Environmental Scoping Report for the Underground Coal Gasification Project and Associated Infrastructure in support of co-firing of gas at the Majuba Power Station, Amersfoort, Mpumalanga

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Eskom Holdings SOC Ltd

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Compiled by:

Prashika Reddy

Date:

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Location:

Pretoria

Review & Approval: Malcolm Roods

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Signature

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Glossary of Terms

Alternatives	Different means of meeting the general purpose and requirements of the activity, which may include site or location alternatives; alternatives to the type of activity being undertaken; the design or layout of the activity; the technology to be used in the activity and the operational aspects of the activity.
Aquifer	A geologic formation of porous rock, often sandstone that stores water. An aquifer may yield significant quantities of water to wells and springs and this water is often utilized as a primary source for municipal, industrial, irrigation and other uses.
Calorific Value	The quantity of heat that can be liberated from one kilogram of coal.
Coal	A solid, brittle, more or less distinctly stratified combustible carbonaceous rock formed by partial to complete decomposition of vegetation; varies in colour from dark brown to black; not fusible without decomposition and very insoluble.
Coal Gasification	The conversion of coal into a gaseous fuel.
Combustion	Burning coal with O_2 to make CO_2 and heat.
Combustion chamber	The part of a gasifier in which coal is oxidised.
Condensate	The liquid product that condensates from the raw gas when initially cooled and contains mainly water with water soluble hydrocarbons and solids of tar and ash.
Core sample	A cylinder sample generally 1-5" in diameter drilled out of an area to determine the geologic and chemical analysis of the overburden and coal.
Cumulative impact	The impact of an activity that in itself may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area.
Depth	The word alone generally denotes vertical depth below the surface. In the case of boreholes it may mean the distance reached from the beginning of the hole, the borehole depth.
Do-nothing alternative	The ‘do-nothing’ alternative is the option of not undertaking the proposed activity.
Environmental Impact Assessment (EIA)	In relation to an application to which scoping must be applied, means the process of collecting, organising, analysing, interpreting and communicating information that is relevant to the consideration of that application as defined in NEMA.
Extraction	The process of mining and removal of cal or ore from a mine.
Fault	A slip-surface between two portions of the earth's surface that have moved relative to each other. A fault is a failure surface and is evidence of severe earth stresses.
Gasification	Any of various processes by which coal is turned into low, medium, or high CV gases.
Gas turbine	The gas turbine (also called a combustion turbine) is a rotary engine that extracts energy from a flow of combustion gas.
Goaf	The term applied to that part of the mine from which the coal has been removed and the space more or less filled up with waste or overburden. Also, the loose waste in a mine.
Grey Water	Water containing gasification condensates.
Groundwater	Water in the ground that is in the zone of saturation from which wells, springs, and groundwater run-off are supplied.
Hydrology	The science encompassing the behaviour of water as it occurs in the atmosphere, on the surface of the ground, and underground.
Interested and Affected Party (I&AP)	Any person, group of persons or organisation interested in or affected by an activity; and any organ of state that may have jurisdiction over any aspect of the activity.

Overburden	Layers of soil and rock covering a coal seam. In surface mining operations, overburden is removed prior to mining using large equipment. When mining has been completed, it is either used to backfill the mined areas or is hauled to an external dumping and/or storage site.
Plan of Study for Environmental Impact Assessment:	A document which forms part of a scoping report and sets out how an environmental impact assessment must be conducted.
Public Participation Process	A process in which potential interested and affected parties are given an opportunity to comment on, or raise issues relevant to, specific matters.
Raw gas	The product gas of gasification containing all substances of the process.
Red Data Species	Species listed in terms of the International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species, and/or in terms of the South African Red Data List. In terms of the South African Red Data List, species are categorised as being extinct, endangered, vulnerable, rare, indeterminate, insufficiently known or not threatened.
Seam	A stratum or bed of coal.
Subsidence	The gradual sinking, or sometimes abrupt collapse, of the rock and soil layers into an underground mine. Structures and surface features above the subsidence area can be affected.
Underground Coal Gasification:	UCG is a process carried out on “unminable” coal seams. These are coal seams that cannot be mined by using the conventional coal mining methods e.g. open cast or underground mining. UCG involves injecting steam and air (or oxygen) into a cavity created in an underground coal seam, to form a synthetic natural gas.

Acronyms

CCGT – Closed Cycle Gas Turbine

DEA – Department of Environmental Affairs

DMR – Department of Mineral Resources

DWA – Department of Water Affairs

EIA - Environmental Impact Assessment

EMPr - Environmental Management Programme

ESS - Environmental Scoping Study

FGM - Focus Group Meeting

GTP – Gas Treatment Plant

I&AP - Interested and Affected Party

IWULA – Integrated Water Use License Application

IWWMP – Integrated Waste Water Management Plan

MDEDET - Mpumalanga Department of Economic Development, Environment and Tourism

NEM:AQA – National Environmental Management – Air Quality Act (No 39 of 2004)

NEM:WA – National Environmental Management – Waste Act (No 59 of 2008)

NEMA – National Environmental Management Act (No 107 of 1998)

NGO - Non-Governmental Organisation

NHRA - National Heritage Resources Act (No 25 of 1999)

OCGT – Open Cycle Gas Turbine

SAHRA - South African Heritage Resources Agency

UCG - Underground Coal Gasification

1 INTRODUCTION

Eskom Holdings SOC Limited (Eskom) is mandated by the South African Government to ensure the provision of reliable and affordable power to South Africa. Eskom currently generates approximately 95% of the electricity used in South Africa. Electricity cannot be stored in large quantities and must be used as it is generated. Therefore, electricity must be generated in accordance with supply-demand requirements. In addition, increasing economic growth and social development within Southern Africa is placing a growing demand on energy supply. Coupled with the rapid advancement in community development, is the growing awareness of environmental impact, climate change and the need for sustainable development.

Eskom's core business is in the generation, transmission (transport), trading and retail of electricity. In terms of the Energy Policy of South Africa "energy is the life-blood of development". Therefore, the reliable provision of electricity by Eskom is critical for industrial development and related employment and sustainable development in South Africa.

Underground Coal Gasification (UCG), a process whereby coal is converted *in situ* into combustible gas that can be used for power generation, is one of the new clean coal technologies being developed for implementation by Eskom. The technology has been through 11 years of intensive research by Eskom since 2001 to achieve a better understanding of the gasification process, and the nature of the gas produced. In order to meet the fuel requirements for optimal power generation at the Majuba Power Station, Eskom proposes the use of synthetic gas or *syngas (*15000 Nm^3/hr) produced by the UCG process as a supplementary fuel source within the boilers at the power station. The 15000 Nm^3/hr plant will be scaled up to 70000 Nm^3/hr and based on the outcomes of the 70000 Nm^3/hr plant, Eskom may investigate the option of a commercial size power plant based on UCG technology.

This Environmental Scoping Study is for the UCG project and associated infrastructure on the farm Roodekopjes 67 HS (Portions 1, 2, 3 and remaining extent), Portions 17 and 21 of the farm Bergvliet 65HS and Portions 4 and 5 of the farm Rietfontein 66HS , in support of the co-firing of gas at the Majuba Power Station (refer to Figure 1 and **Appendix A**). The UCG site is located within the southern portions of Mpumalanga Province, near the town of Amersfoort and opposite the Eskom Majuba Power Station. The area falls within the local administrative boundaries of Pixley ka Seme Local Municipality and the Gert Sibande District Municipality.

1.1 Project Need and Justification

Eskom is committed to investigating and evaluating various options for the diversification of the energy mix over time (including renewable resources). As part of an ongoing effort to assess the viability/feasibility of all supply-side options, a number of power generation technologies, not yet implemented in South Africa on a commercial basis, are being evaluated in terms of technical, socio-economic and environmental aspects. One such type of technology is Combined Cycle Gas Turbine (CCGT) power plant that uses gas from an Underground Coal Gasification (UCG) process as a primary energy, which has been successfully proven to be commercially viable in other countries.

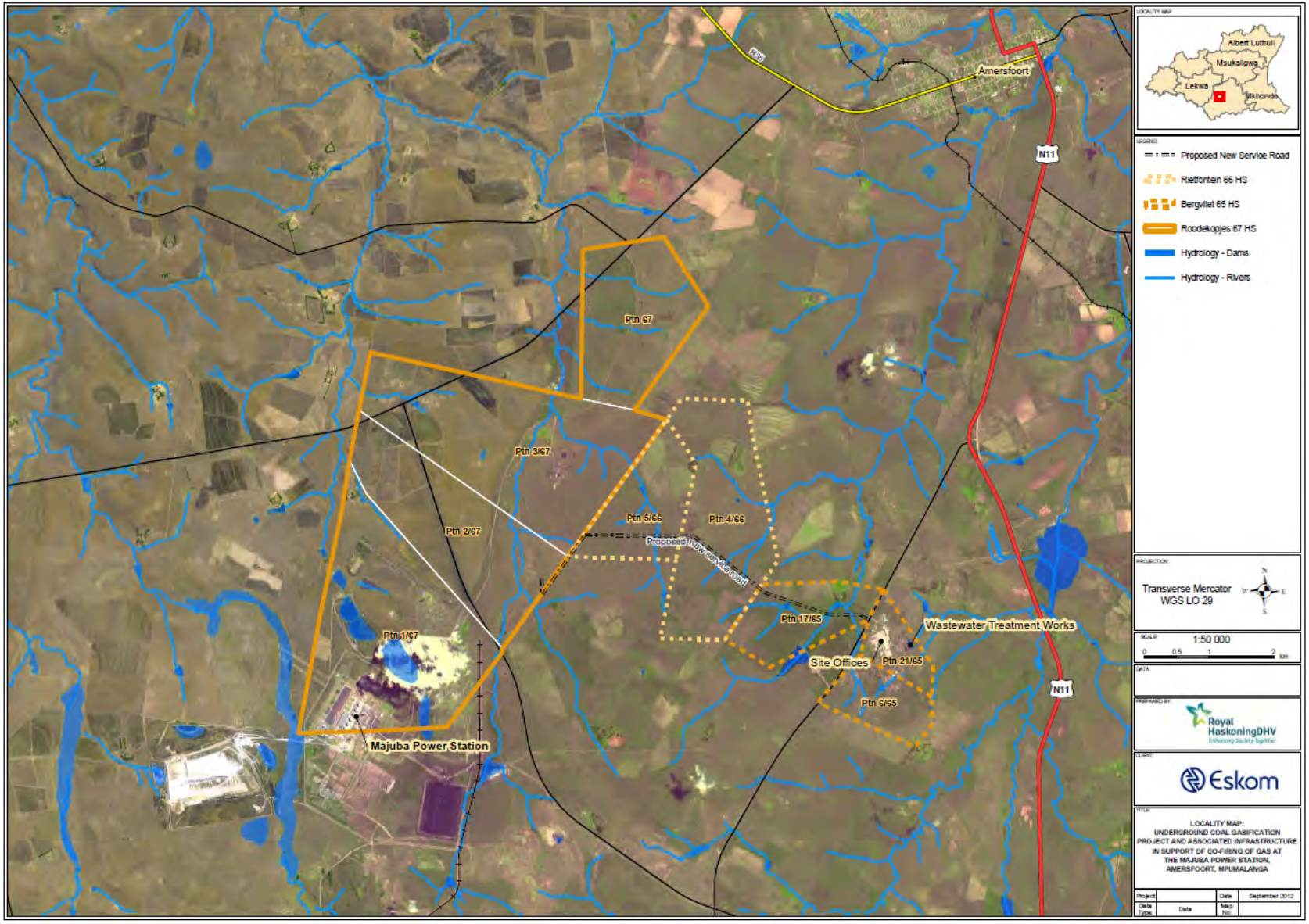

Figure 1: Locality map

In the context of a primary energy supply option for utility scale power generation, the following characteristics of UCG technology are attractive from Eskom's perspective:

- UCG mining, in conjunction with a combined cycle gas turbine power station, is potentially a cleaner method of coal-based power generation. Once Eskom has proven commercial feasibility, the exact technology footprint will be compared to traditional coal power generation technologies.
- The UCG process at a commercial scale would likely create a large underground gas and heat storage inventory, making the gas supply very stable and consistent.
- Dependant on the area and coal resource, the cavity created by UCG could provide a suitable CO_2 sequestration option. This consideration is very embryonic, and will be explored by Eskom during further research.
- The commercial scale UCG production plant is essentially made up of a number of modular underground reactors with largely independent outputs. Thus, the coal extraction and overall gas output from the gasification process may be optimised by varying and then mixing the outputs of the individual modules.
- No ash or slag removal and handling are necessary as there is minimal particulate carry over in the gas, and most of the solids remain underground.
- The operating pressure of the underground gasifier is such that it maintains a negative hydraulic gradient into the cavity, thus preventing contamination of surrounding aquifers in the underground environment.
- Ground water influx into the gasifier creates an effective "steam jacket" around the reactor making the heat loss *in situ* tolerably small.

UCG has the potential to extract coal resources previously regarded as either uneconomic or inaccessible due to depth, seam thickness, seam slope, seam fracturing and displacement, or other mining and safety considerations. The ideal requirements for UCG are generally the opposite of the requirements for conventional underground mining, and hence UCG offers opportunity for expanding South Africa's mineable coal reserve base by extracting coal previously disregarded as being unminable. The Underground Coal Gasification concept therefore provides promising prospects for future energy supplies.

1.2 Project Background

Eskom commenced with UCG activities on the farm Roodekopjes 67HS in January 2007 as part of a phased development and implementation plan. The phased nature of the project enables Eskom to rigorously test the technology requirements and environmental effects of the UCG operations in South Africa.

1.2.1 Environmental Legal Status

Eskom has been granted the following authorisations for the exploration and testing phases (see *Phase 1A* in Figure 2) of the UCG project:

- New Order prospecting right granted in 2005 (F/2005/03/11/0001) by the Department of Minerals and Energy (DME). Extension application lodged in November 2008.
- Exemption from conducting an EIA, in terms of section 22 of the Environmental Conservation Act (Act 73 of 1989) was granted by the Mpumalanga Department of Agriculture and Land Administration in 2005, for the construction of a 7 km gas pipeline between the Majuba Coalfields and Majuba Power Station (Ref 17.2.1EV1).
- Exemption from the requirements of sections 9 and 12 of the Atmospheric Pollution Prevention Act (Act 45 of 1965) granted by the Department of Environmental Affairs and Tourism in 2005 (Ref 23/4/2/1448). However, this exemption lapsed when the National Environmental Management: Air Quality Act (No 39 of 2004) came into effect.
- Renewal of the prospecting rights on 24 February 2009 (MP30/5/1/1/2/1144 PR) issued by the DME – now Department of Mineral Resources (DMR).

- Final Environmental Scoping Report for the 40 – 140MW Open Cycle Gas Turbine (OCGT) power plant was accepted by the Department of Environmental Affairs (DEA) in March 2010. *The EIA process initiated under the EIA Regulations (2006) has subsequently lapsed, hence the new integrated application for authorisation lodged in terms of the EIA Regulations (2010) and the NEM: Waste Act (No 59 of 2008).*
- A new mining right application has been lodged and accepted by the DMR for the farm Roodekopjes 67HS (Portions 1, 2, 3 and the remaining extent) – Ref 30/5/1/1/2/10031 MR.

During the planning process, the initial *modus operandi* was to co-fire at the Majuba Power Station with 15000 Nm^3/hr of UCG syngas. This would then allow the Eskom engineering team to determine the characteristics of the gas (i.e. quality, quantity and stability) in order to drive a 40 – 140 MW Open Cycle Gas Turbine (OCGT) demonstration plant. This demonstration plant would have been the basis upon which a decision would be made for a 2100 MW Combined Cycle Gas Turbine (CCGT) commercial power station.

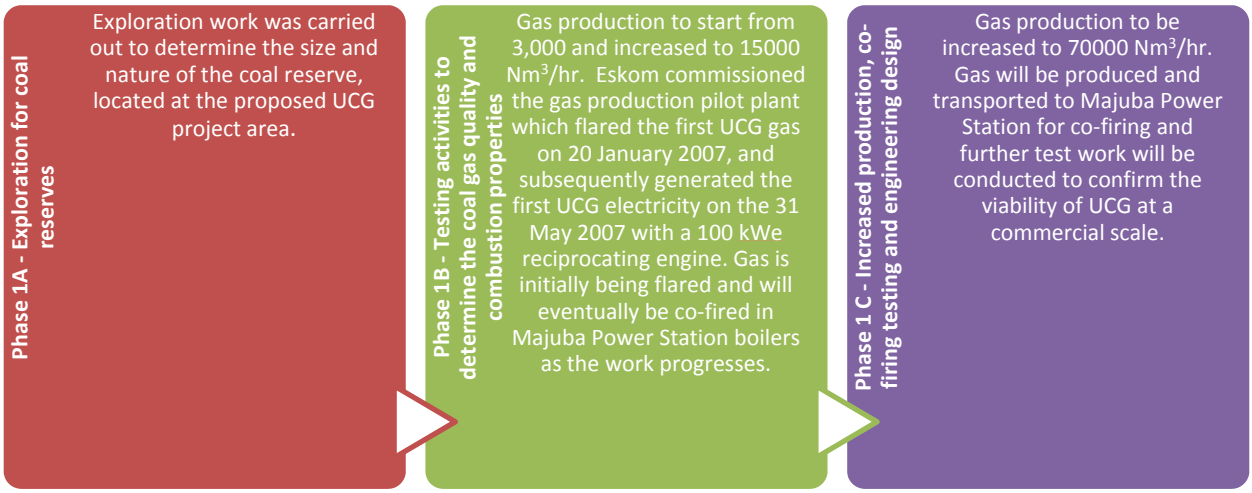

Figure 2: Phases in the UCG project process

From the gas production so far, the Eskom engineering team has come to the conclusion that the production of 15000 Nm^3/hr of UCG syngas is not sufficient to determine the characteristics of the gas with sufficient accuracy to continue with the establishment of the 40 – 140 MW demonstration plant.

It has therefore been decided, to increase the gas production to 70000 Nm^3/hr (Phase 1C, Figure 1) and maintain this level of production for at least 12 months to accurately determine the gas characteristics. This increased gas volume will be disposed of through co-firing at the Majuba Power Station. This exercise is expected to be finalised

in 2017. Once this exercise has been completed and the results evaluated by Eskom engineering team, a decision will be made on further commercial development.

1.3 Approach to the Environmental Scoping Study

1.3.1 Previous Environmental Scoping Study

An Environmental Scoping Study (ESS) was initiated in 2009 for the UCG pilot project and associated infrastructure including the 40 – 140 MW OCGT demonstration plant and gas treatment plants (DEA Ref 12/12/20/1617). The environmental impacts associated with the project required investigation in compliance with the EIA Regulations (2006) published in Government Notice No. R. 385 to No. R. 387 and read with Section 24 (5) of the National Environmental Management Act - NEMA (Act No 107 of 1998) - as amended). The final Environmental Scoping Report for the project was accepted by the Department of Environmental Affairs (DEA) in March 2010.

Due to the research and development (R&D) nature of the project, detailed engineering information / design hindered the progress of the EIA process, which resulted in a time lapse between the ESS and the EIA study.

1.3.2 Current Environmental Scoping Study

Prior to the initiation of the current ESS, advice was sought from DEA, as to whether the applicant could continue with the process and obtain an Environmental Authorisation in terms of the NEMA EIA Regulations (2006). The DEA indicated that in terms of Regulation 77 of the EIA Regulations (2006) – "An application or appeal in terms of these Regulations lapses if the applicant or appellant after having submitted the application or appeal fails for a period of six months to comply with a requirement in terms of these Regulations relating to the consideration of the application or appeal" – that the application has lapsed. The applicant (Eskom) was advised to start the process afresh under the EIA Regulations (2010).

The project study area has since also been reduced to focus only on the farm Roodekopjes 67HS, Portions 4 and 5 of the farm Rietfontein 66HS and Portions 17 and 21 of the farm Bergvliet 65HS. In the previous ESS the following farms were also included as part of the study area: Rietfontein 66HS (including Klein Rietfontein 117HS); Japtrap 115HS; Palmietspruit 68HS; Tweedepoort 54HS; Koppieskraal 56HS; Bergvliet 65HS; Weiland 59HS and Strydkraal 53HS. The 40 – 140 MW OCGT demonstration plant also does not form part of the scope of the current ESS. The major deviations from the previous ESS and this ESS are presented in Table 1.

Table 1: Major deviations from the previous and current ESS

Project Description	Previous ESS (2009 – 2010)	Current ESS (2012)
40 – 140 MW OCGT Demonstration Plant	Included in the scope of work.	Excluded as the production of 15000 Nm^3/hr of UCG syngas is not sufficient to determine the characteristics of the gas with sufficient accuracy to continue with the establishment of the demonstration plant. This ESS will only focus on Phase 1B and 1C (i.e. production of 15000 and 70000 Nm^3/hr of UCG syngas and co-firing at the Majuba Power Station).
Extent of the study area	Focused on 9 core farms i.e. Roodekopjes 67HS; Rietfontein 66 HS (including Klein Rietfontein 117HS); Japtrap 115HS; Palmietspruit 68HS; Tweedepoort 54HS; Koppieskraal 56HS; Bergvliet 65HS;	Only focuses on the farm Roodekopjes 67HS to implement UCG technology as the core study area is quite extensive comprising over 2100 ha in extent. With the DMR refusing to grant prospecting/mining rights for all of the

Project Description	Previous ESS (2009 – 2010)	Current ESS (2012)
	Weiland 59HS and Strydkraal 53HS.	farms, Eskom have decided to focus only on the farm Roodekopjes 67HS (Eskom-owned) on which the UCG pilot plant is operational under the auspices of a prospecting right and subsequent amendments indicated in *Section 1.2.1* above.
Approach to the EIA Study	This ESS was conducted in compliance with the EIA Regulations published in Government Notice No. R. 385 to No. R. 387 and read with Section 24 (5) of the National Environmental Management Act - NEMA (Act No 107 of 1998) (as amended).	RHDHV were advised by the DEA that Eskom will have to start the EIA process afresh and submit an application in terms of the EIA Regulations (2010) due to the lapse between the previous ESS and EIA components of the study. As the project triggers listed activities both in terms of National Environmental Management Act (Act No. 107 of 1998, "NEMA") and the National Environmental Management: Waste Act – NEM:WA (Act No 59 of 2008), an integrated licensing approach will be followed for the project.

The environmental impacts associated with the proposed project require investigation in compliance with the EIA Regulations (2010) published in Government Notice No. R. 543 to No. R. 546 and read with Section 24 (5) of the National Environmental Management Act - NEMA (Act No 107 of 1998) - as amended, as well as the National Environmental Management: Waste Act – NEM:WA (Act No 59 of 2008). An integrated environmental authorisation process will apply as the Minister (Environmental Affairs) is both the -

(a) competent authority for the environmental authorisation applied for in terms of the EIA Regulations, 2010 promulgated under NEMA; and
(b) the licensing authority for the waste management licence in terms of NEM:WA.

The required environmental studies include the undertaking of an Environmental Impact Assessment (EIA) process. This process is being undertaken in two phases (see Figure 3) that will ultimately allow the competent authority (Department of Environmental Affairs) to make an informed decision:

- Phase 1 - Environmental Scoping Study (ESS) including Plan of Study for EIA; and
- Phase 2 - Environmental Impact Assessment (EIA) and Environmental Management Programme (EMPr).

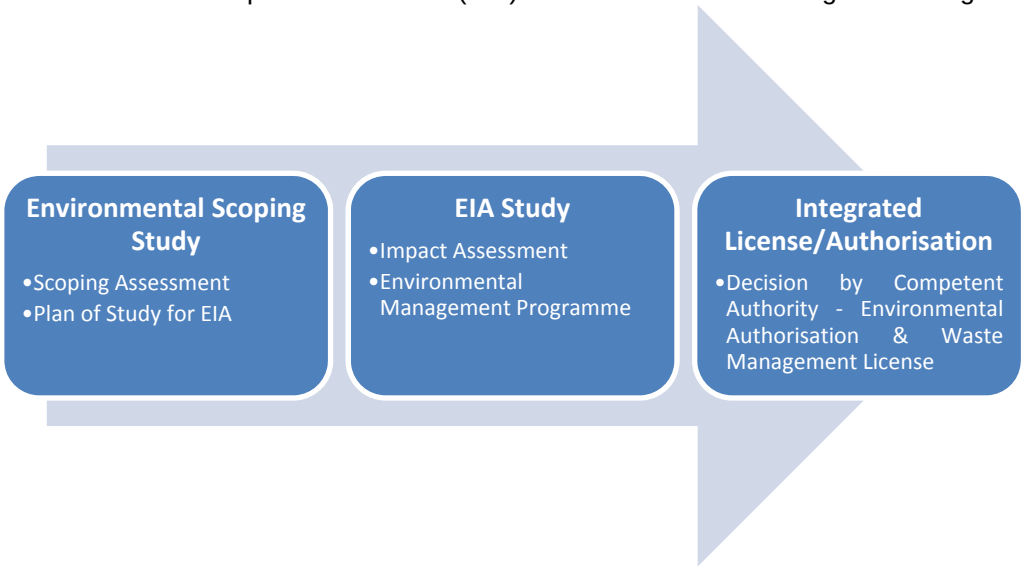

Figure 3: Environmental studies flowchart

1.3.2.1 Environmental Scoping Study

The ESS provides a description of the receiving environment and how the environment may be affected by the development of the proposed project. The ESS will also identify any fatal flaws, alternatives and mitigation options to be evaluated and investigated during the EIA phase of the project. Impacts relating to soil and agricultural potential, terrestrial biodiversity (fauna and flora), wetlands, social and micro-economic aspects, air quality; heritage and visual impacts have been investigated in this ESS. Issues that are considered to be of significance will be recommended for further investigation and assessment within the EIA phase of the project.

Desktop studies making use of existing information (previous specialist studies, monitoring reports, feasibility studies, mining documents) are used to highlight and assist in the identification of potential significant impacts (both social and biophysical) associated with the proposed project.

RHDHV was assisted by various specialists in order to comprehensively identify both potentially positive and negative environmental impacts (social and biophysical) associated with project. These specialists and their fields of expertise are outlined in Table 2:

Table 2 Specialist studies

Specialist Field	Specialist and Organisation
Soils and Agricultural Potential	*Dr Johan van der Waals – Terra Soil Science*
Biodiversity Assessment	*Riaan Robbeson – Bathusi Environmental Consulting* *Dewald Kamffer - Faunal Specialists Incorporated*
Wetland Assessment	*Paul da Cruz – Royal HaskoningDHV*
Visual Impact Assessment	*Dawie van Vuuren* – MetroGIS
Air Quality Impact Assessment	*Stuart Thompson – Royal HaskoningDHV*
Heritage	*Johnny van Schalkwyk -Private*
Micro-Economic Assessment	*Raoul de Villiers – MasterQ Research*
Social	Nonka Byker – *MasterQ Research*
Geology Peer Review *	G. Esterhuizen – *Mine Geology Services*
Groundwater Peer Review *	Reinhard Meyer - *Private*

**Extensive investigations and monitoring was done on the geology and groundwater resources at the UCG site by Eskom. An independent peer review on these studies was requested in order to remain independent throughout the process.*

Additional issues for consideration will be extracted from feedback during the public participation process, which commenced at the beginning of the Scoping phase, and will continue throughout the duration of the project. All issues identified during this phase of the study have been documented within this Environmental Scoping Report (ESR). Thus, this ESR provides a record of all issues identified as well as any fatal flaws, in order to make recommendations regarding the project and further studies required to be undertaken within the EIA phase of the proposed project.

1.4 Details of the Environmental Assessment Practitioner

Royal HaskoningDHV - RHDHV (formerly SSI Engineers and Environmental Consultants (Pty) Ltd), has been appointed as the independent Environmental Assessment Practitioner (EAP) by Eskom, to undertake the appropriate environmental studies for this proposed project. The professional team of RHDHV have considerable experience in the environmental management and EIA fields. RHDHV has been involved in and/or managed several of the largest Environmental Impact Assessments undertaken in South Africa to date. A specialist area of

focus is on the assessment of multi-faceted projects, including the establishment of linear developments (national and provincial roads, and power lines), bulk infrastructure and supply (e.g. wastewater treatment works, pipelines, landfills), electricity generation and transmission, the mining industry, urban, rural and township developments, environmental aspects of Local Integrated Development Plans (LIDPs), as well as general environmental planning, development and management.

The particulars of the EAP are presented in Table 3 below:

Table 3: Details of EAP

Details	
Consultant:	Royal HaskoningDHV (formerly SSI Engineers and Environmental Consultants (Pty) Ltd)
Contact Persons:	Prashika Reddy and Malcolm Roods
Postal Address	PO Box 867 Gallo Manor 2052
Telephone:	012 367 5973 / 011 798 6442
Facsimile:	012 367 5878 / 011 798 6010
E-mail:	prashika.reddy@rhdhv.com / malcolm.roods@rhdhv.com
Expertise:	Prashika Reddy is an Associate / Senior Environmental Scientist (*Pr Sci Nat* 400133/10) with a BSc Honours in Geography. Ms Reddy has the necessary experience in various environmental fields including: environmental impact assessments, environmental management plans/programmes, public participation and environmental monitoring and auditing. Ms Reddy has extensive experience in compiling environmental reports (Screening, Scoping, EIA and *Status Quo* Reports). Ms Reddy is/has been part of numerous multi-faceted large–scale projects, including the establishment of linear developments (roads, and power lines); industrial plants; electricity generation plants and mining-related projects. Malcolm Roods is a Principal with RHDHV specializing in Environmental Impact Assessments (EIA) for electricity supply (generation, transmission and distribution), road infrastructure, residential developments as well as water management projects. This builds on a broad government background, which has made him particularly flexible. His past experiences include 6 years public service which included policy development, environmental law reform and EIA reviews. His experience also includes 5 years of environmental consulting in the field of Impact Assessment and Authorisation Applications, with a focus on legislative requirements and sector area management. He is also a certified Environmental Assessment Practitioner with the Interim Certification Board (ICB) for EAP of South Africa.

1.5 Environmental Scoping Report Structure

This report structure is summarised in Table 4.

Table 4: Report structure

Chapter	Description
Chapter 1 - Introduction	Introduction to project and approach to the study
Chapter 2 – Environmental Legal Requirements	Identification of all legislation and guidelines considered
Chapter 3 – Project Description	Provides the technical description of the project as well as a description of the associated infrastructure
Chapter 4 – Project Alternatives	Consideration of alternatives (do-nothing; site and associated infrastructure) for the proposed project
Chapter 5 – Public Participation	Description on the Public Participation Process that has been or will be undertaken
Chapter 6 – Description of the Receiving Environment	A description of the biophysical and social environment
Chapter 7 – Description of the Receiving Environment: Social	A description of the social environment
Chapter 8 – Potential Impacts: Biophysical	A description of the potential biophysical environmental impacts associated with the project
Chapter 9 – Potential Impacts: Social	A description of the potential social impacts associated with the project
Chapter 9 – Conclusion and Recommendations	Conclusions and recommendations of the Environmental Scoping Study
Chapter 10 – Plan of Study for EIA	Approach to be followed and details pertaining to the EIA phase

2 ENVIRONMENTAL LEGISLATIVE REQUIREMENTS

In order to protect the environment and ensure that this development is undertaken in an environmentally responsible manner, there are a number of significant pieces of environmental legislation that will need to be complied with. They are the following:

2.1 National Environmental Management Act (No 107 of 1998)

The National Environmental Management Act (No 107 of 1998, "NEMA")(as amended) states that the principles of Integrated Environmental Management (IEM) should be adhered to in order to ensure sustainable development. A vital underpinning of the IEM procedure is accountability to the various parties that may be interested in or affected by a proposed development. Public participation is a requirement of the IEM procedure, in terms of the identification of potentially significant environmental impacts during the Scoping Phase. The IEM procedure aims to ensure that the environmental consequences of development proposals are understood and adequately considered during all stages of the project cycle, and that negative aspects are resolved or mitigated and positive aspects enhanced. Furthermore, Section 28(1) of the Act states that "every person who causes or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring". If such pollution cannot be prevented then appropriate measures must be taken to minimise or rectify such pollution.

In 2010, new EIA Regulations were promulgated in order to revise the procedure and criteria relating to environmental authorisations for the commencement of activities in order to avoid detrimental impacts on the environment or, where it cannot be avoided, to mitigate and effectively manage these impacts and optimise positive environmental impacts. These Regulations and a revised set of Listed Activities (Listing Notices 1, 2 and 3) came into force on 02 August 2010. The listed activities applicable to the project are listed in Table 5.

Table 5: Listed activities applicable to the project

Activities subject to a Basic Assessment in terms of GN R.544 – Listing Notice 1	Activities subject to a Scoping and EIA in terms of GN R.545 – Listing Notice 2	Activities subject to a Basic Assessment in terms of GN R.545 – Listing Notice 3
Activity 11: **The construction of:** **(i) bridges** **(iv) dams** **(x) buildings exceeding 50 square meters in size** **(xi) infrastructure or structures covering 50 square metres or more** **where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.** ***Applicability:*** ***Should any infrastructure (roads, bridges, pipelines, etc) occurs within a watercourse, or within 32 m of a watercourse, this activity will be applicable.***	***Activity 4:*** The construction of facilities or infrastructure for the refining, extraction or processing of gas, oil or petroleum products with an installed capacity of 50 cubic metres or more per day, excluding facilities for the refining, extraction or processing of gas from landfill sites. ***Applicability:*** *UCG is extracting and processing gas before being co-firing at the Majuba Power Station boilers.*	***Activity 4:*** The construction of a road wider than 4 metres with a reserve less than 13,5 metres. (a) In Eastern Cape, Free State, KwaZulu-Natal, Limpopo, Mpumalanga and Northern Cape provinces: i. In an estuary; ii. Outside urban areas, in: (aa) A protected area identified in terms of NEMPAA, excluding conservancies; (bb) National Protected Area Expansion Strategy Focus areas; (cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; (dd) Sites or areas identified in terms of an International Convention; (ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; (ff) Core areas in biosphere reserves; (gg) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve; (hh) Areas seawards of the development setback line or within 1 kilometre from the high-water mark of the sea if no such development setback line is determined. iii. In urban areas (aa) Areas zoned for use as public open space; (bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority or zoned for a conservation purpose; (cc) seawards of the development setback line or within urban protected areas.

Activities subject to a Basic Assessment in terms of GN R.544 – Listing Notice 1	Activities subject to a Scoping and EIA in terms of GN R.545 – Listing Notice 2	Activities subject to a Basic Assessment in terms of GN R.545 – Listing Notice 3
		Applicability: *This activity will be verified during the detailed EIA study with detailed engineering input, specialist input, EMFs, NEM: Biodiversity Act, Mpumalanga C-Plan, etc.*
Activity 12: **The construction of facilities or infrastructure for the off-stream storage of water, including dams and reservoirs, with a combined capacity of 50000 cubic metres or more, unless such storage falls within the ambit of activity 19 of Notice 545 of 2010.** ***Applicability:*** ***This activity has been applied for as a precautionary approach and its applicability will be determined during detailed engineering studies.***	***Activity 5:*** The construction of facilities or infrastructure for any process or activity which requires a permit or license in terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent and which is not identified in Notice No. 544 of 2010 or included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case that Act will apply. ***Applicability:*** *An Integrated Water Use License application will be applied for all water uses associated with the UCG operations.*	***Activity 10:*** The construction of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres. (a) In Eastern Cape, Free State, KwaZulu-Natal, Limpopo, Mpumalanga and Northern Cape provinces: i. In an estuary; ii. Outside urban areas, in: (aa) A protected area identified in terms of NEMPAA, excluding conservancies; (bb) National Protected Area Expansion Strategy Focus areas; (cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; (dd) Sites or areas identified in terms of an International Convention; (ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; (ff) Core areas in biosphere reserves; (gg) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve; (hh) Areas seawards of the development setback line or within 1 kilometre from the high-water mark of the sea if no such development setback line is determined; (ii) Areas on the watercourse side of the

Activities subject to a Basic Assessment in terms of GN R.544 – Listing Notice 1	Activities subject to a Scoping and EIA in terms of GN R.545 – Listing Notice 2	Activities subject to a Basic Assessment in terms of GN R.545 – Listing Notice 3
		development setback line or within 100 metres from the edge of a watercourse where no such setback line has been determined; (jj) Within 500 metres of an estuary. iii. In urban areas: (aa) Areas zoned for use as public open space; (bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority or zoned for a conservation purpose; (cc) Within 500 metres of an estuary. ***Applicability:*** *This activity will be verified during the detailed EIA study with detailed engineering input, specialist input, EMFs, NEM: Biodiversity Act, Mpumalanga C-Plan, etc.*
Activity 13: **The construction of facilities or infrastructure for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80 but not exceeding 500 cubic metres.** ***Applicability:*** ***This pertains to the storage of diesel or fuel on site.***	***Activity 6:*** The construction of facilities or infrastructure for the bulk transportation of dangerous goods – (i) in gas form, outside an industrial complex, using pipelines, exceeding 1000 metres in length, with a throughput capacity of more than 700 tons per day; (ii) in liquid form, outside an industrial complex, using pipelines, exceeding 1000 metres in length, with a throughput capacity more than 50 cubic metres per day; or (iii) in solid form, outside an industrial complex, using funiculars or conveyors with a throughput capacity of more than 50 tons day. ***Applicability:*** *Syngas will be transported in pipelines to the main pipeline, which goes to the Majuba Power Station. Should these new "tie-in pipelines" be longer than 1 km in length with a throughput capacity of more than 70 tonnes per day, this activity will be triggered.*	***Activity 13:*** The clearance of an area of 1 hectare or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, except where such removal of vegetation is required for: (1) the undertaking of a process or activity included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008), in which case the activity is regarded to be excluded from this list. (2) the undertaking of a linear activity falling below the thresholds mentioned in Listing Notice 1 in terms of GN No. 544 of 2010. (a) Critical biodiversity areas and ecological support areas as identified in systematic biodiversity plans adopted by the competent authority. (b) National Protected Area Expansion Strategy Focus areas. (c) In Eastern Cape, Free State, KwaZulu-Natal, Limpopo, Mpumalanga, Northern Cape and Western Cape:

Activities subject to a Basic Assessment in terms of GN R.544 – Listing Notice 1	Activities subject to a Scoping and EIA in terms of GN R.545 – Listing Notice 2	Activities subject to a Basic Assessment in terms of GN R.545 – Listing Notice 3
		i. In an estuary; ii. Outside urban areas, the following: (aa) A protected area identified in terms of NEMPAA, excluding conservancies; (bb) National Protected Area Expansion Strategy Focus areas; (cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; (dd) Sites or areas identified in terms of an International Convention; (ee) Core areas in biosphere reserves; (ff) Areas within10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve; (gg) Areas seawards of the development setback line or within 1 kilometre from the high-water mark of the sea if no such development setback line is determined. iii. In urban areas, the following: (aa) Areas zoned for use as public open space; (bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority or zoned for a conservation purpose; (cc) Areas seawards of the development setback line; (dd) Areas on the watercourse side of the development setback line or within 100 metres from the edge of a watercourse where no such setback line has been determined. ***Applicability:*** *This activity will be verified during the detailed EIA study with detailed engineering input, specialist input, EMFs, NEM: Biodiversity Act, Mpumalanga C-Plan, etc.*

Activities subject to a Basic Assessment in terms of GN R.544 – Listing Notice 1	Activities subject to a Scoping and EIA in terms of GN R.545 – Listing Notice 2	Activities subject to a Basic Assessment in terms of GN R.545 – Listing Notice 3
Activity 18: **The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock or more than 5 cubic metres from:** **(i) a watercourse;** **But excluding where such infilling, depositing , dredging, excavation, removal or moving;** (a) **is for maintenance purposes undertaken in accordance with a management plan agreed to by the relevant environmental authority; or** (b) **occurs behind the development setback line.** ***Applicability:*** ***Should any infrastructure (roads, bridges, pipelines, etc) occurs within a watercourse, or within 32 m of a watercourse, this activity will be applicable.***	***Activity 15:*** Physical alteration of undeveloped, vacant or derelict land for residential, retail, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 hectares or more; except where such physical alteration takes place for: (i) linear development activities; or (ii) agriculture or afforestation where activity 16 in this Schedule will apply. ***Applicability:*** *This is applicable to the new gasifier units that are scattered along the farm Roodekopjes 67HS. Note that this activity excludes linear developments (i.e. roads, pipelines, etc), of which it is assumed the 70000 Nm^3/hr gas specification would mostly comprise of. The applicability of other proposed development components, which are not linear in nature will be confirmed during detailed engineering.*	***Activity 14:*** *The clearance of an area of 5 hectares or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, except where such removal of vegetation is required for:* 1) purposes of agriculture or afforestation inside areas identified in spatial instruments adopted by the competent authority for agriculture or afforestation purposes; 2) the undertaking of a process or activity included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case the activity is regarded to be excluded from this list; 3) the undertaking of a linear activity falling below the thresholds in Notice 544 of 2010. (a) In Eastern Cape, Free State, KwaZulu-Natal, Gauteng, Limpopo, Mpumalanga, Northern Cape, Northwest and Western Cape: i. All areas outside urban areas. ***Applicability:*** *This activity will be verified during the detailed EIA study with detailed engineering input, specialist input, EMFs, NEM: Biodiversity Act, Mpumalanga C-Plan, etc.*
Activity 20: **Any activity requiring a mining permit in terms of section 27 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) or renewal thereof.** ***Applicability:*** ***Borrow pits might need to be established for construction and would have to be appropriately licensed.***	***Activity 19:*** The construction of a dam, where the highest part of the dam wall, as measured from the outside toe of the wall to the highest part of the wall, is 5 metres or higher or where the high-water mark of the dam covers an area of 10 hectares or more. ***Applicability:*** *A new dam might be required as part of the 70000 Nm^3/hr gas specification. In addition, brine storage might also be required but this will only be determined during detailed engineering.*	***Activity 16:*** The construction of: (i) jetties exceeding 10 square metres in size; (ii) slipways exceeding 10 square metres in size; (iii) buildings with a footprint exceeding 10 square metres in size; or (iv) infrastructure covering 10 square metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line. (a) In Eastern Cape, Free State, KwaZulu-Natal, Limpopo, Mpumalanga and Northern Cape:

Activities subject to a Basic Assessment in terms of GN R.544 – Listing Notice 1	Activities subject to a Scoping and EIA in terms of GN R.545 – Listing Notice 2	Activities subject to a Basic Assessment in terms of GN R.545 – Listing Notice 3
		i. In an estuary; ii. Outside urban areas, in: (aa) A protected area identified in terms of NEMPAA, excluding conservancies; (bb) National Protected Area Expansion Strategy Focus areas; (cc) World Heritage Sites; (dd) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; (ee) Sites or areas identified in terms of an International Convention; (ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; (gg) Core areas in biosphere reserves; (hh) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve; (ii) Areas seawards of the development setback line or within 1 kilometre from the high-water mark of the sea if no such development setback line is determined. iii. In urban areas: (aa) Areas zoned for use as public open space; (bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority, zoned for a conservation purpose; or (cc) Areas seawards of the development setback line. ***Applicability:*** *This activity will be verified during the detailed EIA study with detailed engineering input, specialist input, EMFs, NEM: Biodiversity Act, Mpumalanga C-Plan, etc.*

Activities subject to a Basic Assessment in terms of GN R.544 – Listing Notice 1	Activities subject to a Scoping and EIA in terms of GN R.545 – Listing Notice 2	Activities subject to a Basic Assessment in terms of GN R.545 – Listing Notice 3
Activity 22: **The construction of a road, outside urban areas,** (i) **with a reserve wider than 13,5 meters or,** (ii) **where no reserve exists where the road is wider than 8 metres, or** (iii) **for which an environmental authorisation was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Notice 545 of 2010.** ***Applicability:*** ***This is applicable to the new service road that will be constructed between the site offices on the farm Bergvliet 65 HS to the UCG Gas Treatment Plant site. In addition, internal secondary roads between the gasifier units must also be considered.***	***Activity 20:*** Any activity which requires a mining right or renewal thereof as contemplated in sections 22 and 24 respectively of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002). ***Applicability:*** *Eskom is applying for a mining right.*	***Activity 19:*** The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre. (a) In Eastern Cape, Free State, KwaZulu-Natal, Limpopo, Mpumalanga and Northern Cape provinces: i. In an estuary; ii. Outside urban areas, in: (aa) A protected area identified in terms of NEMPAA, excluding conservancies; (bb) National Protected Area Expansion Strategy Focus areas; (cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; (dd) Sites or areas identified in terms of an International Convention; (ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; (ff) Core areas in biosphere reserves; (gg) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve; (hh) Areas seawards of the development setback line or within 1 kilometre from the high-water mark of the sea if no such development setback line is determined; (ii) Areas on the watercourse side of the development setback line or within 100 metres from the edge of a watercourse where no such setback line has been determined. iii. Inside urban areas: (aa) Areas zoned for use as public open space; (bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority or

Activities subject to a Basic Assessment in terms of GN R.544 – Listing Notice 1	Activities subject to a Scoping and EIA in terms of GN R.545 – Listing Notice 2	Activities subject to a Basic Assessment in terms of GN R.545 – Listing Notice 3
		zoned for a conservation purpose. ***Applicability:*** *This activity will be verified during the detailed EIA study with detailed engineering input, specialist input, EMFs, NEM: Biodiversity Act, Mpumalanga C-Plan, etc.*
Activity 23: **The transformation of undeveloped, vacant or derelict land to –** **(ii) residential, retail, commercial, recreational, industrial or institutional use, outside an urban area and where the total area to be transformed is bigger than 1 hectare but less than 20 hectares; - except where such transformation takes place –** (i) **for linear activities; or** (ii) **for purposes of agriculture or afforestation, in which case Activity 16 of Notice No.R. 545 applies.** ***Applicability:*** ***This is applicable to the new gasifier units that are scattered along the farm Roodekopjes 67HS. Note that this activity excludes linear developments (i.e. roads, pipelines, etc), of which it is assumed the 70000 Nm^3/hr gas specification would mostly comprise of. The applicability of other proposed development components, which are not linear in nature will be confirmed during detailed engineering.***	***Activity 22:*** Any activity which requires a production right or renewal thereof as contemplated in sections 83 and 85 respectively of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002). ***Applicability:*** *Once Eskom has been granted a mining right, they (Eskom) will be applying for a production right to start extraction.*	***Activity 23:*** The expansion of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage facilities will be expanded by 30 cubic metres or more but less than 80 cubic metres. (a) In Eastern Cape, Free State, KwaZulu-Natal, Limpopo, Mpumalanga and Northern Cape provinces: i. In an estuary; ii. Outside urban areas, in: (aa) A protected area identified in terms of NEMPAA, excluding conservancies; (bb) National Protected Area Expansion Strategy Focus areas; (cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; (dd) Sites or areas identified in terms of an International Convention; (ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; (ff) Core areas in biosphere reserves; (gg) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve; (hh) Areas seawards of the development setback line or within 1 kilometre from the high-water mark of the sea if no such development setback line is determined; (ii) Areas on the watercourse side of the development setback line or within 100

Activities subject to a Basic Assessment in terms of GN R.544 – Listing Notice 1	Activities subject to a Scoping and EIA in terms of GN R.545 – Listing Notice 2	Activities subject to a Basic Assessment in terms of GN R.545 – Listing Notice 3
		metres from the edge of a watercourse where no such setback line has been determined; (jj) Within 500 metres of an estuary. iii. In urban areas: (aa) Areas zoned for use as public open space; (bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority or zoned for a conservation purpose; (cc) Areas on the watercourse side of the development setback line or within 100 metres from the edge of a watercourse where no such setback line has been determined; (dd) Within 500 metres of an estuary. ***Applicability:*** *This activity will be verified during the detailed EIA study with detailed engineering input, specialist input, EMFs, NEM: Biodiversity Act, Mpumalanga C-Plan, etc.*
Activity 28: **The expansion of or changes to existing facilities for any process or activity where such expansion or changes to will result in the need for a permit or license in terms of national or provincial legislation governing the release of emissions or pollution, excluding where the facility, process or activity is included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case that Act will apply.** ***Applicability:*** ***This activity is included considering the Section 21 Water Uses that will be applied for pertaining to existing infrastructure constructed under the prospecting right and which will also be expanded.***	***Activity 26:*** Commencing of an activity, which requires an atmospheric emission license in terms of section 21 of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004), except where [Activity 28 in Notice No. R. 544 of 2010 applies] such commencement requires basic assessment in terms of Notice of No. R544 of 2010. ***Applicability:*** *An Air Emissions License will be required for the co-firing at Majuba Power Station.*	***Activity 24:*** The expansion of (c) buildings where the buildings will be expanded by 10 square metres or more in size; or (d) infrastructure where the infrastructure will be expanded by 10 square metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line. (a) In Eastern Cape, Free State, KwaZulu-Natal, Limpopo, Mpumalanga and Northern Cape: (i) In an estuary; (ii) Outside urban areas, in: (aa) A protected area identified in terms of NEMPAA, excluding conservancies; (bb) National Protected Area Expansion Strategy Focus areas; (cc) Sensitive areas as identified in an

Activities subject to a Basic Assessment in terms of GN R.544 – Listing Notice 1	Activities subject to a Scoping and EIA in terms of GN R.545 – Listing Notice 2	Activities subject to a Basic Assessment in terms of GN R.545 – Listing Notice 3
		environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; (dd) Sites or areas identified in terms of an International Convention; (ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; (ff) Core areas in biosphere reserves; (gg) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve; (hh) Areas seawards of the development setback line or within 1 kilometre from the high-water mark of the sea if no such development setback line is determined. (iii) Inside urban areas: (aa) Areas zoned for use as public open space; (bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority or zoned for a conservation purpose. ***Applicability:*** *This activity will be verified during the detailed EIA study with detailed engineering input, specialist input, EMFs, NEM: Biodiversity Act, Mpumalanga C-Plan, etc.*
Activity 48: **The expansion of facilities for the refining, extraction or processing of gas, oil or petroleum products where the installed capacity of the facility will be increased by 50 cubic meters or more per day, excluding facilities for the refining, extraction or processing of gas from landfill sites.** ***Applicability:*** ***This activity pertains to expansion of facilities for the processing of gas, oil or petroleum products.***		***Activity 26:*** Phased activities for all activities listed in this Schedule and as it applies to a specific geographical area, which commenced on or after the effective date of this Schedule, where any phase of the activity may be below a threshold but where a combination of the phases, including expansions or extensions, will exceed a specified threshold. All the areas as identified for the specific activities listed in this schedule.

Activities subject to a Basic Assessment in terms of GN R.544 – Listing Notice 1	Activities subject to a Scoping and EIA in terms of GN R.545 – Listing Notice 2	Activities subject to a Basic Assessment in terms of GN R.545 – Listing Notice 3
		Applicability: *This activity will be verified during the detailed EIA study with detailed engineering input, specialist input, EMFs, NEM: Biodiversity Act, Mpumalanga C-Plan, etc.*
Activity 49: **The expansion of facilities or infrastructure for the bulk transportation of dangerous goods:** (i) **in gas form, outside an industrial complex, by an increased throughput capacity of 700 tons or more per day;** (ii) **in liquid form, outside an industrial complex or zone, by an increased throughput capacity of 50 cubic metres or more per day; or** (iii) **in solid form, outside an industrial complex or zone, by an increased throughput capacity of 50 tons or more per day.** ***Applicability:*** ***This activity pertains to expansion of facilities or infrastructure for the bulk transportation of dangerous goods e.g. gas pipelines.***		
Activity 56: **Phased activities for all activities listed in this Schedule, which commenced on or after the effective date of this Schedule, where anyone phase of the activity may be below a threshold but where a combination of the phases, including expansions or extensions, will exceed a specified threshold excluding the following activities listed in this Schedule: 2; 11(i)-(vii); 16(i)-(iv); 17; 19; 20; 22(i) & 22(iii); 25; 26; 27(iii) & (iv); 28; 39; 45(i)-(iv) & (vii)-(xv); 50; 51; 53; and 54.** ***Applicability:*** ***This activity pertains to phased activities for all activities associated with the UCG operations.***		

2.2 National Environmental Management: Waste Act (No 59 of 2008)

On 03 July 2009, under section 19 (1) of the National Environmental Management: Waste Act (No 59 of 2008) [NEM:WA], a list of waste management activities (GN R.718) which have, or are likely to have a detrimental effect on the environmental were published. No person may commence, undertake or conduct a waste management activity listed GN R.718 unless a license is issued in respect of that activity. This list of waste activities requiring a Waste Management License in terms of the NEM:WA are included in Table 6.

Table 6: List of waste activities requiring a Waste Management License in terms of the NEM: WA

GN R.718 – Category A **A person who wishes to commence undertake or conduct an activity listed under this Category, must conduct a basic assessment process, as stipulated in the EIA Regulations (2010) made under section 24(5) of the NEMA (No 107 of 1998) as part of a waste management license application**	GN R.718 – Category B **A person who wishes to commence undertake or conduct an activity listed under this Category, must conduct an EIA process, as stipulated in the EIA Regulations (2010) made under section 24(5) of the NEMA (No 107 of 1998) as part of a waste management license application**
Activity 11: **The treatment of effluent, wastewater or sewage with an annual throughput capacity of more than 2000 cubic metres but less than 15000 cubic metres.** ***Applicability:*** ***Effluent, wastewater and sewerage will be treated using the existing WWTW as well as proposed new treatment system for the treatment of condensate to irrigate land. During this stage it is not known how much water will be treated, hence the application for both below 15000 m^3 and above 15000 m^3 thresholds.***	***Activity 2:*** The reuse and recycling of hazardous waste. ***Applicability:*** *This might be required during the 70000 Nm^3/hr gas specification – Eskom to confirm applicability during detailed engineering design.*
Activity 12: **The remediation of contaminated land.** ***Applicability:*** ***Some spills (i.e. diesel, etc) may occur during the operation of the UCG plant, associated infrastructure (this also already previously occurred on site), and will require remediation. It is recommended that this activity be included and that a Standard Operating Procedure (SoP) be developed in this regard.***	***Activity 7:*** The treatment of effluent, wastewater or sewage with an annual throughput capacity of 15000 cubic metres or more. ***Applicability:*** *Effluent, wastewater and sewerage will be treated using the existing WWTW as well as proposed new treatment system for the treatment of condensate to irrigate land. During this stage it is not known how much water will be treated, hence the application for both below 15000 m^3 and above 15000 m^3 thresholds.*
Activity 16: **The disposal of domestic waste generated on premises in areas not serviced by the municipal service where the waste disposed does not exceed 500 kg per month.** ***Applicability:*** ***The site is currently not serviced by the Municipality however no land filling will take place. Other options will be explored regarding the disposal of general waste.***	
Activity 19: **The expansion of facilities of or changes to existing facilities for any process or activity, which requires an amendment of an existing permit or license or a new permit or license in terms of legislation governing the release of pollution, effluent or waste.**	

GN R.718 – Category A	GN R.718 – Category B
A person who wishes to commence undertake or conduct an activity listed under this Category, must conduct a basic assessment process, as stipulated in the EIA Regulations (2010) made under section 24(5) of the NEMA (No 107 of 1998) as part of a waste management license application	**A person who wishes to commence undertake or conduct an activity listed under this Category, must conduct an EIA process, as stipulated in the EIA Regulations (2010) made under section 24(5) of the NEMA (No 107 of 1998) as part of a waste management license application**
Applicability: ***This activity is included considering the Section 21 Water Uses that will be applied for pertaining to existing infrastructure constructed under the prospecting right and which will also be expanded as part of the 70000 Nm^3/hr gas specification.***	

As indicated in *section 1.3.2*, that as the environmental impacts associated with the proposed project require investigation in compliance with the EIA Regulations (2010) as well as the NEM:WA. An integrated environmental authorisation process is therefore being followed.

2.3 National Water Act (No 36 of 1998)

In terms of Chapter 4 of the National Water Act (No 36 of 1998) [NWA], activities and processes associated with the UCG operations are required to be licensed by the Department of Water Affairs (DWA). An integrated Water Use License Application (IWULA) will be lodged with the DWA. Furthermore, an Integrated Water and Waste Management Plan (IWWMP) will be compiled in support of the IWULA.

The following water uses (Table 7), as defined in section 21 of the NWA, will be applied for in terms of the NWA for the UCG operations.

Table 7: Water uses associated with the UCG operations

Relevant water use	Description	Applicability
Section 21 (a)	Taking water from a water resource	Indirect abstraction of water through the gasification process
Section 21 (b)	Storing water	Condensate and raw water dam
Section 21 (c)	Impeding or diverting the flow of water in a watercourse	Working within a watercourse for the construction of UCG related linear infrastructure i.e. pipelines (water and gas), roads (main and access)
Section 21 (e)	Engaging in a controlled activity identified as such in section 37 (1) (which includes the intentional recharging of an aquifer with any waste or water containing waste) or declared under section 38 (1)	The treatment of wastewater as well as the possibility of supporting local irrigation activities
Section 21 (f)	Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit	Wastewater treatment plant system (detailed information and applicability to be provided during detailed engineering studies)
Section 21 (g)	Disposing of waste in a manner which may detrimentally impact on a water resource	Potential seepage, leak, pollution from the mining operations as well as condensate and raw water dams
Section 21 (h)	Disposing in any manner of water which contains waste from, or which has been	Linked to the gasification process

Relevant water use	Description	Applicability
	heated in, any industrial or power generation process	
Section 21 (i)	Altering the bed, banks, course or characteristics of a watercourse	Working within a watercourse for the construction of UCG related linear infrastructure i.e. pipelines (water and gas), roads (main and access)
Section 21 (j)	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	Water produced during the gasification process

2.3.1 Controlled Activities

The Minister of Water and Environmental Affairs is allowed to regulated activities which have a detrimental impact on water resources by declaring them to be controlled activities. The following are considered to be controlled activities:

- Irrigation of any land with waste or water containing waste generated through any industrial activity or by a water work;
- An activity aimed at the modification of atmospheric precipitation;
- A power generation activity which alters the flow regime or a water resource;
- Intentional recharging of an aquifer with any waste or water containing waste; and
- An activity which has been declared as such under section 38.

No person may undertake a controlled activity unless such person is authorised to do so by or under the NWA. The Minister may, by notice in the Gazette, in general or specifically, declare an activity to be a controlled activity. Such notice might be for a specific activity on a specific site.

Due to the synergies between the IWULA and integrated EIA and WML processes (refer to Figure 4 overleaf) every effort will be made to combine common tasks such as public participation, stakeholder engagement etc. to avoid stakeholder fatigue with a project of this scale.

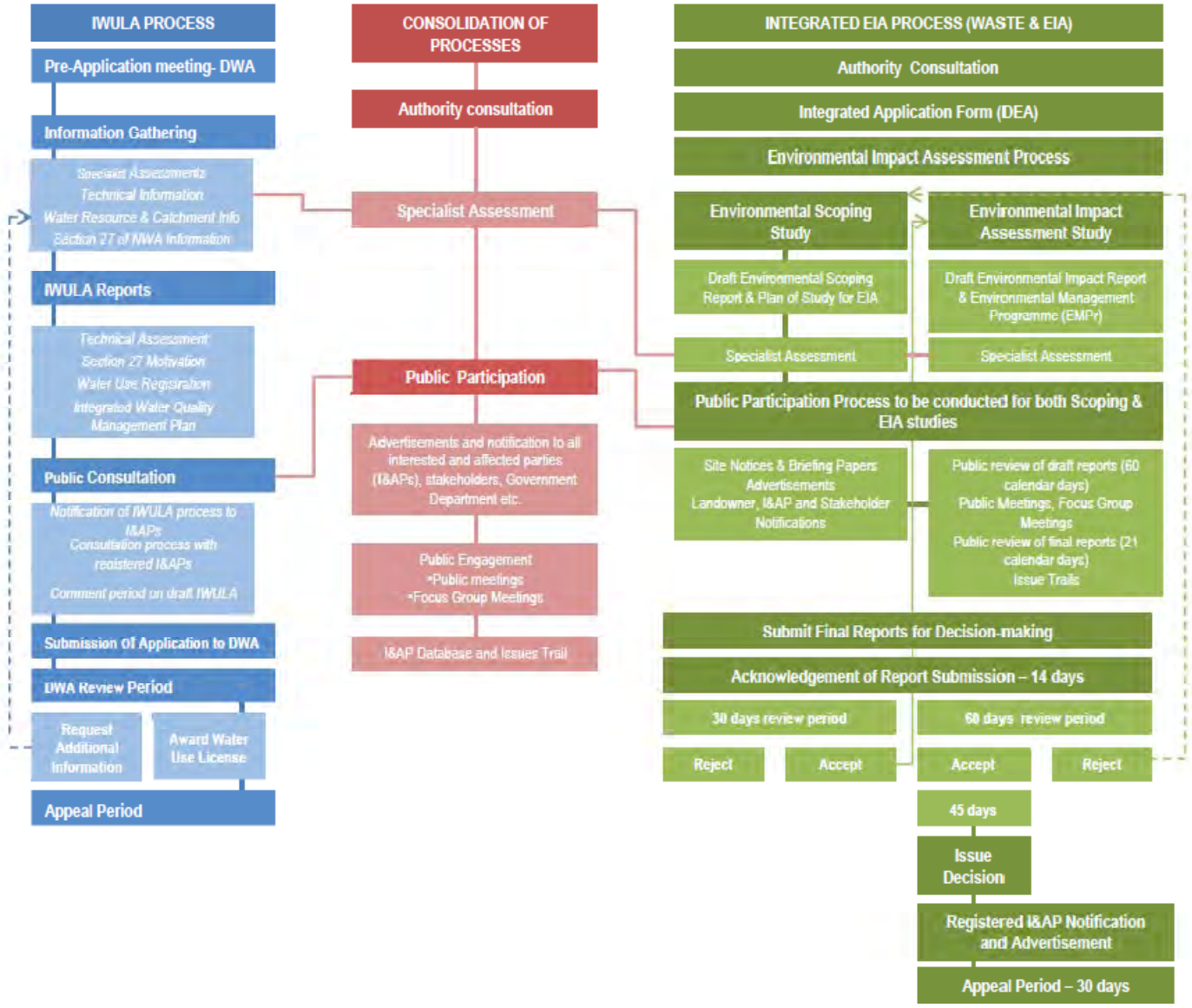

Figure 4: IWULA, EIA and waste licensing synergies

2.4 Mineral and Petroleum Resources Development Act (No 28 0f 2002)

The purposed of the Minerals and Petroleum Resources Development Act (No 28 of 2002) [MPRDA] is 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 Act is administered by the Department of Mineral Resources (DMR). The Act provides that the environmental management principles set out in the National Environmental Management Act No 107 of 1998 shall apply to all prospecting and mining operations and serve as a guideline for the interpretation, administration and implementation of the environmental requirements of the Act. Any prospecting or mining operations must be conducted in accordance with the 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 the exploitation of minerals resources serve both present and future generations.

Eskom has lodged a mining rights application in terms of Section 22 of the MPRDA with the DMR that was subsequently accepted on 11 September 2012 (*Ref MP 30/5/1/1/2/10031 MR*).

2.5 National Environmental Management: Air Quality Act (No 39 of 2004)

The National Environmental Management: Air Quality Act (No. 39 of 2004) [NEM:AQA) repeals the whole of the Air Pollution Prevention Act (No. 45 of 1965). The purpose of the Air Quality Act is to reform the law regulating air quality in order to protect the environment by providing measures for the prevention of pollution and ecological degradation, while, promoting justifiable economic and social development. The Air Quality Act seeks to provide national standards regulating air quality monitoring management and control.

NEM:AQA has shifted the approach of air quality management from source-based control to receptor-based control. The main objectives of the Act are to:

- Give effect to everyone's right 'to an environment that is not harmful to their health and well-being'
- Protect the environment by providing reasonable legislative and other measures that (i) prevent pollution and ecological degradation, (ii) promote conservation and (iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

NEM:AQA makes provision for the setting and formulation of national ambient air quality standards for 'substances or mixtures of substances which present a threat to health, well-being or the environment'. More stringent standards can be established at the provincial and local levels.

The control and management of emissions in the AQA relates to the listing of activities that are sources of emission and the issuing of emission licences. Listed activities are defined as activities which 'result in atmospheric emissions and are regarded as having a significant detrimental effect on the environment, including human health'. Listed activities have been identified by the Minister of Environmental Affairs and atmospheric emission standards have been established for each of these activities. These listed activities now require an atmospheric emission licence to operate. The issuing of emission licences for Listed Activities is the responsibility of the Metropolitan and District Municipalities.

In addition, the Minister may declare any substance contributing to air pollution as a priority pollutant. Any industries or industrial sectors that emit these priority pollutants will be required to implement a Pollution Prevention Plan. Municipalities are required to 'designate an air quality officer to be responsible for co-ordinating matters pertaining to air quality management in the Municipality'. The appointed Air Quality Officer is responsible for the issuing of atmospheric emission licences.

2.5.1 Listed Activities and Atmospheric Emission Licensing

The Air Quality Act requires all persons undertaking listed activities in terms of Section 21 of the Act to obtain an Atmospheric Emission Licence. The Listed Activities and Associated Minimum Emission Standards was issued by the Department of Environmental Affairs on 31 March 2010 (Government Gazette No 33064).

New plants must comply with the new facilities minimum emission standards on the date of publication of the Notice (i.e. 1 April 2010). Existing plants must comply with the minimum emission standards for existing plants within 5 years of the date of publication of the Notice (i.e. 31 March 2015). Existing plants must comply with minimum emission standards for new plants within 10 years of the date of publication of the Notice (i.e. 31 March 2020). In terms of regulation 6, an application can be submitted for the postponement of the compliance timeframes as set out above and the procedure to follow should a person wish to submit a postponement application.

Eskom is currently in the process of amending the Majuba Power Station Atmospheric Emissions License to also provide for an alternative fuel source (i.e. UCG gas).

2.6 National Heritage Resources Act (No 25 of 1999)

In terms of section 38 (subject to the provisions of subsections (7), (8) and (9) of the National Heritage Resources Act (No 25 of 1999) [NHRA], any person who intends to undertake a development categorised as:

- The construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length;
- The construction of a bridge or similar structure exceeding 50 m in length;
- Any development or other activity which will change the character of a site:
  - Exceeding 5000 m² in extent;
  - Involving three or more existing erven or subdivisions thereof; or
  - Involving three or more erven or divisions thereof which have been consolidated within the past five years; or
  - The costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;
- The re-zoning of a site exceeding 10000 m^2 in extent; or
- Any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority –

must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development.

The SAHRA – Mpumalanga Region is listed on the database as an interested and affected party and will be updated on the progress of the EIA study during the different phases.

2.7 National Environmental Management: Biodiversity Act (No 10 of 2004)

The project needs to comply with the National Environmental Management: Biodiversity Act (No 10 of 2004) [NEM:BA] in providing the cooperative governance in biodiversity management and conservation. Biodiversity Act provides for the Minister to publish a notice in the Government Gazette that issues norms and standards, and indicators for monitoring progress for the achievement of any of the objectives of the Act.

The NEM:BA also provides for:

- The National Biodiversity Framework
- Bioregional Plans
- Biodiversity Management Plans
- Biodiversity Management Agreements
- The identification, listing and promotion of threatened or protected ecosystems
- Alien invasive species control and enforcement

2.7.1 National Spatial Biodiversity Assessment (2004)

This informs the policies, plans and day to day activities of a wide range of sectors both public and private. A spatial biodiversity assessment can take place at different spatial scales, from global to local. It involves mapping information about biodiversity features such as species, habitats and ecological processes, protected areas and current and future patterns of land and resource use. It provides a national context for assessments at the sub national scale and points to broad priority areas where further investigation, planning and action are warranted.

It identifies three keys strategies for conserving South Africa's biodiversity existence from the assessment, namely:

- Pursuing opportunities to link biodiversity and socio-economic development in priority geographic areas;
- Focusing on emergency action on threatened ecosystems, to prevent further loss of ecosystem functioning; and
- Expanding of the protected area network.

The ***Mpumalanga Biodiversity Conservation Plan (2007)*** provides a finer scale biodiversity assessment at a provincial level. Any biodiversity prioritisation or projects should take account of the provincial plan and the guidance it provides.

2.8 Other Legislative Requirements

Table 8: Legislative requirements in terms of other Acts, Policies and Plans

Legislation	Relevant Sections	Relates to
The Conservation for Agricultural Resources Act (No 43 o 1983) and Regulations	Section 6	**Implementation of control measures for alien and invasive plant species.**
National Forests Act (No 84 of 1998) and Regulations	Section 7 Sections12-16	**No person may cut, disturb, damage or destroy any indigenous, living tree in a natural forest, except in terms of a licence issued under section 7(4) or section 23; or an exemption from the provisions of this subsection published by the Minister in the Gazette.** **These sections deal with protected trees, with the Minister having the power to declare a particular tree, a group of trees, a particular woodland, or trees belonging to a certain species, to be a protected tree, group of trees, woodland or species. In terms of section 15, no person may cut, disturb, damage, destroy or remove any protected tree; or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire of dispose of any protected tree, except**

Legislation	Relevant Sections	Relates to
		under a licence granted by the Minister.
Fencing Act (No 31 of 1963)	Section 17	**Any person erecting a boundary fence may clean any bush along the line of the fence up to 1.5 meters on each side thereof and remove any tree standing in the immediate line of the fence. However, this provision must be read in conjunction with the environmental legal provisions relevant to protection of flora.**
Occupational Health and Safety Act (No 85 of 1993) and Regulations	Section 8 Section 9	**General duties of employers to their employees.** **General duties of employers and self employed persons to person other than their employees.**
Hazardous Substance Act (No 15 of 1973) and Regulations		**Provides for the definition, classification, use, operation, modification, disposal or dumping of hazardous substances.**
Mine Health and Safety Act (No 29 of 1996)	Chapter 2 Chapter 8	**Health and safety at mines.** **General provisions.**
Mpumalanga Biodiversity Conservation Plan (2007)		
Road Transportation Act (No 74 of 1977)		
Mpumalanga Roads Act (No 1 of 2008)		
Gert Sibande District Municipality Spatial Development Framework (2009)		
Gert Sibande District Integrated Development Plan 2011/12 and 2013/14		
Pixley ka Seme Local Municipality Integrated Development Plan 2009 - 2012		
Pixley ka Seme Local Municipality Spatial Development Framework (2011)		
Other Local Municipality Bylaws		

3 PROJECT DESCRIPTION

3.1 The UCG Process Principles

The Underground Coal Gasification (UCG) theory was developed in the former U.S.S.R. and is based on the principle of combusting coal to produce a synthesis gas, without the removal of the coal. The coal to gas conversion process is a controlled combustion process which is kept deep underground therefore minimising the impact of the operations.

The UCG pilot plant will provide for an initial generating capacity of approximately 6 MWe, which is sufficient to co-fire a single burner at the Majuba Power Station (refer to Table 9). Pending the success of Phase 1B gas production will be scaled up to 70000 Nm^3/hr to eventually produce 28 MWe.

Table 9: Gas production and generating capacity during the UCG project phases

Project Phase	Coal Consumption Total tons	Gas Flow Nm^3/hour	MWe
1A & 1B	5.4 tons/hr	15000	6
1C	25 tons/hr	70000	28

Due to the nature of the technology, the Underground Coal Gasification pilot plant will comprise a vast number of activities. A basic flow diagram for the entire process is presented in Figure 5.

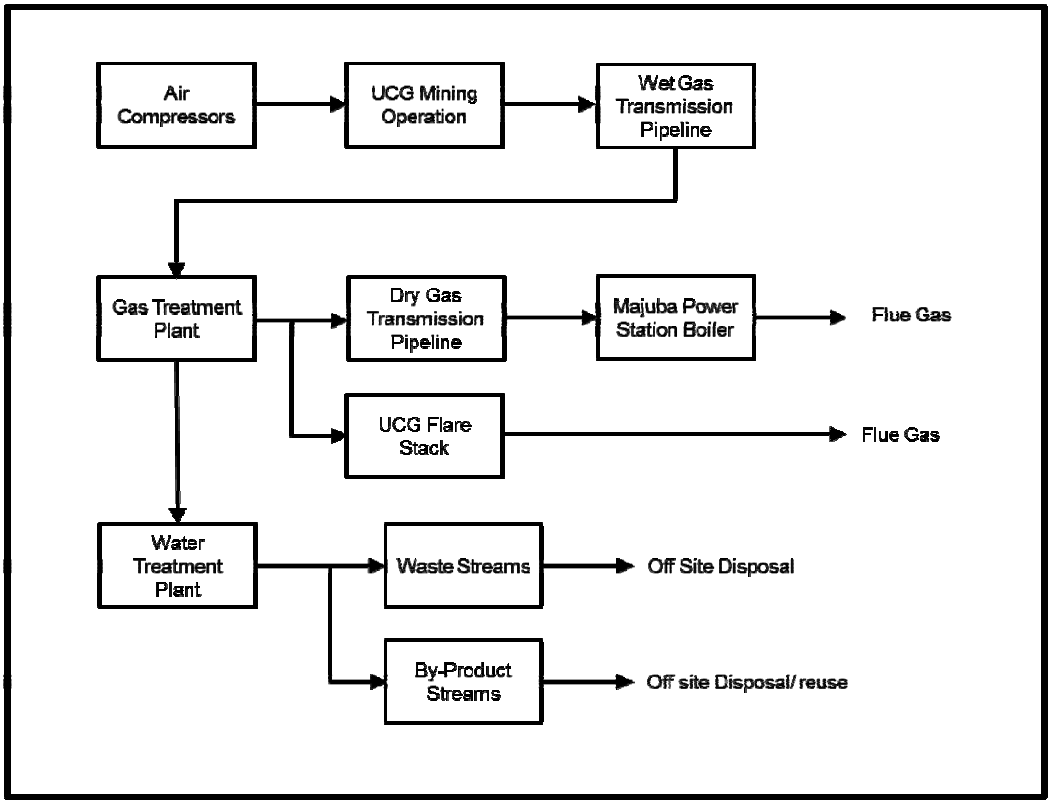

Figure 5: Block flow diagram for the 70000 Nm^3/hr pilot plant

3.1.1 Air Compressors and Mining Operation

The UCG technology is based on the injection of compressed air (10 bar gauge) provided by large stand-alone air compressors into the coal seam (approximately 280 – 300 m deep). Four (4) compressors will initially be installed although provision for a fifth will be made in the site layout. Three compressor units will operate continuously, 24 hours/day.

The main chemical reactions occurring in the underground gasifier are as follows:

Combustion Reactions:		
$C_{(s)} + ½\ O_2 \rightarrow CO_{(g)}$	-111 MJ/kmol	1
$CO_{(s)} + ½\ O_{2(g)} \rightarrow CO_{2(g)}$	-283 MJ/kmol	2
$C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$	-394 MJ/kmol	3
$H_2 + ½\ O_{2(g)} \rightarrow H_{2(l)}$	-286 MJ/kmol	4
The Boudouard Reaction		
$CO_{2(g)} + C_{(s)} \rightarrow 2\ CO_{(g)}$	+ 172 MJ/kmol	5
The Water Gas Reaction		
$C_{(s)} + H_2O_{(g)} \rightarrow CO_{(g)} + H_{2(g)}$	+ 131 MJ/kmol	6
The Methanation Reaction		
$C_{(s)} + 2H_{2(g)} \rightarrow CH_{4(g)}$	-41 MJ/kmol	7

In addition to the above there are a number of homogeneous reactions which occur; these reactions determine the overall syngas composition produced from the gasifier.

Homogeneous Reactions:		
$CO_{(g)} + H_2O_{(g)} \leftrightarrow H_{2(g)} + CO_{2(g)}$	-41 MJ/kmol	1
$CH_{4(g)} + H_2O_{(g)} \leftrightarrow 3H_{2(g)} + CO_{(g)}$	+206 MJ/kmol	2
$CH_{4(g)} + 2O_{2(g)} \leftrightarrow CO_{2(g)} + 2H_2O_{(g)}$	-803 MJ/kmol	3
$Ch_{4(g)} + ½\ O2_{(g)} \leftrightarrow CO_{(g)} + 2H_{2(g)}$	-36 MJ/kmol	4

The above reactions result in the consumption and conversion of the in-seam coal into a syngas which has an estimated composition as displayed in Table 10. Due to the utilisation of coal, the boundaries of the underground reactor continue to grow until such point at which the system is no longer capable of generating a gas of suitable quality. At this stage the specific system is decommissioned and the mine field then proceeds to the next section of available coal.

The gasification reaction displayed above represent the main reactions which occur, there are a number of other minor reactions which result in the formation of various organic and inorganic trace components in the gas. Of the trace components of interest the main compounds are hydrogen sulphide (H_2S), ammonia (NH_3), phenolic compounds, tars and waxes.

Table 10: UCG pilot plant gas specification

Component	Formula	Minimum Vol%	Optimum Vol%	Maximum Vol%
Methane	CH_4	2.800	3.500	4.500
Ethane	C_2H_6	0.100	0.100	0.100
Propane	C_3H_8	0.050	0.050	0.050
Butane	C_4H_{10}	0.000	0.000	0.000
Pentane	C_5H_{12}	0.000	0.000	0.000
Carbon Monoxide	CO	7.000	9.500	11.000
Hydrogen	H	14.000	15.500	18.000
Hydrogen Sulphide	H_2S	0.200	0.200	0.200
Oxygen	O_2	0.200	0.200	0.200
Water	H_2	5.000	5.000	5.000
Ammonia	NH_3	0.100	0.100	0.100
Nitrogen	N_2	51.950	48.750	44.250
Argon	Ar	0.100	0.100	0.100
Carbon Dioxide	CO_2	18.500	17.000	16.500
Total		**100.000**	**100.000**	**100.00**
LHV [MJ/Nm^3]		**3.554**	**4.283**	**5.100**

The gasification process also produces a condensate (liquid) stream which is primarily composed of water. The condensate does however contain a small fraction of organic and inorganic impurities which are displayed in the condensate specification table (Table 11).

Table 11: UCG pilot condensate specification

Description	Minimum	Maximum	Unit
Total Solids per Nm^3	5	40	mg/Nm^3
Total Liquids per Nm^3 gas	25	75	g/Nm^3
ORGANICS			
Benzene	10	22.5	mg/Nm^3
Toluene	1	4.25	mg/Nm^3
m, p - & o-Xylene	0.5	1.25	mg/Nm^3
Naphthalene	10	36.25	mg/Nm^3
Phenol	2000	4000	mg/Nm^3
2-Methylphenol	100	275	mg/Nm^3
4-Methylphenol	200	775	mg/Nm^3
Other Organics	10	50	mg/Nm^3
Ammonia	300	1000	mg/Nm^3
CATIONS and ANIONS			
Ag		<0.01	mg/Nm^3
Al		0.0168	mg/Nm^3
As		0.468	mg/Nm^3
B		0.852	mg/Nm^3
Ba		0.0176	mg/Nm^3

Description	Minimum	Maximum	Unit
Be		<0.01	mg/Nm^3
Bi		<0.01	mg/Nm^3
Ca		0.306	mg/Nm^3
Cd		<0.01	mg/Nm^3
Co		<0.01	mg/Nm^3
Cr		0.0554	mg/Nm^3
Cu		0.1132	mg/Nm^3
Fe		<0.01	mg/Nm^3
Hg		0.015	mg/Nm^3
K		0.302	mg/Nm^3
Li		<0.01	mg/Nm^3
Mg		<0.01	mg/Nm^3
Mn		<0.01	mg/Nm^3
Mo		<0.01	mg/Nm^3
Na		1.754	mg/Nm^3
Ni		0.0368	mg/Nm^3
P		0.0948	mg/Nm^3
Pb		0.0374	mg/Nm^3
S		15	mg/Nm^3
Sb		0.0696	mg/Nm^3
Se		0.316	mg/Nm^3
Si		0.208	mg/Nm^3
Sr		<0.01	mg/Nm^3
Ti		<0.01	mg/Nm^3
Tl		0.1788	mg/Nm^3
V		<0.01	mg/Nm^3
Zn		0.1936	mg/Nm^3
F		0.924	mg/Nm^3
Cl		130	mg/Nm^3
NO_2		<0.01	mg/Nm^3
NO_3		0.05	mg/Nm^3
PO_4		0.05	mg/Nm^3
SO_4		0.3	mg/Nm^3

The solid portion of the condensate specification includes the tars, waxes and unconverted coal and ash particulates.

The UCG process remains primarily a mining operation and the key components of the mining operation include the drilling, exploration and monitoring wells – also referred to as the gasfield (Photograph 1). The gasfield contains two major components namely the gasifier units and ancillary infrastructure such as access roads, pipelines, manifolds etc. The continuous linkage of wells in the gasifier enables the process to access virgin coal and the monitoring and modelling of the geohydrological, rock mechanics and geological characteristics of the targeted coal seam.

Photograph 1: Representation of a gasfield as seen on the surface[1]

The implementation of gasifier units will be based on the gas input requirements for Phase 1B and 1C (production of 15000 and 70000 Nm^3/hr of syngas respectively). The gasifier unit has an approximate footprint of 50 ha with a maximum height of 15 m and will be operated independently from one another in order to control the gasification processes. A typical gasifier unit is made up of the following components:

- Above-ground air pipeline
- A network of above ground primary gas pipelines
- A secondary gas pipeline located at the border of the gasification unit
- Injection and production wells
- Water monitoring wells
- Air pressure unit
- Pressure measurement units
- One lane gravel assess road
- Wastewater pipeline

The gasifier units will be located across portions of the farm Roodekopjes 67HS (Portions 1, 2, 3 and remaining extent). At this stage it is anticipated that nine (9) gasifier units will be established as part of the mining operations on the farm Roodekopjes 67HS. Preliminary designs for gasifier unit 1 – 3 have been developed (Figure 6), although at present only one gasifier (constructed under the auspices of the prospecting right) is operational. The layouts for all future gasifier units will be similar to the layout of gasifier units 1 – 3. Gasifier unit 1 will soon be decommissioned as the underlying coal reserves have been gasified and gasifier unit 2 will be commissioned.

[1] Courtesy of Ergo Exergy Technologies Inc, Canada.

Figure 6: Preliminary layout for gasifiers 1 - 3

Each gasifier unit will have a production lifetime of approximately 7 – 8 years. The operational lifecycle of a gasifier is dependent on the underlying coal seam thickness and composition. The complete lifecycle for a typical gasifier unit is presented in Table 12.

Table 12: Lifecycle of a gasifier unit

Development Stage	Tasks
Pre-Construction Phase	• Identification of a feasible location for the gasifier unit • Detail designing of the gasifier unit and its operational requirements
Construction Phase	• Marking of gasifier unit footprint and location of wells • Construction of a gravel access road to the gasifier unit from the main infrastructure corridor • Drilling of well structures to the underlying coal seam by using a specialised drilling machine • Securing all wells by inserting a steel lining from the surface of the well to the coal seam and sealing it with concrete • Secure all surface pipelines and test for leakages • Secure all additional infrastructure including the air compressor and water monitoring boreholes
Operational Phase	• Commission the gasifier by commencing the sub-surface gasification reaction through high pressure air injection • Operate gasifier through a series of pipelines and pressure units • Syngas to be transported via primary, secondary, and tertiary gas pipelines to the Gas Treatment Plant • Ongoing groundwater monitoring
Decommissioning Phase	• Depleted underlying coal reserves will give effect to the decommissioning of a gasifier unit and the commissioning of another gasifier unit

Development Stage	Tasks
	• Decommission the gasifier and gasification process by closing all injection wells • Seal wells with concrete mixture • Remove all surface infrastructure • Rehabilitate and re-vegetate all disturbed areas • Ongoing groundwater monitoring

3.1.2 Gas Treatment and Surface Plant Infrastructure

Once produced, the syngas is brought to surface through the production wells, the gas is diverted to a common manifold which feeds the wet gas transmission pipeline. This 600 mm pipeline is also accompanied by a 50 mm condensate line which returns condensate collected along the pipeline. The wet gas pipeline feeds the gas treatment plant. A simplified gas treatment plant (GTP) is commissioned and is currently operating at the UCG facility. The extent of the GTP is approximately 30 m x 60 m and consists of the following components:

- Heat exchanger – cooling towers
- Liquid separation vessels
- Emergency gas flare stack – approximate height of 9 m
- Auxiliary pumps, motors and other small equipment

As displayed in Figure 5, the gas treatment plant removes the liquid portion present in the gas and supplies a further dry gas transmission pipeline with dry gas. This dry gas is either piped to the Majuba Power Station for combustion along with coal or it is flared on site if the boiler is unavailable.

The resulting flue gas emissions from the flaring and or co-firing of gas are presented in Table 13.

Table 13: Flue gas emission estimates for UCG project

Component	Estimated Emissions [mg/Nm^3] at 10% O_2 and 101.325 kPa – Dry Basis
Carbon Monoxide (CO)	1024
Hydrogen Sulphide (H_2S)	17
Ammonia (NH_3)	10
Sulphur Dioxide (SO_2)	1596
Oxides of Nitrogen	942
Volatile Organic Compounds	226
Particulate Matter	<50

**These estimates are based on chemical combustion modelling and will be verified during actual operations*

The total expected annual tonnage of these emissions for the 70000 Nm^3/hr pilot plant are presented in Table 14.

Table 14: Total tonnage of regulated flue gas components

Component	Estimated Emissions [tons/annum]
Carbon Monoxide (CO)	1572
Hydrogen Sulphide (H_2S)	36

Component	Estimated Emissions [tons/annum]
Ammonia (NH_3)	21
Sulphur Dioxide (SO_2)	3240
Oxides of Nitrogen (NO_x)	1818
Volatile Organic Compounds	458
Particulate Matter	246

**These estimates are based on chemical combustion modelling and will be verified during actual operations.*

3.2 Water Storage

3.2.1 Process Water Dam

The condensate recovered from the gas treatment plant and gas pipeline is pumped into a process water dam. (12000 m^3 in size). The dam is lined and has monitoring wells in place to provide an early warning system. This dam is within the gasifier unit 1 footprint (refer to **Appendix B**). UCG condensate from gasifier unit 1 is currently piped to this dam. Once gasifier unit 2 is in operation, the condensate will also be routed to this dam.

At the 70000 Nm^3/hr gas production scale, the expected quantity of condensate produced is 46000 m^3 per annum. The condensate will be treated to a quality suitable to either:

a) Support local irrigation activities
b) Re-inject the water into the coal seam aquifer
c) Purify to Majuba Raw water quality requirements

As a safety precaution, a dam with sufficient capacity will be constructed in order to cater for- and down-time of the water treatment plant. Dependant on the final destination for the wastewater, the treatment of the condensate will have various levels of unit operations. It is envisaged that for the option of supplying the water for irrigation purposes, the plant will consist of solid sludge filtration, followed by the removal of organic compounds with the use of activated carbon. The resulting largely organic free condensate will pass through a micro-filtration unit after which it will be made available for irrigation purposes.

In addition to the above there are a number of other options for the treatment of the condensate, the main trace elements which require removal are the cations, the ammonia/ phenols and the brine. These water treatment systems can be added on to the basic system in order to meet higher levels of water purification. Figure 7 depicts the flow diagram for the water treatment circuit and indicates the options available to achieve higher levels of water purification.

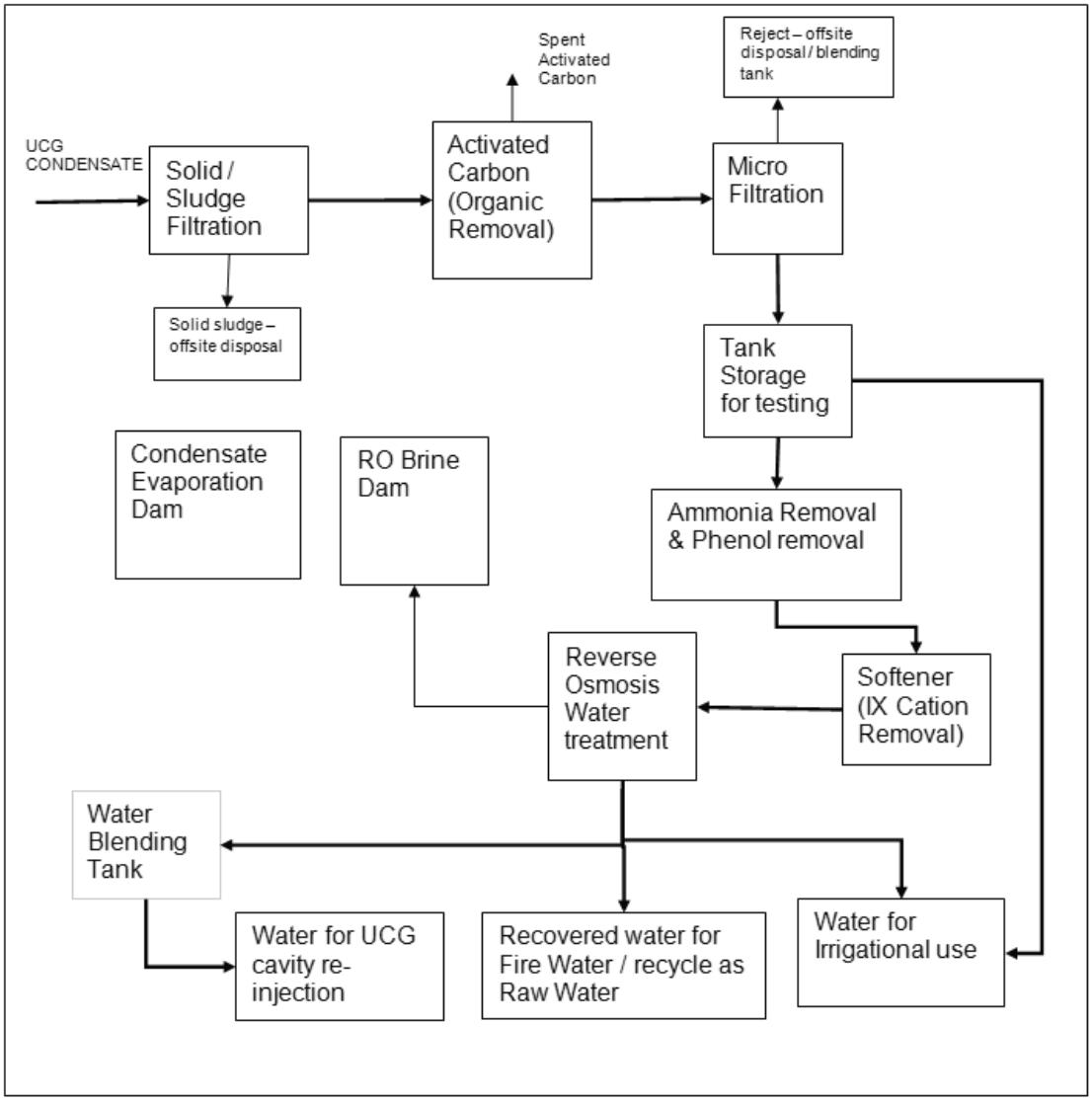

Figure 7: Water treatment plant system

3.2.2 Raw Water Dam

A raw water dam (approximately 1.2 million litres in size) is also situated in the gasifier unit 1 footprint between the offices and control rooms and the compressor station. The raw water contained in this dam is not being utilised for any gasification-related processes.

3.2.3 Water Tanks

Two potable water tanks (approximately 10000 litres in combined size) are located within the footprint of the gas treatment plant. The water from these tanks is used in the gas treatment plant cooling tower circuit (process cooling water make-up). The water is sourced from the Majuba Power Station.

3.3 Waste Streams from the UCG Process

The waste and by-product streams produced by the UCG operations include:

Table 15: Waste streams and by-products produced by the UCG operations

Waste Stream	Quantity	Proposed Handling
UCG condensate	Currently the wastewater generated is disposed off-site as and when required. 1281 m^3 thus far (Based on 30.5 m^3/truck, 42 trucks) *Ad-Hoc*	Treatment off site – Enbitec (Order No: 3070034490)
Brine	3 g per litre @ 46000 m^3	The brine will be disposed off site *via* a contractor to a registered disposal site
Treated wastewater effluent	18 500 m^3/annum at 15 000 Nm^3/hr of gas 86 000 m^3/annum at 70 000 Nm^3/hr of gas	Treated wastewater will be utilised for irrigation purposes at 15 000 Nm3/hr operation At 70 000 Nm^3/hr operations, the wastewater will be either re-injected into the coal seam aquifer or purified to raw water quality and supplied to Majuba Power Station
Flue gas from flaring	190 tons/hr	Flare Stack or Majuba Power Station exhaust stack
Solid sludge and particulates	3 tons per month	The solid sludge waste will be disposed off site *via* a contractor to a registered disposal site
Spent activated carbon	8400 tons/annum	At this stage of the project it is likely that the spent activated carbon will be re-generated off site and reused. The quantity of activated carbon that can be regenerated still requires investigation and therefore there will likely be a activated carbon waste associated with this regeneration process.

3.4 Other Infrastructure

Additional infrastructure includes all the components associated with UCG operations but not specifically associated with one of the major operating sections of the plant. Due to the existing pilot plant operations, Eskom has partly developed infrastructure that will be discussed in Table 16 below:

Table 16: Existing infrastructure associated with the UCG pilot plant operations

Infrastructure	Description	Expansion or Decommissioning
Internal Access Roads	• Internal gravel access roads that are lined with agglomerated stones or brick. • Used to access existing infrastructure associated with UCG pilot plant.	
Site Offices	There are two existing site office locations at the UCG site. • Site office 1 is an old farmhouse that was refurbished as offices. Additional workshops were constructed at	All site offices and associated workshop facilities will remain in operation during Phase 1A, 1B and

Infrastructure	Description	Expansion or Decommissioning
	site office 1 for storage of operating machinery and vehicles. • The existing mining offices on the farm Bergvliet 65HS (portion 21) have been also been converted into site offices – indicated as Site Offices 2 in Figure 8. In the 1990s underground mining activities commenced on the farm Bergvliet 65HS. After a few years, the mine was closed due to the quality of the existing coal seam as well as mining difficulties. Eskom purchased the existing infrastructure including the offices, workshops and Waste Water Treatment Works (WWTW).	1C.
10 m³ per day Waste Water Treatment Works (WWTW)	The existing WWTW are located adjacent to Site offices 2, indicated in Figure 8. The WWTW was constructed as part of the mining operations during the 1990s. The WWTW is used for the treatment of sewage from Site offices 2 and associated employee quarters located on the site.	The WWTW will remain in operation during Phases 1A – 1C.
Site Access and Security	Eskom requires strict site and security access at all power generation facilities. The same access and security points are implemented at the UCG pilot plant site.	Site and security access points will be kept in place for the duration of Phases 1A – 1C.
Above ground fuel storage tanks	Existing 51 m³ fuel storage tanks are located at the UCG site. The tanks provide fuel for vehicles and machinery.	The existing fuel tank capacities may be increased depending on the supply needed for the subsequent project phases i.e. Phase 1C and commercial CCGT.

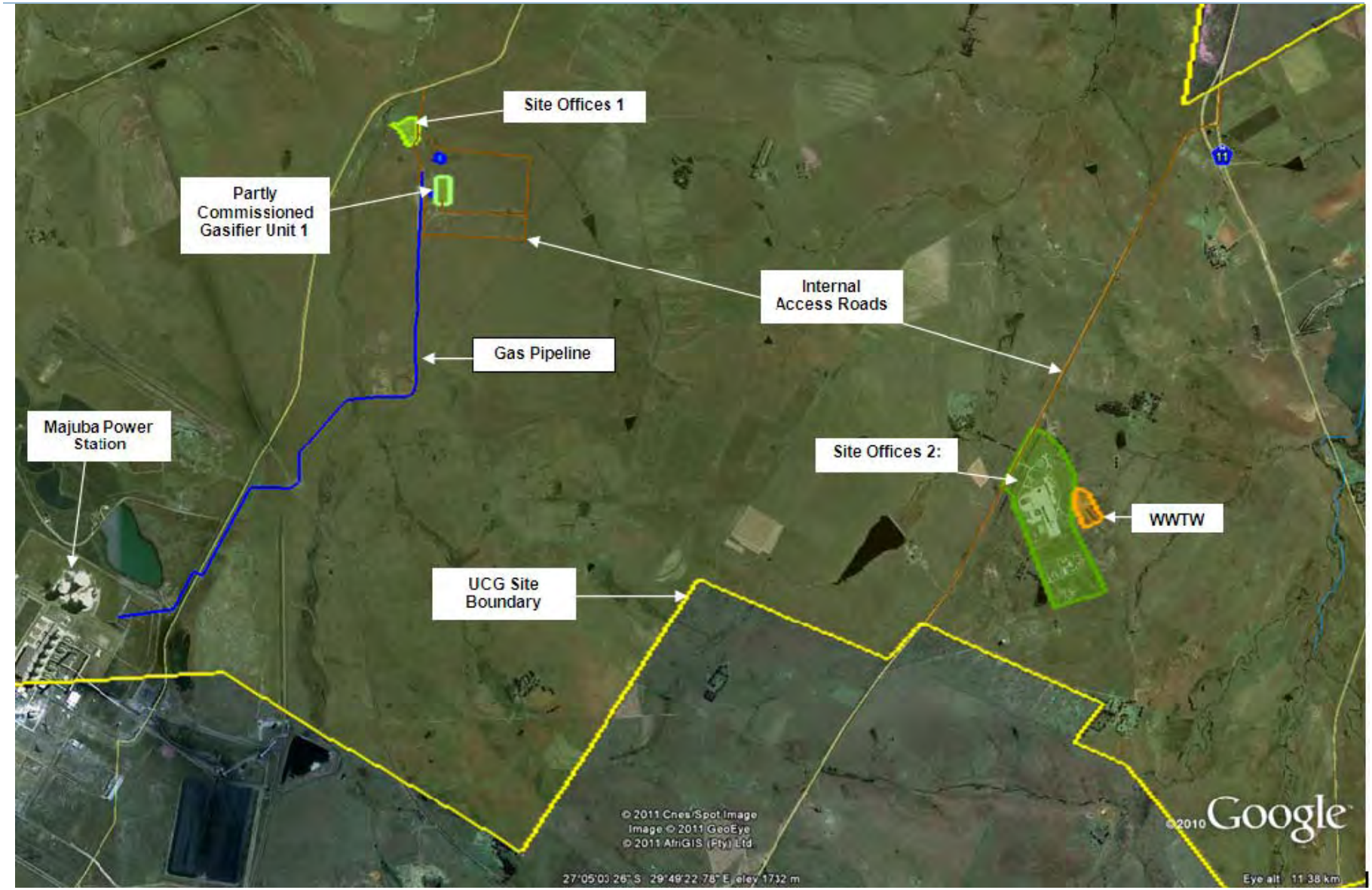

Figure 8: Existing infrastructure associated with the UCG operations

3.4.1 Internal Access Road Network

Internal access roads will be constructed in order to provide access to the development areas, in accordance with Eskom's phased development approach for UCG. A description of the internal road infrastructure is presented in Table 17 below:

Table 17: Internal road infrastructure

Road Type	Characteristics of the Road and Associated Road Reserve
Primary Road	A new service road will be constructed from the Site Offices 2 (farm Bergvliet 65 HS) to the site of the gas treatment plant (see Figure 1 – Locality Map).
Secondary Roads	One lane gravel road surface lined with agglomerated stone or brick. Roads will be located between the primary access roads and specific infrastructure components such as a gasifier unit. Secondary roads will be decommissioned when required or if the road is no longer in use.
Tertiary Roads	One lane gravel roads for internal access within the footprint of infrastructure components such as internal roads within the gasifier unit and gas treatment plant. Roads will be decommissioned if the associated infrastructure is decommissioned by Eskom, for the specific phase of the development.
Bridges associated with Watercourse Crossings	Any bridge structure will be designed in such a manner to allow for adequate surface water flow and speed without causing additional erosion. All watercourse crossings will be authorised under the Integrated Water Use License for UCG operations.
Fire Breaks	Fire breaks will be constructed around all existing operating infrastructure in order to protect the infrastructure against nature grassland fires. The fire breaks will have a width of 50 meters and be clearly marked on all site layout maps.

3.4.2 Electrical Infrastructure

Bergvliet sub-station is an existing 88 kV to 22 kV substation owned by Eskom Distribution. From this substation the UCG project has had a 22 kV power line installed by Eskom Distribution along the servitude of the old coal conveyor from the Majuba Colliery to Majuba Power Station. This power line runs past the site of the Gas Treatment Plant where there are three take off points. From here, it runs to the gas field where there is a take-off point to the compressor plant and the control room. The line then continues to the existing farmhouse that is used as the site office, workshops and stores.

Along the north of the site is the servitude for the Ermelo to Majuba Power Station rail line. Within this servitude there will be an 88 kV power line supplying the traction substations for the rail. There will be two 88 kV power lines from this line forming a turn-in to the proposed High Voltage Yard to be built at the gas turbine generating set.

Refer to **Appendix C** for a layout of the electrical infrastructure.

4 PROJECT ALTERNATIVES

In terms of the EIA Regulations, Section 28 (1)(c) feasible alternatives are required to be considered as part of the environmental investigations. In addition, the obligation that alternatives are investigated is also a requirement of Section 24(4) of the National Environmental Management Act (No 107 of 1998) (as amended). An alternative in relation to a proposed activity refers to the different means of meeting the general purpose and requirements of the activity (as defined in Government Notice R.543 of the EIA Regulations, 2010), which may include alternatives 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.

4.1 Do-nothing Alternative

Electricity cannot be stored in large quantities and must be used as it is generated. Therefore, electricity must be generated in accordance with supply-demand requirements. The demand for electricity in South Africa is currently growing. This growing electricity demand is placing increasing pressure on Eskom's existing power generation capacity. South Africa is expected to require additional peaking capacity (i.e. times of peak demand for electricity) and base-load capacity in the medium- to long-term, depending on the average growth rate. This has put pressure on the existing installed capacity to be able to meet the energy demands into the future, particularly during peak electricity demand times.

South Africa is endowed with 32 billion tons of coal reserves, which are rated as economically extractable, and a further 160 billion tons of coal resources, which are judged uneconomic to mine. Until fairly recently, there was little prospect of exploiting this enormous pent-up energy potential.

UCG technology could potentially unlock this energy resource, which was developed commercially in the former Soviet Union and is now being tested locally. The UCG process has been commercially proven on several sites in the former Soviet Union, and a pilot plant operated successfully from 1999 to 2003 in Chinchilla, in Australia. Moreover, the UCG technology in combination with a combined cycle power station will:

- Increase the overall resource utilisation efficiency (Figure 9) especially when the gas is used for power generation in a combined cycle power station. UCG as a mining technology also effectively extends South Africa's coal reserves, by allowing the extraction of coal previously disregarded as being unmineable.
- Enables Eskom to position new coal generating plant far more strategically, to support demand side needs and stabilise the transmission network through the broader geographic availability of coal suitable for UCG.
- Increase Eskom's operational flexibility and efficiency, by allowing the coal mine and power station to effectively integrate.
- On a large scale, offers the opportunity to reduce the cost of electricity from new coal-based power stations. It achieves this through an inherently simpler mining process, and a shorter resource-to-electricity production supply chain.
- The UCG technology is modular, and Eskom has already pioneered the basis of the first module. The modularity, availability and relative simplicity of major plant components enables faster lead times than for conventional coal plants.

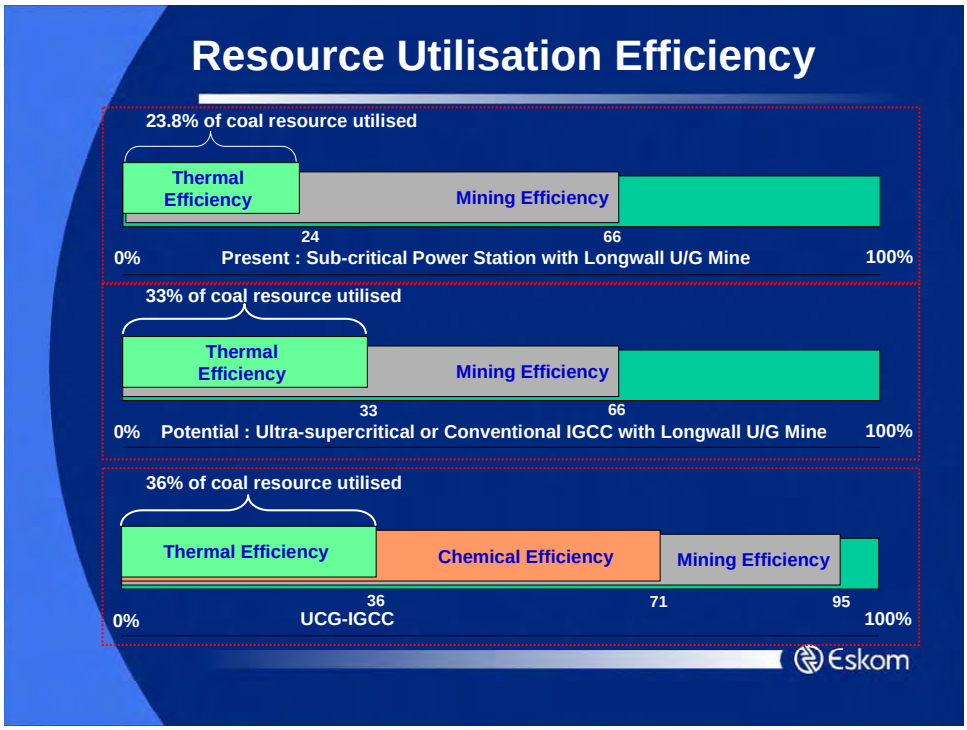

Figure 9: Resource utilisation efficiency

The "do-nothing" option will contribute to Eskom not being able to fulfil its mandate to promote the energy mix and meet the projected growth in demand for electricity. This has serious short to medium-term implications for socio-economic development in South Africa.

4.2 Gasfield Alternatives

There are two proposed alternatives associated with the implementation of UCG technology:

4.2.1 Location of Gasfield Alternative 1 (Preferred)

The location of the gasfield in Alternative 1 will consist of pre-determined gasfield compartments, as indicated in the mining plan attached as **Appendix D**, within the farm Roodekopjes 67HS (Portions 1, 2, 3 and remaining extent). The gasfield compartments have a physical footprint of 700 ha (nine blocks of approximately 50 ha each). The environmental impact process will assess the social, economical and physical environmental feasibility of the proposed alternatives in detail during the EIA study.

4.2.2 Location of Gasfield Alternative 2

The proposed location of the gasfield in Alternative 1 will consist of 1450 ha gasfield compartments located within the farm Roodekopjes 67HS (Portions 1, 2, 3 and remaining extent) – **Appendix D**. The environmental impact process will assess the social, economical and physical environmental feasibility of the proposed alternatives in detail during the EIA study.

4.3 Water Treatment Alternatives

As indicated in Section 3.2, there are a number of options for the treatment of condensate that will be described as assessed in detail in the EIA study. To reiterate, the condensate will be treated to a quality suitable to either:

4.3.1 Irrigation Activities

It is envisaged that for the option of supplying the water for irrigation purposes, the plant will consist of solid sludge filtration, followed by the removal of organic compounds with the use of activated carbon. The resulting largely organic free condensate will pass through a micro-filtration unit after which it will be made available for irrigation purposes on site.

4.3.2 Re-injection of Water into the Coal Seam Aquifer

The main trace elements which require removal are the cations, the ammonia / phenol and brine. The brine can be directed to the Reverse Osmosis brine dam after being treated at the Reverse Osmosis treatment plant. The treated water from the Reverse Osmosis plant can then be re-injected into the UCG cavity.

4.3.3 Purification to Majuba Raw Water Quality Requirements

The treated water can be further purified to Majuba Power Station raw water quality requirements or for use as fire water.

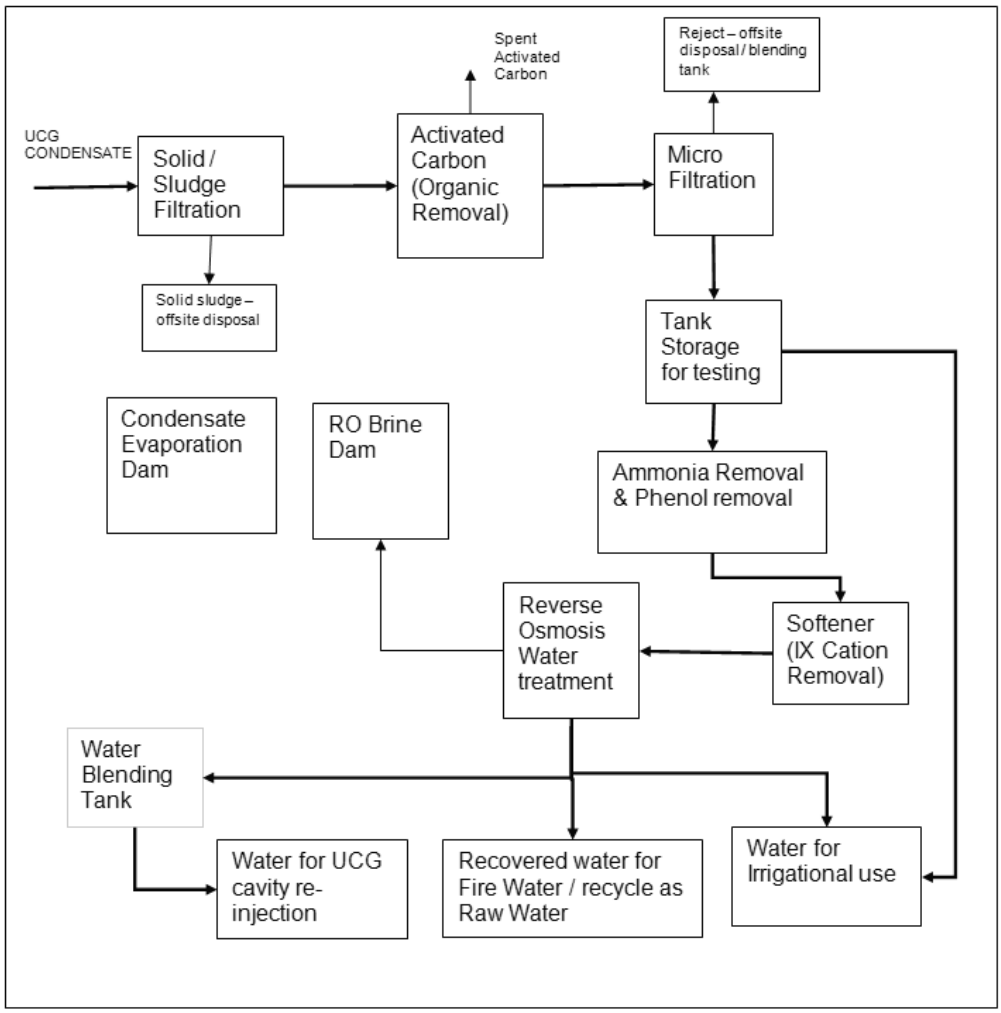

Figure 10: Water treatment options

5 PUBLIC AND STAKEHOLDER PARTICIPATION

One of the general objectives of integrated environmental management laid down in Section 23(2)(d) of NEMA is to "ensure adequate and appropriate opportunity for public participation in decisions that may affect the environment". An inadequate and non-transparent public participation process (PPP) has the potential to provide a negative decision and perception regarding the proposed project.

The EIA Regulations (2010) places a lot of emphasis on the public participation process and have been revised to contain comprehensive guidelines to involve the public in the EIA study.

The primary aims of the public participation process include:

- Meaningful and timeous participation of interested and affected parties (I&APs);
- Identification of issues and concerns of key stakeholders and I&APs with regards to the proposed development, i.e. focus on important issues;
- Promotion of transparency and an understanding of the proposed project and its potential environmental (social and biophysical) impacts;
- Accountability for information used for decision-making;
- Serving as a structure for liaison and communication with I&APs;
- Assisting in identifying potential environmental (social and biophysical) impacts associated with the proposed development; and
- Inclusivity (the needs, interests and values of I&APs must be considered in the decision-making process).

The minimum requirements for public participation as contained in Chapter 6 of the EIA Regulations (2010) are contained hereunder and are discussed in detail in subsequent sections:

Public Participation Requirements according to Section 54 - 57 of GN R 543	Specific Actions to Ensure Compliance
Section 54 (2) (b) – The person conducting a public participation process must give written notice to the owner or person in control of that land if the owner is not the owner or person in control of the land; owners and occupiers of land adjacent to the site municipal councilor; municipality; organ of state having jurisdiction and any other party required by the competent authority.	Compile introductory letters to owners, adjacent landowners, municipal councilor, municipality and organ of state.
Section 54 (2) (a) – Fix a notice board at the site boundary or any alternative site applicable to the application	The notice board accordingly? must – (a) give details of the application subject to public participation (b) state – i. that the application has been submitted to the CA ii. whether basic assessment or scoping procedures are being applied for iii. the nature and location of the activity to which the application relates iv. where further information on the application or activity can be obtained v. the manner in which and the person to whom representation in respect of the application may be made The notice board must be – (a) Of a size of at least 60cm by 42cm (b) Display the required information in lettering and format

Public Participation Requirements according to Section 54 - 57 of GN R 543	Specific Actions to Ensure Compliance
Section 54 (2) (c) & (d) – Place an advert in one local newspaper or official *Gazette* and or placing an advertisement in at least one provincial newspaper or national newspaper, if the activity has or may have an impact that extends beyond the boundaries of the metropolitan or local municipality.	An advert will be placed in the local newspaper/s and any other paper decided by the applicant to advertise the availability of the draft ESR and EIR for review and public meetings as well advertising the environmental authorisation.
Section 55 (1) – An EAP managing a application must open and maintain a register which contains the names, contact details and addresses of – (a) **All persons who as a consequence of the PPP have submitted written comments or attended meetings** (b) **All persons after completion of the PPP have requested in writing their names to be placed on a register** (c) **All organs of state which have jurisdiction in respect of the application.**	Comprehensive I&AP database/register will be opened and maintained.
Section 56 (1) a registered interested and affected party (I&AP) is entitled to comment, in writing, on all written submissions; including draft reports made to the CA within the timeframes that have been set by the CA or any extension of a timeframe agreed to by the EAP or applicant.	According to Section 56 (8) a timeframe of 60 days is provided to I&APs for comments on draft and final reports.
Section 56 (5) Registered I&APs must submit comments on draft reports to the EAP.	According to Section 56 (8) a timeframe of 60 days is provided to I&APs for comments on draft reports. All issues will be recorded in a Comments and Response Report.
Section 56 (6) Comments on final reports must be provided to the CA and a copy provided to the EAP.	A timeframe of 21 days is provided for registered I&APs to comment on the final reports. All comments must be forwarded to the CA and a copy furnished to the EAP.
Section 57 (1) The EAP must ensure that the comments of I&APs are recorded in reports and written comments including record of meetings are attached to the report submitted to the CA.	Compilation of Issues Trail/Comments and Responses Report that will form part of final reports.

5.1 Consultation with the Competent Authority and other Relevant Authorities

The competent authorities issuing decisions regarding the project as well as consultation to date are presented in below.

Table 18: Competent authorities and other relevant authorities associated with the project

Authority	Role	License / Approval	Consultation to date
Department of Environmental Affairs (DEA)	Competent Authority for integrated EIA and Waste Licensing process	Waste Management License and Environmental Authorisation	1. Confirmation of process to be undertaken i.e. integrated waste and EIA process 2. Submission and acceptance of

Authority	Role	License / Approval	Consultation to date
			integrated application form (see **Appendix E**)
Department of Mineral Resources – Mpumalanga Region	Competent Authority for mining right application process	Mining Right	1. Submission and acknowledgement of application for mining right subject to conditions (see **Appendix E**)
Department of Water Affairs	Competent Authority for Integrated Water Use License process	Integrated Water Use License	1. Pre-application meeting
Mpumalanga Department of Economic Development, Environment and Tourism	Commenting Authority for integrated EIA and Waste Licensing process		1. Notification of the integrated waste and EIA process, as well as IWULA and mining right application processes

5.2 Overview of the PP Process undertaken / to be undertaken during the Environmental Scoping Study

The public participation process (PPP) undertaken / to be undertaken during the Environmental Scoping Study is presented in Figure 11.

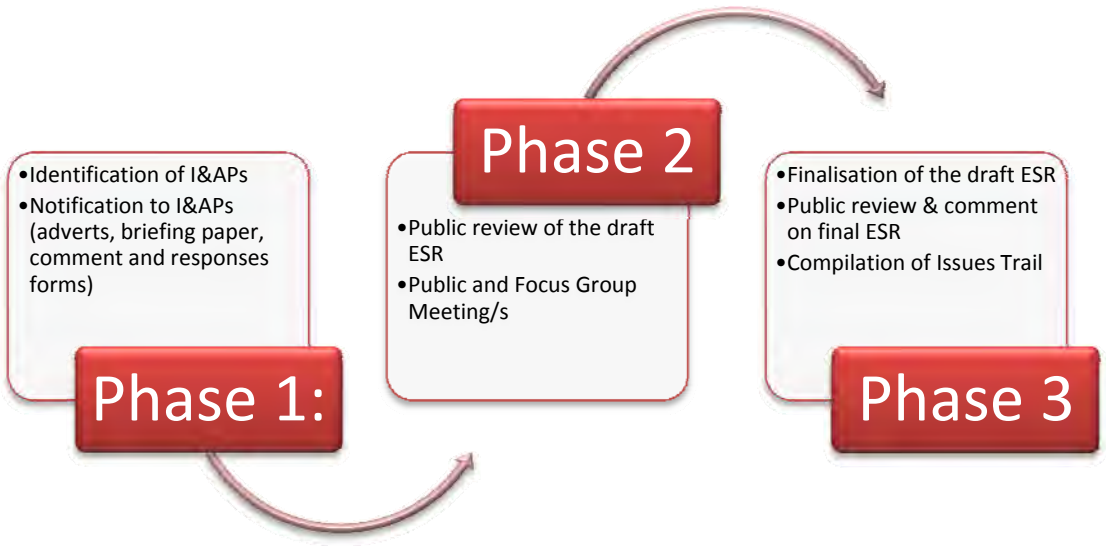

Figure 11: Key phases in the PPP undertaken / to be undertaken during the ESS

5.2.1 Phase I Public Participation

5.2.1.1 Identification of Interested and Affected Parties (I&APs) and Stakeholders

An important step in the public participation process entailed the identification of key stakeholders and I&APs, including:

- Other National and Provincial Government:
  - Department of Agriculture, Forestry and Fisheries
  - Department of Labour
  - Department of Public Enterprises
  - Department of Trade and Industry
  - Mpumalanga Department of Agriculture, Rural Development and Land Administration
  - Mpumalanga Department of Health
  - Mpumalanga Public Works, Roads and Transport
  - Mpumalanga Department of Human Settlements
  - Mpumalanga Department of Social Development
- Pixley ka Seme Local Municipality and Gert Sibande District Municipality
- Ward councillors;
- South African Heritage Resource Association (SAHRA) – Mpumalanga office;
- Mpumalanga Tourism and Parks Agency
- Neighbouring property owners/landowners;
- Farmers Associations; and
- Environmental interest groups and NGOs.

The existing I&AP database from the 40 – 140 MW OCGT demonstration plant project was utilised as a starting point. The identification of additional I&APs will be undertaken through existing contacts, responses to newspaper advertisements, and networking to identify key I&APs within the nominated study area.

All I&AP information (including contact details), together with dates and details of consultations and a record of all issues raised is recorded within a comprehensive database of I&APs (refer to **Appendix F**). This database is updated on an on-going basis throughout the project process. Consultations, in the form of telephone calls and letters will/ have been undertaken with individuals, businesses, institutions and organisations, including the following:

5.2.1.2 Advertising

In compliance with the EIA Regulations (2010), notification of the commencement of the EIA process for the project must be advertised in a local newspaper, namely the *Volksrust Recorder* and in a national newspaper, namely the *City Press.* Interested and affected parties (I&APs) were requested to register their interest in the project and become involved in the EIA process. The primary aim of these advertisements was to ensure that the widest group of I&APs possible was informed and invited to provide input and questions and comments on the project.

In addition to advertisements, site notices (refer to **Appendix F**) were placed at the following public places advertising the EIA process for the proposed project:

- Offices of the Pixley ka Seme Municipality
- Security check-in office at the Majuba Power Station
- UCG Pilot Plant
- Entrance to the Old Mine (Bergvliet Colliery)
- Offices of the Amersfoort Municipality

5.2.1.3 Briefing Paper

A briefing paper for the project has been compiled in English and Afrikaans (refer to **Appendix F**). The aim of this document is to provide a brief outline of the proposed project, provide preliminary details regarding the Scoping and EIA process, and explain how I&APs could become involved in the project. The briefing paper has been distributed to all identified stakeholders, together with a registration/comment sheet, inviting I&APs to submit details of any issues and concerns.

5.2.2 Phase II Public Participation

5.2.2.1 Consultation and Public Involvement

Through consultations, issues for inclusion within the EIA will be identified and confirmed. Telephonic consultation, a public meeting/s as well as focus group meeting/s (FGMs) with I&APs and key stakeholders will be undertaken in order to identify additional key issues, needs and priorities for input into the EIA study for the proposed project. Copies of minutes held during the review of the draft Environmental Scoping Report (ESR) for all formal public involvement meetings held during the ESS will be included in the final ESR.

5.2.2.2 Public Review of the draft ESR

An advert was placed in the *Volksrust Recorder* and *City Press* informing I&APs of the application and the availability of the draft ESR and Plan of Study for EIA for review and comment. The advert will appear on 19 October 2012 (Volksrust Recorder) and 21 October 2012 (City Press). A copy of the advertisements is included in **Appendix F**. Additionally, all registered I&APs were notified of the availability of the report in writing.

The draft ESR, together with the Plan of Study for EIA is being made available for authority and public review for more than 60 calendar days from ***22 October 2012*** to ***07 January 2013***. In addition, the report will also be made available at the following public locations (which are all readily accessible to I&APs) within the study area:

- Volksrust Public Library, Cnr Joubert & Laingsnek Street, Volksrust
- Amersfoort Public Library, Cnr Plein & Bree Street, Amersfoort
- UCG Mine Site Offices, Majuba Colliery, Bergvliet, Amersfoort
- Office of Royal HaskoningDHV, 78 Kalkoen Street, Monument Park, Pretoria
- Royal HaskoningDHV website (http://www.rhdhv.co.za/pages/services/environmental/current-projects.php)

Hard and soft copies of the reports will be forwarded to:

- Department of Water Affairs
- Department of Mineral Resources
- Mpumalanga Department of Economic Development, Environment and Tourism
- Pixley ka Seme Municipality
- Gert Sibande District Muncipality
- SAHRA Mpumalanga Region
- Mpumalanga Tourism and Parks Agency

5.2.2.3 Public Meeting / Open House Session

The primary aim of a public meeting/ open house session will be to:

- provide I&APs and stakeholders with information regarding the proposed project and associated infrastructure;
- provide I&APs and stakeholders with information regarding the EIA process;
- provide an opportunity for I&APs and stakeholders to seek clarity on the project;
- record issues and concerns raised; and
- provide a forum for interaction with the project team.

This meeting will be advertised in the *Volksrust Recorder* newspaper. Registered I&APs and stakeholders were invited to attend the public meeting by individualised letters. Copies of the minutes of meeting will be included in the final Environmental Scoping Report.

5.2.2.4 Focus Group Meeting/s

These meetings will be held with groups that have similar interests in the project, such as the local authorities, landowner's associations, etc. The main aims of these meetings will be to provide stakeholders with information regarding the proposed project and provide them with the opportunity to raise any comments, issues or concerns regarding the proposed project.

5.2.3 Phase III Public Participation

5.2.3.1 Public Review of the Final ESR

In order to give effect to regulation 56 (2) of the EIA Regulations (2010), before submitting the final ESR to the DEA, the EAP must give registered I&APs access to, an opportunity to comment on the report in writing within 21 days.

5.2.3.2 Issues Trail

All issues, comments and concerns raised during the public participation process will be compiled into an Issues Trail that will form part of the final ESR. The Issues Trail will be updated on an on-going basis.

5.3 Submission of Final Environmental Scoping Report

The submission of the final ESR and Plan of Study for EIA is the last stage of the Environmental Scoping Phase for the proposed project. The Final Environmental Scoping Report will be submitted to DEA for review and decision-making.

6 DESCRIPTION OF THE RECEIVING ENVIRONMENT

6.1 Biophysical Environment

6.1.1 Locality

The proposed project is located on the farm Roodekopjes 67HS (27°4'45.66"S; 29°48'1.152"E). The project will take place on Portions 1, 2, 3 and remaining extent of the farm Roodekopjes 67HS (Eskom-owned). Portion 4 of the farm Roodekopjes 67HS is privately owned and is not included as part of this assessment. The total extent of the study area is 2449 ha. Ancillary infrastructure such as a wastewater treatment works and site offices are located on Portion 21 of the farm Bergvliet 65HS. In addition, a new service road will be constructed from the site offices mentioned above to the UCG pilot plant. The road will traverse Portions 4 and 5 of the farm Rietfontein 66HS. A 30 m servitude has been registered in Eskom's name in this regard.

The Majuba Power Station is located south-east to the main gasification operations (i.e. gas treatment plant and gasifier units 1 and 2) primarily on Portion 1 of the farm Roodekopjes 67HS. The current land uses are mainly agricultural (Roodekopjes as well as immediate surrounding farms), mining (UCG pilot plant and Majuba Power Station) as well as industrial (Majuba Power Station as associated infrastructure).

Figure 12: Map indicating the Pixley ka Seme Local Municipality and surrounding municipalities

The proposed project falls in the Mpumalanga Province in Ward 7 of the Pixley ka Seme Local Municipality (MP304) within the Gert Sibande District Municipality (DC30). The Pixley ka Seme Local Municipality is situated on the eastern border between Mpumalanga and KwaZulu-Natal. Furthermore, the municipal area is framed by the Mkhondo Municipality in the east, Msukaligwa Municipality to the north and Lekwa Municipality to the west

(refer to Figure 12. The Pixley ka Seme Local Municipality comprises an area of approximately 5227,98 km² which includes the following major urban areas or towns: Amersfoort; Ezamokuhle; Perdekop; Siyazenzela; Volksrust; Vukuzakhe; Wakkerstroom and eSizameleni. Other residential areas include Daggakraal Ext 1, 2 and 3 as well as Sinqobile A, B, C, and D.

6.1.2 Climate and Rainfall

The study area is characterised by daily summer temperatures that range between ~2 °C and ~32 °C with an average of ~17 °C. Winter temperatures range between ~8 °C and ~23 °C with an average of ~7 °C. Figure 13 illustrates the average monthly maximum and minimum temperatures recorded in the Majuba area, respectively.

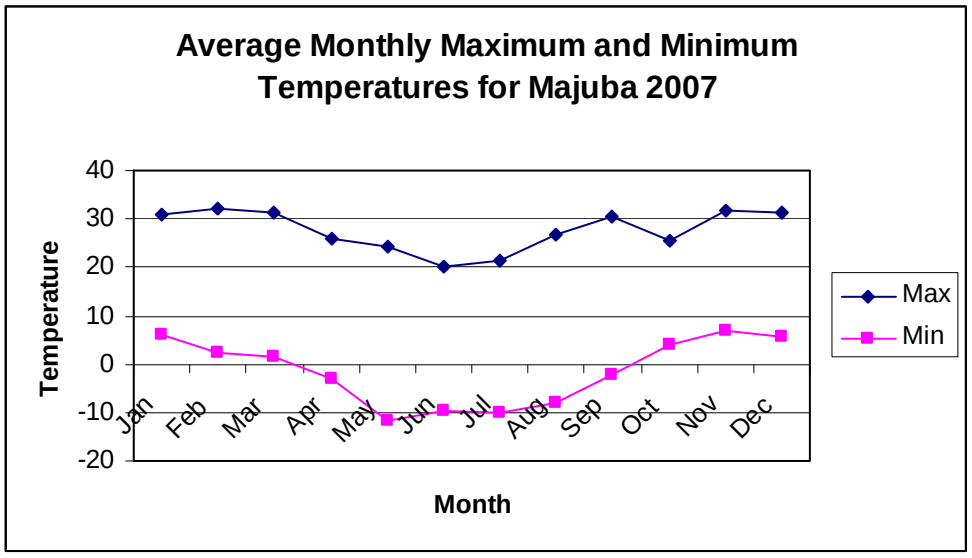

Figure 13: Average monthly maximum and minimum temperatures recorded in the Majuba area (Weather Services Station, 2007)

The study area can be characterised as being a summer rainfall area with the warmer months being October to April. The mean annual rainfall for the Majuba area is 1008 m. Total monthly rainfall figures for modelled South African Weather Services (SAWS) data are illustrated in Figure 14.

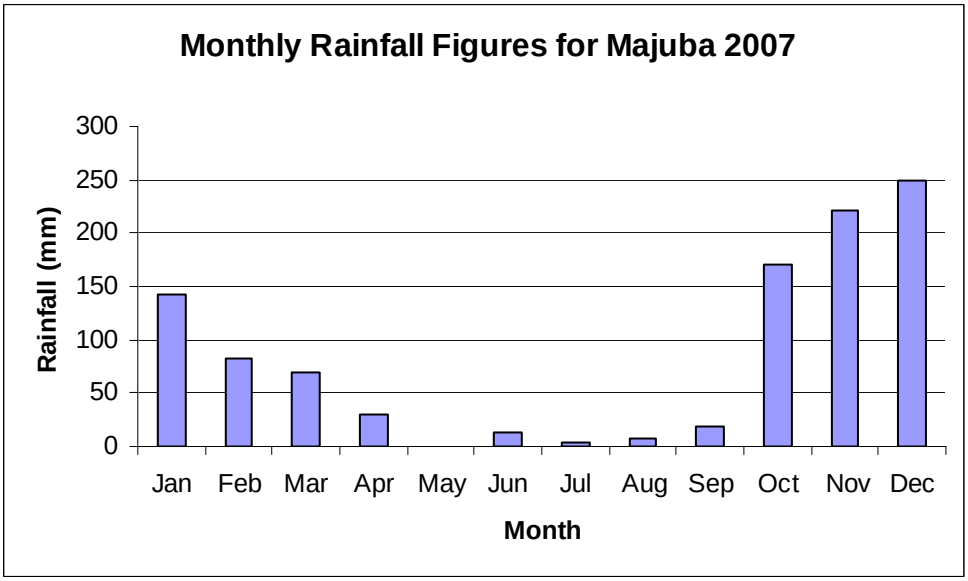

Figure 14: Monthly rainfall figures for Majuba area (Weather Services Station, 2007)

6.1.3 Wind

The UCG pilot plant has its own meteorological station, however data from the SAWS has been included to ensure that the data from the UCG pilot plant station is correct. Comparison was made between data sourced from the UCG pilot plant and data taken from the South African Weather Services. The period wind rose and frequency distribution for the UCG site is presented in Figure 15 and Figure 16 and the period wind rose and frequency distribution for the data sourced from the South African Weather Services is presented in Figure 17 and Figure 18. Wind roses comprise of 16 spokes which represent the directions from which winds blew during the period. The colours reflect the different categories of wind speeds. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories.

For the period assessed, winds predominated from the western and eastern sectors. The wind rose profile is typical of that experienced by low lying areas surrounded by an escarpment. From the eastern vector wind speeds of between 5.7 - 8.8 m/s occurred most of the time. The same wind speeds occurred but were less common from the south easterly and north eastern sectors. Stronger winds of greater than 8.8 m/s were also experienced from the west. Smaller contributions of strong winds were also experienced from the west-southwest and west-northwest directions.

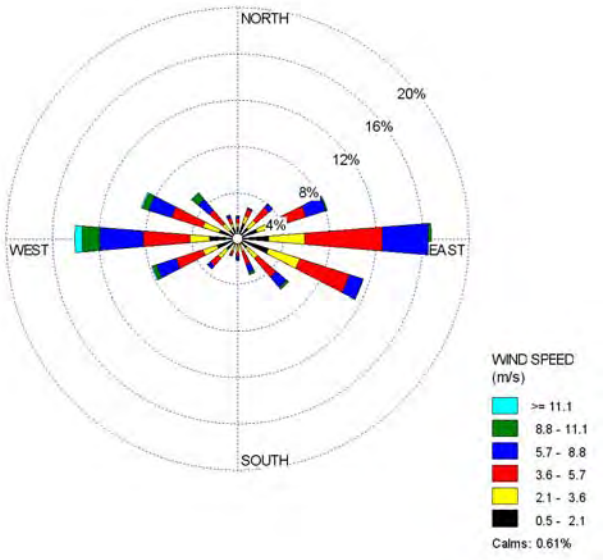

Figure 15: Period wind rose derived from monitored data from the UCG pilot plant (2006 to 2007)

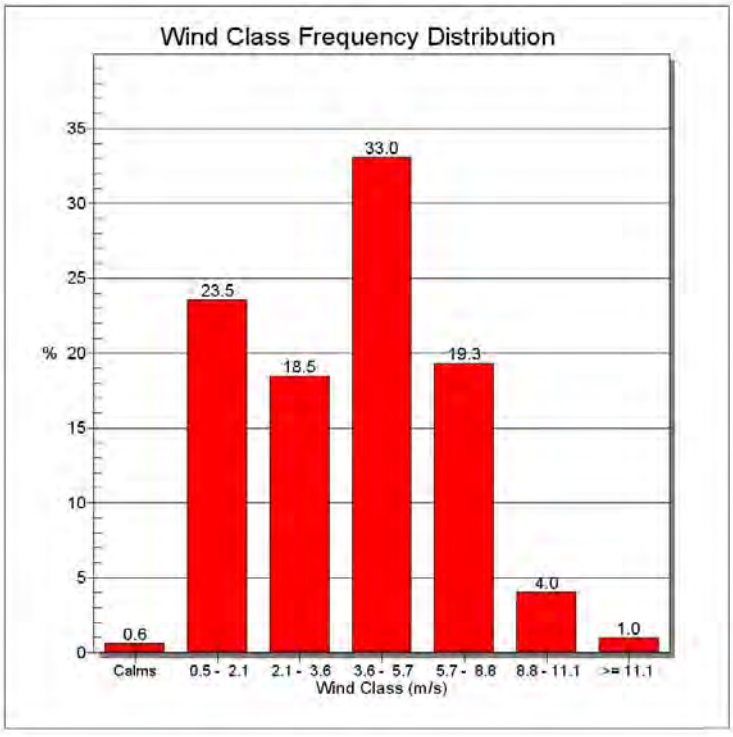

Figure 16: Frequency distribution derived from monitored data (UCG Pilot Plant: 2006 to 2007)

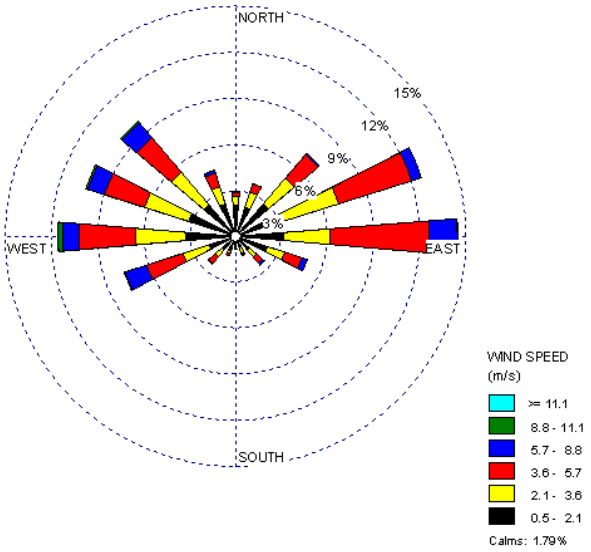

Figure 17: Period wind rose derived from modelled data sourced from the South African Weather Services (2006 to 2007)

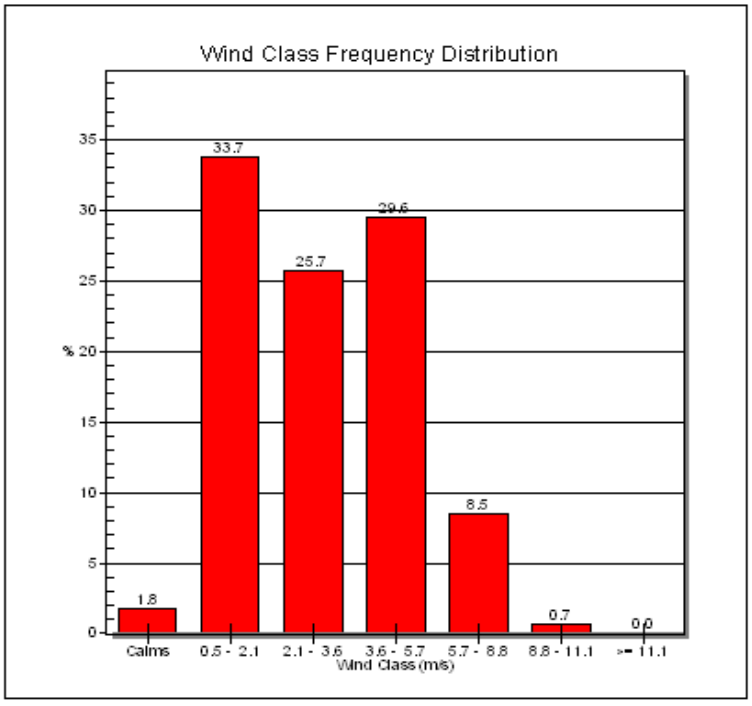

Figure 18: Frequency distribution derived from modelled data (South African Weather Services: 2006 to 2007)

The average wind speed for the Amersfoort area is 3.24 m/s, with the highest recorded wind speeds (between 8 and 11 m/s) coming from the west. Of the annual modelled hourly data from the weather services, approximately 1.79% of that hourly data is recorded as calm winds, representing periods of little dispersion. Information pertaining to calm periods, average wind speeds and wind direction all play a significant role with regards to dispersion effects and will play a fundamental role during the modelling undertaken in the EIA phase of the project.

6.1.4 Atmospheric Stability

Atmospheric stability is commonly categorised into one of six stability classes. These are briefly described in Table 19. The atmospheric boundary layer is usually unstable during the day due to turbulence caused by the sun's heating effect on the earth's surface. The depth of this mixing layer depends mainly on the amount of solar radiation, increasing in size gradually from sunrise to reach a maximum at about 5-6 hours after sunrise. The degree of thermal turbulence is increased on clear warm days with light winds. During the night a stable layer, with limited vertical mixing, exists. During windy and/or cloudy conditions, the atmosphere is normally neutral.

Within the study area, very unstable to stable conditions predominates within most sectors. The highest frequencies of such winds occurring were mainly from the east-north-east and east sectors, and the next highest from the west-south-west and west-north-west sectors.

Table 19: Atmospheric stability classes

A	Very unstable	calm wind, clear skies, hot daytime conditions
B	Moderately unstable	clear skies, daytime conditions
C	Unstable	moderate wind, slightly overcast daytime conditions
D	Neutral	high winds or cloudy days and nights
E	Stable	moderate wind, slightly overcast night-time conditions
F	Very stable	low winds, clear skies, cold night-time conditions

6.1.5 Topography and Landscape

The region is known for its rolling grass landscapes and the study area is a typical example thereof (Photograph 2). A basic analysis of topography and landforms revealed that the study area does not comprise sites where significant slopes are present. It should however be noted that the ENPAT database slope classes is based on a high contour interval. With the use of more detailed data, the identification of smaller areas of significant slopes will be made possible.

The topography of the general region varies between ‘Slightly irregular undulating plains and hills’ and ‘Strongly undulating plains’.

Photograph 2: Greater study area showing the rolling grass landscape

6.1.6 Geology

6.1.6.1 Regional Geology

The majority of the study area is underlain by Karoo Supergroup sedimentary rocks of the Vryheid and Volksrust Formations of the Ecca Group. These are largely comprised of sandstone, mudstone, shale, siltstone, and coal seams. The available geological maps covering the study area did not indicate any major structural features such as faults or fractures. Limited tectonic activity is recognised within the study area, and the only evidence of secondary processes is outcrops of intrusive younger dolerite sills mapped in the Karoo sediments.

Four generations of dolerite intrusions are recognised within the study area, based on olivine or plagioclase content, alteration, and texture. The intrusive dolerite has produced large-scale devolatilisation and structural displacement of the coal. These adverse geological conditions caused the closure of the Majuba Colliery in 1993. The lithostratigraphy of the study area is presented in Table 20 below.

Table 20: Lithostratigraphy of the study area

Age	Supergroup	Group	Subgroup	Formation	Lithology
Jurassic					Dolerite
Permian	Karoo	Ecca		Volksrust	Mudstone, siltstone, shale
Permian	Karoo	Ecca		Vryheid	Sandstone, siltstone, shale, coal

6.1.6.2 Geology of the farm Roodekopjes 67HS

The general geology of the farm Roodekopjes 67HS from surface downwards is illustrated in Figure 19. The B8 dolerite sill outcrops at surface on the site and averages in the order of 30 m thick. A sandstone and siltstone interval of between 5 and 25 m is followed by two to three stages of sill intrusion of the B4 dolerite totalling approximately 120 m in thickness. Below this composite dolerite sill are sequences of sandstones, siltstones and mudstones containing minor coal seams. The main coal seams namely the Alfred and Gus seams are at an average depth of 280 m below surface. They total about 5 m in thickness with a small parting between them that thickens and becomes more prominent towards the east.

Below this is a sequence of bioturbated siltstones, sandstone and mudstone with minor coal seams. The B6 dolerite sill underlies the whole farm. This dolerite has indurated the coal and the coal seams volatile content is well below the required average for Majuba Power Station. The seam elevation and altitude for farm Roodekopjes is flat and consistent.

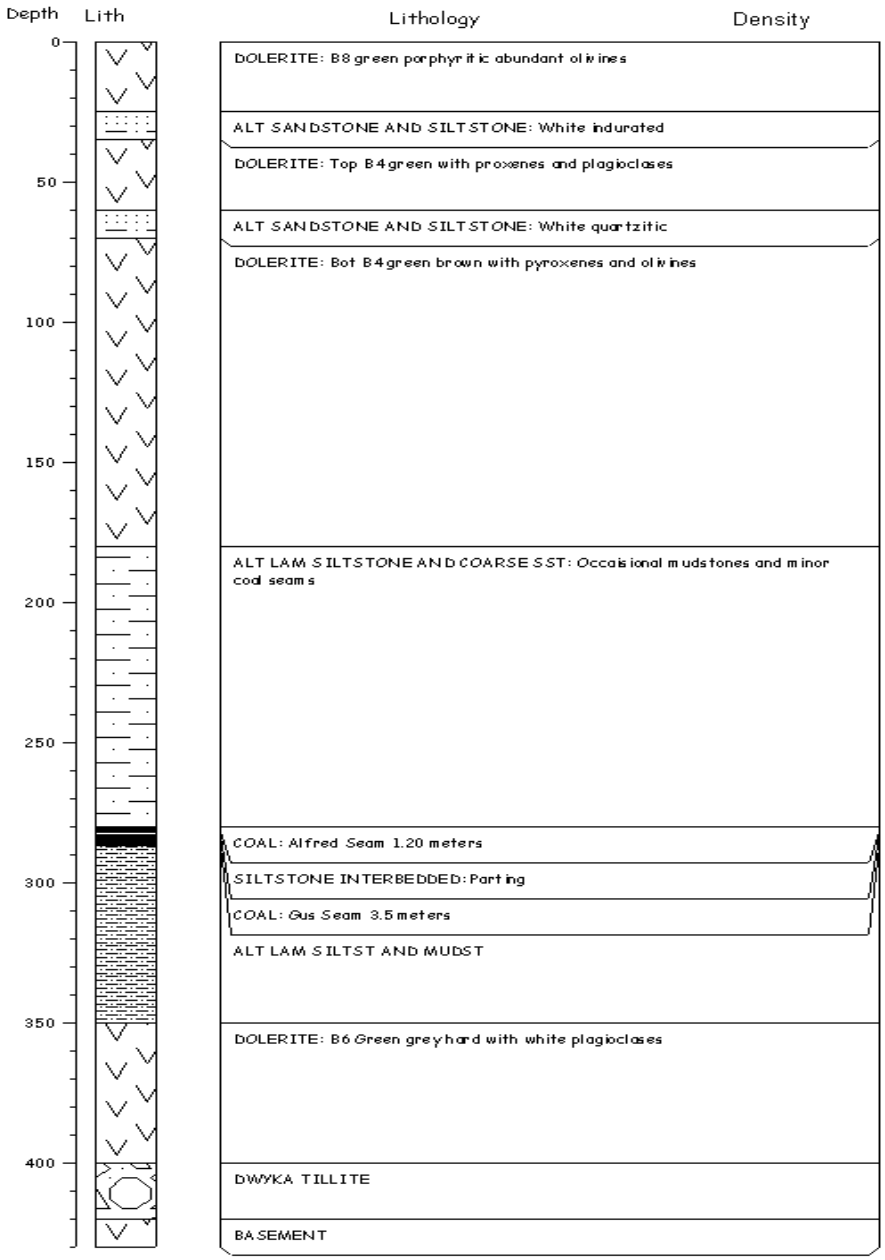

Figure 19: Typical geological profile of the farm Roodekopjes 67HS

6.1.6.3 Coal Seams

The two main coal seams on the farm Roodekopjes 67HS are the Alfred and Gus seams. The Alfred seam varies between 1 and 1.5 m in thickness. It often has contaminated coal and sandstone near the top. The coal is a dull bituminous coal, high in ash with some shaly coal bands. The coal is slightly devolatilised as shown by the range of dry ash free volatiles. The Gus seam is separated from the overlying Alfred seam by a parting of coaly shale

that becomes thicker and more arenaceous to the east. The Gus seam averages over 3.0 m in thickness and is divided into a poor shaly top half and a high quality bottom half. Again the coal shows signs of devolatilisation.

6.1.7 Geohydrology

The groundwater potential of the Karoo formations located in the greater study area is limited in their pristine state due to low permeability and storage capacity. Secondary processes, such as weathering, fracturing, etc., are required to enhance the groundwater potential. Based on regional data and the resource maps, the following geohydrological information is available for the formations within the study area:

- Volksrust Formation
  - Upper and middle Ecca
  - Predominantly argillaceous rocks
  - Fractured aquifers
  - Borehole yields 0.5 to 2.0 l/s
- Vryheid Formation
  - Lower Ecca
  - Intergranular and fractured aquifers
  - Borehole yields 0.1 to 0.5 l/s

A conceptual geohydrological model was developed by Golder Associates Africa in 2010 and was updated in 2012 and is summarised below: The conceptual model (Figure 20) distinguishes between four distinct groundwater systems that are present at the UCG site.

6.1.7.1 Shallow Aquifer Unit

The shallow aquifer is found from surface to an average depth of 70 m below surface. This aquifer is present above the lower B4 dolerite sill and comprises weathered/fractured Karoo sediments and the upper B4 dolerite sill. Very low blow yields were encountered during drilling in this aquifer. The hydraulic conductivity ranges between 1.7×10^{-1} to 8.6×10^{-3} m/day. The groundwater piezometric levels vary between 17 and 35 m below surface and generally follow the topography.

The quality of the groundwater in the shallow aquifer is characteristic of recently recharged water and generally conforms to the SANS 241 Water Quality Guidelines for domestic use.

6.1.7.2 Intermediate Aquifer Unit

The previously defined intermediate aquifer zone is divided into an:

- *Intermediate upper aquifer zone*
  The intermediate upper aquifer zone (+/-70 to +/- 170 m) constitutes out of the top contact of the B5 dolerite sill. A hydraulic conductivity of $8x10^{-4}$ m/d was calculated for the intermediate upper aquifer zone.
- *Intermediate lower aquifer zone*
  The intermediate lower aquifer zone (+/-180 to +/- 270 m) constitutes bottom contact of the B5 dolerite sill including the sugary dolerite zone and the geological sedimentary units above the coal seam. Transmissivity values of the intermediate lower aquifer zone range from 0.1 to 0.9 m^2/d.

The SRK report of 1984[2] suggests hydraulic conductivity of $3x10^{-3}$ – $5x10^{-4}$ m/d for the average value across the aquifer and $3x10^{-4}$ - 5.5 m/d for the running (sugary) dolerite.

[2] **Steffen Robertson & Kirsten, 1984**: Report CI.3936/3: Majuba Coal Mine. Hydrogeological, Hydrological and Environmental Study. Summary Report

6.1.7.3 Coal Seam Aquifer Unit

The coal seam aquifer constitutes the fractured Gus coal seam and potential partings within the coal at depths between ± 280 and ± 284 m below surface. Groundwater levels measured in the deep monitoring boreholes range between 40 and 100 m below surface with recharge from overlying intermediate aquifer.

SRK (1984) suggested a hydraulic conductivity of $8x10^{-4}$ m/day while GCS (2006) suggested 10^{-5} m/day in the undisturbed coal. Golder confirmed the hydraulic conductivity as 10^{-4} m/day in 2007 and 10^{-5} m/day during 2012.

6.1.7.4 Lower Aquifer Unit

A lower aquifer is assumed to be present below the Gus coal seam at depths below 284 m below surface. No information regarding piezometric levels hydraulic properties is available but it can be assumed the hydraulic conductivity will be low.

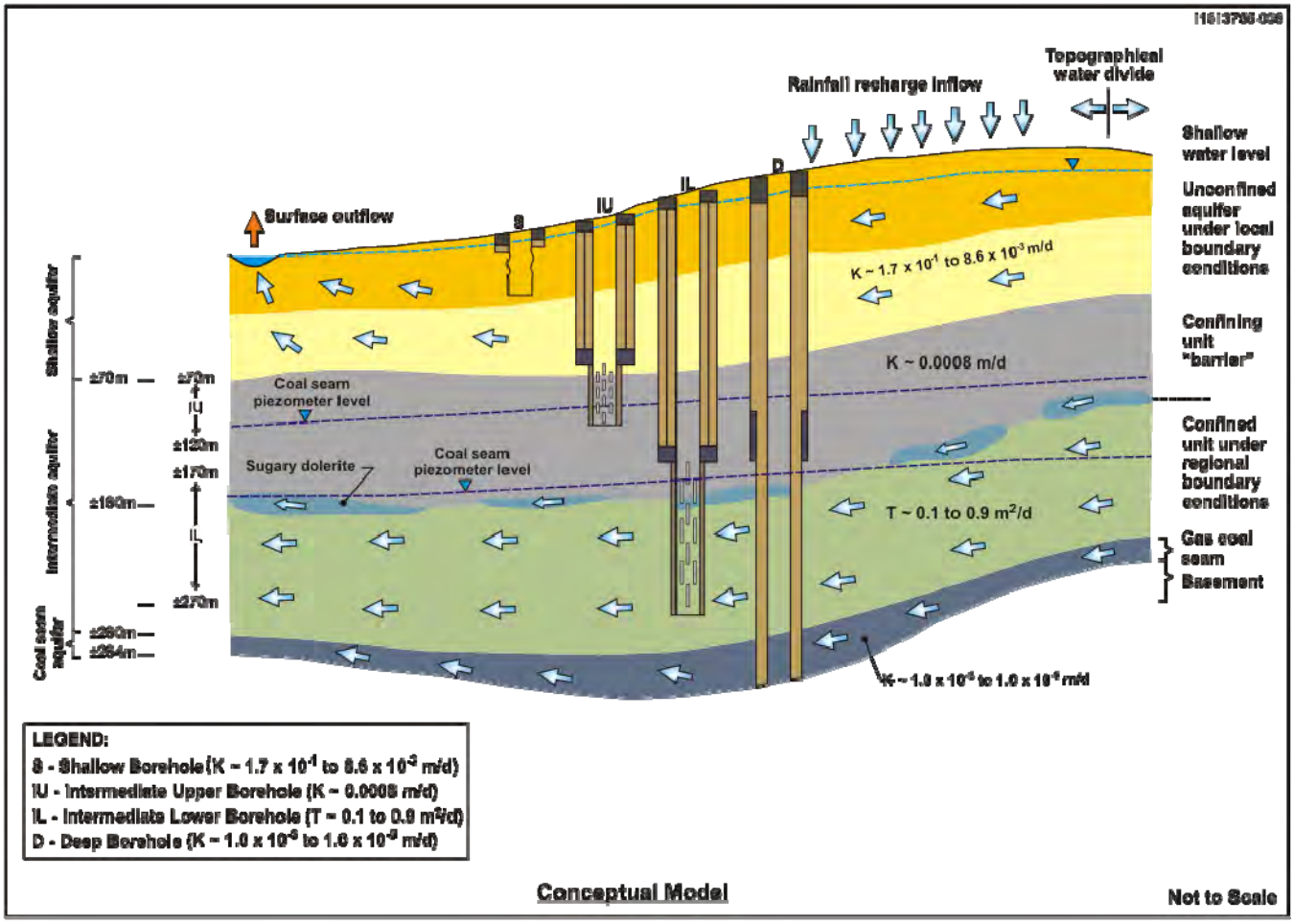

Figure 20: Conceptual geohydrological model

The quality of the groundwater in the shallow aquifer unit is characteristic of recently recharged water and generally conforms to the SANS 241 Water Quality Guidelines for domestic use. There is a significant difference between the shallow aquifer unit and coal seam aquifer in terms of water levels and quality. This suggests that there is limited direct interaction between the two aquifers at the site although indirect interaction via the intermediate aquifer could occur. The saline character of the coal seam water does indicate a long underground flow path between recharge and discharge.

Groundwater hydrochemistry associated with the sediments is variable; the groundwater salinity associated with the formations in the study area can have electrical conductivity concentrations of < 250 up to 1000 mS/m.

The sandstones of the Vryheid Formation of the Ecca Group can be massive and dense and have limited permeability and storage. It thus offers only moderate groundwater yield, especially in the absence of dolerite intrusions. Contacts between different rock lithologies and bedding planes within the sediments often yield groundwater. The contact zone between the dolerites and the sandstone lithologies can be high yielding. Fractured fault zones, especially if related to tensional stresses, are potentially rich targets for groundwater development. Groundwater occurs within the joints, bedding planes, and along dolerite contacts within the sediments (as recognised across the study area).

6.1.7.5 Drainage and Hydrology

The greater study area straddles two quaternary catchments, both of which form part of the Upper Vaal River Catchment. The western part of the site is located within catchment C11J, part of which is drained by the Witbankspruit, a stream that forms a tributary of the Upper Vaal River to the north of the site (the Witbankspruit flows from north to south across the site). The eastern third of the site falls within the quartenary catchment C11E. The Skulpspruit which flows through the eastern part of the site forms a tributary of the Rietspruit, itself a tributary of the Upper Vaal River. This factor is relatively important in a catchment management context as the Vaal River is critical in the supply of water to South Africa's most densely populated area and economic hub.

6.1.8 Wetlands

Wetlands occur predominantly in a number of valley bottom systems that traverse the greater study area in a north-south direction. In some of the upper parts of these valley bottom systems, the wetlands are thought to become hillslope seepage wetlands (on the footslopes and midslopes surrounding the valley bottoms). Wetlands The spatial distribution of wetlands is attached as **Appendix G**.

6.1.9 Soils and Agricultural Potential

The farm Roodekopjes 67HS falls into the **Ca2** land type (refer to the land type map of the study area - **Appendix H**). A brief description of the land type is provided in Table 21.

Table 21: Characteristics of the Land Type Ca2

Soils	Land capability and capability and land use	Agricultural Potential
Landscape dominated by shallow yellow-brown apedal, distrophic soils in higher lying areas, variable depth bleached apedal soils in midslope positions and poorly drained structured soils of variable depth in low lying areas	**Mainly dryland agriculture and extensive grazing**	**Medium to low except for lower lying areas that constitute wetlands**

6.1.10 Regional Vegetation

The greater study area is situated within the Amersfoort Highveld Clay Grassland and Soweto Highveld Grassland vegetation types, however the farm Roodekopjes is situated within the Amersfoort Highveld Clay Grassland vegetation type (refer to **Appendix I**).

6.1.10.1 Amersfoort Highveld Clay Grassland

This vegetation type comprises undulating grassland plains, with small scattered patches of dolerite outcrops in areas. The vegetation is comprised of a short closed grassland cover, largely dominated by a dense *Themeda triandra* (Red Grass) sward, often severely grazed to form a short lawn. The conservation status is regarded as Vulnerable[3], with a planned conservation target of 27%. None is however formally protected. Some 25% of this unit (Amersfoort Highveld Clay Grassland) is transformed, predominantly by cultivation (22%). The area is not suited to forestation. Silver and black wattle and *Salix babylonica* invade drainage areas. Erosion potential is low.

Overgrazing leads to invasion of *Stoebe vulgaris* (Bankrupt Bush). Parts of this unit (Amersfoort Highveld Clay Grassland) were once cultivated and now lie fallow and have been left to re-vegetate with pioneer grass species. These transformed areas are not picked up by satellite for transformation coverage and the percentage of grasslands still in a natural state may be underestimated.

The study area is situated within the African Grasslands/Ekengela Initiative Transition Zone, rendering all areas of natural grassland sensitive[4].

6.1.10.2 Soweto Highveld Grassland

This vegetation type comprises a gently to moderately undulating landscape on the Highveld plateau supporting short to medium-high, dense, tufted grassland dominated almost entirely by *Themeda triandra* and accompanied by a variety of other grasses such as *Elionurus muticus, Eragrostis racemosa, Heteropogon contortus* and *Tristachya leucothrix*. Only scattered small wetlands, narrow stream alluvia, pans and occasional ridges or rocky outcrops interrupt the continuous grassland cover.

This vegetation type is regarded as Endangered with a planned conservation target of 24%. Erosion is generally very low.

6.2 The Social Environment

6.2.1 Social

As mentioned in Section 6.1.1, the study area falls within the Pixley ka Seme Local Municipality (PKSLM). According to the Spatial Development Framework (SDF)[5] of the PKSLM, the current spatial pattern within the municipal area can be divided into 7 broad categories of land use, namely: urban land use, rural land use, mines and quarries, conservation areas, agriculture, tourism areas, and the transport network.

- **Urban land use**: The towns of Volksrust and Vukuzakhe are classified as major urban areas whereas Wakkerstroom, Daggakraal and Amersfoort are regarded as minor urban areas. An area such as Perdekop is regarded as a declining urban area.
- **Rural land use**: Agricultural activities seem to be dominating rural land use in the area, but most of these activities are regarded as subsistence farming.
- **Mines and quarries**: Operational mines are scattered throughout the PKSLM and include sand, dolerite and coal mining. Areas of coal mining are often also associated with energy generation activities.

[3] Vegetation types that have lost up to 20% of their original extent, which could result in some ecosystem function being altered.

[4] **Department of Environmental Affairs and Tourism; 2001.** Environmental Potential Atlas. Pretoria.

[5] **Pixley ka Seme Local Municipality, 2010.** Pixley ka Seme Local Municipality SDF. Available at URL http://pixleykaseme.local.gov.za.

- **Conservation areas**: The PKSLM is home to a number of important conservation and biodiversity areas, but it would appear if these areas are mostly confined to the southern parts of the municipal area, notably around Wakkerstroom. In addition to the conservation areas, the SDF also states that there are a number of natural heritage sites located around Wakkerstroom and Warburton.
- **Agriculture**: The SDF describes the majority of land within the PKSLM as "unimproved grassland" that is mostly used for stock grazing. Other land within the PKSLM is described as cultivated dry land used for crop cultivation (mostly maize).
- **Tourism**: The PKSLM falls within the Grass and Wetlands Tourism Region, which forms, what is called, a "birding paradise".
- **Transportation network**: The national road N11 traverses the municipal area and serves as an important north-south transportation link. In addition, several provincial roads also traverse the local area, including the R23, and portions of the R543. Apart from the road network, two railway lines pass through the PSLM, one being the main Johannesburg-Durban rail connection, the other a north-south rail passing through the towns of Amersfoort, Wakkerstroom and Volksrust.

Amersfoort is classified as a small urban centre. The town was initially established as a result of the coal mining in the area and has since, to a large extent, become dependent on the Majuba Power Station. Approximately 12.8 km to the south-east of Amersfoort lies the town of Daggakraal, which is considered a very large urban settlement. It is believed that up to a third of the total population of the PKSLM resides in Daggakraal. Even though the town has a range of social services, there is still a dire need for a range of diversified services to address the needs of Daggakraal's residents, including physical upgrades such as sanitation services, water reticulation and waste removal. The town is economically unsustainable as it has a very limited economic base which showed little to no growth during the past years – probably owing to the fact that the area is very inaccessible.

6.2.2 Air Quality

6.2.2.1 Identified Sensitive Receptors

A sensitive receptor for the purposes of the current investigation can be defined as a person or place where involuntary exposure to pollutants released by the proposed plant, can be expected to take place. For the purposes of this study, areas of development are identified as sensitive receptors. Those receptors identified during the current study are listed as follows:

- Approximately 8 km north-east is the Amersfoort town;
- Approximately 6 km west are the Vlakplaats and Daggakraal communities; and
- Adjacent to surrounding livestock farms and associated farm houses.

6.2.2.2 Sources of Air Pollution

The following sources of air pollution have been identified in the study area:

- Stack, vent and fugitive emissions from the existing Majuba Power Station operations;
- Flaring and fugitive emissions at the UCG pilot plant operations;
- Agricultural activities on the surrounding farms;
- Vehicle entrained dust and exhaust emissions;
- Domestic fuel burning; and
- Veld fires.

6.2.3 Visual

The landscape character is formed by primary environmental attributes and human activity, which in the case of this study area are the following:

- Grassland;
- Undulating topography with isolated koppies and ridges;
- Perennial and non-perennial streams and isolated dams;
- Cultivated land;
- Majuba Power Station (being a visually dominant feature in the area);
  Dispersed farmsteads, townships and agricultural holdings.

As indicated on the map in

Figure 21 natural grassland and cultivated land are the main environmental attributes in the study. The intrinsic value of these landforms in terms of visual quality is medium – high. Driving through the area leaves one with a pleasant feeling of the natural environment in general. Sense of place is important in this study because sprawl development tends to eliminate unique features of the landscape.

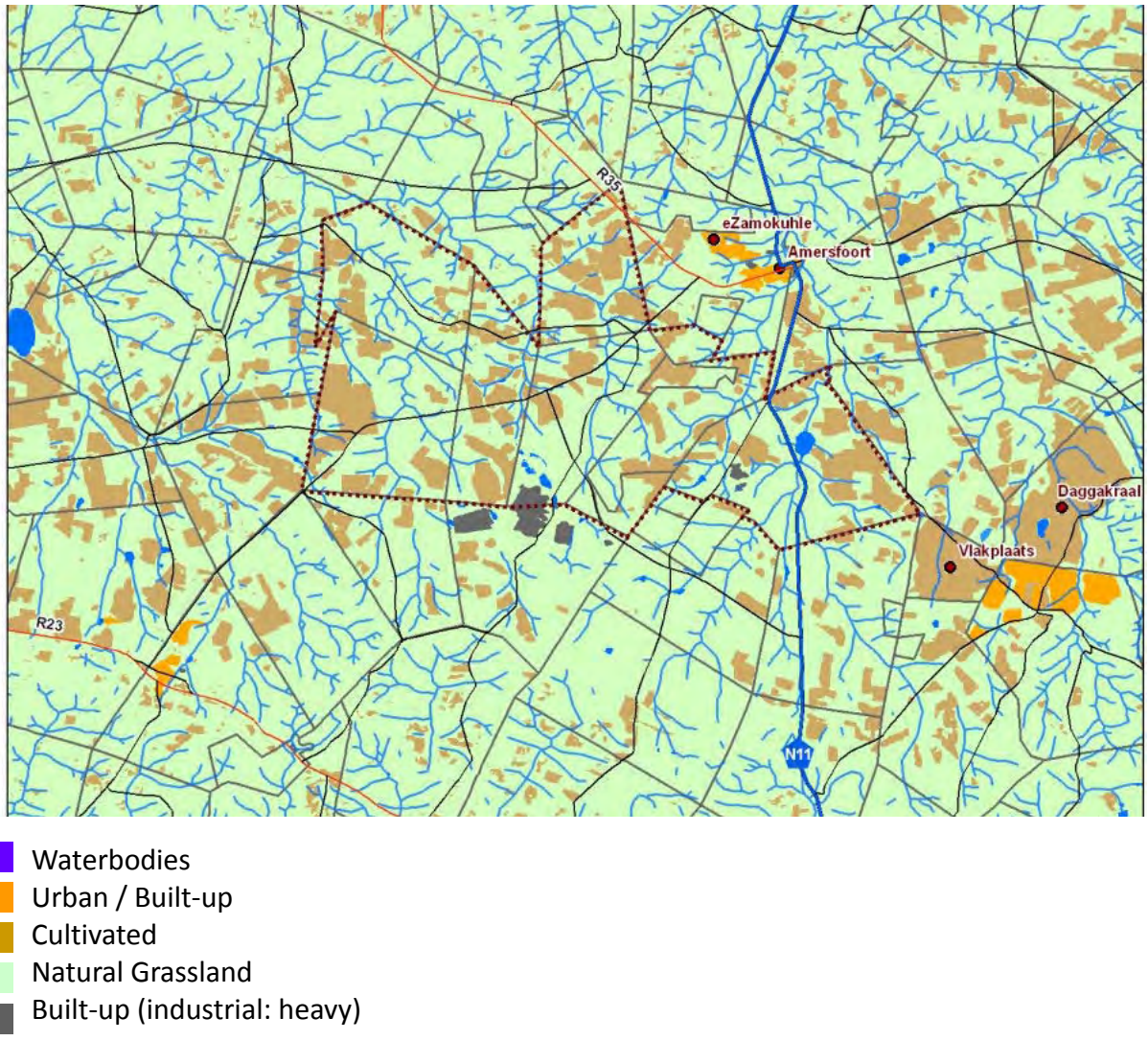

Figure 21: Land use in the study area

6.2.4 Micro-economic Status Quo

The current regional economic environment seems to be dominated by agriculture, and power generation, with towns in the area providing services and products to these industries and local residents providing labour to the industries or running related businesses. This is supported by information contained in the Pixley ka Seme Local Municipality IDP[6] which indicated that agriculture and electricity provision both represented significant sectors in the local economy together with trade and manufacturing.

Skills level in the region remains a problem with less than 18% of pupils achieving grade 12 or above[7]. This is likely to limit the amount of local benefit from the project by increasing the need for outside employees. There seems to be a strong need for organisations to provide skills development and training, and thus providing job mobility to more skilled opportunities. Any large local economic injection could have dramatic effects on local suppliers and employment.

Farming on or near the project site is characterised by both dryland crop farming, and animal husbandry (mostly cattle farming). There are several small communities of workers living in the area in addition to landowners or tenants.

6.2.5 Heritage

6.2.5.1 Stone Age

No information about Stone Age habitation of the area is available. There might be two reasons for this. Firstly, it is unlikely that Stone Age people would have occupied the area specific, as it would have been to cold and no shelters or caves exists locally that could be used to shelter in. Secondly, no systematic survey of the area has been done and, as a result, no sites have been reported.

6.2.5.2 Iron Age

Iron Age people started to settle in southern Africa c. AD 300, with one of the oldest known sites at Silver Leaves, south east of Tzaneen dating to AD 270. However, Iron Age occupation of the eastern highveld area (including the study area) did not start much before the 1500s. Some sites dating to the Late Iron Age is known to exist to the north west of the study area.

6.2.5.3 Historic period

The historical period in this area starts with the arrival of early missionaries, hunters and traders, followed later by the Voortrekkers, who settled permanently and started to farm in the area and developed a number of towns. The town of Amersfoort was founded in 1876 and proclaimed in 1888. During the Anglo Boer War (1899 - 1902), some skirmishes took place in the region[8].

6.2.5.4 Noise

The *noise climate* (ambient noise condition) in the Amersfoort area is quiet and is representative of a rural (farming) noise district (SANS 10103). There are a number of major noise sources in the area namely the existing Majuba Power Station, the traffic on the main roads, coal trucks transporting coal to Majuba Power Station and the coal supply railway line to the power station. The noise sensitive sites/areas are Amersfoort town (approximately 12 km from the Majuba Power Station) and various farmhouses and farm labourer residences in

[6] **Pixley ka Seme Local Municipality, 2009 - 2012.** Pixley ka Seme Local Municipality IDP. Available at URL http://pixleykaseme.local.gov.za.
[7] **Statistics SA; 2007.** Community Survey Interactive Results. Available at http://www.statssa.org.za
[8] **Cloete, P.G, 2000**. The Anglo-Boer War: A Chronology. Pretoria: JP van der Walt. Pp. 243.

the surrounding area (on farms Palmietspruit; Strydkraal; Tweedepoort, Koppieskraal, Rietfontein; Weiland and Bergvliet).

6.2.6 Traffic

There are a number of major roads and secondary roads servicing the study area. These include:

i. National Road N11, which links Amersfoort to Volksrust is aligned in a north-south direction through the eastern sector of the study area.
ii. Road P48/2 (Route R35), which links Amersfoort to Morgenzon, is aligned in an east-west direction through the north-eastern sector of the study area.
iii. Road P97/1 which links Amersfoort to Perdekop, is aligned in a north-east to south-west direction through the western sector of the study area. It passes 4 kilometres to the north-west of the Majuba Power Station.
iv. Road D2514, which links from Road P97/1 to National Road N11, is aligned in a north-west to south-east direction through the central portion of the study area. It is the main access road to Majuba Power Station.
v. Road D284, which links from Road D2514 to National Road N11, is aligned in a south-west to north-east direction through the central portion of the study area. It is the main access road to Majuba Colliery (no longer in operation).

7 POTENTIAL ENVIRONMENTAL IMPACTS - BIOPHYSICAL

7.1 Subsidence

Potential impacts caused by subsidence due to the UCG process could include:

- Disturbance of the surface topography/morphology
- Disturbance of surface water flows, possible flooding, ponding, drying of areas
- Impacts on groundwater flow, decanting, loss of groundwater, borehole yields
- Disturbance of wetlands through flooding or starving of water, impacting on functionality

7.2 Geohydrology

The possible sources of contamination or infrastructure that may impact on the groundwater resources include:

- The UCG process.
- Process (dirty water) dams – overflow, seepage, or irrigation may impact on groundwater resources.
- The raw water dam - source of artificial recharge to the groundwater.
- The wastewater treatment process – seepage or irrigation of effluent may impact on groundwater.
- Potable water storage tanks - source of artificial recharge to the groundwater.
- Treated water (reverse osmosis) system – resultant wet waste brine may impact on groundwater.
- Fuel oil and stored chemicals - oil/chemicals enters water and requires treatment.
- Temporary solid waste site - source of leachate or poor quality water.
- Some sections of the operations plants e.g. workshops, batching plants, etc.
- Ash from the gasification process.

The impacts are thus related to potential artificial recharge, causing increased groundwater levels, changes in groundwater flow patterns, and the potential to cause deterioration of groundwater quality with time. Based on the available data and envisaged impacts on the groundwater resources, the following issues should be taken into consideration:

- The UCG pilot plant and associated infrastructure can potentially impact negatively on the groundwater.
- Where there are groundwater resources, the study will advise on extraction of this water and its impact on the receiving environment, including any wetlands in the area;
- Artificial recharge can increase groundwater levels directly adjacent to the water impoundments associated with the gasification process.. Groundwater levels can become elevated because of infiltration;
- Persistent sources of contaminants can alter the hydrochemistry, causing an increase in dissolved solids, hydrocarbons and metals. The sources must, therefore, be located within areas where groundwater usage or potential for use is reduced.

7.3 Hydrology

The potential impacts on hydrology include:

- Possible flooding; Surface flooding may occur as result of the artificial injection of air and/or/water as part of the UCG operation. If borehole construction is sound and verified this should not occur. The conceptual geohydrological model confirmed that the B4 dolerite sill acts as a hydraulic barrier in the area of the UCG operations and an impact on the shallow groundwater is not expected.
- Possible pollution from plant activities. Any contamination generated at the plant areas may impact on the nearby Witbankspruit a tributary of the Upper Vaal River.
- Increased runoff from disturbed areas and infrastructure;
- The volume of groundwater lost during the mining process (in terms of a water use however it should be noted that the coal seam water is not of a good quality and not suitable as drinking water);

- The likely chemistry of the water (void) post-mining as it may be contentious to assume it can be leached until equivalent to the pre-mining water quality.
- The possible impacts associated with ground/overburden collapse should this occur, both in terms of yield impacts and future decant points, time to decant and quality of decant. Possible post mining water treatment may need to be considered and budgeted for.
- If the surface is to contain waste (liquid or solid) during or post-mining through related activities, then detail on water management of these structures will be required.

A hydrological baseline and impact assessment will be conducted with the focus on these potential impacts and included in the EIA study.

7.4 Wetlands

It should be noted that any wetland occurring within the boundaries of the study area is a sensitive feature of the natural environment. This sensitivity must be equally applied to all wetlands, irrespective of their state or functionality. This 'blanket' sensitivity rating applied to all wetlands is based on a number of factors:

- The National Water Act (No 36 of 1998) affords protection to all types of surface water resources, including wetlands. The Act does not discriminate between different types of wetlands or between wetlands in a differing state of degradation.
- In the context of the biological (especially vegetative) assemblages within the study area, wetlands are typically characterised by relatively high levels of biodiversity.
- Watercourses and wetlands are often utilised as movement corridors for biota and as such are very important for the maintenance of ecosystem processes and functioning.

As all wetlands have been characterised as being sensitive, there is a basic distinction that can be made between parts of the study area in which wetlands are located, and those in which no wetlands are located. It should be noted however that areas located outside of the wetland boundaries will form part of the catchment of the wetland. In reality there is typically no distinctive boundary between the wetland and the surrounding non-wetland grassland, and the maintenance of this transition zone is critical for maintaining ecosystem processes that occur within this area. Many types of biota which inhabit wetlands utilise the surrounding areas for foraging, and are not spatially restricted to the wetland.

As such it is critical to maintain a buffer surrounding the wetlands in which no development should be allowed other than linear infrastructure, where necessary). In the case of the proposed project, a buffer of 150 m is proposed, to allow sufficient area beyond the boundary of the wetland to be preserved, and taking into account the relatively low degree of transformation associated with the gasfield. Section 6.1.8 (Chapter 6) earlier in this report indicates the presence of buffers around wetlands in the study area but it must be noted that these wetland delineations are preliminary and will need to be refined during the EIA phase.

7.4.1 Generic Potential Impacts

If the plant and associated infrastructure is located within a wetland, then the assumption has been made that the wetland is likely to be completely transformed, resulting in the complete loss of wetland habitat as well as functionality of the affected part of the wetland (and possibly the functionality of the downstream portion of the wetland). Wetland functionality can be divided up into a number of components including ecological value, hydrological functioning, water quality enhancement and socio-economic functionality, amongst others. All of these functions are intrinsically related to, and are dependent upon the physical components of the wetland, including the soils and vegetation contained within the wetland as well as other biotic components that are adapted to life within wetlands. The presence of these biotic components is in turn closely related to the nature of the hydrology of the wetland, which in the hydro-geomorphic forms found in the study area is characterised by the retention of, and diffuse flow of water through the wetland in the case of valley bottom wetlands, or the interface with groundwater (discharge) in the case of hillslope seepage wetlands.

The combination of the hydrology, hydromorphology and biota (especially vegetation) within the wetland allow certain chemical and ecological processes to occur that provide much of the wetland's functionality. If the physical characteristics of the wetland are transformed, or destroyed, the hydrology, hydromorphology and ecological assemblages within the wetland will typically be altered. The resulting impact is the loss/destruction of functionality and value of the wetland. If a development is built upon a wetland, the loss and destruction of the wetland and associated impact on functionality is often complete and irreversible. It has been assumed that this level of impact will result in the case of the proposed development if plant infrastructure is located within wetlands. However Eskom has indicated that UCG technology will not be implemented under wetlands, and it appears likely that the same consideration for the locating of the associated infrastructure (i.e. production and injection wells etc) will be applied; in this event the plant would not physically impact wetlands.

7.4.2 Construction-related Impacts

- ***General construction related impacts***
  - A lack of poor stormwater controls being put in place on the construction site. This may result in the creation of runoff containing pollutants such as cement and oils being transported by stormwater runoff into nearby drainage systems.
  - The dumping of construction material, including fill or excavated material into, or close to surface water features that may then be washed into these features.
  - Spills of hazardous materials, especially oils and other hydrocarbons that may be washed into, or infiltrate nearby surface water features.
  - The conducting of certain construction-related activities (such as cement batching) too close to surface water features or without the implementation of certain controls that may lead to the direct or indirect pollution of the surface water feature.
  - The lack of provision of ablutions that may lead to the conducting of 'informal ablutions' within or close to a surface water feature that may lead to its pollution by faecal contaminants.

  Most of these and other potential construction-related impacts can be minimised or adequately mitigated by controlling construction activities on the basis of an appropriately designed EMPr. As mentioned above, the relative proximity of the construction activities to surface water features is an important factor in the degree of risk of these construction-related impacts occurring.

These construction-related impacts apply to all associated infrastructure discussed below.

- ***Impacts related to mining areas***

  The impacts related to the setting-up of mining areas are similar to the general construction impacts discussed above. As stated above, mining areas will not be located within wetlands or their buffers and as such should have a minimal impact on wetlands, with the buffer acting to protect the wetland against any discharges or sedimentation from erosion that may develop. Access roads may need to be constructed through wetlands to link new mining areas with the existing road infrastructure.

- ***Impacts related to pipelines***

  It is not known whether the gas and water pipelines as proposed in the project scope will be buried or located above ground. If these pipelines are buried, it is likely that they will have to be routed through wetlands. If the pipelines are placed above ground, they may still affect wetlands, as they would need to cross the wetlands and the support structures for the pipeline may need to be placed within the wetland. The potential impacts discussed below relate mainly to underground pipelines.

  Owing to the nature of construction of pipelines, which normally would involve the excavation of a trench in order for the pipeline to be placed underground, the most important potential impact of the proposed pipelines

if buried on wetlands, relates to the disturbance and erosion of wetland soils. The laying of the pipeline (through the trenching method, if used) would entail the disturbance and removal of wetland vegetation, and the excavation of soils within the wetland. Water is an erosive force, and the exposed soils could be eroded, especially in the permanently wet parts of the wetlands where above ground or underground flow/seepage of water through the wetland would naturally occur. If the flow of water and seepage out of the wetland soils was not controlled, this could initiate a 'knick point' which may lead to development of gulley (donga) erosion into the upstream part of the wetland. Any eroded material would be deposited in the downstream portion, potentially causing sedimentation in that part of the wetland which may smother the existing vegetation, and leading to further impacts on this part of the wetland.

Other potential impacts relating to the construction of pipelines through wetlands include:

- the pollution of water within the wetland, through construction activities;
- the incorrect re-instatement of wetland vegetation that may result in the exposing and erosion of wetland soils; and
- the compaction of wetland soils through the use of machinery in the wetland.

All wetland/river crossings would need to be licensed under Section 21 of the National Water Act (36 of 1998).

- ***Impacts related to access roads***
  Access roads, like pipelines may also need to cross wetlands, especially those roads that may need to be built to link new mining areas with the existing road infrastructure. The potential impacts of access roads on wetlands are similar to the impacts associated with pipelines, but the primary potential impacts on wetlands are the physical disturbance of wetland soils and vegetation by construction activities that may lead to erosion of wetland soils.

- ***Impacts related to power lines***
  Power lines are not typically associated with impacts on surface water resources, as the lines would not have a physical footprint over the length of the line other than the footprint of the each tower position. As the lines are strung above the ground and the towers spaced at a certain distance apart, most wetlands and rivers are able to be 'spanned' by the lines and thus avoid being physically affected. Power lines can however be associated with impacts on surface water resources if the towers are placed within a river or wetland. The process of constructing the power lines can also cause impacts on surface water resources, especially if certain mitigation measures and procedures are not followed.

  The potential impacts related to power line construction on surface water features are similar to the generic construction-related impacts discussed above as well as the following impacts relating to road construction:

  - Inadequate stormwater management and soil stabilisation measures in cleared areas could lead to erosion that may lead to siltation of nearby wetlands.
  - The placing and use of access roads for construction traffic across wetlands may lead to the erosion of banks and disturbance of wetland vegetation that may trigger the further development of gulley (donga) erosion.
  - Construction of access across wetlands may impede the natural flow of water (especially if access is required across running water). This would alter the hydrology of the wetland and potentially act as a barrier to the movement of aquatic biota. Uncontrolled access of vehicles through wetlands can cause a significant adverse impact on the hydrology and soil structure of these areas through rutting which can act as flow conduits and through the compaction of soils.

7.4.3 Operation-related Impacts

- ***Impacts related to mining areas***

  As discussed above, mining areas will not be located within wetlands or their buffers and as such should have a minimal impact on wetlands, with the buffer acting to protect the wetland against any potential pollutants that may emanate from the above-ground mining operations.

  However the mining operations may have an indirect, but potentially significant impact on wetlands on the site. One of the potential impacts identified to be associated with the proposed subterranean operations is the potential subsidence of the ground in areas above mining operations. Under a worst-case scenario, the subsidence of ground at the surface may be up to 75 cm below original ground level. It is not known how widely this subsidence would take place across mining areas, and whether it would be localised; however when the policy of non-undermining of wetland areas and associated buffer zones is taken into account this may result in localised variations in micro-topography in certain parts of the catchments of wetlands. This may have significant impacts on the water inputs to the wetland from the catchment as the subsidence could conceivably result in a 'ridge' or embankment forming within part of the wetland's immediate catchment whereby the 'upslope' areas could be lower than the downslope areas. This effect could significantly disrupt the overland flow of water from the upslope catchment into the wetland, which due to the highly vertic soils across much of the study area is the most important aspect of the hydrology of wetlands and their catchments. The subsidence may prevent water which would normally move downslope through colluvial processes towards the wetland from reaching the wetland. This subsidence may also conceivably have an impact upon the discharge of shallow groundwater to hillslope seepage wetlands in the area.

  The dynamics of the potential subsidence are unknown at this stage, and will need to be quantified in order to allow the potential impact on wetlands and local catchment hydrological inputs to wetlands in the study area to be further investigated and quantified.

- ***Impacts related to the proposed irrigation of the site***

  In the process of fuel gas extraction a large quantity of deep aquifer water and condensate is entrained in the gas stream. Eskom proposes to treat the condensate in an effluent treatment process. The UCG process generates condensate effluent – approximately 10 tpd or 10m^3/day. Eskom have proposed that the treated condensate stream be considered suitable for irrigation. As this irrigation water would be discharged into the environment, potentially impacting wetlands, the impacts of this aspect of the proposed project need to be scoped. The irrigation of the site could impact wetlands and the wider surface water resource on the site in two ways, in terms of water quality impacts and hydrology impacts.

  The likely nature of the impacts of irrigation on the site will need to be further assessed in the EIA phase, especially if more detailed information on planned irrigation practices is available.

- ***Impacts related to pipelines***

  As discussed above, impacts related to pipelines in the operational phase of the project could be manifested as a result of poor construction techniques, or poor pipeline design that may result in permanent impacts on the wetland through which the pipeline runs. Poor rehabilitation of wetland vegetation may result in an impact on the vegetative composition of the wetland post-construction. The creation of preferential drainage through the pipeline trench, thus affecting the hydrology of the wetland, may also result if the pipeline trench is filled with more easily draining material than the wetland substrate.

- ***Impacts related to access roads***

  The primary potential impacts on wetlands related to roads in the operational phase of the life of the proposed development are:

- The alteration of the hydrology and hydromorphology of the wetland due to the placing of the road in the wetland; if too few culverts are placed under the road, the road will act as an impoundment.
- The introduction of pollutants and other toxicants into the wetland from stormwater off the road that carries fuel/oil spilt onto the road surface.
- The poor maintenance of the road, both in the catchment of the wetland, which could introduce sediments into the wetland through stormwater wash-off of eroded material, or within the wetland, which could lead to erosion of the wetland in the vicinity of the road.

- ***Impacts associated with polluted runoff water***
  Runoff water, including stormwater that may be polluted could run off the site and into nearby drainage lines. This applies especially to runoff water from any areas in which fuel or hydrocarbons are stored, other wastewater storage areas, or from sewage treatment areas. If this polluted runoff were to reach and infiltrate any nearby wetland, it could result in a degradation of water quality and the pollution of downstream parts of the drainage system and even groundwater. This scenario would apply especially in the case of an accidental spillage or failure of lined storage dams causing seepage into the ground from the dam.

  The level of potential risk would be dependent upon the proximity of the plant to surface water resources, the interaction between groundwater and surface water features (i.e. whether there were any areas of groundwater discharge) and the nature and level of mitigation measures instituted at the plant. It is however expected that design and maintenance controls that could be implemented at the plant would be able to significantly limit the risk of this type of impact from occurring.

- ***Water treatment infrastructure***
  The water treatment infrastructure associated with the plant may result in the discharge of 'grey' water into nearby drainage systems. Should treated water need to be discharged into nearby drainage systems, this may alter the hydrology and hydromorpholgy of the drainage line if the discharge was permanent. However, in line with Eskom's no discharge policy, no water is expected to be discharged from the plant and associated infrastructure into the adjacent environment from water treatment infrastructure.

- ***Impacts related to power lines***
  Impacts on water resources may result during the operational phase of the power line through poor operational and servitude management practices. These would relate mainly to residual impacts that arose during the construction phase, as well as due to the incorrect rehabilitation of construction-related access. Certain operational activities such as the clearing of the servitude through the use of herbicides may also pollute nearby watercourses if not properly undertaken. Operational access for vehicles to inspect the servitude and lines may impact watercourses and other wetlands if existing access roads/routes are not utilised.

7.4.4 Decommissioning Impacts

The potential impacts on wetlands related to the decommissioning of infrastructure are similar in many aspects to construction-related impacts, if infrastructure such as buildings is physically removed.

As the plant would contain materials which could potentially act as pollutants to surface water resources, the proper post-operation rehabilitation and removal of any material that could cause pollution of water resources through seepage or stormwater runoff is important. Should this not be undertaken, or improperly undertaken, a residual impact related to the plant and its infrastructure such as fuel/hydrocarbon storage tanks or wastewater storage dams on surface water resources could result. The risk of this impact depends on the proximity of

infrastructure to surface water receptors, and to links between groundwater and surface water resources in the case of seepage of pollutants into the ground that may pollute groundwater.

Decommissioning of mining areas after the 5-year operational life of the particular mining area could result in 'knock-on' impacts on wetlands, if the decommissioning of these mining areas is not properly undertaken. These mining areas would not be located within wetlands or their associated buffers; however any residual impacts of mining activities such as development of soil erosion or improperly maintained roads may result in secondary impacts on nearby wetlands through the extension of erosion into the wetland or deposition of silt into the wetlands. Similarly, any potential pollutants such as fuels/hydrocarbons left within the mining footprint may cause pollution of surface water resources through stormwater runoff. The risk of decommissioning residual impacts on wetlands is minimised the further away mining areas are located from wetlands.

7.5 Soils and Agricultural Potential

The interpretation of the land use, land capability and reconnaissance soil survey results yielded a number of aspects that are of importance to the project.

7.5.1 Agricultural Potential

The agricultural potential of the site varies due to soil conditions. Large areas are covered by shallow soils that are of low potential. The higher potential soils have to a large extent already been tilled and are currently being used for dryland agriculture. The potential of the areas under crop production varies from low to high due to a range of soil conditions. In many cases these soils are structured and of high clay content but of limited depth. The main land use is grazing and it is also this land use that is considered to be the most viable for the bulk of the area.

7.5.2 Overall Soil Impacts

The overall impacts on the soil of the site due to the proposed project are not significant; however, impacts associated with the mining activities on the farm are significant.

Due to the dominantly low agricultural potential of the site, the broader significance of these impacts is not considered to be significant and impacts will therefore be localised to the immediate site.

7.6 Biodiversity

The following impacts/issues were identified that could affect the biodiversity of the study area adversely:

- Potential impacts on the local and regional biodiversity;
- Potential impacts on sensitive/pristine habitat types;
- Potential impacts on threatened/protected species and habitat;
- Potential impacts on surrounding habitat and species; and
- Potential impacts on fauna species.

Impacts of a cumulative nature include:

- Potential increase in habitat transformation (e.g. loss of habitat);
- Potential increase in habitat fragmentation (e.g. loss of migratory routes); and
- Potential increase in environmental degradation (e.g. loss of habitat quality).

Direct impacts, such as physical habitat destruction and modifications, are regarded immediate, long-term and of high significance. These are the impacts that will be addressed in this ESS as well as the subsequent EIA

studies, since they are measurable and the immediate impact thereof can be determined to an acceptable level of certainty.

However, more subtle impacts on biological components, such as effects of aerial pollutants on flora and fauna species, increase in aerial borne dust, changes in local, regional and global climate, effects of noise pollution on fauna species, effects of electro- magnetic fields (EMF) on fauna species, acid rain and groundwater deterioration are impacts that cannot be quantified to an acceptable level of certainty and is mostly subjective in nature, as very little applicable literature is available. However, these impacts are interrelated to abovementioned impacts.

7.6.1 Direct Impact - Potential Impacts on Local and Regional Biodiversity

The transformation of grassland habitat during the construction process will inevitably result in the establishment of habitat types that are not considered representative of the region. As a result of the severity of transformation, surrounding areas are frequently invaded by species not normally associated with the region.

If left unmitigated, this risk will result in decreased habitat, increased competition and lower numbers of endemic biota; the genetic pool of species might eventually be influenced by the introduction of non-endemic species. Different faunal assemblages have developed separate gene structures as a result of habitat selection and geographical separation and the introduction of animals of the same species that might be genetically dissimilar to the endemic species might lead to different genetic selection structures, eventually affecting the genetic structure of current populations.

7.6.2 Direct Impact - Potential Impacts on Sensitive/Pristine Habitat Types

Sensitive habitat types include ridges, koppies, wetlands, rivers, streams and localised habitat types of significant physiognomic variation and unique species composition. These areas represent centres of atypical habitat and contain biological attributes that are not frequently encountered in the greater surrounds. A high conservation value is attributed to the floristic communities and faunal assemblages of these areas as they contribute significantly to the biodiversity of a region. Furthermore, these habitat types are generally isolated and are frequently linear in nature, such as rivers and ridges. Any impact that disrupts this continuous linear nature will risk fragmentation and isolation of existing ecological units, affecting the migration potential of some fauna species adversely, pollinator species in particular.

7.6.3 Direct Impact - Potential Destruction of Threatened and Protected Species Habitat

The loss of Red Data or Threatened species or areas that are suitable for these species is a significant impact on the biodiversity of a region. Threatened species, in most cases, do not contribute significantly to the biodiversity of an area in terms of sheer numbers as there are generally few of them, but they are extremely important in terms of the biodiversity of an area and high ecological value is placed on the presence of such species in an area. Threatened species are particularly sensitive to changes in their environment, having adapted to specific habitat requirements. Habitat changes, mostly a result of human interferences and activities, are one of the greatest reasons for these species having a threatened status.

The level of transformation on a local and regional scale is not clearly understood at this stage and areas where similar activities are practiced will be investigated during the EIA phase of the project in order to assess the levels of changes to particularly the floristic component and structure. At this stage it will suffice to state that any level of surface transformation within all habitat types of medium or higher ecological sensitivity is significant. Habitat types of particular importance include natural grasslands (Soweto Highveld Grassland), ridges and wetland related habitat types. Effects of this impact are usually permanent and recovery or mitigation is generally not perceived as possible.

It should be noted that the estimated presence of Red Data flora and fauna species for the area is regarded highly likely, particularly in the wetland habitat types. Impacts on potential communities of Red Data species are therefore regarded likely to happen.

7.6.4 Direct Impact - Impacts on Surrounding Natural Habitat and Species

Surrounding areas and species present in the direct vicinity of the study area could be affected by impacts resulting from construction and maintenance activities. These impacts could include all of the above impacts, depending on the sensitivity and status of surrounding habitat and species as well as the extent of impact activities.

7.6.5 Direct Impact - Impacts on Fauna Species

It should be noted that animals generally avoid contact with human structures, but do grow accustomed to structures after a period. However, the interaction of animals with the construction and operational areas cannot be avoided entirely and due care must be taken to avoid accidental injuries and death. Of greater concern is the contact between wild animals and personnel that will be employed for the proposed development. Contact between animals, particularly reptiles and scorpions might lead to injuries and death of personnel, while human activities such as littering, poaching, vehicular accidents, illegal collection, etc. will have an adverse impact on some of the smaller fauna species. Some impacts of this nature are expected to occur, but can be avoided through mitigation.

7.6.6 Cumulative Impact - Potential increase in habitat transformation

The development of any industry in a natural environment that is largely characterised by habitat of untransformed status can generally be described as ‘the thin end of the wedge’, implying that subsequent developments will not be viewed as similarly important since areas of existing transformation already exists in the region.

The loss of natural habitat, even small areas, implies that biological attributes have permanently lost that ability of occupying that space, effectively meaning that a higher premium is placed on available food, water and habitat resources. This, in some instances might mean that the viable population of plants or animals in a region will decrease proportionally with the loss of habitat, eventually decreasing beyond a viable population size. The danger in cumulative impacts is that effects are not known, or is not visible; with immediate effect and normally, when these effects become visible they are beyond repair.

7.6.7 Cumulative Impact - Potential increase in habitat fragmentation

Uninterrupted habitat is a precious commodity for biological attributes in modern times, particularly in areas that are characterised by moderate and high levels of transformation. Similar to the regional loss due to habitat transformation, a development of this nature in a largely untransformed area can be seen as the ‘thin end of the wedge’. However, nodal developments do not have the same effect on fragmentation of habitat as linear structures that are associated with developments. These types of developments generally include roads, pipelines, conveyor belts, transmission and distribution lines, etc., affecting the migratory success of animals in particular.

7.6.8 Cumulative Impact - Potential increase in environmental degradation

Impacts associated with this type of development that will lead to initial, incremental or augmentation of existing types of environmental degradation, include impacts on the air, soil and water present within available habitat. Pollution of these elements might not always be immediately visible or readily quantifiable, but incremental or fractional increases might rise to levels where biological attributes could be affected adversely on a local or regional scale. In most cases these effects are not bound and is dispersed, or diluted over an area that is much larger than the actual footprint of the causal factor.

Similarly, developments in untransformed and pristine areas are usually not characterised by visibly significant environmental degradation and these impacts are usually most prevalent in areas where continuous and long-term impacts have been experienced. Particular reference is made to the use of process water for irrigation purposes.

8 POTENTIAL ENVIRONMENTAL IMPACTS – SOCIAL

8.1 Baseline Social Assessment

For the purposes of this Environmental Scoping Study (ESS), the impact variables were categorised in terms of change processes as described below. A change process can be defined as change that takes place within the receiving environment as a result of a direct or indirect intervention. A potential impact follows as a result of the change process. However, a change process can only result in an impact once it is experienced as such by an individual/community on a physical and/or cognitive level.

The categories of processes are as follows:

- Geographical Processes: the land use pattern within the (affected) area;
- Demographical Processes: the number and composition of the local population;
- Empowerment and Institutional Processes: people's ability to become actively involved and influence the decision-making process, and also the efficiency and operation of local authorities and other significant organisations; and
- Socio-Cultural Processes: the way in which humans interact and relate to each other within the context of their environment, and how this interaction is guided by value systems.

8.1.1 Geographical Change Processes

The UCG pilot plant and associated infrastructure might lead to a change in the land use within the local area. The assessment of a land use change process from a social perspective takes into account how the proposed project, such as pipelines, might affect the behaviour/lives of landowners and/or land users.

Table 22 below provides an overview of the expected change process as well as the expected impacts that might occur as a result of the change process taking place. These potential impacts will be assessed in detail during the Impact Assessment phase.

Table 22: Overview of expected geographical change processes and potential impacts

Expected Change Process		Yes	No	Expected Impact	Project Phase	Status
Access to environmental resources	Will the development impact on people's access to environmental resources, such as water, wood, medicinal plants etc?		**X**	No impact foreseen.	N/A	N/A
Change in access to resources that sustain livelihoods	Will the development impact on people's (legal or illegal, formal or informal) access to environmental resources that help to sustain their livelihoods, e.g. grazing land for their cattle; wood for heat/cooking/selling, etc?		**X**	No impact foreseen on the farm Roodekopjes (Eskom property). A temporary loss of cultivated and grazing land due to construction activities can be expected on neighbouring farms if associated infrastructure such as pipelines, access roads cross these farms but this is unlikely as UCG operations will be confined to the farm Roodekopjes for now.	Construction and Operation	Negative
Land acquisition and disposal,	Will the development contribute to or directly impact on the ability of local residents		**X**	No impact foreseen – the majority of the farm Roodekopjes belongs to	N/A	N/A

Expected Change Process		Yes	No	Expected Impact	Project Phase	Status
including availability of land	to keep or acquire property/land?			Eskom.		
	Will the development set a precedent for change in land use in the area?	**X**		Eskom will extend the programme to develop a fully operational plant as well as implementing the UCG technology on other surrounding farms. In such a case, the presence of a commercial plant and its associated infrastructure might prohibit future developments encroaching upon the plant footprint or pipeline servitudes, which means that land is lost for development and mining will be extended over these areas.	Operation	Negative to Neutral

8.1.2 Demographical Change Processes

The UCG pilot plant and associated infrastructure could lead to a change in the number and composition of the population within the affected local areas, which in turn could lead to economic, land use, and socio-cultural change processes.

Table 23 provides an overview of the expected demographical change processes to occur as well as the expected impacts that might occur as a result of these change processes taking place. The potential impact(s) that follow from a particular change process taking place will be assessed in detail during the Impact Assessment phase.

Table 23: Overview of expected demographic change processes and potential impacts

Expected Change Process		Yes	No	Expected Impact	Project Phase	Status
Population change	Will the development lead to an increase in numbers of a certain section of the population, e.g. migratory workers?		**X**	Influx of construction workers that could lead to a change in the number and composition of the local community, and impact on economy, health, safety and social well-being.	Construction	Negative to Neutral
In-migration of unemployed work seekers	Will the development intentionally or unintentionally contribute to the in-migration of work seekers into the area?	**X**		Influx of job seekers that will lead to a change in the number and composition of the local community, and impact on economy, health, safety and social well-being.	Construction and possibly Operation	Negative
Relocation or displacement of individuals or families	Will the development at this or future stages lead to the relocation of residents?		**X**	Residents who are affected have already been relocated and the farm Roodekopjes is owned by Eskom.	Pre-construction	Mitigated

8.1.3 Empowerment and Institutional Change Processes

The EIA process is an opportunity for stakeholders to give input into the process and project. However, stakeholders would have to offer up their time to become actively involved in the process and they should clearly understand their rights in terms of the process to enable them to use these rights to influence the process. Furthermore, most notably during construction, the proposed project would most probably utilise local municipal services such as electricity, sanitation, water and refuse services. If these services are not available, or not sufficient, this in turn could impact on communities in terms of health and safety.

Table 24 below provides an overview of the expected institutional and empowerment change processes as well as the expected impacts that might occur as a result of the change processes taking place. These potential impacts will be assessed in detail during the Impact Assessment phase.

Table 24: Overview of expected empowerment and institutional change processes and potential impacts

Expected Change Process		Yes	No	Expected Impact	Project Phase	Status
Change in/disruption of power relationships	Will the development impact on the levels of power, opportunity and access of individuals or sections of the community, e.g. during the negotiation process?		**X**	No impact foreseen.	n/a	n/a
	Is the development being used for the political gain of a section of the community, and what are the implications for the larger social environment?		**X**	No impact foreseen.	n/a	n/a
Exclusivity	Will the development contribute to the culture of exclusivity?		**X**	No impact foreseen.	n/a	n/a
Inequality	Will the development increase unequal access to opportunities or resources?		**X**	No impact foreseen.	n/a	n/a
Change in community infrastructure	Will the development change any aspect of community infrastructure, such as crèches, clinics, schools, churches, formal or informal sports fields, open areas, dumping grounds etc?		**X**	No impact foreseen.	n/a	n/a
	Will the development create increased demand for basic services, e.g. water, electricity, sewerage, roads?		**X**	No impact foreseen.	Construction	Negative
	Will the existing access of the community to free		X	No impact foreseen.	n/a	n/a

Expected Change Process		Yes	No	Expected Impact	Project Phase	Status
	basic services be impacted by the development?					
Change in housing needs/demands	Will the development create a housing need, e.g. due to the in-migration of construction workers? Has the need for more housing been addressed by the development and or the authorities?	**X**		It is possible that the majority of the construction workforce would be sourced from within the area due to the skills levels required. The specialised workforce would likely be sourced from outside the area and would most probably be housed within neighbouring towns or a construction village.	Construction	Negative to neutral

8.1.4 Socio-cultural Change Processes

Socio-cultural change processes that are associated with the construction and operation of the proposed project include changes such as health and safety aspects and sense of place. The concept of 'health' is not only limited to physical health (i.e. the absence of ailments or illness), but also includes mental and social health. The expected changes that can occur in relation to health and safety aspects can be as a result of the presence of the proposed project and associated infrastructure (such as elevated, above ground pipelines) during operation, as well as the presence of construction workers and/or job seekers during construction.

Table 25 below provides an overview of the expected change process as well as the expected impacts that might occur as a result of the change process taking place. These potential impacts will be assessed in detail during the Impact Assessment phase.

Table 25: Overview of expected socio-cultural change processes and potential impacts

Expected Change Process		Yes	No	Expected Impact	Project Phase	Status
Disruption of social networks	Will the development impact on existing social networks?		X	No impact foreseen.	n/a	n/a
Disruption in daily living and movement patterns	Will the development change the lifestyle of residents?		X	No impact foreseen.	n/a	n/a
	Will the development impact on access to facilities and resources, such as schools, hospitals, fields, forests, etc?		X	No impact foreseen.	n/a	n/a
Dissimilarity in social practices	Do new residents have dissimilar social practices to current residents?	**Unsure**		If construction workers have dissimilar social practices than local residents, conflict can be expected.	Construction	Negative
	Do the new residents have different values, religious practices, social standard, etc?					
Alteration in family structure	Could the development threaten family cohesiveness?	X		Socially acceptable integration, including the risk of spreading STIs and HIV/AIDS with an impact on health. Apart from the obvious health implications, HIV infection in particular also has an economic impact as well as impacts on family structures in terms of roles and responsibilities.	Construction	Negative
	Could it impact on immediate or extended family networks?	X				
	Could it impact on the traditional roles played by members of the family?	X				
Conflict	Will the development lead to conflict between sectors of the social environment?	**Unsure**		If social integration between newcomers and residents is hindered, it can lead to conflict, which in turn delays the construction process and has economic implications for the developer.	Construction	Negative
	Is there conflict between the developer and the public?	**Unsure**		Where conflict exists, it increases the risk for social mobilisation, with resultant delays on the project and an economic impact on both the project proponent and project opponent.	Pre-construction and construction	Negative
	Is this conflict being addressed?					
Safety and crime impacts	Will the development impact on existing crime and safety patterns?	X		Presence of construction workers and job seekers leads people to believe that there will be an increase in crime, which impacts on surrounding landowners' sense of safety and	Construction	Negative

Expected Change Process		Yes	No	Expected Impact	Project Phase	Status
				security.		
Change in sense of place	Will the development impact on people's "sense of place", e.g. through the large-scale development of a rural community?	**Possible**		Although the UCG pilot plant will be located on Eskom property and within an area with similar developments, it is surrounded by farm land and different land uses.	Construction and Operation	Negative
	Will the change "in sense of place" impact on people's relationship to the environment?					
Implications for social history	Does the development have any implications for the social history of affected communities?		X	No impact foreseen.	n/a	n/a

8.2 Air Quality

8.2.1 Construction Phase

Construction is usually temporary in nature and consists of a series of actions of known duration and extent. Thus dust emissions generated at a construction site have a definite beginning and end and will vary substantially over the period of construction. The quantity of dust emissions from construction activities is proportional to the area of land being worked, the level of construction activity and the prevailing meteorological conditions.

The following possible sources of fugitive dust and particulate emissions were identified as activities which could potentially generate air pollution during construction operations:

a) Demolition and debris removal
   - Demolition of obstacles such as boulders, trees, etc.
   - Loading of debris into trucks
   - Truck transport of debris
   - Truck unloading of debris

b) Site preparation (earthworks)
   - Bulldozing
   - Scrapers unloading topsoil
   - Scrapers in travel
   - Scrapers removing topsoil
   - Loading of excavated material into trucks
   - Truck dumping of fill material, road base, or other materials
   - Compacting
   - Motor grading
   - Excavating

c) General Construction
   - Vehicular traffic
   - Portable plants – aggregate processing and
   - Concrete Mixing

The following components of the environment may be impacted upon during the construction phase:

i. Ambient air quality;
ii. Local residents and neighbouring communities;
iii. The aesthetic environment; and
iv. Fauna and flora.

The impact on air quality by fugitive dust is dependent on the quantity and drift potential of the dust particles. Large particles settle out near the source causing a local nuisance problem. Fine particles can be dispersed over much greater distances. Fugitive dust may have significant adverse impacts such as reduced visibility, soiling of buildings and materials, reduced growth and production in vegetation and may affect sensitive industries and aesthetics. The inhalable particulate fraction could adversely affect human health.

Short-term impacts on the local air quality of a negative nature will occur as a result of construction activities at the pilot plant and associated infrastructure. Impacts are however expected to be more of a nuisance value than a potential health risk. Construction traffic, excavation, earthmoving, and aggregate processing facilities will generate dust. Short-term increases in sulphur oxides, nitrogen oxides, and hydrocarbons from vehicle exhaust will occur, but air quality is not expected to deteriorate significantly over the long-term as a result of construction activities. It is expected that air quality will be poorer during the winter months as a result of temperature inversions common over the region in the colder months and the cumulative effects of pollution caused by the burning of coal and wood in households, and from veld fires common in winter.

Sensitive receptors were identified in close proximity to the site. Considering the prevailing winds has a strong easterly and westerly component, it is predicted that construction activities could potentially impact predominantly on farms and farm houses lying to the east and west of the construction site. Amersfoort and eZamokuhle towns are located approximately 4.7 km north east from the proposed study area and impacts due to construction are therefore anticipated to be low. The communities Vlakplaats and Daggakraal lie approximately 6 km east of the proposed study area, and impacts as a result of construction will vary depending on varying wind speeds experienced during the construction period.

8.2.2 Operational Phase

This section aims to deal with the estimated air quality impacts which result due to the plant operations. Details regarding the source characteristics were provided from a site layout plan provided.

- Gas released from potential storage tanks;
- Drilling of injection and production wells on a regular basis;
- Flue gas as released from the flare of the UCG pilot plant and safety valves during regular or upset conditions;
- Fugitive emissions as a result of minor piping system leaks;
- Release of condensate from the gas treatment plant;
- Material transfer operations;
- Wind erosion from exposed storage piles (sand for construction); and
- Vehicle entrained dust from both paved and unpaved road surfaces.

8.2.2.1 Operational Losses from Storage Tanks

Operational and breathing losses are often experienced from storage tanks, particularly when used as buffer tanks, or tanks which are refilled regularly. These emissions are often as a result of refilling when excess air and gas is vented from the tanks.

8.2.2.2 Pressure Release and Upset Conditions

Temperature and pressure changes within the tanks and pipeline can result in gases being vented in order to ensure the safety and integrity of the equipment. This venting is usually during upset or emergency conditions and will not be present under normal operating periods.

8.2.2.3 Condensate Release

Condensate is a classification of all impurities removed from the gas at the treatment plant. This product contains a wide and varying array of chemicals, many of which are oil and sulphur based, which give a very noticeable odour when released. Condensate, while a waste from the gas purification plant, can be sold as a by-product to companies who can extract various other products.

8.2.2.4 Material Transfer Operation

Materials handling operations refers to the transfer of various raw materials and waste products by means of tipping, loading and off-loading of trucks and conveyor transfer operations. Emission rates calculated using the United States Environmental Protection Agency (USEPA) emission factors for these source types, are dependent on the material moisture content and the wind speed at the time.

8.2.2.5 Wind Erosion from Exposed Storage Piles

Windblown dust (wind erosion) from exposed storage piles can be a significant contributor to particulate emissions on-site, especially when large quantities of material are stored at any given point.

8.2.2.6 Vehicle Entrained Dust from Road Surfaces

The force of the wheels of vehicles travelling on unpaved roadways causes the pulverisation of surface material. Particles are lifted and dropped from the rotating wheels, and the road surface is exposed to strong air currents in

turbulent shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed. The quantity of dust emissions from unpaved roads varies linearly with the volume of traffic .

Also emitted from vehicles are various gaseous emissions from vehicle tailpipes. Exhaust fumes contain nitrogen, oxygen, carbon monoxide, water vapour, sulphur dioxide, nitrogen oxide, volatile hydrocarbons and polyaromatic hydrocarbons (PAHs) and their derivatives, acetylaldehyde, benzene and formaldehyde, carbon particles, sulphates, aldehydes, alkanes, and alkenes.

8.2.2.7 Decommissioning Phase

The decommissioning phase is associated with activities related to the demolition of infrastructure and the rehabilitation of disturbed areas. The following activities are associated with the decommissioning phase:

- Existing buildings and structures demolished, rubble removed and the area levelled;
- Remaining exposed excavated areas filled and levelled using overburden;
- Topsoil replaced using topsoil recovered from stockpiles; and
- Land and permanent waste piles prepared for re-vegetation.

Possible sources of fugitive dust emission during the closure and post-closure phase include:

- Grading of sites;
- Infrastructure demolition;
- Infrastructure rubble piles;
- Transport and dumping of building rubble;
- Transport and dumping of topsoil; and
- Preparation of soil for re-vegetation – ploughing and addition of fertiliser, compost etc.

Exposed soil is often prone to erosion by water. The erodability of soil depends on the amount of rainfall and its intensity, soil type and structure, slope of the terrain and the amount of vegetation cover. Re-vegetation of exposed areas for long-term dust and water erosion control is commonly used and is the most cost-effective option. Plant roots bind the soil, and vegetation cover breaks the impact of falling raindrops, thus preventing wind and water erosion. Plants used for re-vegetation should be indigenous to the area, hardy, fast-growing, nitrogen-fixing, provide high plant cover, be adapted to growing on exposed and disturbed soil (pioneer plants) and should easily be propagated by seed or cuttings.

8.3 Waste

8.3.1 Waste generated during Construction

8.3.1.1 General Waste

Workers will generate municipal waste such as food wastes, packaging and wastepaper. It is estimated that this is approximately 1.07 kg / employee/ day[9]. It is proposed that the waste streams generated is characterised and accurate quantities are determined. Disposal of this waste to a general waste site must be ensured.

8.3.1.2 Waste Material from Construction of Surface Structures/Site Formation during Project Construction

The waste material such as topsoil, vegetation, boulders and construction and demolition material will be generated. The volumes to be cleared will be progressive and this should be indicated on the waste operational plan which will then be integrated into the Environmental Management Programme. Clearance area and volumes

[9] http://www.env.gov.bc.ca/epd/mun-waste/waste-solid/landfills/monitoring/index.htm

will determine the extent and quantities of waste. A waste hierarchy plan can then be developed to ensure the waste management hierarchy is implemented.

This waste should be sorted and excavated topsoil segregated from roots for re-use in landscaping works, thus eliminating the need for off-site disposal.

8.3.1.3 Construction and Demolition Waste

These materials should be segregated and stored in different containers to other wastes to encourage the re-use or recycling of materials and their proper disposal.

8.3.1.4 Fuels, oils and other wastes

These must as far as possible be recycled. Should this not be possible, an accredited service provider should be engaged to dispose of these. The above will be carefully considered during the EIA phase of the project.

8.3.2 Waste generated during Operation

A concern at this stage is the condensate and the approach to managing this. It is imperative that a proper classification is carried out to confirm the exact components of the condensate. Section 3.3 and Table 15 of this report indicates some approach to the handling of the waste streams. The precautionary approach should be undertaken to ensure that the protection of the environment is prioritised. Table 26 endeavours to assess the most acceptable means of handling and disposing of the condensate streams. This is based on the DWAF Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste (1998). A priority would be to ensure that the waste streams are properly classified according to the applicable standards.

Table 26: DWAF Minimum Requirements classification and technology applicable

Component	Primary function	Applicability
Benzene	Industrial group F(2) (Production of primary chemicals and feedstocks)	The requirement for pre-treatment and disposal are approximately set in accordance with the waste classification. Hazardous waste handling, transportation and storage are addressed. Please note that the classification will have to be confirmed as per the SANS 10234. One of the objectives of "The Minimum Requirements for the disposal of hazardous waste" is to promote the avoidance, re-use, recycling and treatment of waste. Hazard rating: 3 SANS 10228 Class: 3.2(II) Acceptable Environmental Risk ppm: 2.2 Preferred Technology: Recovery and Incineration Allowed Technology: Encapsulation, landfill ashblend Unacceptable Technology: Landfilling without treatment

Component	Primary function	Applicability
Toluene (S)	Industrial group F(2) (Production of primary chemicals and feedstocks)	The requirement for pre-treatment and disposal are approximately set in accordance with the waste classification as per DWAF Minimum requirements. Hazardous waste handling, transportation and storage are addressed. Please note that the classification will have to be confirmed as per the SANS 10234. One of the objectives of "The Minimum Requirements for the disposal of hazardous waste" is to promote the avoidance, re-use, recycling and treatment of waste. Hazard rating: 3 SANS 10228 Class: 3.2(II) Acceptable Environmental Risk ppm: 1.3 Preferred Technology: Recovery and Incineration Allowed Technology: Encapsulation, landfill ashblend Unacceptable Technology: Landfilling without treatment
m, p - & o-Xylene (S)	Industrial group C(2) (Petroleum & Gas Industry including Extraction & Refined Products).	The requirement for pre-treatment and disposal are approximately set in accordance with the waste classification. Hazardous waste handling, transportation and storage are addressed. Please note that the classification will have to be confirmed as per the SANS 10234. One of the objectives of "The Minimum Requirements for the disposal of hazardous waste" is to promote the avoidance, re-use, recycling and treatment of waste. Hazard rating: 3 SANS 10228 Class: 3.2(II) Acceptable Environmental Risk ppm: 1.1 Preferred Technology: Recovery and Incineration Allowed Technology: Landfill ashblend Unacceptable Technology: Landfilling without treatment
Naphthalene	Industrial group F(3) (Production of fine chemicals)	The requirement for pre-treatment and disposal are approximately set in accordance with the waste classification. Hazardous waste handling, transportation and storage are addressed. Please note that the classification will have to be confirmed as per the SANS 10234.

Component	Primary function	Applicability
		One of the objectives of "The Minimum Requirements for the disposal of hazardous waste" is to promote the avoidance, re-use, recycling and treatment of waste. Hazard rating:2/ 3 SANS 10228 Class: 4.1(III) Acceptable Environmental Risk ppm: 0.38 Preferred Technology: Recovery and Incineration Allowed Technology: Landfill Co-dispose Unacceptable Technology: -
Phenol	Industrial group F(3) (Production of fine chemicals)	The requirement for pre-treatment and disposal are approximately set in accordance with the waste classification. Hazardous waste handling, transportation and storage are addressed. Please note that the classification will have to be confirmed as per the SANS 10234. One of the objectives of "The Minimum Requirements for the disposal of hazardous waste" is to promote the avoidance, re-use, recycling and treatment of waste. Hazard rating: 3 SANS 10228 Class: 6.1(II) Acceptable Environmental Risk ppm: 2.3 Preferred Technology: Recovery and Incineration Allowed Technology: Landfill co-dispose, landfill ashblend Unacceptable Technology: -
2-Methylphenol	Not shown	Not shown
4-Methylphenol	Not Shown	Not shown
Other Organics		Specific breakdown of the constituents required.
Ammonia	Industrial group F(2) (Production of primary chemicals and feedstocks)	The requirement for pre-treatment and disposal are approximately set in accordance with the waste classification. Hazardous waste handling, transportation and storage are addressed. Please note that the classification will have to be confirmed as per the SANS 10234. One of the objectives of "The Minimum Requirements for the disposal of hazardous waste" is to promote the avoidance, re-use, recycling and treatment of waste.

Component	Primary function	Applicability
		Hazard rating: 1 SANS 10228 Class: 8(III) Acceptable Environmental Risk ppm: 0.0024 Preferred Technology: Recovery Allowed Technology: Encapsulation, landfill ashblend Unacceptable Technology: -
Brine	Not shown	Not shown

8.4 Visual

8.4.1 Gas Field

The gas field will consist of a network of surface pipes connected to the production wells. As the mining operation moves after fresh coal, these pipes will be moved on surface, while already gasified areas will be stripped of all surface pipe work. This type of operation will uniquely alter the visual appearance of the plant in relation to the surrounding environment with a consequent change of visual impact.

This should be further investigated in the EIA report and more details with regard to the spatial layout and dimensions should be made available for inclusion in the study.

Photograph 3: UCG pilot plant on the farm Roodekopjes

Photograph 3 gives an indication of the visual appearance and the spatial extent of a UCG pilot gas field. The low vertical dimensions of the pipes are noted. Vertical intrusion of the horizon is a major factor in creating visual impacts, and in this instance the visual impact is minimised by the low density and relative small dimensions of

the pipe work. According to Photograph 3 the gas field displays a relative small footprint. The impact on the surrounding area can be minimised, as is illustrated in the case of Majuba showing that the grass fields are fairly undisturbed.

8.4.2 Night Lighting

The effect of night lighting has not been addressed during this phase of the project. More detailed information with regard to lighting sources needs to be obtained for further analysis.

8.5 Micro-economic Assessment

8.5.1 Possible Economic Change Processes (as a result of the project)

8.5.1.1 Local or Regional Production Gain and/or Loss

There is likely to be a loss in agricultural production in the long-term due to the project as land use changes are involved. If rehabilitation is carried out correctly, agricultural production may be initiated again after project closure.

8.5.1.2 Local or Regional Employment Gain and/or Loss

There is also likely to be a loss in agricultural employment in the long-term due to the project as land use changes are involved. This will be offset (the extent to be determined) by the number of jobs created by the project. If rehabilitation is carried out correctly, agricultural related employment may be initiated again after project closure.

8.5.1.3 Multiplier Effects of the above Impacts that can be modelled at a Regional or Local Level

As certain suppliers production activities and consumer spending are indirectly dependent on production activities associated with the baseline and the project, those that produce and spend as a result of production activities (with our without the project) will experience either a gain or a loss. Calculation of regional or local multipliers may not be possible, depending on information availability.

8.5.1.4 Possible Economic Opportunity Costs, Indirect Costs and Indirect Benefits

Project development decisions often mean that other projects cannot be pursued. Also, there may be other indirect benefits and losses which may not be production and employment related, which must be considered from an economic perspective. These may include positive or negative impacts on property values due to a project, and costs, hassle and job implications associated with relocation.

8.5.1.5 Possible Long-term Fixed Capital and Human Capital Investments that would contribute to Economic Growth

There is a strong possibility that fixed capital of importance will be installed for this project, however, this will require further investigation as to whether significant economic benefits can be realised from this.

8.5.1.6 Possible Government Revenues

The project development also has implications in terms of the revenue implications of local and national governments. This depends on the company structure and revenue expectations of the project and must be investigated further.

Table 27 provides an overview of the expected economic change processes to occur as well as the expected impacts that might occur as a result of the change process taking place. These potential impacts will be assessed in detail during the Impact Assessment phase.

Table 27: Overview of expected economic change processes and potential impacts

Expected Change Process	Potential Impact	Project Phase	Status
Decrease in agricultural production and dependent on indirect production in other industries	Loss in crop and livestock production	Pre-construction and construction	Negative
Possible increase in direct employment opportunities in construction and energy	Hiring of new employees in the construction and power generation sectors	Construction and operation	Positive
Loss of property value due to presence of project activities	Inability to sell surrounding properties at market rates	Pre-construction, construction and operation	Negative
Fixed investment in durable capital goods that may enable the economy	Enable further economic growth and created economic dependencies	Operation	Positive
Local and national government tax revenue	Net increased funds for public service spending in the area	Construction and operation	Positive

8.6 Heritage

A Heritage Impact Assessment is focused on two phases of a proposed development: the construction and operation phases. However, from a cultural heritage perspective, this distinction does not apply. Heritage sites are fixed features in the environment, occurring within specific spatial confines. Any impact upon them is permanent and non-reversible. Those resources that cannot be avoided and that are directly impacted by the proposed development can be excavated/recorded and a management plan can be developed for future action. Those sites that are not impacted can be written into the management plan, whence they can be avoided or cared for in the future.

According to the NHR Act, Section 2(vi), the significance of heritage sites and artefacts is determined by its aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technical value in relation to the uniqueness, condition of preservation and research potential. It must be kept in mind that the various aspects are not mutually exclusive, and that the evaluation of any site is done with reference to any number of these. Sites regarded as having low significance are viewed as been recorded in full after identification and would require no further mitigation. Impact from the development would therefore be judged to be low. Sites with a medium to high significance would require mitigation. Mitigation, in most cases involves the excavation of a site, which is in essence destructive and therefore the impact can be viewed as high and as permanent.

Based on published sources, unpublished archival information, as well as prior experience in the region, no sites, features or objects of cultural significance are currently known from the study area. However, there is a high likelihood that some will be identified during an intensive Phase 1 heritage survey. These would mostly relate to historic times and can include old farmsteads and informal cemeteries. These are generally viewed to have a medium significance on a region level, to a high significance on a local level.

8.7 Noise

8.7.1 The Residual (Existing) Noise Climate

In overview, the existing situation with respect to the existing noise climate in the study area was found to be as follows:

i. The main sources of noise in the area are from:
   a) Traffic on National Road N11, Road P48/1, Road P97/1, Road D2514 and Road D284.
   b) The existing Majuba Power Station. The noise from the power station operations has a significant influence for up to about 4 km from the facility.

ii. The existing noise climate alongside the main roads is degraded with regard to suburban residential living. In some areas residences are negatively impacted from traffic noise (particularly at night) for up to the following distances from these roads:
   a) National Road N11 – 350 m
   b) Road P48/1 – 180 m
   c) Road P97/1 (N) – 400 m
   d) Road P97/1 (S) - 180 m
   e) Road D2514 (W) – 200 m
   f) Road D2514 –I - Road reserve boundary (no impact)
   g) Road D2–4 - Road reserve boundary (no impact)

iii. The residual (existing background) noise levels are relatively low (quiet) in the sections of the study area that are not close to and that are relatively shielded by the terrain from the main roads. Daytime ambient conditions range from about 37 dBA to 45 dBA. The late evening and night-time conditions fall to between 30 dBA and 35 dBA. These are typical of the ambient noise conditions in a rural (farming) area (SANS 10103).

8.7.2 The Predicted Noise Climate (Pre-construction Phase)

Activities during the planning and design phase that normally have possible noise impact implications are those related to field surveys (such as seismic testing and geological test borehole drilling for large building foundations). As these activities are usually of short duration and take place during the day, they are unlikely to cause any noise disturbance or nuisance in adjacent areas.

8.7.3 The Predicted Noise Climate (Construction Phase)

Construction will likely be carried out during the daytime only (06h00 to 18h00 or 20h00). It should however be noted that certain activities may occasionally extend into the late evening (till 20h00) period, while others such as de-watering operations may need to take place over a 24-hour period.

The nature of the noise impact from the construction sites is likely to be as follows:

i. Source noise levels from many of the construction activities will be high. Noise levels from all work areas will vary constantly and in many instances significantly over short periods during any day working period.

ii. Ideally the daytime outdoor ambient noise levels should not exceed 45 dBA for rural residential areas or 55 dBA for urban residential areas (as specified in SANS 10103). The night-time outdoor ambient noise levels should not exceed 35 dBA for rural residential areas or 45 dBA for urban residential areas.

iii. Exact daytime period and night-time period continuous equivalent sound pressure levels are not possible to calculate with certainty at this stage as the final construction site layout, work programme, work modus operandi and type of equipment have not been finalised. Working on a worst case scenario basis, it is

estimated that short term maximum noise levels from general construction operations should not exceed 62 dBA at a distance of 1500 m from the boundary of the activity site.

iv. For general construction, the ambient noise levels generated should not exceed 56 dBA at 250 m offset.

v. It should be noted that for residential areas, higher ambient noise levels than recommended in SANS 10103 are normally accepted as being reasonable during the construction period, provided that the very noisy construction activities are limited to the daytime and during the week, and that the contractor takes reasonable measures to limit noise at the work site. Note that it has been assumed that surface facility construction will generally take place from 07h00 to 18h00 or 20h00 with no activities (or at least no noisy construction activities) at night and so there should not be a problem.

vi. For all construction work, the construction workers working with or in close proximity to equipment will be exposed to high levels of noise.

8.7.4 The Predicted Noise Climate (Operational Phase)

It is estimated at this stage that the total daily traffic that will be generated by the new facility will be relatively small in comparison to the total volume of traffic servicing the Majuba Power Station, on the adjacent main roads.

8.8 Health Impact Assessment

A health impact assessment was originally conducted for the greater study area, but is not deemed relevant for the reduced study area i.e. farm Roodekopjes 67HS.

9 CONCLUSIONS AND RECOMMENDATIONS

This Environmental Scoping Study (ESS) for the proposed UCG project and associated infrastructure in support of co-firing of gas at the Majuba Power Station, has been undertaken in accordance with the Environmental Impact Assessment Regulations (2010) published in Government Notices R. 543 of 18 June 2010 read with Section 44, of the National Environmental Management Act, 1998 (Act No. 107 of 1998).

In line with Regulation 28 (Part 3) of the EIA Regulations, this issues-based ESS aimed to identify and provide:

- A description of the proposed activity;
- A description of the environment that may be affected by the activity and the manner in which the physical, biological, social, and economic aspects of the environment may be affected by the proposed activity;
- The identification of all legislation and guidelines applicable to the development;
- A description of environmental issues and potential impacts, including cumulative impacts, that have been identified;
- Details of the public participation process conducted to date; and
- A Plan of Study for Environmental Impact Assessment (refer to Chapter 10) including the methodology that will be adopted in assessing the potential impacts that have been identified, including specialist studies or specialised processes that will be undertaken.

Based on the Environmental Scoping Study (ESS) undertaken, it can be concluded that there are no fatal flaws associated with the project. Potential environmental impacts have been highlighted and will be further investigated in the EIA phase. The methodology that will be used for assessment of potential significant impacts is contained in Chapter 10 (Plan of Study for EIA).

Table 28: Potentially significant issues identified within the Environmental Scoping Study

Discipline	Potential Impacts	Recommendations
Geology	• Subsidence	**Will be address in more detail during the EIA phase.**
Geohydrology	The possible sources of contamination or infrastructure that may impact on the groundwater resources include: • The UCG process. • Process (dirty water) dams – overflow, seepage, or irrigation may impact on groundwater resources. • The raw water dam - source of artificial recharge to the groundwater. • The wastewater treatment process – seepage or irrigation of effluent may impact on groundwater. • Potable water storage tanks - source of artificial recharge to the groundwater. • Treated water (reverse osmosis) system – resultant wet waste brine may impact on groundwater. • Fuel oil and stored chemicals - oil/chemicals enters water and requires treatment. • Temporary solid waste site - source of leachate or poor quality water. • Some sections of the operations plants e.g. workshops, batching plants, etc. • Ash from the gasification process.	**The impacts are thus related to potential artificial recharge, causing increased groundwater levels, changes in groundwater flow patterns, and the potential to cause deterioration of groundwater quality with time.** **Based on the available data and envisaged impacts on the groundwater resources, the following issues should be taken into consideration:** • **The UCG operations and infrastructure can potentially impact negatively on the groundwater.** • **Artificial recharge can increase groundwater levels directly adjacent to the water impoundments. Groundwater levels can become elevated because of infiltration.** • **Persistent sources of contaminants can alter the hydrochemistry, causing an increase in dissolved solids, hydrocarbons and metals. The sources must, therefore, be located within areas where groundwater usage or potential for use is reduced.** **A peer review of the geohydrology study undertaken for the study area will be completed in the EIA phase.**
Hydrology	The potential impacts on hydrology include: • Possible flooding; Surface flooding may occur as result of the artificial injection of air and/or/water as part of the UCG operation. If borehole construction is sound and verified this should not occur. The conceptual geohydrological model confirmed that the B4 dolerite sill acts as a hydraulic barrier in the area of the UCG operations and an impact on the shallow groundwater is not expected. • Possible pollution from plant activities. Any contamination generated at the plant areas may impact on the nearby Witbankspruit a tributary of the Upper Vaal River. • Increased runoff from disturbed areas and infrastructure; • The volume of groundwater lost during the mining process (in terms of a water use however it should be noted that the coal seam water is not of a good quality and not	• **A hydrological baseline and impact assessment will be conducted with the focus on these potential impacts and included in the EIA study.**

Discipline	Potential Impacts	Recommendations
	suitable as drinking water); • The likely chemistry of the water (void) post-mining as it may be contentious to assume it can be leached until equivalent to the pre-mining water quality. • The possible impacts associated with ground/overburden collapse should this occur, both in terms of yield impacts and future decant points, time to decant and quality of decant. Possible post mining water treatment may need to be considered and budgeted for. • If the surface is to contain waste (liquid or solid) during or post-mining through related activities, then detail on water management of these structures will be required.	
Wetlands	• If associated infrastructure is located within a wetland, then the assumption has been made that the wetland is likely to be completely transformed, resulting in the complete loss of wetland habitat as well as functionality of the affected part of the wetland (and possibly the functionality of the downstream portion of the wetland). • Construction-related impacts: – General construction related impacts. – Impacts related to mining areas. – Impacts related to pipelines. – Impacts related to access roads. – Impacts related to power lines. • Operation-related impacts: – Impacts related to mining areas. – Impacts related to the proposed irrigation of the site – Impacts related to pipelines. – Impacts related to access roads. – Impacts associated with polluted runoff water. – Water treatment infrastructure. – Impacts related to power lines • Decommissioning impacts: – The potential impacts on wetlands related to the decommissioning of the plant and proposed infrastructure are similar in many aspects to construction-related impacts, if infrastructure such as buildings is physically removed. • Post-closure impacts:	**A detailed on-site delineation and assessment of the wetlands occurring in certain parts of the study site where verification of wetland/hydromorphic soil existence is required will need to be undertaken as part of the EIA studies.**

Discipline	Potential Impacts	Recommendations
	– Potential post-closure impacts would equate to residual impacts resulting from the improper decommissioning of the plant and associated infrastructure or lack of removal of any potential pollutants related to the processes of the plant that may over time enter the water cycle.	
Soils and Agricultural Potential	• The soils found on the site of the proposed Eskom UCG project are mainly restricted to structured soils of shallow to variable depth. The main land use is grassland used for extensive grazing. A limited area is used for dryland agriculture and the agricultural potential of these areas is relatively low due to the dominance of structured and limited depth soils. • The proposed mining process will impact large areas but soil conditions will not be altered drastically due to the characteristics of the soils. In the case of swelling soils their self-mulching nature will lead to the disappearance of small disturbances over time. It is anticipated that the grazing potential of the impacted areas will be negatively impacted but it is possible that this potential will improve with time as the signs of impacts fade. • The overall impacts on soils and agricultural potential are considered to be low due to a low baseline. However, the impact area is considered to be large and as such the activities can impact negatively on the low intensity land use of extensive grazing.	**A detailed assessment of the study area will be undertaken within the EIA phase in order to adequately assess the potential impacts on soils and agricultural potential as a result of the proposed project and recommend appropriate mitigation measures, where required.**
Biodiversity	The following impacts/issues were identified that could affect the floristic and faunal attributes of the study area adversely: • Potential impacts on the local and regional biodiversity; • Potential impacts on sensitive/pristine habitat types; • Potential impacts on threatened/protected species and habitat; • Potential impacts on surrounding habitat and species; and • Potential impacts on fauna species. Impacts of a cumulative nature include: • Potential increase in habitat transformation (e.g. loss of habitat); • Potential increase in habitat fragmentation (e.g. loss of migratory routes); and	**A detailed assessment of the study area will be undertaken within the EIA phase in order to adequately assess the potential impacts on biodiversity as a result of the proposed project and recommend appropriate mitigation measures, where required.**

Discipline	Potential Impacts	Recommendations
	• Potential increase in environmental degradation (e.g. loss of habitat quality,).	
Social	The following are likely to have an impact on the social environment: • Geographical change processes – A temporary loss of cultivated and grazing land due to construction activities can be expected on neighbouring farms if associated infrastructure such as pipelines cross these farms. – the presence of the UCG pilot plant and its associated infrastructure might prohibit future developments encroaching upon the plant footprint or pipeline servitudes, which means that land is lost for other development. • Demographic change processes – Influx of construction workers. – Influx of job seekers. • Institutional and empowerment change processes – It is possible that the majority of the construction workforce would be sourced from outside the area due to the skills levels required. The construction workforce would then most probably be housed within a construction village. • Socio-cultural processes – If construction workers have dissimilar social practices than local residents, conflict can be expected. – Socially acceptable integration, including the risk of spreading STIs and HIV/AIDS with an impact on health. – If social integration between newcomers and residents is hindered, it can lead to conflict, which in turn delays the construction process and has economic implications for Eskom. – Where conflict exists, it increases the risk for social mobilisation. – Presence of construction workers and job seekers leads people to believe that there will be an increase in crime, which impacts on surrounding landowners' sense of safety and security.	**A detailed assessment of the study area will be undertaken within the EIA phase in order to adequately assess the potential impacts on the social environment as a result of the proposed project and recommend appropriate mitigation measures, where required.**
Air Quality	The following possible sources of fugitive dust and particulate emissions were identified as activities which could potentially	**A detailed assessment of the study area will be undertaken within the EIA phase in order to adequately**

Discipline	Potential Impacts	Recommendations
	generate air pollution during construction operations: • Demolition and debris removal. • Site preparation (earthworks). • General construction. The following possible sources of fugitive dust and particulate emissions were identified as activities which could potentially generate air pollution during operation: • Gas released from potential storage tanks; • Drilling of injection and production wells; • Flue as released from the flare of the UCG pilot plant and safety valves during regular or upset conditions; • Release of condensate from the gas treatment plant; • Material transfer operations; • Wind erosion from exposed storage piles (sand for construction); and • Vehicle entrained dust from both paved and unpaved road surfaces. The following activities are associated with the decommissioning phase: • Existing buildings and structures demolished, rubble removed and the area levelled; • Remaining exposed excavated areas filled and levelled using overburden; • Topsoil replaced using topsoil recovered from stockpiles; and • Land and permanent waste piles prepared for re-vegetation. Possible sources of fugitive dust emission during the closure and post-closure phase include: • Grading of sites; • Infrastructure demolition; • Infrastructure rubble piles; • Transport and dumping of building rubble; • Transport and dumping of topsoil; and • Preparation of soil for re-vegetation – ploughing and addition of fertiliser, compost etc.	**assess the potential impacts on air quality as a result of the proposed project and recommend appropriate mitigation measures, where required.**
Waste	• The potential sources of waste generated from the UCG operations include:	**A detailed study on the treatment options and the associated impacts of waste will be conducted during**

Discipline	Potential Impacts	Recommendations
	- Waste water produced from the treatment of UCG derived condensate; - Solid organic sludge generated from the UCG operations; - Possible concentrated brine water from the purification of UCG condensate; and - Spent activated carbon from the treatment of UCG condensate.	**the EIA phase.**
Visual	• The issues relating to visual impact are the following: – Visual exposure of a moving gas field across the site and the likelihood of sprawl development; – Distance and observer proximity; – Viewer incidence and perception (input from public participation process); – Visual Absorption Capacity; and – Night lighting.	**A detailed assessment of the study area will be undertaken within the EIA phase in order to adequately assess the potential visual impacts as a result of the proposed project and recommend appropriate mitigation measures, where required.**
Micro-economic	The following are likely to have an impact on the micro-economic environment: • Decrease in agricultural production and dependent indirect production in other industries. • Decrease in direct employment opportunities in agriculture. • Increase in direct employment opportunities in construction and energy. • Unforeseen costs, inconvenience and job related implications of relocation. • Loss of property value due to presence of project activities. • Fixed investment in durable capital goods that may enable the economy. • Local and national government tax revenue.	**The main recommendations pertaining to the impact assessment phase are to:** • **Continue to obtain information from the public participation consultants on registered landowners and those residing on the land to determine the exact extent of economic activities and employment numbers in the area.** • **Obtain information from the public participation consultants on possible land transactions and claims in the area to determine if any possible property impact exists related to power generation activities.** • **Contact landowners and tenants to further expand on economic activities and current job creation.** • **Obtain information from the proponent on expected value of the project in construction and operations, expected tax revenues from the operation and expected job creation.** • **Analyse the current Majuba supply chain to determine extent of possible local supplier benefits.** • **Evaluate applicable information contained in previous local economic assessment reports completed in the area for Eskom for inclusion into**

Discipline	Potential Impacts	Recommendations
		the EIA phase.
Heritage	• No sites, features or objects of cultural significance are currently known from the study area. However, there is a high likelihood that some will be identified during an intensive Phase 1 heritage survey. These would mostly relate to historic times and can include old farmsteads and informal cemeteries. These are generally viewed to have a medium significance on a region level, to a high significance on a local level.	**It is recommended that in terms of Section 38 of the National Heritage Resources Act, No. 25 of 1999, a full Phase 1 survey of the study area is conducted prior to the development taking place.**
Noise	**Potential noise impacts consist of the following:** • **Impacts on the residual (existing) noise climate.** • **Predicted noise climate – pre-construction phase.** • **Predicted noise climate – construction phase.** • **Predicted noise climate – operational phase.** • **UCG pilot plant generated traffic.**	**No noise impact assessment will be conducted in the EIA phase as the potential noise impacts during the construction and operational phases are considered to be of low significance. Appropriate mitigation measures will be proposed in the EMPr.**

10 PLAN OF STUDY FOR EIA

Potential environmental impacts (biophysical and social) associated with the proposed UCG project and associated infrastructure in support of co-firing of gas at the Majuba Power Station, have been identified in the Environmental Scoping Study (ESS). No fatal flaws or highly significant impacts have been identified to date. All potentially significant and cumulative impacts will be further investigated and assessed within the Environmental Impact Assessment (EIA) phase of the project. Mitigation measures will be contained in the Environmental Management Programme (EMPr) to be compiled during the EIA phase. Mitigation measures recommended in the ESS will also be included in the EMPr.

The EIA phase will aim to adequately assess and address all potentially significant environmental issues in order to provide the Department of Environmental Affairs (DEA) and Department of Mineral Resources (DMR) with sufficient information to make an informed decision regarding the proposed project.

The following points below outline the proposed approach to undertaking the EIA phase of the project. It is believed that the proposed approach will adequately fulfil the competent authority's (DEA's) requirements, the requirements of the EIA Regulations (2010) and the objectives of environmental best practice, so as to ensure transparency and to allow an informed decision regarding the project to be made.

10.1 Authority Consultation

Ongoing consultation with DEA, DMR, DWA, the Gert Sibande District Municipality, Pixley ka Seme Local Municipality, Ward Councillors, and all other authorities identified during the Environmental Scoping Study (ESS) phase of the project (and further ones that may be identified during the EIA phase) will continue throughout the duration of the project. Authority consultation is therefore seen as a continuous process that takes place until completion of the environmental investigations.

10.2 Aims of the EIA Study

The EIA will aim to achieve the following:

- to supplement, where necessary, the assessment of the social and biophysical environments affected by the development during the Scoping study;
- to assess impacts on the study area in terms of environmental criteria;
- to identify and recommend appropriate mitigation measures for potentially significant environmental impacts;
- to compile an Environmental Management Programme (EMPr) for the inclusion of proposed mitigation measures; and
- to undertake a fully inclusive public participation process to ensure that I&AP issues and concerns are recorded and addressed.

10.3 Specialist Studies

As part of the Environmental Scoping Study (ESS), the team of specialists made many visits to the farm Roodekopjes 67HS as well as the greater study area (Rietfontein 66HS (including Klein Rietfontein 117HS); Japtrap 115HS; Palmietspruit 68HS; Tweedepoort 54HS; Koppieskraal 56HS; Bergvliet 65HS; Weiland 59HS and Strydkraal 53HS) to determine if, on the basis of a literature review and the site inspection, the scope of their work as originally envisaged could be reduced, or whether it needed to be expanded or amended. The outcome of the workshop was that, while some impacts might have been considered to be relatively benign, best practice and a need to fully understand the implications of the proposed project, warrant that further investigation of all identified

issues be undertaken in the EIA Phase. Accordingly, the following specialist studies and specialists are proposed to be undertaken in the EIA Phase (Table 29):

Table 29: Specialist studies to be undertaken in the EIA phase

Specialist Field	Organisation
Peer review of Geohydrology Study	R Meyer (Private)
Peer review of the Geology Study	Mine Geology Services
Hydrological and Aquatic Study	To be determined
Wetlands	Royal HaskoningDHV
Soils and Agricultural Potential	Terra Soil Science
Biodiversity	Bathusi Environmental Consulting
Baseline Social Study and Micro-economic study	MasterQ Research
Air Quality	Royal HaskoningDHV
Waste	Royal HaskoningDHV
Visual aspects and aesthetics	Royal HaskoningDHV
Heritage	J van Schalkwyk

The Terms of Reference for each of the specialist studies for the EIA phase is provided below. As a critical step in the EIA process, it is important that the public has the opportunity to comment on, and the authorities approve of, the proposed approach to the EIA Phase.

Commenting on the PoS for EIA by the public ensures that the proposed approach, including the scope of work for the specialists, is informed by public and the authority feedback in order to ensure that the work produced addresses the issues of concern at the requisite level of confidence. A robust basis for informed debate and decision making is thus provided.

Key outcomes of the specialist studies would be information which will allow I&APs to engage in informed debate on the implications of the proposed project and will allow Eskom to make an informed decision on the location of the gas treatment plants and various other alternatives (water and gas pipeline/s). Eskom will also gain an understanding of the range and benefits of implementing possible mitigation measures.

Table 30: Terms of Reference for specialist studies to be conducted in the EIA study

Study	Terms of Reference
Geohydrology – Peer Review ***Reinie Meyer (Private)***	This study will entail a peer review of the geohydrological report/s compiled for the study area, making informed assessments as to the repercussions of the UCG pilot plant operations and associated infrastructure on the groundwater resources locally and regionally with a view of both the primary and secondary effects.
Hydrology ***To be determined***	A hydrological baseline and impact assessment will be conducted with the focus on these potential impacts and included in the EIA study.
Geology ***Gerhard Esterhuizen (Mine Geology Services)***	This study will entail a peer review of the geological report/s compiled for the study area, making informed assessments as to the repercussions of the UCG pilot plant operations and associated infrastructure on underlying geology.
Wetlands ***Paul da Cruz (Royal HaskoningDHV)***	The EIA study will aim to: • Verify the occurrence and typology of wetlands in the study area as delineated in the Scoping-phase of the project by desktop methods, and to correct the delineation based on field-based assessment, thus enabling all wetlands in the study area to be mapped. • Assess all of the wetlands of the study area in the field based on the field assessment gain an understanding of the overarching characteristics of wetlands, including hydrology, vegetation and soils and geology, as well as the pressures (threats) currently acting on wetlands. • Undertake a functional assessment and (high-level) assessment of the state of the wetlands, and in so doing identify the following characteristics of wetlands in the study area (as highlighted in the requirements of the MPTA): – the size each of the wetland reaches assessed – the surface roughness of each wetland reach – problem areas in each wetland reach – land form settings and HGMs of the wetland reaches – goods and services provided by each wetland – land cover in the surrounding catchment of each wetland reach – sediment input into wetland reaches – nutrient/toxicant input into wetland reaches – biodiversity associated with each wetland reach, including unique communities • Prioritise wetland reaches in the study area that are associated with a high degree of sensitivity, integrity or functionality, thereby feeding into a sensitivity assessment of the study area. • Assess the impacts of the proposed development on wetlands, and suggest suitable mitigation measures, if relevant, to ameliorate or remove these predicted impacts.
Soils and Agricultural Potential ***Johan van der Waals (Terra Soil Science)***	• Undertake an assessment to predict potential impacts and their significance due to the proposed development on soils and agricultural potential. • Propose mitigation measures to reduce or eliminate the identified impacts and offer an opinion on the preference of alternatives. • Sensitivity maps will be compiled to show the soil profile and agricultural potential of the sites selected. In addition, a

Study	Terms of Reference
	report will be compiled to reflect the findings of the study.
Biodiversity ***Riaan Robbeson & Dewald Kamfer (Bathusi Environmental Consulting)***	Environmental regulations pertaining to minimum requirements for biodiversity assessments require full surveys on all biodiversity data and mitigation measures to manage the impact on these living systems. In order to compile detailed knowledge of the biodiversity of the study area, the following aspects should be included as part of the EIA investigation. • Floristic investigation - Map the location and extent of all plant communities, indicating size and ecological sensitivity, areas of disturbance, surrounding land use, etc; - Compile a list of potential Threatened Plant Species that occur in the area; - Conduct flora surveys during the growing season of all species that may potentially occur; - Supply comprehensive plant species lists; - Identify plant species that may be of conservation importance down to species level; - Provide locality, date surveyed, GPS location, spatial resolution and distribution, including actual numbers, of plant species that may be of conservation importance; - Provide a list of alien plant species occurring on the property, considering eradication programmes of alien vegetation; and - Provide relocation plans for plants of conservation importance. These species may include: * Species endemic to the province; * Red Data listed plants; * Medicinal plants; and * Protected plants. • Faunal investigation The following methodology is recommended to assess the potential occurrence of red data faunal species as well as the biodiversity elements within the study area pertaining to the relevant faunal species, assemblages and communities present in the general region: - ***Invertebrates*** * Pitfall trapping to assess various areas within the study area in terms of relative biodiversity elements such as species richness and species diversity. Specific groups such as beetles (*Insecta: Coleoptera*) will be used as indicator groups to standardise and simplify the data analyses. * A hand-held butterfly net will be used to collect butterfly species (*Insecta: Lepidoptera*) found in the study area. Butterflies are the best known Invertebrate group (both ecologically and taxonomically) and is useful as ecological and biodiversity indicators. * Scorpions will be sampled by excavation of burrows during daytime and night-time surveys using black-lights (UV-lights). - ***Amphibians*** * Identification of species-specific calls of males (early evening) at different surface water areas. * A digital audio field recorder will be used to record animal sounds during the night-time at specific areas (usually near ecological “bottle-necks” such as pans or rivers). The calls of frogs will be identified as part of this remote audio survey. - ***Reptiles*** * Preferred reptile habitat such as outcrops, rocky areas, open water and disused termite mounds will be actively searched for the presence of reptile species.

Study	Terms of Reference
	∗ Reptiles caught in the pitfall traps (as "by-catch") will also be identified. - ***Mammals*** ∗ Small mammal live traps will be used to assess the rodent assemblages of the study area. These traps will be baited with various bait types to include as many rodents and insectivores' food requirements as possible. ∗ Ecological tracks and signs will be used to assess the presence of large and medium-sized mammals. ∗ Digital remote sensing cameras will be used to assess the presence of mammals. These cameras will be baited with bovine rumen to attract various undulates and carnivores. ∗ A digital audio field recorder will be used to record animal sounds during the night-time at specific areas (usually near ecological "bottle-necks" such as pans or rivers). The calls of nocturnal mammals will be identified as part of this remote audio survey. In addition to these the effect of expected or likely impacts on the biological environment will be determined by compilation of an EIA that take the following aspects into consideration: • the relationship of potential impacts to temporal scales; • the relationship of potential impacts to spatial scales; • the severity of potential impacts; • the risk or likelihood of potential impacts occurring; and • the degree of confidence placed in the assessment of potential impacts. This will be done in a holistic manner, taking both the floristic and faunal environment into consideration.
Social ***Nonka Byker (MasterQ Research)***	• **Geographical Change Process** - Obtain and analyse information from the relevant specialist on the agricultural potential of the sites; and - Scrutinise the IDP and SDF of the affected district and local municipality in terms of future developments. If additional information is required other than that contained in the IDP/SDF, interview(s) with relevant town planners will be conducted. • **Demographic Change Process** - Conduct a desktop study to determine what the expected population growth rate is and how this would be influenced by the HIV infection rate in order to establish how the population would have expanded without the influx of construction workers and/or job seekers; - Obtain information from the project proponent and/or their appointed contractor on the size of the construction team and where labour would be sourced from; and - Obtain and analyse information from the public participation consultants on the local residents' expectations in terms of the proposed project within the social realm, in order to better understand local residents' viewpoint on the proposed project and the potential risk for conflict and other forms of active and passive social mobilisation. • **Institutional and Empowerment Change Process** - Obtain the issues register or issues report from the public participation consultants to determine the recurrent issues raised from the public's side and how these issues were addressed throughout the process. An analysis of these issues would indicate the risk for social mobilisation; and - Obtain information from the local municipality on the existing capacity to deliver municipal services and to

Study	Terms of Reference
	determine the capacity for an additional demand on municipal services. • **Socio-cultural Change Process** - Conduct focus group meetings with community leaders and/or an observational study to determine the cultural dynamics and movement patterns of local residents; - Obtain and analyse information, if any, from the project proponent on the mechanisms implemented at a construction site to enhance the safety of both the construction worker as well as that of local residents passing through the area; and - Obtain information from the public participation consultants on the surrounding landowners. Either attend or organise a focus group meeting with these landowners to determine their attachment to the area.
Air Quality ***Stuart Thompson (Royal HaskoningDHV)***	In terms of this Air Quality Scoping Assessment, the following sources of current air pollution have been identified: • Stack, vent and fugitive emissions from the existing Majuba Power Station operations; • Flaring at the UCG operations; • Agricultural activities on the surrounding farms; • Vehicle entrained dust and exhaust emissions; • Domestic Fuel Burning; and • Veld Fires. It is anticipated that the impacts will remain more localised. However, this can only be known once detailed modelling is undertaken, which will take into account the pollutants and rates at which emissions are released. The meteorological data selected for use will also provide a better indication of the proposed impacts at the site. In order to provide a better indication of the extent of the impacts expected from the proposed construction and operational phases of this development, dispersion simulation will need to be undertaken. This will however only be able to take place once more detail is available regarding the nature of each source type and their respective emission rates. Once these impacts have been quantified, appropriate management measures can be suggested to best mitigate the predicted impacts. These modelled results will similarly allow for the assessment of compliance to current South African Ambient Standards.
Waste	The containment, re-use and safe disposal of UCG waste streams poses an environmental and health challenge at mine sites. The condensate stream is defined as a Hazardous Waste stream and as such will have to be analysed and classified according to the Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste, 2e, 1998, which is still in effect. The publication of the draft national standard for disposal of waste to landfill (General Notice 432 of 2011) on 01 July 2011 will have to be considered as part of future assessments. It is important to note that transitional arrangements have not been communicated by the authorities. The National Environmental Management Act (Act No. 59 of 2008) has given legal effect to the waste hierarchy and as such the approach should investigate these principles in terms of waste handling and management. A full assessment is required to inform the management plan for the operations. Specific consultation with the DEA, regarding the approach to classification, handling and disposal of the waste streams. Direction will have to be sought regarding the information available and the legislation processes, specifically relating to the new standards. Authority consultation is therefore seen as a continuous process that takes place until completion of

Study	Terms of Reference
	the environmental investigations. It is proposed that based on the outcomes of the authority consultation, a proper waste management protocol be generated which will be aligned to the operational plan of the process. This will enable a risk assessment to be determined for application during the subsequent EIA process steps.
Visual ***Dawie van Vuuren (MetroGIS) & updated by Paul da Cruz (Royal HaskoningDHV)***	• Visual exposure of a moving gas field across the site and the likelihood of sprawl development; • Distance and observer proximity; • Viewer incidence and perception (input from public participation process); • Visual Absorption Capacity; • Night lighting and • Possible mitigation measures.
Micro-economic Study ***Raoul de Villiers (MasterQ Research)***	The points below outline the variables that will be examined in the micro-economic study to be carried out during the EIA Phase: • Obtain and analyse information from the project proponent; • Obtain and analyse information from the project proponent on the construction and operating financial projections; • Obtain and analyse information from StatsSA, LED plans and IDPs; • Research likely impacts on property values for surrounding landowners; • Determine losses to agricultural production and employment; • Determine value of potential capital investments; and • Determine value of potential local government revenues. A detailed report on the findings of the study will be compiled for the assessment. The report will provide the economic impact of the proposed development in the regional (micro-economic) economic status. Furthermore, the report will propose measures to mitigate any negative impacts and enhance positive impacts resulting from the development.
Heritage ***Johnny van Schalkwyk (Private)***	A full Phase 1 archaeological survey of the study area in accordance with the requirements of Section 38(3) of the National Heritage Resources Act (Act 25 of 1999) will be conducted in the EIA phase. Site-specific, detailed management and mitigation measures will furthermore be compiled for inclusion in the Environmental Management Programme (EMPr). The study should provide a map of the identified archaeological artefacts as well as a report detailing the finding of the study, and mitigation of any impacts.

10.4 Impact Assessment Methodology

The potential environmental impacts associated with the project will be evaluated according to it nature, extent, duration, intensity, probability and significance of the impacts, whereby:

Environmental Criteria	Description
Nature	A brief written statement of the environmental aspect being impacted upon by a particular action or activity.
Extent	The area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment phase of a project in terms of further defining the determined significance or intensity of an impact. For example, high at a local scale, but low at a regional scale
Duration	Indicates what the lifetime of the impact will be
Intensity	Describes whether an impact is destructive or benign
Probability	Describes the likelihood of an impact actually occurring
Cumulative	In relation to an activity, means the impact of an activity that in itself may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area

Table 31: Criteria to be used for the rating of impacts

CRITERIA	DESCRIPTION			
EXTENT	**National (4)** The whole of South Africa	**Regional (3)** Provincial and parts of neighbouring provinces	**Local (2)** Within a radius of 2 km of the construction site	**Site (1)** Within the construction site
DURATION	**Permanent (4)** Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact can be considered transient	**Long-term (3)** The impact will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter. The only class of impact which will be non-transitory	**Medium-term (2)** The impact will last for the period of the construction phase, where after it will be entirely negated	**Short-term (1)** The impact will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase
INTENSITY	**Very High (4)** Natural, cultural and social functions and processes are altered to extent that they permanently cease	**High (3)** Natural, cultural and social functions and processes are altered to extent that they temporarily cease	**Moderate (2)** Affected environment is altered, but natural, cultural and social functions and processes continue albeit in a modified way	**Low (1)** Impact affects the environment in such a way that natural, cultural and social functions and processes are not affected
PROBABILTY OF OCCURANCE	**Definite (4)** Impact will certainly occur	**Highly Probable (3)** Most likely that the impact will occur	**Possible (2)** The impact may occur	**Improbable (1)** Likelihood of the impact materialising is very low

Significance is determined through a synthesis of impact characteristics. Significance 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. The total number of points scored for each impact indicates the level of significance of the impact.

Table 32: Significance rating of classified impacts

Low impact (4 - 6 points)	A low impact has no permanent impact of significance. Mitigation measures are feasible and are readily instituted as part of a standing design, construction or operating procedure.
Medium impact (7 - 9 points)	Mitigation is possible with additional design and construction inputs.
High impact (10 - 12 points)	The design of the site may be affected. Mitigation and possible remediation are needed during the construction and/or operational phases. The effects of the impact may affect the broader environment.
Very high impact (13 - 16 points)	Permanent and important impacts. The design of the site may be affected. Intensive remediation is needed during construction and/or operational phases. Any activity which results in a “very high impact” is likely to be a fatal flaw.
Status	Denotes the perceived effect of the impact on the affected area.
Positive (+)	Beneficial impact.
Negative (-)	Deleterious or adverse impact.
Neutral (/)	Impact is neither beneficial nor adverse.

The suitability and feasibility of all proposed mitigation measures will be included in the assessment of significant impacts. This will be achieved through the comparison of the significance of the impact before and after the proposed mitigation measure is implemented. Mitigation measures identified as necessary will be included in an EMPr. The EMPr will form part of the Environmental Impact Report (EIR).

10.5 Environmental Impact Report

The EIR will contain the following:

- Details of the EAP who compiled the report and their expertise to carry out an EIA;
- Detailed description of the activity/ies;
- A description of the environment that might be affected by the activity and the manner in which the physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed activity;
- Details of the public participation process conducted during the Scoping Phase and the ongoing consultation during the EIA phase;
- Description of the need and desirability of the activity including advantages and disadvantages that the activity may have on the environment and the community that may be affected by the activity;
- An indication of the methodology used in determining the significance of potential environmental impacts;
- A summary of the findings and recommendations of any specialist report or report on a specialised process;
- A description of all environmental issues that were identified during the environmental impact assessment process, an assessment of the significance of each issue and an indication of the extent to which the issue could be addressed by the adoption of mitigation measures;
- An assessment of each identified potentially significant impact, including cumulative impacts, the nature of the impact, the extent and duration of the impact, the probability of the impact occurring, the degree to which the impact can be reversed, the degree to which the impact may cause irreplaceable loss of resources and the degree to which the impact can be mitigated;

- A description of any assumptions, uncertainties and gaps in knowledge;
- An opinion as to whether the activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation;
- An environmental impact statement which contains a summary of the key findings of the environmental impact assessment; and a comparative assessment of the positive and negative implications of the activity.
- A draft Environmental Management Programme (EMPr) and
- Copies of any specialist reports and reports on specialised processes.

10.6 Draft Environmental Management Programme

During the compilation of the EIA, a draft EMPr will be compiled in accordance with the EIA Regulations (2010). The draft EMPr will provide the actions for the management of identified environmental impacts emanating from the project and a detailed outline of the implementation programme to minimise and/or eliminate the anticipated negative environmental impacts. The draft EMPr will provide strategies to be used to address the roles and responsibilities of environmental management personnel on site, and a framework for environmental compliance and monitoring.

The EMPr will include the following:

- Details of the person who prepared the EMPr and the expertise of the person to prepare an EMPr;
- Information on any proposed management or mitigation measures that will be taken to address the environmental impacts that have been identified in the EIR, including environmental impacts or objectives in respect of operation or undertaking of the activities, rehabilitation of the environment and closure where relevant;
- A detailed description of the aspects of the activity that are covered by the draft EMPr;
- An identification of the persons who will be responsible for the implementation of the measures;
- Where appropriate, time periods within which the measures contemplated in the draft EMPr must be implemented;
- Proposed mechanisms for monitoring compliance with the EMPr and reporting thereon;
- An environmental awareness plan; and
- Procedures for managing incidents which have occurred as a result of undertaking the activity and rehabilitation measures.

10.7 Public Participation Process

The primary aims for the public participation process include the following:

- Meaningful and timeous participation of I&APs;
- Promoting transparency and an understanding of the proposed project and its potential environmental (social and biophysical) impacts;
- Accountability for information used for decision-making;
- Serving as a structure for liaison and communication with I&APs;
- Assisting in identifying potential environmental (social and biophysical) impacts associated with the development; and
- The needs, interests and values of I&APs must be considered in the decision-making process.

10.7.1 Advertising

The primary aim of adverts in the EIA phase is to provide information regarding the availability of reports for public review, as well as, if necessary, the advertisement of dates of public meetings.

10.7.2 Identification of and Consultation with Key Stakeholders

The identification of I&APs and key stakeholders will continue into the EIA phase of the project as the public participation process is a continuous process that runs throughout the duration of an environmental study.

10.7.3 I&AP Database

All I&AP information (including contact details), together with dates and details of consultations and a record of all issues raised is recorded within a comprehensive database of I&APs. This database will be updated on an on-going basis throughout the project, and will act as a record of the communication/involvement process.

10.7.4 Consultation and Public Involvement

Consultation with I&APs is considered to be critical to the success of any EIA process. Therefore, one-on-one consultation (via telephone calls, fax and emails) and a public meeting (if necessary) during the EIA phase will be undertaken. The aim of this process will be to provide I&APs with details regarding the process and to obtain further comments regarding the project. Minutes of all meetings held will be compiled and forwarded to all attendees. These minutes will also be included in the EIR.

10.7.5 Issues Trail

All issues, comments and concerns raised during the public participation process of the EIA study will be compiled into an Issues Trail. This Issues Trail will be incorporated as part of the EIR.

10.7.6 Public and Authority Review of the Draft Environmental Impact Report

The draft EIR will be made available at public places for public review and comment. The draft EIR will also be submitted to DMR and MDEDET simultaneously. A 60 calendar day period will be allowed for this review process. An advertisement indicating the availability of this report for public scrutiny will be placed in the local newspaper. I&APs registered on the project database will be notified of the availability of this report by correspondence.

10.7.7 Public and Authority Review of the Final Environmental Impact Report

In order to give effect to regulation 56 (2) of the EIA Regulations (2010), before submitting the final EIR to the DEA, the EAP must give registered I&APs access to, an opportunity to comment on the report in writing within 21 days.

10.7.8 Authority Review and Decision-making

After the public review period, all relevant comments received from the public will be considered and included into the final EIR. This final document will be submitted to DEA for final review and decision-making.

10.7.9 Environmental Authorisation and Waste Management License

On receipt of the environmental authorisation and waste management license for the project, I&APs registered on the project database will be informed and its associated terms and conditions by correspondence.