BOIKARABELO POWER STATION DRAFT ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENTAL MANAGEMENT PROGRAMME

RESGEN SOUTH AFRICA (PTY) LTD

NEAS REF NO: DEA/EIA/0000643/2011

DEA REF NO: 12/12/20/2291

SEPTEMBER 2012

DRAFT FOR PUBLIC REVIEW

Digby Wells & Associates (Pty) Ltd. Co. Reg. No. 1999/05985/07. Fern Isle, Section 10, 359 Pretoria Ave Randburg Private Bag X10046, Randburg, 2125, South Africa
Tel: +27 11 789 9495, Fax: +27 11 789 9498, info@digbywells.com, www.digbywells.com

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Report Title: **Boikarabelo Power Station Draft Environmental Impact Assessment Report and Environmental Management Programme**

Project Number: **RES1065**

Name	**Responsibility**	**Signature**	**Date**
Louise van den Berg-Nicolai	EAP		March 2012
Johan Hayes	Manager: Integrated Services		March 2012
Andries Wilke	Director		May 2012

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In accordance to the National Environmental Management Act, Act No. 107 of 1998 as amended (NEMA), Constitutional Principles and the Promotion of Administrative Justice Act, Act No. 3 of 2000 (PAJA), Interested and Affected Parties (I&APs) must be given an opportunity to comment on proposed projects which may impact on their environmental right. The purpose of the public review process is to allow I&APs to review this draft Environmental Impact Assessment Report (EIAR) and Environmental Management Programme (EIA & EMP). This ensures that comments raised during the public participation process can be addressed before completion and submission of the final document to the competent authorities. All I&AP comments will be recorded and will form part of the findings.

This draft EIAR & EMP Report is compiled in support of an integrated licence for environmental authorisation and a waste licence for the proposed listed activities to be undertaken by Resgen South Africa (Pty) Ltd (Resgen) for the Boikarabelo Power Station and associated infrastructure, located within the mining right area of the proposed Boikarabelo Coal Mine in the Waterberg District, Limpopo Province of South Africa.

Digby Wells Environmental (Digby Wells) is the appointed independent consultant responsible for assessing the environmental and social impacts of the proposed project and documenting the applicants proposed controls for dealing with the key environmental aspects and social issues identified.

This draft EIAR EMP is available for public review electronically at www.digbywells.com and in hard copy at the following locations:

Place	Telephone Number
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Ledjadja Coal (Pty) Ltd/Resgen South Africa (Pty) Ltd Offices	(012) 345 1057
AGRI SA, Lephalale	(014) 763 1888
Lesedi Village (Ward 3), Steenbokpan	(079) 342 2282
Digby Wells Environmental www.digbywells.com	(011) 789 9495

DUE DATE FOR COMMENT: 06 November 2012

You may comment on this draft report by: post; email and/or fax.

Digby Wells Environmental: Lerato Ratsoenyane / Louise van den Berg-Nicolaï
Private Bag X10046, Randburg, 2125
Tel: 011 789 9495: Fax: 086 502 1589
Email: lerato@digbywells.com or louise@digbywells.com

PROJECT DETAILS

Name of Project:	**Boikarabelo Power Station**
NEAS REF NO	DEA/EIA/0000643/2011
DEA REF NO:	12/12/20/2291
Applicant:	**Resgen South Africa (Pty) Ltd**
Contact Person:	Mr H.A. van den Aardweg
Postal Address:	PO Box 5384, Rietvalleirand, 0174
Telephone No.:	012 345 1057
Fax No.:	086 539 3792

Environmental Consultant:	**Digby Wells Environmental**
Contact Person:	Louise van den Berg-Nicolai
Postal Address:	Private Bag X10046, Randburg, 2125
Telephone No:	(011) 789 9495
Fax No:	086 524 0711

EXECUTIVE SUMMARY

Resgen South Africa (Pty) Ltd (Resgen) proposes to construct a coal-fired thermal Power Station with a capacity of up to 260 Mega Watt (MW) which will be located within the footprint of the planned Boikarabelo Coal Mine in the Waterberg Coalfield, Limpopo Province. The proposed Power Station will utilise middlings coal from the Boikarabelo Coal Mine for the generation of electricity. The construction of the power station will be completed in two phases. Phase I involves the construction of a power station with a capacity of 45MW, and the electricity generated will be utilised as a direct electricity supply to the Boikarabelo Coal Mine operation. In Phase II, it is proposed that the 45MW Power Station will be expanded to a potential capacity of up to 260 MW, and surplus electricity could potentially be fed into the National grid, providing additional power stability to the region. As part of the process of the development of a power station, Resgen will register as a power producer.

It should be noted that the Power Station development is essentially a brownfields project, as it will be undertaken in conjunction with the construction of the already approved Boikarabelo Coal Mine.

The proposed Boikarabelo Power Station, ash dump and temporary construction village camp will be located on the farms Kruishout 271LQ and Vischpan 274LQ which are within the Boikarabelo Coal Mine mining right area. The footprint of the initial power station is 9 hectares (ha), the initial ash dump is 31.5ha and the temporary construction village 11ha.

Digby Wells Environmental (Digby Wells), an independent environmental consultancy, has been appointed by Resgen to undertake the EIA process, including the associated public participation and specialist studies.

This report has been complied in terms of an integrated application in terms of the National Environmental Management Act, Act No. 107 of 1998 as amended (NEMA) and the National Environmental Management Waste Act, Act 59 of 2008 (NEMWA) for submission to the decision-making authority, the Department of Environmental Affairs (DEA). The table below outlines the activities which Resgen are applying for authorisation in terms of NEMA and NEMWA.

Activity	Description	On site activity
National Environmental Management Act, Act 107 of 1998 – Environmental Authorisation		
Government Notice No R. 544		
Activity 22(ii)	The construction of roads outside of the urban area where, no reserve exists and where the road is wider than 8m.	A tarred access road will be constructed off the main mine access road to the power station (3.4km).

Activity	Description	On site activity
Government Notice No. R 545		
Activity 1	Construction of a 260 MW Coal-fired thermal power station.	Construction of up to a total capacity of 260MW power station.
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.	The power station will utilise water in the power generation process and will emit air emission which requires additional authorisations.
Activity 15	The development of more than 20ha outside an urban area	The construction of the power station (9ha), ash dump (31.5ha) and associated infrastructure; including the construction camp (11ha)
National Environmental Management Waste Act, Act No. 59 of 2008 – Waste License		
Category A(2)	The storage including the temporary storage of hazardous waste at a facility that has the capacity to store in excess of 35 m^3 of hazardous waste at any one time.	The temporary storage of used turbine oil and oil from generators.
M3Category A(18)	The construction of facilities for activities listed in Category A.	For activities A(1 & 2), the temporary waste storage facilities..
Category B(1)	The storage including the temporary storage of hazardous waste in lagoons.	Waste water will be stored in sumps/ Pollution Control Dams for re-use.
Category B(7) .	The treatment of effluent, wastewater or sewage with an annual throughput capacity of more than 15 000 m^3.	Two sewage plants will be constructed for the Temporary construction village and potentially for the phase II expansion of the power station.
Category B(10)	The disposal of general waste to land covering an area in excess of 200 m^2	Development of ash dump (non-hazardous). 4 million tonnes over 25 years.

Activity	Description	On site activity
Category B(18)	The construction of facilities for activities listed in Category B	For activities B(1, 7 & 10) , as mentioned above

The proposed Boikarabelo Power Station will initially provide power to the Boikarabelo Coal Mine by developing a 45MW coal power station. As the development will occur in the area of disturbance of the proposed coal mine the initial impact of the development will not extend the disturbance of an already disturbed area and will therefore result in less of an impact on the receiving environment, however it will increase the cumulative impact of the project collectively. The most significant potential impact of the proposed development will be the reduction of air quality due to the release of emissions into the atmosphere. The development of the ash dump will also have a potential impact as it will be a potential source of pollution and it will alter the environment through the deposition of ash. The environmental management of the proposed power station will be undertaken in conjunction of that of the mine in order to have an integrated management system.

The proposed power station is required to ensure the stability of the operation of the Boikarabelo Coal Mine. Since the onset of the project, Resgen has been able to secure an initial supply from Eskom, however this supply is not sufficient for the full operation of the processing plant as well as the use of electrical mining shovels. As supply from the grid may not be reliable, Resgen requires a stable source of power to ensure optimal operation of the mine. The construction of the power station will ensure the continued viability of the mine and ensure stability of employment for local workers, to continue to support the local economy.

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Acronym	Description
ABA	Acid-base accounting
AIA	Archaeological Impact Assessment
AMD	Acid mine drainage
BIDs	Background Information Documents
CBOs	Community Based Organisations
CD	Computer Disk
CFB	Circulating Fluidised Bed
DEA	Department of Environment Affairs
DHSD	Department of Health and Social Development
dBA	A-weighted decibels
DMR	Department of Mineral Resources
DPW	Department of Public Works
DRT	Department of Roads and Transport
DTM	Digital Terrain Model
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
LDA	Limpopo Department of Agriculture
LDWA	Limpopo Department of Water Affairs
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMF	Environmental Management Framework
EMP	Environmental Management Programme
FET	Further Education and Training
GG	Government Gazette
GN	Government Notice
GIS	Geographic Information System
g/t	grams per tonne
ha	Hectare
I&APs	Interested and Affected Parties
IDP	Integrated Development Plan
IPP	Independent Power Producer
Km	Kilo metre
ktpm	kilo tonnes per month
kV	kilo Volts
l/s	Litres per second
LEDET	Limpopo Department of Economic Development, Environment and Tourism
LoM	Life of Mine
m^3/d	Cubic Metres per day
m.a.m.s.l.	metres above mean sea level
MAP	Mean Annual Precipitation
mbgl	Metres below ground level
Ml	Mega litres
MPRDA	Mineral and Petroleum Resources Development Act, No. 28 of 2002
MRA	Mining Right Application
mS/m	millisiemens per metre
Mt	Mega tonnes
MW	Mega Watt
NEMA	National Environmental Management Act, No.107 of 1998
NEMAA	National Environmental Management Amendment Act. Act No. 62 of 2008
NEMBA	National Environmental Management Biodiversity Act, No. 10 of 2004

Acronym	Description
NEMWA	National Environmental Management Waste Act, No. 59 of 2008
NFPA	National Fire Protection Act
NGOs	Non-Governmental Organisations
NHRA	National Heritage Resources Act, No. 25 of 1999
PCD	Pollution Control Dam
PDA	Potential Development Area
PF	Pulverised Fuel
PPP	Public Participation Process
PRECIS	Pretoria Computerised Information System
ROM	Run of Mine
SAHRA	South African Heritage Resource Agency
SANBI	South African Botanical Institute
SANS	South African National Standards
SLP	Social and Labour Plan
SMS	Short Message Service
SDF	Spatial Development Framework

1 INTRODUCTION

Resgen proposes to construct a coal-fired thermal Power Station with a capacity of up to 260 Mega Watt (MW) which will be located within the footprint of the planned Boikarabelo Coal Mine in the Waterberg Coalfield, Limpopo Province. The proposed Power Station will utilise middlings coal from the Boikarabelo Coal Mine for the generation of electricity, the middlings would otherwise be discarded as waste product. The construction of the power station will be completed in two phases. Phase I involves the construction of a power station with a capacity of 45MW, and the electricity generated will be utilised as a direct electricity supply to the Boikarabelo Coal Mine operation. In Phase II, it is proposed that the 45MW Power Station will be expanded to a potential capacity of up to 260 MW, and surplus electricity could potentially be fed into the National grid, providing additional power stability to the region. As part of the process of the development of a power station, Resgen will register as a power producer.

The proposed Boikarabelo Power Station, ash dump and temporary construction village will be located on the farms Kruishout 271LQ and Vischpan 274LQ which are within the Boikarabelo Coal Mine mining right area. The footprint of the initial power station is 9 hectares (ha), the ash dump is 31.5ha and the temporary construction village 11ha.

In terms of the NEMA and Regulations GN R 543, GN R 544, GN R 545 and GN R 546 of 18 June 2010 (the EIA Regulations), and the National Environmental Management Waste Act, Act 59 of 2008 (NEMWA) ,the proposed Power Station triggers a suite of activities, which require authorisation from the National Department of Environmental Affairs (DEA) before the activities can be undertaken. This report has been compiled in compliance with the prescribed NEMA process. Additional Process which will be followed will be in accordance to the National Environmental Management Air Quality Act, Act 39 of 2004 and the National Water Act, Act 36 of 1998.

The EIA will ensure that the environmental and social consequences, both negative and positive, of the proposed project and related activities are considered through the life cycle of the project. The findings will be compiled into an Environmental Impact Report (EIAR) and EMP, and then submitted to the decision-making authority, the DEA, for an informed decision on the proposed project.

Digby Wells Environmental (Digby Wells), an independent environmental consultancy, has been appointed by Resgen to undertake the EIA process, including the associated public participation and specialist studies.

2 REGULATORY REQUIREMENTS

Various environmental authorisations are required for the development of the Boikarabelo Power Station. Table 2-1 provides details of the activities which require environmental authorisations which are addressed in this EIAR EMP.

Table 2-1: Required environmental authorisations

Activity	Description	On site activity
National Environmental Management Act, Act 107 of 1998 – Environmental Authorisation		
Government Notice No R. 544		
Activity 22(ii)	The construction of roads outside of the urban area where, no reserve exists and where the road is wider than 8 m.	A tarred access road will be constructed off the main mine access road to the power station (3.4km).
Government Notice No. R 545		
Activity 1	Construction of a 260 MW Coal-fired thermal power station.	Construction of up to a total capacity of 260MW power station.
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.	The power station will utilise water in the power generation process and will emit air emission
Activity 15	The development of more than 20 ha outside an urban area	The construction of the power station (9ha), ash dump (31.5ha) and associated infrastructure; including the construction camp (11ha)
National Environmental Management Waste Act, Act No. 59 of 2008 – Waste Licence		
Category A(1)	Storage in excess of 100 m^3 general waste	The temporary storage of general waste until removal into mines waste management system.
Category	The storage including the temporary	Temporary storage of used turbine

Activity	Description	On site activity
A(2)	storage of hazardous waste at a facility that has the capacity to store in excess of 35 m^3 of hazardous waste at any one time.	oil and oil from generators.
M3 Category A(18)	The construction of facilities for activities listed in Category A.	For activities A(1 & 2), the temporary waste storage facilities..
Category B(1)	The storage including the temporary storage of hazardous waste in lagoons.	Waste water will be stored in sumps
Category B(7) .	The treatment of effluent, wastewater or sewage with an annual throughput capacity of more than 15 000 m^3.	Two sewage plants will be constructed for the temporary construction camp and potentially for the phase II expansion of the power station.
Category B(10)[1]	The disposal of general waste to land covering an area in excess of 200 m^2	Development of ash dump (non-hazardous).
Category B(18)	The construction of facilities for activities listed in Category B	For activities B(1, 7 &10) , as mentioned above. 4 million tonnes over 25 years.
National Water Act, Act No. 36 of 1998 – Integrated Water Use Licence		
Section 21(b)	Storage of potable or raw water.	
Section 21(g)	Disposing of waste or water containing waste in a manner which may detrimentally impact on a water source.	The disposing of ash
Section 21(h)	Disposing in any manner of water which contains waste from, or which has been heated in, any industrial or	The use of water for power generation

[1] Activity B(9) in terms of NEMWA has been omitted as the ash has been classified as general waste, therefore approval for the disposal of hazardous waste is not required. Activity A(1) has also been omitted as temporary general waste storage will not exceed 100m^3.

Activity	Description	On site activity
	power generation process	
The National Environmental Management: Air Quality Act 39 of 2004 –Air Emissions Licence		
Category 1: Combustion installations		
Subcategory 1:1	Solid fuels combustion installations	The burning of coal for the generation of power

2.1 Submissions

The required applications in terms of NEMA and NEMWA have been submitted as an integrated application to the National DEA. The additional environmental licensing required for the development and operation of the power station include a water use licence and an atmospheric emissions licence (AEL). The water use licence will be undertaken as an amendment to the approved water use licence for Boikarabelo Coal Mine and the AEL will be submitted once NEMA approval has been obtained. Table 2-2 outlines the current submissions which have been undertaken to date.

Table 2-2: Regulatory submissions undertaken to date

Authority	Submission	Date
NEMA/NEMWA		
National DEA	Submission of an integrated application	29 September 2011
	Acknowledgement of the application from DEA	19 October 2011
	Public review of draft Scoping Report	16 November 2011 – 20 January 2012
	Submission of final Scoping Report	03 February 2012
	Acceptance of Scoping Report	02 April 2012
	Submission of Draft EIAR and EMP for public review	05 September 2012

2.2 Other Applicable Legislation

Additional legislation applicable to the proposed project is listed below.

2.2.1 National legislation and regulations

- The Conservation of Agricultural Resources Act, Act No 43 of 1983;
- Constitution of the Republic of South Africa Act, Act No. 108 of 1996;
- Hazardous Substances Act, Act No. 15 of 1973;
- Limpopo Environmental Management Act, Act No.7 of 2003;
- National Heritage Resources Act, Act No. 25 of 1999;
- National Environmental Management: Air Quality Act, Act No 39 of 2004;
- National Environment Management: Biodiversity Act, Act No. 10 of 2004;
- Promotion of Access to Information Act, Act No. 2 of 2000;
- Electricity Regulation Act, Act No 4 of 2006; and
- Electricity Act, Act 41 of 1987.

2.2.2 Guideline Documents include

- DEAT Air Quality Guidelines;
- SANS 10103:2004 :The Measurement and Rating of Environmental Noise with Respect to Land Use, Health, Annoyance and to Speech Communication;
- SANS 1929:2005 Edition 1.1 – Ambient Air Quality Limits for Common Pollutants;
- DWAF: Minimum Requirements Guideline for the Handling, Classification and Disposal of Hazardous Waste, 1998;
- DWAF: Minimum Requirements Guideline for the Water Monitoring at Waste Management Facilities;
- International Association for Public Participation, 2007: IAP2 Core Values. [On-line], Available: http://www.iap2.org;
- National Environmental Management Act, 1998 (Act No. 107 of 1998) as amended (NEMA) Implementation Guidelines: Sector Guidelines for Environmental Impact Assessment Regulation (GG No. 33333 of 29 June 2010);
- Waterberg District Municipality Environmental Management Framework, 2011; and
- Limpopo Internal Strategic Perspective, Department of Water Affairs and Forestry, 2004.

3 PROJECT DESCRIPTION

3.1 Background and Context

The proposed Boikarabelo Power Station comprises the construction, commissioning and operation of a coal-fired thermal power station of up to 260MW and associated infrastructure, in the Waterberg Coalfield, Limpopo Province, South Africa. The proposed Boikarabelo Power Station is to be located on the farms Kruishout 271LQ, and Vischpan 274LQ within the existing mining right area of the proposed Boikarabelo Coal Mine. The envisaged Boikarabelo Power Station would combust middlings coal from the Boikarabelo Coal Mine for the generation of electricity.

Electricity generated will initially be utilised for the Boikarabelo Coal Mine, with the possibility of the expanded capacity being fed into the National grid if required, when the Power Station is upgraded up to a potential 260MW plant. The Boikarabelo Power Station will receive coal directly from the mine's middlings coal stockpiles via overland conveyors. To combust this coal stream, which has inherently lower energy or calorific values (CV) than export grade coal, recourse will be made to Circulating Fluidised Bed CFB combustors (boilers) which have the added advantage that sulphur trapping can take place with the sorbent bed (limestone) in these boilers. This ensures a plant with relatively benign emissions. The resulting steam, generated by heat exchange with burned flue gas, will be used to generate electricity by driving a turbine coupled to a generator producing electrical current. It is expected the first electricity generation will be achieved by September 2014.

In the event that the power station is upgraded, a 132 kilovolts (kV) double circuit transmission line will be required to feed the electricity from the power station to the existing network. The construction of the transmission line however, falls outside the scope of this EIA.

As the timing of the development of the power station may not be concurrent with that of the coal mine, there is the possibility of the use of diesel generators for a short period. The use of these generators will cease once power is available from the power station. The period of operation of the generators has to be limited if not entirely avoided due to the high costs.

3.2 Project Motivation

Over the last decade, South Africa has experienced a steady growth in the demand for electricity as a result of healthy economic growth. The continued growth in the economy has exhausted the surplus electricity generation capacity of the National electricity grid.

Although the generation load factor shows a slight negative trend over the past few years, the maximum demand, together with the greater need for maintenance, has put the available power supply under pressure. It is expected that the reserve margin will continue on a downward trend for the next couple of years until new base-load Power Stations are built. In spite of capacity coming on line the electricity demand within the country is still higher than the available capacity.

Eskom is fast-tracking the implementation of its capacity expansion programme and is in the process of constructing two coal-fired power stations, Kusile near Witbank and Medupi near Lephalale, as well as Ingula pumped storage scheme near Ladysmith and extending the Atlantis and Mossel bay Open Cycle Gas Turbine's (Eskom Annual Report, 2011). Additional base load and peaking options are required to meet the growing demand. Eskom is therefore investigating nuclear and coal-fired power stations and intends to start construction on such generation facilities in the future. Until such time as alternative sources of energy are successfully implemented, coal will remain the primary energy source in South Africa. The continuation in the growth in demand has also opened the market for the development of Independent Power Producers (IPP) to enter the market and expand the National Grid.

The proposed power station is required to ensure the stability of the operation of the Boikarabelo Coal Mine. Since the onset of the project, Resgen has been able to secure an initial supply from Eskom, however this supply is not sufficient for the full operation of the processing plant as well as the use of electrical mining shovels. As supply from the grid may not be reliable, Resgen requires a stable source of power to ensure optimal operation of the mine.

Resgen therefore proposes the development of a coal-fired thermal power station with an electrical generation capacity of up to 260MW. An initial phase will involve the construction of a 45MW Power Station for internal supply (2014), to the Boikarabelo Mine, with a possible upgrade of up to 260MW Power Station for potential supply of electricity into the National grid if required (+2016).

It is envisaged that the construction of the proposed Boikarabelo Power Station will commence in 2013 off site initially. Construction will take place over a period of 24-30 months for Phase I (45MW), and 30-40 months for Phase II (215MW). It is envisaged that the power station will be fully operational by 2015 and will last for approximately 40 years, after which it may be decommissioned. Phase II will only commence post 2018 in the event that there are requirements for electricity supply in the surrounding area.

The proposed Boikarabelo Power Station will not draw electricity off the National grid, but result in self-generated power supply to the Boikarabelo Coal Mine. The Boikarabelo Coal Mine requires power to operate and it is proposed that the construction of the Boikarabelo Power Station will supply power directly to the Mine. Additionally, the proposed Boikarabelo Power Station will optimise the coal resource through the use of middlings coal.

Resgen's approach to the viable Power Station development and the benefits of the project can be summarised as follows:

- The Boikarabelo Power Station project presents an opportunity for Resgen to reduce its dependency on the National grid;
- The project will optimise the usage of middlings coal and reduce discard generation;
- The additional generated electrical power, from Phase II of the proposed project, may potentially feed into the national distribution network;

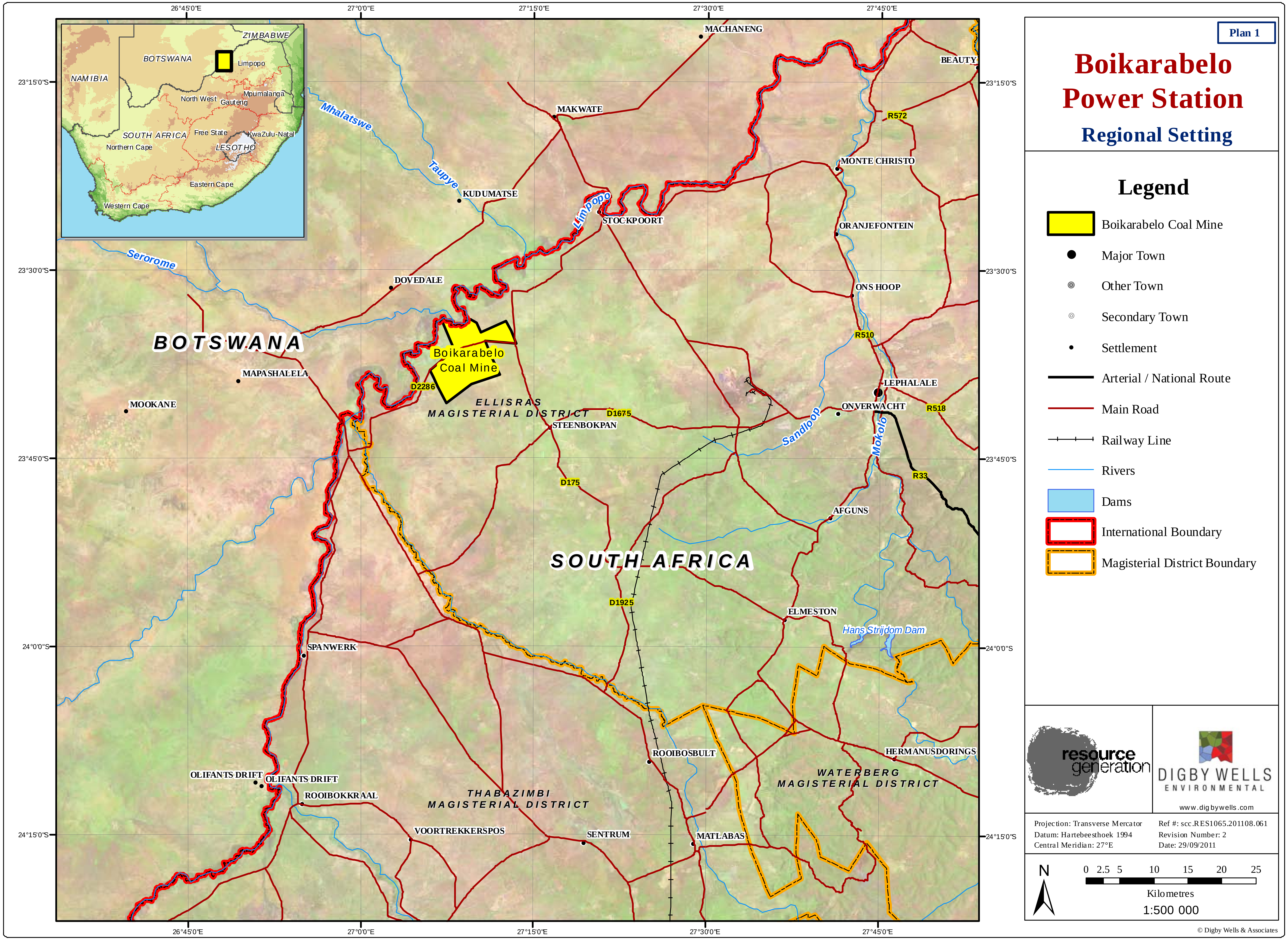
- Approximately 500 employment opportunities will be created during the construction of the proposed 45MW Boikarabelo Power Station;
- During the operation of the proposed Power Station, it is expected that 35 permanent employment opportunities will be created and sustained for more than 30 years. In the event of phase II, additional job opportunities will be available; and
- Training will be provided to employees resulting in an improvement of the local skills base.

3.3 Project Location

3.3.1 Regional setting

The proposed Boikarabelo Power Station will be located within the Waterberg Coalfield, approximately 75km west of Lephalale and 45 km west of the Matimba Power Station, Limpopo Province (Plan 1). The proposed Project area is situated within the Lephalale Local Municipality and the Waterberg Magisterial District. The Limpopo River, which forms the international boundary between South Africa and Botswana, borders the proposed Project area.

The proposed Power Station will be located entirely within the mining and surface right area of the Boikarabelo Coal Mine. The area will already be disturbed through the development of the mining operation. Ledjadja Coal has proactively purchased several properties, thus allowing all operations to be situated centrally with an extensive buffer zone being left surrounding the operations, thus retaining a large portion of the properties in their original sustainable state, retaining significant game on the property and allowing visual, noise and environmental screening for the neighbours.



Plan 1
Boikarabelo Power Station
Regional Setting
Legend
Boikarabelo Coal Mine
Major Town
Other Town
Secondary Town
Settlement
Arterial / National Route
Main Road
Railway Line
Rivers
Dams
International Boundary
Magisterial District Boundary
resource generation
DIGBY WELLS ENVIRONMENTAL
www.digbywells.com
Projection: Transverse Mercator
Datum: Hartebeesthoek 1994
Central Meridian: 27°E
Ref #: scc.RES1065.201108.061
Revision Number: 2
Date: 29/09/2011
N
0 2.5 5 10 15 20 25
Kilometres
1:500 000
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BOTSWANA
SOUTH AFRICA
Boikarabelo Coal Mine
ELLISRAS MAGISTERIAL DISTRICT
THABAZIMBI MAGISTERIAL DISTRICT
WATERBERG MAGISTERIAL DISTRICT
MACHANENG
BEAUTY
MAKWATE
MONTE CHRISTO
KUDUMATSE
STOCKPOORT
ORANJEFONTEIN
ONS HOOP
DOVEDALE
MAPASHALELA
MOOKANE
LEPHALALE
ONVERWACHT
STEENBOKPAN
AFGUNS
ELMESTON
SPANWERK
ROOIBOSBULT
HERMANUSDORINGS
OLIFANTS DRIFT
ROOIBOKKRAAL
VOORTREKKERSPOS
SENTRUM
MATLABAS
Hans Strijdom Dam
Mhalatswe
Taupye
Limpopo
Serorome
Sandloop
Mokolo
R572
R510
R518
R33
D2286
D1675
D175
D1925
ZIMBABWE
BOTSWANA
NAMIBIA
Limpopo
North West
Gauteng
Mpumalanga
SOUTH AFRICA
Free State
KwaZulu-Natal
LESOTHO
Northern Cape
Eastern Cape
Western Cape
26°45'0"E
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27°30'0"E
27°45'0"E
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23°30'0"S
23°45'0"S
24°0'0"S
24°15'0"S

3.3.2 Local setting

The Waterberg Coalfield region is largely undeveloped and is characterised by game farming and grazing. The Boikarabelo study area falls within the Limpopo River Catchment Area, and is approximately 860 metres above mean sea level (mamsl). There are a few small non-perennial streams draining the study area. These non-perennial streams flow in a northerly direction towards the Limpopo River. Wetland areas occur along the banks of the Limpopo River.

Within the study area, the proposed power station including associated infrastructure, construction camp, and ash dump covers an area of approximately 51.5ha. The study area is relatively flat with the exception of the Zoetfontein Fault which outcrops on the farm Boompan 237 LQ just outside the mining right area. This fault is also visible on the farm Kalkpan 243 LQ located within the mining right area but outside of the proposed Power Station area.

The nearest settlement is Dovedale (Botswana), situated approximately 9km north of the proposed Boikarabelo study area and within South African territory it is Steenbokpan 11km to the south. The nearest major town is Lephalale (formerly known as Ellisras), located 54km east of the study area (straight line distance).

The closest towns and settlements, as well as their direct distance, distance by road and direction from the proposed Power Station are summarised in Table 3-1.

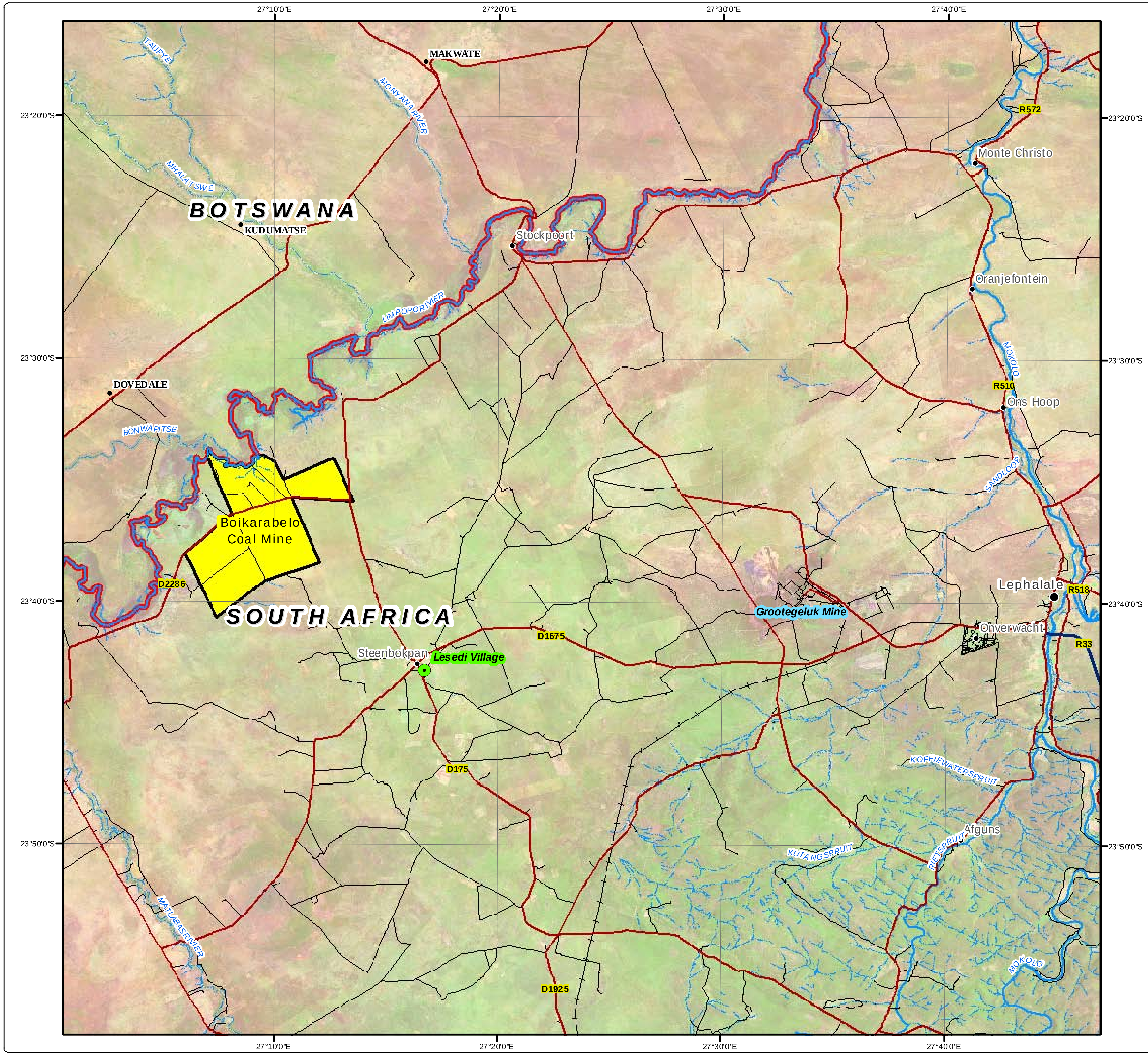
Table 3-1: Closest Towns and Settlements in the local area

Name	Country	Type	Direct distance	Road distance	Direction
Dovedale	Botswana	Settlement	9 km	54 km	N
Steenbokpan	South Africa	Settlement	11 km	17 km	SE
Kudumatse	Botswana	Settlement	18 km	69 km	N
Stockpoort	South Africa	Settlement	21 km	28 km	NE
Mapashalela	Botswana	Settlement	25 km	42 km	W
Makwate	Botswana	Settlement	31 km	46 km	NE
Lephalale	South Africa	Major Town	54 km	67 km	E

Plan 2

Boikarabelo Power Station

Local Setting



Legend

- Boikarabelo Coal Mine
- Major Town
- Secondary Town
- Other Town
- Settlement
- Lesedi Village
- Arterial / National Route
- Main / Secondary Road
- Minor Road
- Railway Line
- Non-Perennial Stream
- Perennial Stream
- Dam Wall
- Dam / Lake
- International Boundary

resource generation

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Datum: Hartebeesthoek 1994
Central Meridian: 27°E

Ref #: scc.RES1065.201108.071
Revision Number: 3
Date: 20/07/2012

N

0 2.5 5 10 15

Kilometres

1:290 000

3.3.3 Land Tenure

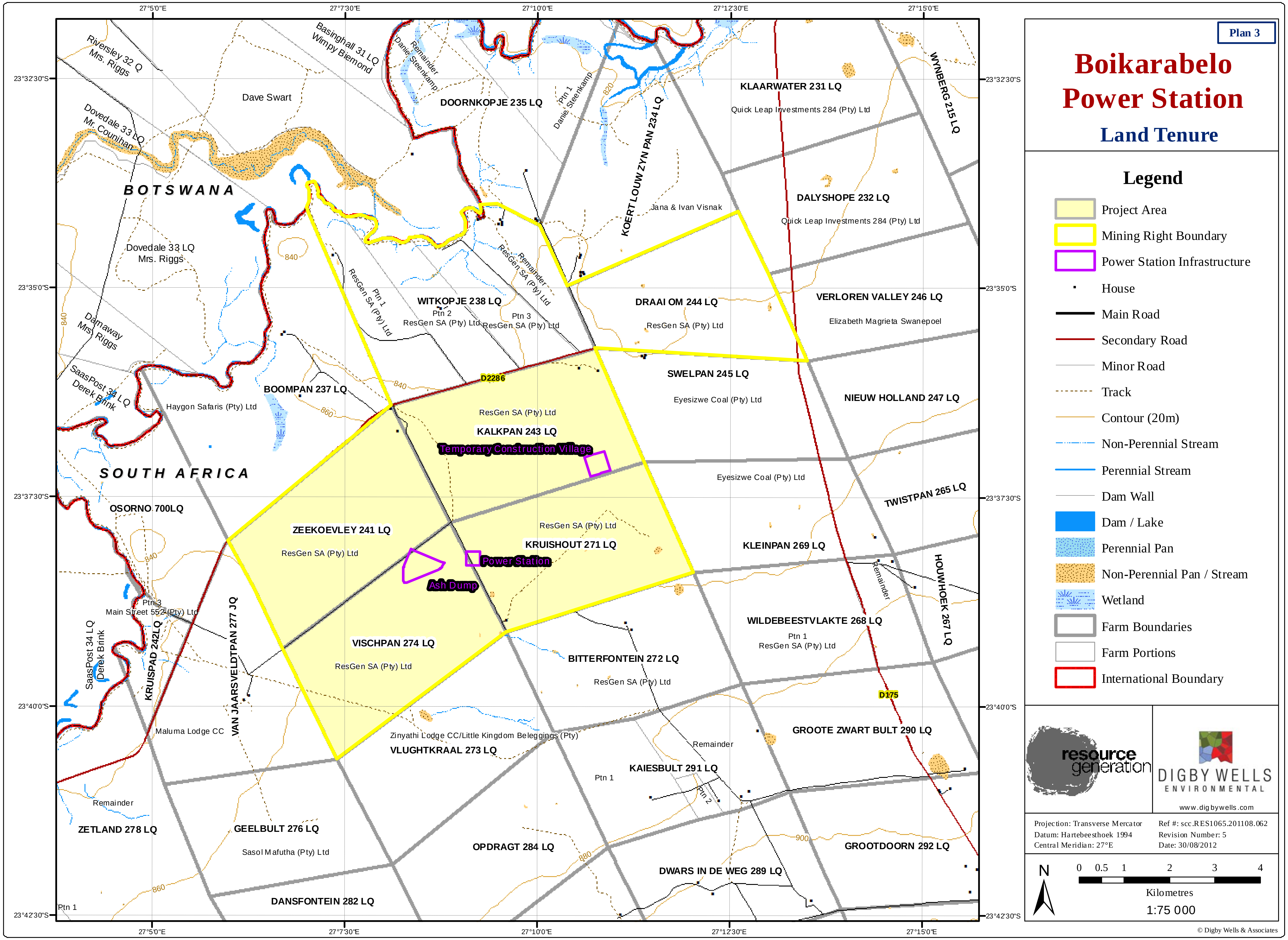
Landowner information of the proposed Power Station area is indicated in Table 3-2 and Plan 3. Land owners adjacent to the proposed Power Station development are indicated in Table 3-3. The directly affected properties are owned by Resgen and adjacent properties are owned by a combination of Resgen, other coal companies and individual owners.

Table 3-2: Land Owner Information

Farm Name	Land Owner
Kruishout 271 LQ	Resgen SA (Pty) Ltd
Vischpan 274 LQ	Resgen SA (Pty) Ltd
Zeekoevley 241 LQ	Resgen SA (Pty) Ltd
Kalkpan 243 LQ	Resgen SA (Pty) Ltd

Table 3-3: Land Owners adjacent to the proposed Power Station

Farm Name	Land Owner
Swelpan 245 LQ	Eyesizwe Coal (Pty) Ltd (*Resgen negotiating purchase*)
Kleinpan 269 LQ	Eyesizwe Coal (Pty) Ltd (*Resgen negotiating purchase*)
Wildebeestvlakte 268 LQ (Ptn 1)	Resgen SA (Pty) Ltd
Bitterfontein 272 LQ	Resgen SA (Pty) Ltd
Vlughtraal 273 LQ	Resgen South Africa (Pty) Ltd /Little Kingdom Beleggings (Pty)
Geelbult 276 LQ	Sasol Mafutha (Pty) Ltd
Van Jaarsveldtpan 277 JQ	Maluma Lodge CC


Plan 3
Boikarabelo Power Station
Land Tenure
Legend
Project Area
Mining Right Boundary
Power Station Infrastructure
House
Main Road
Secondary Road
Minor Road
Track
Contour (20m)
Non-Perennial Stream
Perennial Stream
Dam Wall
Dam / Lake
Perennial Pan
Non-Perennial Pan / Stream
Wetland
Farm Boundaries
Farm Portions
International Boundary
resource generation
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Datum: Hartebeesthoek 1994
Central Meridian: 27°E
Ref #: scc.RES1065.201108.062
Revision Number: 5
Date: 30/08/2012
N
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Kilometres
1:75 000
© Digby Wells & Associates
27°5'0"E
27°7'30"E
27°10'0"E
27°12'30"E
27°15'0"E
23°32'30"S
23°35'0"S
23°37'30"S
23°40'0"S
23°42'30"S
BOTSWANA
SOUTH AFRICA
Riversley 32 Q
Mrs. Riggs
Dave Swart
Basinghall 31 LQ
Wimpy Biemond
Remainder
Danie Steenkamp
DOORNKOPJE 235 LQ
Ptn 1
Danie Steenkamp
KOERT LOUW ZYN PAN 234 LQ
KLAARWATER 231 LQ
Quick Leap Investments 284 (Pty) Ltd
WYNBERG 215 LQ
Dovedale 33 LQ
Mr. Counihan
Dovedale 33 LQ
Mrs. Riggs
Jana & Ivan Visnak
DALYSHOPE 232 LQ
Quick Leap Investments 284 (Pty) Ltd
Remainder
ResGen SA (Pty) Ltd
Ptn 1
ResGen SA (Pty) Ltd
WITKOPJE 238 LQ
Ptn 2
ResGen SA (Pty) Ltd
Ptn 3
ResGen SA (Pty) Ltd
DRAAI OM 244 LQ
ResGen SA (Pty) Ltd
VERLOREN VALLEY 246 LQ
Elizabeth Magrieta Swanepoel
Damaway
Mrs. Riggs
SaasPost 34 LQ
Derek Brink
BOOMPAN 237 LQ
Haygon Safaris (Pty) Ltd
D2286
SWELPAN 245 LQ
Eyesizwe Coal (Pty) Ltd
NIEUW HOLLAND 247 LQ
ResGen SA (Pty) Ltd
KALKPAN 243 LQ
Temporary Construction Village
Eyesizwe Coal (Pty) Ltd
TWISTPAN 265 LQ
OSORNO 700LQ
ZEEKOEVLEY 241 LQ
ResGen SA (Pty) Ltd
ResGen SA (Pty) Ltd
KRUISHOUT 271 LQ
Power Station
Ash Dump
KLEINPAN 269 LQ
Remainder
HOUWHOEK 267 LQ
Ptn 3
Main Street 552 (Pty) Ltd
SaasPost 34 LQ
Derek Brink
KRUISPAD 242LQ
VAN JAARSVELDTPAN 277 JQ
VISCHPAN 274 LQ
ResGen SA (Pty) Ltd
BITTERFONTEIN 272 LQ
ResGen SA (Pty) Ltd
WILDEBEESTVLAKTE 268 LQ
Ptn 1
ResGen SA (Pty) Ltd
D175
Maluma Lodge CC
Zinyathi Lodge CC/Little Kingdom Beleggings (Pty)
VLUGHTKRAAL 273 LQ
Remainder
GROOTE ZWART BULT 290 LQ
KAIESBULT 291 LQ
Ptn 1
Ptn 2
Remainder
ZETLAND 278 LQ
GEELBULT 276 LQ
Sasol Mafutha (Pty) Ltd
OPDRAGT 284 LQ
GROOTDOORN 292 LQ
DWARS IN DE WEG 289 LQ
DANSFONTEIN 282 LQ
Ptn 1
820
840
860
880
900

3.4 Power Generation Process

For the power station proposed, the principles of operation are similar to those found in many other thermal power stations located worldwide. Coal is combusted in a boiler to generate steam. Once the steam reaches a certain temperature and pressure, it is then passed through a steam turbine for expansion which in turn creates rotational energy which then can drive an electrical generator.

3.4.1 Power generation technology

Coal has been selected as the main fuel for the power station boilers. Two well-proven technologies are available for coal combustion in large furnaces – pulverised fuel (PF) and CFB. The more appropriate technology for this project is CFB, which has the following advantages over PF:

- The ability to burn a wider range and a lower quality of coal without modifications to the boiler systems; as the feedstock for this project may have a wide range of specific energies (from 13 MJ/kg to 16 MJ/kg) this benefit is significant;
- Simpler control of sulphur oxide emissions by the addition of limestone to the furnace coal bed, as opposed to the use of more expensive (in both capital and operating costs) flue gas desulphurisation plant required for PF-fired boilers;
- Lower nitrogen oxide emissions due to lower combustion temperatures (typically 800°C to 900°C for CFB compared with 1350°C to 1500°C for PF);
- Reduced slagging problems, also due to the lower combustion temperatures; and
- Simpler coal processing and feeding systems and consequently reduced maintenance.

Against these benefits, power generating plants using CFB boilers are slightly less efficient, partly due to lower steam temperatures and higher auxiliary power consumption. However these disadvantages are offset by the greater suitability of CFB boilers for the coal available, the relative simplicity of emission controls and the lower maintenance levels.

Resgen will ensure that the best available technology with the most efficient boilers and lowest emissions systems are selected for the power station.

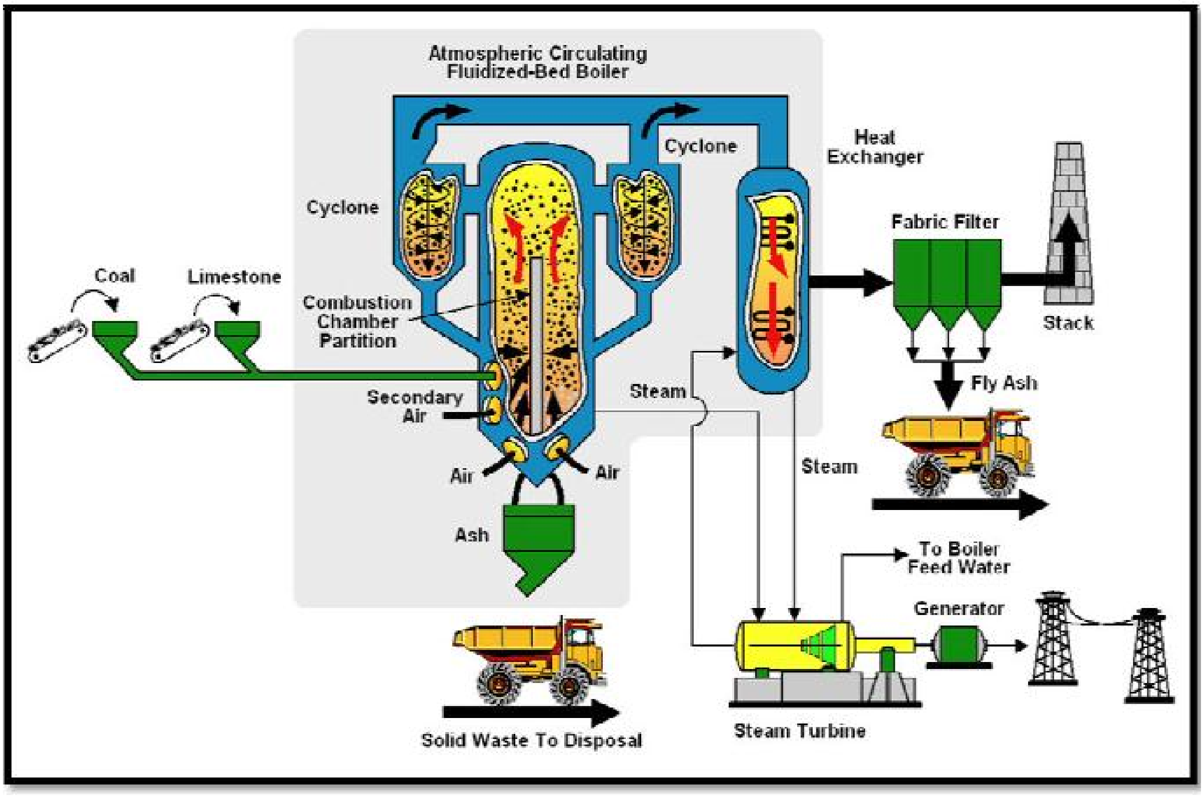


Figure 3-1: Graphical representation of a CFB power station

Each CFB boiler will be of the balanced draft, subcritical (drum- type) reheat design. The firing temperature is expected to be around 850°C, resulting in low NO_x emissions. The addition of crushed limestone into the combustion zone along with the coal absorbs sulphur from the coal to result in low SO_x emissions. A fuel oil or diesel system incorporating oil storage, pumps and burners will provide the means for boiler start up and low load operation. Fuel oil is likely to be less expensive than diesel as a fuel, and will form part of a future study. Due to the scarcity of water in the area, air cooled condensers will be used.

The power station will meet current local and World Bank emission standards by utilising:

- CFB boilers with direct limestone injection to manage SO_x and low combustion temperature to limit NO_x emissions;
- Filter bags/Electrostatic Precipitators to manage particulate emissions.

3.4.2 Plant configuration

A configuration study was undertaken during which configurations including 3 x 10MW, 3 x 12MW, 3 x 15 MW and 2 x 20MW units were reviewed. The analysis led to the recommendation of a 3 x 15MW (gross) coal fired CFB power station to provide the project power requirements. This allows for n+1 configuration (with only minor load management required) and high levels of stability.

The power plant availability by design is for 8000 hours per annum or 667 hours per month. The operation time of the coal processing plant is estimated at over 6000 hours per annum. The configuration of the upgrade up to 260MW has not yet been fully investigated.

3.4.3 Coal supply

Coal for the power station will be supplied by the Boikarabelo Coal Mine which has a life of mine exceeding 60 years. The mine will produce three different coal qualities. There will be export coal for shipment to international markets. The second coal is thermal coal with a CV of 19 MJ/kg which will be sold to Eskom and potentially other local users of thermal coal. The third grade of coal is for allocation to the Boikarabelo Power Station. This coal will consist of various fines; discard coal and other less desirable streams from the coal processing plant. Some beneficiated coal will be added (blended) to ensure that the coal is provided to the power plant is at an average coal quality of 15 MJ/kg. The coal processing plant has been designed to utilise the coal as identified from the various samples. The use of CFB boilers allows a wide range of coal types to be burned. Table 3-4 shows the typical raw coal quality:

Table 3-4: Typical raw coal qualities available.

CUT	Raw	Plant feed				
	RD	Ash %	CV [MJ/kg]	Volatile %	S %	Inherent moisture %
1	1.85	49.60	13.04	21.29	2.43	4.47
3	1.99	57.10	10.17	19.01	0.78	3.95
5	1.91	48.17	12.58	20.89	0.65	3.89
7	1.76	33.95	17.67	21.39	0.74	4.52
9	1.61	25.38	21.44	24.31	0.86	4.6
Weighted total	**1.88**	**48.2**	**13.1**	**20.7**	**1.1**	**4.2**

There will be a live coal stockpile on the mine site (at the edge of the power station site) which will be deposited via conveyor from the coal wash plant to the coal stockpile area. This stockpile will have capacity for two weeks supply which is estimated at 110 000 tonnes for the capacity of 260MW, however for Phase I a smaller capacity will be utilised. From the stockpile it will deposited via front end loader or truck into a hopper complete with screens and crusher (Figure 3-2). The hopper will feed the day bins and shall be designed to ensure sufficient redundancy and capacity to meet the boilers' full maximum continuous rating at 95% availability.

The stockpile will have 1 week worth of coal supply with sufficient storage for 2 weeks of coal at full maximum continuous rating of all three boilers. The power plant will utilise 250 000 to 300 000 tonnes of coal per annum in the first phase and 2 800 000 tonnes for 260MW.

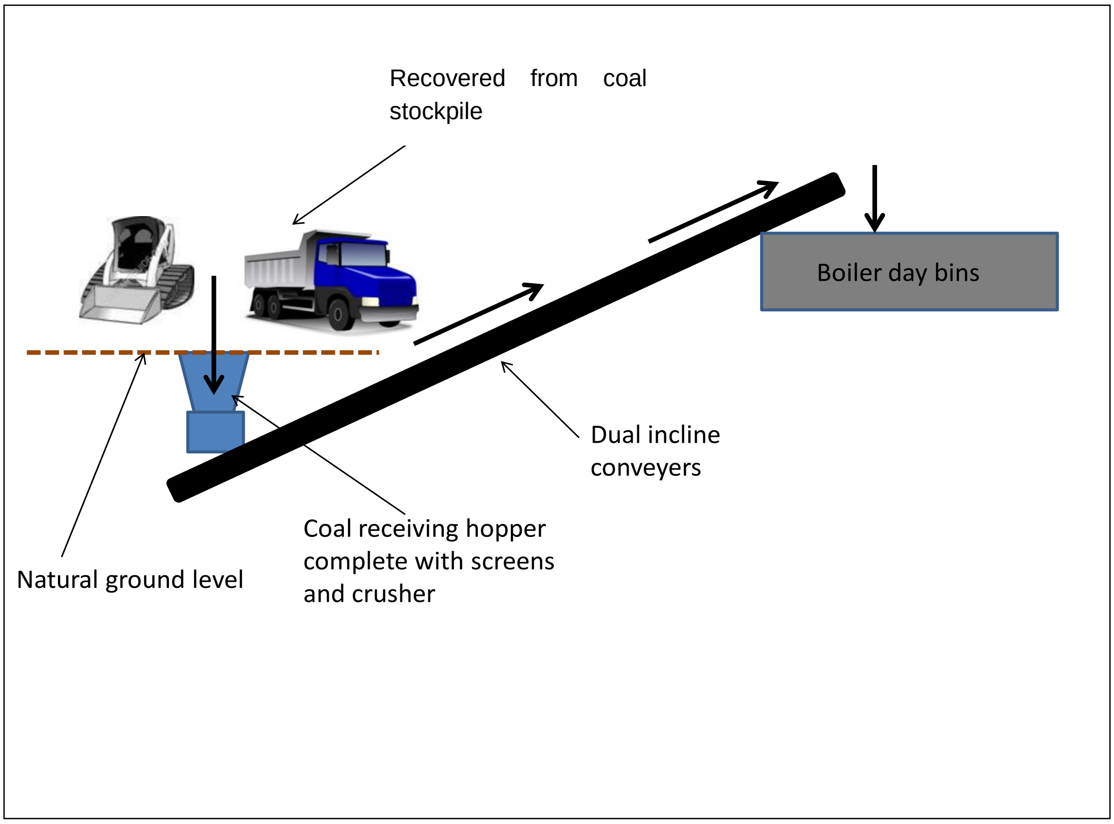


Figure 3-2: Coal feed process

3.4.4 Limestone

Limestone will be used to limit the emissions of sulphur dioxide from the stack. This will be achieved by injecting limestone into the boilers' fluidised beds where it will react with the sulphur during combustion to form calcium sulphate. The calcium sulphate will be disposed of with the bottom ash. The limestone demand will therefore depend on the sulphur content of the coal and the coal consumption.

Limestone will be received via truck from a local resource to ensure development of local business opportunities. As part of the limestone handling there will be a storage pad for 1500 tonnes (Phase I), hopper, crusher, screens and other associated equipment as may be required for handling and injection into the CFB.

3.4.5 Ash disposal

The ash dump covers an area of 31.5ha and approximately 720 tonnes per day of ash will be disposed of during Phase I. Bottom ash including reacted limestone in the form of gypsum will be removed from the boiler by mechanical means and transferred to a bottom ash silo. Fly ash will be collected by the bag filters located between the boiler outlet and the stack. The fly ash will be transported pneumatically to a fly ash silo. Both bottom ash and fly ash will be conditioned with water for ease of handling and to reduce heat levels and dust. The moistened ash will be conveyed to the ash dam facility some 1km from the power station, where mechanical equipment will then be used for the final deposition and compacting of the ash. The design is further detailed in Section 3.8.3.2.

3.4.6 Water requirements

In order to ensure continued preservation of water at Boikarabelo Coal Mine, the use of air-cooled condensers (either natural draft or forced draft) will be utilised for cooling therefore avoiding high water requirements. The use of dry cooling will reduce water demand by more than 80%.

Final water requirements will be subject to detailed design, including optimisation of the sizing of the Air-Cooled Condensers and optimising of water recycling. An estimated 720 kl/d of water is required for phase I.

Table 3-5: Input requirements including water requirements

Consumption	Output 45MW	Output 260MW
Nett Power (MW)	45	260
Ash Production (tph)	19.8	83.2
Water Consumption (kl/h)	30	173
Coal Use (tph)	57	329
Commercial Operation	July 2014	No known date
Nett Plant Efficiency	25%	27.3% - 33%
Steam Conditions	60 – 80 bar and 480 – 500°C	89 – 120 Bar and 510 – 600 °C
Limestone Consumption (tph)	6	35

3.5 Power station services and infrastructure

The power station will interface with the Boikarabelo Coal Mine for various utilities. The terminal points would be as follows:

- **Coal**: The coal will be supplied from the stockpile near the wash plant. From here, it will be conveyed by the mine to the power station stockpile adjacent the power station to a stockpile. There will be a coal hopper, crusher, screens and dual incline conveyors from the power station stockpile to the boiler feed bins. It is estimated that front loader trucks will be used to transfer the coal from the stockpile onto the extraction hoppers;
- **11 kV Connection**: The line links at the power station to main consumer sub-station located within 500m from the power station boundary which shall be the battery limit;
- **Raw water**: An Erichsen reservoir (2 Mega litres (Ml)) will be provided at the power station boundary from the mine water supply. There will be a pipeline from the reservoir to the power station;
- **Water demineralisation plant**: A water demineralisation plant will be constructed to guarantee the demineralised water quality for the boilers requirements.
- **Effluent discharge**: During Phase I a septic tank system will be utilised. During phase II a sewage package plant will be installed;
- **Fire water:** Fire water will be obtained from the raw water Erichsen reservoir and a separate reticulation system will be constructed. The power station and fire protection system will conform to National Fire Protection Act (NFPA) codes;
- **Potable water**: Potable water will be provided by the mine at the power plant boundary;
- **Roads**: 3.5km of internal roads will be developed for the power station, and;
- **Limestone**: The limestone will be delivered to a pad foundation (1500 tonnes capacity) within the power station boundaries.

The power station fuel oil system will supply light (diesel) fuel oil for the back start facility and also the auxiliary fuel requirements for boiler start. The small size of the power plant and the load that the mine infrastructure utilises if the coal processing plant is out of service requires a number of diesel/ fuel oil engines for power production. These will all be situated in the power station footprint.

The buildings and structures within the power station will include :

- Supporting structures and enclosures for the CFB boilers (Boiler Hall);
- Enclosed steam turbine hall;
- Supporting structure for the condensers;

- Auxiliary bay containing de-aerator, electrical switchboards, electrical equipment and plant control room;
- Concrete/Steel chimney stack;
- Water treatment building;
- Coal handling plant buildings;
- Fabric Filter plants/Electrostatic Precipitators;
- Ash handling plant silo;
- Black start facility building for the 2x3MW generators required for back start and for mine idle load;
- Miscellaneous structures to contain equipment such as limestone crushers, ash conditioning and chemical dosing;
- Small administration building and ablution facilities;
- Stores, workshops and other service buildings; and
- HV Switchyard.

A conceptual generic layout of the power station can be seen on Figure 3-4. Figure 3-3 provides a representation of a similar power station.

Figure 3-3: Representation of similar power station

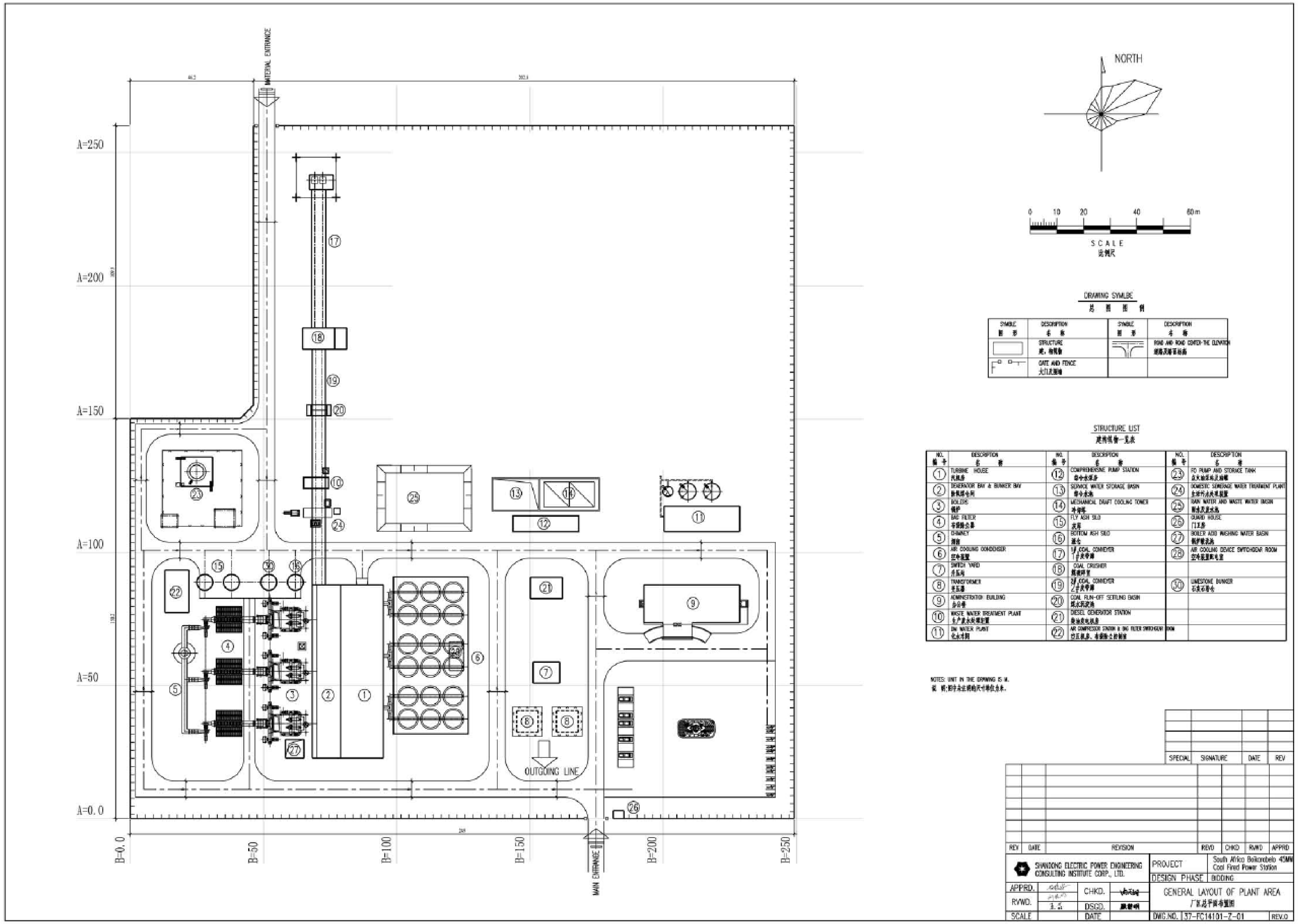
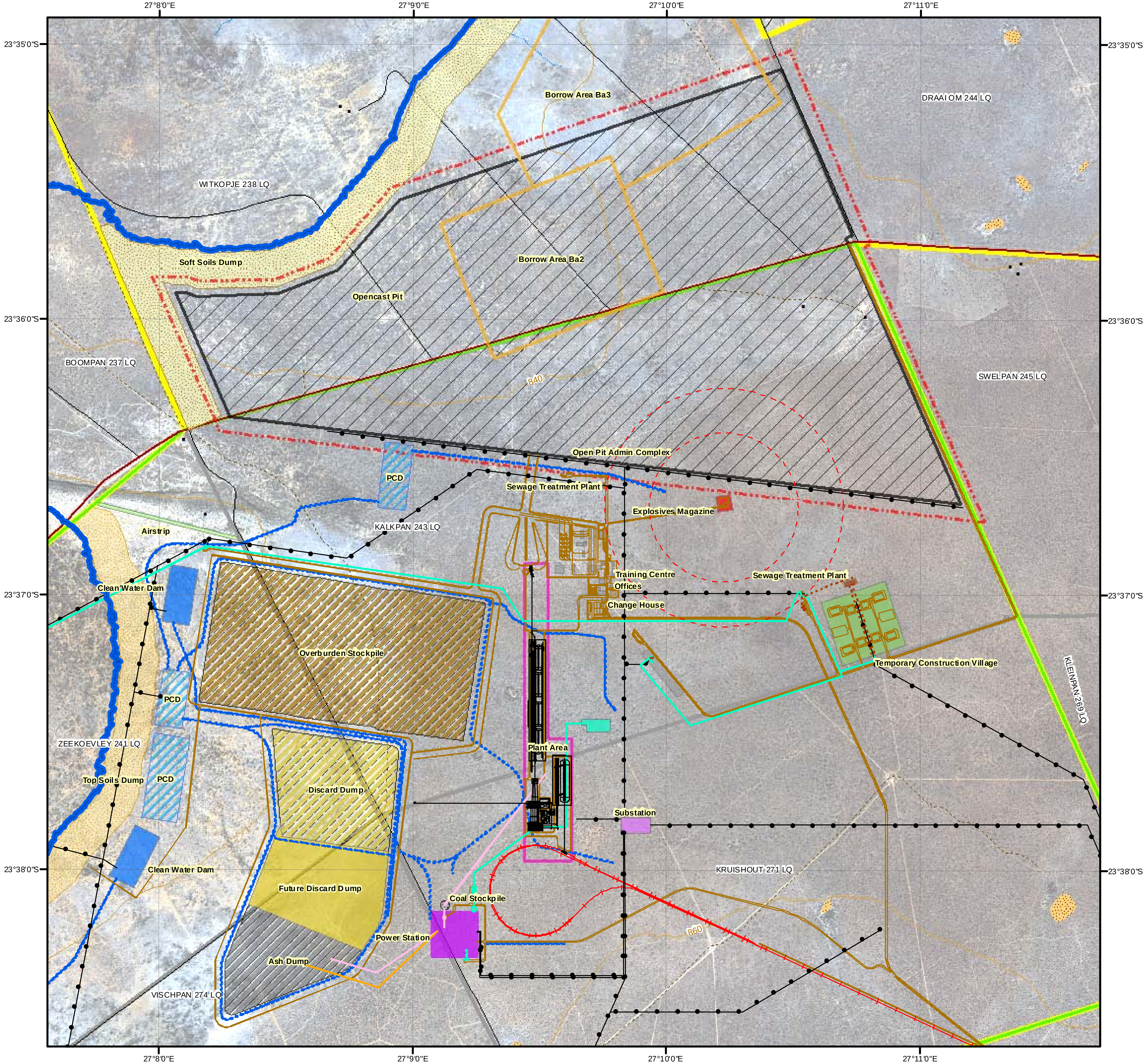


Figure 3-4: General layout of proposed power station (conceptual).



Plan 4

Boikarabelo Power Station

Site Layout

Legend

- Project Area
- Mining Right Boundary
- Predicted Floodline 1:100
- House
- Main Road
- Secondary Road
- Minor Road
- Track
- Contour (20m)
- Non-Perennial Stream
- Perennial Stream
- Dam / Lake
- Perennial Pan
- Non-Perennial Pan / Stream
- Wetland
- Farm Boundaries

Mine Plan

- Conveyor
- Drain
- Explosives Magazine Blastline
- Pipeline
- Power Line
- Railway Line
- Road
- Sewage
- Slurry Line
- Plant
- Airstrip
- Ash Dump
- Blast Line
- Borrow Area
- Buildings
- Clean Water Dam
- Coal Stockpile
- Discard Dump
- Explosives Magazine
- Future Discard Dump
- Offices
- Opencast Pit
- Overburden Stockpile
- PCD
- Plant Area
- Power Station
- Sewage Treatment Plant
- Substation
- Temporary Construction Village
- Water Storage Tanks
- Soft Soils Dump
- Top Soils Dump

resource generation

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Central Meridian: 27°E

Ref #: scc.RES1065.201108.072
Revision Number: 7
Date: 03/09/2012

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Kilometres
1:26 000

3.6 Power demand

The total load of the mine can be separated into the following sections:

- **Mine Process Plant**: This is the total processing plant of the mine.
- **Mine Infrastructure**: This includes loads outside the Process Plant which largely consist of borehole water pumps, return water reticulation, service water reticulation, fire, dust and sewage reticulation; offices; admin buildings and laboratories.
- **Mine Production**: This is primarily the shovel loading, each of which are approximately 1.4MW. There are a number of small in pit auxiliary loads that are required irrespective of whether there are any electric shovels such as water extraction pumps, lights, etc.

There is no requirement to provide power to alternative users other than the Boikarabelo Coal Mine during Phase I.

It is recommended to have diesel generated power for standby power and black start purposes. The idle power of the mine is approximately 3MW (estimated Process plant consumption of 2.3MW and Mine Infrastructure of 0.8MW). This power requirement (assuming no Eskom power is available) can only be met by using diesel generators as any coal boiler unit would not be able to operate at such low levels reliably. In addition, this power would be used for the coal station's black start requirements.

Boikarabelo Coal Mine has permission from Eskom for tie-in to 2 x 2 MVA points on the farm lines. The one point is 3,800 m from the mine substation. There is also another farm line 14 km east from the mine on land that is owned by the mine. Eskom has given permission for a connection to this point (4 year temporary connection). It should be noted that these two lines may never be connected onto the same network as they are from different Eskom areas and that they are only temporarily going to be available for the mine. As a result, it will more than likely be impossible to rely on both lines for initial mine operations as the entire mine is will be connected onto a single grid system.

3.7 Water Management

3.7.1 Water supply

The Boikarabelo Power Station will obtain water from the Boikarabelo Coal Mine water supply. The mine has two main options for water supply.

1. Marapong-Boikarabelo Effluent Transfer Project

Resgen has proposed the upgrade of an additional 16 Ml/d activated sludge municipal wastewater treatment works and sludge disposal facility at the existing Marapong Effluent Wastewater Treatment Works. The treated waste water from the upgrade will be transferred via a pump station and transfer pipeline to the Boikarabelo Coal Mine storage dams.

Resgen proposes to register a servitude for the transfer and use of 16 Ml/d of treated and chlorinated effluent for a period of 30 years. The storage dams on the mine required for the treated water will be incorporated in the existing oxidation ponds as balancing/storage dams to form part of the mines operations and water reticulation system. The water transfer system will operate at a 99% availability service level (3.65 days per year down time). This is the primary option for water supply to the mine.

The Lephalale Local Municipality has signed a memorandum of agreement for the development of the project and the off-take of water. The required authorisations for this project are underway.

2. Groundwater abstraction

Groundwater will be the initial supply for the mining operation until the treated water transfer system has been established. Groundwater will then be used for the power station due to water quality requirements and make up water for the mining operation.

During construction phase, 200 to 800m^3/day of potable water will be required for the construction camp. The volume will be dependent on the phase of construction. This will reduce during operation.

Based on the proposed mine employee numbers and the proposed contractors on site approximately 140 m^3/per day will be required at full operation. Potable water will be obtained via groundwater abstraction which will then be stored in a reservoir.

3.7.2 Waste water management

Waste water from the blow down in the boilers will enter the dirty water management system of the mine. This will then be re-used in the mine water reticulation circuit. This will increase water reuse and reduce water wastage.

The ash dump will lie within the mine's discard dump water management area. There will be cut-off trenches around the ash dump which will collect any seepage as well as run-off from the dump. The detailed design is included in Section 3.8.3.2. The water collected will enter the mine's dirty water management system for treatment and re-use in the process.

Currently for Phase I of the power station, the volumes of sewage effluent generated will be low and therefore the construction of a standalone sewage treatment plant is not feasible. Sewage effluent will be collected in a holding tank which will be emptied by a honey sucker and taken to the mine's sewage treatment plant for treatment.

For the temporary construction village, two sewage package plants will be used for the treatment of waste water. It is planned that one plant will later be utilized for the Phase II expansion of the power station in order to manage increased volumes of effluent. This type of sewage plant utilizes the biological extended aeration principle of operation, which is a variation of the activated sludge treatment process. This system functions by creating an environment with sufficient oxygen levels and agitation to allow for bio-oxidation of the wastes to suitable levels for discharge. Raw sewage first passes through a screen to remove debris after which it enters the reactor basin of the plant. It is then mixed with the activated sludge and treatment is initialized. The micro-organisms suspended in the sewage feed on the organic pollutants. Oxygen is introduced into the system via fine bubble membrane diffusers. The bubbles of oxygen create a circulation system by the displacement of the mixed liquor in the reactor basin ensuring homogeneous treatment of effluent. The activated sludge enters the clarifier where the denser particles settle out. The settled sludge is returned to the reactor. The clear effluent which has separated from the dense sludge in the clarifier flows through notch weirs to the chlorine contact tank where chlorine is added to kill off bacteria. Treated waste water will discharged into waste water dams and will be re-used in the coal beneficiation process.

For the development of sewage plant the only alternative would be to utilise a municipal system, however, due to the location of the mine there are no municipal effluent services in the area. In the event that the area becomes developed in the future there is the potential for the development of such a system. Until such time, the use of sewage plants is considered to be the only sufficient method of managing sewage effluent. Various sewage treatment systems were considered such as French drain and VIP latrines, however due to the number of people that the system will service, a activated sludge package plant was felt to be the best option. Modern sewage plants are very efficient and effective which therefore ensures proper management of effluent and therefore reduced potential of pollution.

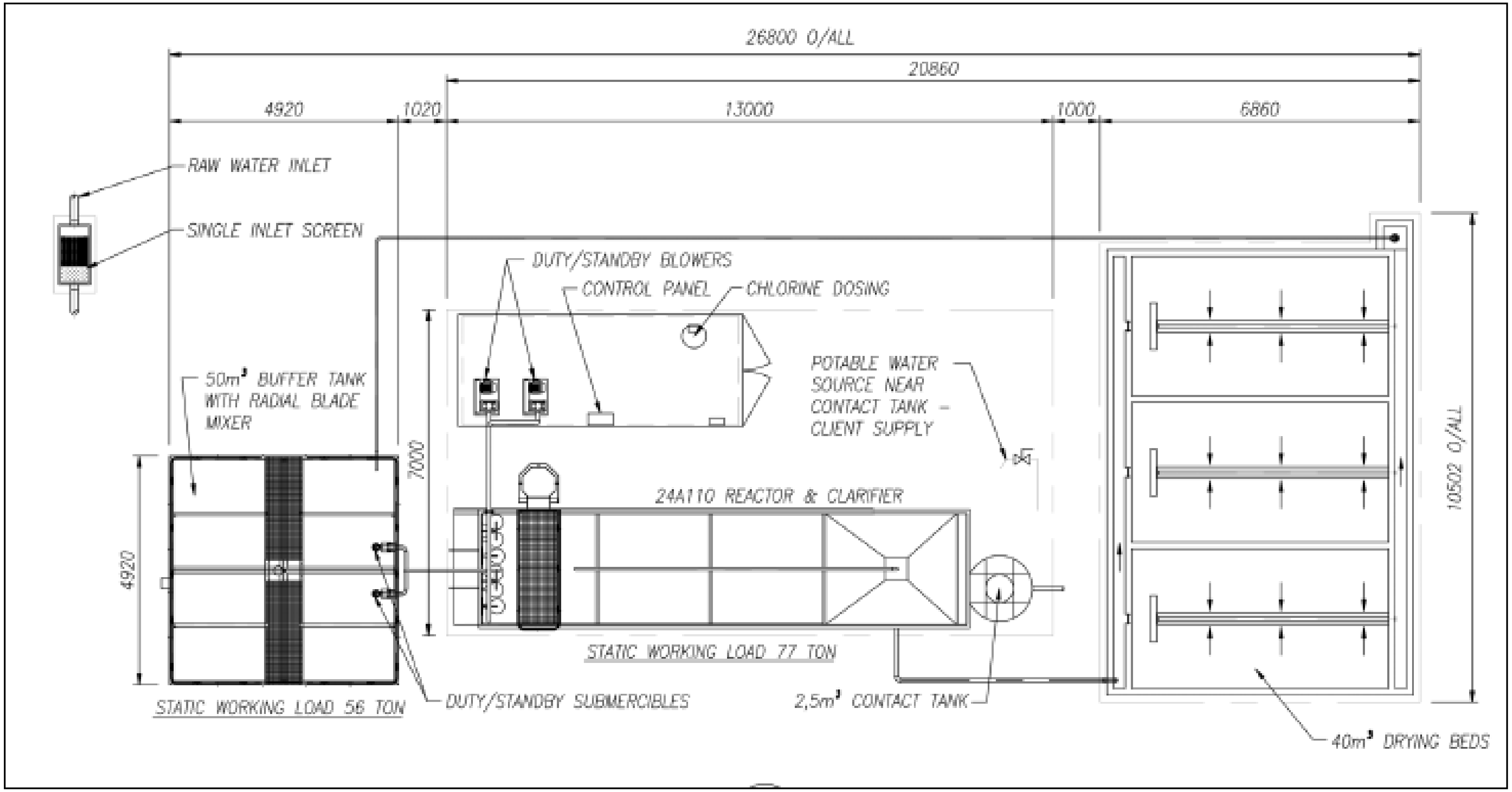


Figure 3-5: Typical package plant layout

3.8 Waste Management

3.8.1 General waste

The power plant will generate a small volume of general waste. The waste management will be undertaken in line with that of the mine. Waste separation will be undertaken at the sources (Figure 3-6). All waste will then be removed daily and taken to the mines waste handling area for collection as part of the mines environmental management system.

Figure 3-6: Example of waste separation bins

Information on the availability of waste contractors which operate in the area have been investigated. The following waste removal companies have confirmed that they can remove recyclable waste for further recycling as well as hazardous waste for disposal. Confirmation from the following waste contractors has been received and is attached in Appendix D:

- Waste-Rite (have an office in Lephalale).
- Waste Hub (based in Johannesburg).

Resgen will utilise local contractors on the onset of mining to ensure development of local business in the area.

3.8.2 Hazardous waste

The power station will mainly generate used oil from the turbines and maintenance of machinery. The used oil will be stored in 200 litre drums and placed in a bunded area. Figure 3-7 provides an illustration of such storage area. Used oil will be collected monthly by a recycling contractor in the area. The use of local contractors is to ensure development of local business.

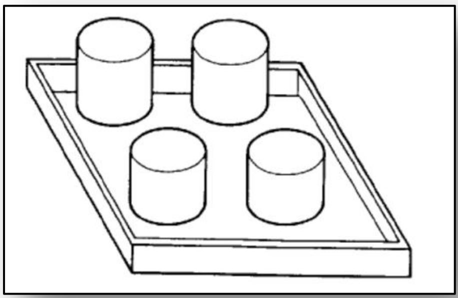


Figure 3-7: Example of bunded oil storage areas.

3.8.3 Ash disposal

3.8.3.1 Ash classification

In order to ensure long term safe disposal of the ash, various potential environmental impacts must be assessed. In order to inform this impact assessment and determine the appropriate design of the waste facility, it is necessary to classify the waste according to its hazardous rating level.

A new system for waste classification in South Africa is currently under development but, until this system is implemented, waste is classified according to the methodologies outlined in the Waste Management Series (DWAF, 1998). Volume 2 of this series, Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste (DWAF 1998), is applied for the classification of a Hazardous Waste. The classification report is attached in Appendix A.

The ash that will be generated from the Boikarabelo Power Plant was classified accordingly. Six representative coal samples were combusted to generate ash and were submitted to Mintek for analysis to ensure the coal quality is within the specified range of constituents. Samples were mixed with 10% by mass of lime, and ashed overnight at 950C in “normal" air so as to reflect ash that will be produced from the power plant.

The resultant ash was then exposed to acid rain leachate test as per DWAF’s Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste to extract hazardous metals at acidic conditions (worst case scenario). The results of the analyses, together with the waste classification are given in Table 3-6. According to these analyses and the corresponding calculations, none of the parameters measured for the waste volume over the 35ha disposal site area (g/ha/month) exceeded the acceptable risk rating and the waste can therefore be classified as a low hazard waste.

As the sulphur in the coal is captured by the limestone in the fluidised bed as $CaSO_4$, it is stable and unlikely to generate acid. The residual CaO in the ash will also further buffer any acid generated, resulting in the waste having a net neutralising characteristic. The ash is thus considered inert and a low environmental risk from a leachate perspective. It is, therefore, not necessary to design the waste site according to the requirements for a hazardous waste site.

Table 3-6: Ash classification

Element	Teratogenicity	Carcinogenicity	Acute Ecotoxicity LC_{50} - mg/l	Ecotoxicity Rating	Acceptable Risk ppb	Concentration in stream mg/kg	Analysis	Waste Rate per month kg/month	Element in stream g/month/ha	EEC ppb	Classification
Al (Aluminium)	Negative	Negative	3.9	highly hazardous: HR2	390	0.05	Acid Rain	19008000	27.15428571	17.92183	
As (Arsenic)	Negative	Negative (potentially +)	4.3	highly hazardous: HR2	430	0.1	Acid Rain	19008000	54.30857143	35.84366	
Ba (Barium)	Negative	Negative	78	moderately hazardous: HR3	7800	0.57	Acid Rain	19008000	309.5588571	204.3088	
Be (Beryllium)	Negative	Positive	42	highly hazardous: HR2	4200	0.1	Acid Rain	19008000	54.30857143	35.84366	
B (Boron)	Positive	Negative	334	moderately hazardous: HR3	33400	0.2	Acid Rain	19008000	108.6171429	71.68731	
Cd (Cadmium)	Negative	Positive	0.31	extremely hazardous:HR1	31	0.1	Acid Rain	19008000	54.30857143	35.84366	
Cr (Chromium) VI	Negative	Positive	0.2	extremely hazardous:HR1	20	0.024	Acid Rain	19008000	13.03405714	8.602478	
Co (Cobalt)	Negative	Negative	69	moderately hazardous: HR3	6900	0.2	Acid Rain	19008000	108.6171429	71.68731	
Cu (Copper)	Negative	Negative	1	highly hazardous: HR2	100	0.1	Acid Rain	19008000	54.30857143	35.84366	
Fe (Iron)	Negative	Negative	90	moderately hazardous: HR3	9000	0.05	Acid Rain	19008000	27.15428571	17.92183	
Pb (Lead)	Positive	Positive, class B	1	highly hazardous: HR2	100	0.1	Acid Rain	19008000	54.30857143	35.84366	
Li (Lithium)	Negative	Negative			-	0.1	Acid Rain	19008000	54.30857143	35.84366	
Mn (Manganese)	Negative	Negative	3	highly hazardous: HR2	300	7.8	Acid Rain	19008000	4236.068571	2795.805	

Element	Teratogenicity	Carcinogenicity	Acute Ecotoxicity LC_{50} - mg/l	Ecotoxicity Rating	Acceptable Risk ppb	Concentration in stream mg/kg	Analysis	Waste Rate per month kg/month	Element in stream g/month/ha	EEC ppb	Classification
*Mo (Molybdenum)	Negative	Negative	77	moderately hazardous: HR3	7700	0.24	Acid Rain	19008000	130.3405714	86.02478	
Ni (Nickel)	Negative	Positive, class B	11.4	highly hazardous: HR2	1140	0.34	Acid Rain	19008000	184.6491429	121.8684	
Se (Selenium)	Negative	Negative	2.6	highly hazardous: HR2	260	0.1	Acid Rain	19008000	54.30857143	35.84366	
Sr (Strontium)	Negative	Negative	10	highly hazardous: HR2	1000	2.5	Acid Rain	19008000	1357.714286	896.0914	
Sn (Tin)	Negative	Negative			-	0.1	Acid Rain	19008000	54.30857143	35.84366	
V (Vanadium)	Negative	Negative	13	highly hazardous: HR2	1300	0.15	Acid Rain	19008000	81.46285714	53.76549	
Zn (Zinc)	Negative	Negative	7	highly hazardous: HR2	700	1.6	Acid Rain	19008000	868.9371429	573.4985	
Zr (Zirconium)	Negative	Negative	20	moderately hazardous: HR3	2000	0.1	Acid Rain	19008000	54.30857143	35.84366	

*Bo (Boron)- Canadian Water Quality Guidelines for Bo

*Mo (Molybdenum)- http://www.imoa.info/HSE/environmental_data/experimental/fish.html

3.8.3.2 Ash dump design

An Ash Dump Design Criteria Report was completed by RSV ENCO and is attached in Appendix B.

For the purpose of the design the requirements outlined in the Minimum Requirements for Waste Disposal by Landfill (DWAF, 1998) was utilised. The ash dump was classified as a a GLB¯ landfill site

The following design criteria were considered:

- Dump Slope: 30° (1:1,73)
- Max Dump Height (m): 30
- Design Storm recurrence: 1:50
- Min. factor of safety: 1,3
- Ash Density (t/m3): 1,5 t/m³ (compacted with fly ash)
- Ash Dump Capacity: 6 million tonnes (4 million m³)
- Plant operation: 8000 (hours pa)

Based on the above only one site fully fulfilled the above criteria and this site was selected as the preferred location. The following were considered during the selection process and the selected site was then identified as the only position that could be used for development of the ash dump:

- The site topography in the central, southern and eastern parts of the total mine property is very flat and contains perennial pans in various places making the drainage and run-off collection and channelling to Pollution Control Dams (PCD) difficult. Contained and contaminated water will remain in the dump for longer periods making groundwater contamination a bigger possibility which we need to avoid.
- The northern portion will be mined as an open pit coal mine.
- The site has geological faults and the portion on the west of the property is the only option where there is enough space in-between faults where the discard and dumping of material could be located as a complex for dumping. This is also the area where the ash dump will be best located.
- The area surrounded by dirty water run-off channels also has an acceptable gradient towards the west where drainage of run-off water can be properly handled to limit contaminated water entering into the ground water and is naturally drained to a point where it will be handled with ease and let into the already designed drainage system to the PCD system.

- The ash dump will be in the immediate vicinity of the proposed site for the Power Station which is a financial consideration. Transportation of the ash to the dump will be much more cost effective under this scenario.
- The results from the Geotechnical Report by Geopractica dated April 2011, Job no 11012 indicates sufficient stability and attributes to place the ash dump in this position. The underlying strata are highly impervious and serve as a good barrier to the water table.
- The areas are unaffected by wet lands and associated flood plains

The waste disposal area has been designed to hold the coarse bottom ash with the fine fraction as fly ash.

Based on the daily ash outfall of 720 tonnes per day, the ash production is 6 million tonnes (4 million m³), for the 25 years of mine plant, with an average of 240 000 tpa (160 000 m³). The ash facility has been sized to contain >6 million tons of ash. The "footprint" of the discard area is approximately 31.5 ha in extent.

The waste disposal area has been designed to hold the coarse bottom ash with the fine fraction as fly ash. On the drawings it comprises the following:

- Ash Dump.
- Clean water diversion trench which is the drain designed for the mine area clean water separation from contaminated water and dirty areas.
- Dirty water/leachate interception drains and filters for percolating captured rain water and drain it to the main dirty water drain and PCD of the Boikarabelo Coal Mine system of drainage as it is situated in the boundaries of the Discard and Overburden Complex of the mine.
- Pollution Control Dam (PCD's) designed to handle the rest of the mine's dirty and raw water catchment. The PCD design criteria are part of the mine design catching water from the Discard Dump and the Carbonaceous Material Dump

Figure 3-8 and Figure 3-9 show the dump design philosophy, which entails constructing a compacted earth wall to act as a starter wall each year for the first 7 years of operation and growing to the full footprint size and then raising the main body of the ash by making use of a lower "bench" to maintain stability over the ±25 years of life.

The maximum height of the dump is of the order of 30m which will be placed in 6 platforms within 30° side slopes (Figure 3-10). The factors of safety will be checked to remain in line with accepted practice. Fill lifts heights of 5m will be landfilled to a maximum height of 30m with 3m bench widths around each lift.

The transportation of ash will be done mainly by ash conveyor from the Power Station to the ash dump and placement will be through front end loader, tipper truck, grader and compactor. The ash will be transported form the PS by tipper only in case of breakdown of the conveyor and then placed in the same manner as mentioned above.

The design of the water and storm water control will be to accumulate clean and dirty water separately and connect to the overall mine system of drains, clean water dams and PCD's. Due to high evaporation and low rainfall seepage through the ash dump is very unlikely and the cementing effect of the ash and will enhance the impervious nature of the whole backfill operation. Run-off water from the dump will accumulate in the dirty water channels around the dump and be transported to the greater mine PCD's for reclamation and re-use. As shown on the mine layout drawing (Plan 4) the open drains and berms separate the 1:100 "clean" water runoff, from the 1:50 "dirty" water, to divert clean run-off around the PCD's and discard dumps. The PCD's will be sized to collect the average dirty run-off from the dump and expected ingress into the open cast areas, plus the 1:100 24 hour storm. It will also act as a reservoir for the plant water requirements.

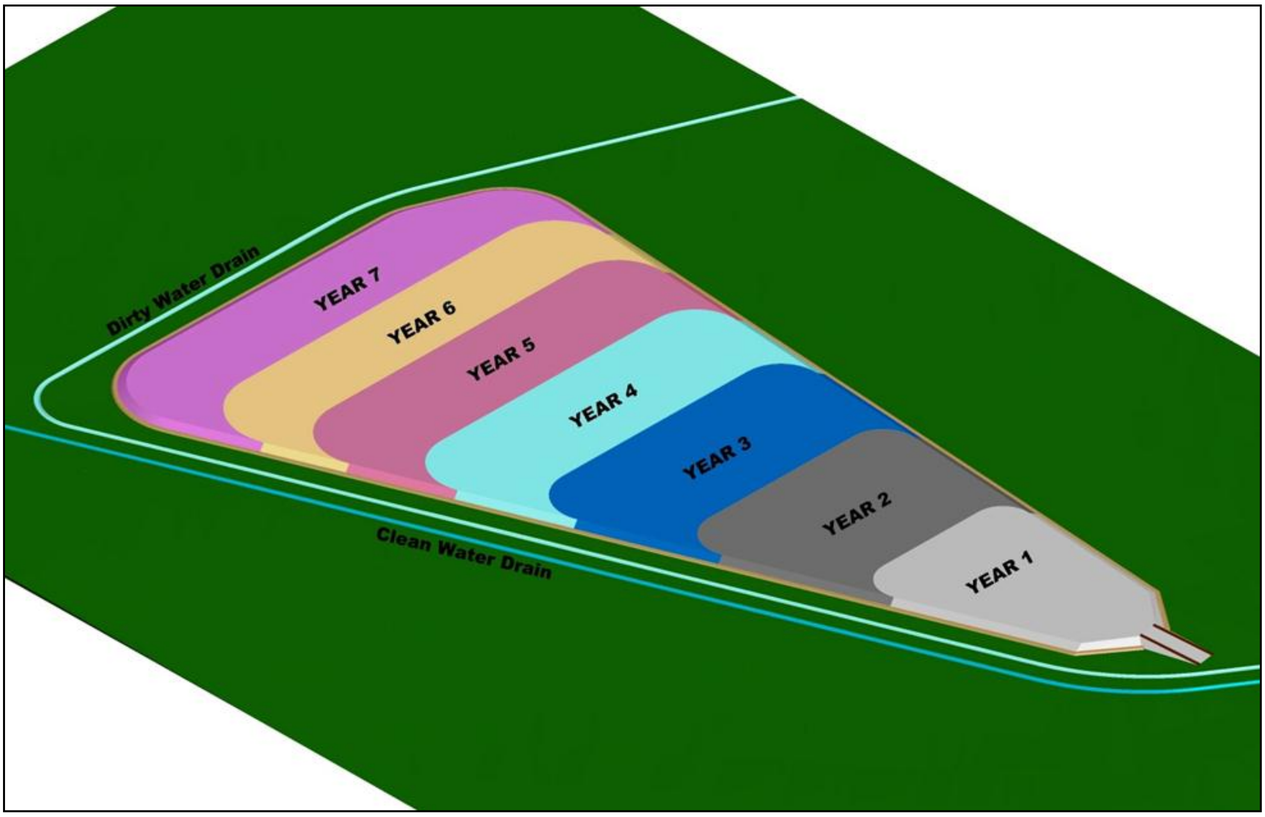


Figure 3-8: Progressive footprint enlargement over year 1 to7

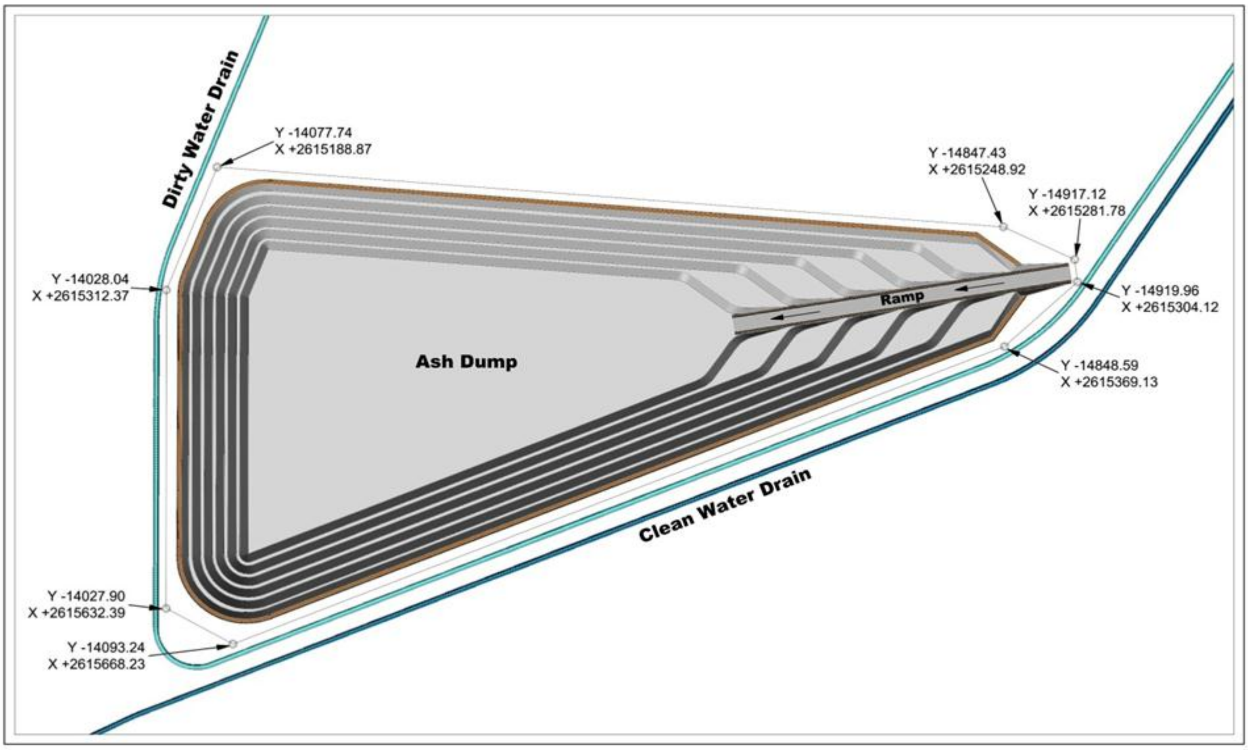


Figure 3-9: Plan view on ash dump at end of life year 30

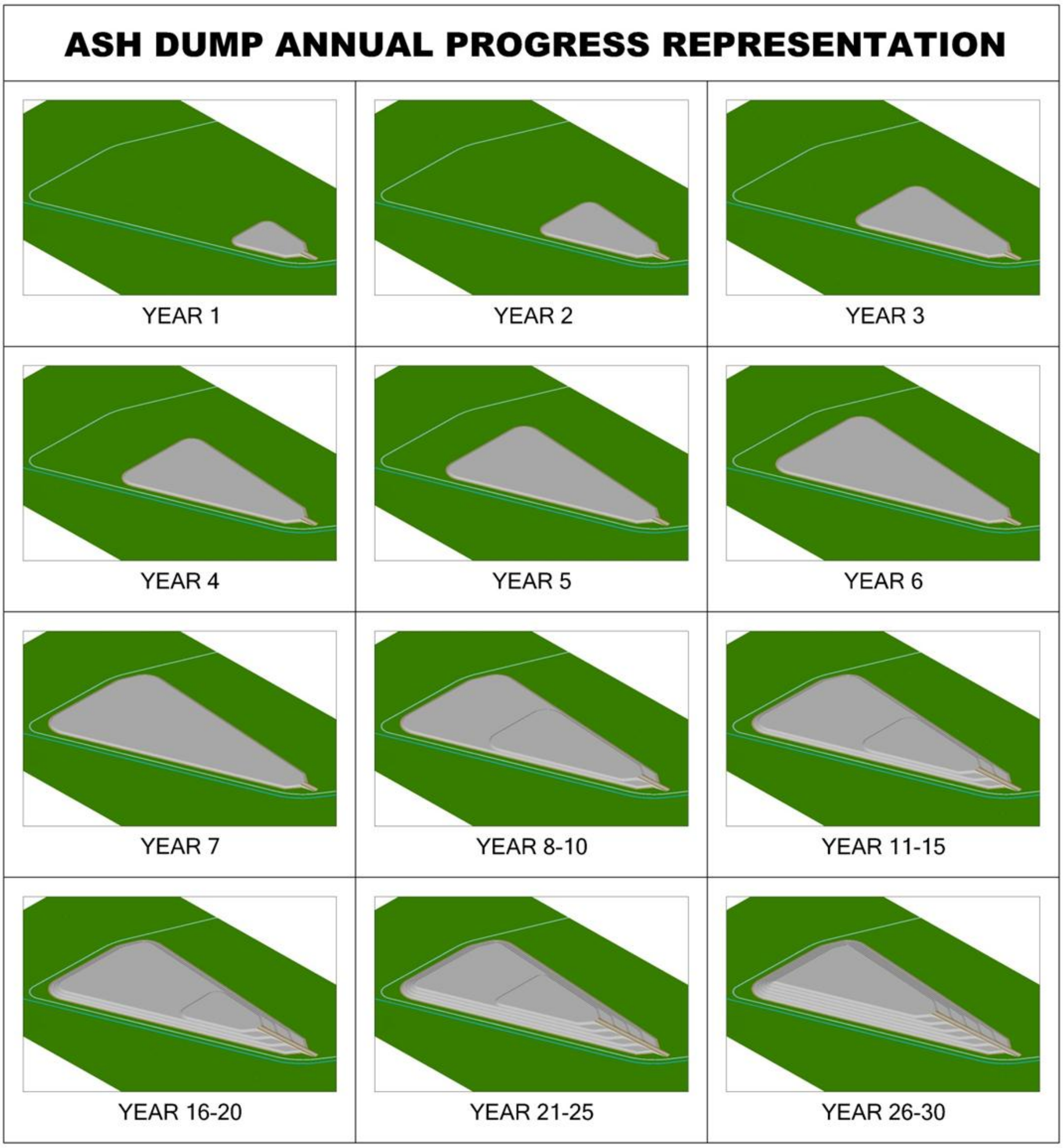


Figure 3-10: Ash Dump progress over years from year 1 to year 30

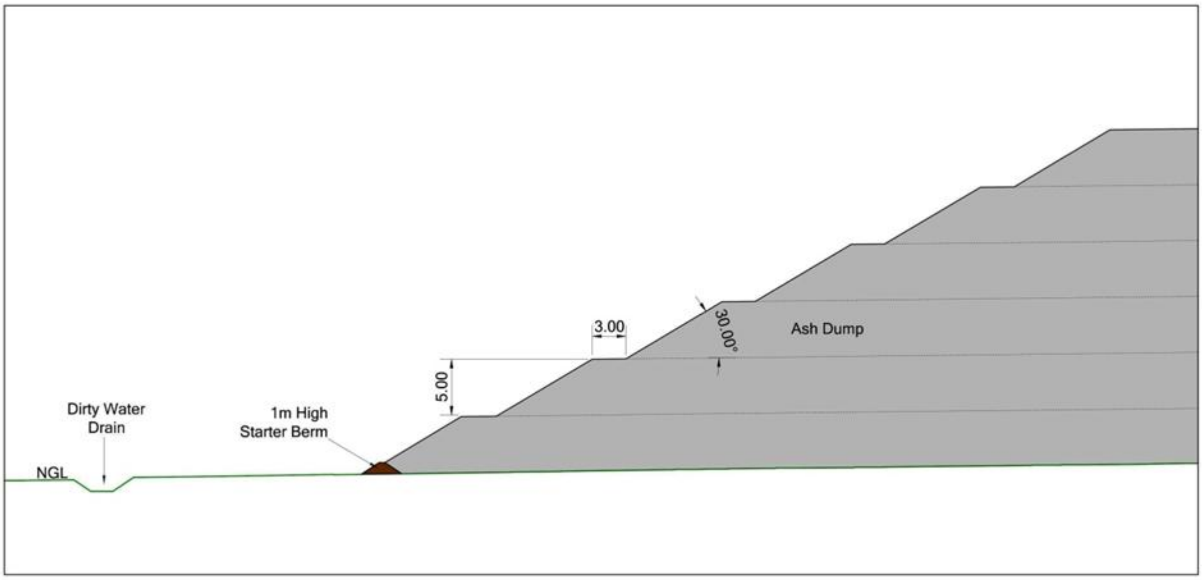


Figure 3-11: Section through side of ash dump showing the dump profile

3.9 Air Emissions Management

Sources contributing to air pollution from coal-fired power generation typically include:

- Flue gas stack emissions;
- Fugitive emissions from material handling (ash and coal); and
- Fugitive emissions from wind erosion (ash dump).

Typical emissions associated with coal-fired power generation include:

- Particulates (particles of dust too small to see with the naked eye);
- Oxides of sulphur (SO_x);
- Oxides of nitrogen (No_x);
- Oxides of carbon (carbon and carbon dioxide - CO and CO_2); and
- Trace elements.

With this in mind, there are a number of environmental measures to reduce the potential impacts of air emissions. Firstly, the flue gas stack has been designed to be 100m high. At this height, emissions from the stacks are dispersed more easily by the wind, and less air pollutants concentrate at ground level.

Secondly, fly ash will be captured and removed from the flue gas by electrostatic precipitators located at the outlet of the furnace. The fly ash is then periodically collected and will be disposed together with the ash on the ash dump.

3.10 Fire protection

The fire protection and detection system will adhere to the South African requirements. The fire detection systems will also be in accordance with the requirements of the latest National Fire Protection Association (NFPA) codes.

The Power Plant facility will be provided with automatic and manual fire detection and alarm systems. Sprinkler protected areas will also be provided with automatic fire detection such as for smoke or flame detection

3.11 Temporary construction village

The temporary construction village will be located on the farm Kruishout 271LQ[2] (Plan 3/4). This construction camp will be utilised for the construction of the mine and power station. During the construction period the number of workers to be housed in the camp will range from 800 to a maximum of 3500 at the peak of construction of both phase I of the power station and the coal mine. This level of construction workers is required due to the overlap of the construction of the various mining operations, such as the coal washing plant, power station and railway line. The camp will be a temporary facility and will be removed on completion of construction after 30 months. The buildings will be temporary container or soft wall structures. The camp will be fenced off and access will be regulated. Two package sewage treatment plants will be put in place for the treatment of effluent from the construction camp.

3.12 Employment

Between 500 and 700 employment opportunities will be created for the construction of the proposed 45MW Power Station consisting of approximately 45% skilled workers and 55% semi-to-unskilled workers.

During the operation of the proposed 45MW Power Station, it is proposed that 22 permanent employment opportunities will be created, consisting of the following:

- 1 x plant manager;
- 4 x operators;
- 4x shift supervisors;
- 1 x administrator;
- 10 x general labour; and
- 2 x electrical and mechanical artisans.

[2] Due to progress in the final design of the mine the exact location of the construction camp has shifted from the original location which was accessed as part of the specialist studies. Due to the uniform nature of the area and as the location not moved significantly, the findings of the studies remain relevant and applicable to this location.

It is expected that an additional 35 permanent employment opportunities will be created for the operation of the proposed 260 MW Power Station. The following employment opportunities will be required:

- 1 x plant manager;
- 12 x operators;
- 12 x shift supervisors;
- 2 x administrators;
- 4 x general labour; and
- 4 x electrical and mechanical artisans.

3.13 Project Schedule

Table 3-7 outlines the schedule for phase I of the Boikarabelo Power Station.

Table 3-7: Project Schedule

Development Phase	Time period
Design	September 2012- February 2013
Construction	March 2013 – June 2014
Operation of 1st Unit	September 2014

4 PROJECT ALTERNATIVES

Alternatives are different means of meeting the general purpose and need of a proposed activity. Alternatives help identify the most appropriate method of developing the project, taking into account location or site alternatives, activity alternatives, process or technology alternatives, temporal alternatives or the no-go alternative. Alternatives also help identify the activity with the least environmental impact.

4.1 Site Location Alternatives

Initially it was proposed that the Power Station be constructed on a farm portion located outside of the mining right area, which would have allowed for separate land ownership of the surface area to be disturbed (Plan 5). This proposed area for development includes Bitterfontein 272 LQ and Portion 1 of the farm Wildebeestvlakte 268 LQ.

The development of the proposed Power Station on these farm portions would have impacted on the railway line servitude and a pan. Therefore, from an environmental perspective it was recommended to limit the increase in the area of disturbance, and to construct the proposed Power Station as close as possible to the mining operation, and therefore within the mining right area.

When assessing the siting of the power station within the mining right area the following criteria were considered:

- The prevailing wind direction;
- The distance to the electricity consumer;
- The position of the local transmission infrastructure and substations (for Phase II);
- The source of coal supplied to the power plant;
- The ash disposal area;
- The water source;
- Geological terrain;
- Future plans for mine infrastructure; and
- EIA limitations.

4.1.1 Prevailing wind direction

The prevailing wind direction is from the North East to East. There is very little wind coming from the South, South West and Westerly directions. The power plant should be sited in such a manner that coal dust from the coal mine, coal handling and loading or mine do not interfere with the operation of the Power Plant infrastructure as it can result in the clogging of the cooling mechanisms which will result in a reduction in efficiency.

4.1.2 Distance to power consumers

As it is intended that this power plant would be the sole source of power for the mine, and that there will be little (if any) grid power available, electrical stability between the mining loads and power plant is a critical factor in the determination of the site location for the power station.

The nature of the loads from the mine is of a relatively constant load required by the mining process plant (~75% of load) with highly variable loading required by the mine shovels (~20%). It is preferable that the plant be located as close as possible to the major loads so as to increase stability and reduce line losses.

In addition, electrical infrastructure from a cost perspective is substantially more expensive than water lines, ash pipes and other mechanical infrastructure and should thus take precedence over the mentioned facilities when considering distance to various facility connections.

4.1.3 Coal supply

The coal will be supplied from the Coal Processing Plant. The coal is likely to be supplied from the first screening portion of the plant. This coal can be transferred via conveyor belt to the power plant. Alternatively the coal could be transported via truck to the power plant.

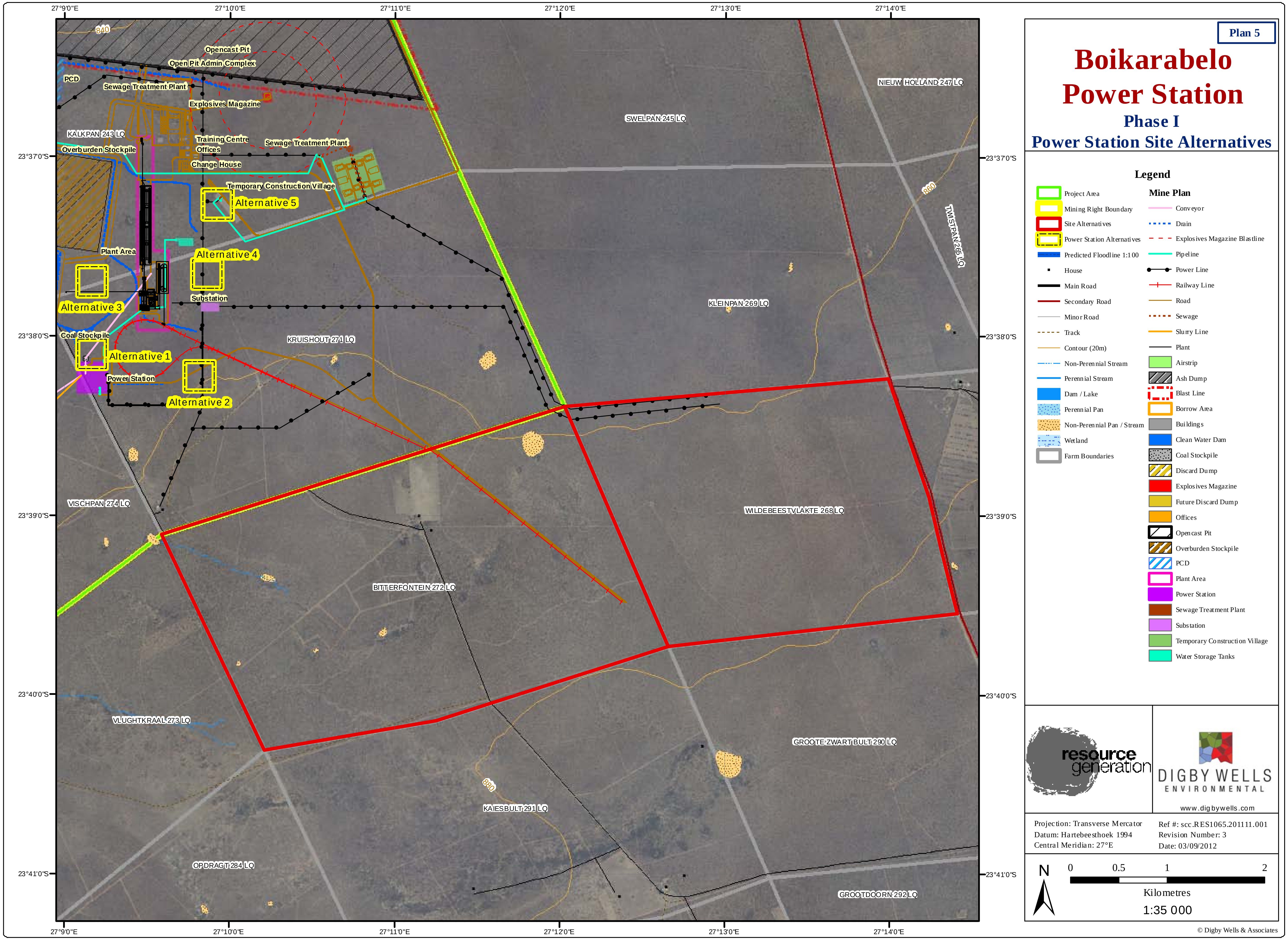
The coal stockpile for the power plant will be situated at the power plant.

4.1.4 Ash disposal and water supply

As the first phase power plant is very small, the ash could be trucked, dry-conveyed or slurried and piped to the ash dump. The cost benefits of one option over the other are unlikely to be large, however adding water to the ash for to for a slurry is not an option due to water restrictions. In general it is preferable to have the ash dump relatively close to the power plant whether it is to minimize dust emissions or reduce transportation issues. Ash will be conveyed to the ash dump. Through the use of various mechanical equipment the ash will be distributed and compacted.

4.1.5 Power station siting

There are five potential sites that could be considered for the first phase of the power plant. All siting options can be seen on Plan 5.


Plan 5
Boikarabelo Power Station
Phase I
Power Station Site Alternatives
Legend
Project Area
Mining Right Boundary
Site Alternatives
Power Station Alternatives
Predicted Floodline 1:100
House
Main Road
Secondary Road
Minor Road
Track
Contour (20m)
Non-Perennial Stream
Perennial Stream
Dam / Lake
Perennial Pan
Non-Perennial Pan / Stream
Wetland
Farm Boundaries
Mine Plan
Conveyor
Drain
Explosives Magazine Blastline
Pipeline
Power Line
Railway Line
Road
Sewage
Slurry Line
Plant
Airstrip
Ash Dump
Blast Line
Borrow Area
Buildings
Clean Water Dam
Coal Stockpile
Discard Dump
Explosives Magazine
Future Discard Dump
Offices
Opencast Pit
Overburden Stockpile
PCD
Plant Area
Power Station
Sewage Treatment Plant
Substation
Temporary Construction Village
Water Storage Tanks
resource generation
DIGBY WELLS
ENVIRONMENTAL
www.digbywells.com
Projection: Transverse Mercator
Datum: Hartebeesthoek 1994
Central Meridian: 27°E
Ref #: scc.RES1065.201111.001
Revision Number: 3
Date: 03/09/2012
N
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Kilometres
1:35 000
© Digby Wells & Associates
Opencast Pit
Open Pit Admin Complex
PCD
Sewage Treatment Plant
Explosives Magazine
KALKPAN 243 LQ
Training Centre
Offices
Sewage Treatment Plant
Overburden Stockpile
Change House
Temporary Construction Village
Alternative 5
Alternative 4
Plant Area
Alternative 3
Substation
Coal Stockpile
Alternative 1
Power Station
Alternative 2
KRUISHOUT 271 LQ
NIEUW HOLLAND 247 LQ
SWELPAN 245 LQ
KLEINPAN 269 LQ
TWISTPAN 265 LQ
WILDEBEESTVLAKTE 268 LQ
VISCHPAN 274 LQ
BITTERFONTEIN 272 LQ
VLUGHTKRAAL 273 LQ
GROOTE ZWARTBULT 290 LQ
KAIESBULT 291 LQ
OPDRAGT 284 LQ
GROOTDOORN 292 LQ
840
860
880
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27°10'0"E
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27°13'0"E
27°14'0"E
23°37'0"S
23°38'0"S
23°39'0"S
23°40'0"S
23°41'0"S