will also be essential that the design of above ground structures is sympathetic to the surrounding environment, and that the visibility of such structures is minimised as much as possible.

### ***2.2.2 Construction EMP***

A comprehensive Construction EMP (CEMP) must be developed and implemented for the construction phase of the project. The principal objectives of the CEMP is to protect human health and the environment from the potential impacts of project-related activities, and to contribute to maintaining and improving the quality of the environment. The Plan will list activities that will be undertaken during the construction phase that are likely to have significant environmental and social impacts, and provide mitigation measures for the impacts. RVM1 will, via its various contractors, ensure that the CEMP is implemented for all activities that will occur during the construction phase, such as vegetation clearance, stripping and storing topsoil, excavating and blasting. Most of these activities will require the preparation of comprehensive Method Statements,

as required by local legislation and international standards and guidelines.

The on-site geotechnical investigations, which will require entry onto the project site with plant and machinery to undertake trial hole excavations and test hole drilling, will be covered by the CEMP, as part of the pre-construction activities, as provided for in s33(b)(ii) of the NEMA EIA Regulations, 2010.

### **2.2.3 Operation EMP**

The Operation EMP (OEMP) lists activities during operation of the project that are likely to have significant environmental and social impacts, and provides mitigation measures for the impacts. The principal purpose of the OEMP is to ensure that the protection afforded to the environment and human health during the construction phase of the project continues undiminished throughout the operational lifetime of the facility. RVM1 must ensure that the OEMP is implemented for all operational activities, as required by local legislation and international standards and guidelines.

In many cases Standard Operating Procedures (SOPs) or Method Statements will be prepared to ensure that all aspects of the operation are properly managed. These should focus on the measures and actions necessary to comply with specific regulations and other applicable standards. For example, an SOP should be developed to deal with the diversion of water from the Orange River into the power station. In addition, Environmental and Social Action Plans (ESAPs) may be developed to address deficiencies identified in existing management programmes or SOPs, to ensure consistency or to provide immediate remedy and timely closure of specific items.

Environmental management during the operation phase will deal with impacts associated with, and caused by, the operational activities of the project. The OEMP eventually becomes the environmental, social, safety and occupational health operational procedures, much like specifications, that govern the actual day-to-day operational activities of the operation, and must therefore be practical, implementable and precise. They will form part of the Technical Operational Procedures that detail exactly how each operation needs to be undertaken and by whom, as well as when, to ensure efficient, safe and environmentally and socially acceptable operations. They deal with the "on-the-ground" management of actions that may have a direct impact on the environment and people.

### **2.2.4 Decommissioning EMP**

There is no requirement in the Renewable Energy Independent Power Producer Procurement Programme (REIPPP) for the establishment of a closure / rehabilitation bond for renewable energy facilities. These facilities are regarded as strategic resources, and although it will, in most cases, be necessary to replace / upgrade certain elements of infrastructure to extend the operating lifetime, the facilities are regarded as long-term resources for the supply of electrical energy.

The operating lifetime of the RVM 1 hydroelectric power project is anticipated to be at least 50 years, and could be up to 80 years. When the facility eventually reaches the end of its operating life it will be necessary close the facility and rehabilitate the project site. However, it is not possible to predict the environmental and social conditions, or the requirements of the environmental legislation, that far in the future.

Accordingly it is considered premature to develop a Decommissioning EMP (DEMP) at this stage.

It will, however, be necessary to prepare a closure plan for the facility, including a DEMP, at least one year prior to ceasing operational activities. The closure plan must comply with environmental circumstances and legislation in force at the time. It should be informed by a comprehensive risk analysis that will consider, for instance, the risks to human beings and the environment associated with abandoning underground infrastructure, and whether access to these voids should be sealed, or if the voids should be completely filled.

### 3. PROJECT DESCRIPTION

#### 3.1 Introduction

Hydroelectricity is generated by the use of the gravitational force of flowing water to rotate a turbine, which in turn rotates a generator that converts the mechanical, rotational energy into electrical energy. The power that can be generated is proportional to the height through which the water falls to the turbine (the head), the volume of water flowing through the turbine per unit of time (the flow rate), and the efficiency of the turbine / generator combination at converting rotational energy into electrical energy.

#### 3.2 Project infrastructure

##### 3.2.1 Process related infrastructure

In broad terms the project will entail the construction of infrastructure comprising:

- (a) A low diversion weir across the Orange River upstream of the Augrabies Falls.
- (b) An off-take structure at the weir to facilitate diversion of water from the river.
- (c) A conduit – the headrace - to convey water from the intake structure to the penstock head pond.
- (d) A head pond and power station intake structure - forebay.
- (e) Vertical (or very steep) penstocks – pipes - to transfer the water from the head pond to the power chamber.
- (f) An underground power chamber containing up to four Francis turbines.
- (g) An underground tailrace and outlet works to convey water from the power chamber back to the river channel.
- (h) Haul roads to facilitate access for construction and the removal of excavated material off site for disposal or re-use.
- (i) A high voltage power line to evacuate the power from the power station to the national grid.
  - Underground cable across portions 1/497 and Rem 498 (approximately 7.5 km); and
  - Overhead power lines across the river, over private land to the connection point (approximately 8 km).
- (j) A transformer yard and mini substation located at the headpond and a new substation.
- (k) Fencing as required for public safety.

In addition, a previously existing pedestrian bridge across the river channel a short distance upstream of the Augrabies Falls, which was washed away by a recent flood event, might be rebuilt as part of the hydropower project.

Details of the proposed layout of the infrastructure and the route of the power lines are provided in Chapter 3 of the EIR, where each element of infrastructure is described in detail.

##### 3.2.2 Ancillary Infrastructure

The duration of construction phase will be up to three years, and up to 350 people (of which between 150 and 200 will be local people) will be employed at the peak of construction activities. A temporary site office will be required to accommodate professional, technical, engineering, supervisory and administrative staff for the duration of construction. The offices will require water and electricity supplies, and an appropriate on-site package sanitation system. A suitable site for the office will be identified in conjunction with the contractor.

It is anticipated that three site camps will be required, one to service the construction of the diversion weir and offtake structure, one to service the construction of the tailrace, and for the head pond, powerhouse and tailrace. Suitable locations for these camps have not yet been identified in detail. The size of the camps will be of the order of 50m x 75m, and will provide space to store materials and plant, small satellite staff offices, canteens and ablution facilities for staff and

workers.

All staff and workers will be accommodated in the Kakamas / Augrabies area, and there will be no residential accommodation on site.

All camps will be demolished at the end of construction, and all materials will be removed from site. During operations only about 10 people will be employed. It is anticipated that the operation phase will be up to 80 years.

## 4. LEGAL REQUIREMENTS AND ENVIRONMENTAL PRINCIPLES

There are many national regulatory instruments – laws, policies and guidelines – that must be considered when undertaking a project of this nature. In addition, many projects require funding from international financial organisations such as the Equator principles Financial Institutions (EPFIs). Details of the main national and international instruments that are relevant to this project are presented in this chapter.

### 4.1 National Instruments

An overview of the relevant legislation, as well as national environmental standards and guidelines are provided in Tables 4.1 and 4.2, respectively. It should be noted that the list provided below is not exhaustive, and has been restricted to documents that have direct relevance to either the environment and/or communities.

**Table 4.1: Applicable Legislation**

<b>Legislation</b>	<b>Administering Authority</b>
<b>The Constitution of South Africa (Act No.108 of 1996)</b>	<b>All departments</b>
The environmental right contained in section 24 of the Constitution provides that everyone is entitled to an environment that is not harmful to his or her well-being. Obligations are to: <ul style="list-style-type: none"> <li>• Ensure that the proposed development will not result in pollution and ecological degradation; and</li> <li>• Ensure that the proposed development is ecologically sustainable, while demonstrating economic and social development.</li> </ul>	
<b>The National Environmental Management Act (NEMA) (107 of 1998)</b>	<b>Department of Environmental Affairs (DEA)</b>
Several listed activities in terms of NEMA GN No. 544, 545 and 546, 18 June 2010, have been triggered and need to be authorised. Obligations are to: <ul style="list-style-type: none"> <li>• Ensure that the proposed development should, where possible, be in accordance with the NEMA guiding principles. Where this is not possible, deviation from the principles would have to be very strongly motivated;</li> <li>• Ensure that the proposed development will not result in pollution and ecological degradation; and</li> <li>• Ensure that the proposed development is ecologically sustainable, while demonstrating economic and social development.</li> </ul>	
<b>The National Forests Act (84 of 1998)</b>	<b>Department of Agriculture, Forestry and Fisheries (DAFF)</b>
Section 12(1)(d) read with s15(1) and s62(2)(c) lists protected tree species that may not be cut, destroyed or disturbed without a licence. Should the project be granted a positive EA, the obligation is to: Apply for the relevant licences if any endangered trees, as per those listed in the NFA, are to be cut, destroyed or disturbed during the project activities.	
<b>Northern Cape Nature Conservation Act (NCNCA) (9 of 2009)</b>	<b>Department of Environmental Affairs and Nature Conservation (DENC)</b>
Numerous sections (specifically sections 50-51) under NCNCA deal with indigenous and protected plants. <ul style="list-style-type: none"> <li>• A permit in terms of NCNCA will be required if species listed in the act are located on site and it would be necessary to remove or destroy them.</li> </ul>	
<b>National Heritage Resources Act (25 of 1999)</b>	<b>South African Heritage Resources Agency (SAHRA)</b>
The development would change the character of a site exceeding 5 000m <sup>2</sup> in extent and encompass the construction of an access road and transmission line exceeding 300m in length. The obligations include:	



- To undertake a Heritage Impact Assessment during the detailed EIA phase of the proposed project.
- No person may alter or demolish any structure or part of a structure, which is older than 60 years or disturb any archaeological or paleontological site or grave older than 60 years without a permit issued by the relevant provincial heritage resources authority.
- No person may, without a permit issued by SAHRA, destroy, damage, excavate, alter or deface archaeological or historically significant sites.

<b>National Environmental Management: Air Quality Act (39 of 2004)</b>	<b>DEA</b>
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The obligations would include the adoption of the following:

- The “best practicable means” for the abatement of dust during construction and operation, if approved, have to be taken.
- All appliances used for preventing or reducing to a minimum the escape into the atmosphere of noxious or offensive gases have to be properly operated and maintained and the best practice means for achieving this implemented.

<b>Occupational Health and Safety Act (85 of 1993)</b>	<b>Department of Labour</b>
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- The developer must be mindful of the principles and broad liability and implications contained in the Occupational Health and Safety (OH&S) Act and mitigate any potential impacts.

<b>National Water Act (NWA Act No.36 of 1998)</b>	<b>Department of Water and Sanitation (DWS)</b>
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The proposed hydropower station would divert water from the Orange River for the generation of electricity. The location of the hydropower station falls within the D81A quaternary catchment and the Lower Orange DWS water management area and requires authorisation from them for the following activities as listed in section 21 of the NWA:

- 21 (c) Impeding or diverting flow of water in a watercourse; and
- 21 (i) Altering the bed, banks, course or characteristics of a watercourse.

Additional obligations according to section 19(1) requires that an owner of land, a person in control of land or a person who occupies or uses the land on which—

- (a) any activity or process is or was performed or undertaken; or
- (b) any other situation exists, which causes, has caused or is likely to cause pollution of a water resource, must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring.

<b>National Environmental Management: Biodiversity Act, Act No. 10 of 2004 (NEM:BA)</b>	<b>DENC</b>
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The facility is located adjacent to the AFNP in an area managed by SANParks, and protected species listed in NEM: BA do occur, such as *Aloe dichotoma*.

- Permit is required from the Northern Cape DENC for the removal of the listed species should the project receive a positive Environmental Authorisation (EA).

<b>The National Energy Act, Act No. 34 of 2008 (NEA)</b>	<b>Department of Energy (DoE)</b>
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In terms of the New Generation Regulations, the Integrated Resource Plan (IRP) has been developed by the DoE and sets out the new generation capacity requirement per technology, taking energy efficiency and the demand-side management projects into account. This required, new generation capacity must be met through the technologies and projects listed in the IRP and all Independent Power Producer (IPP) procurement programmes will be undertaken in accordance with the specified capacities and technologies listed in the IRP

<b>National Environmental Management: Protected Areas Act, Act No. 57 of 2003 (NEM:PAA)</b>	<b>DEA</b>
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The proposed project is situated within a buffer area of the AFNP, which is managed by SANParks. Portions may therefore fall under the requirements of NEM:PAA which serves to provide for the protection and conservation of protected areas in South Africa. The Act is also aimed at managing protected areas in accordance with national norms and standards. Specific sections that are applicable for the proposed project are, *inter alia*, section 41 (Management Plans). The obligation include to:

- Development specific environmental management plans for the protection of the natural environmental. These plans may include, Waste Management Plan, Biodiversity

Management Plans etc.

<b>Biodiversity Policy and Strategy for South Africa: Strategy on Buffer Zones for National Parks (GN 106 of 2012)</b>	<b>DEA</b>
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In terms of the approved SANParks management plan, infrastructure for the proposed project would fall in an area which is zoned as a Priority Natural Area. The area has however not yet been declared as such by Government as per the requirements of the Strategy on Buffer Zones which states on p. 13 that: “To establish buffer zones around each national park, Government will –

- (a) Identify buffer zones for all national parks in park management plans;
- (b) Establish these buffer zones by publication in the Gazette;
- (c) Integrate the buffer zones into municipal spatial development frameworks as special control/ natural area where appropriate; and
- (d) Where necessary or appropriate, declare the buffer zones or part thereof as protected environments in terms of the Act (i.e. NEM:PAA).”

Due consideration will be given to this Policy during the EIA Phase.

<b>National Environmental Management: Waste Act (59 of 2008)</b>	<b>DEA: Waste</b>
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If no other alternatives are available and spoil is to be left on site, it might trigger the need for a Waste Management Licence (WML). DEA will be consulted in this regard to confirm if a WML will be required.

- All reasonable measures must be taken to avoid the generation of waste and where such generation cannot be avoided, minimise the toxicity and amounts of waste that are generated; reduce, re-use, recycle and recover waste; where waste must be disposed of, ensure that the waste is treated and disposed of in an environmentally sound manner;
- Manage the waste in such a manner that it does not endanger human health or the environment or cause a nuisance through noise, odour or visual impacts.
- Prevent any employee or any person from contravening this Act; and prevent the waste from being used for an unauthorised purpose.
- All triggered listed waste management activities should be licensed.

The requirements of certain other instruments, such as the Augrabies Falls National Park Management Plan 2013-2023, while not legislative instruments, must also be considered in constructing and operating the facility.

**Table 4.2: National Environmental Standards and Guidelines**

<b>Sector</b>	<b>Relevant Documents</b>
<b>Solid waste</b>	National Waste Management Strategy (DEA, 2011)
	Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste, 3rd ed. (DWAF, 2005a)
	Minimum Requirements for Waste Disposal by Landfill, 3rd ed. (DWAF, 2005b)
	Minimum Requirements for Water Monitoring at Waste Management Facilities, 3rd ed. (DWAF, 2005c)
	White Paper on Integrated Pollution and Waste Management for South Africa (2000)
	National Norms and Standards for the Storage of Waste, Government Notice 926 of 2013
	National policy for the Provision of Basic Refuse Removal Services to Indigent Households (DEA, 2010)
	National Domestic Waste Collection Standards, Government Notice 21 of 2011

Sector	Relevant Documents
	Waste Classification and Management Regulations, Government Notice R634 of 2013 National Norms and Standards for the Assessment of Waste for Landfill Disposal, Government Notice R635 of 2013 National Norms and Standards for Disposal of Waste to Landfill, Government Notice R636 of 2013 Guidelines for the Utilization and Disposal of Wastewater Sludge. Vol.1 to 5 (DWAF, 2006) Framework for the Management of Contaminated Land (DEA, 2010) Draft Standards for Assessment of Waste for Landfill Disposal. Notice 613 of 2012 Waste Classification and Management Regulations 2013 National Norms and Standards for the Remediation of Contaminated Land and Soil Quality 2014 Guidelines for the Utilisation and Disposal of Wastewater Sludge, Vol. 1-5 (DWAF, 2005)
Water quality	SANS 241-1:2011: Drinking Water Specifications. Part 1: Microbiological, Physical, Aesthetic and Chemical Determinants SANS 241-2:2011: Application of SANS 241-1:2011 National Guidelines for the Discharge of Effluent from Land-based sources into the coastal environment (2014) South African Water Quality Guidelines series, Vol. 1–8, (DWAF, 1996) General Authorisations, Government Gazette NO. 20526 of 1999 Water Quality Management - Catchment Management Series 8.1 to 8.3 (DWAF, 2001)
Noise Quality	SANS 10103:2008: The Measurement and Rating of Environmental Noise with Respect to Annoyance and to Speech Communication SANS 10328:2008: Methods for Environmental Noise Impact Assessments
Air Quality	SANS 69:2004: Framework for setting and implementing national Ambient Air Quality Standards SANS 1929:2005: Ambient Air Quality – Limits for Common Pollutants National Ambient Air Quality Standards. Notice 1210 of 2009 SANS 1929:2011: Air Quality Standard limits Model Air Quality Management By-Law for Easy Adoption by Municipalities. Notice 579 of 2010 National Ambient Air Quality Standards. Notice 1210 of 2009 National Dust Control Regulations. Notice 827 of 2013

## 4.2 International Instruments

A portion of the funding for the proposed hydropower station is likely to be sourced from an EPFI and as such the IFC Performance Standard (2012) will apply. A brief description of the Equator Principles (EP III, 2013) and the IFC Performance Standards (2012) follow.

### 4.2.1 The Equator Principles

The Equator Principles (Box 1 below) are a financial industry benchmark for determining, assessing and managing environmental and social risks to projects. They are intended to ensure that projects financed by the EPFI are developed in a manner that is socially responsible and reflects sound environmental management practices. In January 2013 a total of 79 financial institutions from 32 countries across the globe had adopted the Equator Principles.

## Box 1: The Equator Principles (EP III - June 2013)

### Statement of Principles

The EPFI will only provide Project Finance and Project-Related Corporate Loans to Projects that meet the requirements of Principles 1-10.

#### Principle 1: Review and Categorisation

When a Project is proposed for financing the EPFI will, as part of its internal environmental and social review and due diligence, categorise it based on the magnitude of its potential environmental and social risks and impacts. Such screening is based on the environmental and social categorisation process of the International Finance Corporation (IFC).

Using categorisation the EPFI's environmental and social due diligence is commensurate with the nature, scale and stage of the Project, and with the level of environmental and social risks and impacts.

The categories are:

**Category A** – Projects with potential significant adverse environmental and social risks and/or impacts that are diverse, irreversible or unprecedented;

**Category B** – Projects with potential limited adverse environmental and social risks and/or impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures; and

**Category C** – Projects with minimal or no adverse environmental and social risks and/or impacts.

#### Principle 2: Environmental and Social Assessment

For all Category A and Category B Projects, the EPFI will require the client to conduct an Assessment process to address, to the EPFI's satisfaction, the relevant environmental and social risks and impacts of the proposed Project (which may include the illustrative list of issues found in Exhibit II <sup>[1]</sup>). The Assessment Documentation should propose measures to minimise, mitigate, and offset adverse impacts in a manner relevant and appropriate to the nature and scale of the proposed Project.

The Assessment Documentation will be an adequate, accurate and objective evaluation and presentation of the environmental and social risks and impacts, whether prepared by the client, consultants or external experts. For Category A, and as appropriate, Category B Projects, the Assessment Documentation includes an Environmental and Social Impact Assessment (ESIA). One or more specialised studies may also need to be undertaken. Furthermore, in limited high risk circumstances it may be appropriate for the client to complement its Assessment Documentation with specific human rights due diligence. For other Projects, a limited or focused environmental or social assessment (e.g. audit), or straightforward application of environmental siting, pollution standards, design criteria, or construction standards may be carried out.

For all Projects, in all locations, when combined Scope 1 and Scope 2 Emissions are expected to be more than 100 000 tonnes of CO<sub>2</sub> equivalent annually, an Alternatives Analysis will be conducted to evaluate less Greenhouse Gas (GHG) intensive alternatives. Refer to Annex A for alternatives analysis requirements

#### Principle 3: Applicable Environmental and Social Standards

The Assessment process should, in the first instance, address compliance with relevant host country laws, regulations and permits that pertain to environmental and social issues.

EPFIs operate in diverse markets: some with robust environmental and social governance, legislation systems and institutional capacity designed to protect their people and the natural environment; and some with evolving technical and institutional capacity to manage environmental and social issues.

The EPFI will require that the Assessment process evaluates compliance with the applicable standards as follows:

1. For Projects located in Non-Designated Countries, the Assessment process evaluates compliance with the then applicable IFC Performance Standards on Environmental and Social Sustainability (Performance Standards) and the IFC / World Bank Group Environmental, Health and Safety Guidelines (EHS Guidelines) (Exhibit III <sup>[2]</sup>).
2. For Projects located in Designated Countries, the Assessment process evaluates compliance with relevant host country laws, regulations and permits that pertain to environmental and social issues. Host country laws meet the requirements of environmental and/or social assessments (Principle 2), management systems and plans (Principle 4), Stakeholder Engagement (Principle 5) and, grievance mechanisms (Principle 6).

The Assessment process will establish to the EPFI's satisfaction the Project's overall compliance with, or justified deviation from, the applicable standards. The applicable standards (as described above) represent the minimum standards adopted by the EPFI. The EPFI may, at their sole discretion, apply additional requirements.

#### Principle 4: Environmental and Social Management System and Equator Principles Action Plan

For all Category A and Category B Projects the EPFI will require the client to develop or maintain an Environmental and Social Management System (ESMS).

Further, an Environmental and Social Management Plan (ESMP) will be prepared by the client to address issues raised in the Assessment process and incorporate actions required to comply with the applicable standards. Where the applicable standards are not met to the EPFI's satisfaction, the client and the EPFI will agree an Equator Principles Action Plan (AP). The Equator Principles AP is intended to outline gaps and commitments to meet EPFI requirements in line with the applicable standards.

**Principle 5: Stakeholder Engagement**

For all Category A and Category B Projects the EPFI will require the client to demonstrate effective Stakeholder Engagement as an ongoing process in a structured and culturally appropriate manner with Affected Communities and, where relevant, other stakeholders. For Projects with potentially significant adverse impacts on Affected Communities, the client will conduct an Informed Consultation and Participation process. The client will tailor its consultation process to: the risks and impacts of the Project; the Project's phase of development; the language preferences of the Affected Communities; their decision-making processes; and the needs of disadvantaged and vulnerable groups. This process should be free from external manipulation, interference, coercion and intimidation.

To facilitate Stakeholder Engagement the client will, commensurate to the Project's risks and impacts, make the appropriate Assessment Documentation readily available to the Affected Communities, and where relevant other stakeholders, in the local language and in a culturally appropriate manner.

The client will take account of and document the results of the Stakeholder Engagement process, including any actions agreed resulting from such process. For Projects with environmental or social risks and adverse impacts disclosure should occur early in the Assessment process, in any event before the Project construction commences, and on an ongoing basis.

EPFIs recognise that indigenous peoples may represent vulnerable segments of project-affected communities. Projects affecting indigenous peoples will be subject to a process of Informed Consultation and Participation, and will need to comply with the rights and protections for indigenous peoples contained in relevant national law, including those laws implementing host country obligations under international law. Consistent with the special circumstances described in with adverse impacts on indigenous people will require their Free, Prior and Informed Consent (FPIC).

**Principle 6: Grievance Mechanism**

For all Category A and, as appropriate, Category B Projects, the EPFI will require the client, as part of the ESMS, to establish a grievance mechanism designed to receive and facilitate resolution of concerns and grievances about the Project's environmental and social performance.

The grievance mechanism is required to be scaled to the risks and impacts of the Project and have Affected Communities as its primary user. It will seek to resolve concerns promptly, using an understandable and transparent consultative process that is culturally appropriate, readily accessible, at no cost, and without retribution to the party that originated the issue or concern. The mechanism should not impede access to judicial or administrative remedies. The client will inform the Affected Communities about the mechanism in the course of the Stakeholder Engagement process.

**Principle 7: Independent Review**

***Project Finance***

For all Category A and, as appropriate, Category B Projects, an Independent Environmental and Social Consultant, not directly associated with the client, will carry out an Independent Review of the Assessment Documentation including the ESMPs, the ESMS, and the Stakeholder Engagement process documentation in order to assist the EPFI's due diligence and assess Equator Principles compliance.

The Independent Environmental and Social Consultant will also propose or opine on a suitable Equator Principles AP capable of bringing the Project into compliance with the Equator Principles, or indicate when compliance is not possible.

***Project-Related Corporate Loans***

An Independent Review by an Independent Environmental and Social Consultant is required for Projects with potential high risk impacts including, but not limited to, any of the following:

- adverse impacts on indigenous peoples
- Critical Habitat impacts
- significant cultural heritage impacts
- large-scale resettlement

In other Category A, and as appropriate Category B, Project-Related Corporate Loans, the EPFI may determine whether an Independent Review is appropriate or if internal review by the EPFI is sufficient. This may take into account the due diligence performed by a multilateral or bilateral financial institution or an OECD Export Credit Agency, if relevant.

**Principle 8: Covenants**

An important strength of the Equator Principles is the incorporation of covenants linked to compliance.

For all Projects, the client will covenant in the financing documentation to comply with all relevant host country environmental and social laws, regulations and permits in all material respects.

Furthermore for all Category A and Category B Projects the client will covenant the financial documentation:

- a) to comply with the ESMPs and Equator Principles AP (where applicable) during the construction and operation of the Project in all material respects; and
- b) to provide periodic reports in a format agreed with the EPFI (with the frequency of these reports proportionate to the severity of impacts, or as required by law, but not less than annually), prepared by in-house staff or third party experts, that i) document compliance with the ESMPs and Equator Principles AP (where applicable), and ii) provide representation of compliance with relevant local, state and host country environmental and social laws, regulations and permits; and
- c) to decommission the facilities, where applicable and appropriate, in accordance with an agreed decommissioning plan.

Where a client is not in compliance with its environmental and social covenants, the EPFI will work with the client on remedial actions to bring the Project back into compliance to the extent feasible. If the client fails to re-establish compliance within an agreed grace period, the EPFI reserves the right to exercise remedies, as considered appropriate.

**Principle 9: Independent Monitoring and Reporting**

**Project Finance**

To assess Project compliance with the Equator Principles and ensure ongoing monitoring and reporting after Financial Close and over the life of the loan the EPFI will, for all Category A and, as appropriate, Category B Projects, require the appointment of an Independent Environmental and Social Consultant, or require that the client retain qualified and experienced external experts to verify its monitoring information, which would be shared with the EPFI.

**Project-Related Corporate Loans**

For Projects where an Independent Review is required under Principle 7 the EPFI will require the appointment of an Independent Environmental and Social Consultant after Financial Close, or require that the client retain qualified and experienced external experts to verify its monitoring information which would be shared with the EPFI.

**Principle 10: Reporting and Transparency**

**Client Reporting Requirements**

The following client reporting requirements are in addition to the disclosure requirements in Principle 5.

For all Category A and, as appropriate, Category B Projects:

- the client will ensure that, at a minimum, a summary of the ESIA is accessible and available online.
- the client will publicly report GHG emission levels (combined Scope 1 and Scope 2 Emissions) during the operational phase for Projects emitting over 100,000 tonnes of CO<sub>2</sub> equivalent annually. Refer to Annex A for detailed requirements on GHG emissions reporting.

**EPFI Reporting Requirements**

The EPFI will report publicly, at least annually, on transactions that have reached Financial Close and on its Equator Principles implementation processes and experience, taking into account appropriate confidentiality considerations. The EPFI will report according to the minimum reporting requirements detailed in Annex B.

**Notes:**

- [1] **Exhibit II:** Illustrative List of Potential Environmental and Social Issues to be addressed in the Environmental and Social Assessment Documentation.
- [2] **Exhibit III:** IFC Performance Standards on Environmental and Social Sustainability and the IFC / World Bank Group Environmental, Health and Safety Guidelines

The IFC Performance Standards (2012), to which the Equator Principles refer, specifically in Exhibit III, are those that were published and took effect on 1st January 2012.

**4.2.2 International Finance Corporation Performance Standards (2012)**

In 2005 the IFC embarked on an extensive review of its environmental assessment procedures and performance standards. These performance standards (see Box 2) have become the international benchmark for ESIA's and are used to measure the environmental performance and management of large international projects. They have been adopted by most lender groups and Equator Principle-compliant commercial banks. Since early 2010 these eight Performance Standards have been revised, and the revisions were approved by the Board of the World Bank.

These slightly more rigorous and more clearly defined Performance Standards came into effect in January, 2012. Box 2 below outlines these standards, the main objectives of which are briefly described.

Of particular relevance to this report is the IFC PS 1, since it requires, among other things, the establishment of an Environmental and Social Management System (ESMS) for the project, as part of the assessment and management of project-related risks and impacts. A summary of the key objectives of the Performance Standards is set out in the Table 4.3 below.

**Table 4.3: Key Objectives of the IFC Performance Standards**

Performance Standard	Key objectives
<b>PS 1: Assessment and management of environmental and social risks and impacts</b>	<ul style="list-style-type: none"> <li>➤ To identify and evaluate environmental and social risks and impacts of the project.</li> <li>➤ To adopt a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimize and, where residual impacts remain, compensate/offset for risks and impacts to workers, Affected Communities, and the environment.</li> <li>➤ To promote improved environmental and social performance of clients through the effective use of management systems.</li> <li>➤ To ensure that grievances from Affected Communities and external communications from other stakeholders are responded to and managed appropriately.</li> <li>➤ To promote and provide means for adequate engagement with Affected Communities throughout the project cycle on issues that could potentially affect them and to ensure that relevant environmental and social information is disclosed and disseminated.</li> </ul>
<b>PS 2: Labour and Working Conditions</b>	<ul style="list-style-type: none"> <li>➤ To promote the fair treatment, non-discrimination, and equal opportunity of workers.</li> <li>➤ To establish, maintain, and improve the worker-management relationship.</li> <li>➤ To promote compliance with national employment and labour laws.</li> <li>➤ To protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the client's supply chain.</li> <li>➤ To promote safe and healthy working conditions, and the health of workers.</li> <li>➤ To avoid the use of forced labour.</li> </ul>
<b>PS 3: Resource efficiency and pollution prevention</b>	<ul style="list-style-type: none"> <li>➤ To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities.</li> <li>➤ To promote more sustainable use of resources, including energy and water.</li> <li>➤ To reduce project-related GHG emissions.</li> </ul>
<b>PS 4: Community Health, Safety and Security</b>	<ul style="list-style-type: none"> <li>➤ To anticipate and avoid adverse impacts on the health and safety of the Affected Community during the project life from both routine and non-routine circumstances.</li> <li>➤ To ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the Affected Communities.</li> </ul>
<b>PS 5: Land Acquisition and Involuntary Resettlement</b>	<ul style="list-style-type: none"> <li>➤ To avoid, and when avoidance is not possible, minimize displacement by exploring alternative project designs.</li> <li>➤ To avoid forced eviction.</li> <li>➤ To anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by: <ul style="list-style-type: none"> <li>- providing compensation for loss of assets at replacement cost and</li> <li>- ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected.</li> </ul> </li> <li>➤ To improve, or restore, the livelihoods and standards of living of displaced persons.</li> <li>➤ To improve living conditions among physically displaced persons through the provision of adequate housing with security of tenure at resettlement sites.</li> </ul>
<b>PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources</b>	<ul style="list-style-type: none"> <li>➤ To protect and conserve biodiversity.</li> <li>➤ To maintain the benefits from ecosystem services.</li> <li>➤ To promote the sustainable management of living natural resources through the adoption of practices that integrates conservation needs and development priorities.</li> </ul>

Performance Standard	Key objectives
<b>PS 7: Indigenous Peoples</b>	<ul style="list-style-type: none"> <li>➤ To ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture, and natural resource-based livelihoods of Indigenous Peoples.</li> <li>➤ To anticipate and avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not possible, to minimize and/or compensate for such impacts.</li> <li>➤ To promote sustainable development benefits and opportunities for Indigenous Peoples in a culturally appropriate manner.</li> <li>➤ To establish and maintain an ongoing relationship based on informed consultation and participation with the Indigenous Peoples affected by a project throughout the project's life-cycle.</li> <li>➤ To ensure the Free, Prior, and Informed Consent (FPIC) of the Affected Communities of Indigenous Peoples when the circumstances described in this Performance Standard are present.</li> <li>➤ To respect and preserve the culture, knowledge, and practices of Indigenous Peoples.</li> </ul>
<b>PS 8: Cultural Heritage</b>	<ul style="list-style-type: none"> <li>➤ To protect cultural heritage from the adverse impacts of project activities and support its preservation.</li> <li>➤ To promote the equitable sharing of benefits from the use of cultural heritage.</li> </ul>

**Note:** IFC PS 7 is not applicable to the project, since there is no indication that any group of potentially affected persons in the project's area of influence falls into the IFC definition of indigenous people (social groups with identities that are distinct from dominant groups in national societies)

The effective implementation of the EMPr depends to a considerable extent on the structure and practice of RVM1's existing Environmental and Social Management System (ESMS). In the absence of an existing management system, any production and quality-based management systems operating within the organisation can be used as a foundation on which to build the elements of a system consistent with Performance Standard 1. The RVM1 Hydro Electric Power Project will therefore adopt industry best practice management systems that will be implemented in a manner that ensures all requirements presented here are met.

As part of its ongoing engagement with affected communities, RVM1 is required to disclose its various Environmental, Health and Safety (EHS) management plans in advance of project implementation to affected communities and stakeholders, and provide updates throughout the life of the project as mitigation measures are adjusted and upgraded to reflect the feedback from the affected communities.

#### **4.2.3 IFC General Environmental, Health and Safety Guidelines (2007)**

The IFC General EHS Guidelines (2007) provide an organized, hierarchical, best-practice approach to managing EHS issues at facility or project level, which in broad terms comprises the following steps:

- Identifying EHS project hazards and associated risks as early as possible in the facility development or project cycle.
- Understanding the likelihood and magnitude of EHS risks, based on the nature of the project activities and the potential consequences to workers, communities, or the environment if hazards are not adequately managed.
- Prioritising risk management strategies with the objective of achieving an overall reduction of risk to human health and the environment, focusing on the prevention of irreversible and / or significant impacts.
- Favouring strategies that eliminate the cause of the hazard at its source to avoid the need for EHS controls.
- When impact avoidance is not feasible, incorporating engineering and management controls to reduce or minimize the possibility and magnitude of undesired consequences.
- Preparing workers and nearby communities to respond to accidents, including providing



technical and financial resources to effectively and safely control such events, and subsequently restoring workplace and community environments to a safe and healthy condition.

- Improving EHS performance through a combination of ongoing monitoring of facility performance and effective accountability.

The guideline document covers environmental, occupational health and safety, community health and safety, performance indicators, and monitoring.

## **5. TRAINING AND AWARENESS PROGRAMMES**

### **5.1 Introduction**

RVM1's personnel and its contractors, including third parties, must be conversant with all environmental and social legislation and international best practice applicable to their contract. They will need to be appropriately trained in environmental management in order to possess the skills necessary to impart on their subordinates.

All personnel involved in the construction and operation of the project must participate in a training and awareness programme on environmental management prior to commencing activities. A proposed environmental awareness programme is presented in Appendix A. RVM1 will develop a procedure for environmental training which will lay out in detail the methodology for developing and presenting environmental awareness and induction training.

Information will be transferred in an appropriate manner and training courses will take language and cultural and educational levels into consideration. In particular, the training of illiterate staff will require the development of appropriate training programmes and extensive use of signage (such as pictures, logos, drawings etc). A site Environmental Handbook will be developed and distributed to all literate personnel. This handbook will cover some of the information presented in the Environmental Awareness and Induction Training. Records will be maintained of all E&S training.

### **5.2 General staffing and environmental and social training**

It is intended that as many employees as possible will be sourced locally, in line with the Independent Power Producer (IPP) Procurement Programme (Vol. 5 Economic Development Requirements). In addition, every effort will be made to ensure that skills development takes place in order to enable permanent employment positions to be filled by members of the local community. As such, a community liaison officer needs to be appointed in order to mediate between the contractor and/or the project proponent and the local communities.

RVM1 will ensure that its staff and other employed parties or their contractors, who carry out any aspects of the work, in any phase of the project, are adequately trained with regard to the implementation of the EMP described here. Contractors and third parties will be aware of their health, safety, environmental and social requirements and obligations, and these will be legally and contractually binding on them. A training-needs-analysis that would cover EHS and Community issues would need to be developed and should identify the appropriate training programmes and target groups.

The training staff will be appropriately trained in their respective disciplines and will possess the skills necessary to train, inform and sensitise all personnel involved in the project.

All personnel involved in the construction and operation of the RVM1 project will be required to participate in an all EHS and community related training and induction programme. Training programmes will be targeted at three distinct levels of employment, i.e. executive, middle management and labour, and awareness training programmes will contain the following information:

- The names, positions and responsibilities of personnel to be trained.
- The framework for appropriate training plans.
- The summarised content of each training course.
- A schedule for the presentation of the training courses.

The range of topics that need to be covered in the awareness training will, inter alia, include:

- RVM1 Project's Environmental Policy;
- RVM1 Project's Health and Safety Policy;
- RVM1 Project's Community Policy;

- RVM1 Project's Environmental Objectives and Targets;
- Organizational structure and responsibilities;
- Aspects of routine day-to-day operational activities, which can have environmental, social, safety or health impacts;
- Environmental and safety hazards which could arise from non-routine situations and corrective actions;
- The importance of environmental and safety Incident reporting and completion of appropriate reports;
- Emergency Preparedness and Response;
- Channels of communication for discussing and reporting E&S issues;
- Documentation systems for maintaining appropriate records of E&S matters;
- Responsibilities under the applicable E&S legislation and international best practice;
- Responsibilities related to Labour and Working Conditions, in particular, the requirements of IFC Performance Standard 2 that will apply to project and their contractors;
- Culturally appropriate behaviour; and
- Community engagement, awareness, security and grievances.

Additional training on cultural heritage and culturally appropriate behaviour, and on health, safety, environmental and social hazards which could arise from non-routine situations and corrective actions will be provided. Training will highlight the importance of incident reporting and completion of appropriate reports, channels of communication for reporting EHS and Community issues and incidents, documentation systems and responsibilities under South African legislation.

Information will be transferred in an appropriate manner and form part of the induction process for all employees and contractors. The induction and training courses will take language, culture and educational levels into consideration. It is proposed that an EHS and Community Handbook be developed and distributed to all literate personnel.

### **5.3 Community Health and Safety, Awareness and Competence**

The objectives of the community health and safety are:

- Induction and training to raise awareness levels;
- Specific community-based interventions based on the proactive identification of safety behaviour and trends; and
- Training for community-based monitoring of health and safety issues addressed by the Community Health and Safety Operating Procedure.

Many aspects of community engagement related to the project involve partnerships with Non-Governmental Organisations (NGOs) and other relevant local government and non-government structures. These partnerships may be facilitated under the following Operating Procedures:

- Health and Safety;
- Resettlement;
- Emergency Preparedness and Response;
- Rehabilitation and Closure; and
- Stakeholder Engagement.

### **5.4 Emergency Preparedness and Training**

Where the project involves specifically identified physical elements, aspects and facilities that are likely to have significant impacts, RVM1 will establish and maintain an Emergency Preparedness and Response (EPR) Plan, in collaboration with appropriate and relevant third parties. The EPR plan will be developed to respond to accidental and emergency situations associated with the project in a manner that will assist in preventing and mitigating any harm to people and/or the environment. In particular, the EPR plan will address:

- areas where accidents and emergency situations may occur (high risk areas),

- communities and individuals that may be impacted (high risk receptors),
- response procedures,
- provision of equipment and resources,
- designation of responsibilities,
- communication, including that with potentially affected communities; and
- periodic training to ensure effective response.

All staff, including contractors, will adhere to RVM1's EPR plans, including incident and accident-reporting requirements, as well as all relevant South African legislation. Where necessary, Method Statements or Standard Operating procedures (SOPs) that detail the exact process, resource requirements and responsibilities for ensuring that these emergency procedures are documented and enforceable will be developed.

EPR training and awareness will form part of the EPR plan to be developed. Incidents that will be considered during the development of the EPR will include but will not be limited to:

- Details on emergency organisation (manpower) and responsibilities, accountability and liability;
- A list of key personnel to be contacted;
- Details of emergency services applicable to the various areas along the route that components will need to be transported and for the site itself (e.g. the fire department, spill clean-up services, etc.);
- Internal and external communication plans, including prescribed reporting procedures where required by legislation;
- A risk assessment and Hazard and Operability (HAZOP) study to identify all potential incidents and emergencies;
- Actions to be taken in the event of different types of emergencies;
- Incident recording, progress reporting and remediation measures required to be implemented;
- Information on hazardous materials, including the potential impact associated with each, and measures to be taken in the event of accidental release; and
- Training plans, testing exercises (including fire drills) and schedules for effectiveness;

Training and awareness component to be considered for the EPR plan will include:

- Accidental discharges to water and land;
- Accidental exposure of employees to hazardous substances;
- Medical evacuation;
- Work stoppage incidents requiring medical intervention across all aspects of the operation;
- Accidental fires and fire drill; and
- Vehicle accidents, including vehicle collisions with pedestrians.

## 6. ORGANISATIONAL REQUIREMENTS FOR IMPLEMENTATION

This section outlines the proposed organisational structures and other activities that will be required to effectively implement the EMPr. It should be noted that the organisational structure provided here is meant to ensure that the EMPr is adequately implemented and is subject to changes and modifications.

### 6.1 Introduction

RVM1 shall assume overall responsibility for the administration and implementation of the EMPr throughout the project's life cycle. The sections below provide the roles and responsibilities of key RVM1 staffs with a focus on the design and planning phase as well as the construction phase of the project. This section of the EMPr would have to be updated to reflect the roles and responsibilities relating to the operation and decommissioning phases of the project life cycle.

### 6.2 RVM1 Staff Complement

The key management positions required the management and implementation of the various management instruments are shown in the organogram below (Figure 6.1). The roles and responsibilities of identified person are discussed in subsequent sections.

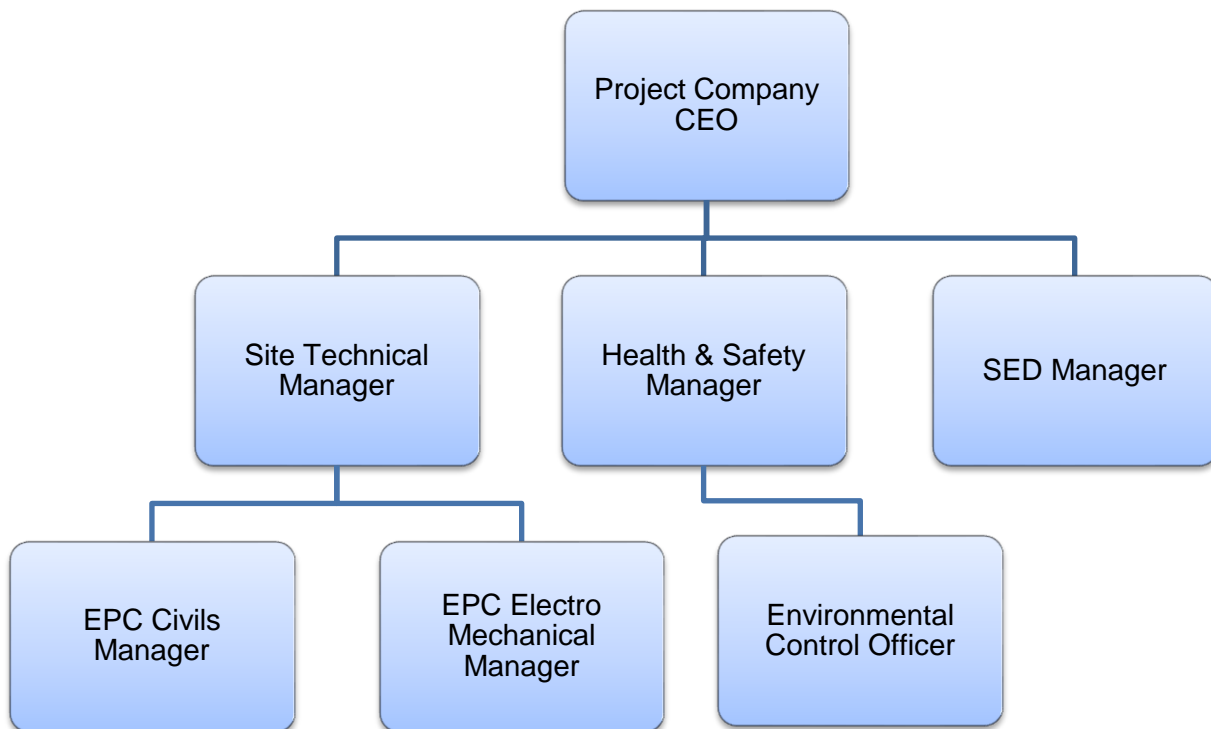


Figure 6.1: Riemvasmaak 1 Hydro Electric Power Project Organogram

#### 6.2.1 Project Company Chief Executive Officer

RVM1 will appoint a suitably qualified Project Company Chief Executive Officer (CEO) whose main responsibility is to ensure that the hydro power facility is built within the allocated time. The CEO will amongst others be responsible for:

- Monitoring the project build and ensuring that the project construction meets its project milestones and targets;
- He will liaise on a constant basis with all managers to ensure that the various elements of the build are on schedule;
- Produce monthly progress reports to the Lenders and the Equity Partners;

- Ensure that the project attains its Economic Development objectives and will meet regularly with the Socio-economic & Economic Development (SED) Manager in this regard;
- Provide feedback to the Board of Directors as to the progress of the construction and advise of any delays or contingencies within a reasonable amount of time
- Attend to any industrial relations issues quickly and efficiently should they escalate to this level;
- The CEO will be the Project Company representative to the Lenders and the Department of Energy; and
- Monitoring the project compliance and ensure that the construction process is aligned to the recommendations of the EMPr.

The Project Company CEO will report to the Board of Directors of the Project Company

### **6.2.2 Site Technical Manager**

The role of the Site Technical Managers will be to ensure that all areas of the project are designed, constructed and operated to meet the specified contractual and legal requirements of the RVM1 project. The incumbent will be responsible for the efficient operation of the construction site and the Civils Manager and Electromechanical Manager will be his direct reports. It will be the duty of the Site Technical Manager to:

- Ensure that the project remains on time and on budget;
- Provide monthly status reports to the Project Company CEO;
- Oversee the Civils and Electromechanical operations and liaise constantly with the respective managers;
- Ensure that the project remains compliant in terms of the environmental permitting and construction industry laws and standards;
- Confirm that all relevant construction, environmental & transport permits have been acquired and are valid and that all municipal consents have been acquired;
- Address all labour relations issues that may arise, speedily and effectively;
- Monitor p[project progress and maintain an updated project schedule; and
- Liaise with the SED Manager to ensure that the project meets its Economic Development Commitments as submitted at Bid. The position requires the candidate to be based on or near site for the duration of the construction period.

The Site Technical Manager will report directly to the Project CEO.

### **6.2.3 Health & Safety Manager**

The incumbent will be responsible for maintaining a safe environment for personnel to operate in. The Health & Safety Manager will be responsible for the independent Environmental Control Officer to be appointed. To effectively complete the responsibilities of this position, the candidate must be able to complete the following:

- Monitor the safety performance of all on-site workers to ensure that all workers on the site work safely;
- Encourage and educate employees to take precautions and adhere to safety rules to protect themselves and the equipment they use from damage;
- Identify and review various health and safety concerns specific to the work site and ensure construction site activities do not put non-construction site people outside of the site at risk;
- Investigate all injuries, accidents and near misses. Identify the causes and advise on any improvement in safety standards that need to be made;
- Review accident summary reports and take appropriate action when accident trends are unfavourable;
- Ensure safety reports and data are collected and submitted to the Project Company CEO as required, including:
  - a) man-hours worked and safety logistics

- b) copies of accident reports
- c) description of any unsafe conditions discovered and steps taken to correct those conditions
- d) copy of inspection reports on equipment
- e) copy of safety inspection checklists or visit summary reports; and
- f) copy of audit reports and actions taken
- Maintain up-to-date knowledge of and enforce OH&S legislation and codes of practice;
- Provide internal or arrange external safety training to employees;
- Act as a liaison with the government (OH&S), ambulance services and hospitals, management, subcontractors and workers regarding aspects of health and safety on and off the job;
- Ensure daily risk assessments are being conducted as per policy
- Re-certify in any courses pertaining to the CSO status that expire every three years;
- Coordinate and conduct the following according to OH&S legislation:
  - a) Site orientations
  - b) Weekly Toolbox Safety Meetings
  - c) Safety inspections - Audits - Joint Work Site Health and Safety Meetings
- Update and display safety policies and pertinent information on the bulletin board;
- Advise on appropriate protective equipment and on the cost of implementing changes;
- Maintain an inventory list of equipment purchased;
- Establishing inspection schedules for all tools, major equipment, lifting devices and mobile equipment to ensure safe operating conditions and compliance with current regulations; and
- Assist injured workers in obtaining Modified Duties and administer the return to work policy.

The Health & Safety Manager will report directly to the Project Company CEO

#### **6.2.4 Socio Economic & Economic Development Manager**

The position requires various statutory outputs as defined by Schedule Two of the Implementation Agreement and requirements of the Department of Energy's (DoE) Monitoring and Evaluation Department as below:

- **Construction report:** This report must be submitted to the Monitoring & Evaluation Department within the DoE on or before the 7th of each month and submission must be made in the format prescribed by the DoE. The report comprises construction data broadly as follows:
  - The number of persons (not person months) planned for and actual persons on site.
  - The number of youths on site
  - Actual construction spend compared with contract total
  - Civils progress report compiled by civils contractor
  - Site photographs to show construction progress
  - Project Schedule – to include any updates or delays
- **Monthly Economic Development Report:** This report is generated for inclusion in the monthly report to lenders and management. It tracks the monthly economic development achievements against the quarterly target as committed to at Bid to the DoE. The SED Manager must:
  - ensure that all supporting documentation, such as copies of IDs and proof of residence, is submitted and verified to ensure compliance.
  - Track the monthly Local Content spend
  - Ensure that BBBEE certificates supplied are current to include spend for preferential procurement.
  - Check the number of hours that have been submitted
  - Include a copy of the monthly construction report for distribution

- Incorporate any information pertaining to the RVM Community Trust
- **Quarterly Economic Development Report:** This report is submitted quarterly to the DoE and is required in terms of the Implementation Agreement. It allows the DoE to monitor the IPP and ensure that the Economic Development commitments are met. The Quarterly Report must be submitted within 21 days after the end of a specific quarter. Compilation of the report requires the collation of the monthly Economic Development reports but the data is presented in a template prescribed by the Department. The SED Manager must ensure that the quarterly targets are met and that no termination points or penalties are incurred. Should this not be possible a remedy must be in place for inclusion with the submission.
- **Liaison with the Community Trust:** Various ad hoc requests arise especially relating to the Community Trust. The SED Manager will be the interface between the Project Company, the Community Trust and the Community.
- **Annex 11 – Annual Economic Development Plan:** The annual submission must be made to the Department on 31 March each year. It details the needs assessment done by the developer for the new financial year as well as the achievements as per the commitments of the previous year. The project's socio economic budget for the financial year is detailed in this plan.

The outputs as stated above require that the incumbent have:

- The ability to communicate well on all levels
- Pay attention to detail and have strong administrative skills
- The ability to multi task effectively

### **6.2.5 Engineering Procurement & Construction Civils Manager**

The Engineering Procurement & Construction (EPC) Civils Manager will be in the person responsible for the construction of the civils component of the hydro facility. The incumbent will amongst others be responsible for:

- Overseeing the construction of the intake structure, headrace canal, lining of the coffer dam where required, concreting of the power chamber;
- Manage the construction of all access roads and temporary laydown areas;
- Ensuring that the project remains on schedule and budget;
- Provide monthly status reports to the Project CEO;
- Maintain an updated project schedule;
- Provide monthly labour and procurement reports to the SED Manager;
- Ensure that the requisite local labour is on site;
- Engage with the ECO and Health & Safety personnel to ensure a safe working environment and maintain a project site that remains compliant in terms of the environmental record of decision and construction industry laws and standards;
- Aligning the construction process to the conditions as provided in the EMPr;
- Manage all aspects relating to subcontractors and their staff; and
- Enabling a smooth handover to the electromechanical team when the turbine installation occurs.

The Civils Manager will report to the Site Technical Manager

### **6.2.6 Engineering Procurement & Construction Electro Mechanical Manager**

The EPC Electromechanical Manager will be responsible for the installation of the electromechanical works component of the hydro facility. The incumbent will amongst others be responsible for:



- Monitoring the manufacture of the various components for the turbine units;
- Manage the installation of the turbine units, generators and all associated electrical infrastructure including the transmission line and substations;
- Oversee the commissioning and testing phase of the plant;
- Liaise with the ECO and Health and Safety Managers to ensure that the highest levels of safety are practiced and that the construction process is aligned to the EMPr & Construction Industry laws and standards;
- Ensure that all industrial relations issues or accidents are dealt with correctly and efficiently;
- Provide monthly status report to the Site Technical Manager;
- Maintain an updated Program Schedule;
- Provide the SED Manager with monthly Labour and Procurement Reports; and
- Ensure that the requisite local labour is employed on site.

The Electromechanical Manager will report directly to the Site Technical Manager

### **6.2.7 Environmental Control Officer**

The role of the Environmental Control Officer (ECO) will be to ensure that the project remains compliant in terms of its environmental obligations during the construction period. The role of ECO will include but not be limited to the following tasks:

- Ensure compliance at all times with the Record of Decision issued by the Department of Environmental Affairs for the duration of the project construction;
- Maintain the Environmental Management Plan and ensure that it is adhered to and updated on a regular basis;
- Ensure that Final Layout Plan is submitted to Department of Environmental Affairs (DEA) prior to construction commencing;
- Keep a daily record or diary of all activities on site;
- Note any transgressions made;
- Identify problems;
- Keep a schedule of all ECO tasks;
- Maintain a detailed incident and complaints register – showing how all incidents or complaints were addressed or rehabilitation instituted;
- The ECO will keep copies of all reports submitted to the DEA;
- Keep a schedule of current site activities and how they are managed;
- The ECO shall ensure that all records are kept and are made available to any relevant authority for inspection;
- Liaise with an independent environmental auditor to compile and submit an Environmental; and
- Audit and Rehabilitation Report to the DEA on completion of the construction of the facility if required.

The ECO will liaise with the Project CEO and the Health & Safety Officer to ensure that environmental best practices are followed and to ensure that the all incidents are reported to the relevant authorities and correction measures are implemented immediately.

## **7. STRUCTURE AND IMPLEMENTATION OF THE MANAGEMENT PLANS**

### **7.1 Introduction**

As discussed in Chapter 2 of this report the EMP requirements described here are presented as a framework to allow for flexibility in the development of the specific mitigation measures that were identified during the EIA process. The framework EMP requirements for the project life cycle are detailed in section 7.2.

The requirements that need to be incorporated into the design of the project to mitigate some of the impacts identified by the specialist, and also to address some of the concerns expressed by I&APs, are set out in section 7.3

The impacts and mitigation measures identified during the EIA process for construction and operation are set out in sections 7.5 / Table 7.1 and 7.6 / Table 7.2 respectively. These are the impacts and mitigation measures that must be used by RVM1 and the contractor as the basis of the development of the final EMPs.

As discussed previously, it is premature to propose a Decommissioning EMP for closure and decommissioning activities that may be 80 years in the future.

### **7.2 Framework Requirements**

Included here are a number of plans targeting specific phases of the project and also a number of “cross-cutting” plans that are applicable to the construction and operational phases. Once developed for the construction phases these cross cutting plans should be reviewed and, where required, adapted and modified to address environmental and social issues associated with the operational phase.

#### **7.2.1 Construction Framework EMP**

The CEMP must deal with all environmental and social issues associated with establishing, constructing and commissioning the project, and must address all environmental and social impacts and mitigation measures set out on section 7.5 / Table 7.1

This EMP must also deal with labour-related issues such as labour requirements and how local labour will be managed, OHS issues on site, and it must specify the environmental and social contractual obligations for contractors; define the EHS and Security role of RVM1s and contractor staff; and apply aspects of all other EMPs as applicable.

#### **Geotechnical Investigations**

These investigations are part of the pre-construction activities, and will require access to the site for surveys, drilling of test holes and excavation of test pits along the route of the headrace and tailrace, and for the site of the power chamber. All activities will be subject to all the relevant requirements of the CEMP.

The investigations will comprise:

- A detailed and accurate account of the site-specific geotechnical and geophysical conditions and possible constraints should be determined through additional site testing. Recommended studies include the following:
- A local topographical survey along the centreline of the headrace route, including a strip of 50 metres on either side of the centreline. In the headpond area the survey should be extended to include the surface area of the pond, as well as the pond wall and a strip 50 metres wide surrounding it. The aim of the survey is to record localised steep slopes which may impact on the site route elements and construction activities.
- Local geological surface mapping of the sites of project infrastructure in order to better establish site conditions and recommend test pit/drill spacing.

- Determination of the rock profile in the river in order to establish conditions for construction of the weir. Diving with a stave and camera should be considered.
- Test pit digging and rock core drilling and logging along the centreline of the headrace route, the site of the power chamber and the route of the tailrace prior to construction in order to establish thickness and properties of soil cover and rock mass properties, including degree of weathering, hardness, discontinuity properties and rock type variation. The digging / drilling needs to be as deep as final construction depth for the specific infrastructural element and needs to be spaced at short enough distances along the route to ensure a proper prediction of site conditions over the entire site. Closer spacing is expected to be necessary in the headpond-power chamber-tailrace area due to the expected poorer rock mass properties and location of more sensitive structures in this area. Pit / hole spacing could be increased, and numbers reduced, by undertaking a geophysical traverse (electrical resistivity, seismic) survey along the site route.
- Definition of site specific soil / rock conditions by means of on-site and laboratory testing to determine engineering characteristics of the materials. This can include soil grading and shear strength as well as compressive strength and durability of rock and deformability of the rock mass. These parameters can be of use for both establishing excavation properties of soil/rock mass and material properties for use in construction.
- In view of the recent earthquake swarm in the area, and also the location of the headpond, power chamber and tailrace on or in the immediate vicinity of a suspected geological fault zone, a site-specific seismic assessment should be undertaken of this part of the site.
- Determination (measurement) of water table depths as well as rock permeability in boreholes. This is particularly of relevance in the headpond, power chamber and tailrace area.
- Slope stability analysis of specific locations with steep topography and poor rock mass properties, where fixed structures (headrace, headpond and tailrace) or temporary construction infrastructure is planned. This is expected to be particularly relevant to the northern parts of the site.

### **7.2.2 Operation Framework EMP**

The OEMP must deal with all environmental and social issues and impacts associated with the operation of the facility. The scope of this Plan will be similar to that of the CEMP, although the priority issues requiring careful consideration will be different, as set out in section 7.6 / Table 7.2.

In addition, the EMP will need to include a specific requirement for the implementation of a formal, project-specific Environmental and Social Management System (ESMS) and deal with any other specific aspects not covered elsewhere.

Certain aspects will be covered by the cross cutting plans, brief details of which are provided below.

#### **Labour Recruitment, Procurement and In-migration Management Plan**

In order to avoid spontaneous settlement and speculative in-migration adjacent to or within the project area, and to ensure consistency of these practices on behalf of contractors, RVM1 must implement a Recruitment, Procurement and In-migration Management Plan, which will include a Local Hiring and Purchasing Plan and a Temporary Employment Plan.

RVM1 will make commitments to deal with local expectations and risks, specifically maximizing local hiring for the unskilled job opportunities and local purchasing in the areas of project influence during the construction and operational phases. A Local Hiring and Local Purchasing Plan is required to govern RVM1 and its contractors' hiring processes and purchasing programmes in the area of influence. The objectives are to:

- Develop procedures and practices that maximize opportunities for hiring local workers,

and to minimize social risks in the areas of influence.

- Develop transparent procedures that allow access to project jobs by the local population in an organized and fair manner.
- Establish a hiring process that respects local cultural and social norms in order to facilitate local participation and avoid conflicts and other negative social impacts.
- Promote fair practices in the hiring of local workers that protect against unauthorized third-party job brokers, child and forced labour, and discrimination.
- Promote employment of women.

Contractors, in consultation with RVM1 will design and implement a Temporary Employment Programme for the local population that will anticipate the demand for a skilled and unskilled work force, duration of the employment, and the requirements the applicant will have to meet to be accepted. The objectives of this program are to:

- Maximize the number of local personnel hired in the project's direct area of influence.
- Minimize local expectations in terms of potential employment.
- Prevent the migration of unwanted people towards the project area in search of work.

This programme will be provided to the authorities, the local populations and stakeholders by offices that will be opened for that purpose. RVM1 and its Contractors will provide information to the community and local stakeholders, through local and regional communication media, on the location of offices where they may learn about job opportunities and the priorities that will be given to local workers. These offices will in turn provide information on jobs; will identify the number of available positions and application requirements. It must be made clear that no workers will be hired at the construction sites.

To decrease and control the flow of people seeking employment in the project area, it will be made clear that members of the population directly impacted by the project will be given preference when hiring, as long as they qualify technically and meet RVM1's requirements.

Recruiting strategies will identify the methods used for informing candidates that equal priority will be given to project affected people for unskilled positions.

The above measures will serve to minimize in-migration to the project area. Furthermore, no goods and services can be procured from the project gate or stalls by the road. This prevents encouraging opportunistic traders into the area.

### ***Integrated Waste Management Plan***

This Plan will include a commitment for RVM1 to manage all waste streams in a manner that minimizes the likelihood of harm to the environment or human health. Furthermore, all waste streams will be managed according to the waste management hierarchy which requires that production of wastes is avoided and minimized. Wastes will then be re-used or recycled and where this is not possible, it will be disposed of in an environmentally responsible manner and in line with the relevant legal and other obligations.

This plan will cover all solid and liquid wastes, both hazardous and non-hazardous, and will also cover the management of spills or leakage from any storage areas.

### ***Occupational Health and Safety Management Plan***

Construction and operation of the facilities will present a number of significant hazards to employees. RVM1 will implement a comprehensive Occupational Health, Safety and Environmental plan or system. This Plan will include a detailed assessment of all occupational hazards associated with operation of the facilities and a clear set of procedures aimed at minimizing harm to employees during the course of their activities on site. This plan must at least cover the following:

- Handling, management and storage of hazardous materials,

- HIV/AIDS,
- Risks associated with operation of crushers and cutters
- Workplace air quality
- Workplace noise

### **Emergency Preparedness and Response Plan**

Emergency preparedness strategies are required to deal with general spillages, as well as the spillage of any hazardous materials and other forms of environmental and social incidents mishaps that may occur during the project life cycle. Emergency response catering for hazardous substance spillage is particularly important in areas adjacent to riparian environment where spillages may easily enter these waters.

The identification of upset conditions that can cause major environmental impacts (such as. major storm events, large fires and explosions) is required, and measures to effectively handle these must be developed. A number of action plans or SOPs are therefore anticipated, including an Emergency Preparedness: Spillages action plan; and a Site / Facility Evacuation Plan (particularly relevant for underground working areas).

Preparation of this plan will include an assessment of the emergency response capabilities of local authorities, and provisions to assist if deficiencies are identified.

### **Community Health and Safety Management Plan**

Construction and operation of the facilities may present a number of hazards to local communities. RVM1 will develop a Community Occupational Health, Safety and Environmental Plan. This Plan will include a detailed assessment of all hazards associated with operation of the facilities that may impact negatively on local communities. It will also include a clear set of procedures aimed at minimizing harm to community members. This plan must at least cover the following:

- Transport, handling and storage of hazardous materials,
- Traffic safety
- HIV/AIDS,
- Ambient air quality
- Ambient noise

### **Environmental & Social Monitoring Plan**

The objectives of monitoring are to:

- Characterise environmental features (such as vegetation, surface water features) and identify changes or trends in their condition or state over time.
- Identify specific existing or emerging problems in condition or state.
- Gather information to design specific impact prevention or remediation programmes.
- Determine whether project goals, such as compliance with regulations or implementation of effective control actions, are being met.
- Provide early warning for emergencies such as floods.

It is anticipated that at least the following environmental and social components will need to be monitored:

- Water quality (rivers, wetlands, wells and boreholes for water quality and quantity).
- Condition of vegetation
- Changes in faunal prevalence and composition
- Use of natural resources, including power and water.
- Waste disposal monitoring will need to be implemented during the construction and operational phase to confirm the effectiveness of the Integrated Waste Management Plan.
- Ambient noise and air quality to ensure compliance with the required limits.
- Occupational health and safety monitoring including entrance, exit and surveillance medicals for employees, workplace noise, lighting and air quality etc.

- Storm water quality would need to be initiated during the construction phase
- Social monitoring to ensure that grievances are being attended to and that any necessary changes to the overall process are being timeously and sensibly made.

It is proposed that monitoring takes place at two levels, namely Internal Monitoring by a suitably qualified person within RVM1, and External Monitoring through a contracted independent body. The external monitoring should be conducted for quality control and verification purpose.

### ***Hazardous Materials Management Plan***

The construction and operation of the facilities may include the storage and use of hazardous materials such as hydrocarbons and chemicals. If not managed correctly, these could result in harm to the environment, in particular soil and water, as well as workers and community members.

The objectives of this plan are to ensure that:

- The use and management of hazardous materials is carefully controlled;
- Hazardous materials are only used by authorised personnel;
- The likelihood of harm to humans or the environment is minimised;

This management plan will need to cover at least the following:

- Approval and procurement of hazardous chemicals;
- Storage of chemicals
- Disposal of expired materials and containers
- Emergency response
- Availability of Material Safety Data Sheets (MSDS)

### ***Roads and Transport Management Plan***

The construction and operational phases of the project will result in an increase in traffic volumes which could pose a risk to the health and safety of the community and the facility employees.

The principal objective of this plan is therefore to reduce the risk of injury to community members and employees. The management plan will cover at least the following:

- Emphasizing safety aspects among drivers;
- Improving driving skills and requiring appropriate licensing of drivers;
- Adopting limits for trip duration and arranging driver rosters to avoid over tiredness;
- Avoiding dangerous routes and times of day to reduce the risk of accidents;
- Regular maintenance of vehicles and use of manufacturer approved parts to minimise potentially serious accidents caused by equipment failure;
- Minimise pedestrian interaction with construction vehicles; and
- Using signage and flag persons to warn of dangerous conditions.

### ***Stormwater Management Plan***

If not managed, stormwater run-off can result in the pollution and contamination of the soils and the freshwater systems in the adjacent riparian areas. The objective of this plan is to:

- Protect the health, welfare and safety of the public and to protect property from flood hazards by safely routing and discharging stormwater from developments; and
- Preserve the natural environment.

This management plan will need to cover at least the following:

- Incorporate measures to divert clean stormwater away from sources of potential pollution, including waste storage and disposal areas and other operation areas; and
- Reduce the contact between stormwater and hazardous materials.

## **Security Management Plan**

This plan provides guidelines and standards that RVM1 and its security contractors need to adhere to during the project's life cycle, in addition to all current laws, regulations and international conventions. Since components of project security may be out-sourced to third parties, it is important to ensure that these third party service providers also comply with the overall management plans and policies established for the project. This EMP needs to detail how this will be achieved, and cover topics such as:

- Selection of security personnel
- Securing the plant and operations
- Monitoring of safety and security
- Physical security enhancement
- Inherently safer options
- Restricted access to information
- Public Disclosure
- Security risk assessment

### **7.3 Design and Planning Environmental Management Plan**

Observations made by several of the specialists during the EIA process, together with comments offered by SANParks and other I&APs, make it clear that some of the potential impacts of the project can be addressed by incorporating certain features in the design of the project infrastructure, and ensuring that the project is operated in certain prescribed ways. These features and measures are discussed in this section.

#### **7.3.1 Diversion weir and offtake structure**

##### ***Fish passage facility***

###### Rationale

The diversion weir will act as a barrier in the river – a *serial discontinuity* - that will impede freedom of movement of migrating aquatic biota, particularly fish, from downstream to upstream areas. Migratory freedom is required to allow for aquatic biota to exploit available habitat for various reasons, including feeding, breeding and spawning. The diversion weir will isolate a reach of river about 2km long between the weir and Augrabies falls. The falls are an absolute barrier to migration from downstream. However, the Ecological Importance and Significance of the river is rated as High, and it may be necessary to provide a fish passage facility – a fish ladder – in the weir to facilitate longitudinal migration. DWS may require such a facility as a matter of policy and good practice.

###### Action required

- DWS should be consulted on its requirements for a fish ladder.
- If necessary the extent to which the weir will represent a barrier to migration must be determined by, among other things, studying the extent to which any part of the weir will be drowned, and possibly passable by migratory species without the need for a fish ladder.

##### ***Flow diversion protocol***

###### Rationale

A sequence of events has been presented in the EIA Report (section 3.3.1) detailing the flow rate in the Orange River at which flow diversion can commence, and below which no flow may be diverted, the procedure for increasing the rate of diversion to the maximum flow to the power station, and the flow rate in the river at which diversion will cease.

This sequence is important to maintain the ecosystem functioning downstream of the diversion weir, as well as to maintain the visual spectacle of the Augrabies Falls as an integral part of the Augrabies Falls National Park.

### Action required

- After refining the hydrological analysis of the flow on the Orange River, develop a formal protocol for the diversion of water into the power station.
- Ensure that the protocol includes a procedure for the emergency shutdown of the facility, similar to the one developed for the Neusberg HPP.
- Submit the protocol to DEA and SANParks for approval.

### **7.3.2 Offtake structure and head pond / forebay**

#### **Faunal mortality**

##### Rationale

There is a possibility that large mammals and reptiles, such as otters, monitors and tortoises, could be drawn into the offtake structure from the river, or into the power station penstock via the headpond.

##### Action required

- Include the provision of effective barriers to faunal entry, such as floating booms and screens, in the design of the offtake structure and forebay.

### **7.3.3 Power station**

#### **Noise**

##### Rationale

The exhaust from the air conditioning system for the power chamber could create a noise nuisance at the surface, in an area that will otherwise be relatively quiet.

##### Action required

- Include effective measures in the design of the air exhaust system to minimise sound levels at ground level, either on terms of the location of the exhaust or noise abatement measures, or both as necessary.

### **7.3.4 Tailrace outfall**

#### **Erosion**

##### Rationale

The tailrace outfall will be a few metres above the floor level of the lower palaeochannel, and long-term erosion of the channel sides and floor could occur due the velocity of the flow issuing from the end of the tailrace.

##### Action required

- Streamflow breakers must be included in the design of the outfall to reduce flow velocity and erosive potential

**Note:** Although overflow from the headpond is likely to be relatively infrequent, similar measures must be incorporated into the design of the overflow from the headpond to reduce the erosive potential of spills into the into the lower palaeochannel.

#### **Faunal mortality**

##### Rationale

The turbines and generators can start up very rapidly – in a matter of a few minutes. Under normal circumstances it is anticipated that the rate of flow into the power station will be relatively gradual, as the flow rate in the Orange River increases to allow a progressively higher rate of flow diversion



to the power station. However, it is possible that, under certain flow conditions in the river, the maximum diversion rate could be achieved very rapidly, and the turbines and generators could be brought up to full speed equally rapidly. This will result in the discharge from the tailrace outfall into the lower palaeochannel increasing from zero to 38 m<sup>3</sup>.s in a few minutes, and this in turn could result in terrestrial animals in the dewatered dry channel be caught unawares and drowning.

Action required

- Unless there is an urgent requirement to power up the station from zero to 40MW in a few minutes the turbines should be brought on line progressively, and at a rate that will result in a relatively gradual increase in discharge from the tailrace and equally gradual increase in flow rate and water levels in the lower palaeochannel.

## 7.4 Construction Phase Environmental Management Plan

This section provides detailed recommendations aimed at mitigating negative impacts and enhancing benefits associated with the construction phase of the project life cycle. Specific requirements aimed at mitigating the various environmental and social impacts identified during the EIA process have been included. As described in chapter 2 of this report it should be noted that flexibility is allowed in the development and implementation of the specific mitigation measures, to accommodate working procedures proposed by the contractor. These requirements will, where possible, be incorporated into the relevant management plans referred to under the framework requirements. Alternatively, they may be incorporated into other forms of instructional documents such as Standard Operating Procedures (SOPs) or Method Statements for specific activities.

**Table 7.1: Construction Environmental Management Plans**

Spatial scale of impact	Sources of Impacts	Mitigation Measures
<b>Impact category - Agriculture</b>		
Localised	Reduction of agricultural potential	<p>The loss of agricultural potential could be influenced by three project activities:</p> <ol style="list-style-type: none"> <li>1. The sterilisation of agricultural potential by the project footprint</li> <li>2. Disruption of the soil profile and vegetation</li> <li>3. Changes in the river level and flow due to weir construction and water extraction</li> </ol> <p>Since the agricultural potential of the site is considered to be very low, losses caused by the main structural elements of the project (offtake structure, headrace, headpond, power station headworks) will not be significant.</p> <p>Hydraulic simulations in the river channel upstream of the diversion weir indicate that increased water levels will extend for a distance of about 3km upstream of the weir, and will not adversely affect irrigation or drainage infrastructure in any island or river bank areas upstream of the weir.</p> <p>The route alignment of the 132 kV overhead power line could cause the loss of agricultural production if it affects irrigated land. Consultation with affected land owners will be required to minimise impacts in this regard.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Landowners should be consulted for their input into the best placement of pylons.</li> <li>• Place all pylons off irrigated land, or if not possible, place between or at the edges of existing land units so as to have minimal disturbance of irrigated land.</li> <li>• Store topsoil separately for re-use later during site rehabilitation.</li> </ul>
<b>Impact category – Aquatic Ecology</b>		
Project area	Destruction of aquatic ecology	<p>The construction of infrastructure in an ecologically sensitive habitat will cause significant disturbance, but, on completion the overall significance of this impact is considered to be localized and temporary. With proper site reinstatement the significance of the impacts will not carry over into the operations phase (see operations phase analysis for further details pertaining to this infrastructure development).</p>

Spatial scale of impact	Sources of Impacts	Mitigation Measures
		<p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• The construction footprint must be as small as possible.</li> <li>• Indiscriminate habitat destruction must be avoided.</li> <li>• Proper site and habitat reinstatement must be implemented during site rehabilitation following the completion of construction. In particular, the substrate of the channel must be restored to as near as possible its pre-construction state in order to restore as much as possible of the previously-usable habitat. For instance, a pre-construction habitat comprising cobbles and rocks must be restored to the same type of substrate.</li> </ul>
Project area	Destruction of local watercourses and side tributaries to accommodate the construction of the headrace	<p>The region is considered arid and the Orange River represents one of the very few perennial watercourses. Steep and undulating topography means that there are many surface water drainage lines that convey water towards the river during rainfall events. Since no water is retained in the watercourses they are not regarded as aquatic habitat, but they do carry water, and are prone to erosion and sediment transport. Soils are generally loose and unstructured, and are vulnerable to the effects of erosion. Further disturbances will merely aggravate the effects of erosion.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Minimise the time during which excavations through water courses are left open: backfill excavations and reinstate drainage lines as soon as possible.</li> <li>• Avoid vegetation disturbance and removal in the catchment areas of the drainage lines.</li> <li>• Install appropriate erosion control measures to contain and limit sediment runoff towards the river.</li> </ul>
Regional	Reduction of water volume flowing over the Augrabies Falls to accommodate the hydropower scheme.	<p>In order for the hydropower scheme to function, a portion of the water in the Orange River will be diverted from the main channel that flows towards the Augrabies Falls through the headrace to the power station. This will deprive the aquatic habitat in an approximately 10km-long reach of the river of a portion of the river flow. Diversion of flow to the power station will not commence until the river flow rate reaches 30 m<sup>3</sup>/s, and the diversion of a maximum of 38 m<sup>3</sup>/s to the power station will increase progressively until the river flow reaches 90 m<sup>3</sup>/s. (It is acknowledged that flow rates lower than this could occur due to management of upstream impoundments, upstream abstraction, or natural low season flows.) This diversion protocol is sufficient to maintain the ecological functionality of the watercourse. Downstream of the falls the watercourse constricts to a narrow gorge, which requires relatively less water for maintenance compared with the braided channel above the falls. The impact of the flow diversion is not considered to be of major significance. The hydropower scheme is not a consumptive user, as diverted water is returned to the main channel downstream of the gorge. The impact of the project on downstream users of the river will be negligible.</p> <p><b>Mitigation measures</b></p> <ul style="list-style-type: none"> <li>• Adhere strictly to the agreed minimum flow rate in the Orange River at which diversion of flow to the power station may commence, and adhere to any Conditions attached to the Water Use Licence.</li> <li>• Adhere strictly to the agreed schedule for increasing the diversion of flow to the power station up to the maximum rate of diversion.</li> <li>• Establish and implement, in conjunction with SANParks staff, an emergency shutdown procedure for the diversion of flow to the power station.</li> </ul>

Spatial scale of impact	Sources of Impacts	Mitigation Measures
Regional	Contamination of surface waters	<p>Leakage of hazardous materials such as hydrocarbons (fuel and lubricants) and chemicals from storage areas, and areas where vehicles and plant are refuelled, serviced and washed, can result in the pollution of soils and groundwater, and washoff of pollutants into watercourses. Poorly managed sewage and lack of proper ablution and toilet facilities can result in human waste polluting surface and groundwater sources. This can lead to the loss of aquatic biota.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• All hazardous materials must be stored only in designated areas, which are properly secured, and banded to contain any potential leakage into the environment.</li> <li>• Construction vehicles and plant should be properly serviced, on impervious surfaces, to avoid fluid leaks.</li> <li>• Leakage and spillage of hazardous materials must be cleaned up immediately they occur, using appropriate spill kits, which must be readily available at all times at all sites and locations where hazardous materials are stored or used.</li> <li>• Proper management of sewerage systems and sewage must be practised to avoid contamination of soil, groundwater and surface waters through untreated sewerage.</li> </ul>
Regional / Project area	<p>Impacts on riparian vegetation:</p> <ul style="list-style-type: none"> <li>• Decrease in filtration of runoff.</li> <li>• Loss of biodiversity</li> <li>• Decreased flood attenuation capacity</li> </ul>	<p>Development activities will affect only a small section of the riparian vegetation on the north bank of the river. However, since the riparian vegetation is Lower Gariep Alluvial Vegetation, which is listed as a threatened ecosystem in a Government Notice published in terms of the NEM: Biodiversity Act, measures must be taken to protect it.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Removal of riparian vegetation must be minimised.</li> <li>• Indiscriminate destruction of riparian habitat must be avoided</li> </ul>
Project area	Increased rate of erosion from soil stripping, soil compaction, soil stockpiles and vegetation removal	<p>Soil stripping, soil compaction and vegetation removal will increase rates of surface runoff, and therefore erosion and entry of sediment into the general aquatic ecosystem. Erosion and transport of sediment into watercourses can result in smothering of rock and cobble substrates, with consequent displacement or mortality of aquatic species.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Erosion must be strictly controlled through the utilization of measures such as silt traps, silt fencing and gabions, especially where surface gradients are steep.</li> </ul>
<b>Impact category – Vegetation</b>		
Localised	The intake facility	<p>The intake facility will require construction of a weir that will require removal of vegetation in the riparian zone (Lower Gariep Alluvial Vegetation – a declared threatened ecosystem), but at a localised scale.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• The river banks around the weir and abstraction point should be reshaped immediately after construction is</li> </ul>

Spatial scale of impact	Sources of Impacts	Mitigation Measures
		<p>completed, and steps taken to re-establish riparian vegetation.</p> <ul style="list-style-type: none"> <li>Young trees of species such as <i>Acacia karroo</i>, <i>Searsia pendulina</i> and <i>Euclea pseudebenus</i> should be cultivated in a nursery and re-introduced to disturbed areas at the site after construction, under the guidance of a restoration ecologist.</li> </ul>
Localised	<ul style="list-style-type: none"> <li>Route of the headrace, underground power cables, haul roads and access roads.</li> <li>Sites of the headpond, forebay and , power station headworks</li> </ul> <p><b>Note:</b> Impacts on vegetation along the route of the 132kV overhead power lines are addressed under Agriculture</p>	<p>The headrace will be aligned roughly parallel to a side channel of the Orange River. The conduit will traverse mostly Bushmanland Arid Grassland, which is not botanically sensitive, <u>except</u> for the presence of <i>Acacia erioloba</i> (camel-thorn) trees in some places. These trees are nationally protected. If any are on the proposed conduit route, application for permits would be required to remove them. The cables required to evacuate power from the power station will be buried for much of its route in the same trench as the headrace. There will, be a relatively short section of cable, from the site of the offtake structure to the boundary of the AFNP, that requires a separate excavated trench, albeit very much narrower than the one required for the headrace.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>Restricted construction zones must be delineated and marked, beyond which no access should be permitted.</li> <li>Implement post-construction rehabilitation of vegetation in disturbed areas as soon as possible after construction is completed.</li> <li>No foreign plant species, such as foreign grass species, should be brought into the environment and used for rehabilitation.</li> <li>No hydro-seeding with grass-seed mixes of plant species not found locally should be permitted.</li> <li>Measures should be taken to ensure that invasive alien shrubs, particularly mesquite (<i>Prosopis glandulosa</i> var. <i>glandulosa</i>) are not introduced to disturbed sites.</li> <li>In the arid environment that will be impacted, rehabilitation will take a long time. The area must be monitored for at least four years after construction to assess the success of the rehabilitation, and to ensure that any invasive plants and shrubs are eradicated.</li> </ul>
<b>Impact category - Fauna</b>		
Localised	Loss of biodiversity:	<p><b>Amphibian diversity</b></p> <p>There are fewer species of amphibians in the concession area than any other group of terrestrial vertebrates. However, frogs, along with bats and lizards are important predators of insect pests. (In 1996 blood-sucking blackflies, particularly <i>Simulium chutteri</i>, caused R88 million damages in the middle and lower Orange River.) Habitat loss and mortalities directly associated with project actions will probably result in a loss of amphibian diversity. Amphibian mortalities will occur during all project phases, but will be most significant during construction because of habitat loss, particularly if wetlands are affected. The Marbled Rubber Frog (<i>Phrynomantis annectans</i>) requires temporary water bodies for tadpole development, and breeding sites in the Power House region must therefore be avoided.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>Avoid clearing or damaging wetlands, and limit river and stream crossings for any purpose as far as</li> </ul>

Spatial scale of impact	Sources of Impacts	Mitigation Measures
		<p>possible. Associated infrastructure, particularly transport linkages, should avoid these areas with a buffer distance of at least 30 m if possible.</p> <ul style="list-style-type: none"> <li>• Wetlands must be protected and/or rehabilitated if damaged.</li> <li>• Water quality and flow dynamics should be maintained.</li> </ul>
Localised	Loss of biodiversity:	<p><b>Reptile diversity</b> The project area probably contains a greater diversity of reptiles than discovered during the site survey. Reptile populations, particularly snakes, are difficult to study. Increased human numbers associated with the development of the project will lead to increased mortality of reptiles, particularly tortoises and snakes, directly from road mortalities and human attitudes (that is, that they are dangerous or nuisances, and should be killed) as well as the losses from habitat loss and fragmentation. All reptiles recorded on, or likely to occur on the RVM1 project area also occur in the AFNP, where they remain fully protected.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Avoid clearing or damaging pristine (unaltered) habitats, particularly in the riverine zone.</li> <li>• Protect abiotic (non-living) habitats such as rock outcrops, which shelter many reptile species, by prohibiting access to these areas.</li> <li>• Limit unnecessary night driving on roads during construction.</li> <li>• Prohibit exploitation of sensitive reptiles, such as tortoises and chameleons by construction staff, and levy penalties for transgressions.</li> <li>• Educate construction staff about the necessity of protecting snakes.</li> </ul>
Localised	Loss of biodiversity:	<p><b>Bird diversity</b> There is a greater number of bird species in the region than any other group of vertebrates. Birds play important and diverse roles in ecosystem functioning (such as seed dispersal). Maintenance of viable habitats for birds is therefore important to maintain bird diversity. Although a few bird species can rapidly and successfully adapt to disturbed environments, the majority of birds are sensitive to disturbance and either migrate away from degraded habitats, or suffer greater mortality within them. However, because of their high mobility, birds are capable of rapidly re-colonising rehabilitated habitats, provided suitable microhabitats are available. All birds recorded on, or likely to occur on the RVM1 project area also occur in the AFNP, where they remain fully protected.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Prior to commencing construction activities, conduct a survey of the affected area to identify active and potential breeding sites for Verreaux's Eagle, Lanner Falcon, Secretary bird, Kori Bustard, Ludwig's Bustard, and Black Stork, and, as far as possible, avoid disturbing them.</li> <li>• Avoid clearing or damaging pristine (unaltered) habitats, particularly the riverine zone which shelters the highest bird diversity.</li> <li>• Maintain habitat connectivity, particularly to protected areas, by maintaining habitat corridors.</li> <li>• Wherever possible undertake habitat clearance during winter when birds are not breeding.</li> </ul>
Localised	Loss of biodiversity:	<p><b>Mammal diversity</b> The long history of human settlement, associated with subsistence and later commercial farming, has greatly</p>

Spatial scale of impact	Sources of Impacts	Mitigation Measures
		<p>reduced the presence of large mammals in the region. A number of large mammals, the populations of which were previously completely hunted out in the region have been re-introduced, whilst several large predators such as leopard and brown hyena have probably increased in number during the period of management of the Riemvasmaak property by SANParks. The maintenance of these animals, as well as smaller mammals, depends on the continued conservation management and the maintenance of habitat corridors and habitat diversity. All mammals recorded on, or likely to occur on the RVM1 project area also occur in the AFNP, where they remain fully protected.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Avoid clearing or damaging wetlands, and limit river and stream crossings as far as possible. Associated infrastructure, particularly transport linkages, should avoid these areas with a buffer distance of at least 30 m if possible.</li> <li>• Wetlands must be protected and/or rehabilitated if damaged.</li> <li>• Water quality and flow dynamics should be maintained.</li> </ul>
Study area	Loss of biodiversity:	<p><b>Loss of Species of Conservation Concern</b></p> <p>Numerous birds, reptiles and mammal species are either endemic to the region or are species of conservation concern (SCC). Two characteristic reptiles, the Augrabies Flat Lizard and Augrabies thick-toed Gecko are charismatic Near Endemics, whilst the Marbled Rubber Frog is a habitat specialist with only a marginal presence in South Africa.</p> <p>Fourteen of the possible 247 bird species in the region are threatened or near threatened globally or regionally. The most significant avian SCC recorded on site, either during the faunal survey or elsewhere, include Ludwig's Bustard (Endangered -EN), Secretary Bird (Vulnerable -VU) and Black Harrier (VU). Fifteen bird species are regional or biome endemics.</p> <p>Of the 72 terrestrial mammal species which may occur on site, only one is threatened (Hartmann's Mountain Zebra - VU), whilst another was reintroduced but has been relocated (Hook-lipped Rhinoceros – Critically Endangered - CR), and another may be present (Small Spotted Cat - VU). A number of other mammals are Near Threatened (Dassie Rat, Honey Badger and Brown Hyena), but no species are Endemic or Near Endemic to the region.</p> <p>All SCCs recorded on, or likely to occur on the RVM1 project area also occur in the AFNP, where they remain fully protected.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Avoid clearing or damaging pristine habitats if possible.</li> <li>• Maintain habitat connectivity, particularly to intact habitats, via habitat corridors.</li> <li>• Protect habitats such as rock outcrops, which shelter many small faunal species, including reptiles and bats.</li> <li>• The design of project structures and transport linkages should avoid where possible sensitive habitat corridors, such as drainage lines and wetlands.</li> <li>• Road designs should incorporate underpasses and culverts that allow the movement of animals where these are indicated to be necessary by a faunal specialist.</li> </ul>



Spatial scale of impact	Sources of Impacts	Mitigation Measures
		<ul style="list-style-type: none"> <li>• Where possible road traffic in the project area should be limited after dark to absolutely necessary trips , as much of the surviving fauna is nocturnal – such as bats, most snakes, small rodents, amphibians.</li> <li>• Vehicle speed in the project area should be limited to the lowest possible, and should not exceed 50km/h.</li> <li>• Drivers should be educated regarding their role in impacting on animals and the need to minimize collisions with animals at all times.</li> </ul>
Localised	Habitat loss and fragmentation	<p><b>Impacts on fauna due to habitat fragmentation and loss</b></p> <p>Various components of the development will cause biodiversity loss directly or indirectly through fragmentation of viable habitats for the various faunal groups. This is usually a loss of vegetation (plant communities) that supply food or shelter, but may include abiotic features such as the loss of temporary wetlands, caves or rocky outcrops.</p> <p>Impacts to sensitive habitats are highly probable and will be local and negative in nature, and occur over the long-term. The significance of these impacts may vary from low to high depending upon the local importance of the habitat and the particular fauna that it harbours.</p> <p>The proposed transport linkages and associated infrastructure will all cause additional habitat loss and fragmentation, over and above the project footprint. The greatest impact on habitat loss and fragmentation will be associated with the haul roads, and less so with the proposed headrace from the weir to the power station. The location of the proposed weir is in a region of riverine habitat and Lower Gariep Alluvial Vegetation, and access and construction of the weir should avoid where possible all riverine vegetation.</p> <p>The most sensitive region will probably be the construction and rehabilitation of a haul road down the steep sides of the 'Canyon Zone' into the lower palaeochannel in order to allow drilling of the horizontal tailrace tunnel. As the descent into the lower palaeochannel is very steep it may not be possible to fully rehabilitate this track, particularly as it may be required for access to the tunnel entrance during the operation phase. Two routes have been proposed, both traversing the walls of the Canyon zone below the palaeofalls. Option 2 is shorter and does not cross the 'upper palaeochannel' above the 'palaeofalls' and is thus the preferred option. However, the design and construction of these haul road options have not been detailed, and either option is likely to result in a permanent impact (in terms of the project life) that cannot be mitigated in a region highlighted as Sensitive in the AFNP Management Plan 2013-203.</p> <p><b>Mitigation measures:</b></p> <p>The negative impact of habitat loss associated with the development of the project cannot be fully mitigated. But the following can assist in reducing the severity of the impact:</p> <ul style="list-style-type: none"> <li>• All specific project actions associated with construction, access roads, borrow pits and cut-and-fill construction must avoid sensitive habitats as far as is practicable.</li> <li>• Natural drainage should be maintained, and construction activity should not result in increased silt loads into rivers, streams and wetlands.</li> <li>• Avoid clearing or damaging pristine habitats where possible.</li> <li>• Maintain habitat connectivity, particularly to intact habitats, via habitat corridors. The excavation of the headrace will form a linear impact, and this should be undertaken in sections. This will allow faunal migration (for access to water access, for instance) across rehabilitated sections before construction begins on</li> </ul>



Spatial scale of impact	Sources of Impacts	Mitigation Measures
		<p>adjacent sections.</p> <ul style="list-style-type: none"> <li>• Protect abiotic habitats, such as rock outcrops, which shelter many small faunal species, including reptiles and bats.</li> <li>• The design of project structures and transport linkages should avoid where possible sensitive habitat corridors, e.g. drainage lines and wetlands.</li> <li>• Mitigation of the impact entails protection and where necessary, rehabilitation of adjacent habitats as an environmental offset particularly wetland and riparian habitats.</li> </ul>
Localised	Ecological impacts from dust	<p>Increased dust levels are common during construction especially from habitat clearance and increased vehicular traffic. Short-term increased dust levels will accompany all land preparation associated with construction.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• As most access roads will be rehabilitated after the construction phase, the impact cannot be mitigated by hard paving. It is suggested that the area is watered during high wind conditions, or treated with an approved dust suppressant.</li> <li>• Vehicle speed should be limited to the lowest possible, and should not exceed 50km/h.</li> <li>• Any small particulate material to be transported that is likely to be blown off during transit should be in covered trucks or containers to avoid contamination to the surrounding area.</li> </ul>
Study area	Disruption to fauna from increased noise levels	<p>Construction and associated vehicle traffic will create noise pollution that can depress local populations of sensitive faunal groups. Animals differ in the degree to which they tolerate such disturbance, and noise can be expected to have potentially negative and positive impacts on various faunal groups. Large breeding birds do not usually tolerate continuous disturbance. Increased noise and motor vibrations in wetlands may also impact amphibian breeding choruses, but these impacts will be localised and many amphibian species are surprisingly tolerant of vehicle noise. Noise pollution will occur during all phases (construction, operational, and decommissioning /closure). Mitigation of this impact is difficult, but noise reduction measures should be implemented in all</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Ensuring that silencers on all vehicle exhaust systems are intact and maintained in good condition, and static plant items such as compressors and breakers are fitted with effective mufflers or other noise reduction equipment. Noise reduction measures are especially important in sensitive areas (adjacent to wetlands, for instance) and at sensitive times (at night, for instance).</li> <li>• Construction activities after dark should be strictly controlled, limited to unavoidable circumstances, and undertaken only by arrangement with park management.</li> </ul>
Localised	Impacts from chemical pollution	<p>Many faunal groups are sensitive to pollutants. Lead concentrations are higher in small terrestrial mammals collected alongside roads than in bats caught in the same areas. Frog diversity in ponds affected by pollution from road run-off is depressed and the accumulation of herbicides and their residues in adjacent wetlands can lead to developmental abnormalities in tadpoles and metamorphosing froglets and also masculinization of female frogs.</p> <p>Pollution may result from periodic accidents, or from a slow, ongoing contamination. During the construction</p>

Spatial scale of impact	Sources of Impacts	Mitigation Measures
		<p>phase heavy mechanical equipment and vehicles will be present. The use of inflammable liquids such as diesel will probably result in periodic accidents. Heavy vehicle traffic is also associated with increased local pollution resulting from exhaust fumes, oil spillage and accumulation of rubber compounds from tyre wear. These pollutants can cause localised impacts.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Storage facilities for chemicals, particularly diesel, should not be situated in regions subject to flooding.</li> <li>• Such stores should be bunded so that in the event of spillage their contents run immediately into large catchments for decontamination.</li> <li>• The application of herbicides or insecticides to control plant growth or insect pests should be prohibited.</li> </ul>
<b>Impact category - Heritage</b>		
Localised	Archaeological heritage resources	<p>By far the most significant impacts to archaeological resources will occur along the route of the headrace, which runs approximately parallel to secondary river channel and where there is evidence of many small campsites that likely relate to pastoralist people. The sites are fragile and very easily disturbed. Mitigation will be required where the sites cannot be avoided.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• A Chance Find procedure must be developed that sets out the procedures that must be followed when it is suspected that project activity, especially ground clearance and excavation, has encountered or uncovered archaeological resources. The procedure must address alerting a qualified archaeologist of the find, inspection of the site, formal excavation and collection of archaeological materials, analysis of the finds and radiocarbon dating of the sites.</li> </ul>
Localised	Impacts on grave sites	<p>Apart from the few known graves and the single graveyard (which is fenced around, clearly identifiable as a graveyard, and not on the alignment of any structure), there are a large number of features on the landscape that may be graves. These will need to be carefully assessed when final alignments and disturbance corridors have been determined and it is suggested that every stone feature of unknown function that will be disturbed should be tested by an archaeologist to see if it is a grave.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• All known graves should be avoided unless the community authorises exhumation and reburial. The Riemvasmaak community members need to be made aware of this issue and should be requested to issue a statement indicating their wishes for the deceased should any such features turn out to be graves.</li> <li>• An attempt should be made before further planning progresses to identify any other graves known to the community and which are not clearly identifiable today (these would include all the stone mounds recorded during the present survey).</li> <li>• In such instances where the remains have to be exhumed, a plan needs to be in place as to the procedures for and location of re-interment.</li> <li>• During the planning of the development the client should be accompanied on site by community members</li> </ul>

Spatial scale of impact	Sources of Impacts	Mitigation Measures
		<p>such that any stone mounds that are known to be graves can be flagged and protected without further disturbance.</p> <ul style="list-style-type: none"> <li>• A final walk-down survey should be undertaken once final (and accurate) alignments are known. The spatial extent of the impacts (disturbance corridor) will also need to be indicated prior to this survey. Note that it may not be necessary for all areas to be rechecked – this can be determined through comparison with the survey tracks used in the heritage resources study.</li> <li>• Known graves, or stone cairns that are believed could be graves, that will not be directly impacted by any infrastructure should be fenced around before construction activities commence to protect them from damage.</li> </ul>
Localised	Impacts on cultural landmarks	<p>The cultural landscape here is not deemed highly significant for two reasons. One is that it is not very old and the other is that the community that created it has given its permission for the proposed development to go ahead through the areas once inhabited by them and their predecessors.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• It is desirable that the proposed development attempt to avoid all the main historical features (like house ruins and large collections of stone features) in order to try to retain the cultural landscape in as intact a form as possible, but it is acknowledged that many of the smaller – and often isolated – features make very little contribution to the cultural landscape and could be removed (subject to testing for graves). Besides avoidance where possible, no other mitigation is suggested for the cultural landscape.</li> </ul>
Regional	Impacts on the heritage of the AFNP	<p>This impact is largely visual.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Cables should be underground as far as possible,</li> <li>• The sizes of above-ground structures should be minimised, and architectural treatments should be as sympathetic as possible with the surrounding environment</li> <li>• Any lighting necessary must be as muted as possible concomitant with safety and security considerations.</li> </ul>
<b>Impact category - Noise</b>		
Study area	Noise impact	<p>The construction phase is estimated to have duration of three years. Generally, day-time noise levels associated with construction activities is limited to an area within 500 meters from the activity. The nature of the noise is generally more impulsive and in a sensitive natural environment animals will try to relocate further from the noise source. Sources of potential noise impact during construction may include, inter alia, construction and or upgrade of access roads, laying of concrete foundations and other concrete work, installation of power chambers, construction of power lines and other housing infrastructures; use of equipment required to complete the construction and blasting, which may be required as part of the civil works to clear obstacles or to prepare foundations.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Make use of the smallest available equipment for the task;</li> </ul>

Spatial scale of impact	Sources of Impacts	Mitigation Measures
		<ul style="list-style-type: none"> <li>• Notify potentially sensitive receptors about work to take place at least 2 days before the activity in the vicinity (within 500 meters) of the receptor is to start. Following information to be presented in writing:                             <ul style="list-style-type: none"> <li>○ Description of Activity to take place;</li> <li>○ Estimated duration of activity;</li> <li>○ Working hours;</li> <li>○ Contact details of responsible party.</li> </ul> </li> <li>• Ensure that all equipment is maintained and fitted with the required noise abatement equipment;</li> <li>• When any noise complaints are received, noise monitoring should be conducted at the complainant, followed by feedback regarding noise levels measured;</li> <li>• The construction crew must abide by the local by-laws regarding noise, and if no local by-laws exist comply with “Draft model air quality management by-laws for adoption and adaptation by municipalities, GN 964 of 2009” (section 2.6);</li> <li>• Under normal circumstances construction work should be undertaken during normal working hours (06H00 – 18H00), from Monday to Saturday. These hours may be extended only by agreement with all surrounding sensitive receptors, including the Management of the AFNP.</li> </ul>
<b>Impact category – Socio-Economic and Tourism</b>		
Localised	Land acquisition	<p><b>Permanent loss of land</b></p> <p>As a result of the proposed project, there will be no permanent loss of land experienced by SANParks or the RCT. While the project area may be temporarily classified as a ‘No-Go’ area, this should not be an issue, as that particular section of the park is not currently open to the public. However, there will be a permanent loss of land associated with the substation to be constructed on private land adjacent to the AFNP. The maximum footprint of the substation will be 50x50m. The proposed site is not currently being used for any economic activity and, therefore, there should be no significant financial loss as a result of the loss of land.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• There should be sufficient consultation with the affected landowners;</li> <li>• Landowners should be compensated for any permanent loss at market value</li> <li>• Landowners should be compensated for any temporary loss to land.</li> </ul>
Localised	Land acquisition	<p><b>Temporary Disruption to Farming Activities</b></p> <p>Power will be evacuated via a 33kV underground transmission line across Farms 498/1 and Rem 497 (see Figures 3.2). Once beyond the boundary of Farm Re 497 the voltage is stepped up to 132kv via a new substation / transformer and becomes an overhead line for the remainder of the route to a point on the south side of the river where it connects to the existing Eskom Renosterkop – Blouputs line From aerial imagery and observations during fieldwork, it is evident that the majority of the proposed alignment is through land not currently under cultivation and without existing transmission line infrastructure. There is, however, a section of approximately 1.3km where the proposed route will go through land used for grape cultivation. During construction, there will be a temporary disruption to farming activities in this area. However, with mitigation measures, no losses should be incurred.</p>

Spatial scale of impact	Sources of Impacts	Mitigation Measures
		<p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Ensure there is sufficient consultation with affected landowners;</li> <li>• Ensure that affected landowners are informed well in advance prior to any construction taking place on their land;</li> <li>• Endeavour to conduct construction activities associated with transmission lines out of season and not during peak growing or harvesting time so that disruptions are kept to a minimum;</li> <li>• Where possible, align transmission lines in existing servitudes</li> <li>• Ensure that landowners are compensated for any temporary loss to land and/or damages to infrastructure or crops caused during the construction process.</li> </ul>
Regional	Local economic development	<p><b>Employment opportunities</b>                      During the approximately 3-year construction phase between 150 and 200 temporary jobs will be created for local people. Of these, approximately 75% will be skilled or semi-skilled positions, whereas 25% will be unskilled workers. This is a significant impact, coupled with high levels of unemployment, as the expectation of employment opportunities is high in the region.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• A local Community Liaison Officer (CLO) should be appointed in order to mediate between the employer and the employees;</li> <li>• Employment opportunities should be provided to the RCT;</li> <li>• Ensure that the requirements set out by the IPPP process are strictly adhered to;</li> <li>• Consult with local government and community organisations regarding the hiring of local labour;</li> <li>• Endeavour to train and employ local people as far as is feasibly possible;</li> <li>• Embark on skills development training for potential employees from local communities</li> <li>• Maintain clear lines of communication between the project proponent and local communities regarding employment opportunities.</li> </ul>
Regional	Local economic development	<p><b>Stimulating Small, Medium and Micro Enterprises</b>                      The project will create opportunities for Small, Medium and Micro Enterprises (SMMEs) in the region. Services which could be provided by local SMMEs may include road maintenance, removal of spoil material, provision of accommodation, provision of meals, etc.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Identify which services could be supplied by local SMMEs and contractors;</li> <li>• Identify SMMEs and contractors who could supply the required services in consultation with local government and community organisation</li> <li>• Endeavour to employ local contractors and SMMEs as far as is feasibly possible.</li> </ul>
Localised	Local economic development	<p><b>Increase in Informal Traders</b>                      Although it is unlikely that informal traders will be present at the construction site, opportunities will exist for</p>

Spatial scale of impact	Sources of Impacts	Mitigation Measures
		<p>informal traders in the vicinity of where the construction team is accommodated. This will lead to a temporary source of income for local households and indirectly increase money in the local economy, albeit by a small amount.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• In conjunction with the local municipality ensure that refuse disposal facilities are available.</li> </ul>
Localised	Local economic development	<p><b>Tourism</b></p> <p>It should be noted that the Augrabies Falls is a significant tourism destination within the Northern Cape. Furthermore, while the falls may not be the primary reason for tourists being in the area, many tourists pass through the area en route to Namaqualand or Namibia, and if in the area, these tourists invariably visit the AFNP. The construction activities of the project might have an effect on tourism in terms of the following impacts noise, visual, dust or sense of place.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Ensure that all project activities are carried out in such a manner so as to reduce the visual impact;</li> <li>• Avoid construction after daylight hours;</li> <li>• Advanced warning should be provided to landowners and the AFNP prior to any blasting taking place;</li> <li>• Ensure that strict speed limits are adhered to by all project vehicles to reduce dust;</li> <li>• Ensure strict adherence to the agreed protocol for flow diversions from the Orange River into the power station to ensure maintenance of flow to the Augrabies Falls.</li> </ul>
Regional	Health and safety	<p><b>Spread of diseases</b></p> <p>As the majority of labour will be sourced from the surrounding communities, the spread of diseases should be limited as the number of outside workers should be small. Still, job-seekers are expected, who can contribute to an increased likelihood of spread of disease. While the impact is not thought to be significant, it should be taken into consideration and the necessary mitigation measures followed.</p> <p>An increase in the spread of diseases and, in particular, HIV/Aids, is also likely to be caused by the movement of trucks carrying construction materials moving in and out of the project site. While it has not been confirmed where the required construction materials will be sourced, it is likely that there will be a significant increase in truck traffic through towns such as Augrabies, Marchand and Kakamas as well as other towns en route to the project site.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• An HIV/Aids awareness/education component should be included in the induction programme for all personnel working on the proposed project</li> <li>• Ensure there is easy access to HIV/Aids-related information and condoms for all workers involved with the proposed project.</li> </ul>
Regional	Health and safety	<p><b>Increase road accidents</b></p> <p>An anticipated increase in vehicle traffic along the access road is significant. It is assumed that there will be a significant increase in the volume of traffic on the access road linking the N14 to the study site. The current road</p>

Spatial scale of impact	Sources of Impacts	Mitigation Measures
		<p>is a gravel/sand road, which is not heavily utilised. This could lead to an increase in road accidents. A section of the road is currently used by people travelling to and from the Riemvasmaak Community as well as by farmers and farm workers living and working in the area. The road has not been designed to take high volumes of traffic or for use by heavy duty vehicles required for the transportation of large pieces of equipment such as pipes, generators, etc. associated with the project. In addition, the road is often used by slow moving farm machinery such as tractors as well as by pedestrians</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Considering the remote nature of the project site and the limited access to healthcare facilities, it is important that emergency healthcare facilities are available on site and that there is a suitable evacuation plan in the event of serious and/or life threatening injuries;</li> <li>• Develop a traffic management plan, including maximum speed limits dependent on the type of vehicle;</li> <li>• Ensure that access roads are maintained in a good condition at all times and is not allowed to deteriorate;</li> <li>• Prior to construction commencing, ensure that the public road to the site road is widened to a suitable width</li> <li>• All drivers should be briefed regarding the traffic management plan.</li> </ul>
Localised	Health and safety	<p><b>Increased dust generation</b></p> <p>During construction, it is likely that there will be a significant amount of dust generated through various activities, which, in turn, will have a negative impact on the surrounding environment. Some of these activities include, but are not limited to:</p> <ul style="list-style-type: none"> <li>○ Soil/sand stockpiles;</li> <li>○ Trenching activities for the laying of underground pipelines and transmission lines;</li> <li>○ Blasting;</li> <li>○ Windblown dust</li> <li>○ Increased vehicle traffic along the access road (the current road is a gravel/sand road).</li> </ul> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Dust on the public road to the site and on the construction site should be controlled by means of water spraying or approved dust suppressants, especially during windy conditions.</li> <li>• Speed limits should be strictly enforced.</li> <li>• Farmers using the public road to the site should be consulted prior to the road being used by high volumes of construction traffic to determine overlaps with high volumes of agricultural traffic, and to identify the need for additional safety measures.</li> <li>• Ensure that strict speed limits are adhered to by all project vehicles to reduce dust.</li> </ul>
Localised	Health and safety	<p><b>Fire hazards</b></p> <p>Construction activities are often associated with fire risks. These could result from exposed fires for cooking and warmth, cigarettes, burning of firebreaks, and the use of flammable liquids. The dry and hot conditions associated with the project site make the area particularly vulnerable to fire. Uncontrolled fires may lead to the loss of wild game in the AFNP, as well as undesirable visual impacts for tourists in the AFNP.</p>



Spatial scale of impact	Sources of Impacts	Mitigation Measures
		<p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>No fires must be allowed on site, and penalties must be imposed for transgressions.</li> </ul>
Localised	Health and safety	<p><b>Increase in criminal activity</b>                      Prior to and during construction, the in-migration of job-seekers is likely to bring with it criminal opportunists. Although the relatively remote nature of the project site is likely to limit the likelihood of criminal activities in the direct vicinity of the project site, it should be noted that one of the issues which came out of discussions with Riemvasmaak community members is the need to ensure that there is no poaching of game in and around the AFNP and the land owned by the RCT.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>Housing the construction workers within Kakamas town should greatly reduce the possibility of an increase of criminal activities;</li> <li>Construction teams should be clearly identified by wearing uniforms and/or wearing identification cards that should be exhibited in a visible place on their body;</li> <li>Construction workers should be accommodated in a nearby town and not on site;</li> <li>Instant dismissal and prosecution of any staff caught in criminal activities of any kind, including the poaching of plants and animals;</li> <li>Establishment of a Community Management and Monitoring Committee (CMMC) to act as a communication link between the local community and the project proponent, in this case, in relation to criminal activity</li> <li>Inform local law enforcement agencies of the possibilities of increased criminal activity in the area.</li> </ul>
Regional	Social services	<p><b>Increased pressure on existing social infrastructure</b>                      Construction workers are to be housed in formal accommodation either in Kakamas town or between Kakamas and the project site. However, there is the possibility that a temporary influx of construction workers into these towns or the surrounding area could place increased pressure on the existing service infrastructure, including water and electricity supply, and sanitation systems. In addition, road infrastructure is also likely to be negatively impacted as a result of the project.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>If feasible, excess spoil excavated as part of the proposed project be donated to the provincial roads authority or the district and local municipalities to use for the upgrading of roads in the area. This material can, therefore, be used to upgrade and/or maintain the gravel roads that might be negatively affected by the proposed project;</li> <li>Upgrading and maintenance of road infrastructure before construction</li> <li>Establishment of a CMMC to act as a communication link between the local community and the project proponent, in this case, in relation to damaged infrastructure.</li> </ul>
Localised	Cultural heritage	<p><b>Sense of place</b>                      The project site is one of significant historical and cultural value to the Riemvasmaak community. There are a number of historical artefacts within the project site, in particular, graves and ruins of buildings. During discussions with members of the Riemvasmaak community, there is little concern regarding the proposed</p>



Spatial scale of impact	Sources of Impacts	Mitigation Measures
		<p>development as long as there is no damage to the existing graves, historical artefacts and other areas of cultural significance to the Riemvasmaak community.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Ensure that areas of cultural heritage and areas of historical significance are clearly identifiable and avoided by project staff;</li> <li>• Areas of cultural heritage and historical significance should be clearly demarcated prior to construction;</li> <li>• Construction workers should be briefed about the importance of remaining clear of areas of cultural heritage and historical significance;</li> <li>• Fines should be imposed on contractors and or construction workers found to be damaging areas of cultural heritage and historical significance;</li> <li>• In the event of chance finds, all work in the area of the find is to cease and SAHRA is to be contacted to provide direction on a way forward;</li> <li>• Ensure that the construction site is left in a tidy manner at the close of work every day;</li> <li>• Ensure that efforts are made to reduce the visibility of construction materials through the use of camouflaged netting and/or tarpaulins;</li> <li>• All visible infrastructure should be constructed in such a way so as to reduce the visual impact;</li> <li>• A Chance-Find Procedure should be developed for the construction phase;</li> <li>• In the event of such sites being unearthed, construction activities will need to be temporarily halted in the immediate area until such time as the site has been assessed, the community consulted and direction provided by the South African Heritage Resources Agency (SAHRA);</li> <li>• All of the alternative designs under investigation would be aligned to avoid impacting on the cultural heritage sites. During construction, these areas should be clearly demarcated as “no go” areas in order to ensure that there is no damage to the sites;</li> <li>• Measures should be put in place to ensure that the visibility of construction equipment and materials are reduced as far as possible. This is especially the case when closing camp at the end of the day or during periods of no work, in particular, during peak tourism periods;</li> <li>• It is recommended that the location of the proposed sub-station be moved a few kilometres from the park boundary in an effort to reduce the visual impact, alternatively, the sub-station could be banded using spoil material to create artificial landscape that blends in with the surrounding environment; and</li> <li>• Consideration should be given to reducing potential visual impacts of the substation and overhead transmission lines by extending the underground cables for a distance beyond the AFNP boundary.</li> </ul>
<b>Impact category - Visual</b>		
Study area	Visual impacts	<p>The potential negative visual impact of the project component on sensitive visual receptors in close proximity to the infrastructure or activities.</p> <p>The anticipated visual impact of the facility on the regional visual quality, and by implication on the sense of place of the region, is expected to be of moderate significance during the construction phase of the project.</p>

Spatial scale of impact	Sources of Impacts	Mitigation Measures
		<p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Plan all infrastructure in such a way and in such a location that clearing of vegetation is minimised. Make use of already disturbed sites rather than pristine areas wherever possible.</li> <li>• Mitigation of visual impacts associated with the construction of access roads is possible through the use of existing roads wherever possible. Where new roads are required to be constructed, these should be planned carefully, taking due cognisance of the local topography.</li> <li>• Roads should be laid out along the contour wherever possible. Construction of roads should be undertaken properly, with adequate drainage structures in place to minimise erosion potential.</li> <li>• Access roads that are not required after construction should be ripped and actively rehabilitated. It should be taken into consideration that this vegetation type would take years to recover to its former status if left by itself, thus rehabilitation of vegetation should be planned properly and a management programme followed to ensure optimal rehabilitation.</li> <li>• For potentially visible above-ground structures, implement materials and architectural forms that utilise and compliment the natural rock and soil colour and texture. This can greatly reduce the visibility of the proposed structures.</li> <li>• Night time lighting must be minimised and must be designed with input from a visual specialist.</li> <li>• Mitigation of visual impacts associated with the construction phase, albeit temporary, entails proper planning, management and rehabilitation of all construction sites. Construction should be managed according to the following principles:             <ul style="list-style-type: none"> <li>○ Ensure that vegetation is not unnecessarily cleared or removed during the construction period.</li> <li>○ Minimise the length of the construction period through careful logistical planning and productive implementation of resources.</li> <li>○ Plan the placement of lay-down areas and any potential temporary construction camps in locations that require minimal vegetation clearing.</li> <li>○ Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads.</li> <li>○ Ensure that rubble, litter, and disused construction materials are appropriately stored and removed from the site regularly and frequently for disposal at a licensed waste disposal facility.</li> <li>○ Reduce and control construction dust through the use of approved dust suppression techniques as and when required (i.e. whenever dust becomes apparent).</li> <li>○ Restrict construction activities to daylight hours in order to negate or reduce the visual impacts associated with lighting.</li> <li>○ Any night work must be approved by AFNP Management</li> <li>○ Ensure that all infrastructure and the site and general surrounds are maintained and kept neat.</li> <li>○ Rehabilitate all disturbed areas, construction areas, roads, slopes etc. immediately after the completion of construction works. Due to the sensitive nature of the vegetation, an ecologist should be consulted to assist or give input into rehabilitation specifications.</li> </ul> </li> </ul>
<b>Impact category - Waste</b>		

Spatial scale of impact	Sources of Impacts	Mitigation Measures
Study area	Management of non-hazardous construction solid wastes	<p>Impacts may include the pollution of land and water and the generation of nuisance (including production of odours, visual impact and attraction of pest and vermin). The proposed development will produce solid waste in the form of building rubble such as excavated soil and vegetation and excess concrete, bricks, etc. and general waste such as litter during the construction phase. All construction waste will be removed from site, by the contractors, and disposed of at the nearest registered waste disposal site. In addition, the construction camps will generate up to 0.7 cubic metres of domestic waste per day that will require disposal.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• All wastes must be managed according to the requirements of South African legislation and, preferably, the requirements of the IFC General EHS Guidelines (2007);</li> <li>• As far as practicable, the philosophy of the waste management hierarchy should be applied to the management of all waste streams in accordance with the Waste Classification and Management Regulations, Government Notice R634 of 2013;</li> <li>• All general wastes that cannot be reused or recycled should be stored in a dedicated and secure area and then transported regularly to the nearest registered landfill for disposal;</li> <li>• All bins for temporary storage of waste that are located outdoors should be covered to prevent ingress of water and access by animals;</li> <li>• A comprehensive Integrated Waste Management Plan should be developed for the site and it should include Key Performance Indicators (KPIs) against which the management of wastes can be audited;</li> <li>• All employees, contractors and visitors to the site must be informed of correct waste management procedures, including separation of general and hazardous waste at source;</li> <li>• Waste storage and disposal areas must be located at least 100m from surface water resources or important drainage lines.</li> </ul>
Study area	Management of hazardous construction solid wastes	<p>Impacts may include the pollution of land and water and the generation of nuisance (including production of odours, visual impact and attraction of pest and vermin) Hazardous solid waste includes contaminated soils and spill kits, which could result from spills of hazardous materials, or small amounts of machinery maintenance materials, such as oily rags, used oil filters, and used oil.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• The Integrated Waste Management Plan for the facility must cover the management of all hazardous waste types;</li> <li>• Prior to safe disposal, all hazardous wastes must be temporarily stored at the hazardous waste storage facility. This facility should be designed to include secondary containment lined and covered to protect the contents from weather (sunlight and rain). If wastes are corrosive, the base of the storage facility should be lined with an acid-resistant coating;</li> <li>• Where possible, empty containers for hazardous chemicals will be returned to suppliers. Where empty containers for hazardous chemicals (hydrocarbons, pesticides, laboratory chemicals, degreasing agents etc.) cannot be returned to the suppliers, they must be triple-rinsed, punctured and stored in a secure area until</li> </ul>

Spatial scale of impact	Sources of Impacts	Mitigation Measures
		<p>such time as they can be disposed of safely. Rinse water may not be discharged directly to the environment;</p> <ul style="list-style-type: none"> <li>• Empty pesticide containers should be disposed of according to the Food and Agricultural Organisation’s (FAO) Guidelines on Management Options for Empty Pesticide Containers (2008);</li> <li>• As per the FAO (2008) guidelines, burning of empty pesticide containers should be strongly discouraged. Specific guidance on the management of empty pesticide containers is provided by the FAO (2008);</li> <li>• A Hydrocarbon Management Operating Procedure should be designed and implemented. Copies of this document should be made available at designated facilities where hydrocarbons are used or stored. The purpose of this procedure is to provide for the proper storage and handling of hydrocarbons, including waste hydrocarbons, on site and hence prevent any form of contamination;</li> <li>• It is recommended that soil contaminated with hydrocarbons should be immediately removed and disposed of at a soil bioremediation facility on site or else disposed of as hazardous waste;</li> <li>• MSDS for all chemicals must be readily available on site and the precautions stipulated in these must be adhered to at all times. All staff must be trained on the correct management of bunded facilities, including the discharge of collected liquids;</li> <li>• Spill kits must be readily available at strategic points throughout the site and staff must be trained on the correct use of these kits;</li> <li>• There are two potential disposal options for medical waste which must be managed according to the management procedure described in Annex 3 of the ICRC Medical Waste Management (2011) and the requirements of the Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste, 3rd ed. (DWAF, 2005). The first would be to transport this material to the closest clinic suitably equipped for safe disposal of medical wastes. The second would be to incinerate the material on site to render it harmless for safe disposal.</li> </ul>
Study area	Disposal of domestic wastewater and sewage sludge	<p><b>Health impacts on employees and communities</b></p> <p>Because the construction period will be up to 3 years long it is recommended that a package waste water treatment works is installed on site. The Clarus Fusion Sewage Treatment Plant has been identified as a low-maintenance option, since it is able to capture and use rain water as well as recycle its treated effluent, which means that effluent discharged is minimised or reduced to zero. The system incorporates anaerobic digestion and an aerobic process for stabilisation of the effluent and chlorination. UV can be used to sterilize the treated effluent.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Sewage effluent from sanitary facilities should be manage as described in the Guidelines for the Utilization and Disposal of Wastewater Sludge (Vol.1 to 5) (DWAF, 2006) as well as the EHS Guidelines for Water and Sanitation (2007);</li> <li>• The quality of effluent discharges must satisfy discharge requirement as prescribed in the General Authorisations (Gov. Gazette NO. 20526 8 Oct. 1999).</li> <li>• All domestic wash water and sewage from all sites must be diverted or transported to the central WWTW for treatment.</li> <li>• Sewage sludge must be removed from the site periodically and treated and disposed of as prescribed by</li> </ul>

Spatial scale of impact	Sources of Impacts	Mitigation Measures
		<p>DWAF (2006) (see Appendix C). Alternatively, the local municipality can be contracted to collect the sludge for disposal at a designated municipal sewage treatment facility.</p> <ul style="list-style-type: none"> <li>• Oil and grease in effluent from canteen facilities must be intercepted via grease traps prior to discharge into sewage treatment facilities;</li> <li>• The contents of chemical toilets must be disposed of in a manner that does not pose a threat to the environment;</li> <li>• The performance of the sewage treatment systems must be monitored regularly. Where a system is found to be performing poorly, the cause of the poor performance must be investigated immediately and remediation measures put in place to restore performance;</li> <li>• The environmental monitoring programme for the facility must incorporate monitoring points that are able to detect a negative impact on the environment associated with the discharge of treated sewage.</li> </ul>

## 7.5 Operation Phase Environmental Management Plan

This section provides detailed recommendations aimed at mitigating negative impacts and enhancing beneficial impacts associated with the operation phase of the project's life cycle. Specific requirements aimed at mitigating the various E&S impacts identified during the EIA process have been included and will be considered by RVM1 for implementation. As described in chapter 2 of this report, it should be noted that a certain degree of flexibility is allowed in the development and implementation of the specific mitigation measures contained here (Table 7.3). These requirements will, where possible, be incorporated into the relevant management plans referred to under the framework requirements. Alternatively, they may be incorporated into other forms of instructional documents such as SOPs or Method Statements for specific activities.

**Table 7.2: Operation Phase Environmental Management Plans**

Spatial Scale of Impact	Sources of Impacts	Mitigation Measures
<b>Impact category - Agriculture</b>		
Localised	Entry onto land for maintenance purposes	<p>The agricultural potential of the land occupied by the offtake structure, headrace, power station headworks and the substation is negligible agricultural potential, and access for routine operational, repair and maintenance work will have no impacts on agriculture. Access to the overhead power lines has the potential to damage agricultural land if vehicles stray from defined roads / tracks, or if waste materials are discarded on the site.</p> <p><b>Mitigation measures:</b> Develop and establish a formal protocol for access to sites for operational purposes, including:</p> <ul style="list-style-type: none"> <li>• Requirement to inform landowners / occupiers of the intention to enter sites for maintenance purposes.</li> <li>• Prohibition of driving off defined roads or tracks.</li> <li>• Requirement to clean up work sites after work is completed</li> </ul>
<b>Impact category – Aquatic Ecology</b>		
	Contamination of surface waters	<p>Contamination of surface water features hazardous materials such as hydrocarbons during maintenance and repair work can lead to loss of aquatic biota.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Contain hazardous materials in secure bunded areas.</li> <li>• Avoid spills of hazardous materials onto the ground surface and especially into water bodies.</li> <li>• Clean up spills immediately they occur using appropriate spill kits that area always readily available at the site of the work</li> <li>• Dispose of spill kits off site at an approved facility</li> </ul>
	Exotic vegetation encroachment	<p>Exotic vegetation encroachment can follow soil disturbances because of the reactivation of previously dormant seed banks.</p> <p><b>Mitigation measures:</b></p>

Spatial Scale of Impact	Sources of Impacts	Mitigation Measures
		<ul style="list-style-type: none"> <li>• Monitor disturbed sites for at least four years after construction is completed to identify exotic vegetation and remove it from the site.</li> </ul>
	Habitat transformation and sedimentation of aquatic habitats	<p>Increased soil erosion is likely to continue after construction is complete, until the site is revegetated. Continual maintenance will be required to ensure that the entry of sediment into watercourses from project activities is contained.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Continued maintenance of erosion control measures, particularly on rehabilitated areas and along access roads.</li> </ul>
<b>Impact category – Vegetation</b>		
Localised	Access to site for operational, maintenance or repair purposes	<p>The direct impacts on vegetation of the operation of the project relate mainly to possible damage to vegetation resulting from indiscriminate driving on the site, which may also hinder the rehabilitation / recovery process. The success of rehabilitation must also be monitored.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Monitor disturbed sites for at least four years after construction is completed and address any failures and deficiencies.</li> <li>• Prohibit driving off defined roads or tracks.</li> <li>• Clean up work sites after work is completed</li> </ul>
<b>Impact category - Faunal</b>		
Localised	Loss of Biodiversity	<p><b>Faunal diversity</b></p> <p>Impacts during the operation of the proposed project will vary for the different faunal groups. Amphibian diversity may be impacted by possible small scale, localized changes in water flow dynamics in the region of the diversion weir and offtake structure. For some species, however, this will probably be offset by increased breeding habitat associated with the existence of the head pond and also increased water flow via the discharge tunnel into the lower palaeochannel. Similarly, increased bird numbers and diversity can be expected in the riverine habitats in the lower palaeochannel, where vegetation can be expected to increase. Both groups may be positively impacted during this phase. Mammals such as Cape Clawless Otter and Water Mongoose may increase in number in the lower palaeochannel due to an increase in fish numbers and other small vertebrates that form their diet. Due to an increase in well-vegetated riverine habitats along the lower 'palaeochannel' changes negative impacts on faunal diversity in the region can be expected to be self-mitigated.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Avoid clearing or damaging wetlands, and limit river and stream crossings as far as possible. Associated infrastructure, particularly transport linkages, should avoid these areas. Including a buffer distance of 30 m if possible.</li> <li>• Maintenance of water quality and flow dynamics.</li> </ul>



Spatial Scale of Impact	Sources of Impacts	Mitigation Measures
		<ul style="list-style-type: none"> <li>Prohibit night driving on access roads during maintenance visits to the site except in emergency situations.</li> <li>Monitor alien plant encroachment and eradicate when detected, particularly aquatic aliens such as <i>Phragmites</i> reeds in the Head Pond and lower palaeochannel.</li> </ul>
Study area	Loss of Biodiversity	<p><b>Loss of Species of Conservation Concern</b></p> <p>The primary impact on SSC will be mainly related to the section of above-ground power lines, particularly the crossing of the Orange River to connect to the existing Eskom transmission network near Augrabies. Overhead Transmission lines form a well-documented threat to a number of threatened bird species. This results from two main impacts: electrocution from contact with live elements when birds nest or roost on the supporting pylons, and collisions with overhead power lines when in flight (Anderson 2002; Jenkins and Smallie 2009; Jenkins et al. 2010; Jenkins et al. 2011, 2013). Electrocutions on support pylons have been greatly reduced with new pylon designs. In fact, due to their use as roosting and nesting structures, well-designed pylons may even have a beneficial impact in arid regions by supplying roosting and nesting sites in areas where these are of limited availability.</p> <p>Some mammals and ground-nesting birds are known to avoid habitats up to several kilometres from high-voltage power lines. Tyler et al. (2014) propose that ultraviolet discharges on power lines ('standing corona' along cables and irregular 'corona flashes' from insulators) are a possible cause of this avoidance.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>There are a number of pylon designs and transmission cable attachments available to reduce bird collisions and electrocutions (for an international review see: APLIC 2012; and Jenkins et al. 2013). Suitable design and warning attachments should be incorporated into the design of the above ground transmission network.</li> <li>Regular monitoring for bird mortalities along the transmission line should be included as part of the EMP.</li> </ul>
Localised	Loss of Biodiversity	<p><b>Introduction of alien fauna</b></p> <p>The threat presented by alien invasive fauna is limited. Developments provide corridors for the introduction of alien species via roads associated with their construction and operation. Introduced urban rodent pests such as the house mouse (<i>Mus musculus</i>), house rat (<i>Rattus rattus</i>) and the Norwegian rat (<i>Rattus norvegicus</i>) are not recorded in the AFNP, but are likely to occur in adjacent populated areas. These species generally tend to survive alongside human habitation, and do not spread into natural areas. The most widespread and common alien bird is the House Sparrow (<i>Passer domesticus</i>) which is now distributed almost worldwide. In addition, the European Starling (<i>Sturnus vulgaris</i>) is also an abundant introduced resident avian species. Neither was recorded on site. The most recent and active bird invasive in the Nama Karoo region is the Pied Crow (<i>Corvus splendens</i>), which is actively expanding its range in association with the greater availability from human structures of nesting sites in semi-arid regions. Increased food resources, via mortalities and prey visibility, are also afforded by roads. As the operational phase of the project requires little road access and no on-site habitation the risk of alien fauna introduction is slight.</p>



Spatial Scale of Impact	Sources of Impacts	Mitigation Measures
		<p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• The deliberate introduction of alien species must be prohibited.</li> <li>• Eradication programs of problem animals should be undertaken if needed, and in consultation with conservation authorities.</li> </ul>
Study area	Loss of Biodiversity	<p><b>Threats to Animal Movements</b> Overhead power lines are a well-documented threat to birds, particularly large threatened species such as raptors, storks and bustards</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Night driving on roads in the project area should be prohibited except in emergency situations, particularly alongside wetlands during the amphibian breeding season.</li> <li>• There is a number of pylon designs and transmission cable attachments available to reduce bird collisions and electrocutions (for an international review see: APLIC 2012; and Jenkins et al. 2013). Suitable design and warning attachments should be incorporated into the design of the above ground transmission network.</li> <li>• Regular monitoring for bird mortalities along the transmission line, and for road mortalities within the Riemvasmaak region should be included as part of the EMP.</li> </ul>
Localised	Habitat impacts	<p><b>Impacts on fauna due to habitat fragmentation and habitat loss</b> No additional habitat loss or fragmentation will occur during the operational phase. The maintenance of some access roads to the power house and into the lower 'palaeochannel' will maintain habitat fragmentation generated during the construction phase.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Access routes for maintenance and repair should be the minimum required for intermittent access.</li> <li>• Material required for road maintenance should be sourced from surplus excavated material if possible. Opening new borrow pits in the project area should be avoided.</li> </ul>
Localised	Habitat impacts	<p><b>Impacts due to changes in hydrology</b> These changes will generate changes in the distribution and availability of water for the fauna in the project area.</p> <ul style="list-style-type: none"> <li>• At low water levels the weir will retain water in a greater area of the upstream braided channels. In general this will be a positive or insignificant impact.</li> <li>• The route of the proposed headrace runs close to the route of the secondary channel, which is a significant ecological corridor of High Sensitivity. Intrusion into this area should be avoided if possible.</li> <li>• The head pond will form a substantial new water body that will provide increased access to water for large mammals, birds and amphibians. This will have a generally positive impact on the fauna, although increased mortality from animals passing into the power tunnel can also be expected and should be mitigated by the installation of a surface boom and a screen</li> <li>• The discharge of up to 38 cumecs of water into the lower palaeochannel from the tailrace for up to 8-9</li> </ul>

Spatial Scale of Impact	Sources of Impacts	Mitigation Measures
		<p>months of the year will result in a substantial increase of water into the seasonally dry drainage line. This will generate increased vegetation growth resulting in increased riparian habitat for all vertebrate groups. The numbers of fish migrating up from the Orange River will also increase and form increased food for piscivores, including various birds (fish eagle, cormorants, kingfishers, etc), otters, water monitors, etc. This change in hydrology will also have a generally positive impact on the fauna.</p> <ul style="list-style-type: none"> <li>Deaths and breeding disruptions may occur with the sudden outflow of water into the lower palaeochannel when power generation is initiated. This should be avoided.</li> </ul> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>An effective barrier should be erected at the entrance of water into the power chamber from the head pond to prevent large mammals or reptiles (monitors and large tortoises) from being sucked into the penstock.</li> <li>The release of water into the lower palaeochannel after power generation should occur in stages before full discharge to allow wildlife to vacate the area.</li> </ul>
Localised	Additional operational impacts on fauna	<p><b>Increased Dust Levels</b> Increased dust levels are common after veld clearance activities, and from vehicular traffic, even on paved surfaces. Dust settling on adjacent vegetation can block plant photosynthesis, respiration and transpiration, in addition to causing physical injuries to plants. Its presence may also make plants unpalatable, thus acting as a possible deterrent to grazing. Dust from road surfaces can also transport chemical pollutants to adjacent regions, thus affecting riparian ecosystems via impacts on water quality.</p> <p><b>Mitigation measures included</b></p> <ul style="list-style-type: none"> <li>After the construction phase, roads within the area should be returned to small tracks.</li> <li>Road speed throughout the region should be limited to 50km per hour to curtail dust generation.</li> <li>Road use during and immediately after heavy rain should be limited to avoid damage to the surface.</li> <li>All vehicular traffic should be restricted to existing roads and tracks, and no off-road vehicle activity should be permitted.</li> </ul>
<b>Impact category - Heritage</b>		
Impacts on heritage resources are significant only during the construction phase of a project, when sensitive heritage features may be altered or destroyed. No impacts are anticipated during the operation of the project		
<b>Impact category - Noise</b>		
Localised	Noise impacts	<p>Although the power chamber will be situated a considerable depth underground, which will attenuate sound from the electro-mechanical equipment, the ventilation system will vent at ground level. If not carefully located, and properly muffled and maintained this system can result in noise nuisance at the surface.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>Ensure that the sound abatement system for the ventilation system for the power chamber is always</li> </ul>

Spatial Scale of Impact	Sources of Impacts	Mitigation Measures
		operational and properly maintained
<b>Impact category – Socio-Economic and Tourism</b>		
Regional	Local economic development	<p><b>Financial Benefits to the Riemvasmaak Community Trust</b>                      The RCT will receive income <i>via</i> two sources, namely rental income for the use of their land, as well as being a shareholder in the company and, thus, receiving dividends from the project. It is understood that the payment of dividends will commence six months after the project becomes operational. Both of these will provide a consistent income for the RCT throughout the projects lifespan. While it could not be confirmed for what exactly this income will be used, it was confirmed by the RCT trustees that it will be put towards the upliftment of the community.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Ensure that there are no irregularities with the spending of monies received by the RCT;</li> <li>• Ensure that all monies received by the RCT are used for community upliftment purposes;</li> <li>• Ensure that the agreed conditions are adhered to.</li> </ul>
Regional	Local economic development	<p><b>Establishing a Broad-Based Community Trust</b>                      In terms of the IPP Procurement Programme, all communities within 50km of the project are required to benefit from the project. While details are not finalised as to how the Broad Based Community Trust would be structured in terms of the IPP Procurement Programme, the needs of the surrounding communities are to be identified and strategies put in place as to how these will be addressed. It is assumed that the Broad Based Community Trust would essentially be tasked with addressing the socio-economic needs of communities within 50km of the project site.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• The project proponent should have representatives on the trust committee;</li> <li>• Ensure that there are no irregularities with the spending of monies received; and</li> <li>• Ensure that all monies received are used for community upliftment purposes</li> </ul>
Regional	Local economic development	<p><b>Stimulating Small, Medium and Micro Enterprises</b>                      This impact has already been discussed. However, it is anticipated that the significance of this impact would be different and longer term during the operational phase.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Identify which services could be supplied by local SMMEs and contractors;</li> <li>• In consultation with local government and community organisation, identify SMMEs and contractors who could supply the required services; and</li> <li>• Endeavour to employ local contractors and SMMEs as far as is feasibly possible.</li> </ul>
Localised	Local economic development	<p><b>Increase Tourism Opportunities</b>                      It was noted by representatives of the Riemvasmaak Tourism Association and representatives of the AFNP that there are plans to extend tourism into the northern sections of the AFNP. Moreover, it was noted that</p>

Spatial Scale of Impact	Sources of Impacts	Mitigation Measures
		<p>there is potential for the proposed hydropower scheme to be used to generate tourism. In the event of the scheme being used as a tourism attraction, various spin-off opportunities arise, such as employment opportunities for tour guides which will assist the local communities.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• The project should consider the potential to stimulate the tourism sector early on its design, such as to construct viewing decks, or consider the project's marketability as a tourism attraction;</li> <li>• Ensure that tours of the hydroelectric scheme are well marketed; and</li> <li>• Ensure that guides are well trained and can provide tourists with the necessary information</li> </ul>
Regional	Local economic development	<p><b>Employment Opportunities</b>                      During the operational phase, between five and ten permanent jobs will ultimately be created once the necessary skills training has taken place. Of the aforementioned, only one job would not be local. In addition, there is the likelihood of skills development as an indirect result of the employment opportunities. This will increase the ability of individuals to access other skilled positions of a similar nature.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Ensure that the skills development programme for local people initiated during construction continues into the operation phase of the project, and that as many positions as possible are filled by local people.</li> </ul>
Regional	Health and Safety	<p><b>Increased Road Accidents</b>                      This impact is discussed under the construction phase. However, the impact should be less severe during the operational phase.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Considering the remote nature of the project site and the limited access to healthcare facilities, it is important that emergency healthcare facilities are available on site and that there is a suitable evacuation plan in the event of serious and/or life threatening injuries;</li> <li>• Develop a traffic management plan or include a traffic management section within the Environmental Management Programme (EMP), including maximum speed limits dependent on the type of vehicle;</li> <li>• Ensure that all roads and tracks are maintained in a good condition at all times and is not allowed to deteriorate;</li> <li>• All drivers should be briefed regarding the traffic management plan.</li> </ul>
Regional	Social Services	<p><b>Improved Energy Production</b>                      Through the proposed project, there will be additional power supplied to Eskom who, at present and for the foreseeable future, are experiencing shortfalls in power. The benefits of the project will include carbon savings from the decreased reliance on non-renewable sources such as coal-fired power stations, as well as contributing towards South Africa's energy requirements.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• Ensure that the project infrastructure is well maintained to ensure the efficient functioning of the project</li> </ul>

Spatial Scale of Impact	Sources of Impacts	Mitigation Measures
		throughout its life span.
<b>Impact category - Visual</b>		
Study area	Visual intrusion	<p>The potential negative visual impact of the project component on sensitive visual receptors in close proximity to the under-ground infrastructure.</p> <p>Sense of place refers to a unique experience of an environment by a user, based on his or her cognitive experience of the place. Visual criteria and specifically the visual character of an area (informed by a combination of aspects such as topography, level of development, vegetation, noteworthy features, cultural / historical features, etc.) play a significant role. A visual impact on the sense of place is one that alters the visual landscape to such an extent that the user experiences the environment differently, and more specifically, in a less appealing or less positive light.</p> <p>Tourism access and development within the Augrabies Falls National Park is limited to the area south of the river. This corresponds with the zoning of the Park, which has allocated both low and high intensity leisure activity zones in this area. The northern part of the Park is zoned as Remote and Primitive. In this respect, the area to the north of the river may be considered for tourism development in the future. The presence of the power station infrastructure should not be a limiting factor as most of the project infrastructure is located below ground, and hence the expected visual impact will be of moderate significance.</p> <p><b>Mitigation measures:</b></p> <ul style="list-style-type: none"> <li>• During operation, the maintenance of the structures (e.g. the substation), the access roads, the power line servitude and other ancillary structures and infrastructure will ensure that the facility does not degrade, thus aggravating visual impact.</li> <li>• Roads must be maintained to prevent erosion and to suppress dust, and rehabilitated areas must be monitored for rehabilitation failure. Remedial actions must be implemented as and when required.</li> <li>• Monitor rehabilitated areas for rehabilitation failure, and implement remedial actions as and when required</li> </ul>
<b>Impact category - Waste</b>		
Operational waste impacts and mitigation measures are similar to those documented for the construction phase in terms of general waste, sewage management, and soil and water pollution. Only 10 persons will be employed, and as a result impacts will be of reduced significance. Refer to Table 7.2 for details.		

## 8. MONITORING PROGRAMME

### 8.1 Introduction

This section outlines the environmental and social monitoring requirements for the project's life cycle. This programme has been based on the findings of the EIA and the contents of the EMPr and will be periodically reviewed and updated. It should be noted that in order to comply with international best practice, it is required that where standards are available for the host country, these will be compared to international standards and where there is a difference, the most stringent requirement for each monitoring parameter will be adopted.

#### 8.1.1 Objectives

The objectives of the Environmental Monitoring Programme are:

- To confirm compliance with commitments to legislative and non-legislative environmental and social Standards as detailed in chapter 4 of this EMPr;
- To provide early warning of potential impacts, determine the extent of predicted impacts and identify any unforeseen impacts associated with the project activities;
- To provide a baseline environmental and social data set;
- To provide feedback on the adequacy of environmental management practices and allow improved practices to be developed to continuously improve operations;
- To detect and measure environmental trends or changes and enable analysis of their cause; and
- To provide site management with information and data that can be used as a basis for decision making.

Baseline data will be used to compare pre-project conditions with future phases of the project. Where baseline conditions are not known or deficient, this programme describes additional baseline data requirements.

#### 8.1.2 Monitoring Programmes Structure

Four monitoring categories shall be included and these are described below:

1. **Discharge (Emission) Monitoring:** This will involve monitoring of contaminants being discharged or emitted from construction and operational activities, as well as decommissioning activities, into the environment. Discharge monitoring will be undertaken either at the discharge point or within the local catchment area. Discharge monitoring will provide direct information concerning the concentrations and loads of contaminants being released from the operation, and will also serve as a link between ambient monitoring results and the operation itself.
2. **Ambient Monitoring:** This involves the monitoring of background conditions and receiving environments that could be affected by project activities. While discharge monitoring should determine if environmentally significant releases have occurred, effects on the ultimate receptors within the receiving environment beyond the boundary of the facility can be determined only by ambient monitoring. Ambient monitoring will be undertaken for surface water (both upstream and downstream in project-affected rivers), groundwater, ambient dust, noise & vibration monitoring and workplace air quality.
3. **Investigation Monitoring:** This will be completed as required to determine the occurrence, nature and extent of possible impacts following an environmental incident, such as oil spillage, or to verify/refute third-party claims of environmental impacts. For example, investigation monitoring may be undertaken upstream of a routine monitoring point to identify a source of contamination.

4. **Occupational Health and Safety Monitoring:** The working environment will be monitored for occupational hazards relevant to the project. Occupational Health and Safety monitoring will be designed and implemented by accredited professionals as part of an occupational health and safety monitoring program with recognition for post-closure long term health concerns. As part of the monitoring programme, occupational accidents, diseases and dangerous occurrences and accidents will be documented for all facilities.

### **8.1.3 Monitoring responsibilities**

Implementation of the environmental monitoring as well as the OH&S monitoring is primarily the responsibility of the Health and Safety Manager. RVM1, through the Health and Safety Manager, will ensure that bio-physical monitoring responsibilities are clearly defined, where appropriate, RVM1 will consider involving representatives from affected communities to participate in the monitoring activities. Where skills do not exist, or where significant impacts are involved, RVM1 will retain external experts to verify its monitoring information. In instances where a third party has responsibility for managing specific risks and impacts and associated mitigation measures, RVM1 will collaborate in the establishment and monitoring of such activities.

### **8.1.4 Review and Modification of the Monitoring Programme**

Data from the monitoring programme will be continually reviewed trends will be identified. The monthly Environmental Report will subsequently become a basis for discussion on monitoring programme effectiveness, and the need (if any) for changes to sampling sites, sampling frequencies and analytical methods. The report will also include recommendations from relevant departments and conditions appended to issued permits, licences, and corrective measures identified in NCRs as well as any Environmental Authorisation regarding any necessary changes to the project.

Modification of the programme will also be required:

- 1) When the configuration or operation of the Project changes significantly; and/or
- 2) Where environmental or social impacts vary from initial predictions; and/or
- 3) In response to new company commitments, legislative / financing requirements or stakeholder concerns.

### **8.1.5 Reporting**

Monthly or quarterly monitoring results will be compiled by the Health and Safety Manager for submission to the Project Company CEO. Environmental monitoring results shall be incorporated into quarterly, bi-annual and annual reports.

## **8.2 Water Monitoring**

Issues affecting ambient water quality mainly relate to surface run-off from areas subject to the project activities and are likely to be significant during the construction phase of the project's life cycle. A number of mitigation measures, based on informed predictions, aimed at reducing potential impacts on water quality have been identified.

### **8.2.1 Potable Water Quality**

All potable water on site will meet the most stringent of the South African National Standards (SANS) 241-1:2011: Drinking Water Specifications and the WHO (2011) drinking water standards (Table 9.1).

**Table 9.1: Drinking water quality guidelines applicable to RMV1 Project**

Pollutant/Measure	Units	SANS 2011	241-1:	WHO 2011
Arsenic	mg/l	0.01		0.01
Barium	mg/l	-		0.7
Ammonia	Mg/l	1.5		-
Boron	mg/l	-		0.5
Bromin	mg/l	-		-
Chromium (total)	mg/l	0.05		0.05
Fluoride	mg/l	1.5		1.5
Colour	Mg/L Pt-Co	15		-
Cobalt	Mg/l	0.5		-
Manganese	mg/l	0.1		0.4
Free Chlorine	mg/l	5		-
Selenium	mg/l	0.01		0.01
Uranium	mg/l	0.015		0.015
Sodium	mg/l	200		-
Vanadium	Mg/l	0.2		-
Nitrate (NO <sub>3</sub> ) as N	mg/l	11		-
Nitrite (NO <sub>2</sub> )	mg/l	0.9		-
Sulphate	mg/l	250		-
Total Dissolved Solids	mg/l	1200		-
Cadmium	mg/l	0.003		0.003
Cyanide	mg/l	0.07		0.07
Mercury	mg/l	0.006		0.006
Aluminium	mg/l	0.3		-
Iron	mg/l	0.3		-
Zinc	mg/l	5		--
Chloride	mg/l	300		-
Chlorine	mg/l	5		-
Chlorite	mg/l	-		0.7
Antimony	mg/l	0.02		0.02
Copper	mg/l	2		2
Lead	mg/l	0.01		0.01
Nickel	mg/l	0.07		0.07
Total Coliform	MPN/100ml	10		-
E. Coli	Count per 100ml	Not detected		Not detected
Turbidity	NTU	1		<5
Hardness	mg CaCO <sub>3</sub> /l	-		100 - 300
Conductivity	mS/cm	170		-
pH		5.0 to 9.7		-
Total Organic Carbon	mg/l	0.01		-
Microcystin	mg/l	0.001		0.001
Phenols	mg/l	0.01		-

**Note:** The blue highlighted cells indicate the most stringent requirements that will be adopted



### **8.2.2 Point Source Discharge**

In the event of discharge of the sanitary effluent from the packaged sewage treatment plant into the environment, the discharge should meet the General Authorisations in terms of Section 39 of the National Water Act No.36 of 1998 (Gov. Gazette NO.20526 8 Oct. 1999). The General Authorisations provide that the discharge of up to 2 000 m<sup>3</sup> of wastewater (sanitary effluent) on any given day into a non-Listed Water Resource must adhere to the General Limit Values while wastewater discharge into a Listed Water Resource (see Appendix B) must adhere to the Special Limit Values (Table 9.2 below). Discharge of Complex Industrial Wastewater<sup>1</sup> is however prohibited in both cases.

In terms of the IFC requirements, specific guidelines exist for discharge of sanitary effluent into the environment (General EHS Guidelines, 2007). In accordance with IFC (2012) Performance Standard 3 (*Resource Efficiency and Pollution Prevention*) and Good International Industry Practice (GIIP), the most stringent between the national and the international standards / guidelines will suffice and deemed applicable and a justification for the choice of use, other than the use of the most stringent, should be provided.

It should be noted that the prescribed levels should be achieved, without dilution, at least 95% of the time that the plant or unit is operating, to be calculated as a proportion of annual operating hours. Deviation from these levels in consideration of specific, local project conditions should be justified.

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<sup>1</sup> Wastewater arising from industrial activities and premises, that contain (a) a complex mixture of substances that are difficult or impractical to chemically characterise and quantify, or (b) one or more substances, for which a Wastewater Limit Value has not been specified, and which may be harmful or potentially harmful to human health, or to the water resource (Identification of complex industrial wastewater will be provided by the Department upon written request).

**Table 9.2: Discharge water quality guidelines applicable to the RMV1 Project**

Pollutant/Measure	Units	RSA GENERAL AUTHORISATIONS (Gov. Gazette NO. 20526 8 Oct. 1999)		IFC EHS Guidelines
		General Limit	Special Limit	Sanitary Effluent
Ammonia (ionized and un-ionised) as Nitrogen	mg/l	3	2	-
Arsenic	mg/l	0.02	0.01	-
Biochemical Oxygen Demand (BOD)	mg/l	-	-	30
Boron	mg/l	1	0.5	-
Cadmium	mg/l	0.005	0.001	-
Chlorine as Free Chlorine	mg/l	0.25	0	-
Chromium (VI)	mg/l	0.05	0.02	-
Chemical Oxygen Demand (COD)	mg/l	75c	30c	125
Copper	mg/l	0.01	0.002	-
Cyanide	mg/l	-	-	-
Cyanide (Free)	mg/l	0.02	0.01	-
Cyanide WAD	mg/l	-	-	-
Electric Conductivity	mS/m	70f	50f	-
Fluorides	mg/l	1	1	-
Iron (Total)	mg/l	0.3	0.3	-
Lead	mg/l	0.01	0.006	-
Manganese	mg/l	0.1	0.1	-
Mercury	mg/l	0.005	0.001	-
Nickel	mg/l	-	-	-
Nitrate/Nitrite as Nitrogen	mg/l	15	1.5	-
Nitrogen (total)e	mg/l	-	-	10
Oil and Grease including soap	mg/l	2.5	1	10
pH	S.U.	5.5 to 9.5	5.5 to 7.5	6 to 9

Pollutant/Measure	Units	RSA GENERAL AUTHORISATIONS (Gov. Gazette NO. 20526 8 Oct. 1999)		IFC EHS Guidelines
		General Limit	Special Limit	Sanitary Effluent
Phenols	mg/l	-	-	-
Phosphorous	mg/l	10h	1 to 2.5h	2
Selenium	mg/l	0.02	0.02	-
Temperature	° C	<3°	<2°	-
Total Suspended Solids (TSS)	mg/l	-	-	50
Total Coliform bacteria	MPNb/100ml	1000	0	400a
Zinc	mg/l	0.1	0.04	-

Note:  
 The blue highlighted cells indicate the most stringent requirements that will be adopted.  
**a:** Not applicable to centralized, municipal, wastewater treatment systems which are included in EHS Guidelines for Water and Sanitation  
**b:** MPN = Most Probable Number  
**c:** After removal of algae  
**e:** Nitrogen (Total) is the sum of all nitrogen (Total Kjeldahl nitrogen-TKN plus Nitrate). TKN - The sum of organic-nitrogen (e.g urea) plus the ammonia. It is present in raw sewage. This must be converted for the entire process to be effective and high Dissolved oxygen within the system is required for the conversion. High TKN signifies no ammonification (conversion of organic-nitrogen to ammonia) and nitrification (conversion of ammonia to nitrite to nitrate) occurring.  
**f:** General Limit = 70 Sm/m above intake to a maximum of 150 mS/m and Specific Limit = 50 mS/m above background receiving water, to a maximum of 100 mS/m  
**h:** Ortho-phosphate as phosphorus  
**q:** water used for irrigation

### 8.3 Air Quality Monitoring

Air quality monitoring is particularly relevant during the construction and decommissioning phase of the project’s life cycle. Ensuring that no visible evidence of windblown dust exists represents an example of a source-based indicator, whereas maintaining off-site dustfall levels to below 600 mg/m<sup>2</sup>/day represents an impact- or receptor-based performance indicator. Source-based performance indicators have been included in most international regulations.

- Source based performance indicators for the unpaved roads would be no visible dust when trucks/vehicles drive on the roads. Dust fallout in the immediate vicinity of the road perimeter should be less than 1200 mg/m<sup>2</sup>/day and less than 600 mg/m<sup>2</sup>/day at the sensitive receptors.
- From all activities associated with the proposed construction activities, dust fallout rates will not exceed 600 mg/m<sup>2</sup>/day outside the project area for on-site activities or at the sensitive receptor areas for on-site and off-site activities.

Depositional dust that may be generated from active construction areas (e.g. access roads and construction sites) will be monitored within the project area and at suitable control sites and compared against the Air Quality Standard Limits SANS 1929 (Table 9.3). Duplicate samples and blank samples will be sent for analysis. The monitoring frequency will be monthly using fall out dust buckets.

**Table 9.3: Acceptable dust fall rates as measured (SANS 1828) at and beyond the boundary of premises where dust originates**

Areas	Site ID	Dustfall rate D (mg/m <sup>2</sup> /day, 30-days average)	Frequency and Permitted Frequency of exceeding dust fall rate
Residential Area	Residential	D < 600	Monthly Two within a year, not sequential months
Non-Residential Area	Plant	600 < D < 1200	Monthly Two within a year, not sequential months

### 8.4 Noise Monitoring

Noise will be monitored monthly at the plant site and homesteads closest to the project activities and compared with ambient international thresholds, while occupational noise exposure within the facility will be compared to the guideline limits shown in Table 9.4.

**Table 9.4: Ambient and Occupational Noise Level Guidelines**

Ambient Noise	Applicability	Day time (07:00 – 22:00)	Night time (22:00 – 07:00)
	One hour LA <sub>eq</sub> (dBA)		
	Beyond boundary of the facility	55	45
Occupational Noise	Applicability	Equivalent Level	Maximum
		8 hour LA <sub>eq, 8h</sub> (dBA)	
	Operational areas	85	110
	Control rooms and offices	50	-

### 8.5 Waste Management Practices

Various types of waste will be generated during the project’s life cycle. During construction phase the waste management practices, including disposal, will require monitoring to ensure compliance

with best waste management practices. Waste monitoring parameters will include the physical state of waste storage facilities (temporary or permanent), volumes of waste generated, waste separation, presence of disease vectors, and compliance with licence conditions and state of housekeeping. See Appendix C for specific requirements relating to sewage disposal and land contamination.

## 8.6 Occupational Health and Safety Monitoring

Occupational health and safety (OH&S) monitoring programmes will verify the effectiveness of prevention and control strategies. The selected key performance indicators (KPIs) are to be representative of the most significant occupational, health, and safety hazards, and the implementation of prevention and control strategies. The OH&S monitoring programme will be designed and implemented by accredited professionals and will include plans for mitigating post-closure long term health concerns. Facilities will also maintain a record of occupational accidents and diseases and dangerous occurrences and accidents.

As a minimum, the occupational health and safety monitoring programme will include:

- **Safety Inspection, Testing and Calibration:** This will include regular inspection and testing of all safety features and hazard control measures focusing on engineering and personal protective features, work procedures, places of work, installations, equipment, and tools used. The inspection will verify that issued PPE continues to provide adequate protection and is being worn as required. All instruments installed or used for monitoring and recording of working environment parameters will be regularly tested and calibrated, and the respective records maintained.
- **Surveillance of the Working Environment:** RVM1 will document compliance using an appropriate combination of portable and stationary sampling and monitoring instruments. Monitoring and analyses will be conducted according to internationally recognized methods and standards. Monitoring methodology, locations, frequencies, and parameters will be established individually for each project following a review of the hazards. Generally, monitoring will be performed during commissioning of facilities or equipment and at the end of the defect and liability period, and otherwise repeated according to the monitoring plan.
- **Surveillance of Workers Health:** When extraordinary protective measures are required (for example, against biological agents and/or hazardous compounds), workers will be provided appropriate and relevant health surveillance prior to first exposure, and at regular intervals thereafter. The surveillance will, if deemed necessary, be continued after termination of the employment.
- **Training and Induction:** Training and induction activities for employees and visitors will be adequately monitored and documented (curriculum, duration, and participants). Emergency exercises, including fire drills, will be documented adequately. Service providers and contractors will be contractually required to submit to the employer adequate training and induction documentation before start of their assignment.

### 8.6.1 Accident and Disease Monitoring

During construction and decommissioning phase, RVM1 will establish procedures and systems for reporting and recording occupational accidents and dangerous occurrences, and incidents. These systems will enable workers to report immediately to their immediate supervisor any situation they believe presents a serious danger to life or health. The systems and the employer will further enable and encourage workers to report to management all:

- Occupational injuries and near misses
- Suspected cases of occupational disease
- Dangerous occurrences and incidents

All reported occupational accidents, occupational diseases, dangerous occurrences, and incidents

together with near misses will be investigated with the assistance of a person knowledgeable/competent in occupational safety. The investigation will:

- Establish what happened
- Determine the cause of what happened
- Identify measures necessary to prevent a recurrence

## **8.7 Socio-Economic Monitoring**

RVM1 will assume responsibility for providing the funding for monitoring of affected persons and project affected people. Such monitoring is required to ensure that all community related activities are properly implemented and in line with local and international standards, and that grievances are being attended to. In order to be compliant with best practice, monitoring will need to take place at two levels *external* and *internal* monitoring.

*Internal Monitoring* will be conducted by a suitably qualified person within the management of RVM1. The form that this monitoring takes is flexible and can be tailored to the personnel and capacity of the management team. However it is strongly recommended that monitoring have at least three data sources. These would be:

- The Grievance Register results and minutes of the local level engagement programme as per the OP - Stakeholder Engagement
- Qualitative monitoring database developed as the baseline for the Social Impact Assessment for the project.

*External Monitoring* will be conducted through a contracted independent body so as to provide external third party verification of social monitoring data gathered by the internal monitoring team.

## **9. MANAGEMENT IMPLEMENTATION AND REVIEW**

### **9.1 Introduction**

RVM1 will establish procedures to monitor and measure the effectiveness of the EMPr as well as its compliance with any related legal and/or contractual obligations and regulatory requirements and standards. Where government authorities or other third parties have responsibility for managing specific risks and impacts and associated mitigation measures, RVM1 will collaborate in establishing and monitoring such mitigation measures. Where appropriate, RVM1 will consider involving representatives from Affected Communities to participate in monitoring activities.

A number of monitoring, measurement and review measures will be adopted by the RVM1 project in accordance with the IFC Performance Standard 1 and are described below.

### **9.2 Checking and Monitoring**

Checking and monitoring of the environmental management programme will be implemented and is required to ensure that the management activities are being implemented and desired outcomes are being achieved. In the instance of a non-conformance being determined, corrective and or preventive measures / actions must be identified and implemented. This component includes five key relevant activities:

- Defining objectives and targets;
- Monitoring selected E&S and H&S quality variables as defined in the objectives and targets;
- On-going inspections and continuous improvement of general state of the operations;
- Internal audits to assess the robustness of the management programmes (mitigation measures) being implemented or to focus on a particular performance issue; and,
- External audits to provide independent verification of the efficacy of the management programmes and its associated reports and procedures.

#### **9.2.1 Performance objectives and targets**

Performance objectives and targets (measurable indicators) against which the performance of the project can be measured and monitored will be developed as part of management report development, and agreed upon for activities in all phases of the project's life cycle. These objectives and targets will be clearly defined and incorporated, where appropriate, as contractual obligations that have to be fulfilled by third parties. In so doing, RVM1 will be better able to manage its health, safety, environmental and community risks and obligations. Objectives and targets will be reviewed on a regular basis. In cases where objectives and targets are not met, new and revised method statements indicating proposed corrective measures will be developed and approved.

#### **9.2.2 Monitoring Programmes**

RVM1 and its contractors will establish procedures to monitor and measure the effectiveness of the management plans, as well as compliance with any related legal and/or contractual obligations and regulatory requirements. The variables that are to be monitored are identified and defined in the Monitoring Programme to be developed. Results obtained from the monitoring programme will be structured and presented for review on an on-going basis so that if objectives and targets are not met, corrective action can be taken.

It is required that all monitoring programmes are to be headed by appropriately qualified and trained personnel. Where appropriate, RVM1 will consider involving representatives from affected communities to participate in the monitoring activities. Where skills do not exist, or where significant impacts are involved, RVM1 will retain external experts to verify its monitoring information. In instances where a third party has responsibility for managing specific risks and

impacts and associated mitigation measures, RVM1 will collaborate in the establishment and monitoring of such activities.

### **9.2.3 On-going inspections and continuous improvement**

On-going inspection and continuous improvement will form a key component of the E&S and H&S management as documents associated with the EMPr will be regularly reviewed and updated. Research on certain aspects will be undertaken to refine environmental management and to ensure that the levels of environmental protection outlined in the respective EMPr are achieved.

Owing to the transient nature of the construction phase, the greatest source of information will be obtained through on-going visual inspection. At the same time some potential impacts are difficult to monitor quantitatively, such as soil erosion and waste management. An on-going, but pragmatic inspection regime will be developed that allows for potential E&S and H&S non-conformances to be identified proactively so that mitigation can be quickly and effectively implemented.

### **9.2.4 Internal and external audits**

It is proposed that an internal audit of the environmental performance of the project will be conducted regularly by trained in-house personnel while external audits will be undertaken on an annual basis by accredited institutions. The purpose of the audits will be to:

- Assess compliance with the conditions of the Environmental Licence and Certification,
- Determine if the objectives and targets outlined in the monitoring programmes and SOPs are being met.

The findings of internal and external audits and informal environmental reviews will be recorded and items requiring action will be identified. The implementation of these actions will be assessed in the following audit.

Where the monitoring data and the inspection reports highlight problems, an internal audit can be used to ascertain the source of the problem and to define action to prevent its recurrence. The three key areas for audit are operating efficiencies of facilities, project procedures and their implementation, and Contractor's EHS performance.

## **9.3 Incident Reporting, Non-conformance and Corrective Action**

### **9.3.1 Incident Documentation and Reporting**

RVM1 and its contractors will develop procedures for managing all EHS incidents, subject to approval by senior management. A report will be completed for all incidents, and appropriate action taken where necessary to minimise any potential impacts. The relevant local and national South African authorities will be informed of any environmental incident, in accordance with legislative requirements.

A procedure for reporting E&S and H&S complaints from the affected community and employees will be developed prior to the onset of construction activities and will be applicable to all phases. Notification of an incident or emergency will include the following:

- Description of the incident;
- The location of the emergency or incident;
- The name and telephone number of the designated contact person;
- The time of the emergency or incident;
- The suspected root cause of the emergency or incident;
- The environmental harm and/or environmental nuisance caused, or suspected to be caused, by the emergency or incident; and
- The action taken to prevent future occurrence of the incident and mitigate any harm and/or environmental nuisance caused by the emergency or incident.



The Incident reporting and documentation requirements will be based on best practice principles, and will take the following requirements into account:

- Documents associated with the EMPr will be regularly reviewed and updated by all environmental management parties;
- It is proposed that an appointed independent ECO will undertake monthly or quarterly external audits during the construction phase. External annually audit during the operation phase will be conducted by accredited institutions that are vetted by the local authorities.
- Internal audit will be conducted regularly for the duration of the project's life cycle. The purpose of the audits will be to assess compliance with the conditions of the Environmental Licence, and objectives and targets outlined in the related EMPr, and its various management tools;
- The findings of external, internal and informal environmental reviews will be recorded and items requiring action will be identified from the recommendations made and Action Plans developed; and
- RVM1 is contractually obliged to fulfil any reasonable recommendations, and implementation of applicable EMPr.

### **9.3.2 Non-conformance**

The EMPr or any other requirements contained in relevant legislation, standards, environmental or social documentations such as the SOP, are deemed not to have been complied with when:

- There is evidence of contravention of the recommendations in the document, its environmental specifications or the developed Method Statements or Procedures;
- If Company activities take place outside the legal boundaries of the concession area;
- Environmental damage ensues due to negligence;
- Personnel fail to comply with corrective/preventive or other instructions that have been issued as corrective/preventive measures; and
- Personnel fail to respond adequately to complaints from the public or local/national authorities.

### **9.3.3 Corrective Action and Non-Conformance Reports**

All supervisory staff including foremen, Resident Engineers, and the ECO must be able to issue non-conformance reports (NCRs). NCRs will describe in detail the cause, nature and effects of any environmental non-conformance. The records must be made available to the ECO and relevant authority for inspection when the need arises.

The NCR will be updated on completion of the corrective measures indicated on the finding sheet. The report must indicate the root cause and the remediation measures recommended for timely implementation.

In order to ensure compliance with the EMPr, a staff warning and disciplinary system will be developed. The developed system will cater for non-conformity and corrective action and will be of international best practice. There are several mechanisms for implementing corrective action and they include verbal instructions, written instructions and contract notices.

**Verbal instructions** are likely to be the most frequently used form of corrective action and are given in response to minor transgressions that are evident during routine site inspections. Verbal instructions are also used to create further awareness amongst Contractors, as often the transgressions are a function of a lack of awareness.

**Written instructions** in the form of NCR will be issued following the identification of non-conformances after an audit. The NCRs will indicate the source(s) of the problem(s), and proposed feasible solution(s). The implementation of these solutions can also be assessed in a follow-up audit and further NCRs issued if required. All NCRs will be centrally logged to ensure that there is an auditable record of such instructions and how they were responded to.

**A contract notice** is a more extreme form of written notice because it reflects the transgression as a potential breach of contract. If there is not an adequate response to a contract notice, then the next step can be to have the contractor removed from the site and the contract cancelled. Contracts will be drafted with this in mind.

#### 9.4 Safety and Security Management

The affected parties in the area as well as other interested parties have raised concerns about safety and security during the construction period. It is therefore necessary to ensure that measures are put in place to address these concerns.

According to the IFC Performance Standard 4 (*Community Health, Safety and Security*), the main objectives are:

- To anticipate and avoid adverse impacts on the H&S of the Affected Community during the project life from both routine and non-routine circumstances.
- To ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the Affected Communities.

During the construction phase, the Contractor is required to submit a Method Statement on how to deal with safety and security issues. The minimum requirements should include:

- Mobilisation of a security company to safeguard equipment, the works and the affected community 24 hours a day.
- Implementation of access control measures within specified timeframes.
- Contractors must screen prospective employees and subcontractors, including making criminal background checks.
- Control access to construction sites by properly constructed and secured fences.
- Workers should be encouraged to recognise and report suspicious activity and signs of burglary and be informed of crime prevention measures that they themselves can take (such as closing farm and residential gates).
- All construction workers must wear clothing and reflective vests marked with the logo of the Contractor or Sub-contractor, and carry identification cards that cannot be easily forged, so that they can be easily recognised as being legitimate members of the workforce.
- Sound design and servitude management practices should be applied to minimise impacts.
- Contact details of the local police station and ambulance services must be kept at the site office.
- Danger tape and appropriate signage must be used around trenches and open pits.
- Drivers of construction vehicles should be licensed and experienced in handling their machinery and cautioned to obey the rules of the road.
- Construction vehicle movement should be limited to off-peak periods on all major roads.
- All access roads used for construction purposes should be maintained, e.g. kept free of pot-holes, and sprayed with water regularly to suppress dust which could impede visibility.
- Construction workers must return to the construction camp daily and may not stay at the construction site overnight.
- Personal Protective Equipment must be provided, where appropriate. For example workers handling dangerous / hazardous materials should be supplied with masks and goggles, workers using noisy machinery should be supplied with earplugs, all workers to be supplied with reflective clothing and hard hats, etc.
- Herbicides should not be used in windy or rainy conditions.
- The contractor should ensure that workers are educated on HIV/AIDS and that condoms are distributed within the construction camp.

## **9.5 Management review**

The process of management review is in keeping with the principle of continual improvement and will be conducted at least once annually aiming to critically examine the effectiveness of the EMPr and its implementation and to decide on potential modifications as and when necessary. As such, RVM1 will develop a management review procedure to ensure that the Company defines and maintains a documented process and agenda for Senior Managers to periodically review the continuing suitability, adequacy and effectiveness of the EMPr. The management review, which will be conducted regularly, will include a review of internal and external audit reports.

## **9.6 Financial Resources**

RVM1 will be responsible for ensuring that sufficient financial resources are made available for the effective implementation of the requirements of this EMPr. Where applicable, and particularly during the construction phase, RVM1 will need to ensure that all contractors are aware of their obligations in terms of this EMPr and that they have made appropriate financial provisions to ensure full compliance.

## 10. REFERENCES

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- South African National Standard 10234 (2008): Globally Harmonized System of classification and labelling of chemicals
- South African National Standard 241-1 (2011): Drinking Water Specifications. Part 1: Microbiological, Physical, Aesthetic and Chemical Determinants

## APPENDIX A: ENVIRONMENTAL AWARENESS PROGRAMME

### PROPOSED ENVIRONMENTAL EDUCATION COURSE

# WHAT IS THE ENVIRONMENT?

- Soil
- Water
- Plants
- People
- Animals
- Air we breathe
- Buildings, cars and houses



# WHY MUST WE LOOK AFTER THE ENVIRONMENT?

- It affects us all as well as future generations
- We have a right to a healthy environment
- A contract has been signed
- Disciplinary action (e.g. construction could stop or fines issued)

## HOW DO WE LOOK AFTER THE ENVIRONMENT?

- Report problems to your supervisor/ foreman
- Team work
- Follow the rules in the EMP



## WORKING AREAS

Workers & equipment must stay inside the site boundaries at all times



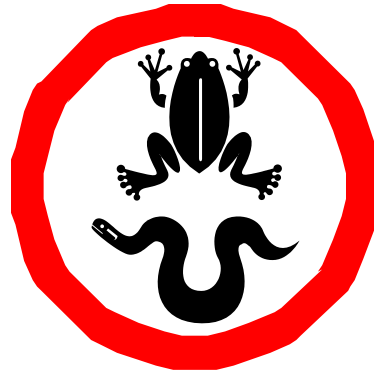
## RIVERS & STREAMS

- Do not swim in or drink from streams
- Do not throw oil, petrol, diesel, concrete or rubbish in the stream
- Do not work in the stream without direct instruction
- Do not damage the banks or vegetation of the stream



## ANIMALS

- Do not injure or kill any animals on the site
- Ask your supervisor or Contract's Manager to remove animals found on site



## TREES AND FLOWERS

- Do not damage or cut down any trees or plants without permission
- Do not pick flowers



## SMOKING AND FIRE

- Put cigarette butts in a rubbish bin
- Do not smoke near gas, paints or petrol
- Do not light any fires without permission
- Know the positions of fire fighting equipment
- Report all fires
- Do not burn rubbish or vegetation without permission





## PETROL, OIL AND DIESEL

- Work with petrol, oil & diesel in marked areas
- Report any petrol, oil & diesel leaks or spills to your supervisor
- Use a drip tray under vehicles & machinery
- Empty drip trays after rain & throw away where instructed



## DUST

Try to avoid producing dust -  
Use water to make ground & soil wet



## NOISE

- Do not make loud noises around the site, especially near schools and homes
- Report or repair noisy vehicles



## TOILETS

- Use the toilets provided
- Report full or leaking toilets



## EATING

- Only eat in demarcated eating areas
- Never eat near a river or stream
- Put packaging & leftover food into rubbish bins



## RUBBISH

- Do not litter – put all rubbish (especially cement bags) into the bins provided
- Report full bins to your supervisor
- The responsible person should empty bins regularly



## TRUCKS AND DRIVING

- Always keep to the speed limit
- Drivers - check & report leaks and vehicles that belch smoke
- Ensure loads are secure & do not spill



## EMERGENCY PHONE NUMBERS

Know all the emergency phone numbers:

- Ambulance:
- Fire:
- Police:
- Khai lGarib Local Municipality:



## FINES AND PENALTIES

- Spot fines of between

To be confirmed by Engineer

- Your company may be fined
- Removal from site
- Construction may be stopped



## PROBLEMS - WHAT TO DO!

- Report any breaks, floods, fires, leaks and injuries to your supervisor
- Ask questions!



**APPENDIX B: SOUTH AFRICA LISTED WATER RESOURCES**

<b>LISTED WATER RESOURCES</b>	
1	Hout Bay River to tidal water
2	Palmiet River from Kogelberg Dam to its estuary
3	Lourens River to tidal water
4	Steenbras River to tidal water
5	Berg and Dwars Rivers to their confluence
6	Little Berg River to Vogelvlei weir
7	Sonderend, Du Toits and Elandskloof Rivers upstream and inclusive of Thee Waterskloof Dam
8	Witte River to confluence with Breede River
9	Dwars River to Ceres divisional boundary
10	Olifants River to the Ceres divisional boundary
11	Hlsloot and Smalblaar (or Molenaars) Rivers to their confluence with Breede River
12	Hex River to its confluence with Breede River
13	Van Stadens River to tidal water
14	Buffalo River from its source to where it enters the King Williams Town limits
15	Klipplaat River from its source to Waterdown Dam
16	Swan Kei River to its confluence with the Klipplaat River
17	Great Brak River
18	Bongola River to Bongola Dam
19	Kubusi River to the Stutterheim limitsy
20	Langkloof River from its source to Barkly East limits
21	Kraai River to its confluence with the Langkloof River
22	Little Tsomo River
23	Xuka River to the Elliot limits
24	Tsitsa and Inxu Rivers to their confluence
25	Mvenyane and Mzimvubu Rivers from sources to their confluence
26	Mzintlava River to its confluence with the Mvalweni River
27	ngwangwana River to its confluence with Umzimkulu River
28	Umzimkulu and Polela Rivers to their confluence
29	Elands River to the Pietermaritzburg-Bulwer main road
30	Umtamvuma and Weza Rivers to their confluence
31	Umkomaas and Isinga Rivers to their confluence
32	Lurane River to its confluence with the Umkomaas River
33	Sitnundjwana Spruit to its confluence with the Umkomaas River
34	Inudwini River to the Polela district boundary
35	Inkonza River to the bridge on the Donnybrook-Creighton road
36	Umlaas to the bridge on District Road 334 on the farm Maybole
37	Umgeni and Lions River to their confluence
38	Mod River to the road bridge at Rosetta
39	Little Mooi and Hlatikula Rivers to their confluence
40	Bushmans Fverto Wagendnft Dam
41	Little Tugela Rver and Sterkspruit to their confluence

<b>LISTED WATER RESOURCES</b>	
42	M'Lambonjwa and Mhlawazeni Rivers to their confluence
43	Mnweni and Sandhlwana Rivers to their confluence
44	Tugela Rwer to its confluence with the Kombe Spruit
45	Inyamvubu (or Mnyamvubu) River to Craigie Burn Dam
46	Umvoti River to the bridge on the Seven Oaks-Rietvlei road
47	Yarrow River to its confluence with the Karkloof River
43	Incandu and Ncibidwane Rivers to their confluence
49	Ingogo River to its confluence with the Harte River
50	Pivaan River to its confluence with Soetmelkspruit
51	Slang River and the Wakkerstroom to their confluence
52	Elands and Swartkoppie Spruit to their confluence
53	All tributaries of the Komati River between Nocitgedacht Dam and its confluence with and including Zevenfontein Spruit
54	Seekoeispruit to its confluence with Buffelspruit
55	Crocodile River and Buffelskloofspruit to their confluence
56	All tributaries of the Steelpoort River down to its confluence with and including the Dwars River
57	Potspruit to its confluence with the Waterval River
58	Dorps River (or Spekboom River) to its confluence with the Marambanspruit
59	Ohrigstad River to the Ohrigstad Dam
60	Klein-Spekboorn River to its confluence with the Spekboom River
61	Blyde River to the Pilgrims Rest municipal boundary
62	Sabie River to the Sabie municipal boundary
63	Nels River to the Pilgrims Rest district boundary
64	Houtbosloop River to the Lydenburg district boundary
65	Blinkwaterspruit to Longmeer Dam
66	Assegaai River upstream and inclusive of the Heyshope Dam
67	Komati River upstream and inclusive of the Nooitgedacht Dam and the Vygeboorn Dam
68	Ngwempisi River upstream and inclusive of Jericho Dam and Morgenstond Dam
69	Slang River upstream and inclusive of Zaaihoek Dam
70	All streams flowing into the Olifants River upstream and inclusive of Loskop Darn, Witbank Dam and Middelburg Dam
71	All streams flowing into Ebenezer Dam on the Great Letaba River
72	Dokolewa River to its confluence with the Politzi River
73	Ramadiepa River to the Merensky Dam on the farm Westfalia 223, Letaba
74	Pienaars River and tributaries as far as Klipvoor Darn
75	Crocodile River and tributaries as far as Roodekopjies Dam
76	Elands and Hex River and trrbutaries as far as Vaalkop Dam
77	Molopo River and Tributaries as far as Madimola Dam

RAMSAR LISTED WETLANDS:		PROVINCE	LOCATION
78	Barberspan	North-West	26°33 S 25°37 E
79	Blesbokspruit	Gauteng	26°17 S 28°30 E
80	De Hoop Vlei	Western Cape	34°27 S 20°20 E
81	De Mond (Heuningnes Estuary)	Western Cape	34°43 S 20°07 E
82	Kosi Bay	KwazuluNatal	27°01 S 32°48 E
83	Lake Sibaya	Kwazulu-Natal	27°20 S 32°38 E
84	Langebaan	Western Cape	33°06 S 18°01 E
85	Orange River Mouth	Northern Cape	28°40 S 16°30 E
86	St Lucia System	Kwazulu-Natal	28°00 S 32°28 E
87	Seekoeivlei Nature Reserve	Free State	27°34 S 29°35 E
88	Verlorenvlei	Western Cape	32°24 S 18°26 E
89	Verloren Valel	Mpumalanga	25°14 S 30°4 E
90	Nylsvlei	Northern Cape	24°39 S 28°42 E
91	Wilderness Lakes	Western Cape	33°59 S 22°39 E



**APPENDIX C: SEWAGE SLUDGE MANAGEMENT AS PRESCRIBED BY DWAF 2006**

**Sludge Management and Monitoring**

The stabilized sludge can then be dried and either disposed at the proposed landfill or alternatively, applied as a soil conditioner during rehabilitation of the mine, provided that levels of toxic constituents is sufficiently low. If soil application is adopted, soil contamination should be avoided and the soil standard prescribed by DWAF (2006) should be adhered to. The required limits for the permissible utilisation and disposal of treated sewage sludge as prescribed by the DWAF (2006) are detailed in Appendix D and they including Vol.1 Selection of Management Options; Vol.2 Requirements for the agricultural use of sludge; Vol.3 Requirements for the on-site and off-site disposal of sludge; Vol.4 Requirements for the beneficial use of sludge; and Vol.5: Requirements for the thermal sludge management practices and for commercial products containing sludge.

**VOLUME 1: SELECTION OF MANAGEMENT OPTIONS**

**Table 1a: The South African wastewater sludge classification system**

Classification	Best quality	Intermediate quality	Worse quality
Microbiological class	A	B	C
Stability class	1	2	3
Pollutant class	a	b	c

**Table 1b: Metal limits to determine the pollutant class for the preliminary classification of wastewater sludge to assess possible management options**

Aqua regia extractable metals (mg/kg)		Pollutant class		
		a	b	c
Elements for classification (risk based limits)	Arsenic	<40	40-75	>75
	Cadmium	<40	40-85	> 85
	Chromium	< 1 200	1 200 –3 000	> 3 000
	Copper	< 1 500	1 500-4 300	> 4 300
	Lead	< 300	300-840	> 840
	Mercury	< 15	15-55	> 55
	Nickel	< 420	420	> 420
	Zinc	< 2 800	2 800-7 500	> 7 500
Elements for benchmarking purposes to identify potential risks (20th percentile for class a, between 20th and 80th percentile for class b and 80 <sup>th</sup> percentile values for class c)	Antimony	<1.1	1.1-7	>7
	Boron	<23	23-72	>72
	Barium	<108	108-250	>250
	Beryllium	<0.8	0.8-7	>7
	Cobalt	<5	5-38	>38
	Manganese	<260	260-1225	>1225
	Molybdenum	<4	4 to 12	>12
	Selenium	<5	4 to 12	>12
	Strontium	<84	84-205	>205
	Titanium	<0.03	0.03-0.14	>0.14
	Vanadium	<85	85-430	>430

**VOLUME 2: REQUIREMENTS FOR THE AGRICULTURAL USE OF SLUDGE**

**Table 2a: Pollutant limits for the agricultural use of wastewater sludge in South Africa**

Aqua regia extractable metals	Pollutant class (mg/kg)		
	a	b	c
Arsenic	<40	40-75	>75
Cadmium	< 40	40-85	> 85
Chromium	< 1 200	1 200 –3 000	> 3 000
Copper	< 1 500	1 500-4 300	> 4 300
Lead	< 300	300-840	> 840
Mercury	< 15	15-55	> 55
Nickel	< 420	420	> 420
Zinc	< 2 800	2 800-7 500	> 7 500

Note: A 90% compliance is required to comply with a pollutant class.

**Table 2b: Limits for metals in soils (mg kg-1)**

Parameters	Total investigative level#	Total maximum threshold#	Maximum available threshold*
	(TIL)	(TMT)	(MAT)
Arsenic	2	2	0.014
Cadmium	2	3	0.1
Chromium	80	350	0.1
Copper	100	120	1.2
Mercury	0.5	1	0.007
Nickel	50	150	1.2
Lead	56	100	3.5
Zinc	185	200	5

# - Total digestion method (Aqua regia, EPA 3051)

\* - NH<sub>4</sub>NO<sub>3</sub> extraction method

**VOLUME 3: REQUIREMENTS FOR THE ON-SITE AND OFF-SITE DISPOSAL OF SLUDGE**

**Table 3a: Metal limits based on the TCLP test for the disposal of sludge**

TCLP extractable metals	Pollutant class (mg/l)		
	a	b	c
Arsenic (As)	≤0.43	0.43 – 4.3	>4.3
Cadmium (Cd)	≤0.031	0.031 – 0.31	>0.31
Chromium (Cr III)	≤4.7	4.7 – 47	>47
Chromium (Cr VI)	≤0.02	0.02 – 0.2	>0.2
Copper (Cu)	≤0.1	0.1 – 1	>1
Lead (Pb)	≤0.1	0.1 – 1	>1
Mercury (Hg)	≤0.022	0.022 – 0.22	>0.22
Nickel (Ni)	≤1.14	1.14 – 11.4	>11.4
Zinc (Zn)	≤0.7	0.7 - 7	>7

TCLP - Toxicity Characteristic Leaching Procedure

**VOLUME 4: REQUIREMENTS FOR THE BENEFICIAL USE OF SLUDGE**

**Table 4a: Metal limits for soil receiving high sludge loads**

Parameters	Total Maximum Threshold (TMT)	Maximum permissible level (MPL)
	mg/kg	mg/kg
Arsenic	2	20
Cadmium	3	5
Chromium	350	540
Copper	120	375
Lead	10	150
Mercury	1	9
Nickel	150	200
Zinc	200	700

**VOLUME 5: REQUIREMENTS FOR THE THERMAL SLUDGE MANAGEMENT PRACTICES AND FOR COMMERCIAL PRODUCTS CONTAINING SLUDGE**

No metal limits are stipulated for the thermal treatment of sludge. However, a general risk-based equation is proposed to determine the pollutant limits for sludge destined for complete combustion and co-combustion.

$$C = CRSC \times 86400 / DF \times (1 - CE) \times SF$$

Where:

- C = The pollutant limit (allowable daily concentration of As, Be, Cd, Cr, Pb, Hg or Ni in sludge, in mg/kg of total solids, dry-weight basis)
- CRSC = Chronic Risk Specific Concentration of a pollutant (the allowable increase in the annual average ground-level ambient air concentration for a pollutant at or beyond the property line of the site in  $\mu\text{g}/\text{m}^3$ )
- DF = Dispersion Factor (in  $\mu\text{g}/\text{m}^3/\text{g}/\text{s}$ , based on an annual average air dispersion model)
- CE = Sewage sludge incinerator control efficiency for As, Be, Cd, Cr, Pb, Hg or Ni (in hundredths, based on a performance test)
- SF = Sludge feed rate (in  $\text{ton}_{\text{dry}}/\text{day}$ )
- 86400 = Time conversion factor (number of seconds per day)