SISHEN IRON ORE MINE RETURN WATER DAM: FINAL BASIC ASSESSMENT REPORT

An EOH Company

Technical Report: **BAR-2017-05-22**

Prepared for: **Department of Mineral Resources**

Prepared by: **Exigo Sustainability (Pty) Ltd**

mineral resources

Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

BASIC ASSESSMENT REPORT

And

ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT

SUBMITTED FOR ENVIRONMENTAL AUTHORIZATIONS IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 AND THE NATIONAL ENVIRONMENTAL MANAGEMENT WASTE ACT, 2008 IN RESPECT OF LISTED ACTIVITIES THAT HAVE BEEN TRIGGERED BY APPLICATIONS IN TERMS OF THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT, 2002 (MPRDA) (AS AMENDED).

NAME OF APPLICANT: Sishen Iron Ore Company (Pty) Ltd

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FILE REFERENCE NUMBER SAMRAD: NC 30/5/1/2/2/(106) MR

1. IMPORTANT NOTICE

In terms of the Mineral and Petroleum Resources Development Act (Act 28 of 2002 as amended), the Minister must grant a prospecting or mining right if among others the mining "will not result in unacceptable pollution, ecological degradation or damage to the environment".

Unless an Environmental Authorisation can be granted following the evaluation of an Environmental Impact Assessment and an Environmental Management Programme report in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA), it cannot be concluded that the said activities will not result in unacceptable pollution, ecological degradation or damage to the environment.

In terms of section 16(3)(b) of the EIA Regulations, 2014, any report submitted as part of an application must be prepared in a format that may be determined by the Competent Authority and in terms of section 17 (1) (c) the competent Authority must check whether the application has taken into account any minimum requirements applicable or instructions or guidance provided by the competent authority to the submission of applications.

It is therefore an instruction that the prescribed reports required in respect of applications for an environmental authorisation for listed activities triggered by an application for a right or a permit are submitted in the exact format of, and provide all the information required in terms of, this template. Furthermore please be advised that failure to submit the information required in the format provided in this template will be regarded as a failure to meet the requirements of the Regulation and will lead to the Environmental Authorisation being refused.

It is furthermore an instruction that the Environmental Assessment Practitioner must process and interpret his/her research and analysis and use the findings thereof to compile the information required herein. (Unprocessed supporting information may be attached as appendices). The EAP must ensure that the information required is placed correctly in the relevant sections

of the Report, in the order, and under the provided headings as set out below, and ensure that the report is not cluttered with un-interpreted information and that it unambiguously represents the interpretation of the applicant.

2. Objective of the basic assessment process

The objective of the basic assessment process is to, through a consultative process—

(a) determine the policy and legislative context within which the proposed activity is located and how the activity complies with and responds to the policy and legislative context;

(b) identify the alternatives considered, including the activity, location, and technology alternatives;

(c) describe the need and desirability of the proposed alternatives,

(d) through the undertaking of an impact and risk assessment process inclusive of cumulative impacts which focused on determining the geographical, physical, biological, social, economic, heritage , and cultural sensitivity of the sites and locations within sites and the risk of impact of the proposed activity and technology alternatives on the these aspects to determine:

  (i) the nature, significance, consequence, extent, duration, and probability of the impacts occurring to; and
  (ii) the degree to which these impacts—
    (aa) can be reversed;
    (bb) may cause irreplaceable loss of resources; and
    (cc) can be managed, avoided or mitigated;

(e) through a ranking of the site sensitivities and possible impacts the activity and technology alternatives will impose on the sites and location identified through the life of the activity to—
  (i) identify and motivate a preferred site, activity and technology alternative;
  (ii) identify suitable measures to manage, avoid or mitigate identified impacts; and
  (iii) identify residual risks that need to be managed and monitored.

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ABBREVIATIONS

DAFF	Department of Agriculture, Forestry and Fisheries
DMR	Department of Mineral Resources
DWS	Department of Water & Sanitation
EAP	Environmental Assessment Practitioner
EMPR	Environmental Management Programme Report
Exigo	Exigo Sustainability (Pty) Ltd
I&APs	Interested and Affected Parties
IDP	Integrated Development Programme
IWULA	Integrated Water Use License Application
LOM	Life of Mine
MPRDA	Mineral and Petroleum Resources Development Act (Act 28 of 2002)
NEMA	National Environmental Management Act (Act 107 of 1998)
NFA	National Forest Act (Act 84 of 1998)
NHRA	National Heritage Resources Act (Act 25 of 1999)
NWA	National Water Act (Act 36 of 1998)
SAHRA	South African Heritage Resources Agency
SIOM	Sishen Iron Ore Mine

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PART A

SCOPE OF ASSSSMENT AND BASIC ASSESSMENT REPORT

1 Contact Person and correspondence address

a) Details of:

1.1 The EAP who prepared the report

Name of the Practitioner: Exigo Sustainability (Pty) Ltd (Exigo)

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Fax No. : 086 607 2406

e-mail address: christine@exigo3.com / catherine@exigo3.com

1.2 Expertise of the EAP

1.2.1 The qualifications of the EAP

(with evidence).

Table 6-1: EAP expertise

EAP	Qualifications	Years' experience
Christine Vivier	PhD Environmental Management, M.Org.Leadership (Pr.Sci.Nat) Director (Environmental Assessment Practitioner)	15 years
Catherine Da Camara	BSc. Hons (Animal, Plants and Environmental Sciences); Pr.Sci.Nat	13 years

Qualifications are attached as Appendix 1: EAP's Qualifications

1.2.2 Summary of the EAP's past experience.

(In carrying out the Environmental Impact Assessment Procedure)

The Exigo team is composed of a variety of professionals from various technical backgrounds to address the diverse nature of natural resources-, environmental- and social management with expertise in environmental authorization processes, prospecting and mining authorisation application processes, feasibility studies, water supply investigations, environmental monitoring, compliance investigations, due diligence assessments, closure and rehabilitation plan development, engineering geology, agricultural-, soil-, heritage-, ecological and wetland studies as well as social assessments. Exigo has achieved strong marketplace recognition through:-

- the quality and comprehensiveness of its documentation;

- completion of numerous EIAs, EMPRs, IWULAs, with associated public participation processes, technical reports and due diligence studies, in accordance with both local and international reporting standards;
- strong understanding of critical project issues.

Company profile and CV's are attached under Appendix 2: Company Profile & EAP's Curriculum Vitae

2 Location of the overall activity

Farm Name:	Remaining Extent of Sekgame 461
Application area (Ha)	10 ha
Magisterial district:	John Taolo Gaetsewe District Municipality
Distance and direction from nearest town	5 km South West of Kathu
21 digit Surveyor General Code for each farm portion	C04100000000046100000

2.1 Locality map

*(show nearest town, scale not smaller than 1:250000 attached as **Appendix 3).***

Please refer to Appendix 3: Locality Map and Figure 6-1.

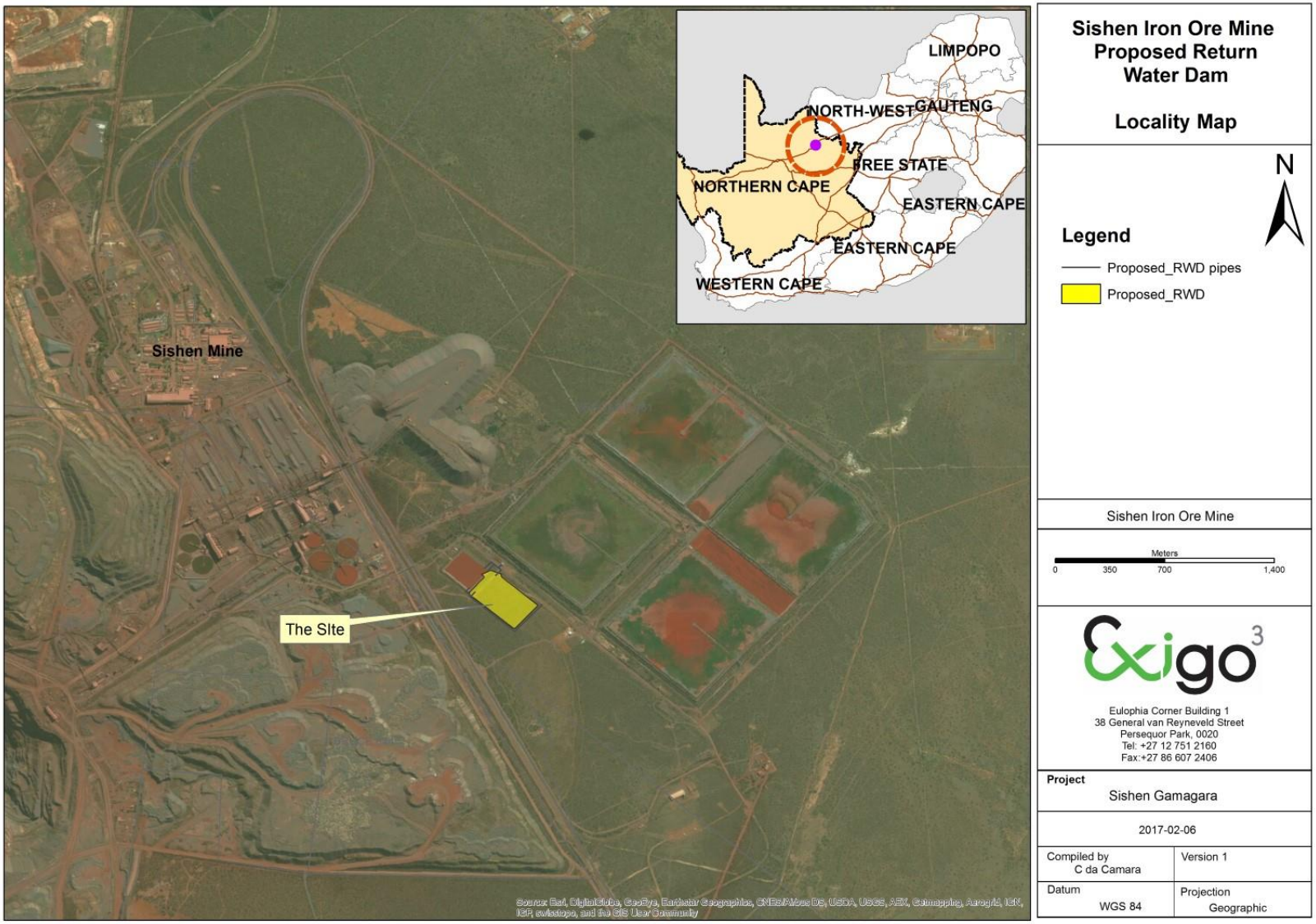

Figure 6-1: Locality Map

Figure 6-2: View of the project area from the north, looking south-west towards the Sishen Mine dumps

Figure 6-3: Surface rock dumps in the project area

Figure 6-4: General surroundings along the eastern periphery of the project area, looking west towards the Sishen Mine plant

Figure 6-5: Sparse surface cover visible in a central portion of the project area

Figure 6-6: View of general surroundings in the project area, looking north towards the existing process water dam

3 Description of the scope of the proposed overall activity.

Provide a plan drawn to a scale acceptable to the competent authority but not less than 1: 10 000 that shows the location, and area (hectares) of all the aforesaid main and listed activities, and infrastructure to be placed on site

Refer to Appendix 4.

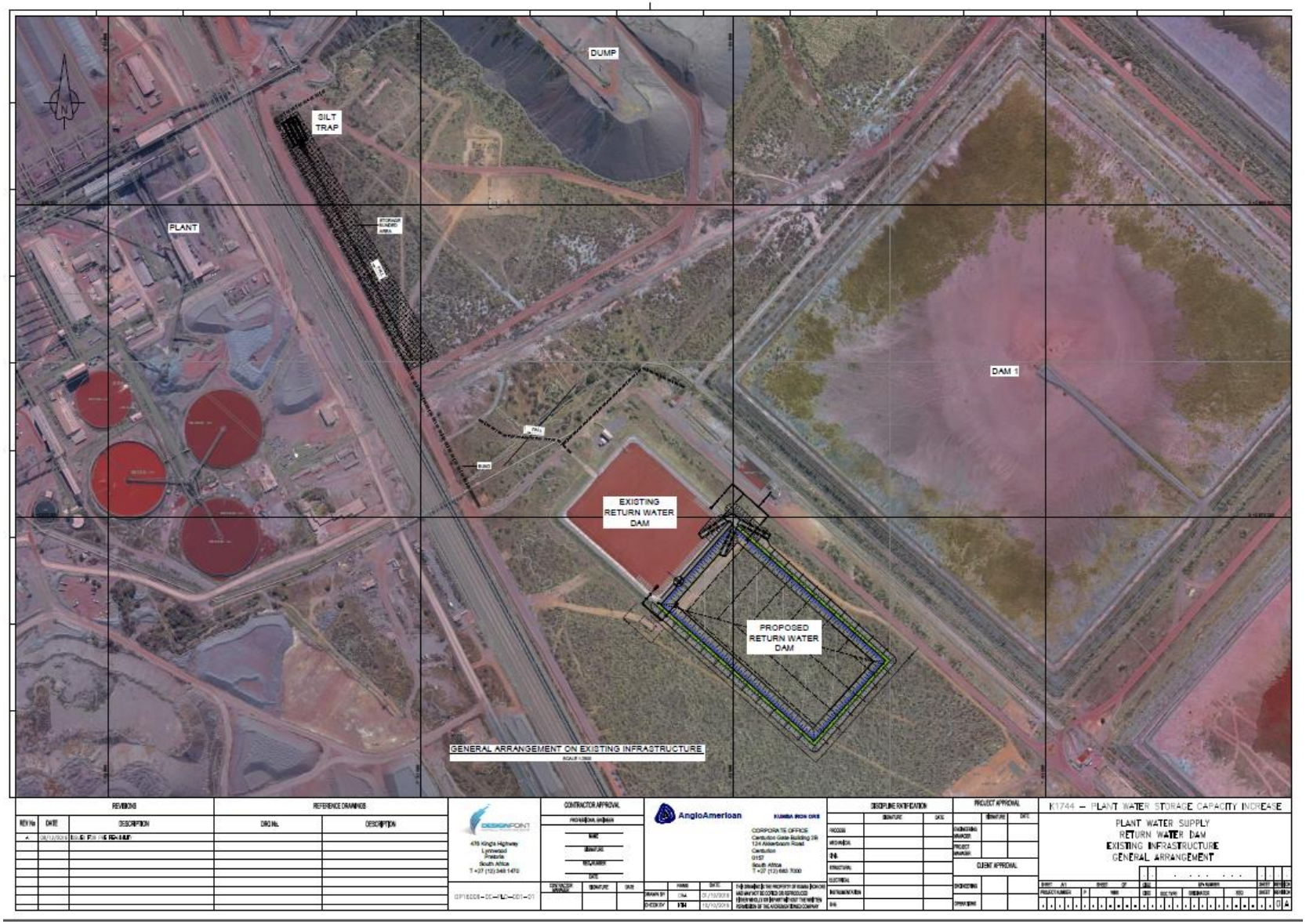

Figure 6-7: Site layout plan

3.1 Listed and specified activities

NAME OF ACTIVITY (E.g. For prospecting - drill site, site camp, ablution facility, accommodation, equipment storage, sample storage, site office, access route etc…etc…etc E.g. for mining,- excavations, blasting, stockpiles, discard dumps or dams, Loading, hauling and transport, Water supply dams and boreholes, accommodation, offices, ablution, stores, workshops, processing plant, storm water control, berms, roads, pipelines, power lines, conveyors, etc…etc…etc.)	Aerial extent of the Activity Ha or m²	LISTED ACTIVITY (Mark with an X where applicable or affected).	APPLICABLE LISTING NOTICE (GNR 544, GNR 545 or GNR 546)	WASTE MANAGEMENT AUTHORISATION (Indicate whether an authorisation is required in terms of the Waste Management Act). (Mark with an X)
Site clearance at project site	8 ha	X	GNR 983, Activity 27	-
Temporary Site Camp	+/- 250m^2	-	-	-
Construction of the Return Water Dam	8 ha and 250 000 m^3	X	GNR 983, Activity 34 and, 50	-
New inlet and outlet piping	Approximately 400 m	-	-	-
Storage of decant water from the tailings dams and treated effluent from the Municipal wastewater treatment works	8 ha and 250 000 m^3	X	GNR 983, Activity 34	

3.2 Description of the activities to be undertaken

(Describe Methodology or technology to be employed, and for a linear activity, a description of the route of the activity

A new return water dam (RWD) is proposed at the Sishen Iron Ore Mine (SIOM). The proposed RWD will be constructed immediately adjacent to the existing RWD and it is therefore reffered to as an expansion, as per the NEMA Regulations (2014) which states:

- ***"expansion"*** *means the modification, extension, alteration or upgrading of a facility, structure or infrastructure at which an activity takes place in such a manner that the capacity of the facility or the footprint of the activity is increased.*

The proposed RWD will be filled with decant water from the tailings dams and treated effluent from the Municipal wastewater treatment works. The capacity of the new dam will be 151 000 m^3. The total volume of both dams (new and extension) will be 250 000 m^3. The dam wall will be less than 5m in height.

The alernative option requies the new dam extension to have a capacity of 250 000m^3. Refer to Section 7.1.3.

The study area for the RWD occurs on the south-western side of the existing tailings dam on the farm RE of Sekgame 461.

3.2.1 Access Roads

The existing access road will be used.

4 Policy and Legislative Context

The legislation in the following table may be relevant to the project.

Any permits or authorizations that may be required under other legislation needs to be considered and adhered to as may be relevant.

APPLICABLE LEGISLATION AND GUIDELINES USED TO COMPILE THE REPORT (a description of the policy and legislative context within which the development is proposed including an identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks and instruments that are applicable to this activity and are to be considered in the assessment process)	**REFERENCE WHERE APPLIED**
Legislation	
The Constitution of the Republic of South Africa (Act 108 of 1996) Section 2 of the Constitution of the Republic of South Africa (Act 108 of 1996) (CA) states that: "This Constitution is the supreme law of the Republic; law or conduct inconsistent with it is invalid, and the obligations imposed by it must be fulfilled." Section 24 of the CA, states that everyone has the right to an environment that is not harmful to their health or well-being and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that: • prevent pollution and ecological degradation; • promote conservation; and • secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development. Section 24 guarantees the protection of the environment through reasonable legislative (and other measures) and such legislation is continuously in the process of being promulgated. Section 33(1) concerns administrative justice which includes the constitutional right to administrative action that is lawful, reasonable and procedurally fair.	The BAR was accordingly prepared, submitted and considered within the constitutional framework set by inter alia section 24 and 33 of the Constitution.
The National Environmental Management Act (107 of 1998) and the Environmental Impact Assessment Regulations, 2014 The overarching principle of the National Environmental Management Act 1998 (Act 107 of 1998) (NEMA) is sustainable development. It defines sustainability as meaning the integration of social, economic and environmental factors into planning, implementation and decision making so as to ensure the development serves present and future generations. Section 2 of NEMA (Act no 107 of 1989) provides for National Environmental Management Principles. These principles include: • Environmental management must place people and their needs at the forefront of its concern. • Development must be socially, environmentally and economically sustainable. • Environmental management must be integrated, acknowledging that all elements of the environment are	A new application needs to be submitted to the DMR in line with the provisions contained in GNR 982 (EIA Regulations 2014). An environmental authorisation application in terms of section 24 of the NEMA has been submitted to the Department of Mineral Resources: Eastern Cape Region (DMR) for consideration (Application submitted to DMR on 22 February 2017). The activities specified above in section 3.2 were identified as being applicable to the proposed project, and were included in the application submitted to the DMR. The Draft BAR was distributed for public review on the 13 April 2017 for a period

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linked and interrelated. • Environmental justice must be pursued. • Equitable access to environmental resources, benefits and services to meet basic human needs and ensure human wellbeing must be pursued. • Responsibility for the environmental health and safety consequences of a policy, programme, project, product, process, service or activity exists throughout its life cycle. • The participation of all Interested and Affected Parties (I&APs) in environmental governance must be promoted. • Decisions must take into account the interests, needs and values of all I&APs. • The social, economic and environmental impacts of activities, including disadvantages and benefits, must be considered, assessed and evaluated, and decisions must be appropriate in the light of such consideration and assessment. • Decisions must be taken in an open and transparent manner, and access to information must be provided in accordance with the law. • The environment is held in public trust for the people, the beneficial use of environmental resources must serve the public interest and the environment must be protected as the people's common heritage. • The costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment. The Environmental Impact Assessment (EIA) process to be undertaken in respect of the authorization process of the proposed mining operations is in compliance with the MPRDA, as well as the NEMA read with the Environmental Impact Assessment Regulations of 2014 (Government Notice No's R982, 983, 984 and 985 of 2014). The proposed development involves 'listed activities', as identified in terms of the NEMA and in terms of section 24(1), the potential consequences for or impacts on the environment of inter alia listed activities must be considered, investigated, assessed and reported on to the Minster of Mineral Resources or to the relevant office of the Department responsible for mineral resources, except in respect of those activities that may commence without having to obtain an environmental authorisation in terms of the NEMA.	of 30 days (13 April 2017 to 19 May 2017) as part of the environmental impact assessment process.
Mineral and Petroleum Resources Development Act, 2002 (Act No 28 of 2002)	The Application was prepared and submitted according to the provisions of

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Previously South African mineral rights were owned either by the State or the private sector. This dual ownership system represented an entry barrier to potential new investors. The current Government's objective is for all mineral rights to be vested in the State, with due regard to constitutional ownership rights and security of tenure. The MPRDA was passed in order to make provision for equitable access to and sustainable development of the nation's mineral and petroleum resources, and to provide for matters connected therewith. The Preamble to the MPRDA inter alia affirms the State's obligation to: • protect the environment for the benefit of present and future generations; • ensure ecologically sustainable development of mineral and petroleum resources; and • promote economic and social development. The aforesaid preamble affirms the general right to an environment provided for in section 24 of the Constitution (as set out hereinabove). The objects of the MPRDA, as set out in section 2 thereof serve as a guide to the interpretation of the Act. The objects of the MPRDA are as follows: • recognise the internationally accepted right of the State to exercise sovereignty over all the mineral and petroleum resources within the Republic; • give effect to the principle of the State's custodianship of the nation's mineral and petroleum resources; • promote equitable access to the nation's mineral and petroleum resources to all the people of South Africa; • substantially and meaningfully expand opportunities for historically disadvantaged persons, including women, to enter the mineral and petroleum industries and to benefit from the exploitation of the nation's mineral and petroleum resources; • promote economic growth and mineral and petroleum resources development in the Republic; • promote employment and advance the social and economic welfare of all South Africans; • provide for security of tenure in respect of prospecting, exploration, mining and production operations; • give effect to section 24 of the Constitution by ensuring that the nation's mineral and petroleum resources are developed in an orderly and ecologically sustainable manner while promoting justifiable social and economic development; and • ensure that holders of mining and production rights contribute towards the socio-economic development of	this legislation. The legislation will be heeded throughout the proposed mining operations and will be considered in the compilation of the EMPr.

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the areas in which they are operating. The national environmental management principles provided for in section 2 of the NEMA apply to all prospecting and mining operations and any matter relating to such operation. These principles apply throughout the Republic to the actions of all organs of state including inter alia the Department of Mineral Resources that may significantly affect the environment. Any prospecting or mining operation must be conducted in accordance with generally accepted principles of sustainable development by integrating social, economic and environmental factors into the planning and implementation of prospecting and mining projects in order to ensure that exploitation of mineral resources serves present and future generations. Section 38 of the MPRDA states that the holder of inter alia, a prospecting right, mining right or mining permit: • Must at all times give effect to the general objectives of integrated environmental management laid down in Chapter 5 of NEMA; • Must consider, investigate, assess and communicate the impact of his or her prospecting or mining on the environment as contemplated in section 24(7) of NEMA; • Must manage all environmental impacts – - In accordance with an environmental management plan or approved environmental management programme, where appropriate, and - As an integral part of the prospecting or mining operations, unless the Minister directs otherwise. • Must as far as reasonably practicable, rehabilitate the environment affected by the prospecting or mining operations to its natural or predetermined state or to a land use which conforms to the generally accepted principle of sustainable development; and • Is responsible for any environmental damage, pollution or ecological degradation as a result of prospecting or mining operations and which may occur inside and outside the boundaries of the area to which such right, permit or permission relates.	
National Water Act (Act No 36 of 1998) [NWA] In terms of the NWA, the national government, acting through the Minister of Water and Environmental Affairs (previously the Minister of Water Affairs and Forestry), is the public trustee of South Africa's water resources, and must ensure that water is protected, used, development, conserved, managed and controlled in a sustainable and equitable manner for the benefit of all persons (section 3(1)).	In terms of Section 22 of the National Water Act (NWA) a person may only use water without a license under certain circumstances. All other use, provided that such use qualify as a use listed in section 21 of the Act, require a water use license. A person may only use water without a license if such water use is

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In terms of the NWA a person may only use water without a license under certain circumstances. All other use, provided that such use qualify as a use listed in section 21 of the Act, require a water use license. A person may only use water without a license if such water use is permissible under Schedule 1 (generally domestic type use) if that water use constitutes a continuation of an existing lawful water use (water uses being undertaken prior to the commencement of the NWA, generally in terms of the Water Act of 1956), or if that water use is permissible in terms of a general authorisation issued under section 39 (general authorisations allow for the use of certain section 21 uses provided that the criteria and thresholds described in the general authorisation is met). Permissible water use furthermore includes water use authorised by a license issued in terms of the NWA. Section 21 of the NWA indicates that "water use" includes: • taking water from a water resource (section 21(a)); • storing water (section 21(b)); • impeding or diverting the flow of water in a water course (section 21(c)); • engaging in a stream flow reduction activity contemplated in section 36 (section 21(d)); • engaging in a controlled activity which has either been declared as such or is identified in section 37(1) (section 21(e)); • discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit (section 21(f)); • disposing of waste in a manner which may detrimentally impact on a water resource (section 21(g); • disposing in any manner of water which contains waste from, or which has heated in, any industrial or power generation process (section 21 (h)); • altering the bed, banks, course or characteristics of a water course (section 21(i)); • removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people (section 21(j)); and • using water for recreational purposes (section 21(k)).	permissible under Schedule 1 (generally domestic type use), if that water use constitutes a continuation of an existing lawful water use (water uses being undertaken prior to the commencement of the NWA, generally in terms of the Water Act of 1956), or if that water use is permissible in terms of a general authorisation issued under section 39 (general authorisations allow for the use of certain section 21 uses provided that the criteria and thresholds described in the general authorisation is met). The project will require water use licensing in terms of Section 21 g of the NWA (Storage of water containing waste in a settling dam). A water use license application was be submitted to the Department of Water and Sanitation.
National Heritage Resources Act (Act 25 of 1999) (NHRA) The NHRA established the South African Heritage Resources Agency (SAHRA) as well as provincial heritage resources agencies. In terms of the NHRA, no person may destroy, damage, deface, excavate, alter, remove from its original position, subdivide or change the planning status of any heritage site	SAHRA will be notified of the project and all necessary information will be provided. A heritage impact assessment was undertaken for the project area (Appendix 7). Isolated heritage resources of low significance occur within the Project area.

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without a permit issued by the heritage resources authority responsible for the protection of such site. No person may damage, disfigure, alter, subdivide or in any other way develop any part of a protected area unless, at least 60 days prior to the initiation of such changes, he/she/it has consulted with the relevant heritage resources authority. Section 34 of the NHRA provides for the protection of immovable property by providing for a prohibition on altering or demolishing any structure or part of any structure, which is older than 60 years, without a permit issued by the relevant provincial heritage resources authority. Accordingly, should the proposed activities, prospecting or mining activities or the closure and rehabilitation of mined land involve the altering or demolishing of any structure or part of any structure, which is older than 60 years, a permit issued by the relevant provincial heritage resources authority is required. No person may, without a permit issued by the responsible heritage resources authority destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite; destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite; trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites. No person may, without a permit issued by SAHRA or a provincial heritage resources authority destroy, damage, alter, exhume or remove from its original position or otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves; destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority; or bring onto or use at the burial ground or grave referred to above any excavation equipment or any equipment which assists in the detection or recovery of metals. Section 38 of the NHRA states that any person who intends to undertake developments categorised in Section 38 of the NHRA must at the very earliest stages of initiating such development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development. By way of example, the developments	The intensity of impact on the general heritage landscape is considered to be low and it is the opinion of the author of this Archaeological Impact Assessment Report that the proposed project may proceed from a culture resources management perspective, subject to the implementation of recommendations and provided that no subsurface heritage remains are encountered during construction.

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referred to in Section 38 of the NHRA include: • the construction of a road, wall, power-line, pipeline, canal or other similar form of linear development or barrier exceeding 300 metres in length; • the construction of a bridge or similar structure exceeding 50 metres in length; • any development or other activity which will change the character of a site as specified in the regulations; • any other category of development provided for in regulations by SAHRA or the provincial heritage resources authority. However, the abovementioned provisions are subject to the exclusion that section 38 does not apply to a development as described in subsection (1) if an evaluation of the impact of such development on heritage resources is required in terms of the Environment Conservation Act 73 of 1989 (now presumably the NEMA in view of the repeal of the listed activities under the ECA): Provided that the consenting authority must ensure that the evaluation fulfils the requirements of the relevant heritage resources authority in terms of subsection (3), and any comments and recommendations of the relevant heritage resources authority with regard to such development have been taken into account prior to the granting of the consent. Based on the archaeological findings on site the NHRA and the associated permitting process may be applicable to this project. An Archaeological Impact Assessment will be conducted for the project.	
Integrated Development Plans	
Gamagara Local Municipality has become a significant player in the Northern Cape Province and an important contributor to South Africa's mining sector, and international mining value chain. Thus making it a centre of concentration on the development for providing relevant and up to date infrastructure to accommodate such development. The municipality has identified the economic pull and push factors, such as education and training, research, entrepreneurship, community image and the arts. Gamagara has planned to develop into a commercial and industrial town over and above the mining economic spin-offs. It has a potential to develop into a City as envisioned by Council. (Gamagara Local Municipality IDP 2015-2017).	The purpose of the project is to ensure the separation of clean and dirty water in terms of Regulation GN704 and to ensure improved management of environmental impacts at the Sishen Mine. The project can be considered to be in line with the IDP due to the contribution of the project to the improved environmental management at Sishen Mine.

5 Need and desirability of the proposed activities.

(Motivate the need and desirability of the proposed development including the need and desirability of the activity in the context of the preferred location).

The Sishen mine near Kathu is one of the largest open-cast iron mines in the world. The mine is the Northern Cape's largest employer (www.northerncapebusiness.co.za), and a major trainer of artisans in South Africa. Having identified skills shortages as one of the key hindrances to economic growth in the area, Sishen mine has one of the few fully accredited institutions in South Africa that provides outstanding theoretical and practical training (www.kumba.co.za). The sheer scale of the mine means it has a significant impact socially, environmentally and economically. The mine recognises its role in the community and it works closely with local and district municipalities and other stakeholders to participate in the integrated development plan (IDP).

The project can be considered to be in line with the IDP due to the contribution of the project to the improved environmental management at Sishen Mine.

The Department of Water and Sanitation (DWS) requires mine's to separate clean and dirty storm water under Regulation GN704.

On-going consultations with DWS at both a regional and national level have confirmed the DWS requirements and the mine has recently embarked on a process to implement measures for the more effective management of storm water and pollution control at its Sishen operations. This will improve both the protection of the environment and water resources.

Furthermore, the facilities will also create the opportunity for the control of any residual hydrocarbon pollution potentially contaminating storm water.

The separation of clean and dirty water at Sishen Mine will prevent contaminated water from discharging into the environment and the Gamagara River.

The impacts assessed do not have a rating higher than "Moderate". However all impacts can be mitigated and contained on site by implementing and complying to the Environmental Management Programme. The impacts can be mitigated to "Low" or "Negligible.

Benefits of the existing Sishen Mine to date have included:

- Employment opportunities at the mine.
- Upliftment of the surrounding communities through community projects.
- Supply of iron ore to the local, national, and international markets, and therefore contribution to local, provincial and national economies.

6 Motivation for the overall preferred site, activities and technology alternative

The main aim of this project is to extend the existing RWD on the Sishen Mine site to increase the available process water storage available for the Sishen beneficiation plants, with the following objectives:

- To create water surety on the mine (buffer storage capacity for plant use) during times of low borehole yields, increased operational demands or reduced return water from the tailings;

- Ensure a continuous supply of water to the process facility; hence minimising the risk of standing time or down time if water is not available.
- To create buffer storage capacity for plant use to reduce the dependency on groundwater, to remain within the groundwater use limits set by the mine's water use license, and improve the reliability of supply of groundwater to the regional water supply system.
- To construct a dam with evaporation control and lining to ensure that losses are minimised.
- Ensure adherence to Sishen's agreement with Department of Water and Sanitation (DWS) and Anglo American Water Management Standard; to optimise water management.
- To create a dam that will integrate with the existing return water system at Sishen.

7 Full description of the process followed to reach the proposed preferred alternatives within the site.

NB!! – This section is about the determination of the specific site layout and the location of infrastructure and activities on site, having taken into consideration the issues raised by interested and affected parties, and the consideration of alternatives to the initially proposed site layout.

7.1 Details of all alternatives considered

With reference to the site plan provided as Appendix 4 and the location of the individual activities on site, provide details of the alternatives considered with respect to:

(a) the property on which or location where it is proposed to undertake the activity;

(b) the type of activity to be undertaken;

(c) the design or layout of the activity;

(d) the technology to be used in the activity;

(e) the operational aspects of the activity; and

(f) the option of not implementing the activity

7.1.1 The property on which or location where it is proposed to undertake the activity

The alternative property or location for additional plant water storage was evaluated for a new Groundwater Dam located to the North of the mine near Kathu. The Groundwater Dam could store surplus groundwater discharged from the mine for later use either on the mine, or for the Gamagara Municipality. It however lacked the ability to store other sources of water such as treated effluent from the Municipal wastewater treatment works due to water quality limitations. As such it did not support the mine's strategy to prioritise the use of lower quality water before groundwater is utilised.

7.1.2 The type of activity to be undertaken

There are no alternatives with regards to the type of activity as the project involves the storage of water.

7.1.3 The design or layout of the activity

Alternative 1: Preferred Alternative

The current dam design and the drawings are based on this option (Figure 6-7). This is the preferred alternative due to the following reasons:

- It can be integrated with the mine's existing return water system. This includes the recovery and recycling of water off the tailings dam, runoff captured in storm water dams and treated effluent from the Municipal wastewater treatment works.
- The dam will be a process water buffer dam, and will be operated at or close to full capacity to ensure sufficient process water buffer capacity is available throughout the year.
- Although no dedicated storm water storage capacity is provided for in the dam itself, the frequency of overflows can be managed and mitigated by changing the control levels in the dam through the year. By allowing the RWD to be drawn down to 80% in December after the critical dry months on the mine, the 20% free capacity could then be allocated for storm water storage over the rainy season when the buffer storage of process water is less critical. This significantly reduces the frequency of any spillages from the dam. For the rest of the year (outside of the rainy season), the dam is operated at full capacity.
- Large storm events may still result in spillages from the RWD, however these will report to the Sishen storm water system. Overflows will flow down to the Eastern Storm water Sump (part of the mine's pollution control and storm water management system), where it can be recovered back to the process.
- This option requires the new dam extension to have a capacity of 151 000m^3.

Alternative 2

The alternative option would allow for process water storage as with option 1, but with an additional allowance above the normal operating level that would be dedicated to storm water storage.

- The storm water provision above the normal operating level is sized to store a 1 in 50 year flood from the tailings dam. The total useable process and storm water storage between the new and proposed return water dams would be 345 000m^3.
- This means that the new dam extension requires a capacity of 250 000m^3.
- This option requires a larger dam to manage storm water at source, and removes the interaction between the return water system and the wider Sishen storm water management system. The storm water management system for Sishen has already been planned and designed to manage the storm water arising from the mine, and to control the water quality of any discharges to the environment. Storm water discharges from the return water dam will be diluted sufficiently in the downstream silt traps and eastern storm water sump to meet environmental discharge limits. A monitoring programme will monitor the quality of discharges to confirm compliance, and if necessary an additional storm water dam is planned to the north of the mine to contain storm water from the full mining operation.
- The increase in the return water dam to accommodate storm water from the tailings dams is consequently not seen as offering significant benefits for water quality leaving the mine, as this will be managed in the wider Sishen storm water system.

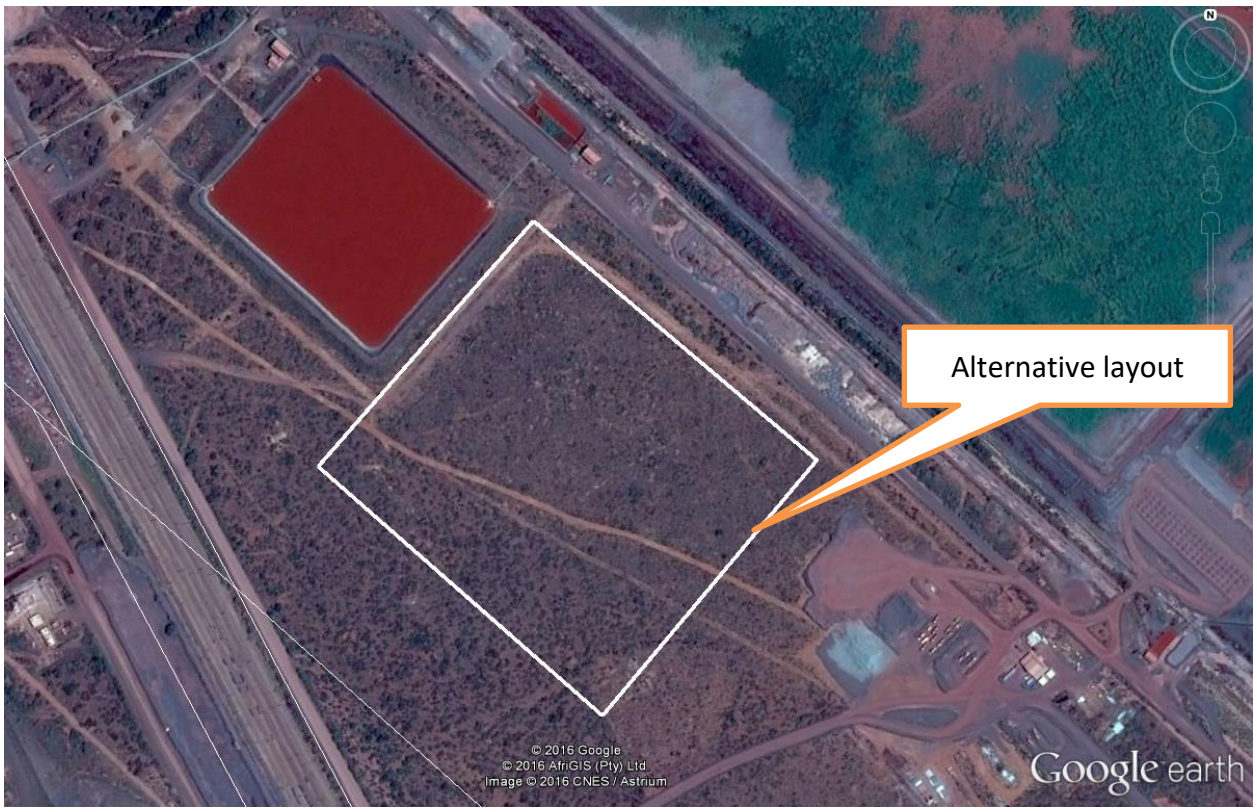


Figure 7-1: Alternative Layout – indicated as white line

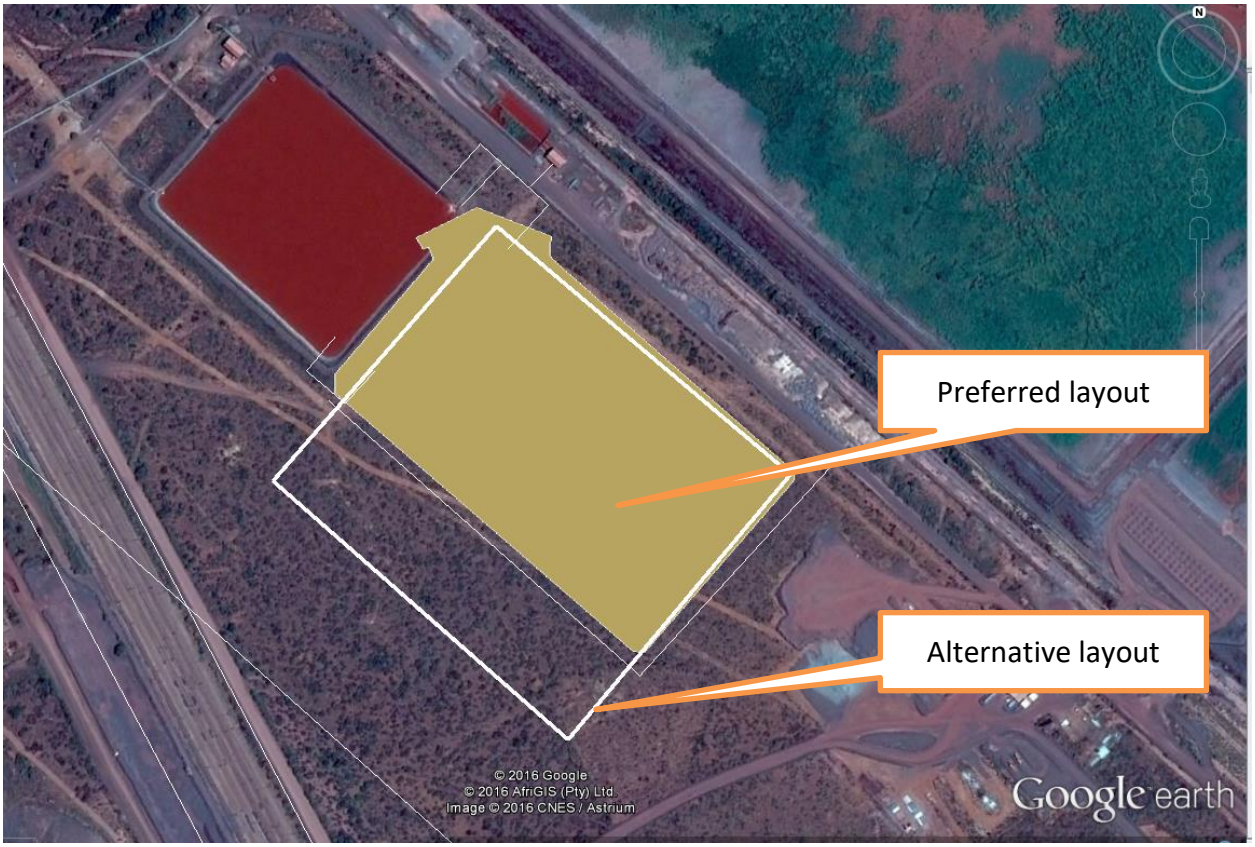


Figure 7-2: Alternative Layout overlain with preferred alternative

7.1.4 The technology to be used in the activity

There are no alternatives with regards to the technology to be used in the activity.

7.1.5 The option of not implementing the activity

The RWD is being developed to allow for sufficient storage for decant water from the tailings dams and treated effluent from the Municipal wastewater treatment works. If the RWD is not developed this will result in negative impacts on water quality as the treated effluent will be stored in the Groundwater Dam

8 Details of the Public Participation Process Followed

Describe the process undertaken to consult interested and affected parties including public meetings and one on one consultation. NB the affected parties must be specifically consulted regardless of whether or not they attended public meetings. (Information to be provided to affected parties must include sufficient detail of the intended operation to enable them to assess what impact the activities will have on them or on the use of their land.

The following process was undertaken to facilitate the public participation for the proposed project:

8.1 Newspaper Advertisement

A newspaper advertisement notifying the public of the application and requesting I&AP's to register their comments with Exigo was placed in the Kathu Gazette on 24 February 2017.

8.2 Site notices

In order to inform surrounding communities and adjacent landowners of the proposed project; site notice boards were placed at the following locations:

- Kathu Foodzone
- Sishen mine entrance (Permit office).

8.3 Direct Notification of Identified I&AP's

Key stakeholders, who include the following sectors, were directly informed of the proposed project by means of registered mail, faxes and emails on 24 February 2017:

- Northern Cape Department of Environment and Nature Conservation (DENC)
- Northern Cape Department of Mineral Resources (DMR)
- Northern Cape Department of Water and Sanitation (DWS)
- Department of Agriculture, Forestry and Fisheries (DAFF)

Local Authorities:

- Gamagara Local Municipality
- John Taolo Gaestsewe District Municipality

List of Government Agencies identified

- South African Heritage Resource Agency (SAHRA)
- Eskom Distribution North Western Region
- Transnet Freight Rail

- Tshiping Water Users Association (WUA)
- Agri Kuruman
- McGregor Museum
- Sedibeng Water
- Wildlife and Environment Society of South Africa (WESSA) - Northern Cape Region

The proof of notification is included in Appendix 9.

8.4 Draft Basic Assessment Report (DBAR)

The EIA Regulations specify that the BAR must be subjected to a public participation process of at least 30 days. A period of 30 days (from the 13 April 2017 to 19 May 2017) was made available for public comment on the Draft BAR as part of the environmental impact assessment process.

The DBAR was distributed for comment as follows:

- Electronic copies were made available on dropbox or email; and
- Hard copies were available on request.

8.5 Final Basic Assessment Report

The final BAR has been updated after the draft review to incorporate any comments received and issues raised by I&APs.

8.6 Summary of issues raised by I&APs

(Complete the table summarising comments and issues raised, and reaction to those responses)

Table 8-1: Summary of issues raised

Interested And Affected Parties Contact Person	Organisation / Company	Date	Notifications/Comments Received	EAP's response to issues as mandated by the applicant	Section and paragraph reference in this report where the issues and or response were incorporated
Government Departments and authorities					
Viljoen Mothibi	Department of Agriculture, Land Reform and Rural Development	23/02/2017	No comments received to date	n/a	
Gail Parker	Department of Agriculture, Land Reform and Rural Development	23/02/2017	No comments received to date	n/a	
Felicity van Heerden	Department of Agriculture, Land Reform and Rural Development	23/02/2017	No comments received to date	n/a	
Jacoline Mans	Department of Agriculture, Forestry and Fisheries	23/02/2017	No comments received to date	n/a	
Abe Abrahams	Department of Water and Sanitation	23/02/2017	No comments received to date	n/a	
Gerrie van Wyk	Department of Water and Sanitation	23/02/2017	No comments received to date	n/a	
Ms J Meyer	Development Planning, Provincial Support.	23/02/2017	No comments received to date	n/a	
Masibulele Mvana	Northern Cape Department of Environmental Affairs and Nature Conservation	23/02/2017	No comments received to date	n/a	
Sylvia Lucas	Northern Cape Department of Environmental Affairs and Nature Conservation	23/02/2017	No comments received to date	n/a	

Interested And Affected Parties Contact Person	Organisation / Company	Date	Notifications/Comments Received	EAP's response to issues as mandated by the applicant	Section and paragraph reference in this report where the issues and or response were incorporated
Raisibe Sekepane	DMR Northern Cape	23/02/2017	No comments received to date	n/a	
Bryan Fisher	Northern Cape Department of Environmental Affairs and Nature Conservation	23/02/2017	No comments received to date	n/a	
LOCAL AUTHORITIES					
Municipal Manager	Gamagara Local Municipality	23/02/2017	No comments received to date	n/a	
Malodi Rakoi	Gamagara Local Municipality	23/02/2017	No comments received to date	n/a	
Johan Burger	Gamagara Local Municipality – town planning officer	23/02/2017	No comments received to date	n/a	
Municipal Manager	John Taolo Gaestsewe district Municipality	23/02/2017	No comments received to date	n/a	
Service providers					
Hoffie Joubert	Agri Northern Cape	23/02/2017	No comments received to date	n/a	
Andrea van Gensen	Eskom	23/02/2017	No comments received to date	n/a	
Mr D Maleke	Sedibeng Water	23/02/2017	No comments received to date	n/a	
Jaco Hanekom Senior Property Technician	Transnet Freight Rail	02/032017	Via email: Mr Hanekom replied with the following comment: • **Transnet land (the Sishen –**	Ms Catherine Da Camara replied and thanked Transnet for their comments on the project	Section 9.14

Interested And Affected Parties Contact Person	Organisation / Company	Date	Notifications/Comments Received	EAP's response to issues as mandated by the applicant	Section and paragraph reference in this report where the issues and or response were incorporated
			Saldanha Iron Ore line) will not be directly affected by this proposal. • This office in principle has no objection to the proposed application. • See attached Google Earth image indicating Transnet cadastral boundaries (bordered green) in relation to the proposed development. • Our office's reference: SBS0298		
Gilbert Nortier Depot Engineering Manager	Transnet Freight Rail	23/02/2017	No comments received to date	n/a	
Marina Lourens	Transnet Freight Rail	23/02/2017	No comments received to date	n/a	
Mr Livhuwani Wilson Ndou	Transnet Freight Rail – Risk Department	23/02/2017	No comments received to date	n/a	
Albertus Viljoen	Tshiping Water user Association	23/02/2017	Via email: Mr Viljoen replied on 3 April 2017 asking when they plan to start with the process. Via email: Mr Viljoen replied on 4 April 2017 that he shall provide input as the process gets underway.	Via email: On 4 April 2017 Ms Da Camara replied and stated that the Draft Bar will soon be placed on public review, and that she will register Tshiping Water User Association on the project database.	n/a
Mr. J Markram	Agri Kuruman	23/02/2017	No comments received to date	n/a	
ADJACENT LANDOWNERS					
Adjacent landowners are Transnet, Eskom and Gamagara Local Municipality (see above).					

Interested And Affected Parties Contact Person	Organisation / Company	Date	Notifications/Comments Received	EAP's response to issues as mandated by the applicant	Section and paragraph reference in this report where the issues and or response were incorporated
OTHER INTERESTED AND AFFECTED PARTIES					
Morgan Griffiths	WESSA Port Elizabeth	23 February 2017	An email was received regarding correct contact details for WESSA	The database was updated with the correct details	
Tania Anderson	WESSA: NC Conservation	23 February 2017	No comments received to date	n/a	
Sunet Swanpoel	McGregor Museum	23 February 2017	An email was received regarding correct contact details for The McGregor Museum	The database was updated with the correct details	

9 The Environmental attributes associated with the sites

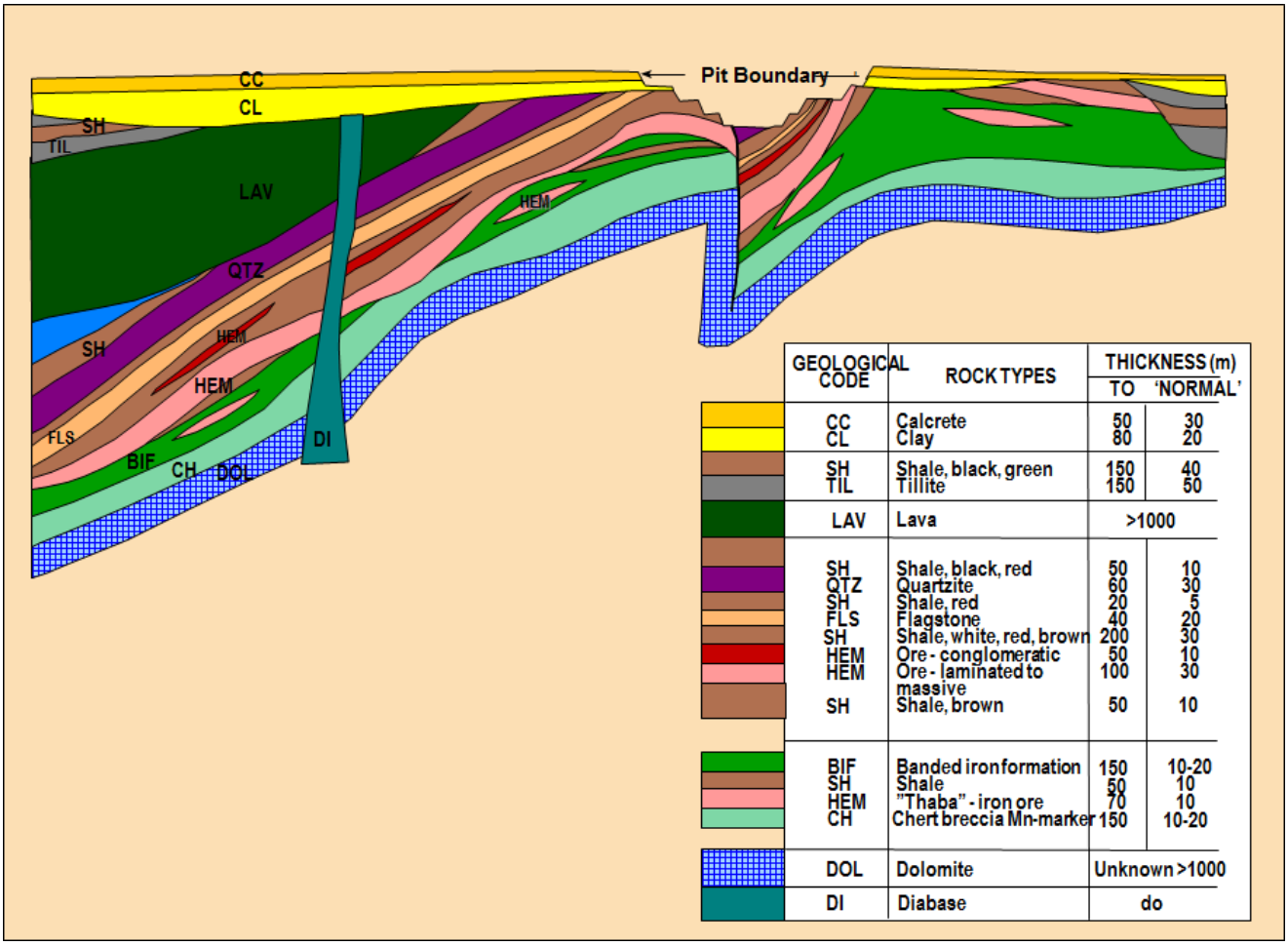
Baseline Environment

9.1 Type of environment affected by the proposed activity

(its current geographical, physical, biological, socio- economic, and cultural character).

9.2 Geology

The Sishen iron ore deposits are the Superior-type banded iron formations (BIFs) of the Transvaal Supergroup lithologies. The Transvaal Supergroup rocks were deposited in two related sedimentary basins, one in an extensive continental shelf environment and the other in an intra-continental sea, both situated on the present Kaapvaal Craton. The Griqualand West basin occurs on the western margin of the Kaapvaal Craton and hosts the largest high-grade hematite ore on the Southern African continent. The iron ore deposits occur in the Transvaal and Olifantshoek Supergroups and form a regional anticlinal structure termed the Maremane Dome. Due to the Maremane Dome, the geological succession dips to the west so that mining becomes deeper. The SIOM is located at the northern end of the Maremane anticline, with the Beeshoek Mine and Kolomela Mine at the southern end (Figure 8-1).



GEOLOGICAL CODE	ROCK TYPES	THICKNESS (m) TO	'NORMAL'
CC	Calcrete	50	30
CL	Clay	80	20
SH	Shale, black, green	150	40
TIL	Tillite	150	50
LAV	Lava	>1000	
SH	Shale, black, red	50	10
QTZ	Quartzite	60	30
SH	Shale, red	20	5
FLS	Flagstone	40	20
SH	Shale, white, red, brown	200	30
HEM	Ore - conglomeratic	50	10
HEM	Ore - laminated to massive	100	30
SH	Shale, brown	50	10
BIF	Banded iron formation	150	10-20
SH	Shale	50	10
HEM	"Thaba" - iron ore	70	10
CH	Chert breccia Mn-marker	150	10-20
DOL	Dolomite	Unknown >1000	
DI	Diabase	do	

Figure 8-1: General regional West-East cross-section at the Sishen Mine (Kotze, 2012)

9.3 Climate

9.3.1 Regional Climate

In terms of the climatic region, the proposed project site falls within the Kalahari Bushveld Region (South African Weather Service, Climatic Regions). Climatic conditions consist of warm summers with moderate but very dry winters (SIOM EMPR; 2002).

9.3.2 Rainfall and evaporation

The mean annual precipitation (MAP) of the Sishen North Mine is 387 mm/a as measured from 1963 to 2016 (Figure 8-2). The average evaporation rate is very high at 2276 mm/a, which is almost six times the MAP. Precipitation occurs mainly in the summer months during thunder storms with the peak rainy season occurring from December to March. Most precipitation occurs in the form of thunderstorms. The driest months are June to August. The area is classified as semi-arid with hot days and cold nights. The summer average minimum and maximum temperatures are 18°C and 37°C respectively and the winter night-day average temperatures are 3°C and 21°C respectively, although temperatures as low as -9°C and as high as 42°C have been recorded.

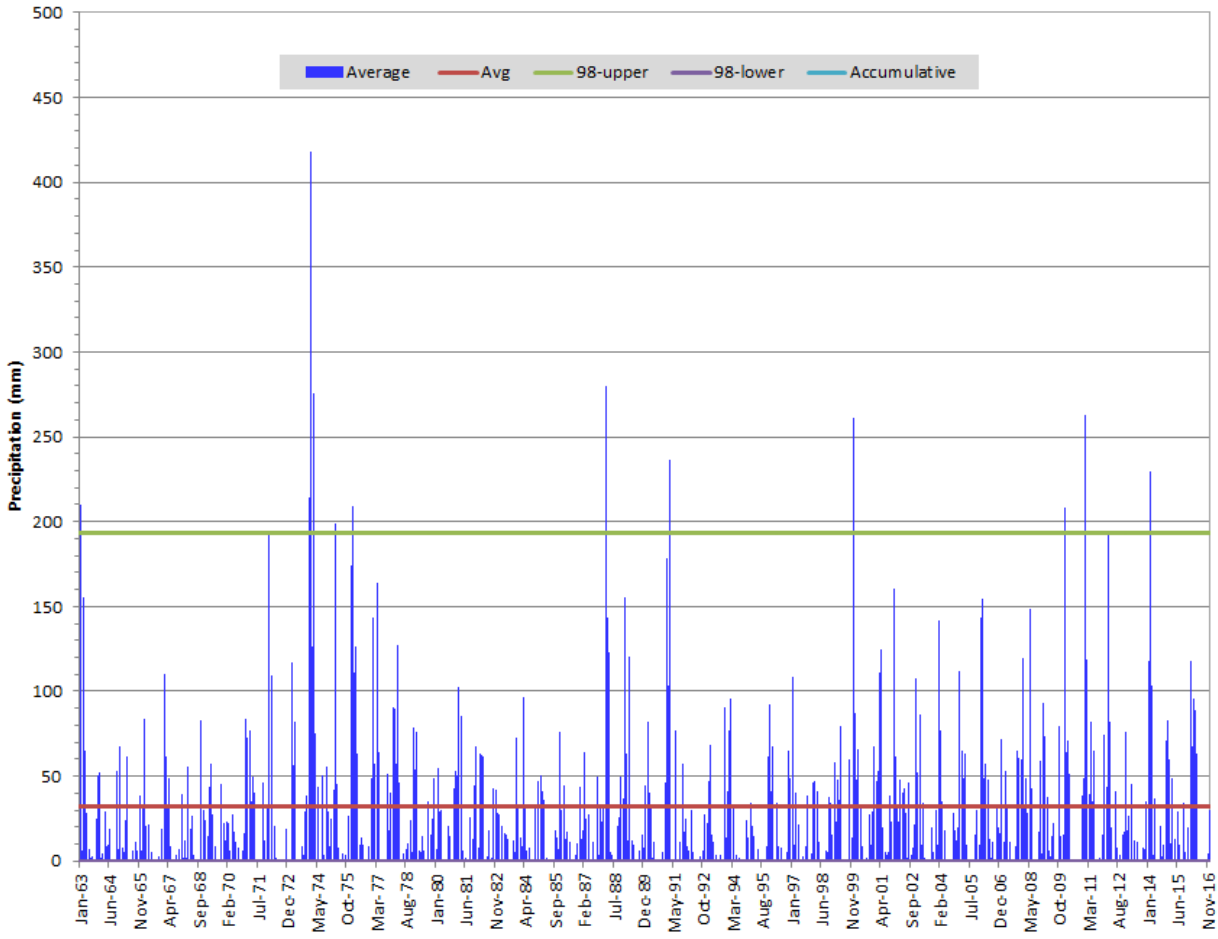


Figure 8-2: Monthly rainfall for Sishen Mine and Kathu (SIOM, 2016)

9.3.3 Temperature

The mean annual temperature at the Sishen Mine is 19ºC. The average annual maximum temperature is 26,7ºC and minimum temperature is 11,8ºC. January is the warmest month with an average maximum temperature of 32,9ºC and July is the coldest month with an average minimum temperature of 3,1ºC. The mean monthly temperatures at Sishen Mine are tabled below (Table 8-2).

Table 8-2: Average Monthly Temperatures at Sishen Mine

	Ave.	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sep
Minimum (^{O}C)	**11,8**	13,2	16,0	17,8	19,0	18,3	16,3	12,2	7,3	3,6	3,1	5,3	9,7
Maximum (^{O}C)	**26,7**	28,5	30,7	32,4	32,9	31,4	29,4	25,7	22,3	19,0	19,6	22,0	26,0
Source: Sishen Weather Station (Station No. 0356857AX) 1961 to 2001.													

9.3.4 Wind Direction and Speed

At Sishen mine the prevailing wind direction is from the northwest (strongest winds) during the daytime and the southeast. Daytime airflow is characterised by higher occurrence of strong winds of more than 5 m/s. There is an increase in the number of calm conditions during the night; from 7.2% (daytime) to 12.6% during the night. The wind velocity also decreases significantly and the airflow changes to be predominantly from the southeast during the night (Airshed, 2013). Period, daytime and night-time wind roses for Sishen Mine for the abovementioned period are provided in Figure 8-3.

9.3.5 Extreme Weather Conditions and Hazards

Fog and snow are unlikely to occur at Sishen. Thundershowers occur irregularly in the summer months, from October to March. Frost occurs in the winter months, from May to August. Excessively high temperatures, above 45ºC, typically occur in the months of December and January and are often correlated with an excessively low humidity volume.

The highest recorded precipitation in 60 minutes and 24 hours, and the expected maximum precipitation event over 24 hours for the return periods of 25, 50 and 100 years are provided in Table 8-3 below.

Table 8-3: Recorded Storm Events and Predicted Flood Events

	Maximum recorded in:		Expected maximum in 24 hours for period:		
Recurrence Interval	60 min	24 hrs	25 yrs	50 yrs	100 yrs
Maximum Rainfall intensity (mm)	35.9	101.0	92.1	108.5	124.7
Source: Sishen Weather Station (Station No. 0356857AX) 1961 to 2001.					

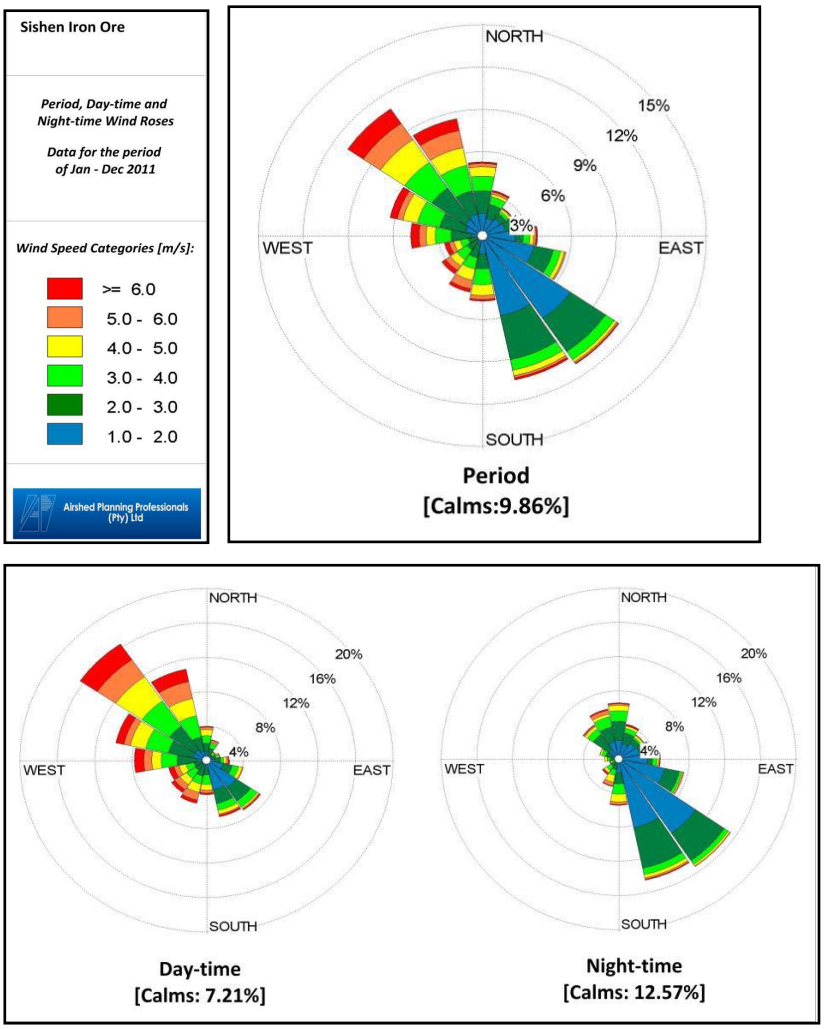


Figure 8-3: Wind roses for SIOM (Airshed 2013)

9.4 Topography and Drainage

The natural topography surrounding the Sishen Mine is generally flat with some isolated undulating areas. The average altitude of the flat plains is at 1200 metres above mean sea level. There are a number of hills, stretching up to 1350 metres above mean sea level, to the southeast of the Sishen mining areas, close to the N14 road. The Langberg is located approximately 35 km southwest of Sishen Mine. The general slope of the land, specifically the Sishen mining area, is in a westerly and south-westerly direction towards the ephemeral Gamagara River. According to the Environmental Potential Atlas of South Africa (ENPAT, 2000) the project area is classified as being “Level Plains with some relief” (Figure 8-4).

The natural topography of the site has been significantly altered as a result of historic and on-going mining activities. Currently, the existing mine infrastructure and activities dominate the landscape at Sishen, and the natural, relatively flat topography has been replaced by man-made topographical features.

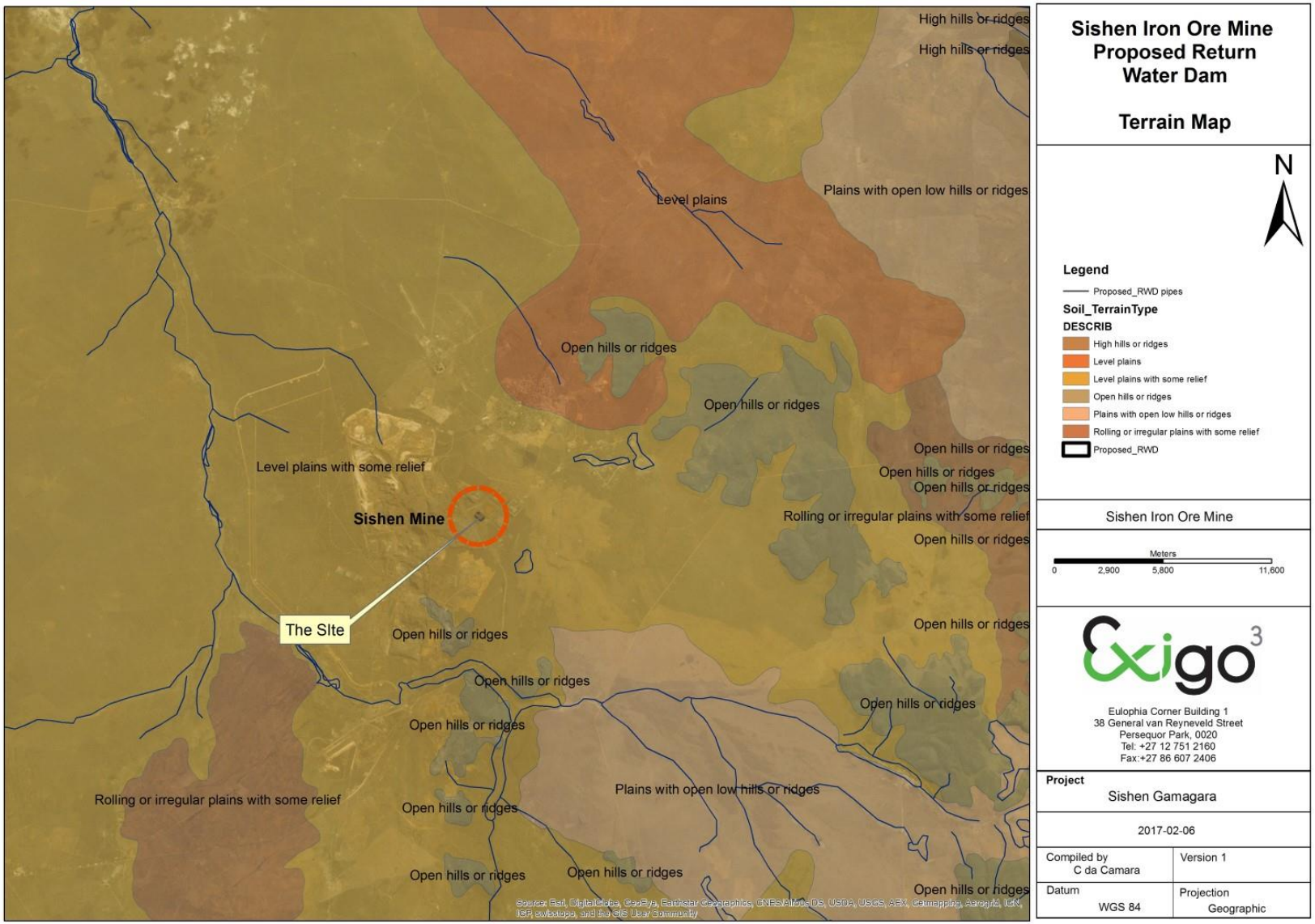


Figure 8-4: Terrain Map

9.5 Surface Water

The project area is situated within the quaternary catchment D41J, which is located in the Lower Vaal Water Management Area (WMA). There are no perennial rivers in the area. The local quaternary catchment D41J covers an area of 3 847 km^2 (Figure 8-5). The catchment system is endoreic with the Gamagara River flowing into the Kuruman River close to Hotazel. The Kuruman River flows into the Molopo River at Andriesvale south of the Kalahari Gemsbok Park. From there, the Molopo flows into the Abiekswasputs pans north of the town of Noenieput. There is no outflow to the sea.

The Gamagara River is located 7.8 km to the south of the site. The Gamagara is a non-perennial river which flows north-northwest.

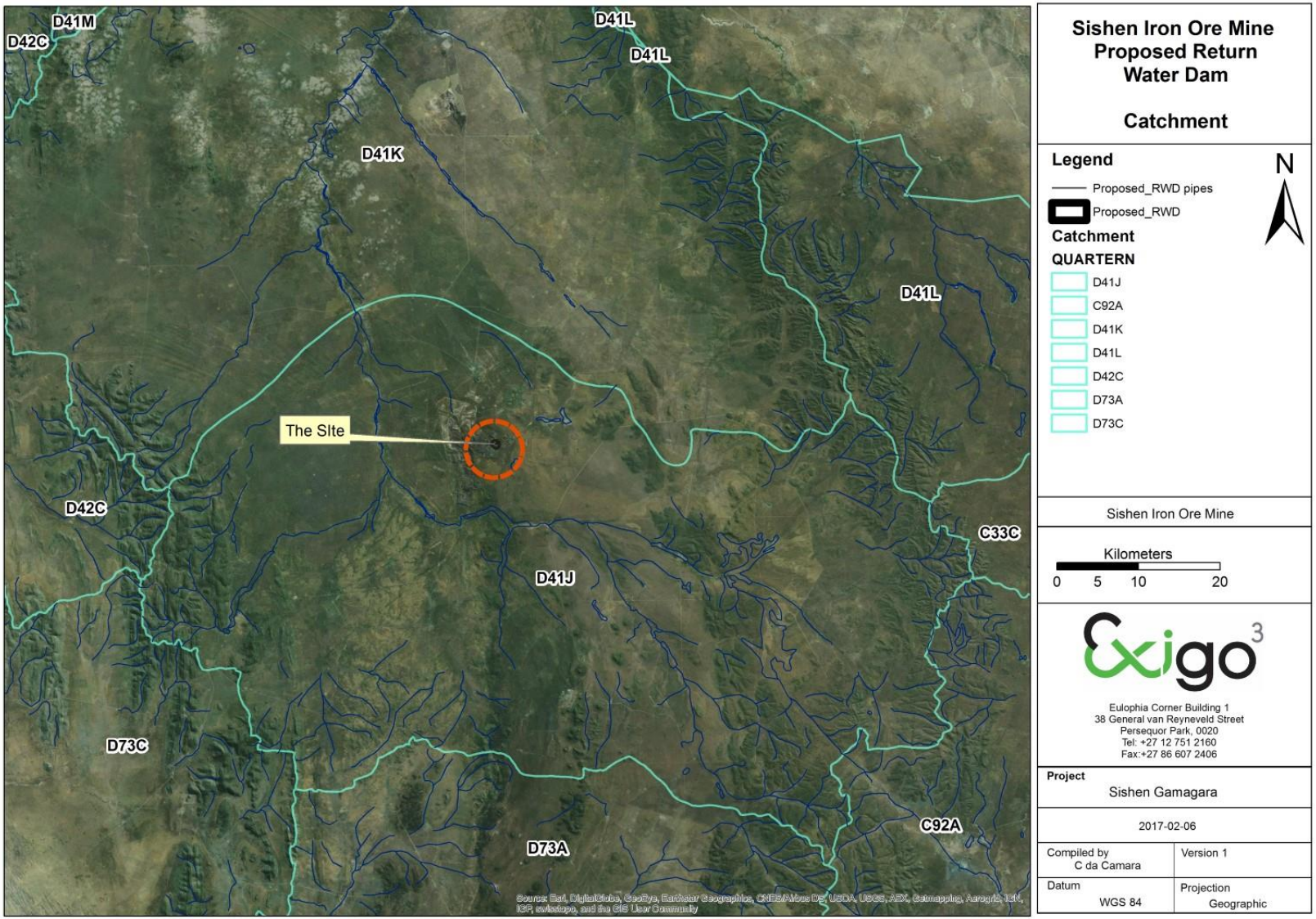


Figure 8-5: Catchment locality map

9.6 Ground Water

There were at least 7 groundwater compartments identified in the Sishen area (Exigo, 2015). The Gamagara Drainage flows across the Sishen Main Compartment where the flow is mostly captured by vertical seepage via the permeable river channel bed and ingress via the swallet zones (Figure 8-6).

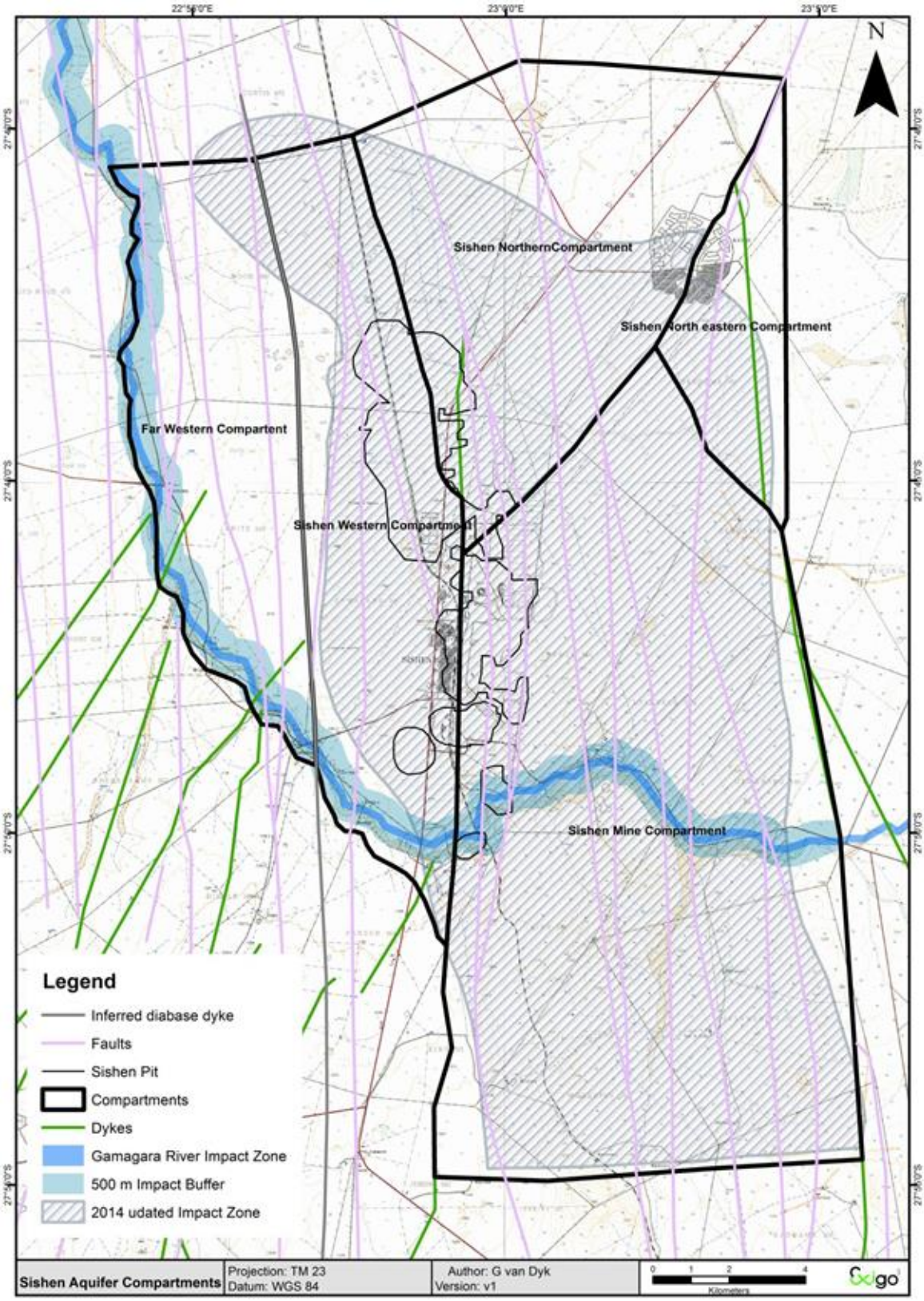


Figure 8-6: Sishen Compartments with geological structures and current impact zone (Meyer, 2014)

9.6.1 The Sishen groundwater compartments and zones

There are at least 7 groundwater compartments or zones identified in the mining and surrounding area (Figure 8-6, Figure 8-7). Five of the compartments are in the deep aquifer system and one in the upper, shallow aquifer system and one in the Gamagara Alluvial Aquifer.

1. The Sishen Mine Compartment that has been dewatered. The boundaries of this compartment are formed by an east-west dolerite dyke, two north-south diabase dykes, a northwest-southeast diabase dyke and a northeast-southwest diabase dyke. The latter dyke has been mined through and breached. This compartment is in constrained hydraulic connection with the some of the neighbouring compartments. Constrained hydraulic connection means that there is no direct link across which groundwater can flow freely. The constrained flow is called leakage. The constrained hydraulic connection is due to the fact that some dykes are younger than others, notably the dolerite dyke is much younger than the diabase dykes. The younger dykes cut through the older dykes. There are also faults that are inferred to cut through some of the dykes.

2. The Sishen North-Eastern Compartment that is partially impacted by dewatering. It is inferred that leakage takes place from this compartment across the diabase dyke/s to the Sishen Mine Compartment. This compartment's western boundary is formed by the northeast-southwest diabase dyke and the northwest-southeast diabase dyke.

3. The Sishen Northern Compartment is partially dewatered. The southern boundary of this compartment is formed by the two diabase dykes (northeast-southwest and northwest-southeast dykes). The northern boundary of this compartment is formed by the Dwyka Tillite Aquitard.

4. The Sishen Western Compartment is partially impacted by dewatering. This compartment's eastern boundary is formed by the north-south trending diabase dyke that forms the western boundary of the Sishen Mine Compartment. Leakage takes place across constrained hydraulic connections from the Western Compartment to the Sishen Compartment. The western boundary of this compartment is formed by an inferred dyke across which groundwater levels vary by 20-50 m (Meyer, personal communication). This inferred dyke has to date been intersected in one borehole but has not been yet been geophysically traced. A weak geophysical (magnetic) signature is expected due to the thick Kalahari Group cover.

5. Groundwater conditions have not been impacted in the Sishen Far Western Compartment. This compartment is to the west of the Sishen Western Compartment and extends towards the Gamagara River and beyond. The exact western extent of this compartment and groundwater head elevations is uncertain as it is far from the Sishen Mine Compartment.

6. The shallow upper calcrete and Kalahari Aquifer/s is formed by recent geological deposits and overlies the deep aquifers. It is not constrained by the dyke boundaries of the deep aquifers. The shallow aquifers are separated by the deep aquifers by a thick clay aquiclude. The clay aquiclude is continuous in the central and northern sections but are discontinuous to the south. Groundwater in the shallow aquifer seeps towards the mine within an impacted zone, which is limited to a 500 m zone from the pit boundary. The seepage does not contribute materially to the dewatering rates of the mine, as most evaporates at the pit face (AGES, 2013). A characteristic of the shallow aquifer is that it is a low groundwater potential. Groundwater seeps to the Gamagara River Alluvial Aquifer where it contributes to hypoeiric flow.
7. The Gamagara River Alluvial Aquifer forms a groundwater zone along the Gamagara River. The hydrogeological dynamics and conceptual model of this aquifer has been described in AGES (2013). This aquifer has mainly hypoeiric flow below the alluvium. The vertical thickness of this aquifer varies between 10 m to ±75 m (PHD, 2006). It has three sub zones. The first is the zone upstream of the Sishen Mine Compartment where the weathered/fractured aquifers (mainly BIF and dolomite) feed hypoeiric flow into the Gamagara Alluvial Aquifer. The upstream zone is inferred to have a minor impact due to leakage across and above the eastern diabase dyke boundary to the Sishen Compartment. The Gamagara Alluvial Aquifer overlies the diabase dykes as it is younger. The zone of the Gamagara Alluvial Aquifer in the Sishen Mine Compartment is dewatered and does not exist in this area anymore, except during and after flood events when it can have a temporary existence. The downstream zone receives hypoeiric flow from the shallow calcrete aquifer, and is not impacted directly by the dewatered Sishen Mine Compartment. The upstream zone is still recharged by the Gamagara River surface flows which occurs every 5-8 years and during rainfall events. The downstream zone does not frequently receive surface flows from the upstream zone as these mainly drain into the Sishen Mine Compartment via swallet zones (PHD, 2006). It is impacted in that recharge due to flood events does not reach the downstream environment, except during big flood events. The downstream impacted area in this zone has been delineated to Deben (GCS, 2011). The downstream zone does receive surface flows from the environment downstream from the Sishen Compartment and for e.g. from the Olifantsloop tributary. It does receive recharge from direct rainfall in between flood events.

The impact of dewatering at the Sishen pit is mainly on the deep BIF-Dolomite-Chert aquifer. The effect of localised seepage to the pit is visible on the SIP 2 filling station site in the form of a hydrostatic head that is 44 m below the surface level as measured in the deep borehole BH SW872 that was drilled during a previous study, on the eastern boundary of the filling station site. This borehole is located on the eastern boundary on the northern side of the site. Borehole (SW872) penetrated the calcrete layer to a depth of 26 m the clay layer to a depth

of 86 m and the gravel layer to a depth of 105 m. The borehole was ended 5 meters into the shale and tillite layer (AGES, 2013).

Shallow Aquifers

Shallow aquifers are formed by the calcrete and clay layers in the northern section of the mine. The clay layer can be seen as an aquiclude that separate the aquifers above and below the clay layers. The shallow aquifer to a large extent is located above deep aquifers below.

The shallow aquifers have a more localised lateral extent but could stretch above and beyond the boundaries in the deep aquifers (i.e. dykes do not cross the shallow aquifer, refer to Figure 8-7). The shallow aquifers are important for water supply to local farms and could interact with the deep aquifers via windows in clay layers and weathered hard rock or through fractures in the deeper hard rock formations or via exploration core boreholes that were drilled through the original geological successions. These shallow aquifers are unconfined and sensitive to contamination from surface sources. Groundwater flow that is constrained by low permeability formations such as dykes can form springs in the shallow aquifer zones. A spring which emanates on a dyke contact zone and at times reaching a flow rate of approximately 2 ℓ/s, exists on the farm McCarthy (Meyer, 2009).

The calcrete aquifer

The most important local shallow aquifer zone is formed by the calcrete aquifer, which is underlain by the mainly clay aquitard/aquiclude (Figure 8-7, Meyer 2009 and 2013). Interpretations were done in this study to determine the lateral extent of the calcrete aquifer as it forms the most important shallow aquifer on the mine to the west and north.

The clay aquiclude

The clay originated from mudstone that was deposited in a shallow lake environment (Sishen Geology Dept). This clay can be considered as an aquiclude and not an aquifer which will protect the higher yielding conglomerate, lava, BIF and dolomite aquifers below. No prominent water strikes were encountered during the drilling of the eleven boreholes on the SIP 2 filling station site (AGES, 2013) and the HEF Plant site (Exigo, 2015) projects. The clay layer, according the drilling information and the conceptual groundwater model thins out to the south-west. The clay zone not only thins out but is inter-layered with calcrete as can be seen in borehole SW 881 (AGES, 2013).

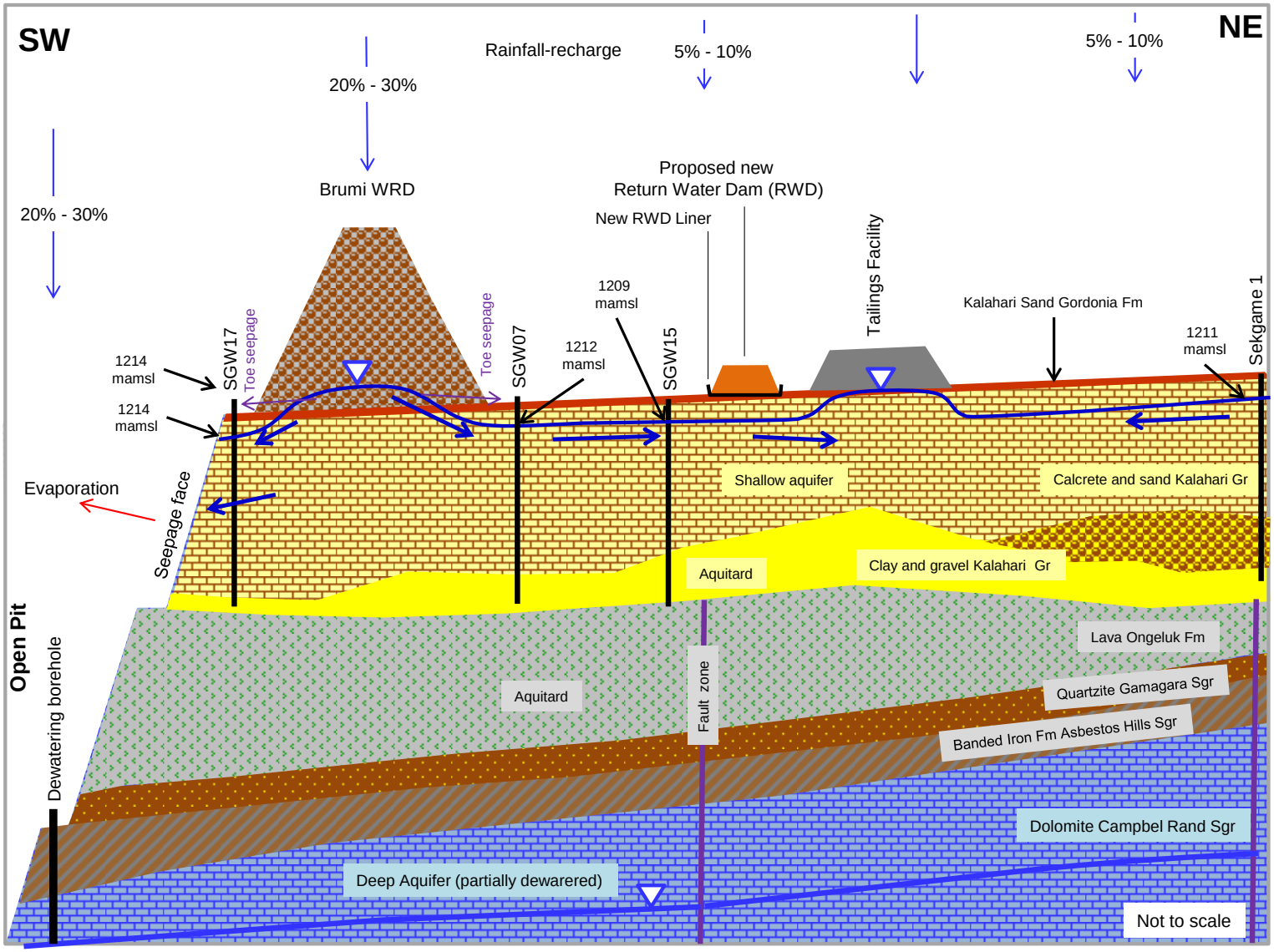


Figure 8-7: Conceptual hydrogeological cross-section and groundwater flow in the study area

Deep Aquifers

The deep aquifers are deeper than the clay layer and are formed by the Dwyka Formation, fractured and weathered lava, BIFs, chert and, dolomite (Figure 8-7). The chert breccias and extensive karstification of dolomite form the most important deep aquifer in the area (Meyer, 2009) which occurs at the base of the geological sequence.

The deep aquifers are compartmentalised with dykes and other aquitards, such as the Dwyka Tillite and some formations in the Kalahari Group. The dykes are considered to be almost impermeable, as confirmed by pump tests on either side of the dykes in specific locations (Meyer, 2009). Although a study in 2009 (Meyer, 2009) provides confirmation of the compartmentalisation of groundwater systems, water level differences and leakage across the dykes are inferred.

Meyer (2009) found no evidence of a dyke structure defining the northern boundary and attributes the break in water levels to the influence of the Dwyka and Kalahari Group sediments in controlling expansion of the dewatering impact in a northern direction.

9.6.2 Aquifer classification and vulnerability assessment

Aquifer types

A number of studies have been performed for the D41J and D73A quaternary catchments as well as the Sishen Mine study area. Consequently the aquifers in the study area have been significantly studied and defined as shown in Figure 8-6 to Figure 8-7. The aquifers, aquitards and aquicludes of importance underlying the Sishen Mine and proposed new RWD area can be summarised as shown in Table 8-4. From existing studies and material tests the clay aquitard, below the Kalahari sands-(alluvium, Gordonia Fm) and calcrete-aquifer, creates an aquiclude that effectively forms a protective barrier from contamination for the deep dolomitic aquifer. From previous investigations this clay aquiclude is present below the proposed new RWD. Some distance further to the south however, the clay diminishes, and the shallow Kalahari sands and calcrete aquifer is directly underlain by the deep dolomitic aquifer. The distance to the absence in the clay aquiclude to the south, from the proposed RWD is however of such magnitude, that it is unlikely that contaminant would reach this distance during the LoM and decommissioning phases.

Table 8-4: Aquifers found at Sishen Mine study area and below the proposed new RWD

No	Aquifer or aquitard	Typical thickness	Aquifer type
1	Shallow alluvial and calcrete aquifer	30 m (up to 50 m)	Porous (aquifer/aquitard)
2	Clay aquitard/aquiclude	20 m (up to 80 m)	Porous aquitard
3	Deep dolomitic aquifer	Unknown; > 1000 m	Karstic aquifer

Aquifer Classification

Based on the aquifer and aquitards defined above, an aquifer classification was performed during this study based on the Aquifer Classification system by Parsons (1995).

According to Parsons (1995), aquifer classification is based on the aquifer characteristics and the non-technical and water-supply considerations. The classifications and definitions for each aquifer system are summarised in Table 8-5 below.

Table 8-5: Definitions of Aquifer System Management Classes (After Parsons (1995))

Sole source aquifer	An aquifer which is used to supply 50% or more of domestic water for a given area, and for which there are no reasonable available alternative sources should the aquifer be impacted upon or depleted. Aquifer yields and natural water quality are immaterial
Major aquifer system	Highly permeable formations, usually with a known probable presence of significant fracturing. They may be highly productive and able to support large abstractions for public supply and other purposes. Water quality is generally very good (less than 150 mS/m)
Minor aquifer system	These can be fractured or potentially fractured rocks, which do not have a high primary permeability, or other formations of variable permeability. Although these aquifers seldom produce large quantities of water, they are important both for local supplies and supplying base flow to rivers
Non aquifer system	These are formations with negligible permeability that are generally regarded as not containing groundwater in exploitable quantities. Water quality may also be such that it renders the aquifer as unusable. However, groundwater flow through such rocks, although imperceptible, does take place, and needs to be considered when assessing the risk associated with persistent pollutants
Special aquifer system	An aquifer designated as such by the Minister of Water Affairs, after due process

Although there are essentially two aquifers underlying the study area, only the shallow alluvium and calcrete aquifer is applicable to impacts from of the proposed RWD. This is due to the very low permeability aquiclude that the clay strata creates, which is overlying the deep dolomitic aquifer and present underneath the proposed RWD. Nonetheless all three main aquifers/aquitards have been classified in terms of the Aquifer system Management Classes and are summarised in Table 8-6. Given that the shallow alluvial and calcrete aquifer is the only aquifer where impact could be expected, it has been fully classified, thus including a vulnerability assessment as well (Table 8-7). The assessment found the aquifer to be a Minor Aquifer System, however highly vulnerable to contamination. Using the classification system it scored 6 points and requires a medium level of protection.

Table 8-6: Aquifer System Management Classification summary table

No	Aquifer or aquitard	Aquifer type	Aquifer Classification
1	Shallow alluvial and calcrete aquifer	Porous (aquifer/aquitard)	Minor Aquifer
2	Clay aquitard/aquiclude	Porous aquitard	Non Aquifer
3	Deep dolomitic aquifer	Karstic aquifer	Sole Source Aquifer

The aquifer system and the aquifer vulnerability are assigned a value as defined in Table 8-7 below. Through multiplying the aquifer system value by the vulnerability value the Groundwater Quality Management (GQM) index is determined. Based on this value, the level of protective action that must be upheld is recommended. The values shaded in blue indicate the rating of the aquifer.

Table 8-7: Aquifer classification and vulnerability assessment for shallow alluvial aquifer

Aquifer system		Aquifer vulnerability	
Management qualification		Classification	
Class	Points	Class	Points
Sole Source Aquifer System	6	High	3
Major Aquifer System	4	Medium	2
Minor Aquifer System	2	Low	1
Non-Aquifer System	0		
Special Aquifer System	0-6		

GQM INDEX	Level of protection
<1	Limited Protection
1 to 3	Low Level Protection
3 to 6	Medium Level Protection
6 to 10	High Level Protection
>10	Strictly Non- Degradation

9.6.3 Water Quality

Figure 8-8 shows a map the location of the groundwater level monitoring boreholes.

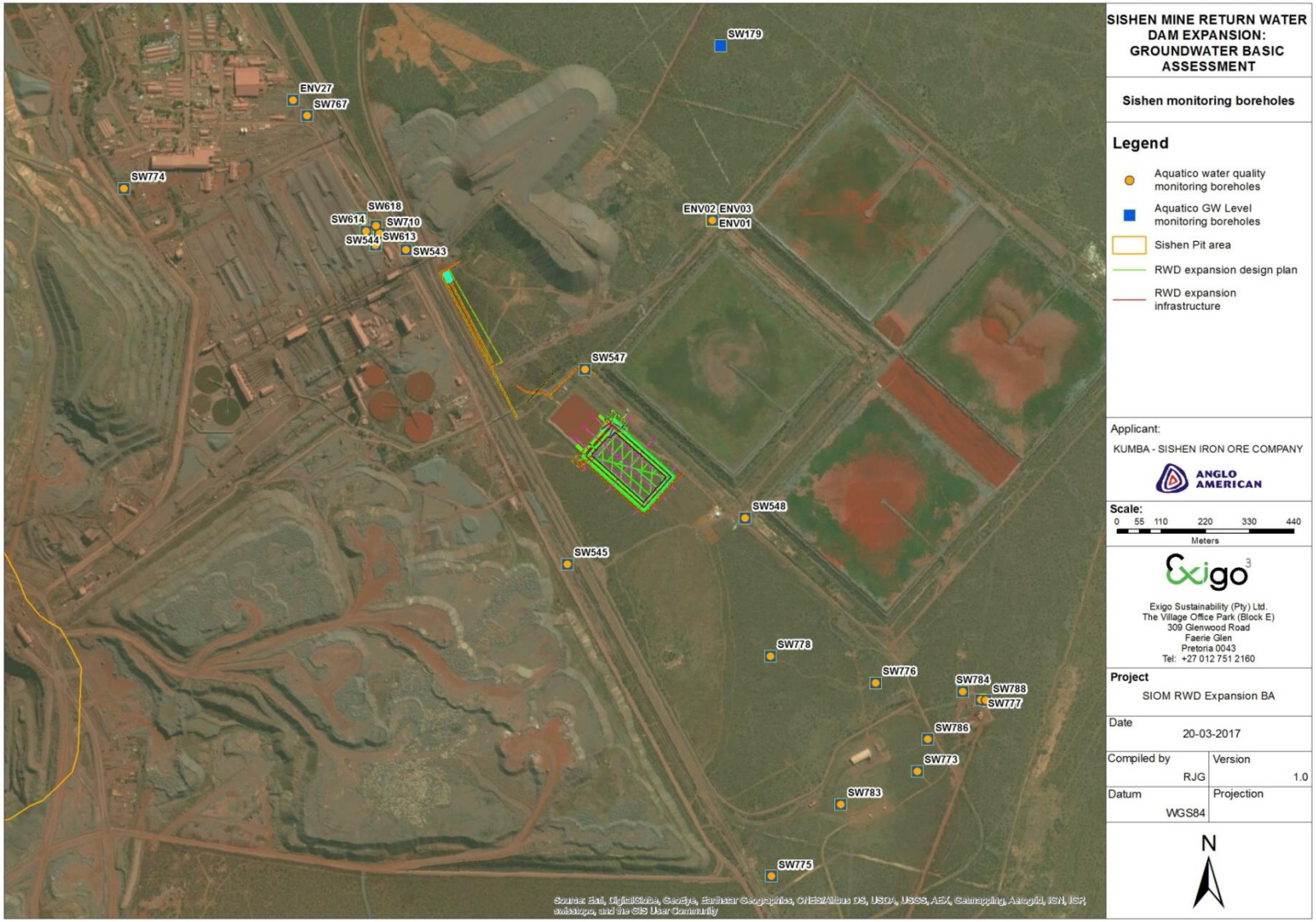


Figure 8-8: Actively monitored boreholes around the proposed RWD

Table 8-8: Most recent groundwater quality analysis results classified according to the WUL limits and SANS 241

Site ID	Date sampled	GW level (mbgl)	Ph [ ]	EC (mS/m)	TDS (mg/l)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	K (mg/l)	HCO3 (mg/l)	Cl (mg/l)	SO4 (mg/l)	NO3-N (mg/l)	F (mg/l)	Fe (mg/l)	Mn (mg/l)	PO4 (mg/l)
ENV01	24-Nov-2015	30.2	7.42	82	449	58.2	59.1	13	5.68	446.52	53.3	19.3	0.831	-0.472	-0.009	-0.001	0.032
ENV02	24-Nov-2015	18.2	7.55	58	353	57	39	11.4	3.46	385.52	25.5	2.02	0.673	-0.472	-0.009	-0.001	0.031
ENV03	24-Nov-2015	11.3	7.07	200	1340	218	103	28	4.32	652.7	138	20.6	104	-0.472	-0.009	-0.001	0.033
ENV27	24-Nov-2015	2.1	7.5	68	422	72	41.5	13	2.9	459.94	23.8	3.24	-0.416	-0.472	0.022	0.018	0.063
SW543	24-Nov-2015	2.0	8.02	74	487	69	35.3	29.4	3.22	315.98	43.7	41.2	12.7	0.683	-0.009	-0.001	0.065
SW544	13-Nov-2013	2.5	8.22	52	353	48	20.7	32.5	3.57	259.86	31.7	33.2	2.06	0.605	-0.006	-0.001	-0.025
SW545	14-Aug-2013	14.0	8.57	17	82	12	10.8	1.15	1.99	97.112	1.72	5.19	0.372	0.338	-0.006	-0.001	0.043
SW547	23-Nov-2015	10.5	7.68	89	531	49	47.5	55.5	23.2	451.4	47.2	65.5	-0.416	-0.472	-0.009	0.034	0.062
SW548	23-Nov-2015	40.0	7.45	88	559	92	56.6	14.4	2.77	590.48	20.9	12.9	1.77	-0.472	-0.009	-0.001	0.064
SW613	23-Nov-2015	2.5	7.83	70	485	68	28.6	36.4	5.16	340.38	37.2	41.1	5.27	0.722	-0.009	-0.001	0.065
SW614	23-Nov-2015	2.1	7.81	72	530	63	29.7	37.8	5.92	302.56	35.6	59.3	11.5	0.916	-0.009	-0.001	0.064
SW618	23-Nov-2015	4.7	7.69	88	563	65	58.2	35.1	6.88	480.68	49.3	46.2	2.87	1.29	-0.009	-0.001	0.07
SW710	24-Nov-2015	1.4	7.6	86	625	83	46.4	27.2	2.66	405.04	40.1	37.9	19.3	0.877	-0.009	-0.001	0.062
SW767	13-Sep-2011	2.5	7.46	89	439	99	43	10.6	1.95	464.82	21.4	22.1	12.3	0.506	-0.006	-0.001	0.034
SW773	24-Nov-2015	9.2	7.41	91	596	93	53	22.7	1.55	544.12	41.5	22.4	1.9	-0.472	-0.009	-0.001	0.073
SW774	24-Nov-2015	9.4	7.29	92	642	124	48.1	5.97	2.71	595.36	12.2	5.25	18.1	-0.472	-0.009	-0.001	0.058
SW775	24-Nov-2015	6.6	7.29	85	562	99	52.4	8.69	1.73	597.8	13.3	6.09	2.5	-0.472	-0.009	-0.001	0.069
SW776	23-Nov-2015	12.5	7.46	83	559	98	49.2	10.1	2.22	579.5	13.1	8.01	4.01	-0.472	-0.009	-0.001	0.062
SW777	24-Nov-2015	13.6	7.03	517	3992	654	143	38.2	13.7	262.3	10.7	22.4	641	0.527	-0.009	0.04	0.059
SW778	24-Nov-2015	11.1	7.33	88	585	97	56.9	15.8	1.65	629.52	16.4	11.9	0.981	-0.472	-0.009	-0.001	0.061
SW783	24-Nov-2015	18.4	7.42	91	621	101	54	12.5	2.37	562.42	13.1	8.66	18.3	-0.472	-0.009	-0.001	0.058
SW784	24-Nov-2015	49.0	7.32	292	2171	336	105	25.2	8.39	326.96	23.2	17.8	317	0.59	-0.009	-0.001	0.056
SW786	24-Nov-2015	36.4	7.27	122	867	133	69.1	11.4	2.92	540.46	13	10.4	65.1	-0.472	-0.009	-0.001	0.057
SW788	24-Nov-2015	44.1	7.11	354	2685	381	141	28.6	10.3	478.24	22.8	14.5	387	-0.472	-0.009	-0.001	0.057
Water use licence limits			**7.7 - 8.5**	**90**	**450**	**80**	**53**	**66**	**6.6**	**N/A**	**82**	**56**	**3.6**	**0.6**	**0.2**	**1.45**	**0.45**
SANS 241 (2015)			≥ 5; ≤ 9.7	≤170	≤1200	N/A	N/A	≤ 200	N/A	N/A	≤ 300	≤500	≤0.9	≤ 1.5	≤ 2	≤ 0.4	N/A
Below detection limit (-)													-0.416	-0.472	-0.009	-0.001	-0.025

Groundwater quality results

Groundwater qualities from selected actively monitored boreholes were reviewed and evaluated for this study. Boreholes in the vicinity of the proposed RWD and for which groundwater levels could be correlated were selected and that were thought to be representative of the shallow aquifer. Groundwater quality was assessed using the Sishen mine DWS water use licence limits as well as the SANS241 drinking water standards. The most recent groundwater chemistry results were compared with the former mentioned standards and are presented in Table 8-8. Locations of the groundwater monitoring boreholes are shown in Figure 8-8.

When the groundwater qualities are compared in Table 8-8 to the IWUL limits and SANS241 drinking water standards, nitrate (NO_3) seems to be the constituent that is of actual concern. There are also at least four boreholes (ENV03, SW777, SW784, SW788) where total dissolved solids (TDS) is highly elevated, even compared to the SANS241 TDS drinking water limit. SW777, SW784 and SW788 have elevated NO_3 concentrations. The former mentioned boreholes are all located in close proximity in and around the HEF plant and contamination seen in these boreholes is due to a known nitrate spill that has occurred at the HEF plant, which has influenced the groundwater qualities in this area.

The nitrate concentrations at borehole SW545, SW547, SW548 (immediate proximity to TSF) and SW778, which are ideal monitoring boreholes surrounding the proposed new RWD, are all comparably much lower than the boreholes surrounding the HEF plant. This indicates that the nitrate contamination plume has not reached the proposed RWD location yet, and that there is also very little if any nitrate contamination from the existing tailings dams. It is also probable that from the HEF plant, the shallow aquifer groundwater flow direction is not towards the northwest and the proposed new RWD area.

ENV03 is however another groundwater monitoring borehole that is of concern, given its elevated TDS and nitrate concentrations. It is recommended that this location be investigated for possible chemical spillages.

9.7 Soil types

Geology is directly related to soil types and plant communities that may occur in a specific area (Van Rooyen & Theron, 1996). A Land type unit is a unique combination of soil pattern, terrain and macroclimate, the classification of which is used to determine the potential agricultural value of soils in an area. The land type unit represented within the proposed footprint area include the Ag110 land type (Land Type Survey Staff, 1987) (ENPAT, 2000). The land type, geology and associated soil type is presented in Table 8-9 below as classified by the Environmental Potential Atlas, South Africa (ENPAT, 2000).

Table 8-9: Land types, geology and dominant soil types of the proposed development site

Land type	Soils	Geology
Ag110	Red-yellow apedal, freely drained soils, red, high base status, < 300 mm deep	Surface limestone, alluvium and red wind-blown sand of Tertiary to Recent age with a few occurrences of amygdaloidal andesitic lava (Ongeluk Formation).

The geology of the general area comprises red aeolian sand (Gordonia Formation, Kalahari Group) that forms part of the Kalahari and what is now considered to be a fossil desert. The red sands of the Kalahari are often underlain by calcrete of Tertiary to Recent age which in turn overlies andesitic or basaltic lava of the Ventersdorp Group (Visser, 2006). The soils on the proposed development site varies from being shallow calcareous soils (western section) to deeper Hutton soil form where the sand is deeper and the calcrete is not near or at the surface.

9.8 Biodiversity

The proposed development site is currently located on mining land owned by the Sishen Mine property. The vegetation units on the site vary according to soil characteristics, topography and land-use. Vegetation units were identified and only one vegetation unit occurs on site.

The following vegetation unit was identified during the survey as indicated in Figure 8-9 for the RWD site:

1. *Acacia mellifera – Tarchonanthus camphoratus* shrubveld;

Figure 8-9: Vegetation Map of the proposed RWD area

9.8.1 *Acacia mellifera - Tarchonanthus camphoratus* shrubveld

The *Tarchonanthus – Acacia* shrubveld occurs on red-yellow Kalahari sands overlying calcrete bedrock and is the most dominant vegetation unit in the project area on the proposed RWD development site. The area could be clearly distinguished by the open shrubveld structure with the dense grass layer dominated by *Schmidtia pappophoroides*.

The dominant species is camphor bush *Tarchonanthus camphoratus* and *Acacia mellifera*, which is taller in this vegetation unit. Other common shrub species include Sears*ia ciliata, Grewia flava, Ehretia rigida* and *Diospyros lycioides*. Smaller shrubs include *Pentzia species, Felicia muricata, Barleria rigida, Melhania burchelli*i and *Hermannia* species. The dominant grasses are *Heteropogon contortus, Eragrostis lehmanniana* and *Schmidtia pappophoroides*. The characteristics of both variations of this vegetation unit are summarized in Table 8-10, while the state of the woody and herbaceous layers is indicated in photograph 1.

Table 8-10: Botanical analysis and characteristics of the *Acacia mellifera – Tarchonanthus camphoratus* shrubveld

State of the vegetation:	Natural woodland
Conservation priority	Medium
Characteristics	This vegetation unit is characterized by a woody layer mostly dominated by low shrubs that form an open to medium dense structure. The woody species is dominated by black thorn and camphor bush shrubs throughout its distribution in the local context. Substrate is shallow, rocky soils derived from mudstone
Density of woody layer	Trees: 1-2% (avg. height: 3-6m) Shrubs: 25-40% (avg. height: 1-2m)
Density of herbaceous layer	Grasses: 40-50% (avg. height: 0.8-1.2m) Forbs: 2-5 (avg. height: 0.8m)
Sensitivity	Medium – indigenous woodland with a widespread status
Protected / Red data species	None observed
Protected tree species	*Boscia albitrunca*

This vegetation unit has a medium sensitivity (natural variation) mostly due to the fact that the vegetation unit as an entity occurs widespread throughout the Savanna Biome.

Figure 8-10: Natural variation of the *Acacia mellifera – Tarchonanthus camphoratus* shrubveld

9.8.2 Flora: Species level assessment

South Africa has been recognized as having remarkable plant diversity with high levels of endemism. The major threats to plants in the study area are urban expansion, non-sustainable harvesting, collecting, overgrazing/browsing, mining and agriculture. The objective of this section was to compile a list of plant species for which there is conservation concern. This included threatened, rare, declining, protected and endemic species.

Red data Flora Species

The only species listed in the POSA database potentially occurring in the area is the Near Threatened species *Eleadendron transvaalense*. No individuals of this tree species was documented during the surveys. No other red data plants were found during the ecological survey.

Endemic or near-endemic species

No individuals of these plants were observed during the surveys.

Protected tree species (NFA)

Taking cognizance of the data obtained from the field surveys, no protected tree species was found during the surveys.

Protected Plants (NCNCA)

After a detailed survey was conducted no protected plants listed were found in the area.

Invasive alien species

No listed alien invasive species was documented on the proposed development footprints, although a few exotic weeds occur along roadsides in the larger project area.

9.8.3 Fauna Survey: Data processing

A comparison of the habitats (vegetation units) occurring on the property was made to the preferred habitats of the faunal species. In addition to species observed on the site, lists of the potential mammal, bird, reptile, amphibian and insect species were compiled and mitigating measures recommended if needed. Refer to Ecological Assessment for additional information (Appendix 6).

9.9 Noise

For the purposes of this application baseline ambient noise, surveys that have been conducted for the Sishen Mine in 2012 by Acusolv Consulting Engineers, was used.

The 14 measurement points used are depicted in Figure 8-11.

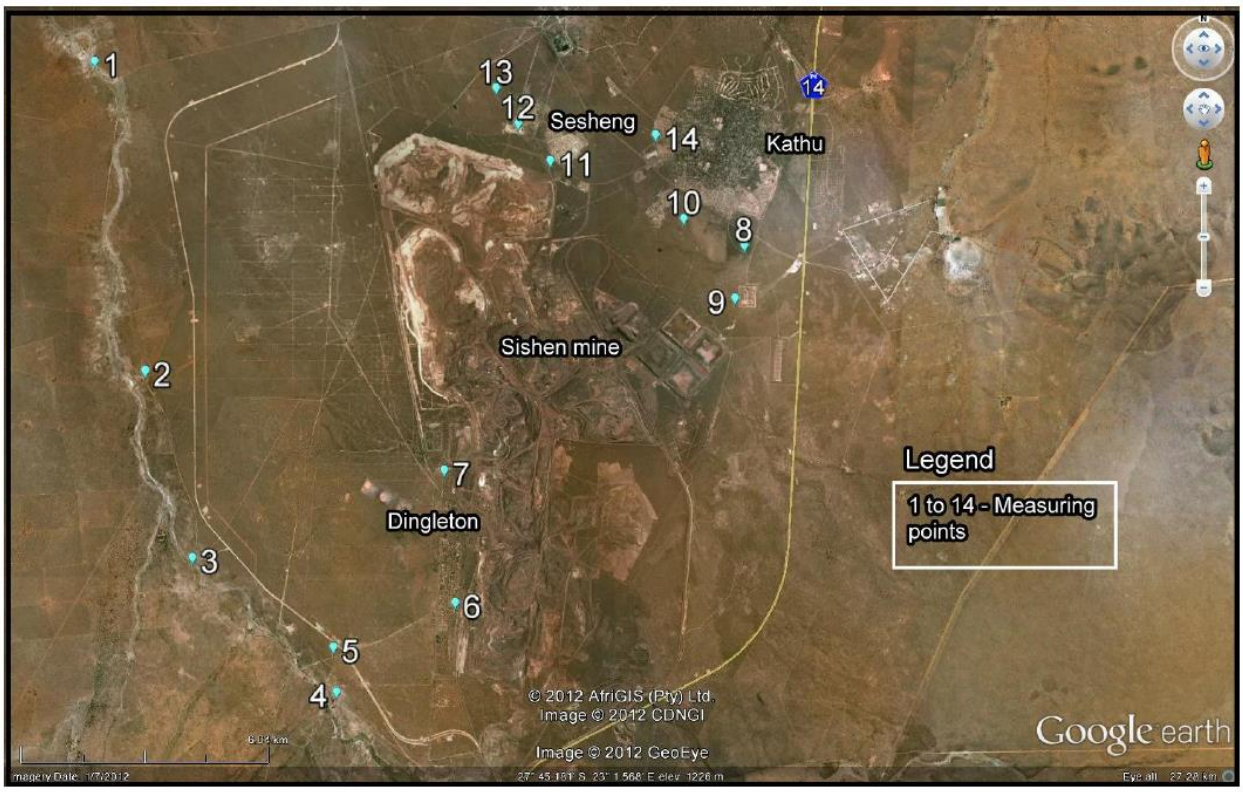


Figure 8-11: Noise monitoring locations (Acusolv, 2012)

The noise survey to determine the noise levels from the mine activities was done as close as possible to the boundary of the mine (MPs 6 to 12) and along the gravel road which separate the distant Sishen mine and the farm houses (MPs 1 to 5).

The noise impact of Sishen Mine in most of the areas to the north, east and south of the mine is still relatively low. The survey found that the noise levels at the different measuring points were in line with the recommended day time noise level of 55.0dBA. The prevailing night time noise levels are below the

recommended noise level for a residential area of 45.0dBA. The higher noise levels during night time at MP14 were from the mechanical ventilation system at the Kathu Mall which is north of the measuring point.

This and previous surveys show that ambient noise in most areas around the mine is still within acceptable levels (Acusolv, 2012).

9.10 Air quality

An air quality study for the SIOM operations was undertaken by Golder Associates Africa (Pty) Ltd. (Golder) in 2015. The air quality assessment undertaken included an update of baseline air quality studies undertaken from 2009 to 2011.

The following information was obtained from the Air Quality Study conducted by Golder and Associates (2015).

The SIOM is largely surrounded by natural bush-land and thicket. Key sensitive receptors include:

- The Dingleton community located directly adjacent to the SIOM west boundary;
- The Sesheng community located approximately 200 m from the SIOM north boundary; and
- The Kathu community located approximately 2 km from the north-eastern boundary

SIOM has operated an ambient monitoring (PM10) and dust fallout (deposition) network since 2002. The monitored ambient PM10 concentrations and dust fallout are benchmarked against the NAAQS and dust fallout standards. These account for the contribution of the SIOM operations as well as other sources of particulate emissions in the region such as: unpaved roads, construction activities and large unvegetated areas exposed to wind erosion.

Daily and annual average PM10 monitoring data was provided by the SIOM for the period spanning 01 January 2011 – 31 December 2014 for the Dingleton, Sesheng, Kathu and Voelklub monitoring stations.

During 2011 and 2012, annual average concentrations exceeded the NAAQS (40 µg/m^3) annual average standard at all four monitoring stations. During 2013 and 2014, annual average concentrations exceeded the NAAQS (40 µg/m^3) annual average standard at Dingleton, Sesheng, and Kathu. A decreasing trend in the annual average concentrations was noted for Dingleton and Sesheng over the 2011 to 2014 monitoring period.

In comparing the daily average data trends to the 2014 NAAQS of the 120 µg/m^3, several exceedances were observed at Dingleton and Sesheng. In comparing the daily average data trends to the current NAAQS of the 75 µg/m^3, the frequency of exceedances greatly increases, with all three monitoring stations displaying numerous exceedances.

Dust fallout results from November 2013 to October 2014 were provided by SIOM for analysis. The dust fall monitoring network currently consists of non-direction dust samplers installed at various locations in and around the SIOM.

Internal dust fallout results show extremely high deposition rates within the SIOM operational areas. Internal fence line dust fallout results show high deposition rates. SB01 and SB02, although located within

the SIOM fence line are considered by SIOM to be “residential” due to their proximity to Dingleton. These stations show frequent exceedances of the residential area standard.

Dust fallout results show comparatively lower deposition rates at non-residential areas outside the SIOM boundary. Exceedances of the non-residential area standard were not common with just four exceedances noted between November 2013 and October 2014.

Dust fallout results show similar deposition rates at residential areas outside the SIOM boundary. The residential area standard was frequently exceeded, particularly from June 2014 to October 2014.

9.11 Sites of archaeological and cultural interest

The town of Kathu is the location of a cluster of highly significant ESA localities, which is known as the Kathu Archaeological Complex. These sites are subject to on-going archaeological research by archaeologists from the University of Cape Town and the University of Toronto, in collaboration with the McGregor Museum in Kimberley. This presence of Stone Age people in the landscape can probably be attributed to the abundance of locally available raw material for the manufacture of stone tools. Locally, the location of the project area within the Sishen Mine Complex has resulted in the transformation of the landscape in places, where recent and historical human activities has potentially sterilised these zones of heritage remains.

9.11.1 The Stone Age

Three broken MSA points were documented from various locations in the project area. The first tool was observed in the access road to the project area and the other two tools were noted on the surface at random (often disturbed) locations where precipitation and groundwater have exposed the stone tools. The tools were produced on fine grained ironstone, specularite and jaspilite which are locally available, and use wear marks and secondary retouch are visible on some of the points. These single Stone Age representations are of limited scientific value as diagnostic artefact densities are low and site context for the artefacts have been lost and, as such, the occurrences are of low heritage significance.

Figure 8-12: Broken MSA points from the project area.

9.11.2 The Iron Age Farmer Period

A frontier zone between in the later Iron Age and Colonial times, the Northern Cape Province landscape holds remnants of precolonial Iron Age Farmer Period remnants. However, the site inspection produced no Iron Age farmer sites.

9.11.3 Historical / Colonial Period

Kathu is surrounded by farming communities and Historical and Colonial Period dwellings occur across the landscape. However, the project site is surrounded by the developed / developing Sishen Mine Complex and no Historical Period / Colonial Period (Farmer Period) occurrences were observed in the project area.

9.12 Socio-Economic Environment

Sishen mine is located in the Northern Cape Province in the John Taolo Gaetsewe District Municipality (JTGDM) and the Gamagara Local Municipality.

The JTGDM covers an area of 27 283 km^2 and is made up of the Kgalagadi District Management Area as well as the Gamagara, Ga-Segonyana and Moshaweng Local Municipalities. Sishen Mine falls within the Gamagara Local Municipality. Towns within the Gamagara Local Municipality's area of jurisdiction include Kuruman, Kathu, Dibeng, Olifantshoek, Hotazel, Black Rock and Van Zylsrus (John Taolo Gaetsewe District Municipality, 2012).

The main industries in the municipal area include mining, agriculture and tourism. While agricultural activities focus on cattle and goats, game farming and hunting are increasing in popularity (Aucamp, 2010). The area is sparsely populated and characterised by vast open spaces with significant underground deposits of manganese and iron ore, the latter being the most prominent commodity in Gamagara's mainstay economic sector, which is mining (www.businesswomen.co.za).

The Gamagara Local Municipality is tgeographically the smallest municipal area within the District Municipality and has the second smallest population size in the area. The primary land uses include mining (iron ore and manganese) and agriculture (cattle and goat farming). Water is supplied to the municipality by the Sishen Mine as a result of dewatering of the mining pits (Ptersa, 2011).

Kathu is one of the youngest towns in South Africa, founded in 1974 and owes its existence to the Sishen Mine. Kathu is often promoted as the 'Town under the Trees' because of its location in the Kathu 'Bos' (forest), which is famous for its Camel thorn trees. The town came into being as a result of the iron ore mining activities of the then ISCOR in the area only a few decades ago. The town has a circular form with residential areas surrounding the CBD, which is located in the centre of town (Kgalagadi District Municipality, 2007). In Sesheng, just outside Kathu, residential use is characterised mainly by hostels for mine workers.

Approximately 85% of the population of Kathu and Dingleton is associated with Sishen Mine and related industries. This includes employment in the various support services and trades. The other 15% of the population functions to cater for the needs of the affiliated community that include employment in shops, banks, garages, and other retail facilities. The municipality of Kathu similarly employs a notable percentage of the population.

The Sishen mine is one of the largest opencast iron mines in the world, and is the Northern Cape's largest employer (www.northerncapebusiness.co.za), and a major trainer of artisans in South Africa. Having identified skills shortages as one of the key hindrances to economic growth in the area, Sishen Mine boasts one of the few fully accredited institutions in South Africa that provides outstanding theoretical and practical training (www.kumba.co.za). The sheer scale of the mine means it has a significant impact socially, environmentally and economically. The mine recognises its role in the community and it works closely with local and district municipalities and other stakeholders to participate in the integrated development plan (IDP). The mine is owned by Anglo American Kumba Iron Ore, which is an Anglo American plc company, and has an approximate workforce of 16 695 who work in three eight hour shifts, six days a week (www.northerncapebusiness.co.za; www.dwaf.gov.za).

The province faces a number of societal challenges that predominantly emanate from the effects of poverty (Kgalagadi District Municipality, 2007). These challenges include reducing the backlog in services relating to basic needs such as water, sanitation and housing; access to health, education and social services; the prevalence of HIV and AIDS; creating of opportunities for employment; reducing crime and addressing the needs of vulnerable groups (Aucamp, 2012).

The population of towns in Gamagara Local Municipality is tabled below (Table 8-11):

Table 8-11: Population of Towns in the Gamagara Local Municipality

Local Towns	Population
Deben (Dibeng)	4900[$]
Dingleton	2487[$]
Kathu	9266[$]
Sesheng	1898[#]
Olifantshoek	8242[$]
Mapoteng	2095[$]
$ Source: http://www.dwaf.gov.za/dir_ws/WaterServices/reports # Source: Census 2001	

Dingleton was built in the 1950s by the Sishen Mine to house its workers (KIO, 2009) and was previously known as Sishen (www.businesswomen.co.za). It was developed in a linear form all along the one side of the then main road between Upington and Kuruman (Kgalagadi District Municipality, 2007). The town is surrounded by large mine activities and the resettlement of Dingleton's residents is eminent due to the expansion of the mining activities in this direction.

9.12.1 Population

The growth rate in the Northern Cape Province is lower than the national average. The John Taolo Gaetsewe District Municipality (JTGDM) shows a decline in population size since 2001, and this can most likely be ascribed to the closure of some of the asbestos mines in the district as well as the prevalence of HIV/AIDS (although it is well below the national prevalence rate). Negative growth is estimated for the area between 2005 and 2015 for both high and low growth scenarios (Kgalagadi District Municipality,

2007). The population in the Gamagara area has increased by almost 20% since 2001 and as the Sishen Mine is the largest employer in the area, the increase is in all likelihood due to an increase in mining activities (Ptersa, 2011).

In 2011 the Gamagara area had an average household size of 3.85, the highest of the three levels (provincial, district and local) under investigation. The household sizes on provincial and district level have also decreased slightly.

The population distribution of the Gamagara area shows greater similarities with the Northern Cape Province than with the JTGDM. 40% of the population of the Northern Cape Province belong to the coloured population and almost 50% to the black population group. In the JTGDM just over 80% belong to the black population group. This can be ascribed to the large presence of tribal land in the district. In Gamagara the black population makes up just over 55% of the population with only about 28% of the population belonging to the coloured population. Gamagara has proportionately the most people from the white population with about 14% of the population being white. This is most likely due to the presence of the Sishen Mine as the largest employer in the area. Technical expertise and tertiary education is required for many jobs in mining operations. People from the white population group had a historical advantage in acquiring the technical skills and tertiary education required for some of the jobs (Figure 8-13).

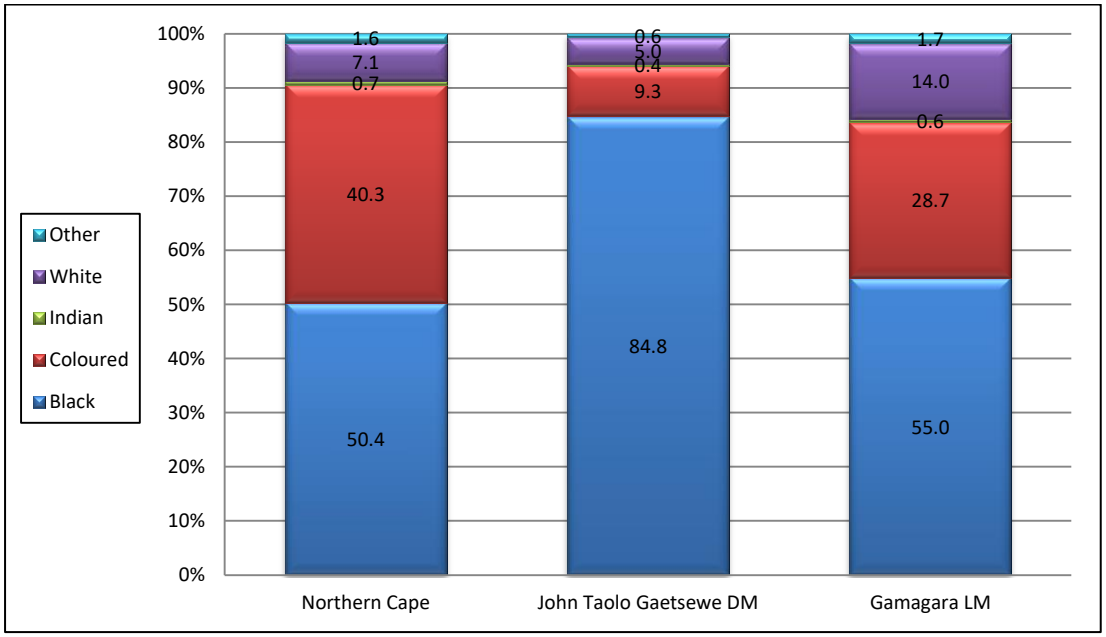


Figure 8-13: Population distribution (shown in percentage, source: CS 2011)

9.12.2 Age

The average age in Gamagara (28.87 years) is much higher than that of the district but just slightly lower than the average age of the province. The average age in the JTGDM is much lower than on provincial or local level. This can most likely be ascribed to the large tribal areas in the district where many people from economically active age migrate to other areas in search for work in order to support their families, while children and older people stay behind (Figure 8-14).

The age distribution profile of Gamagara is very similar to that of the Northern Cape Province with about 25% of the population being younger than 15 years and 72% of economically active age (aged between

15 and 64 years). In the JTGDM a smaller proportion of people from economically active age (59.2%) than in the other areas has to take care of children who make up almost a third of that population. This put more strain on those who are economically active.

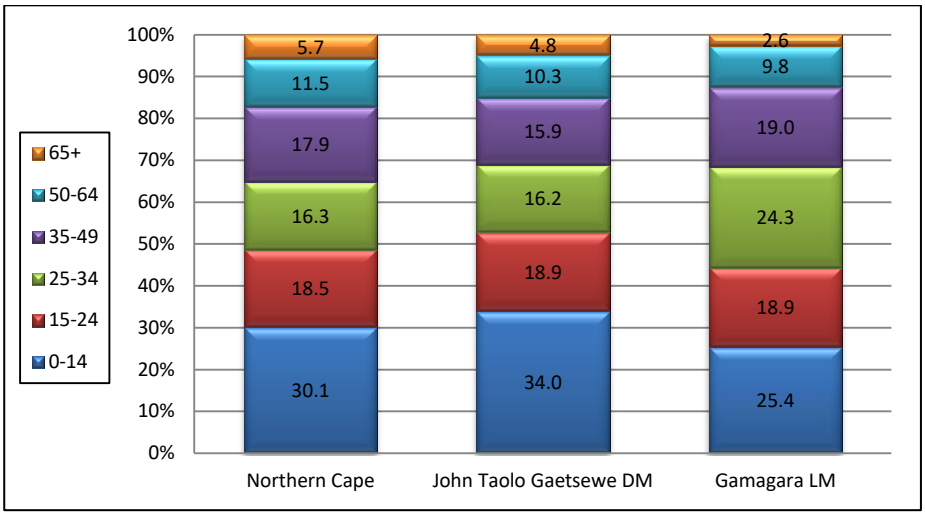


Figure 8-14: Age distribution (shown in percentage, source: CS 2011)

The large proportion of people below the age of 15 years in the district indicates a greater future demand for employment and infrastructure. More work seekers can migrate from the rural areas to the more urbanised areas in the district such as Kuruman and Kathu in search of job opportunities.

9.12.3 Gender

On provincial level the gender distribution is more or less equal (Figure 8-15), but in the JTGDM there are much more females than males. This is due to the large portions of tribal land in the district where many males have migrated to other areas in search of employment.

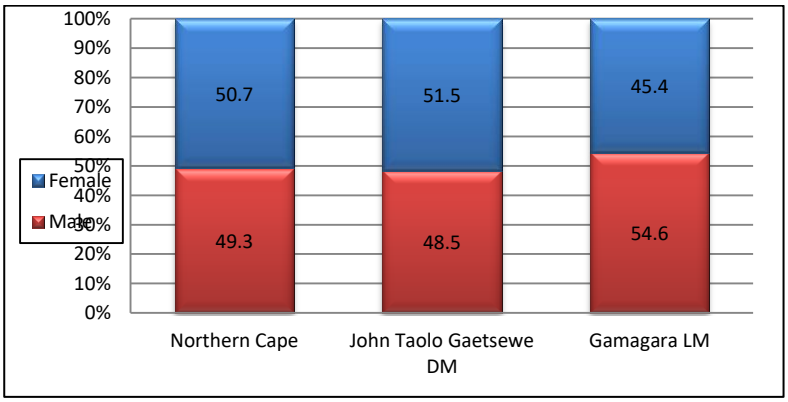


Figure 8-15: Gender distribution (shown in percentage, source: CS 2011)

In the Gamagara area there are more males than females, which can be ascribed to the extensive mining activities in the area. Traditionally mine workers tend to be male.

9.12.4 Language

The Census 2011 data for language was used to get an indication of the language distribution in the area. The language distribution of the Gamagara area is very similar to that of the Northern Cape Province

(Figure 8-16) with Afrikaans being the home language of more than 50% of the people and Setswana the home language of about a 30% of the people.

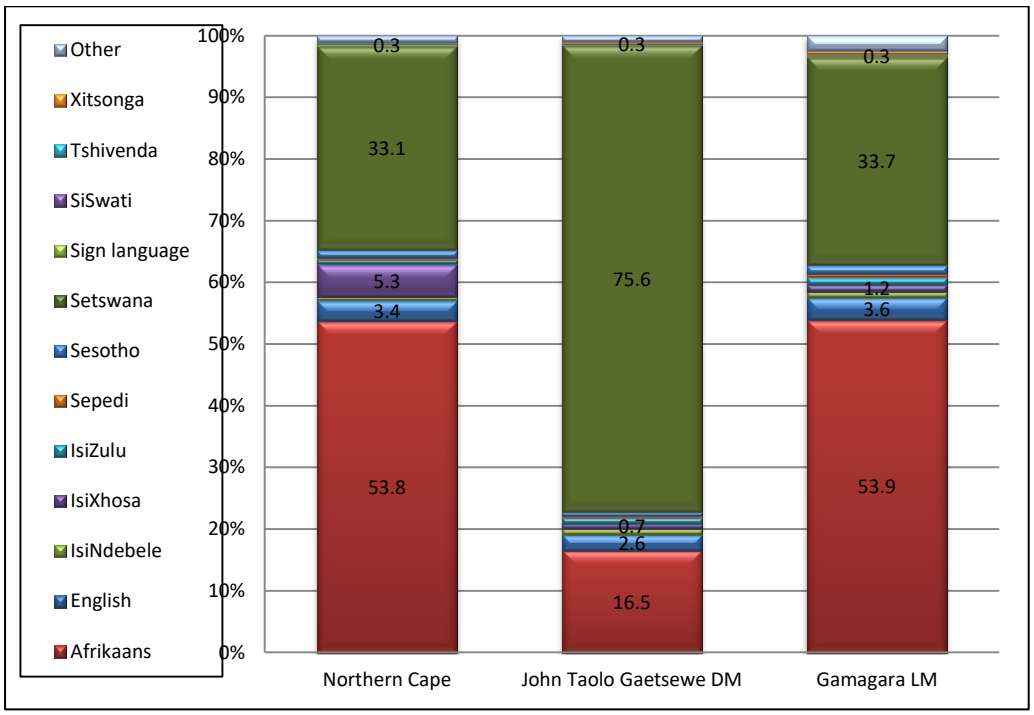


Figure 8-16: Language distribution (shown in percentage, source: Census 2001)

More than 70% of the people in the JTGDM district have Setswana as home language, indicating that this district is culturally very different from the other areas under discussion. The district borders Botswana and the greatest part of the population in the district live in tribal areas where mainly Setswana is spoken. All the tribal land in the Northern Cape is situated in the JTFDM.

9.12.5 Education

The education profile for people 20 years or older in the Gamagara area is very similar to that of the Northern Cape with the exception that Gamagara has a greater proportion people with tertiary education and less people who stopped their education at Grade 12. This can be ascribed to the nature of skills required by the Sishen mine as the largest employer in the area. Educational facilities in the area include a training college and six schools (Kgalagadi District Municipality, 2007).

Education Deprivation is one of the domains of multiple deprivations that were used to calculate the Provincial Indices of Multiple Deprivation (Noble et al, 2006). There is a close link between educational attainment, the type of work an individual is engaged in and the associated earnings potential. The level of education achieved by an individual determines current income and savings potential, as well as future opportunities for individuals and their dependants. This does not bode well for the JTGDM, as the education levels in the area are generally low.

9.13 Description of the current land uses

Land uses of the area include mining, as the proposed RWD is situated on the Sishen Mine site. The N14 highway is located 3.8 km east of the site. The town of Kathu is located 5 km to the north of the site.

9.14 Description of specific environmental features and infrastructure on the site

Other infrastructure on or near the site include the existing tailings dam, the existing RWD, railway line, waste rock dumps, and product stockpile.

An important aspect relating to the proposed development should be to protect and manage the biodiversity (structure and species composition) of the Kathu Bushveld vegetation type which are represented in the project area (refer to Section 9.8). Vegetation removal should be kept to a minimum during any future construction activities and only vegetation on the footprint areas should be removed. The unnecessary impact on the surrounding vegetation types should be avoided as far as possible.

Considering the footprint area to form part of a widespread vegetation entity, the impact on the vegetation of the larger area would be medium to low. Mitigation measures and monitoring should therefore be implemented should the development application be approved.

The Sishen – Saldanha Railway line is adjacent to the site but is not affected by the project (refer to correspondence from Transnet, in Section 8.6).

9.15 Environmental and current land use map

(Show all environmental and current land use features)

The environmental and current land use map is included as Figure 8-17.

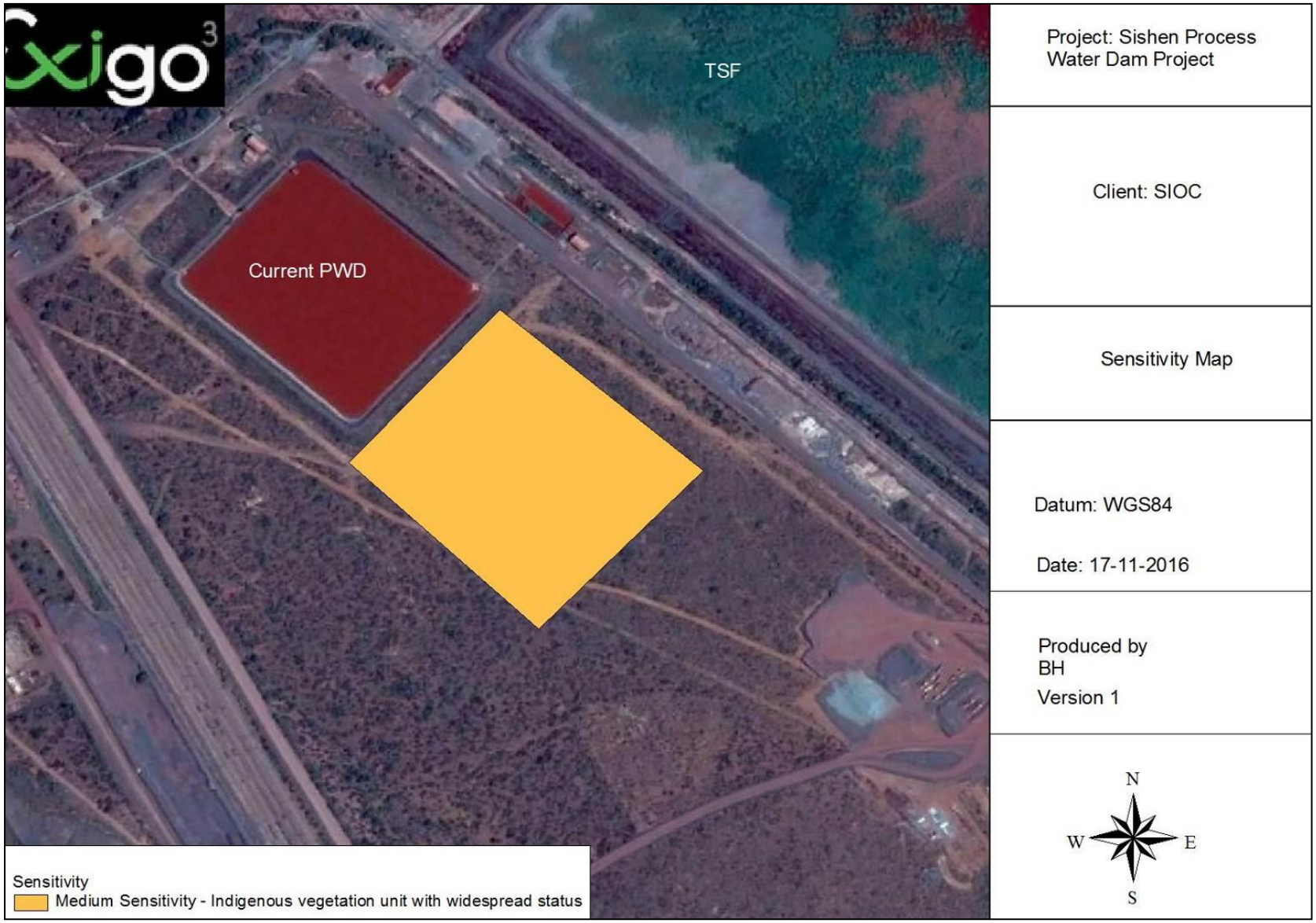


Figure 8-17: Environmental and current land use map

10 Impacts and risks identified including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts

(Provide a list of the potential impacts identified of the activities described in the initial site layout that will be undertaken, as informed by both the typical known impacts of such activities, and as informed by the consultations with affected parties together with the significance, probability, and duration of the impacts. Please indicate the extent to which they can be reversed, the extent to which they may cause irreplaceable loss of resources, and can be avoided, managed or mitigated).

Table 8-12: Impact Assessment Table

Activity	Potential Impact	Phase	Probability		Duration		Scale		Magnitude/ Severity		Significance		
			Score	Magnitude	Score	Magnitude	Score	Magnitude	Score	Magnitude	Score	WOM	WM
Soils and Land Capability													
Site establishment & clearing	Soil erosion once vegetation clearance has taken place and bare soils surfaces are exposed to wind and water	Construction	5	Definite	5	Permanent	2	Site	2	Low	45	Moderate	Low
			4	Highly Probable	3	Medium Term	2	Site	2	Low	28		
Spillages of hydrocarbons	Contamination of soil due to oil spillages	Construction	4	Highly Probable	3	Medium Term	2	Site	6	Medium	44	Moderate	Negligible
			1	Improbable	3	Medium Term	1	Local	2	Low	6		
Groundwater													
Construction of RWD	Spillage of hydrocarbons during on-site refuelling of earth moving equipment and construction vehicles	Construction	2	Probable	3	Medium Term	1	Local	2	Low	12	Negligible	Negligible
			1	Improbable	3	Medium Term	1	Local	2	Low	6		
Construction of RWD	Oil leakages and oil spillages during servicing and operation of construction machinery during construction phase	Construction	2	Probable	3	Medium Term	1	Local	2	Low	12	Negligible	Negligible
			1	Improbable	3	Medium Term	1	Local	2	Low	6		
Construction of RWD	Spillage of any chemicals or treatments used for RWD materials during construction of the RWD	Construction	4	Highly Probable	3	Medium Term	1	Local	2	Low	24	Low	Negligible
			2	Probable	3	Medium Term	1	Local	2	Low	12		
Construction of RWD	Alteration of natural topography and drainage patterns. Possible flooding and inundated areas	Construction	5	Definite	4	Long Term	1	Local	2	Low	35	Low	Negligible
			1	Improbable	3	Medium Term	1	Local	2	Low	6		
RWD design capacity and implementation of fail-safe measures for possible overflows; extreme rainfall events	Overflow of RWD onto unlined receiving environment	Operational	2	Probable	3	Medium Term	2	Site	6	Medium	22	Low	Negligible
			1	Improbable	1	Short Term	2	Site	2	Low	5		
No Routine inspection of RWD facility and liner for identification of possible failure zones or cracks on visible surfaces. No Inspection for seepage along sides of RWD	Failure to recognise leakage of RWD and contaminant transport plume. Prolonged contamination of groundwater and surface water, erosion	Operational	1	Improbable	4	Long Term	2	Site	6	Medium	12	Negligible	Negligible
			1	Improbable	1	Short Term	2	Site	2	Low	5		
Groundwater and surface water monitoring: Failure to adhere to monitoring and maintenance requirements	Failure to recognise leakage of RWD and contaminant transport plume. Prolonged contamination of groundwater and surface water, erosion	Operational	1	Improbable	4	Long Term	1	Local	6	Medium	11	Negligible	Negligible
			1	Improbable	1	Short Term	1	Local	2	Low	4		
Storm water management and extreme rainfall events	Flooding of the RWD, surrounding infrastructure and land uses	Operational	2	Probable	3	Medium Term	2	Site	6	Medium	22	Low	Negligible
			1	Improbable	3	Medium Term	1	Local	2	Low	6		

Contamination of groundwater from temporary and permanent pit latrines	Groundwater contamination	Operational	2	Probable	3	Medium Term	1	Local	2	Low	12	Negligible	Negligible
			1	Improbable	3	Medium Term	1	Local	2	Low	6		
Ecology													
Clearance of vegetation	Direct habitat destruction	Construction	5	Definite	5	Permanent	1	Local	6	Medium	60	Moderate	Low
			5	Definite	5	Permanent	1	Local	2	Low	40		
Clearing of vegetation for development footprints, construction of infrastructure, access roads etc.	Habitat fragmentation	Construction	5	Definite	5	Permanent	1	Local	6	Medium	60	Moderate	Low
			5	Definite	5	Permanent	1	Local	2	Low	40		
Exposure of soils and increased hardened surfaces	Soil erosion	Construction & Operational	4	Highly Probable	4	Long Term	2	Site	6	Medium	48	Moderate	Low
			4	Highly Probable	4	Long Term	2	Site	2	Low	32		
Movement of vehicles on site during construction	Spillage of harmful substances	Construction & Operational	4	Highly Probable	4	Long Term	2	Site	6	Medium	48	Moderate	Low
			4	Highly Probable	4	Long Term	2	Site	2	Low	32		
Exposure of soils and materials handling	Dust impacts	Construction & Operational	5	Definite	4	Long Term	2	Site	6	Medium	60	Moderate	Low
			4	Highly Probable	4	Long Term	2	Site	2	Low	32		
Continued movement of personnel and vehicles on and off the site during the construction phase, as well as occasional delivery of materials required for maintenance	Spread of alien invasive species	Construction & Operational	4	Highly Probable	4	Long Term	2	Site	6	Medium	48	Moderate	Low
			4	Highly Probable	4	Long Term	2	Site	2	Low	32		
Construction of infrastructure, access roads etc.	Negative effect of human activities	Construction & Operational	4	Highly Probable	3	Medium Term	2	Site	6	Medium	44	Moderate	Low
			4	Highly Probable	3	Medium Term	2	Site	2	Low	28		
Air Quality													
Vegetation clearance and wind erosion	Dust impacts	Construction	5	Definite	3	Medium Term	2	Site	6	Medium	55	Moderate	Low
			4	Highly Probable	3	Medium Term	1	Local	2	Low	24		
Heritage													
General construction and operational activities	Impact on RWD site	Construction and Operational	2	Probable	5	Permanent	1	Local	2	Low	16	Negligible	Negligible
			2	Probable	5	Permanent	1	Local	2	Low	16		
Social													
Establishment of new facilities	Job creation (positive)	Construction, Operational, Decommissioning	4	Highly Probable	3	Medium Term	3	Regional	6	Medium	48	Moderate	Negligible
			2	Probable	3	Medium Term	1	Local	2	Low	12		

10.1 Methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks

(Describe how the significance, probability, and duration of the aforesaid identified impacts that were identified through the consultation process was determined in order to decide the extent to which the initial site layout needs revision).

An impact can be defined as any change in the physical-chemical, biological, cultural and/or socio-economic environmental system that can be attributed to human activities related to alternatives under study for meeting a project need. Assessment of impacts will be based on the Department of Environmental Affairs Guideline Document: EIA Regulations 2010. The significance of the aspects/impacts of the process will be rated by using a matrix derived from Plomp (2004) and adapted to some extent to fit this process. These matrixes use the consequence and the likelihood of the different aspects and associated impacts to determine the significance of the impacts.

The significance of the impacts will be determined through a synthesis of the criteria below:

Probability. This describes the likelihood of the impact actually occurring.

Improbable:	The possibility of the impact occurring is very low, due to the circumstances, design or experience.
Probable:	There is a probability that the impact will occur to the extent that provision must be made therefore.
Highly Probable:	It is most likely that the impact will occur at some stage of the development.
Definite:	The impact will take place regardless of any prevention plans, and there can only be relied on mitigatory actions or contingency plans to contain the effect.

Duration. The lifetime of the impact

Short term:	The impact will either disappear with mitigation or will be mitigated through natural processes in a time span shorter than any of the phases.
Medium term:	The impact will last up to the end of the phases, where after it will be negated.
Long term:	The impact will last for the entire operational phase of the project but will be mitigated by direct human action or by natural processes thereafter.
Permanent:	Impact that will be non-transitory. Mitigation either by man or natural processes will not occur in such a way or in such a time span that the impact can be considered transient.

Scale. The physical and spatial size of the impact

Local:	The impacted area extends only as far as the activity, e.g. footprint
Site:	The impact could affect the whole, or a measurable portion of the above mentioned properties.
Regional:	The impact could affect the area including the neighbouring residential areas.

Magnitude/ Severity. Does the impact destroy the environment, or alter its function.

Low:	The impact alters the affected environment in such a way that natural processes are not affected.
Medium:	The affected environment is altered, but functions and processes continue in a modified way.
High:	Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.

Significance. This is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required.

Negligible: The impact is non-existent or unsubstantial and is of no or little importance to any stakeholder and can be ignored.

Low: The impact is limited in extent, has low to medium intensity; whatever its probability of occurrence is, the impact will not have a material effect on the decision and is likely to require management intervention with increased costs.

Moderate: The impact is of importance to one or more stakeholders, and its intensity will be medium or high; therefore, the impact may materially affect the decision, and management intervention will be required.

High: The impact could render development options controversial or the project unacceptable if it cannot be reduced to acceptable levels; and/or the cost of management intervention will be a significant factor in mitigation.

The following weights will be assigned to each attribute:

Aspect	Description	Weight
Probability	Improbable	1
	Probable	2
	Highly Probable	4
	Definite	5
Duration	Short term	1
	Medium term	3
	Long term	4
	Permanent	5
Scale	Local	1
	Site	2
	Regional	3
Magnitude/Severity	Low	2
	Medium	6
	High	8
Significance	Sum (Duration, Scale, Magnitude) x Probability	
	Negligible	<20
	Low	<40
	Moderate	<60
	High	>60

The significance of each activity will be rated without mitigation measures and with mitigation measures for both construction, operational and closure phases of the Platinum Mine development.

The findings of the impact assessment have been consolidated in the sections below. The impacts have been classified as impacts on the biophysical environment and impacts on the socio-economic environment. The impacts are further classified in terms of the phase of the development in which they are likely to occur, namely the construction phase, the operational phase and the decommissioning phase (where applicable).

10.2 The positive and negative impacts that the proposed activity (in terms of the initial site layout) and alternatives will have on the environment and the community that may be affected.

(Provide a discussion in terms of advantages and disadvantages of the initial site layout compared to alternative layout options to accommodate concerns raised by affected parties)

On Alternatives please refer to Section 7.

Biophysical Environment

10.2.1 Impacts on Soils (Degradation, Erosion and Sedimentation)

Topsoil will be stripped prior to construction of infrastructure associated with the proposed RWD project. Topsoil must be stockpiled to be re-used in rehabilitation at a later stage or in another area of the mine. The mine has a general deficit in topsoil that can be used in rehabilitation methods. For this reason it is important for the stripping and stockpiling of topsoil to be carefully managed and placed in order to support future re-vegetation initiatives.

Topsoil could possibly become physically degraded due to compaction, surface crusting, erosion and structural degradation. Soil erosion also promotes a variety of terrestrial ecological changes associated with disturbed areas, including the establishment of alien invasive plant species, altered plant community species composition and loss of habitat for indigenous fauna and flora. Care must be taken to ensure wind and water erosion are limited at the topsoil stockpiles, with the primary focus being on the effective placement of these stockpiles.

Soil pollution may occur predominantly as a result of fuel spills by construction and operational vehicles. This should only have a localised impact on the soil. The impact may occur predominantly during the construction phase.

Significance Rating

Vegetation clearance, soil stripping and stockpiling will have a moderate impact on soils, without mitigation. All impacts rated have a high to definite probability of occurrence; however impacts will be limited to the proposed development area.

Effective mitigation will reduce any significant impacts on soil to low.

10.2.2 Impacts on surface and ground water quality and quantity

The Hydrogeological Assessment for the proposed RWD was undertaken by Exigo in February 2017 (refer to Appendix 8).

Possible sources of impacts on the receiving groundwater environment are:

- Construction vehicles and earth moving machinery and servicing during construction phase (oil leaks and spillages);
- Unlined and bare earth on-site refuelling locations and temporary servicing bays;
- Leaking liner in new RWD;
- Overflowing RWD due to improper process water management.

Pathways

The proposed new RWD will be lined. The liner is the most important possible groundwater contamination mitigation measure that can be taken, given the nature of the development. Thus the risk of groundwater contamination from the proposed RWD is negligible to low. In the improbable case that the liner should leak, pathways still need to be identified for the contamination in order to be environmentally prepared for this case. There are also other possible groundwater contamination sources as listed above, for which pathways need to be defined, to the identified Receptors below. Possible pathways for soil and groundwater contamination are:

- Leaks/cracks in RWD liner and the soil horizons immediately below the proposed RWD liner;
- The shallow Kalahari sands (alluvial) and calcrete aquifer below the soil horizons will be the next possible groundwater pathway in which possible groundwater contamination can travel. Clay below the Kalahari sands-(alluvium, Gordonia Fm) and calcrete-aquifer creates an aquiclude that effectively forms a protective barrier from contamination for the deep aquifer. From previous investigations this clay aquifer is present below the proposed new RWD. Some distance further to the south however, this clay diminishes, and the shallow Kalahari sands and calcrete aquifer is directly underlain by the deep dolomitic aquifer. The distance of this absence in the clay aquiclude to the south, from the proposed RWD is however of such magnitude, that in the unlikely case that the liner should fail, the probability of the contaminant reaching this distance over the LoM is low. There is also a groundwater monitoring network in place for early detection of possible leaking of the RWD liner.

Receptors

From groundwater modelling and existing studies/data, the groundwater receptors are:

- The shallow alluvial- and calcrete-aquifer;
- The Sishen open cast pits to the west;
- The Local natural surface depressions and pans to the east of the proposed RWD.

10.2.3 Impacts on Biodiversity

An Ecological Assessment for the proposed RWD was undertaken by Exigo in November 2016 (refer to Appendix 6).

There are three major categories of impacts on biodiversity namely:

- Impacts on habitat resulting in loss, degradation and / or fragmentation.
- Direct impacts on fauna and flora and species, for example plants and animals that are endemic / threatened / special to a particular habitat will not be able to survive if that habitat is destroyed or altered by the development.
- Impact on natural environmental processes and ecosystem functioning. This can lead to an accumulated effect on both habitat and species.

10.2.3.1 Direct habitat destruction

The proposed development of the RWD will result in some loss of and damage to natural habitats if the vegetation is cleared. Rehabilitation of some areas would be possible but there is likely to be long-term damage in large areas. Most habitat destruction will be caused during the construction phase. The impact of the habitat destruction will be on the flora and fauna of the study area:

a) Destruction or loss of floral diversity or vegetation communities

The following major impacts of the development will potentially impact on the flora of the site:

- The construction will lead to the loss of individual plants such as grasses, forbs, trees and shrubs that will be cleared on the footprint area;
- Loss of threatened, “near-threatened” and endemic taxa: The anticipated loss of some of the woodland habitats that support endemic species will result in the local displacement of endemic listed flora;
- The construction activities can impact on surrounding vegetation by dust and altered surface run-off patterns;
- The disturbance of the area could lead to an increase in the growth of alien vegetation.

b) Loss of faunal diversity through migration and decline in animal numbers

The following major impacts of the proposed development will potentially impact on the faunal habitats of the site:

- Habitat modification by construction activities will force animals out of the area and animal numbers will decrease. This impact could also take place because of hunting and snaring of animals in natural areas;
- Loss of threatened, “near-threatened” and conservation important taxa: The anticipated loss of the natural woodland will result in the local displacement of some fauna species;
- Changes in the community structure: It is expected that the faunal species composition will shift, due to an anticipated loss in habitat surface area.

10.2.3.2 Habitat fragmentation

The construction of the proposed RWD will inevitably result in natural movement patterns being disrupted and, to a varying degree depending on how different species react to these barriers will result in the fragmentation of natural populations. The development will have a medium to low impact in fragmenting the habitats on the property. Such impacts would be short-term provided that proper rehabilitation methods are used.

10.2.3.3 Increased soil erosion and sedimentation

The construction activities associated with the development may result in widespread soil disturbance and is usually associated with accelerated soil erosion. Soil, sediments and associated contaminants are transported into water bodies such as pans, resulting in the loss or alteration of habitats for aquatic organisms, as well as changes in water quality. Soil erosion also promotes a variety of terrestrial

ecological changes associated with disturbed areas, including the establishment of alien invasive plant species, altered plant community species composition and loss of habitat for indigenous fauna and flora.

10.2.3.4 Soil and water pollution

Construction work for the proposed development will always carry a risk of soil and water pollution, with vehicles operating on site. If not promptly dealt with, spillages or accumulation of waste matter can contaminate the soil and surface or ground water, leading to potential impacts on fauna and flora.

10.2.3.5 Air pollution

The environmental impacts of wind-borne dust, gases and particulates from the construction activities associated with the proposed development are primarily related to ecosystem damage. The proposed development will typically comprise the following sources and associated air quality pollutants:

- Land clearing operations, building and scraping;
- Stockpiling (particulate matter);
- Materials handling operations (truck loading & unloading, tipping, stockpiling);
- Vehicle entrainment on paved and unpaved roads;
- Windblown dust-fugitive emissions (stockpiles).

One of the primary impacts on the biophysical environment is linked to emission of dusts and fumes both from the transportation system. Dust pollution impacts will be most severe during the construction phase. Construction vehicles and equipment are the major contributors to the impact on air quality.

Diesel exhaust gasses and other hydrocarbon emissions all add to the deterioration in air quality during this phase. Vehicles travelling at high speeds on dirt roads significantly aggravate the problem.

Although the potential for severe fugitive dust impacts is greatest within 100 m of dust-generating activities, there is still the potential for dust to affect vegetation up to five kilometres or more downwind from the source. Dust deposited on the ground may cause changes in soil chemistry (chemical effects), and may over the long-term result in changes in plant chemistry, species composition and community structure. Sensitivities to dust deposition of the various plant species present in the area are not known. It is therefore difficult to predict which species may be susceptible.

Poor air quality results in deterioration of visibility and aesthetic landscape quality of the region, particularly in winter due to atmospheric inversions.

10.2.3.6 Spread and establishment of alien invasive species

This is probably one of the most significant potential impacts from a terrestrial invertebrate perspective, and also may have very significant knock-on effects that could impact of virtually every aspect of the surrounding ecosystem. Vehicles often transport many seeds and some may be of invader species, which may become established along the road, especially where the area is disturbed. The construction almost certainly carries by far the greatest risk of alien invasive species being imported to the site, and the high levels of habitat disturbance also provide the greatest opportunities for such species to establish themselves, since most indigenous species are less tolerant of disturbance. The biggest risk is that seeds

of noxious plants (especially *Prosopis glandulosa*) may be carried onto the site along with materials that have been stockpiled elsewhere at already invaded sites.

Continued movement of personnel and vehicles on and off the site, as well as occasional delivery of materials required for maintenance, will result in a risk of importation of alien species throughout the life of the project.

10.2.3.7 Negative effect of human activities and road mortalities

An increase in human activity on the site and surrounding areas is anticipated. The risk of snaring, killing and hunting of certain faunal species is increased. Certain faunal species may be captured for selling to the pet trade. If staff compounds are erected for construction workers, the risk of pollution because of litter and inadequate sanitation and the introduction of invasive fauna and flora are increased. The presence of a large number of construction workers or regular workers during the construction phase on site over a protracted period will result in a greatly increased risk of uncontrolled fires arising from cooking fires, improperly disposed cigarettes etc.

Large numbers of fauna are also killed daily on roads. They are either being crushed under the tyres of vehicles in the case of crawling species, or by colliding with the vehicle itself in the case of avifauna or flying invertebrates. The impact is intensified at night, especially for flying insects, as result of their attraction to the lights of vehicles. The impact of the RWD on the local fauna population would be significant, although considering the degraded state of the area surrounding the Sishen Mine, these impacts will mainly be on generalised species.

10.2.4 Impacts on air quality

Activities that could impact on air quality which are associated with the proposed RWD during the construction phase include the development of new access roads to the project area, vegetation clearing and wind erosion from exposed areas causing increased PM10 concentrations and dust fall-out.

With mitigation measures, all of the abovementioned impacts can be managed to have a low – negligible significance.

10.2.5 Impact on heritage resources

A Heritage Assessment for the proposed RWD was undertaken by Exigo in November 2016 (refer to Appendix 7).

Single Middle Stone Age stone tools were documented in the proposed project footprint. The tools occur out of context in isolated locations and they are of low significance. The potential impact on these Stone Age occurrences is considered to be low. In terms of the area's Stone Age it is important to note a concern raised by Morris (2014: unpaged) that a "consistent issue in the assessment of the presence or absence of archaeological deposits in and around Kathu … is the fact that the landscape is often capped by (1) calcrete (not uniformly ancient – Walker et al 2013) and (2) younger Gordonia Formation Aeolian sands (Almond 2014)". That subsurface archaeological remains may occur under overlying soils and calcretes should be taken into account when archaeological and heritage surveys are undertaken. The clearing of topsoil during development activities frequently exposes archaeological deposits.

Socio-Economic Environment

Sources of social impacts are often not as clear-cut as those in the biophysical environment. Social impacts are not site-specific, but occur in the communities surrounding the proposed site (Aucamp, 2012). The following section attempts to rate the potential impacts of the proposed project on elements of the social and socio-economic environment.

It must be considered that the social environment is dynamic and constantly changing, making it difficult to predict exact impacts. External processes not related to the project, such as political changes or global economic changes can alter the social environment in a short period of time, and therefore alter the predicted impacts. Additionally, impacts on the social environment are often related to public perception and are thus qualitative and not quantitative in nature.

Social impacts resulting from the project will be cumulative to existing impacts and it is socially responsible to look at the effect an impact will have not in isolation, but when added to existing impacts.

10.2.6 Job creation and associated expectations

The proposed development of the RWD will result in existing jobs being retained that will have a positive impact on the local economy.

10.3 The possible mitigation measures that could be applied and the level of risk

(With regard to the issues and concerns raised by affected parties provide a list of the issues raised and an assessment/ discussion of the mitigations or site layout alternatives available to accommodate or address their concerns, together with an assessment of the impacts or risks associated with the mitigation or alternatives considered).

Biophysical Environment

10.3.1 Impacts on soils (Degradation, Erosion and Sedimentation)

Specific mitigation measures include:

- Clearance of vegetation should be done only within the footprint of the project site
- .Minimize clearance of vegetation. Retain natural trees, shrubbery and grass species wherever possible.
- Protect all areas susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and work areas.
- Repair all erosion damage as soon as possible and in any case not later than six months before the termination of the Maintenance Period to allow for sufficient rehabilitation growth.
- Institute a storm water management plan including strategies such as:
    - Minimising impervious area;
    - Increasing infiltration to soil by use of recharge areas.
- Have both temporary (during construction) and permanent erosion control plans. Temporary control plans should include:
    - Temporary silt trap basins;
    - Short term seeding or mulching of exposed soil areas (particularly on slopes);
    - Limitations on access for heavy machinery and the storage of materials to avoid soil compaction.
- Permanent erosion control plans should focus on the establishment of stable native vegetation communities.
- Conservation of topsoil should be prioritized on site and done as follows:
    - Topsoil should be handled twice only - once to strip and stockpile, and secondly to replace, level, shape and scarify.
    - Stockpile topsoil separately from subsoil.
    - Stockpile in an area that is protected from storm water runoff and wind.
    - Topsoil stockpiles should not exceed 2.0 m in height and should be protected by a mulch cover where possible.
    - Maintain topsoil stockpiles in a weed free condition.

- Topsoil should not be compacted in any way, nor should any object be placed or stockpiled upon it.
- Stockpile topsoil for the minimum time period possible i.e. strip just before the relevant activity commences and replace as soon as it is completed.

- In the case of hydrocarbon spills on a paved area absorbent material will be used to recover the hydrocarbons. The recovered hydrocarbons with the absorbent material will be disposed of at a licensed disposal site for hazardous waste.
- Following any spillage on an unpaved surface:
  - The spilled material needs to be classified to determine if it is hazardous.
  - The spill needs to be contained through the use of soil, Safsorb or any other suitable dry material.
  - Polluted soils must be removed to the mine's concrete-lined temporary storage area, in clearly marked containers.
  - If it is not possible to contain the spill the site needs to be closed off and a full site assessment needs to be undertaken – relevant specialist advice to be obtained prior to the activities on-site being ceased.
- Waste oil, fuel and other chemicals will be disposed of as hazardous waste and not with domestic waste.
- Particular attention will be given to training of staff and contractors in the handling of oils, diesel and other hazardous substances on site in order for spills to be avoided.

10.3.2 Impacts on surface and ground water quality and quantity

The following mitigation measures are recommended:

10.3.2.1 Spillage of hydrocarbons during on-site refuelling

Spillage of hydrocarbons during on-site refuelling of earth moving equipment and construction vehicles [Construction phase]

- All vehicles should be inspected for oil and fuel leaks regularly and frequently. Any vehicle showing signs of leaking should be serviced immediately.
- Daily pre-shift inspection must also include identification of oil leaks for repair prior to making use of the equipment
- All spillages must be reported to the site construction manager and Site Environmental Officer who will make sure that the site is cleaned with immediate effect and measure are put in place to prevent re-occurrences of similar incidents
- All spills should be cleaned up immediately to the satisfaction of the Site Environmental Control Officer by removing the spillage together with the polluted soil and by disposing of them at a recognized and licensed facility.

- In the case of hydrocarbon spills on a paved area, absorbent material will be used to recover the hydrocarbons. The recovered hydrocarbons with the absorbent material will be disposed of at a licensed disposal site for hazardous waste.
- Following any spillage on an unpaved surface:
    - The spilled material needs to be classified to determine if it is hazardous.
    - The spill needs to be contained through the use of soil, Safsorb or any other suitable dry material.
    - Polluted soils must be removed to the mine's concrete-lined temporary storage area, in clearly marked containers.
    - If it is not possible to contain the spill the site needs to be closed off and a full site assessment needs to be undertaken – relevant specialist advice to be obtained prior to the activities on-site being ceased.
- Waste oil, fuel and other chemicals will be disposed of as hazardous waste and not with domestic waste.
- Particular attention will be given to training of staff and contractors in the handling of oils, diesel and other hazardous substances on site in order for spills to be avoided

10.3.2.2 Oil leakages and oil spillages during construction phase

Oil leakages and oil spillages during servicing and operation of construction machinery during construction phase [Construction phase]

- Vehicles must be maintained in such a manner that fuel and oil leaks are limited.
- Drip trays should be used and be a requirement for all vehicles and earth moving machinery that have been identified, during routine inspections, to have oil leaks.

10.3.2.3 Spillage of any chemicals or treatments used for RWD construction

Spillage of any chemicals or treatments used for RWD materials during construction of the RWD [Construction phase]

- Chemicals used during the construction and preparation of materials used in the construction of the RWD, should be handled according to chemical handling procedures specified in the mine's chemicals handling SOP and best practices guidelines.
- The safety instructions in handling and use of the chemicals should be adhered to.
- Areas where work is done with chemicals above the undisturbed receiving environment should be temporarily lined so as to prohibit contamination from possible spillages.

10.3.2.4 Contamination of groundwater from temporary/mobile toilets/pit latrines

Contamination of groundwater from temporary pit latrines for construction personnel [Construction phase]

- Temporary pit latrines used by construction personnel at the RWD, should be routinely emptied and precautionary measures taken to prevent spillages of sewerage and possible soil

and groundwater contamination.

- Permanent sanitation and sewerage systems (such as septic tanks and French drains) must be maintained and serviced regularly.

10.3.2.5 Alteration of natural topography and drainage patterns

Alteration of natural topography and drainage patterns: Possible flooding and inundated areas

- The RWD is temporary and applicable to the operational phase of the mine.
- When the mine is decommissioned, the RWD will be removed and the area will be restored and rehabilitated to follow the natural topography as closely as possible.
- Proper decommissioning procedures need to be followed for the RWD during the mine decommissioning and closure phase.
    - These include removal of the waste water and precipitates that may have formed in the RWD over time as well as the liner of the RWD, should it be constructed of synthetic material.
    - An accredited and registered professional waste removal contractor should be used for the removal and transport of the waste water and material after decommissioning of the RWD and disposed of at an approved hazardous waste disposal/storage site.
- The embankments of the RWD should be removed and the landscape restored as best as possible to the original topography and slopes of the original receiving environment.

10.3.2.6 Overflow of RWD onto unlined receiving environment

Overflow of RWD onto unlined receiving environment [Operational and Decommissioning phase]

- The RWD should have engineering design capacity plans and report in place and should be designed to handle a 1:100 rainfall event, either by having enough storage capacity or through fail-safe storm water conduits and overflow conduits to a safe mine water containment facility.
- The new RWD should be included in the operational mine water balance.
- A storm water management plan should be in place that includes the expanded RWD.

10.3.2.7 Failure to recognise leakage of RWD and contaminant transport

Failure to recognise leakage of RWD and contaminant transport plume - Prolonged contamination of groundwater and surface water

- Routine visual inspection from a qualified person should be performed for the expanded RWD and existing RWD to check for any visual defects of the visible liner.
- The banks and raised wall of the RWD should also be checked for possible seepage from leaks.

10.3.2.8 Failure to adhere to monitoring and maintenance requirements – prolonged groundwater contamination

Failure to recognise leakage of RWD and contaminant transport plume - Prolonged contamination of groundwater and surface water

- Groundwater and surface water monitoring should be continued.
- There are existing suitable monitoring boreholes in the vicinity of the RWD to monitor possible groundwater contamination that could occur if the liner leaks.
- Process water should be properly contained in process water pipes, channels and storage facilities and the infrastructure regularly inspected and maintained if required.

10.3.2.9 Flooding due to improper storm water management and extreme rainfall events

Flooding of the RWD, surrounding infrastructure and land uses

A storm water management plan should be put in place and its recommendations and designs implemented where required and feasible.

10.3.3 Impacts on biodiversity

10.3.3.1 Direct habitat destruction

- The removal of the indigenous trees and shrubs should only occur on the footprint area of the proposed RWD footprint and not over the larger area. No trees may be trimmed or removed without the prior permission of the project manager or Environmental Control Officer (ECO).
- Clearly demarcate the entire development footprint prior to initial site clearance and prevent construction personnel from leaving the demarcated area.
- Monitoring should be implemented during the construction phase of the development to ensure that minimal impact is caused to the fauna of the area.
- The ECO should advise the construction team in all relevant matters to ensure minimum destruction and damage to the environment. The ECO should enforce any measures that he/she deem necessary. Regular environmental training and awareness should be provided to construction workers to ensure the protection of the habitat, fauna and flora and their sensitivity to conservation.
- Poisons for the control of problem animals should rather be avoided since the wrong use thereof can have disastrous consequences for the raptors occurring in the area. The use of poisons for the control of rats, mice or other vermin should only be used after approval from an ecologist.

10.3.3.2 Habitat fragmentation

- Use existing facilities (e.g., access roads, degraded areas) to the extent possible to minimize the amount of new disturbance.
- Ensure protection of important resources by establishing protective buffers to exclude unintentional disturbance. All possible efforts must be made to ensure as little disturbance as possible to the sensitive habitats on site during construction;
- During construction, sensitive habitats must be avoided by construction vehicles and equipment, wherever possible, in order to reduce potential impacts. Only necessary damage must be caused and, for example, unnecessary driving around in the veld or bulldozing natural habitat must not take place. Construction activities must remain within defined

construction areas and the road servitudes. No construction / disturbance will occur outside these areas.

- Any access roads to the RWD should be developed without pavements to ensure small fauna can move freely over the road surface area. Where necessary small culverts should be inserted beneath the road, especially where the road is slightly higher than ground level, or in the riparian woodland and along the periphery of the salt pans to ensure fauna can migrate between areas.

10.3.3.3 Increased Soil erosion and sedimentation

- Minimize the amount of land disturbance and develop and implement stringent erosion and dust control practices. Control dust on construction sites and access roads using water-sprayers.
- Institute a storm water management plan including strategies such as:
    - minimising impervious area
    - increasing infiltration to soil by use of recharge areas
    - use of natural vegetated swales instead of pipes or
    - Installing detention or retention facilities with graduated outlet control structures.
- Have both temporary (during construction) and permanent erosion control plans.
    - Temporary control plans should include:
        - silt fencing
        - temporary silt trap basins
        - short term seeding or mulching of exposed soil areas (particularly on slopes)
        - Limitations on access for heavy machinery and the storage of materials to avoid soil compaction.
    - Permanent erosion control plans should focus on the establishment of stable native vegetation communities.
- Ensure the amount of bare soil exposed is minimized by staging earthworks in phases and leaving as much ground cover intact as possible during construction.
- Protect all areas susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and Work Areas.
- Repair all erosion damage as soon as possible and in any case not later than six months before the termination of the Maintenance Period to allow for sufficient rehabilitation growth.
- Conservation of topsoil should be prioritized on site and done as follows:
    - Topsoil should be handled twice only - once to strip and stockpile, and secondly to replace, level, shape and scarify.

- Stockpile topsoil separately from subsoil.
- Stockpile in an area that is protected from storm water runoff and wind.
- Topsoil stockpiles should not exceed 2.0 m in height and should be protected by a mulch cover where possible.
- Maintain topsoil stockpiles in a weed free condition.
- Topsoil should not be compacted in any way, nor should any object be placed or stockpiled upon it.

- Stockpile topsoil for the minimum time period possible i.e. strip just before the relevant activity commences and replace as soon as it is completed

10.3.3.4 Soil and water pollution

- Water falling on areas polluted with oil/diesel or other hazardous substances must be contained. Any excess or waste material or chemicals should be removed from the site and discarded in an environmental friendly way. The ECO should enforce this rule rigorously.
- Chemicals to be stored on an impervious surface protected from rainfall and storm water run-off.
- Ensure that refuelling stations on site are constructed so as to prevent spillage of fuel or oil onto the soil, and put in place measures to ensure that any accidental spillages can be contained and cleaned up promptly.
- Sewage should either be treated in a suitable plant or removed from the site for treatment elsewhere.
- Spill kits should be on-hand to deal with spills immediately.
- Spillages or leakages must be treated according to an applicable procedure as determined by a plan of action for the specific type of disturbance.
- All construction vehicles should be inspected for oil and fuel leaks regularly and frequently. Vehicle maintenance will not be done on site except in emergency situations in which case mobile drip trays will be used to capture any spills. Drip trays should be emptied into a holding tank and returned to the supplier.

10.3.3.5 Air pollution

- Dust suppression must be undertaken in conjunction with a dust monitoring programme that places dust deposition gauges or receiving buckets, directional dust collection receptacles, high volume active air samplers or continuous particle monitors or even personal exposure samplers at generation sites, around the mine and in adjacent areas.
- Implement standard dust control measures, including periodic spraying (frequency will depend on many factors including weather conditions, soil composition and traffic intensity and must thus be adapted on an on-going basis) of construction areas and access roads, and ensure that these are continuously monitored to ensure effective implementation.

- A speed limit (preferably 40 km/hour) should be enforced on dirt roads.

10.3.3.6 Spread and establishment of alien invasive species

- Institute strict control over materials brought onto site, which should be inspected for potential invasive invertebrate species and steps taken to eradicate these before transport to the site. Routinely fumigate or spray all materials with appropriate low-residual insecticides prior to transport to or in a quarantine area on site. The Argentine ant is nearly impossible to eradicate once it has established itself.
- Rehabilitate disturbed areas as quickly as possible to reduce the area where invasive species would be at a strong advantage and most easily able to establish.
- Institute a monitoring programme to detect alien invasive species early, before they become established and, in the case of weeds, before the release of seeds.
- Institute an eradication/control programme for early intervention if invasive species are detected, so that their spread to surrounding natural ecosystems can be prevented.

10.3.3.7 Negative effect of human activities and road mortalities

- Adequate rubbish bins and sanitation facilities should be provided.
- The ECO should regularly inspect the site, including storage facilities and compounds and eradicate any invasive or exotic plants and animals.
- Maintain proper firebreaks around entire development footprint.
- Educate construction workers regarding risks and correct disposal of cigarettes.
- Travelling at night should be avoided or limited as much as possible.
- Lights should be positioned 5m from the roads or paved areas.

10.3.4 Impacts on air quality

- During the construction phase, use water sprays on access area before grading, and at areas to be cleared of vegetation. Ensure exposed areas remain moist through regular water spraying. Moist topsoil will reduce the potential for dust generation when tipped onto stockpiles.

10.3.5 Impact on Heritage Resources

The Sishen Iron Ore Mine is situated in a rich cultural landscape. The Kathu Pan, Kathu Townlands and Bestwood Stone Age sites are of notable scientific significance and other heritage sites. However, pockets of the demarcated footprint have been transformed and disturbed as a result of rock dumping, digging and infrastructure development, potentially sterilising the area of heritage remains. The following recommendations provide an outline for the management of the heritage landscape around the proposed RWD:

- A Palaeontological Desktop Study should be considered for the development. Should fossil remains such as fossil fish, reptiles or petrified wood be exposed during construction, these objects should carefully safeguarded and the relevant heritage resources authority (SAHRA)

should be notified immediately so that the appropriate action can be taken by a professional palaeontologist.

- Single Middle Stone Age (MSA) stone tools were identified on the surface in an access road and at calcrete exposures in the proposed project area. The occurrences, consisting out of 3 broken points, are of low heritage significance due to the limited numbers of formal and diagnostic tools, and general loss of context of the lithics at the site. Cognisant, of the sensitive nature of the heritage landscape around Kathu, it is recommended that the RWD project area be carefully monitored by an informed Environmental Control Office (ECO) but an archaeologist suitably qualified in Stone Age fieldwork and research must be appointed to undertake an Archaeological Watching Brief during the Construction Phase of the project since previously undetected heritage remains might occur in subsurface calcrete deposits. The appointed archaeologist will be responsible for the following:
    - Provide training to the ECO in Stone Age archaeology and the identification of Stone Age artefacts and sites. The ECO will be responsible for daily on-site monitoring during the Construction Phase with the appointed archaeologist visiting the site monthly.
    - Conduct an archaeological monitoring program whereby the construction site is visited monthly for at least the first two months of the project.
    - On-site assessment of any Stone Age material exposed during construction and the provision of recommendations for the way in which the exposed material must be mitigated.
    - Compile and submit an archaeological monitoring report at the end of the monitoring process.

Generally, should any subsurface paleontological, archaeological or historical material or heritage resources be exposed during construction activities, all activities should be suspended and the archaeological specialist should be notified immediately. It is essential that cognisance be taken of the larger archaeological landscape of the area in order to avoid the destruction of previously undetected heritage sites. Should any subsurface paleontological / archaeological / historical material and /or graves/human remains be uncovered, all activities should be suspended and the archaeological specialist should be alerted immediately. It should be noted that mitigation measures are valid for the duration of the development process, and mitigation measures might have to be implemented on additional features of heritage importance not detected during this Phase 1 assessment (e.g. uncovered during the construction process).

In addition to these site-specific recommendations, careful cognizance should be taken of the following:

- As Palaeontological remains occur where bedrock has been exposed, all geological features should be regarded as sensitive.
- Water sources such as drainage lines, fountains and pans would often have attracted human activity in the past. As Stone Age material the larger landscape should be regarded as

potentially sensitive in terms of possible subsurface deposits.

Socio-Economic Environment

10.3.6 Job creation and associated expectations

Contractors should be required to make use of a certain proportion of local labour although it is acknowledged that all skills will not be available locally.

10.4 Motivation where no alternative sites were considered.

n/a – Refer to Section 7.

10.5 Statement motivating the alternative development location within the overall site

(Provide a statement motivation the final site layout that is proposed)

The development location within the overall site was identified as described in Section 7.1.3.

10.6 Full description of the process undertaken to identify, assess and rank the impacts and risks the activity will impose on the preferred site (In respect of the final site layout plan) through the life of the activity.

In order to identify the potential impacts associated with the proposed project the following steps were undertaken:

- The stakeholder consultation process is undertaken in a manner that is interactive and which provides landowners and identified stakeholders with the opportunity to provide input into the project. Identified stakeholders have the opportunity to provide their comments on the project and any concerns that they may have. All comments and concerns are documented in the Consultation Report and captured in the impact assessment.
- A detailed desktop investigation was undertaken to determine the environmental setting of the proposed project. Resources included the use of Geographic Information Systems and databases for the area, Municipal Integrated Development Plan etc.
- A site visit was undertaken during November 2016 in order to get an overview of the site including the environmental features and existing infrastructure.
- Specialist studies were undertaken (heritage, ecology and hydrogeology) to determine the impacts and associated management and mitigation measures. The specialist studies included an on-site assessment and identification of sensitive areas.
- The methodology of the ratings of impacts is described under Section 10.1.

10.7 Assessment of each identified potentially significant impact and risk

(This section of the report must consider all the known typical impacts of each of the activities (including those that could or should have been identified by knowledgeable persons) and not only those that were raised by registered interested and affected parties).

Table 8-13: Impact and risk identification

NAME OF ACTIVITY **(E.g. For prospecting -** drill site, site camp, ablution facility, accommodation, equipment storage, sample storage, site office, access route **etc…etc…etc** **E.g. For mining**,- excavations, blasting, stockpiles, discard dumps or dams, Loading, hauling and transport, Water supply dams and boreholes, accommodation, offices, ablution, stores, workshops, processing plant, storm water control, berms, roads, pipelines, power lines, conveyors, etc…etc…etc.)	**POTENTIAL IMPACT** (Including the potential impacts for cumulative impacts) (e.g. dust, noise, drainage surface disturbance, fly rock, surface water contamination, groundwater contamination, air pollution etc….etc…)	**PHASE** In which impact is anticipated (e.g. Construction, commissioning, operational Decommissioning, closure, post-closure)	**SIGNIFICANCE** if not mitigated	**SIGNIFICANCE** if mitigated	**MITIGATION TYPE** (modify, remedy, control, or stop) through (e.g. noise control measures, storm-water control, dust control, rehabilitation, design measures, blasting controls, avoidance, relocation, alternative activity etc. etc) E.g. Modify through alternative method. Control through noise control Control through management and monitoring through rehabilitation..

Activity	**Potential Impact**	**Phase**	**Significance**		**Mitigation Type**
			WOM	**WM**	
Soils and Land Capability					
Site establishment & clearing	Soil erosion once vegetation clearance has taken place and bare soils surfaces are exposed to wind and water	Construction	Moderate	Low	Control through the delineation of the project area, taking recovered soil and stockpiling it at the nearest designated topsoil storage sites
Spillages of hydrocarbons	Contamination of soil due to oil spillages	Construction	Moderate	Negligible	Vehicle inspections, drip trays, spill kits and treatment of spillages
Groundwater					
Construction of RWD	Spillage of hydrocarbons during on-site refuelling of earth moving equipment and construction vehicles	Construction	Negligible	Negligible	Vehicle inspections, drip trays when refuelling and treatment of spillages
Construction of RWD	Oil leakages and oil spillages during servicing and operation of construction machinery during construction phase	Construction	Negligible	Negligible	Equipment inspections, drip trays to be used during servicing of equipment on site and treatment of spillages. No servicing of vehicles onsite unless it is a case of emergency.
Construction of RWD	Spillage of any chemicals or treatments used for RWD materials during construction of the RWD	Construction	Low	Negligible	Chemicals handling, prevention of spillages and clean-up kits
Construction of RWD	Alteration of natural topography and drainage patterns. Possible flooding and inundated areas	Construction	Low	Negligible	Construction and decommissioning plans for the RWD
RWD design capacity and implementation of fail-safe measures for possible overflows; extreme rainfall events	Overflow of RWD onto unlined receiving environment	Operational	Low	Negligible	RWD design and capacity plans and operational mine water balance. Storm water management plans
No Routine inspection of RWD facility and liner for identification of possible failure zones or cracks on visible surfaces. No Inspection for seepage along sides of RWD	Failure to recognise leakage of RWD and contaminant transport plume. Prolonged contamination of groundwater and surface water, erosion	Operational	Negligible	Negligible	Routine inspections of expanded RWD and associated infrastructure
Groundwater and surface water	Failure to recognise leakage of	Operational	Negligible	Negligible	Groundwater and surface water monitoring programme continuation

monitoring: Failure to adhere to monitoring and maintenance requirements	RWD and contaminant transport plume. Prolonged contamination of groundwater and surface water, erosion				
Storm water management and extreme rainfall events	Flooding of the RWD, surrounding infrastructure and land uses	Operational	Low	Negligible	Storm water management plan
Contamination of groundwater from temporary and permanent pit latrines	Groundwater contamination	Operational	Negligible	Negligible	Routine servicing and emptying of tempory and permanent sewerage and grey water infrastructure
Ecology					
Clearance of vegetation	Direct habitat destruction	Construction	Moderate	Low	Removal of vegetation only in the project footprint areas
Clearing of vegetation for development footprints, construction of infrastructure, access roads etc.	Habitat fragmentation	Construction	Moderate	Low	Use existing facilities, ensure as little disturbance as possible to surrounding habitats during construction
Exposure of soils and increased hardened surfaces	Soil erosion	Construction & Operational	Moderate	Low	Minimize the amount of land disturbance and develop and implement stringent erosion and dust control practices.
Movement of vehicles on site during construction	Spillage of harmful substances	Construction & Operational	Moderate	Low	Vehicle inspections and treatment of spillages
Exposure of soils and materials handling	Dust impacts	Construction & Operational	Moderate	Low	Dust suppression and control of vehicle speed
Continued movement of personnel and vehicles on and off the site during the construction phase, as well as occasional delivery of materials required for maintenance	Spread of alien invasive species	Construction & Operational	Moderate	Low	Institute strict control over materials brought onto site, rehabilitate disturbed areas as quickly as possible, institute a monitoring programme
Construction of infrastructure, access roads etc.	Negative effect of human activities	Construction & Operational	Moderate	Low	Control through the delineation of the project area
Air Quality					
Vegetation clearance and wind erosion	Dust impacts	Construction	Moderate	Low	Dust suppression and control of vehicle speed
Heritage					
General construction and operational activities	Impact on RWD site	Construction and Operational	Negligible	Negligible	On site monitoring
Social					
Establishment of new facilities	Job creation (positive)	Construction, Operational, Decommissioning	Moderate	Negligible	Use of local labour as far as possible

10.8 Summary of specialist reports

(This summary must be completed if any specialist reports informed the impact assessment and final site layout process and must be in the following tabular form):-

Table 8-14: Specialist summary

LIST OF STUDIES UNDERTAKEN	RECOMMENDATIONS OF SPECIALIST REPORTS	SPECIALIST RECOMMENDATIONS THAT HAVE BEEN INCLUDED IN THE EIA REPORT (Mark with an X where applicable)	REFERENCE TO APPLICABLE SECTION OF REPORT WHERE SPECIALIST RECOMMENDATIONS HAVE BEEN INCLUDED.
Ecological Study, 2016	Most development has an impact on the environment. In this study the flora and fauna of the proposed footprint areas of the proposed Return Water Dam site was described and potential anticipated impacts of the proposed development discussed. Detailed ecological surveys were conducted during November 2016 to verify the ecological sensitivity and ecological components of the site at ground level. The natural woodland / shrubveld areas surrounding the area have a MEDIUM sensitivity. These areas play an important role as part of the Kathu Bushveld vegetation type and as corridors for fauna, although the development can be supported provided that specific mitigation are implemented as stipulated in this report; A number of ecological potential impacts were identified and assessed. A few of these were assessed, including the following: ○ Destruction or disturbance to ecosystems leading to reduction in the overall extent of a particular habitat; ○ Impairment of the movement and/or migration of animal species resulting in genetic and/or ecological impacts (habitat fragmentation); ○ Increased soil erosion; ○ Establishment and spread of declared weeds and alien invader plants; ○ Air pollution as a result of dust; Mitigation measures are provided that would reduce these impacts from a higher to a lower significance. The importance of rehabilitation and implementation of mitigation processes to prevent negative impacts on the environment during and after the constructional phase should be considered a high priority. The proposed development sites is in a slightly to moderately degraded state. Furthermore, the proposed layout plan of the development should be consistent with the sensitivity map and recommendations stipulated in this report, and the impact on the sensitive habitats on site should be kept to a minimum.	x	Section 9.8; 9.13; 10.2.3; 10.3.3; 10.7
Archaeological study, 2016	Single Middle Stone Age (MSA) stone tools were identified on the surface in an access road and at calcrete exposures in the proposed project area. The occurrences, consisting out of 3 broken points, are of low heritage significance due to the limited numbers of formal and diagnostic tools, and general loss of context of the lithics at the site. Cognisant, of the sensitive nature of the heritage landscape around Kathu, it is recommended that the RWD project area be carefully monitored by an informed Environmental Control Office (ECO) but an archaeologist suitably qualified in Stone Age fieldwork and research must be appointed to undertake an Archaeological Watching Brief during the Construction Phase of the project since previously undetected heritage remains might occur in subsurface calcrete deposits.	x	Section 9.11; 10.2.5; 10.3.5; 10.7
Hydrogeological Assessment, 2016	○ The new RWD will be lined, thus the anticipated potential groundwater impact is negligible to low. The liner should however be inspected regularly for any possible leaks or failures in its hull integrity. The volumes pumped to the return water dam and its water levels should also be checked monthly through its inclusion in the operational mine water balance. The water levels in the RWD, also considering evaporation, can provide an easy practical method for assessing if possible leakages and failure of the RWD liner has occurred. ○ Potential impacts from hydrocarbon leaks and spillages (oil leaks, diesel spillages, etc.) and chemical leaks and spillages should be prevented by ensuring drip trays of vehicles and earth moving machinery during the construction phase and lined areas where on-site refuelling and storage occurs. ○ Possible overflow of RWD due to improper engineering designs and lack of storm water management are environmental risks that need to be designed/planned for and managed. ○ The potential groundwater impacts and mitigation measures as outlined in the Groundwater Impact Assessment section of this report (Section 10) should be reviewed and implemented where applicable for the proposed development.	X	Section 9.6; 10.2.2; 10.3.2; 10.7

Attach copies of Specialist Reports as Appendix 6, 7 and 8.

10.9 Environmental impact statement

10.10 Summary of the key findings of the environmental impact assessment;

All impacts can be mitigated to Low or Negligible.

There are no impacts of High significance.

Impacts of moderate significance prior to mitigation include:

- Impacts on Soils: Soil erosion
- Impacts on Soils: Soil pollution
- Impacts on Ecology: Habitat Destruction
- Impacts on Ecology: Habitat Fragmentation
- Impacts on Ecology: Soil Erosion
- Impacts on Ecology: Spillage of harmful substances
- Impacts on Ecology: Dust
- Impact on Ecology: Spread of alien invasive species
- Impact on Ecology: Negative effect of human activities on site
- Impact on Air Quality: Dust
- Impact on Social environment: Job creation (positive)

10.11 Final Site Map

Please refer to Appendix4.

10.12 Summary of the positive and negative impacts and risks of the proposed activity and identified alternatives;

Please refer to Section 10.10.

10.13 Proposed Impact Management Objectives and the Impact Management Outcomes for Inclusion in the EMPR;

Please refer to Table 8-16. Also note the following objectives for the project:

Through the implementation of the proposed mitigation measures, it is anticipated that the identified social and environmental impacts can be managed and mitigated effectively. Through the implementation of the mitigation and management measures it is expected that:

- Topsoil degradation and erosion can be mitigated through delineation of the project area, and rehabilitation of disturbed areas;
- Impacts on ecology can be mitigated through:
  - Removal of the indigenous trees and shrubs only in the project footprint areas, and rehabilitation of disturbed areas.
  - Protect all areas susceptible to erosion and ensure that there is no undue soil erosion resultant from activities.
  - Limit compaction of soils which reduces water infiltration and increases runoff and erosion.
  - Undertaking dust suppression.
- The pollution of soil and water resources can be managed by correct:
  - Cleaning up of spills, disposal of waste fluids, sewage and other waste off site at a registered facility. Correct storage of fuel and oil (bunded) to prevent spillages.
  - Control of waste and litter.
- Impacts on groundwater can be mitigated by:
  - Inspection of the RWD liner regularly
  - Monitoring of volumes pumped to the RWD and water levels monthly
  - Possible overflow of RWD due to improper engineering designs and lack of storm water management are environmental risks that need to be designed/planned for and managed.
- Impact on archaeological remains can be mitigated through:
  - Site Monitoring: Regular examination of trenches and excavations.
- Socio-economic impacts and aesthetic impacts can be mitigated through:
  - Dust suppression and control of vehicle speed.
  - Employment of local labour.

10.14 Aspects for inclusion as conditions of Authorisation

Any aspects which must be made conditions of the Environmental Authorisation

All mitigation as listed in Section 10.3 must be adhered to.

10.15 Description of any assumptions, uncertainties and gaps in knowledge

(Which relate to the assessment and mitigation measures proposed)

There is an inherent level of uncertainty in an impact assessment, as impact assessments essentially aim to determine what would happen in the future, and is thus associated with unforeseen and unforeseeable events. This uncertainty cannot be reduced by doing more research and has to be addressed by acknowledging the assumptions, uncertainties and gaps in knowledge associated with an impact assessment study (Thissen & Agustinata, 2008).

The conclusions and recommendations made in this impact assessment have to be routinely verified through monitoring exercises during the construction and operational phases of the proposed project, as measuring the actual impacts of a development as they occur is the only undisputable way of showing which impacts are of an acceptable significance and which impacts may require additional or adapted management measures in order to reduce their physical, measured impact.

Thus while this report was compiled with due regard to public consultation, authority consultation, specialist input and in accordance with the relevant legislation, it cannot be seen as a "promise" of what is going to happen, but rather should be seen as a scientific prediction of the most likely significant effects that could be brought about by the proposed project based on current knowledge.

The detailed specialist studies referred to the adequacy of their predictions. Where an uncertainty existed the precautionary principle was applied and the impact rated with a higher significance.

10.16 Reasoned opinion as to whether the proposed activity should or should not be authorised

10.17 Reasons why the activity should be authorized or not

The activity should be authorised due to the fact that no fatal flaws are foreseen for the project and impacts can be managed and mitigated.

10.18 Conditions that must be included in the authorisation

Refer to section 10.14.

10.19 Period for which the Environmental Authorisation is required

The life of mine (LoM) is 30 years and it is therefore requested that the authorization be issued for the same period.

10.20 Undertaking

(Confirm that the undertaking required to meet the requirements of this section is provided at the end of the EMPr and is applicable to both the Basic assessment report and the Environmental Management Programme report).

The undertaking is applicable to both the Basic Assessment Report and the Environmental Management Programme Report.

11 FINANCIAL PROVISION

State the amount that is required to both manage and rehabilitate the environment in respect of rehabilitation.

The amount required for rehabilitation according to the DMR rates **is R 3,004,992** (incl. Vat) (refer to Table 8-15).

Table 8-15: Calculation of the Quantum

CALCULATION OF THE QUANTUM

Mine: Sishen RWD Project **Location: 5 km South West of Kathu**

Evaluators: Exigo Sustainability (Pty) Ltd **Date: 21-Feb-17**

Risk Class	C
Area Sensitivity	Medium

No.	Description	Unit	A	B	C	D	E=A*B*C*D
			Quantity	Master rate (February 2017)	Multiplication factor	Weighting factor 1	Amount (rands)
CPI							
1	Dismantling of **processing plant and related structures** (including overland conveyors and powerlines)	m^3	0	13.70	1.00	1.00	0
2(A)	Demolition of **steel buildings and structures**	m^2	0	190.30	1.00	1.00	0
2(B)	Demolition of **reinforced concrete buildings and structures**	m^2	0	280.46	1.00	1.00	0
3	Rehabilitation of **access roads**	m^2	0	34.05	1.00	1.00	0
4(A)	Demolition and rehabilitation of **electrified railway lines**	m	0	330.50	1.00	1.00	0
4(B)	Demolition and rehabilitation of **non-electrified railway lines**	m	0	180.30	1.00	1.00	0
5	Demolition of **housing and/or administration facilities**	m^2	0	380.60	1.00	1.00	0
6	**Opencast rehabilitation** including final voids and ramps	ha	0	193,716.30	0.52	1.00	0
7	Sealing of **shafts, adits and inclines**	m^3	0	102.17	1.00	1.00	0
8(A	Rehabilitation of **overburden and spoils**	ha	0	133,017.1	1.00	1.00	0

)				9			
8(B)	Rehabilitation of processing waste **deposits and evaporation ponds (basic salt-producing waste)**	ha	7.5	165,670.50	1.00	1.00	1,242,529
8(C)	Rehabilitation of processing waste **deposits and evaporation ponds (acidic, metal-rich waste)**	ha	0	481,185.70	0.80	1.00	0
9	Rehabilitation of **subsided areas**	ha	0	111,381.90	1.00	1.00	0
10	**General surface rehabilitation**	ha	7.5	105,372.05	1.00	1.00	790,290
11	**River diversions**	ha	0	105,372.05	1.00	1.00	0
12	**Fencing**	m	0	120.20	1.00	1.00	0
13	**Water management**	ha	0	40,065.40	0.67	1.00	0
14	2 to 3 years of **maintenance and aftercare**	Sum	1.0	320,714.40	1.00	1.00	320,714
15A	Specialist study (and aftercare)	Sum	0	0.00	1.00	1.00	0
15B	Specialist studies (soil remediation)	ha	0	0.00	1.00	1.00	0
						SubTotal 1 (At Closure)	**2,353,534**
	Preliminary and General	6.0%	if Subtotal 1 > 100 000 000		Weighting factor 2		282,424
		12.0%	if Subtotal 1 < 100 000 000		1.00		
						SubTotal 2 (Subtotal 1 plus sum of management and contingency)	**2,635,958**
						Add Vat (14%)	369,034
						GRAND TOTAL (Subtotal 2 plus VAT)	**3,004,992**

11.1 Explain how the aforesaid amount was derived

The financial provision required was calculated according to the criteria as set out in the official Mine Closure Quantum Guideline document (DME, 2005). As per the Mine Closure Quantum Guideline, specific weighing factors have been taken into account in these calculations.

11.2 Confirm that this amount can be provided for from operating expenditure

The stated financial provision that is required to both manage and rehabilitate the environment will be provided by means of either a) a financial bank guarantee, b) insurance backed guarantee or c) by direct payment to the DMR.

11.3 The preferred method is being assessed and will be in place prior to the right being granted and provided to the DMR for consideration. Specific Information required by the competent Authority

11.4 Impact on the socio-economic conditions of any directly affected person

Please refer to Section 10.3.6

11.5 Impact on any national estate referred to in section 3(2) of the National Heritage Resources Act

Please refer to Section 10.2.5

11.6 Other matters required in terms of sections 24(4)(a) and (b) of the Act

Please refer to Section 7.

PART B
ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT

12 ENVIRONMENTAL MANAGEMENT PROGRAMME.

12.1 Details of the EAP

The provision of the details and expertise of the EAP are already included in PART A, Section 1.

12.2 Description of the Aspects of the Activity

The description of the activity is already included in PART A, Section 3.

12.3 Composite Map

Refer to Appendix 5.

12.4 Description of Impact management objectives including management statements

Please refer to Table 8-16. Also note the following objectives for the project:

- Not to harm ecologically sensitive areas
- Not to pollute the groundwater resource
- Not to pollute the surface water resource
- Not to impact on sites of archaeological importance
- To enhance the socio-economic status of the surrounding area
- To provide a safe environment for workers to work in

12.5 Determination of closure objectives

Closure Objective:

The following closure objectives and goals are proposed:

- To rehabilitate all disturbed land to a state that is suitable for its post closure use;
- To ensure that affected areas are safe and secure for both human and animal activities;
- The physical and chemical stability of the remaining structures should be such that risk to the environment through naturally occurring forces is eliminated;
- To rehabilitate all disturbed land to a state where limited or preferably no post closure management is required;
- To rehabilitate all disturbed land to a state that facilitates compliance with current environmental quality objectives (air and water quality); and
- To limit the impact on personnel whose positions may become redundant on decommissioning of the operations.

Rehabilitation: The post closure land use proposed for the project area is to return the area to wilderness/natural/agricultural area suitable for grazing.

..

12.6 Volumes and rate of water use required for the operation

Operational Phase: The operation of the RWD will involve storage of water.

12.7 Has a water use licence been applied for?

Sishen Mine has an existing water use license. A water use license amendment will be submitted for the RWD. The amendment of the water use license will be required for the following activities:

- Storage of water containing waste in a return water dam – Section 21 (g).

The Department of Water and Sanitation (DWS) in terms of the National Water Act (Act no 36 of 1998) (NWA) requires that such activities be subject to an Integrated Water Use Licence (IWUL) in terms of the NWA prior to such development taking place.

12.8 Impacts to be mitigated in their respective phases

Measures to rehabilitate the environment affected by the undertaking of any listed activity

Table 8-16: Impacts to be mitigated in their respective phases

ACTIVITIES **(E.g. For prospecting -** drill site, site camp, ablution facility, accommodation, equipment storage, sample storage, site office, access route **etc…etc…etc** **E.g. For mining**,- excavations, blasting, stockpiles, discard dumps or dams, Loading, hauling and transport, Water supply dams and boreholes, accommodation, offices, ablution, stores, workshops, processing plant, storm water control, berms, roads, pipelines, power lines, conveyors, etc…etc…etc.)	**SIZE AND SCALE of disturbance** **(volumes, tonnages and hectares or m²)**	**POTENTIAL IMPACT** (e.g. **dust, noise, drainage surface disturbance, fly rock, surface water contamination, groundwater contamination, air pollution etc….etc…)**	**PHASE** **(of operation in which activity will take place.** **State;** **Planning and design,** **Pre-Construction'** **Construction,** **Operational,** **Rehabilitation,** **Closure, Post closure).**	**ASPECTS AFFECTED**	**MITIGATION MEASURES** **(describe how each of the recommendations in herein will remedy the cause of pollution or degradation and migration of pollutants)**	**COMPLIANCE WITH STANDARDS** **(A description of how each of the recommendations herein will comply with any prescribed environmental management standards or practices that have been identified by Competent Authorities)**	**TIME PERIOD FOR IMPLEMENTATION** **Describe the time period when the measures in the environmental management programme must be implemented Measures must be implemented when required.** **With regard to Rehabilitation specifically this must take place at the earliest opportunity. .With regard to Rehabilitation, therefore state either:-..** **Upon cessation of the individual activity** **or.** **Upon the cessation of mining, bulk sampling or alluvial diamond prospecting as the case may be.**
Activity	**Size and Scale of disturbance**	**Potential Impact**	**Phase**	**Aspects Affected**	**Management and Mitigation**	**Compliance with Standards**	**Time period for implementation**
Soils and Land Capability							

Site establishment & clearing	10 ha	Soil erosion once vegetation clearance has taken place and bare soils surfaces are exposed to wind and water	Construction	Local soil disturbance, soil erosion, alteration of aquatic habitats and water quality. Ecological changes, alien plant species establishment.	• Clearance of vegetation should be done only within the footprint of the project site
					• Minimize clearance of vegetation. Retain natural trees, shrubbery and grass species wherever possible.
					• Protect all areas susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and work areas.
					• Repair all erosion damage as soon as possible and not later than six months before the termination of the Maintenance Period to allow for sufficient rehabilitation growth.
					• Institute a storm water management plan including strategies such as:
					  ○ Minimising impervious area;
					  ○ Increasing infiltration to soil by use of recharge areas.
					• Have both temporary (during construction) and permanent erosion control plans. Temporary control plans should include:
					  ○ Temporary silt trap basins;
					  ○ Short term seeding or mulching of exposed soil areas (particularly on slopes);
					  ○ Limitations on access for heavy machinery and the storage of materials to avoid soil compaction.
					• Permanent erosion control plans should focus on the establishment of stable native vegetation communities.
					• Conservation of topsoil should be prioritized on site and done as follows:
					  ○ Topsoil should be handled twice only - once to strip and stockpile, and secondly to replace, level, shape and scarify.
					  ○ Stockpile topsoil separately from subsoil.
					  ○ Stockpile in an area that is protected from storm water runoff and wind.
					  ○ Topsoil stockpiles should not exceed 2.0 m in height and should be protected by a mulch cover where possible.
					  ○ Maintain topsoil stockpiles in a weed free condition.
					  ○ Topsoil should not be compacted in any way, nor should any object be placed or stockpiled upon it.
					  ○ Stockpile topsoil for the minimum time period possible i.e. strip just before the relevant activity commences and replace as soon as it is completed.
						No specific standards other than the relevant SABS standard for infrastructure design	Throughout construction phase

Spillages of	0.5 ha	Contamination	Construction	Local soil disturbance,	• All vehicles should be inspected for oil and fuel leaks regularly and	No specific standards other than the NFA for	Throughout

hydrocarbons		of soil due to oil spillages		soil erosion, alteration of aquatic habitats and water quality. Ecological changes, alien plant species establishment.	frequently, and that any vehicle showing signs of leaking should be serviced immediately. • Daily pre-shift inspection must also include identification of oil leaks for repair prior to making use of the equipment • All spillages must be reported to the site construction manager and Site Environmental Officer who will make sure that the site is cleaned with immediate effect and measure are put in place to prevent re-occurrences of similar incidents • All spills should be cleaned up immediately to the satisfaction of the Site Environmental Control Officer by removing the spillage together with the polluted soil and by disposing of them at a recognized and licensed facility. • In the case of hydrocarbon spills on a paved area absorbent material will be used to recover the hydrocarbons. The recovered hydrocarbons with the absorbent material will be disposed of at a licensed disposal site for hazardous waste. • Following any spillage on an unpaved surface: o The spilled material needs to be classified to determine if it is hazardous. o The spill needs to be contained through the use of soil, Safsorb or any other suitable dry material. o Polluted soils must be removed to the mine's concrete-lined temporary storage area, in clearly marked containers. o If it is not possible to contain the spill the site needs to be closed off and a full site assessment needs to be undertaken – relevant specialist advice to be obtained prior to the activities on-site being ceased. • Waste oil, fuel and other chemicals will be disposed of as hazardous waste and not with domestic waste. • Particular attention will be given to training of staff and contractors in the handling of oils, diesel and other hazardous substances on site in order for spills to be avoided	permitting and the relevant SABS standard for infrastructure design	construction phase
Groundwater							
Construction of RWD	10 ha	Spillage of hydrocarbons during on-site refuelling of earth moving equipment and construction vehicles	Construction	Local contamination of soil and shallow alluvium and calcrete aquifer	• All vehicles should be inspected for oil and fuel leaks regularly and frequently, and that any vehicle showing signs of leaking should be serviced immediately. • All spills should be cleaned up immediately to the satisfaction of the Regional Manager by removing the spillage together with the polluted soil and by disposing of them at a recognized facility. • In the case of hydrocarbon spills on a paved area absorbent material will be used to recover the hydrocarbons. The recovered hydrocarbons with the absorbent material will be disposed of at a licensed disposal site for hazardous waste. • Following any spillage on an unpaved surface: o The spilled material needs to be classified to determine if it is hazardous. o The spill needs to be contained through the use of soil, Safsorb or any other suitable dry material. o Polluted soils must be removed to the mine's concrete-lined temporary storage area, in clearly marked containers. o If it is not possible to contain the spill the site needs to be closed off and a full site assessment needs to be undertaken – relevant specialist advice to be obtained prior to the activities on-site being ceased. • Waste oil, fuel and other chemicals will be disposed of as hazardous waste and not with domestic waste. • Particular attention will be given to training of staff and contractors in the handling of oils, diesel and other hazardous substances on site in order for spills to be avoided	NWA for IWULA GN704 - separation of clean and dirty water	Throughout construction phase
Construction of RWD	1 ha	Oil leakages	Construction	Local contamination of	• Vehicles must be maintained in such a manner that fuel and oil leaks	NWA for IWULA GN704 - separation of	Throughout

		and oil spillages during servicing and operation of construction machinery during construction phase		soil and shallow alluvium and calcrete aquifer	are limited. • Drip trays should be used and a requirement for all vehicles and earth moving machinery that have been identified to have oil leaks during routine inspections	clean and dirty water	construction phase
Construction of RWD	1 ha	Spillage of any chemicals or treatments used for RWD materials during construction of the RWD	Construction	Local contamination of soil and shallow alluvium and calcrete aquifer	• Chemicals used during the construction and preparation of materials used in the construction of the RWD, should be handled according to chemical handling procedures specified in the mine's chemicals handling SOP and good practices. The safety instructions in handling and use of the chemicals should be adhered to. Areas where work is done with chemicals above the undisturbed receiving environment should be temporarily lined so as to prohibit contamination from possible spillages.	NWA for IWULA GN704 - separation of clean and dirty water	Throughout construction phase
Construction of RWD	100 ha	Alteration of natural topography and drainage patterns. Possible flooding and inundated areas	Construction	Surrounding surface activities and surface water drainage patterns	• The RWD is temporary and applicable to the operational phase of the mine. When the mine is decommissioned, the RWD will be removed and the area will be restored and rehabilitated to follow the natural topography as closely as possible. • Proper decommissioning procedures need to be followed for the RWD during the mine decommissioning and closure phase. These include removal of the waste water and precipitates that may have formed in the RWD over time as well as the liner of the RWD, should it be constructed of synthetic material. An accredited and registered professional waste removal contractor should be used for the removal and transport of the waste water and material after decommissioning of the RWD and disposed of at an approved hazardous waste disposal/storage site. • The embankments of the RWD should be removed and the landscape restored as best as possible to the original topography and slopes of the original receiving environment.	NWA for IWULA GN704 - separation of clean and dirty water	Construction, Operational and Decommissioning phases
RWD design capacity and implementation of fail-safe measures for possible overflows; extreme rainfall events	100ha	Overflow of RWD onto unlined receiving environment	Operational	Surrounding surface activities and surface water drainage patterns	• The RWD should have engineering design capacity plans and report in place and should be designed to handle a 1:100 rainfall event, either by having enough storage capacity or through fail-safe storm water conduits and overflow conduits to a safe mine water containment facility. A storm water management plan should be in place that includes the expanded RWD.	NWA for IWULA GN704 - separation of clean and dirty water	Throughout construction phase
No Routine inspection of RWD facility and liner for identification of possible failure zones or cracks on visible surfaces. No Inspection for seepage along sides of RWD	10ha	Failure to recognise leakage of RWD and contaminant transport plume. Prolonged contamination of groundwater and surface water, erosion	Operational	Shallow aquifer and possibly deep aquifer including dolomitic aquifer	• Routine visual inspection from a qualified person should be performed for the expanded RWD and existing RWD to check for any visual defects of the visible liner. The banks and raised wall of the RWD should also be checked for possible seepage from leaks.	NWA for IWULA GN704 - separation of clean and dirty water	Operational Phase
Groundwater and surface water monitoring: Failure to adhere to monitoring and maintenance requirements	10ha	Failure to recognise leakage of RWD and contaminant transport plume. Prolonged contamination of groundwater and surface	Operational	Shallow aquifer and possibly deep aquifer including dolomitic aquifer	• Groundwater and surface water monitoring should be continued. There are existing suitable monitoring boreholes in the vicinity of the RWD to monitor possible groundwater contamination that could occur if the liner leaks. • Process water should be properly contained in process water pipes, channels and storage facilities and the infrastructure regularly inspected and maintained if required.	NWA for IWULA GN704 - separation of clean and dirty water	Operational Phase

		water, erosion					
Storm water management and extreme rainfall events	100ha	Flooding of the RWD, surrounding infrastructure and land uses	Operational	Surrounding surface activities and surface water drainage patterns	• A storm water management plan should be put in place and its recommendations and designs implemented where required and feasible.	NWA for IWULA GN704 - separation of clean and dirty water	Operational Phase
Contamination of groundwater from temporary and permanent pit latrines	10 ha	Groundwater contamination	Operational	Local contamination of soil and shallow alluvium and calcrete aquifer	• Temporary pit latrines used by construction personnel at the RWD, should be routinely emptied and precautionary measures taken to prevent spillages of sewerage and possible soil and groundwater contamination. Permanent sanitation systems must be serviced and cleaned regularly	NWA for IWULA GN704 - separation of clean and dirty water	Throughout construction phase
Ecology							
Clearance of vegetation	10 ha	Direct habitat destruction	Construction	Clearance of vegetation leads to the loss of plant species	• The removal of the indigenous trees and shrubs should only occur on the footprint area of the proposed RWD footprint and not over the larger area. No trees may be trimmed or removed without the prior permission of the project manager or Environmental Control Officer (ECO). • Clearly demarcate the entire development footprint prior to initial site clearance and prevent construction personnel from leaving the demarcated area. • Monitoring should be implemented during the construction phase of the development to ensure that minimal impact is caused to the fauna of the area. • The ECO should advise the construction team in all relevant matters to ensure minimum destruction and damage to the environment. The ECO should enforce any measures that he/she deem necessary. Regular environmental training and awareness should be provided to construction workers to ensure the protection of the habitat, fauna and flora and their sensitivity to conservation. • Poisons for the control of problem animals should rather be avoided since the wrong use thereof can have disastrous consequences for the raptors occurring in the area. The use of poisons for the control of rats, mice or other vermin should only be used after approval from an ecologist.	No specific standards other than the NFA for permitting and the relevant SABS standard for infrastructure design	Throughout construction phase
Clearing of vegetation for development footprints, construction of infrastructure, access roads etc.	10 ha	Habitat fragmentation	Construction	Natural movement patterns disrupted resulting in the fragmentation of natural populations	• Use existing facilities (e.g., access roads, degraded areas) to the extent possible to minimize the amount of new disturbance. • Ensure protection of important resources by establishing protective buffers to exclude unintentional disturbance. All possible efforts must be made to ensure as little disturbance as possible to the sensitive habitats on site during construction; • During construction, sensitive habitats must be avoided by construction vehicles and equipment, wherever possible, in order to reduce potential impacts. Only necessary damage must be caused and, for example, unnecessary driving around in the veld or bulldozing natural habitat must not take place. Construction activities must remain within defined construction areas and the road servitudes. No construction / disturbance will occur outside these areas. • Any access roads to the RWD should be developed without pavements to ensure small fauna can move freely over the road surface area. Where necessary small culverts should be inserted beneath the road, especially where the road is slightly higher than ground level, or in the riparian woodland and along the periphery of the salt pans to ensure fauna can migrate between areas.	No specific standards other than the NFA for permitting and the relevant SABS standard for infrastructure design	Throughout construction phase
Exposure of soils and increased hardened surfaces	10 ha	Soil erosion	Construction & Operational	Disturbance to the natural geomorphology Soil compaction	• Minimize the amount of land disturbance and develop and implement stringent erosion and dust control practices. Control dust on construction sites and access roads using water-sprayers. • Institute a storm water management plan including strategies such as: ○ minimising impervious area increasing infiltration to soil by	No specific standards other than the NFA for permitting and the relevant SABS standard for infrastructure design	Throughout construction phase

					use of recharge areas ○ use of natural vegetated swales instead of pipes or ○ Installing detention or retention facilities with graduated outlet control structures. • Have both temporary (during construction) and permanent erosion control plans. ○ Temporary control plans should include: ○ silt fencing ○ temporary silt trap basins ○ short term seeding or mulching of exposed soil areas (particularly on slopes) ○ Limitations on access for heavy machinery and the storage of materials to avoid soil compaction. ○ Permanent erosion control plans should focus on the establishment of stable native vegetation communities. • Ensure the amount of bare soil exposed is minimized by staging earthworks in phases and leaving as much ground cover intact as possible during construction. • Protect all areas susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and Work Areas. • Repair all erosion damage as soon as possible and in any case not later than six months before the termination of the Maintenance Period to allow for sufficient rehabilitation growth. • Conservation of topsoil should be prioritized on site and done as follows: ○ Topsoil should be handled twice only - once to strip and stockpile, and secondly to replace, level, shape and scarify. ○ Stockpile topsoil separately from subsoil. ○ Stockpile in an area that is protected from storm water runoff and wind. ○ Topsoil stockpiles should not exceed 2.0 m in height and should be protected by a mulch cover where possible. ○ Maintain topsoil stockpiles in a weed free condition. ○ Topsoil should not be compacted in any way, nor should any object be placed or stockpiled upon it. ○ Stockpile topsoil for the minimum time period possible i.e. strip just before the relevant activity commences and replace as soon as it is completed.		
Movement of vehicles on site during construction	10 ha	Spillage of harmful substances	Construction & Operational	Soil contamination and pollution of water resources	• Water falling on areas polluted with oil/diesel or other hazardous substances must be contained. • Hazardous chemicals to be stored on an impervious surface protected from rainfall and storm water run-off. • Spill kits should be on-hand to deal with spills immediately. • Spillages or leakages must be treated according to an applicable procedure as determined by a plan of action for the specific type of disturbance.	No specific standards other than the NFA for permitting and the relevant SABS standard for infrastructure design	Throughout construction phase
Exposure of soils and materials handling	10 ha	Dust impacts	Construction & Operational	Ecosystem damage	• Dust suppression must be undertaken in conjunction with a dust monitoring programme that places dust deposition gauges or receiving buckets, directional dust collection receptacles, high volume active air samplers or continuous particle monitors or even personal exposure samplers at generation sites, around the mine and in adjacent areas. • Implement standard dust control measures, including periodic spraying (frequency will depend on many factors including weather conditions, soil composition and traffic intensity and must thus be adapted on an on-going basis) of construction areas and access roads, and ensure that these are continuously monitored to ensure effective implementation. • A speed limit (preferably 40 km/hour) should be enforced on dirt roads.	No specific standards other than the NFA for permitting and the relevant SABS standard for infrastructure design	Throughout construction phase

Continued movement of personnel and vehicles on and off the site during the construction phase, as well as occasional delivery of materials required for maintenance	10 ha	Spread of alien invasive species	Construction & Operational	Litter and inadequate sanitation causes increased invasive fauna and flora.	• Institute strict control over materials brought onto site, which should be inspected for potential invasive invertebrate species and steps taken to eradicate these before transport to the site. Routinely fumigate or spray all materials with appropriate low-residual insecticides prior to transport to or in a quarantine area on site. The Argentine ant is nearly impossible to eradicate once it has established itself. • Rehabilitate disturbed areas as quickly as possible to reduce the area where invasive species would be at a strong advantage and most easily able to establish. • Institute a monitoring programme to detect alien invasive species early, before they become established and, in the case of weeds, before the release of seeds. • Institute an eradication/control programme for early intervention if invasive species are detected, so that their spread to surrounding natural ecosystems can be prevented.	No specific standards other than the NFA for permitting and the relevant SABS standard for infrastructure design	Throughout construction phase
Construction of infrastructure, access roads etc.	10 ha	Negative effect of human activities	Construction & Operational	Loss of faunal species, by snaring, killing and hunting, as well as insects and other fauna being killed on roads	• Adequate rubbish bins and sanitation facilities should be provided. • The ECO should regularly inspect the site, including storage facilities and compounds and eradicate any invasive or exotic plants and animals. • Maintain proper firebreaks around entire development footprint. • Educate construction workers regarding risks and correct disposal of cigarettes. • Travelling at night should be avoided or limited as much as possible. • Lights should be positioned 5m from the roads or paved areas.	No specific standards other than the NFA for permitting and the relevant SABS standard for infrastructure design	Throughout construction phase
Air Quality							
Vegetation clearance and wind erosion	10 ha	Dust impacts	Construction	Air quality, nuisance to surrounding receptors	• During the construction phase, use water sprays on access area before grading, and at areas to be cleared of vegetation. Ensure exposed areas remain moist through regular water spraying. Moist topsoil will reduce the potential for dust generation when tipped onto stockpiles.	NEM:AQA, Ambient Air Quality Standards, National Dust Control Regulations	Throughout construction phase
Heritage							
General construction and operational activities	10 ha	Impact on RWD site	Construction and Operational	Potential loss of heritage resources	• The ECO will be responsible for daily on-site monitoring during the Construction Phase with the appointed archaeologist visiting the site monthly. • Conduct an archaeological monitoring program whereby the construction site is visited monthly for at least the first two months of the project. • On-site assessment of any Stone Age material exposed during construction and the provision of recommendations for the way in which the exposed material must be mitigated. • Compile and submit an archaeological monitoring report at the end of the monitoring process.	Apply for a heritage destruction permit from SAHRA if required	Throughout construction phase
Social							
Establishment of new facilities	10 ha	Job creation (positive)	Construction, Operational, Decommissioning	Provision of jobs	• Contractors should be required to make use of local labour as far as possible.	Mine Health and Safety Act (Act 29 of 1996) & the Occupational Health and Safety Act (Act 85 of 1993) World Bank Environmental, Health and Safety guidelines Occupational Health and Safety Act (Act 85 of 1993) Skills development initiatives Employment Guideline	Throughout construction phase

12.9 Impact Management Outcomes

(A description of impact management outcomes, identifying the standard of impact management required for the aspects contemplated in paragraph;

Please refer to Table 8-16.

12.10 Impact Management Actions

(A description of impact management actions, identifying the manner in which the impact management objectives and outcomes contemplated in paragraphs (c) and (d) will be achieved).

Please refer to Table 8-16.

13 Financial Provision

The following items are included in the Final Rehabilitation, Decommissioning and Mine Closure Plan for the project.

13.1 Storm water Management

All storm water management structures around rehabilitated areas may be removed if not required post-closure.

13.2 General Surface Rehabilitation

General surface rehabilitation will be done to all disturbed areas. This will entail returning the areas to a state as close as possible to its pre-mining environment and in line with the intended post-closure use.

The following criteria apply to the General Surface Rehabilitation:

- General re-shaping to resemble natural topography; and
- All disturbed areas not covered specifically in the details above will at least be ripped to a depth of 500mm where possible, covered with 100mm topsoil and vegetated.

13.3 Monitoring and Management

The suggested post-closure monitoring and management period at the site is at least 3 years. Activities during this period include, but are not limited to:

- Air quality / Dust monitoring;
- Re-vegetation of disturbed areas where required;
- Annual biodiversity monitoring; and
- Annual third party environmental compliance monitoring.

13.3.1 Methodology

The financial provision required was calculated according to the criteria as set out in the official Mine Closure Quantum Guideline document (DME, 2005). As per the Mine Closure Quantum Guideline, specific weighing factors have been taken into account in these calculations.

Table 8-17: Calculation of the Quantum

CALCULATION OF THE QUANTUM

Mine: Sishen RWD Project **Location: 5 km South West of Kathu**

Evaluators: Exigo Sustainability (Pty) Ltd **Date: 21-Feb-17**

Risk Class	C
Area Sensitivity	Medium

No.	Description	Unit	A	B	C	D	E=A*B*C*D
			Quantity	Master rate (February 2017)	Multiplication factor	Weighting factor 1	Amount (rands)
CPI							
1	Dismantling of **processing plant and related structures** (including overland conveyors and powerlines)	m^3	0	13.70	1.00	1.00	0
2(A)	Demolition of **steel buildings and structures**	m^2	0	190.30	1.00	1.00	0
2(B)	Demolition of **reinforced concrete buildings and structures**	m^2	0	280.46	1.00	1.00	0
3	Rehabilitation of **access roads**	m^2	0	34.05	1.00	1.00	0
4(A)	Demolition and rehabilitation of **electrified railway lines**	m	0	330.50	1.00	1.00	0
4(B)	Demolition and rehabilitation of **non-electrified railway lines**	m	0	180.30	1.00	1.00	0
5	Demolition of **housing and/or administration facilities**	m^2	0	380.60	1.00	1.00	0
6	**Opencast rehabilitation** including final voids and ramps	ha	0	193,716.30	0.52	1.00	0
7	Sealing of **shafts, adits and inclines**	m^3	0	102.17	1.00	1.00	0
8(A)	Rehabilitation of **overburden and spoils**	ha	0	133,017.19	1.00	1.00	0

8(B)	Rehabilitation of processing waste **deposits and evaporation ponds (basic salt-producing waste)**	ha	7.5	165,670.50	1.00	1.00	1,242,529
8(C)	Rehabilitation of processing waste **deposits and evaporation ponds (acidic, metal-rich waste)**	ha	0	481,185.70	0.80	1.00	0
9	Rehabilitation of **subsided areas**	ha	0	111,381.90	1.00	1.00	0
10	**General surface rehabilitation**	ha	7.5	105,372.05	1.00	1.00	790,290
11	**River diversions**	ha	0	105,372.05	1.00	1.00	0
12	**Fencing**	m	0	120.20	1.00	1.00	0
13	**Water management**	ha	0	40,065.40	0.67	1.00	0
14	2 to 3 years of **maintenance and aftercare**	Sum	1.0	320,714.40	1.00	1.00	320,714
15 A	Specialist study (and aftercare)	Sum	0	0.00	1.00	1.00	0
15 B	Specialist studies (soil remediation)	ha	0	0.00	1.00	1.00	0
						SubTotal 1 (At Closure)	**2,353,534**

	Preliminary and General	6.0%	if Subtotal 1 > 100 000 000	Weighting factor 2		
		12.0%	if Subtotal 1 < 100 000 000	1.00		282,424
					SubTotal 2 (Subtotal 1 plus sum of management and contingency)	**2,635,958**
					Add Vat (14%)	369,034
					GRAND TOTAL (Subtotal 2 plus VAT)	**3,004,992**

13.4 Describe the closure objectives and the extent to which they have been aligned to the baseline environment described under the Regulation.

Closure Objective:

The following closure objectives and goals are proposed:

- To rehabilitate all disturbed land to a state that is suitable for its post closure use;
- To ensure that affected areas are safe and secure for both human and animal activities;
- The physical and chemical stability of the remaining structures should be such that risk to the environment through naturally occurring forces is eliminated;
- To rehabilitate all disturbed land to a state where limited or preferably no post closure management is required;
- To rehabilitate all disturbed land to a state that facilitates compliance with current environmental quality objectives (air and water quality); and
- To limit the impact on personnel whose positions may become redundant on decommissioning of the operations.

Rehabilitation: The post closure land use proposed for the project area is to return the area to wilderness/natural/agricultural area suitable for grazing and limited agronomy.

Any topsoil removed during construction will be stockpiled and used for rehabilitation

13.5 Confirm specifically that the environmental objectives in relation to closure have been consulted with landowner and interested and affected parties.

The identified land owners and interested and affected parties will be informed and consulted about the proposed RWD. A period of 30 days (from the 13 April 2017 to 19 May 2017) was made available for public comment on the Draft BAR in which Interested and Affected parties had an opportunity to provide comments on the environmental objectives in relation to closure.

13.6 Provide a rehabilitation plan that describes and shows the scale and aerial extent of the main mining activities, including the anticipated mining area at the time of closure.

The project does not involve mining. Please refer to Section 13.

13.7 Explain why it can be confirmed that the rehabilitation plan is compatible with the closure objectives.

The rehabilitation plan will return the site to a state that is suitable for its post closure use.

13.8 Calculate and state the quantum of the financial provision required to manage and rehabilitate the environment in accordance with the applicable guideline.

The amount need for rehabilitation according to the DMR rates **is R 3,004,992** (incl. Vat).

13.9 Confirm that the financial provision will be provided as determined.

The stated financial provision that is required to both manage and rehabilitate the environment will be provided by means of either a) a financial bank guarantee, b) insurance backed guarantee or c) by direct payment to the DMR.

The preferred method is being assessed and will be in place prior to the right being granted and provided to the DMR for consideration.

13.10 Mechanisms for monitoring compliance with and performance assessment against the environmental management programme and reporting thereon, including

a) Monitoring of Impact Management Actions

b) Monitoring and reporting frequency

c) Responsible persons

d) Time period for implementing impact management actions

e) Mechanism for monitoring compliance

Table 8-18: Monitoring Programme

SOURCE ACTIVITY	IMPACTS REQUIRING MONITORING PROGRAMMES	FUNCTIONAL REQUIREMENTS FOR MONITORING	ROLES AND RESPONSIBILITIES (FOR THE EXECUTION OF THE MONITORING PROGRAMMES)	MONITORING AND REPORTING FREQUENCY and TIME PERIODS FOR IMPLEMENTING IMPACT MANAGEMENT ACTIONS
Clearance of vegetation for site establishment	Soil erosion once vegetation clearance has taken place and bare soils surfaces are exposed to wind and water	• The ECO must continuously check that all construction activities are located outside of the delineated areas and buffer zones. • All exposed areas, access roads, and soil stockpiles must be monitored for erosion on a regular basis and specifically after rain events. • The ECO must monitor according to the EMP	ECO, Contractor, Applicant	Daily inspections, reporting monthly
	Direct habitat destruction		ECO, Contractor, Applicant	Daily inspections, reporting monthly
	Habitat fragmentation		ECO, Contractor, Applicant	Daily inspections, reporting monthly
	Dust impacts	• Monitoring of dust, noise and visual aspects of the proposed construction activities must take place on a daily basis by the ECO.	ECO, Contractor, Applicant	Daily inspections, reporting monthly
	Heritage impact on RWD site	• The ECO will be responsible for daily on-site monitoring during the Construction Phase with the appointed archaeologist visiting the site monthly. • Conduct an archaeological monitoring program whereby the construction site is visited monthly for at least the first two months of the project. • On-site assessment of any Stone Age material exposed during construction and the provision of recommendations for the way in which the exposed material must be mitigated. • Compile and submit an archaeological monitoring report at the end of the monitoring process.	ECO, Contractor, Applicant	Daily inspections, reporting monthly
Continued movement of personnel and	Spillage of harmful substances	• All secondary containments structures will be inspected on a regular basis to	ECO, Contractor, Applicant	Daily inspections, reporting monthly

SOURCE ACTIVITY	IMPACTS REQUIRING MONITORING PROGRAMMES	FUNCTIONAL REQUIREMENTS FOR MONITORING	ROLES AND RESPONSIBILITIES (FOR THE EXECUTION OF THE MONITORING PROGRAMMES)	MONITORING AND REPORTING FREQUENCY and TIME PERIODS FOR IMPLEMENTING IMPACT MANAGEMENT ACTIONS
vehicles on and off the site during the construction phase, as well as occasional delivery of materials required for maintenance		confirm the integrity thereof and to identify potential leaks. • All spill incidents will be identified and corrective action taken in accordance with an established spill response procedure.		
	Spread of alien invasive species	• Institute strict control over materials brought onto site, which should be inspected for potential invasive species and steps taken to eradicate these before transport to the site • Institute a monitoring programme to detect alien invasive species early, before they become established and, in the case of weeds, before the release of seeds. • Institute an eradication/control programme for early intervention if invasive species are detected, so that their spread to surrounding natural ecosystems can be prevented.	ECO, Contractor, Applicant	Daily inspections, reporting monthly
	Negative effect of human activities	• The ECO must continuously check that all construction activities are located outside of the delineated areas and buffer zones. • The ECO must monitor according to the EMP	ECO, Contractor, Applicant	Daily inspections, reporting monthly
Refuelling of vehicles	Contamination of soil due to oil spillages	• All spill incidents will be identified and corrective action taken in accordance with an established spill response procedure.	ECO, Contractor, Applicant	Daily inspections following rehabilitation, reporting monthly
Storage of water in	Impacts on	• A well-developed monitoring borehole	ECO, Contractor, Applicant	Monthly / quarterly monitoring of

SOURCE ACTIVITY	IMPACTS REQUIRING MONITORING PROGRAMMES	FUNCTIONAL REQUIREMENTS FOR MONITORING	ROLES AND RESPONSIBILITIES (FOR THE EXECUTION OF THE MONITORING PROGRAMMES)	MONITORING AND REPORTING FREQUENCY and TIME PERIODS FOR IMPLEMENTING IMPACT MANAGEMENT ACTIONS
the RWD	groundwater quality	network is already in place. Directly towards the west of SW778 and towards the east of SW545 (i.e. in between SW545 and SW778) one additional shallow aquifer monitoring borehole can perhaps be added for plume detection. • Groundwater monitoring at the existing groundwater monitoring network around the RWD and tailings dam should continue. The monitoring of groundwater quality constituents such as nitrate and TDS provide one of the best methods of assessing possible leakages of the RWD (if other infrastructure such as a TSF cannot possibly influence the groundwater quality based on hydraulic gradient and proximity).		water quality

13.11 Indicate the frequency of the submission of the performance assessment/ environmental audit report.

An annual performance assessment / environmental audit report must be undertaken on the EMP.

13.12 Environmental Awareness Plan

13.12.1 Manner in which the applicant intends to inform his or her employees of any environmental risk which may result from their work

Environmental conditions will be included in any operational contracts, thereby making contractors aware of the potential environmental risks associated with the project and the necessity to prevent accidental spillages by implementing good housekeeping practices. The following principles will apply to the Environmental Awareness Plan (Safety, Health and Environment):

- All personnel will as a minimum undergo general SHE induction and awareness training.
- The Environmental Officer(s) or the responsible personnel from the SHEQ Department will identify the Safely, Health and Environment (SHE) training requirements for all personnel and contractors. The training requirements will be recorded in a training need matrix indicating particular training that must be undertaken by identified personnel and contractors. The training matrix will be administrated by the SHEQ Department.
- Development of a training programme:
    - General Awareness training. The SHEQ manager will be responsible for adopting and customising the existing SHE induction and awareness training being undertaken at SIOM. It should include a general environmental awareness training module that will need to be integrated into the induction programme. The training manual shall include a review of the Environmental Policy, a review of significant environmental aspects, a description of the EMP and the importance of compliance to its requirements, general responsibilities of personnel with regard to the EMP and a review of the emergency and corrective action procedures.
- Specific environmental training:
    - Specific environmental training will be in line with the requirements identified in the training matrix;
    - People whose work tasks can impact on the environment will be made aware of the requirements of appropriate procedures/ work instructions. The SHE Representative will communicate training requirements to responsible supervisors to ensure that personnel and contractors are trained accordingly.
- Training evaluation and re-training:
    - Effectiveness of the environmental training will be reflected by the degree of non-conformance to EMPR requirements, the results of internal audits and the general performance achieved.

Incidents and non-conformances raised against the EMPR will be assessed by the SHEQ manager and SHE Representative(s) determine the cause. Should it be evident that re-training is required the SHE Representative(s) will take the appropriate actions.

13.12.2 Manner in which risks will be dealt with in order to avoid pollution or the degradation of the environment

In order for the EMP to be successfully implemented, all the role players involved in the project need to co-operate. For this to happen, role players must clearly understand their roles and responsibilities in the project, must be professional, form respectful and transparent relationships, and maintain open lines of communication.

Responsibility of the Contractor

The principle contractor is responsible for implementation and compliance with the requirements of the EMP and conditions of the Environmental Authorisation, contract and relevant environmental legislation. The Contractor must ensure that all sub-contractors have a copy of and are fully aware of the content and requirements of this EMP.

Responsibility of the Environmental Officer(s) [EO] or the responsible personnel from the SHEQ Department

The EO is employed by the Contractor as his/her environmental representative to monitor, review and verify compliance with the EMP by the contractor. This is not an independent appointment; rather the EO must be a respected member of the contractor's management team.

Dependent on the size of the development the EO must be on site one week prior to the commencement of construction. The EO must ensure that he/she is involved at all phases of the construction (from site clearance to rehabilitation).

Responsibility of the Environmental Control Officer (ECO)

The ECO must conduct, at a frequency as determined by the Department and stipulated in the relevant Environmental Authorisation (EA) for the project, independent environmental audits. The audits are to verify the projects compliance with the EMP and conditions of the Environmental Authorisation (EA).

Before any construction activities commence, the ECO must compile, for the approval by the Department, an audit checklist based on the contents of this EMP and conditions of the Environmental Authorisation (EA). The ECO must at the request of the Department forward audit reports to the Department at a frequency determined by the Department which must be stipulated in the Environmental Authorisation (EA).

Evidence of the following as key performance indicators, must be included in the audit reports where required:

1. Complaints received from landowners and actions taken.
2. Environmental incidents, such as oil spills, concrete spills, etc. and actions taken (litigation excluded).
3. Incidents leading to litigation and legal contraventions.
4. Environmental damage that needs rehabilitation measures to be taken.

13.13 Specific information required by the Competent Authority

(Among others, confirm that the financial provision will be reviewed annually).

The financial provision will be reviewed annually.

14 UNDERTAKING

The EAP herewith confirms:

i) the correctness of the information provided in the reports ☒

ii) the inclusion of comments and inputs from stakeholders and I&APs ; ☒

iii) the inclusion of inputs and recommendations from the specialist reports where relevant; ☒and

iv) that the information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested and affected. parties are correctly reflected herein. ☒

Signature of the environmental assessment practitioner:

Name of company:

Date:

-END-

1. Appendix 1: EAP's Qualifications

2. Appendix 2: Company Profile & EAP's Curriculum Vitae

3. Appendix 3: Locality Map

4. Appendix 4: Site Plan

5. Appendix 5: Composite Map

6. Appendix 6: Ecological Assessment

7. Appendix 7: Archaeological Impact Assessment

8. Appendix 8: Hydrogeological Assessment

9. Appendix 9: Public Participation Documentation

10. Appendix 9.1: Newspaper Advert

11. Appendix 9.2: Site Notice

12. Appendix 9.3: Correspondence with I&APs

13. Appendix 9.4: Notification of Public Review