ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT REPORT: KHANYISA COAL FIRED POWER STATION, eMALAHLENI, MPUMALANGA

VOLUME 1 of 4

(Copy __of 5)

PROJECT NAME	Khanyisa Coal Fired power Station
PROJECT NUMBER	106468
REPORT TITLE	Final Environmental Impact Assessment Report
DEPT. REPORT NO.:	12/12/20/2067
AURECON REPORT NO.:	5920
CLIENT DOC. NO.:	5200059605
DATE	March 2012

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UPDATE SUMMARY: FINAL ENVIRONMENTAL IMPACT REPORT: FEBRUARY 2012

This Update Summary describes the process followed since the Draft Environmental Impact Report (dEIR) for the proposed Khanyisa discard-coal power station and associated infrastructure in the Witbank area was made available to interested and affected parties (I&APs) for their comment. It also indicates how the finalisation of the EIR has responded to public and review input and outlines the way forward in the environmental decision-making process.

PROCESS SINCE RELEASING THE DRAFT ENVIRONMENTAL IMPACT REPORT

The public participation process undertaken during the EIR Phase was as follows:

- Registered I&APs were notified of the imminent release of the dEIR and the details of the Public Meetings, that would be held to present the report to the public, by means of an email and a letter, dated 24 October 2011. The letters to I&APs also included a copy of the Executive Summary of the dEIR.
- The dEIR was released into the public domain (lodged in the eMalahleni public library, the Kleinkopje Colliery, Kleinkopje Community Development Office, Greenside Colliery, Landau Colliery and Anglo American Public Affairs Regional Office) from 24 October 2011. In addition it was placed on the Aurecon websites shortly thereafter.
- Media notices (in English, Afrikaans and Zulu) were placed in the Sunday Times, Beeld, The Star, Middelburg Observer and Witbank News from 12 November 2011 – 3 December 2011 in order to notify the public of the availability of the dEIR and to notify them of the Public Meetings.
- The dEIR was presented to the public during two Public Meetings held at the Matimba Community Hall on 21 November 2011. Attendees were provided with an opportunity to ask questions and provide comment on the report. Minutes of the meetings were distributed to the attendees on 29 November 2011 (see Annexure E.3).
- In addition to the above, a copy of Issues Trail , which had been compiled from responses received between the finalisation of the dEIR and the release of the fEIR, was distributed to all those who submitted written comment (see Annexure H).
- Taking cognisance of the time of year, the public comment period for the submission of written comment on the dEIR was made longer than the usual and ended on 18 January 2012.

UPDATING OF THE DRAFT ENVIRONMENTAL IMPACT REPORT

Updating of the dEIR to this fEIR has entailed the following:

- Amending typographical and other insignificant errors that appeared in the dEIR;
- Updating the Public Participation Process to reflect the latest round of public engagement;
- Refinement of the layout to indicate the power station island footprint in relation to the wetlands south and south east of the site;
- Appending the following additional annexures, *viz*.
    - Annexure G: Responses from commenting authorities
    - Annexure E.3: Meeting minutes;
    - Annexure H: Issues Trail;

The dEIR has been updated to the fEIR by means of the inclusion of this Update Summary, the incorporation of the above changes in the text of the report, as well as the additional annexures as listed. Significant amendments to the body of the report are indicated by means of underlining in the final version, to enable readers to track the changes.

INGUQUKO YESANDULELO: UMBIKO QOBO WALOKHO OKWENZEKA ENHLALWENI FWBRUARY 2012

Lenguquko yesandulelo ichaza uhlelo olwalandelwa kusukela ngesikhathi sesiphakamiso sombiko walokho okwenzeka enhlalweni (dEIR) wokuhlongozwa kwesiteshi samandla i-Khanyisa esisendaweni yase Witbank, lombiko wavezwa kulabo abanothando nabathintekayo (I&APs) ukuze bafake imibono yabo. Bese futhi ikhombise indlela le EIR ebhekene nayo qobo imibono eyafakwa umphakathi kanye nokuqhubeka ohlelweni lokuthathwa kwesingqumo sezenhlalo.

UHLELO OLWALANDELWA EMUVA KOKUKHISHWA KWESIPHAKAMISO SOMBIKO WALOKHO OKWENZEKA ENHLALWENI

Uhlelo lokuhlanganiswa komphakathi olwathathwa esigabeni se-EIR lwahamba ngalendlela:

- Ama I&APs ayezibhalisile aziswa ngokukhishwa kwe dEIR kanye nemininingwane yemihlangano yomphakathi eyayizobanjwa ukuze kuchazelwe umphakathi ngalombiko, lokhu kwenziwa ngokuthunyelwa kwe-email kanye nencwadi, ngomhlaka 24 October 2011. Lezizincwadi ezathunyelwa kuma I&APs zahlanganisa icopy yesandulelo qobo se dEIR.
- LedEIR yaphinde yafakwa esigabeni somphakathi (yatholakala eMalahleni public library, eKleinkopje Colliery, eKleinkopje Community Development Office, eGreenside Colliery, eLandau Colliery kanye naseAnglo American Public Affairs Regional Office) kusukela ngomhlaka 24 October 2011. Emva kwalokho yafakwa kwiwebsite yakwa Aurecon.
- Izaziso zafakwa emaphephandabeni (esiNgisi, Afrikaans kanye nesiZulu) lawa iSunday Times, iBeeld, The Star, iMiddelburg Observer kanye neWitbank News kusukela ngomhlaka 12 November 2011 – 3 December 2011 ukuze kwaziswe umphakathi ngokuba khona kwe dEIR kanti nokubazisa futhi ngemihlangano yomphakathi.
- Umphakathi waziswa ngale dEIR emhlanganweni owawuphethwe eMatimba Community Hall ngomhlaka 21 November 2011. Ababekhona banikezwa ithuba lokubuza imibuzo kanye nokufaka imibono yabo kulombikko. AmaMinutes omhlangano athunyelwa kulabo ababekhona, ngomhlaka 29 November 2011 (bheka iAnnexure E.3).
- Ngaphezu kwalemihlangano icopy yendlela yezinzakanzaka, eyayihlanganiswe ngemibono nezimpendulo ezatholakala ngalesikhathi esasiphakathi kokukhishwa kwe dEIR kanye fEIR, yathunyelwa kulabo ababethumele imibono yabo ebhaliwe (bheka iAnnexure H).
- Ngenxa yokubheka isikhathi sonyaka, isikhathi sokuthi umphakathi uthumele imibono yawo ebhaliwe mayelana ne dEIR sakhuphukiswa kulesi esijwayelekile saphela ngomhlaka 18 January 2012.

UKUGUQUKISWA KWESIPHAKAMISO SOMBIKO WALOKHO OKWENZEKA ENHLALWENI

Ukuguqukiswa kwe dEIR ibe yi fEIR kwahlanganisa lokhu:

- Ukushintshwa kwendlela ebukeka ngayo kanye namaphutha amancane kwi dEIR;
- Ukuguqukiswa kohlelo lokuhlanganyiswa komphakathi ukuze liveze imihlangano emisha;

- Refinement of the layout to indicate the power station island footprint in relation to the wetlands south and south east of the site;
- Ukushintshwa kwalama annexures, *viz*.
    - Annexure G: Responses from commenting authorities
    - Annexure E.3: Meeting minutes;
    - Annexure H: Issues Trail;

Le dEIR iguqukiswe ukuthi ibe yi fEIR ngokuhlanganiswa kwalenguquko yesandulelo, ukufakwa kwalezizinguquko ezingaphezulu embhalweni walombiko, kanye nalama annexures ahlanaganisiwe. izinguquko ezibalulekile embhalweni walombiko sitshengiswe ngokufakwa imigqwa ukuze abafundi bazibone.

PROJECT DETAILS

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		Earth Science Solutions
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		Ferret Mining & Environmental Services (Pty) Ltd
		Green Gain Consulting
		Jongens Keet Associates
		Kudzala Antiquity
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REPORT STATUS	:	**Final**

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This report is to be referred to in bibliographies as:

AURECON 2011. Khanyisa proposed coal-fired power station: Final Environmental Impact Report. *Report No.5920 DEIR*

NON-TECHNICAL SUMMARY

1.1. INTRODUCTION

1.1.1. The proposed development

The Project, as defined, will involve the design, construction, commissioning, ownership, operation and maintenance of an individual base load power plant providing 450MW (net) of electricity capacity to Anglo American. The proposed power station will be located within the South African Coal Estates (SACE) complex, east of eMalahleni (Witbank) in Mpumalanga Province. The SACE complex includes the Greenside, Kleinkopje and Landau collieries and associated discard coal dumps. Please refer to Figure 1 at the end of this summary for the locality map.

A unique aspect of the Khanyisa project is that not only is a waste product going to provide the power generation in the form of discard coal, but the plant will also utilise reclaimed and treated mine water from the EWRP. This is significant in that by utilising both waste coal and water the project significantly reduces its environmental impact on the regions natural resources.

Aurecon (Pty) Ltd, as the independent Environmental Assessment Practitioner (EAP), has been appointed by Anglo American Limited South Africa (AOL) to compile the Environmental and Social Impact Assessment (ESIA) in terms of the National Environmental Management Act (No. 107 of 1998), (as amended).

A Scoping Report was submitted outlining the actions to be undertaken to meet all legal, procedural, and technical requirements of the developer for an Environmental Impact Assessment (EIA)/Environmental Management Programme (EMP) process and to outline the scope of work for the specialist studies. The Final Scoping Report (FSR) was acknowledged by the Department of Environmental Affairs (DEA) in August 2011.
The purpose of the EIR is to gain an understanding of the social and biophysical environment in which the Khanyisa Power Plant will be located and to describe and assess the range of feasible alternatives identified during the Scoping process in terms of the potential environmental impacts identified.

This in turn provides a basis for informed decision making, by both the proponent, with respect to the option they wish to pursue, and the environmental authority regarding the environmental acceptability of the proponents' preferred option, by minimising the negative impacts and enhancing the positive impacts associated with the Project.

1.1.2. Purpose of this document

This document provides a summary of the Final Environmental Impact Assessment Report for the proposed Khanyisa Coal Fired Power Station, Mpumalanga. It provides a brief background and overview of the proposed project, a description of the public participation process undertaken thus far, the list of project alternatives and potential impacts that have been assessed.

The findings have been included in this ESIA/EMP Report and will be submitted to the decision-making authority (the DEA) for an informed decision on the proposed Project. This EIA report has been compiled in accordance with the process described in the National Environmental Management Act (NEMA) in addition to the National Environmental Management Waste Act (NEMWA), the National Water Act (NWA) and the National Environmental Air Quality Management Act (NEMAQA).

1.2. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

The EIR has been undertaken in accordance with international standards (e.g. IFC Performance Standards and Thermal Power Guidelines etc.) and the international conventions that South Africa is a party to.

The Khanyisa application includes both the NEMA and NEM:WA listed activities which require environmental authorisation from the respective directorates. The DEA has indicated that an integrated environmental authorisation will be provided for both NEMA and NEM:WA listed activities as contemplated in Section 24L of NEMA.

The integrated environmental authorisation process as contemplated in section 24L of NEMA is currently only applicable in instances where the **Minister** is both the –

- competent authority for the environmental authorisation applied for in terms of NEMA and the EIA Regulations, 2010; and

- the licencing authority for the waste management licence in terms of NEM:WA.

The environmental authorisation process prescribed for listed activities under Listing Notices 1, 2 and 3 published in Government Gazette Numbers R544, R545 and R546 respectively, and the waste licensing process for listed activities contained in the Schedule in Government Notice 718, 2009 published in terms of section 19 of NEM:WA are as defined in the Environmental Impact Assessment (EIA) Regulations made under section 24(5) of the National Environmental Management Act, 2008 (Act No. 107 of 1998) ("NEMA").

Furthermore, the EIA process for the proposed coal-fired power station and ancillary infrastructure has been undertaken in accordance with the requirements of all relevant South African legislation including *inter alia*, the following:

- National Water Act, Act No. 36 of 1998;
- National Heritage Resources Act, Act No. 25 of 1999.
- National Environment Management: Biodiversity Act, Act No. 10 of 2004;
- National Environmental Management: Waste Act, Act 59 of 2008;
- National Environmental Management: Air Quality Act, Act No. 36 of 2004 including
- Government Notice 220 of 26 March 2010;
- Occupational Health and Safety Act, Act No. 85 of 1993;
- Major Hazardous Installation Regulations (July 2001);
- National Road Traffic Act, Act No 93 of 1996;

Guidelines set by the International Finance Corporation (IFC), part of the World Bank Group, for projects in which it is going to be involved are provided in Annexure A Volume 2.
In terms of the IFC definitions, the Highveld would qualify as a degraded airshed (DA) and consequently the emission requirements for installations less than 600 MW and measured at 6% oxygen content in the flue gas would be:

- Particulate matter less than 30 mg/ Nm3
- SO2 less than 400 mg/Nm3
- NOx less than 200 mg/Nm3

This project has been assessed on the basis that the power station will meet the IFC standards for all identified impacts. From an environmental and social perspective, no fatal flaws which could hamper the construction of the proposed Khanyisa power plant have been identified. Although there are potential significant impacts that could arise from the proposed project, mitigation and management measures recommended in the EIR and EMP will ensure that these impacts are less significant.

1.3. THE PROJECT

1.3.1. Need and Benefits

Electricity generating capacity in South Africa is expected to remain constrained for a number of years. The Draft Integrated Electricity Resource Plan for South Africa (IRP 2010), recently compiled by the Department of Energy, aims to determine how long term electricity demand should be met in terms of generating capacity, type, timing and cost. The evaluation process established a “Revised Balanced Scenario”, representing a balance between certain key factors, including funding availability, new technology uncertainties, water usage and security of supply.

The plan is subject to funding and other implementation constraints and is dependent on demand reduction initiatives. It acknowledges the high price of unserved energy. Eskom, currently the sole supplier of electricity, has been and will be increasing its tariffs at relatively high rates, with annual increases of ~25% for each year of the MYPD2 period (April 2010 to March 2013). It is expected that further significant increases will be granted well beyond this period.

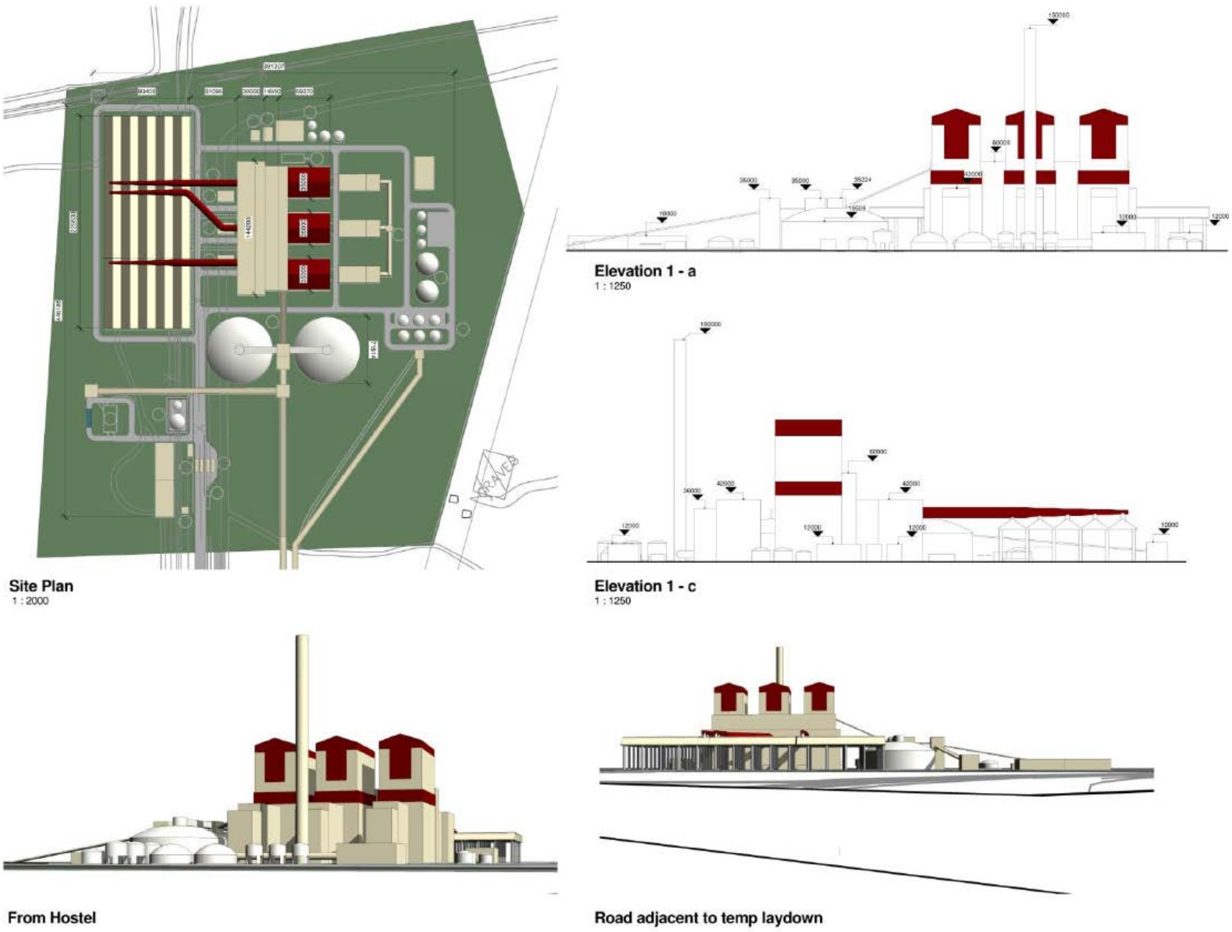
Anglo American has commenced this ESIA process to procure its own dedicated supply for a portion of its requirements via the Khanyisa IPP project. Such supply is aimed at increasing Anglo American’s security of supply, as well as limiting the impact of electricity price increases.

1.3.2. Description of the project

The project essentially comprises the construction and operation of a coal-fired power station and associated infrastructure. The power station itself would comprise three 150MW generating units fuelled by discard coal with a total nominal electricity generation capacity of approximately 450MW. Apart from the power station buildings (including admin buildings, maintenance services, etc.), there would be various ancillary infrastructures including:

- Coal silo and sorbent stock yards;
- Coal, ash, sorbent and gypsum conveyors;
- A High Voltage (HV) yard within the power station precinct;
- Water and wastewater treatment facilities;

- Ash and spent sorbent disposal systems and dump site;
- Gypsum (sorbent) storage facility;
- Access roads (temporary and permanent, and external and internal roads);
- Maintenance, medical, administration, services, control buildings;
- Water supply pipeline for construction and operation phase;
- Raw water pipeline and reservoirs;
- Dams for storage of "clean" and "dirty" water;
- Power supply for the construction phase;
- Communication mast/telecommunication facilities;
- General and hazardous waste storage and handling facilities (temporary and permanent);
- Batching plant (including concrete and asphalt); and
- Construction accommodation.



(Visual representation for illustration purposes only)

The power plant and associated infrastructure will require an area of approximately 197ha, however, due to extensive undermine workings within the project area it has not proved possible to identify the required 197ha within a single parcel of land. Therefore, the proposed power island can be accommodated on a 21ha non-undermined site (6C) and the ash dump can be accommodated on a 150ha rehabilitated open cast mine (Ash site 3).

It is proposed that the power station utilize Circulating Fluidised Bed (CFB) technology because it has the advantage of being able to burn coals with a wide range of properties and hence can cope with high ash and high sulphur discard coal reserves, which are proposed as the fuel source for the project. The removal of sulphur from the coal during the combustion process will be achieved in CFB boilers by the addition of limestone which acts as a sorbent.

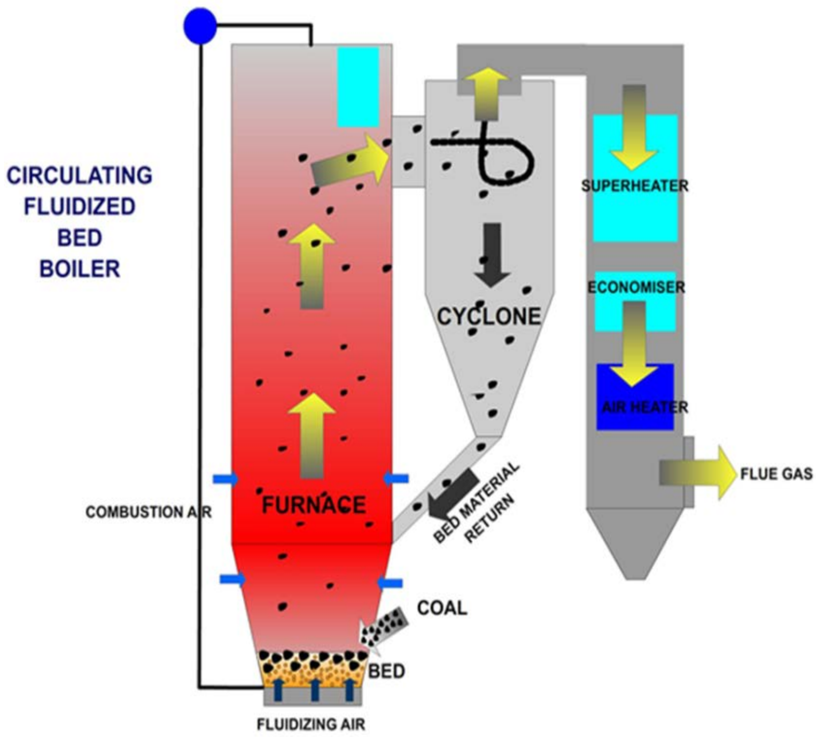
The proposed power station will be a dry-cooled station using Air Cooled Condensers (ACCs) . The use of dry-cooled technology is necessitated as a result of South Africa being a water scarce country and limited water availability in the area.

The power station will be designed to be a zero liquid effluent discharge station; particulate emissions will be within IFC guidelines for degraded airsheds due to the sufficient quantities of lime proposed for the CFB units.

The plant will be Flue Gas Desulphurization (FGD) ready, a decision and timing for retrofitting the power station with FGD will be based on ambient air quality monitoring results, South African regulations including proposed emission limits and water availability.

At the bottom of the boiler there is a bed of inert material where the coal or fuel spreads. Air is supplied from under the bed at high pressure lifting the bed material and the coal particles and keeping it in suspension. The coal combustion takes place in this suspended condition allowing a more effective combustion and heat transfer. This is the Fluidized bed.

Fine particles of partly burned coal, ash and bed material are carried along with the flue gases to the upper areas of the furnace and then into a cyclone. In the cyclone the heavier particles separate from the gas and falls to the hopper of the cyclone. This returns to the furnace for recirculation. Hence the name Circulating Fluidized Bed combustion. The hot gases from the cyclone pass to the heat transfer surfaces and go out of the boiler



The power station will commence by sourcing discard coal from the Klippan and Blauwkrans dumps which will be delivered to the power station via conveyor belts. Secondary discard from the Klippan and Blauwkrans beneficiation plants will be retained on the Klippan and Blauwkrans dumps respectively in separate stockpiles. A small short term new discard dump area will be required at both locations during initial reclaim.

1.4. ALTERNATIVES

It is a requirement of the EIA process that due consideration is given to reasonable alternatives, although not all alternatives need to be investigated at the same level of detail. The Final Scoping Report identified and screened the activity, location, process and layout alternatives with respect to the construction and operation of the proposed coal fired power station. The following sections summarise the outcome of the Scoping Phase and hence describe the proposed project alternatives.

Alternative	Description
Activity	Strategic-level alternatives, i.e. those alternatives related to the method of electricity generation for the proposed power station, fall outside of the scope of this project-level ESIA process, as they were determined in a strategic process undertaken by Anglo Operations Limited (AOL) and other prior to initiating this ESIA process. The purpose of the proposed project is to provide base load power to Anglo American operations to ensure availability of electricity for its operations. The project is crucial to future investment in the mining industry in South Africa and the concomitant creation of jobs. It is therefore critical to bear the need for the project in mind, when considering reasonable and feasible activity alternatives.
Location	Once the need for the new coal-fired power stations was established, AOL undertook a process to identify suitable areas within their current mining operations. The initial selection process identified 6 candidate sites based on size

	and proximity to the discard coal dumps. After evaluating the 6 sites the technical advisors (MM) concluded that all the sites considered (Sites 1 to 6) are to varying degrees compromised by undermining, and that treatment options will prove too complex or expensive to make them a practical option for an IPP. Only Site 6C is sufficiently large enough to accommodate the power station without undermining and is therefore proposed as the only site option (preferred option).
Process	During the Scoping phase, three combustion technology alternatives were discussed; namely fluidised bed combustion, pulverised fuel combustion and coal gasification technologies. Pulverised fuel combustion requires higher financial costs in sourcing the requisite quality coal for fuel and also produces a larger carbon foot print, therefore, this technology was not considered for further investigation. Coal gasification technology has been investigated at a pilot plant scale only and is not technologically proven for plant of the desired magnitude (i.e. 450 MW units). Fluidised bed combustion boilers have the advantage of being able to burn coals with a wide range of properties and can cope with high ash and high sulphur coals as proposed for this power project. The removal of sulphur from the coal during the combustion process is achieved in CFB boilers by the addition of limestone which acts as a sorbent; the sulphur becomes bound to the limestone enabling its removal and disposal. Additionally, the lower combustion temperatures of the CFB boiler result in lower emissions of nitrogen oxide (NOx) by reducing the production of thermal NOx within the furnace. Consequently, fluidised bed combustion was selected as the combustion alternative for further investigation.
Cooling	Three cooling technology alternatives were considered during the Scoping Phase, including wet cooling, indirect dry cooling and direct dry cooling. Given its greater consumption of water than the other technologies, wet cooling was not

	assessed in the EIA, while indirect and direct dry cooling alternatives were investigated further. Direct dry cooling occurs within a closed water circuit, by means of forced draught fans and there is no need for cooling towers but fans. Indirect dry cooling is achieved via a secondary circuit, resulting in the need for cooling towers for the release of steam.
Ash disposal site	Three site alternatives were identified for the ash waste disposal site, as Ash 1, 2 and 3 respectively. With regards to the proposed waste sites, none are near to significant surface water bodies, sensitive ecological and/or historical areas, steep slopes, highly permeable soils, land uses which are incompatible with waste disposal or in areas important for water resources such as dams, overlying or adjacent to important or potentially important aquifers, or overlying or adjacent to major fault zones. The presence of mine workings below Ash Site 1 introduces the potential risk of subsidence occurring in the future. Ash site 2 is an operating open cast mine with an unknown life of mine and site 2 abuts a farming community that is very opposed to this site being proposed as a potential ash disposal site. Ash site 3 is a former opencast site which has since been rehabilitated and backfilled with opencast material from the excavation, with a maximum depth of approximately 25m to 35m. This site fulfils all the technical and environmental criteria and is therefore the preferred alternative.
Ash	Four ash disposal alternatives were discussed during the Scoping Phase, namely above-ground ashing, in-pit ashing, wet disposal in a lagoon and pumping into underground mine workings. The in-pit ashing is not economically viable due to the fact that no proximal pits are available, rendering this option not

	feasible. The use of wet disposal is deemed to be impractical due to the volumes of water which would be lost to evaporation. The option of using non- standard disposal options such as pumping the ash into worked-out underground mining would create a liability with regards to ash disposal management and control and therefore the economic implications of mixing the ash with cement disqualifies this option as a feasible alternative. Although this option may present a practical option, the environmental implications will require significantly more detailed studies. Above ground ash disposal is the primary method of ash disposal considered in this EIA process. It is the only feasible alternative given the available information and is therefore the preferred alternative. Consequently, in-pit, wet disposal in a lagoon and pumping into underground mine workings will be considered in this EIA process at a conceptual level, and to compare these against above-ground ashing.
Site Layout	As already mentioned above, only one site (site 6C) is not undermined and large enough to accommodate the power station and temporary areas associated with the construction phase. Alternative site layouts have not been investigated because the final configuration of the power station components within site 6C will not create any significant impacts. The site contains no environmental sensitivities and the constrained nature of the site implies that the entire 17ha which is not undermined will be developed and/or transformed.
Ash Transport	Three methods of ash transportation were investigated; wet slurry by pipeline, dry on a conveyor and dry in trucks. Some systems for pneumatic transport of fly ash exist but these systems can be prone to unreliability and are usually used for very short distances. The preferred ash disposal site is not capable of supporting a lagoon for dewatering ash transported by slurry and the

	environmental impact of road transport of ash to the disposal site, either through the mine or via a new entrance from the Tweefontein road, will be significant and therefore these options were discounted as the primary disposal route, although the trucking option may present a practical back up option. Consequently, transporting ash by using a pipe conveyor was investigated in more detail as this would most effectively manage the dust impacts. Due to the reduced impacts associated with closed conveyor this is the preferred alternative.
Access road	The Tweefontein Road is a public highway which directly crosses Site 6C and therefore needs to be relocated in order for the site to be used. Three alignment options were investigated with the priority being attached to road safety and prescribed geometric design criteria.
Powerline route	Power will be evacuated from the plant through a high voltage interconnection to the existing Eskom transmission and distribution system. The scoping phase identified two feasible alignment options which were presented to Eskom for their inputs. These alignment options were investigated as part of the EIA and the specialist studies indicated that there is little difference in the sensitivity index of the two proposed transmission line routes, since both routes occur in the same quarter-degree grid and cross similar habitat.

1.5. DESCRIPTION OF PROJECT ENVIRONMENT

1.5.1. Water Resources

a) Surface Water

The study area falls within the Upper Olifants catchment (Quaternary Catchment: B11G) The Olifants River originates near Bethal in the Highveld region of Mpumalanga. The river initially flows northwards before curving in an easterly direction through the Kruger National Park and into Mozambique, where it joins the Limpopo River before discharging into the Indian Ocean.

The Olifants catchment can be subdivided into the following four catchments dominated by varying economic activities:

Sub-catchment	Primary economic activities
Upper Olifants	Heavy industry and mining
Middle Olifants	Agriculture
Steelpoort	Agriculture and mining
Lower Olifants	Tourism and mining

The proposed project will be located in the Upper Olifants sub-catchment, which is characterised by coal mining activities. Based on this GIS information, there are no natural surface water resources (streams, wetlands, or water bodies) located on and/or close to the site. The site consists of "bare rock and soil" and "cultivated land" (National Landcover 2000).

The only water body close to the site is a stormwater dam (called the Kleinkopje-Klippan Dam) which is located ± 800 m south of the site. This stormwater dam is part of the mine's dirty water management system.

Groundwater

From a hydrogeological viewpoint, the mined areas are situated in fractured Karoo Bedrock with a very low hydraulic conductivity. Borehole yields in this formation are less than 1 ℓ/s (litre/second), and statistically the majority of boreholes were expected to be dry.

Three distinct superimposed groundwater systems are present within the occurring geology. They can be classified as the upper weathered Ecca aquifer, the fractured aquifers within the unweathered Ecca sediments and the aquifer below the Ecca sediments.

Ecca Weathered Aquifer

The Ecca sediments are weathered to depths between 5 – 12 meters below surface and often form a perched aquifer. This aquifer is recharged by rainfall and estimated to be between 1-3 % of the annual rainfall. This aquifer is generally low-yielding (100 – 2000 ℓ//h) because of its insignificant thickness.

Fractured Ecca Aquifer

The pores within the Ecca sediments are too well cemented to allow any significant permeation of water. Groundwater movement is therefore along secondary structures, such as fractures, cracks and joints in the sediments. In terms of water quality, the fractured Ecca aquifer always contains higher salt loads than the upper weathered aquifer. Although the sulphate, magnesium and calcium concentrations in the Ecca fractured aquifer are higher than that in the weathered zone, they are well within expected limits.

Pre-Karoo Aquifer

Drilling in only a few instances has intersected the basement of the Karoo Supergroup which can be regarded as an insignificant aquifer

Water Users

A hydrocensus of existing boreholes (data received from Kleinkopje Colliery) was performed within the project area. A number of boreholes on the database are either destroyed/dry or have collapsed. Furthermore the location of most of the existing boreholes is however located at such a distance from the investigated sites and consequently falls outside the zone of impact and model boundaries, making the data irrelevant to our investigation. Useful information (water levels & water samples for chemical analysis) was gathered from six boreholes. From the hydrocensus data it can be concluded that groundwater is not used as source of potable water due to poor quality water. Existing boreholes are mainly used for monitoring purposes.

1.5.2. Ecology and Biodiversity

The study area is indicated in Mucina & Rutherford[1] (2006) as being situated within **Eastern Highveld Grassland**. Eastern Highveld Grassland is mostly confined to Mpumalanga and western Swaziland, occurring marginally as well into Gauteng. The conservation status of this vegetation type is **Endangered**, and whilst the conservation target is 24%, only a small fraction (<1%) is currently protected and 44% is considered to be transformed, mostly by cultivation, forestry, mines, dams and urbanisation. However, due to the high levels of habitat transformation and fragmentation, most of the project area has been classified as least concern or no natural habitat remaining by the Mpumalanga Biodiversity Conservation Plan (MBCP).

[1] Based on Mucina & Rutherford, 2006

Vegetation types that occur in the study area include:

Transformed Grassland

This community covers the proposed new Ash Pit site and covers an area of approximately 144 ha and represents a rehabilitated waste rock dump. Vegetation structure has been classified as Low Closed Grassland. Only 18 plant species were recorded in this entire vegetation community, of which five (28%) are invasive alien species. Species richness in sample quadrats ranged from 6-11 species per 100m² (n=3), considerably lower than typical untransformed Highveld grassland.

Seriphium – Imperata Secondary Grassland

This community represents the dominant vegetation type at the power plant site, covering an area of approximately 44 ha and appears to represent secondary grassland on old cultivated lands. Vegetation structure is Low Closed Grassland to Low Closed Shrubland.

Only 24 species were recorded in this vegetation community, of which 4 (17%) are invasive alien species. Species richness in sample quadrats varied from 8-11 species per 100m² (n=2), which is much lower than typical untransformed Highveld grassland.

Themeda - Tristachya Untransformed Grassland

This vegetation community is confined to the southern half of the power plant site and covers approximately 21 ha and does not appear to have been transformed historically. Vegetation structure is also Low Closed Grassland.

Forty species were recorded in this vegetation community, of which one (2.5%) is an invasive alien species. Species richness in the single sample quadrat was 28 species per 100m², which is more typical of untransformed Highveld grassland.

Fuirena-Helichrysum Wetland

This vegetation community is confined to the south-western corner of the power plant site and covers approximately 6.4 ha and does not appear to be have been historically transformed. Again, the vegetation structure is Low Closed Grassland.

Only 19 species were recorded in this vegetation community, of which one (*Rumex crispus*) is an alien species, although not invasive. Species richness in the single sample quadrat was 13 species per 100m², which is fairly typical of sedge wetlands in Highveld grassland.

No invertebrate species currently considered of conservation importance were observed in the study area, and very few such species are predicted as likely to occur in the region. In addition, both the proposed ash disposal and power station sites have been previously disturbed, resulting in reduced biodiversity value of both sites. However, given the very high transformation levels and the endangered status of the vegetation type in the region, any areas that could contribute to sustaining overall invertebrate biodiversity levels in the area may be considered of conservation importance and effective rehabilitation of areas disturbed by the project, as well as unused portions of the sites, should be of high priority.

1.5.3. Social Environment

The site of the proposed power station is located approximately 10 km south of the town of eMalahleni, in the Emalahleni Local Municipality, which forms part of the Nkangala District Municipality in Mpumalanga. Emalahleni Local Municipality (ELM) is one of the six local municipalities forming part of the Nkangala District Municipality and borders the Gauteng Province.

The Emalahleni LM (Local Municipality) is situated strategically within provincial context and in relation to the national transport network. It is situated relatively close to the City of Johannesburg Metropolitan, City of Tshwane Metropolitan Municipality and the Ekurhuleni Metropolitan Municipality. It is connected to these areas by the N4 and N12 freeways as well as a railway network. The Maputo Corridor runs through the municipality. There are rich coal reserves in the area as well as a number of power stations such as Kendal, Matla, Duvha and Ga-Nala. The main urban centre is the town of Emalahleni with the other towns / activity nodes being Ogies, Phola, Ga-Nala, Thubelihle, Rietspruit, Van Dyksdrift and Wilge.

1.5.4. Land Use

The existing land uses in the area are:

a) Residential:

- The southern residential suburbs of Emalahleni (Tasbet Park) lie in the north-eastern sector of the study area.
- The Village of Clewer.
- There are several mine residences in the area.
- Agricultural holdings on the banks of the Witbank Dam.

- Vlaklaagte Agricultural Holdings.
- There are several farmhouses and farm labourer houses scattered throughout the study area.

Educational:

- There are several schools in the urban areas of Emalahleni/Witbank.
- There are several farm schools in the rural areas to the south of the town.

Hospitals:

There are six hospitals in the mining areas to the south of Emalahleni/Witbank.

Mining:

There are several collieries to the south of Emalahleni/Witbank. Some are active and some are now dormant. Three Anglo Coal Collieries, namely the Landau, Greenside and Kleinkopje Collieries, lie in the immediate vicinity of the planned power plant site.

Farming:

There are a number of farms in the area that are being actively farmed.

Population

The data used for the socio-economic description was sourced from the Community Survey (CS) conducted by Statistics South Africa in 2007. The Community Survey is a large-scale household survey conducted by Statistics South Africa to bridge the gap between censuses

The total population of Emalahleni Local Municipality is in the order of 435,217 people. The majority of residents in the Emalahleni LM belong to the Black population. The proportion of people belonging to the Black population group in the Emalahleni LM is lower than on district and provincial level, with a higher proportion of people belonging to the White population group. As such the Emalahleni LM can be expected to be culturally different from the district.

The household density for the country is estimated on approximately 3.87 people per household, indicating an average household size of 3-4 people (leaning towards 4) for most households which are slightly down from the 2001 average household size of 4 people per household.

According to the Community Survey 2007, the growth rate in Mpumalanga was very similar to the national average, but Nkangala DM and Emalahleni LM experienced growth rates well above the national average with the population in Emalahleni LM more than doubled since 2001.

Emalahleni LM has the largest household sizes of the areas under investigation and has also shown an increase in household sizes since 2001.

Half of the people in the Emalahleni LM who are of economically active age (aged between 15 and 65 years) have indicated that they are employed, compared to 42.1% in Nkangala and 40.1% in Mpumalanga, indicating the greater concentration of economic activities in the area.

Unemployment rates

The unemployment rate in Emalahleni Local Municipality is in the order of 21.3%. This is very similar to the proportions on district and provincial level. The Emalahleni LM has the smallest proportion of people who have described themselves as not economically active.

Sectoral employment

The main industry of employment in Mpumalanga is Manufacturing; Community, social and personal services and Wholesale and retail trade. The Community; social and personal services sector includes public administration and defence activities, education and health and social work. In the Emalahleni LM, the dominant industry of employment is Mining and quarrying, followed by Manufacturing.

Income

On local, district and provincial level, 50% or more of the population between the ages of 15 and 65 years have indicated that they did not have any income in 2007, while only 25% of Emalahleni earn more than R3200 per month. The Emalahleni area is financially slightly better off than the district and the province, but the levels of poverty are still high.

Housing

The Emalahleni LM has the lowest proportion of who own their dwellings and have paid them off in full, compared to 58.5% on district level and 62.7% on provincial level. Almost a quarter of the households in Emalahleni LM have indicated that they occupy their dwellings rent-free, which is much higher than on district or provincial level.

Services

Access to electricity

In the Emalahleni LM only about 60% of the households in the study area use electricity as source for lighting, followed by candles and paraffin. This is much lower than on district or provincial level where more than 80% of households use electricity for lighting purposes.

Water and sanitation

On a provincial level, almost 70% of the households in Mpumalanga had access to piped water inside the dwelling or yard in 2007, compared to about 75.9% on district level and 78% on local level. Only about a third to just less than half of households have access to piped water inside their dwellings.

The absence of a flush toilet or a pit toilet with ventilation is one of the indicators of Living Environment deprivation (Noble et al, 2006). From this perspective, the Emalahleni LM is the least deprived area in terms of sanitation services with almost 60% of households having access to flush toilets or pit toilets with ventilation.

1.6. IDENTIFIED IMPACTS

1.6.1. Impact Methodology

The methodology applied during this EIA is broadly consistent with that described in DEA's Guideline Document on the EIA Regulations (1998). The methodology was outlined in the Plan of Study for EIA. Using a tabulated rating system, each impact is described according to its extent (spatial scale), magnitude (size or degree scale) and duration (time scale). These criteria are used to ascertain the significance of the impact, firstly in the case of no mitigation and then with the most effective mitigation measures in place. Once the significance of an impact has been determined, the probability of this impact occurring as well as the confidence in the assessment of the impact is determined. Lastly, the reversibility of the impact is estimated.
Challenges faced during the application of the methodology as described relate to the subjectivity in assigning significance to an impact, the consideration of cumulative impacts and the need for integration with other development proposals that impinge on the proposed power station.

1.6.2. Construction Phase Impacts

None of the construction phase impacts were deemed to have a highly significant impact on the environment, given their relatively short duration and localised extent. The following potential impacts have been identified as relevant to the construction of this project:

- Disturbance of flora and fauna;
- Soil (and land use capability) impact
- Storage of hazardous substances on site;
- Impact of waste generation;
- Increase in traffic volumes;
- Increased risk of fire;
- Socio-economic impacts (negative);
- Noise impact;
- Visual impact;
- Air quality impact; and
- Employment (positive and negative)

However, many of the construction phase impacts are of medium significance and require a suite of mitigation interventions in order to avoid and minimise impacts on the biophysical and especially the human environment. A detailed construction and operational EMP has been developed to guide the construction and operational phases of the proposed project. The EMP will be updated and further developed based on the Conditions of Approval in the ROD, should the project be approved. The implementation of the EMP would minimise possible negative impacts on construction and operation and assigns responsibility for environmental controls.

1.6.3. Operational Phase Impacts

With reference to Table 1, the most significant operational phase impacts of the proposed power station and its associated infrastructure on the biophysical and social environment, without mitigation, include the following:

- Impact on air quality
- Impact of powerlines on avifauna
- Impact of artificial lighting on invertebrate fauna
- Impact on groundwater resources;

- Impact on visual receptors
- Impact on heritage resources ;

The proposed terms of reference for the specialist studies are detailed in the Scoping Report and associated Plan of Study for EIA.

a) Air Quality

A comprehensive emissions inventory has recently been completed for the region as part of the Highveld Priority Area (HPA) baseline study. The results of the inventory were then used to carry out a comprehensive dispersion modelling study over the area using the CALPUFF model (DEA 2011). Results of this dispersion study as well as monitoring carried out at Witbank and Phola indicate that the eMalahleni area is already marginal with respect to conformance to both PM10 and SO2 SA ambient air quality standards.

The proposed power station would be associated with emissions of various common pollutants such as sulphur oxides (SO_X), nitrogen oxides (NO_X), particulate matter and trace emissions of various heavy metals. However, the proposed power station is located within the Highveld Priority Airshed (HPA), an area characterised by poor air quality and exceedances of pollutant limits set in South African legislation. If uncontrolled, the proposed power station could impact significantly on air quality in the eMalahleni (Witbank) region and potentially further afield.

Resulting calculated ambient concentrations of the various pollutants were compared with local and international standards and guidelines, focusing on the proposed SANS 1929 standards recently published for comment by the Department of Environmental Affairs and Tourism. These standards are based on WHO guidelines and represent good international practice for ambient air quality standards.

Particulate Matter (PM10)

Contribution of the project to the PM10 concentration in adjacent residential areas is small, but cumulative values may continue to exceed South African standards because of the elevated background values being experienced in the area.

Predicted ground level PM10 concentrations indicate that there will be small localised areas, mainly in the coal and ash handling facilities, where highest daily and annual average values will exceed the SA community exposure limit values; occupational exposure values will however be used as limit values at this location.. These impacts do however not extend to the sensitive community receptors. Both the highest daily and annual average impacts of the particulate matter from the boiler stack is a small fraction of the respective limit values at these locations.

Dust Fallout (TSP)

Contribution of the project to dust fallout in adjacent residential areas is small and does not exceed SANS 1929 action limit for residential areas.
Predicted contributions of material handling to dust deposition rates indicate that these will not exceed the SANS 1929 proposed value of 600 mg/m2-day anywhere and that the impact will minimal at the sensitive receptors.

Carbon Monoxide (CO)

Contribution of the project to the carbon monoxide concentration in adjacent residential areas is a negligible fraction of the South African standard. Cumulative concentrations are also expected to be below the SA ambient limit values at all receptors.
The predicted impact of CO emissions on ambient concentrations is minimal at all receptors

Sulphur Dioxide (SO2)

Contribution of the project to the sulphur dioxide concentration in adjacent residential areas is a negligible fraction of the South African limit values, but cumulative values may continue to exceed South African standards because of the elevated background values being experienced in the area.

Predicted worst case short-term impacts are much less than 50% of the hourly limit value and less than 20% of the daily limit value at the point of maximum impact. Predicted annual average concentration contributions are a small fraction of the annual limit vale. At the Witbank sensitive receptors, the contribution is minimal.

Nitrogen Dioxide (NO2)

Contribution of the project to the nitrogen dioxide concentration in adjacent residential areas is a small fraction of the South African standard. Exceedences of the SA ambient values may continue to occur because of the elevated background values.
Predicted worst case short-term impacts are much less than 50% of the hourly limit value at the point of maximum impact. Predicted annual average concentration contributions are a

small fraction of the annual limit vale. At the Witbank sensitive receptors, the contribution is minimal.

Mercury Emissions

Although mercury capture in CFBs is much higher than in equivalent pulverised fuel (PF) boilers, the discard coal proposed for use probably has a much higher mercury content. There is however considerable uncertainty on the emission of mercury from ash disposal sites and from the uncontrolled combustion of discard waste dumps, which could occur if discard were not used in a controlled fashion. Given the size of the proposed installation compared to the existing power stations and the low modelled and measured ambient concentrations, it is considered unlikely that the mercury emissions from the project will contribute significantly to ambient mercury concentrations in the area.

b) Groundwater Quality

The geohydrological investigations indicated that groundwater within the proposed sites is not used as source of potable water due to poor quality water. This poor quality water is as a result of historical mining within the region pertaining to open cast and underground mining and its related activities. Thus, the existing boreholes in the area are mainly used for monitoring purposes. A hydrocensus of existing boreholes (data received from Kleinkopje Colliery) was performed within the project area and found that a number of boreholes on the database are either destroyed /dry or have collapsed.

Based on the field work, interpretation of available and newly acquired data and results of the numerical model it can be concluded that the proposed power station and associated ash dam will have a “low to very low” impact on the investigated geohydrological environment, given that sound environmental infrastructure and management procedures are put in place as discussed in EIR. The proposed mitigations include liners, leachate containment, leachate treatment, monitoring programme and surface water controls.

c) Noise

The general procedure used to determine the noise impact was guided by the requirements of the Code of Practice SANS 10328 *Methods for Environmental Noise Impact Assessments.*

The impact of the power plant itself will, to a large extent, be reduced by the fact that the noise climate has already been degraded by the operations at the Landau, Greenside and Kleinkopje Collieries, and traffic noise. The cumulative effects between the existing sources of noise and the noise generated by the power station operations will be minor, except in the near field around the power plant.

Construction phase

Working on a worst case scenario basis, it is estimated that the ambient noise level from general construction activities could negatively affect noise sensitive sites within a distance of 1400 metres of the construction site. Virtually none the noise sensitive receptors outside the power station property will be impacted by and ambient noise climate greater than 45dBA during construction.

Operational phase

Overall, taking the residual noise climate into consideration, the noise generated by the power station and ancillary works will have a relatively minor impact on the noise sensitive receptors in the study area.

d) Visual

The landscape character of the area is degraded due to the existing electrical power lines, mine dumps and run down industrial and alien infested type landscapes that characterize the location. The proposed power station is located within a highly modified coal mining landscape with the Duvha Power Station located approximately 10 km from the site and15 km from eMalahleni/ Witbank. The landscape is characterised by high levels of contrast which is suitable for large / high contrast generating landscape modifications such as the proposed power station.

The overall visual exposure of the proposed landscape modification would be Moderate as the more sensitive residential receptors from the town of Witbank are mainly outside of the 6 km buffer zone. The distance from the site combined with the existing air pollution of the area, would limit the visual exposure. The landscape modifications would however be recognizable to the viewer. Receptor sensitivity would be Low due to the existing degraded industrial and mining landscapes that dominate the surrounding landscapes and significantly detract from the scenic quality of the area.

However, recommendations were made to reduce the visual intrusion of the power station from the highly exposed road receptors by retaining as many of the existing trees in the area, planting new trees in specific locations as well as to change the colour scheme of the plant.

e) Impacts on terrestrial flora and fauna

Four vegetation communities were identified during fieldwork, however, two of these represent transformed or degraded forms of grassland that have low conservation value (Transformed Grassland on the proposed Ash Pit site, and Secondary Grassland on old cultivated lands on the Power Plant site).

The anticipated impacts of the coal-fired power plants and associated infrastructure on the ecosystem services would be negligible to very low. The Mpumalanga Biodiversity Conservation Plan has classified much of the general vicinity of the study area as least concern or no natural habitat remaining, primarily due to the high levels of habitat transformation and fragmentation related to mining activities. The areas of natural grassland, which have been classified as Important and Necessary, such as the untransformed grasslands south east and west of the power station footprint, will remain undeveloped and therefore the ecosystem's processes should continue to operate as they currently do.

General recommendations related to the fauna and flora have been developed including removing, relocation, preservation of some species, prevention of accidental fires, control of invasive plants, etc.

- remove, relocate, protect and utilize as many of the other protected tree species on site as possible, preserving existing integrity of surrounding natural vegetation;
- contain all construction and operational activities within the boundaries of the specified areas;
- utilise trees that normally grow to extensive heights for screening effects;
- an alien species control and monitoring program must be developed starting during the construction phase and to be carried over into the operational phase.

f) Heritage impacts

Based on what was found and its evaluation, it is recommended that the proposed development can continue, on condition that the identified grave yard be securely fenced out and access to visitors be accommodated. Furthermore, if any archaeological sites are exposed during construction work these must be immediately reported to a museum for investigation and evaluation.

g) Impacts on agricultural potential

In general, the land capability (soils, climate, ground roughness etc.) ranges from very low intensity (poor quality) grazing lands with little to no significant economic potential, to at best moderate arable land.

The development of the proposed power station will involve permanent loss of the soil resource and therefore, it is recommended that the topsoil (approximately 700-750mm) be stripped and stored prior to construction.

Effective removal and storage of the utilizable materials will result in the permanent protection of the growth medium thereby making provision for retention of utilizable material for the decommissioning and/or during rehabilitation. This will not only result in significant cost savings at closure, but will ensure that additional impacts to the environment do not occur.

Erosion of the side slopes are of concern but this risk has been adequately mitigated by the ash liner design. If the ash liner design is adopted as a minimum specification then erodibility is not a concern, however, appropriate mitigation measures will be implemented to ensure that erosion does not occur.

h) Traffic impact assessment

The primary findings of the traffic assessment identified two intersections which need to be upgraded in order to accommodate the existing (in the case of the Watermeyer Street intersection) traffic volumes and the anticipated (Road D2257 and Road D 2769) future traffic volumes:

Watermeyer Street / Road D 2257 intersection;

- this intersection be investigated for the possibility of signalisation (the intersection is located at a gradient which may or may not be too steep for signalisation);
- The double lane in the westbound direction terminates to a single lane at a distance of approximately 280m from the intersection only to become double lanes once again approximately 420m from this point. It is consequently advised that the existing dual carriageway road to the west of Watermeyer / Road D 2257 intersection be extended up to the latter intersection in both the east and westbound directions;

- The desirability to relocate the existing Watermeyer / Road D 2257 intersection approximately 1km towards the west (better gradients for signalisation and dual carriage way road) be further investigated and considered by the authorities from a capacity as well as safety point of view. ROAD D 2257 / ROAD D 2769 (IPP Access intersection).

Road D 2257 / Road D 2769 (IPP Access intersection).

The IPP Access intersection was analysed as a normal two way stop controlled intersection. Although the latter type of intersection control is expected to operate initially at acceptable levels of service, the level of service is expecting normal background traffic growth on Road D 2257. It is consequently advised that the access intersection be a four way stop controlled intersection for a period of approximately after the signalisation or upgrading.

i) Socio-economic impacts

The proposed project will be associated with a number of positive and negative social impacts.

The positive impacts include;

- Economic activities

  Creation of employment opportunities:

  It was determined that the proposed power station would lead to local employment and associated income stability; training and employment; local procurement and associated local economic

  Impacts on the local municipality:

  The investigation determined that the power station would bring about an increase in the demand for housing and infrastructure in the surrounding area. This increase would have a positive impact on the local municipality.

  Because the power station will receive operational water requirements from the EMalahleni Waste Water Treatment Works (treated mine water) the project will not increase the burden on municipal water. Electricity will be self-generated (after construction phase) and a private service provider will manage all solid waste removal.

The negative impacts include;

- Social change 1: In-migration

  The most significant impact relating to In-migration will occur during the construction phase of the proposed project due to the high demand for labour during this period. The construction period will last for approximately two to four years, depending on the contractors. It is estimated that at peak construction time (a period of six to eight months) approximately 1200 people will be employed, with approximately 900 people for the remaining construction period.

  The construction and operation of the power station are likely to result in an increase in traffic volumes. This could lead to damage of local roads and increased speeding through town, thereby impacting on the safety and daily movement patterns of residents in surrounding communities.

- Social change 2: Resettlement

  The proposed project will require the relocation of two households. The members of these households are non-landowning tenants; the household heads were formerly employed on the farm before the land was purchased by Anglo American Limited. They have been living there for more than 20 years. The households currently house a total of sixteen people, of which three are employed.

  Specialist consultants have been appointed to undertake the resettlement process to relocate these households to a suitable alternative location. The resettlement process is currently in the planning stages, which involves the compilation of a Resettlement Action Plan (RAP).

  The process will be undertaken in accordance with international best-practice principles, such as the World Bank Operation Policy 4.12 and the International Finance Corporation (IFC) Performance Standard 5 on Involuntary resettlement, as well as with Anglo American Limited policies incorporated into the company's Socio-Economic Assessment Toolbox (SEAT).

  As such, it will involve:

  - Involvement of the affected households in all decision-making that will affect them, including the choice of resettlement site;

- o Compensation for all assets that will be lost or displaced by relocation, where such compensation will preferably be by means of the replacement of assets rather than monetary remuneration;
- o Replacement of affected assets – in particular, replacement housing at the resettlement site – will be to a similar or better quality than those lost;
- o Post-resettlement support will be provided in the form of a livelihood restoration programme to ensure that the households are not worse off after resettlement than they were before;
- o A monitoring and evaluation programme will be implemented to ensure that the resettlement process does not lead to a deterioration in the households' standard of living; and
- o Resettlement will be completed before construction commences.

These measures are intended to avoid or mitigate any negative impacts that may arise from resettlement, as well as to maximise its benefits for the affected households.

- Social Change 3: Change in land use
  It was determined that the power station could impact on surrounding communities' way of life and on the area's sense of place. This, in turn, could have a negative effect on property values.

- Social change 4: Deviant social behaviour
  Deviant social behaviour can be described as the types of social behaviour that might be deviant or anti-social, such as excessive alcohol consumption, illegal drug use, various types of risk-taking behaviour and vandalism. The project area is currently experiencing high levels of unemployment and poverty rates are high, therefore, opportunistic criminals may take advantage of this situation.
  Based on the outcome of the EIA Phase of the proposed project, it is believed that the final EIR provides a relatively comprehensive investigation and assessment of the environmental issues raised during the Scoping Phase by I&APs, National, Provincial and Local authorities, Anglo American and the EIA project team.

  The EIA indicated that, many of the negative impacts are anticipated to respond favourably to mitigation measures, whereas some of the positive impacts (e.g. maximisation of employment opportunities for members of local communities) can be optimised. The final mitigation measures implemented during the project are to be informed by the recommendations made in the environmental impact report, formalised in the Framework EMP and Social Management Plan and subjected to mitigation and monitoring process throughout the construction and operational phases.

1.7. THE PUBLIC PARTICIPATION PROCESS

Engagement with Interested and Affected Parties (I&APs) forms an integral component of the EIA process. I&APs will have an opportunity at various stages throughout the EIA process to gain more knowledge about the proposed project and to provide input into the process. The proposed project was advertised in national, regional and local newspapers and erecting site notices on and around the proposed sites in order to make as many people as possible aware of the project and associated EIA process. This was done to elicit comment from and register I&APs from as broad a spectrum of public as possible. Thereafter, the Public Participation Process (PPP) focused only on registered I&APs and the local communities.

The I&APs had various opportunities throughout the EIA process to provide input in the consideration of the decision. Public participation during the Scoping Phase was comprehensive and comprised of advertisements, holding key stakeholder meetings, distributing both the draft and final Scoping Reports and the draft EIR for comments and inputs. All responses received were captured in an Issues and Responses Report.

The next stage of the public participation process involves lodging the final EIR in the public library, various AOL collieries in the area and on the internet.. Below is a chronology of key public engagement events:

Date	Action
15 November 2010	Distribute Background Information Document
15 November 2010 – 24 January 2011	Public registration period
29 November 2010 & 8 December 2010	Initial public meeting
16 May 2011	Distribute Draft Scoping Report for public comment
16 May 2011 – 25 June 2011	Public comment period

31 May 2011	Host public meetings
28 July 2011	Distribute Final Scoping Report for public comment
29 July 2011 – 10 August 2011	Public comment period
2 August 2011	Final Scoping report issued to DEA
9 September 2011	DEA acceptance of Final Scoping Report
31 October 2011	Distribute Draft Environmental Impact Report
31 October 2011 – 18 January 2012	Public comment period
21 November 2011	Host public meeting
17 February 2012	Distribute Final Environmental Impact Report
17 February 2012 – 9 March 2012	Public comment period
12 March 2012	Final Environmental Impact Report issued to DEA

In general the public is supportive of the project with expectation of benefits from additional employment during the construction and operational phases. During the public participation process, several of the inhabitants of the surrounding farms raised concerns that the proposed power station may result in an increase in air, noise and ground water pollution, and that this may impact on their health.

1.8. Environmental Management Programme (EMP)

The main purpose of an EMP is to ensure the sustainable management of the environment, whilst avoiding and/or minimising any environmental damage, during the entire lifespan of the project, which includes the construction phase, operational phase and decommissioning of the plant. The EMP, including the Constructional Environmental Management Programme and Operational Environmental Management Programme, must be viewed as a legal binding document to which all employees and outside contractors involved in the construction and operation of the plant must be compliant to.

The EMP supersedes any contracts and must be adhered to during the entire lifespan of the power plant. No environmental fatal flaws were identified through the EIA process to be associated with the operation and maintenance of the Khanyisa Power Station. However, a number of potential impacts require management and mitigations were identified in the EIR and EMP.

1.8.1. Organizational structure and responsibility

The organisational structure identifies and defines the responsibilities and authority of the various role-players (individuals and organisations) involved in the project.

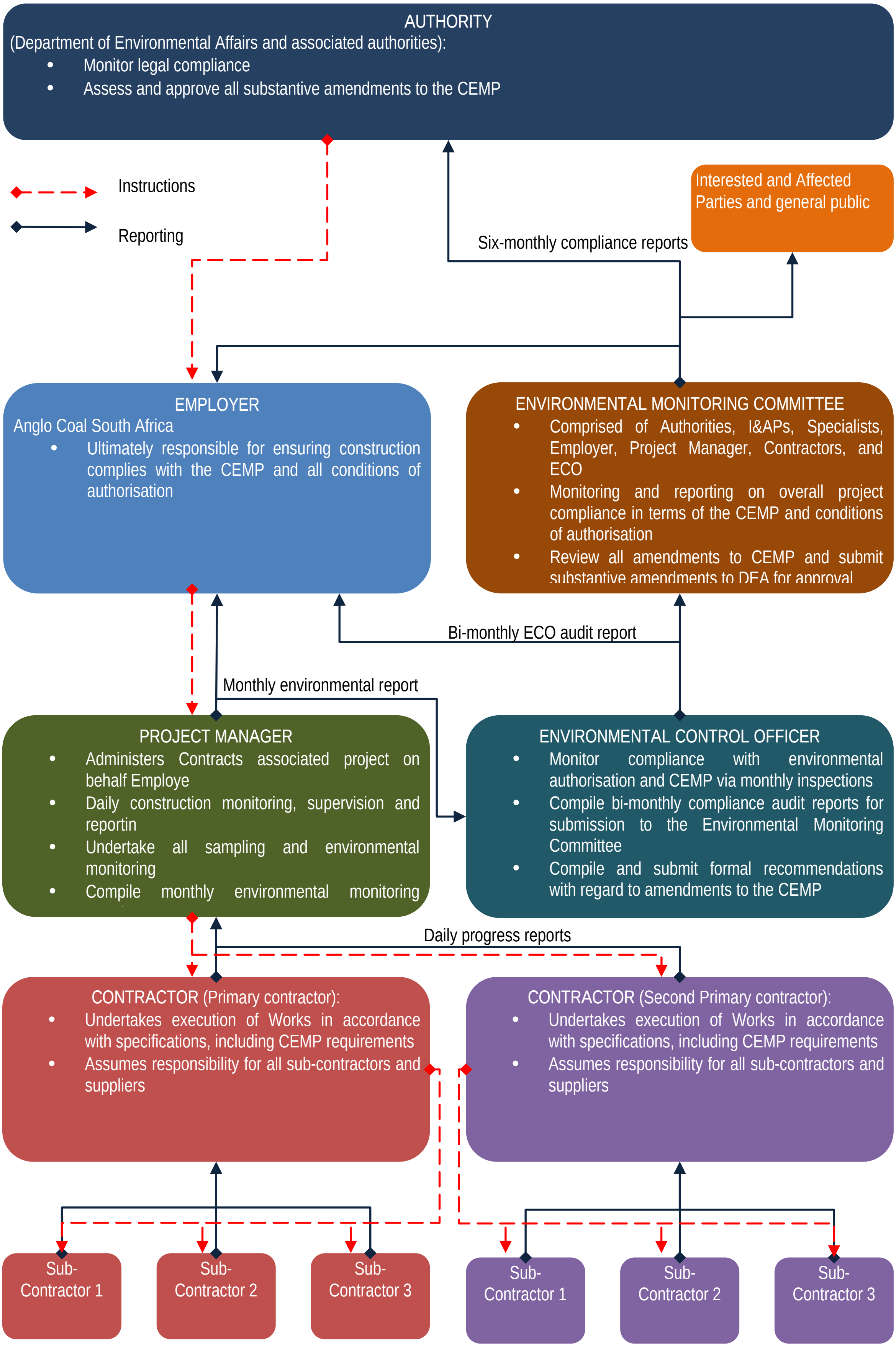
All instructions and official communications regarding environmental matters shall follow the organisational structure shown in the figure below.

The organisational structure has been developed to ensure that:

- There are clear channels of communication;
- There is an explicit organisational hierarchy for the project; and
- Potential conflicting or contradictory instructions are avoided.

In terms of the defined organisational structure, all instructions that relate to environmental matters will be communicated to the Contractor via the Project Manager's Representative. The only exception to this rule would be in an emergency (defined as a situation requiring immediate action and where failure to intervene timeously would, in the reasonable opinion of the Environmental Control Officer, result in unacceptable environmental degradation), where instructions may be given directly to the Contractor[2]. The key-role-players for the project are Department of Environmental Affairs, the Environmental Monitoring Committee, the Employer, and the Contractor. The detailed roles and responsibilities of the various role-players identified in the organisational structure are described in the EMP.

[2] It should be noted that there is likely to be a considerable amount of informal communication between the ECO and the Contractors environmental representatives. However, where such communication (1) represents an instruction, (2) could lead to liability on the part of the Employer or Engineer or (3) could have financial implications, this must be address through the formal channels of communication defined in the organisational structure.


AUTHORITY
(Department of Environmental Affairs and associated authorities):
• Monitor legal compliance
• Assess and approve all substantive amendments to the CEMP
Instructions
Reporting
Interested and Affected Parties and general public
Six-monthly compliance reports
EMPLOYER
Anglo Coal South Africa
• Ultimately responsible for ensuring construction complies with the CEMP and all conditions of authorisation
ENVIRONMENTAL MONITORING COMMITTEE
• Comprised of Authorities, I&APs, Specialists, Employer, Project Manager, Contractors, and ECO
• Monitoring and reporting on overall project compliance in terms of the CEMP and conditions of authorisation
• Review all amendments to CEMP and submit substantive amendments to DEA for approval
Bi-monthly ECO audit report
Monthly environmental report
PROJECT MANAGER
• Administers Contracts associated project on behalf Employe
• Daily construction monitoring, supervision and reportin
• Undertake all sampling and environmental monitoring
• Compile monthly environmental monitoring
ENVIRONMENTAL CONTROL OFFICER
• Monitor compliance with environmental authorisation and CEMP via monthly inspections
• Compile bi-monthly compliance audit reports for submission to the Environmental Monitoring Committee
• Compile and submit formal recommendations with regard to amendments to the CEMP
Daily progress reports
CONTRACTOR (Primary contractor):
• Undertakes execution of Works in accordance with specifications, including CEMP requirements
• Assumes responsibility for all sub-contractors and suppliers
CONTRACTOR (Second Primary contractor):
• Undertakes execution of Works in accordance with specifications, including CEMP requirements
• Assumes responsibility for all sub-contractors and suppliers
Sub-Contractor 1
Sub-Contractor 2
Sub-Contractor 3
Sub-Contractor 1
Sub-Contractor 2
Sub-Contractor 3

1.9. Conclusions and Recommendations

1.9.1. Conclusions

The findings of the specialist studies undertaken within this EIA provide an assessment of both the benefits and potential negative impacts anticipated as a result of the proposed project. The findings conclude that there are no environmental fatal flaws that should prevent the proposed project from proceeding, provided that the recommended mitigation and management measures are implemented.

An important function of the report's conclusion is to identify the project elements that justify the proposed project. In this regard, the following project elements are noteworthy:

- The Khanyisa power station will relieve the electricity strain currently being experienced in South Africa by providing 450MW of electricity into the national grid;
- The project will be utilising reclaimed mine water from the EWRP for all required purposes (potable and process water requirements) and will therefore not place any burden on the regions municipal and groundwater resources;
- The project will utilise existing discard coal for the fuel source and therefore no new mining operations are required for the power station;
- The power station will meet the World Bank and IFC emission standards which are more stringent that the South African standards;
- The project will utilise Air Cooled Condensers to further reduce the projects impact on water requirements (saving of approximately 4570 Tonnes of water per hour);
- The project will provide positive economic benefits for the region by providing job opportunities for approximately 1200 skilled and semi-skilled people for the 36 month construction period and the broad based economic stimulation associated with the contractors and suppliers. and
- The proposed sites falls within transformed land which is situated within existing mining operations and will not present any material impacts on biophysical sensitivities.

1.9.2. Recommendations

With reference to the operational impacts described above, it can be noted that their significance levels could generally be reduced by implementing the identified mitigatory measures as highlighted in the EIR. Assuming that the identified suite of mitigatory measures is implemented, the following describes the various project alternatives in terms of their biophysical and socio-economic impact:

With reference to the alternative sites, the initial site selection process evaluated each site against a range of project dependent criteria such as size of the site, potential boundaries, buffer zones, distance from fuel source, electricity evacuation etc. It was concluded that all 6 initial sites are comprised to varying degrees by undermining activities except for site 6C.

Since undermined sites present both a technical and financial risk in terms of the foundational cost and ground settlement during the operational life of the plant, all other site alternatives were disqualified and site 6C is the only site option that is large enough for the power station and associated infrastructure which is not undermined.
It is recommended that refinement of the site layouts be considered in the future, once further technical information is available.

In terms of cooling alternatives, indirect dry cooling, which utilises cooling towers, greatly increases the disturbance footprint and visual prominence of the power station, making it a more imposing structure. Furthermore, indirect dry cooling entails a significantly greater capital cost. However, direct dry cooling, which utilises a bank of fans for each boiler unit, is unlikely to increase the residual noise climate by more than 5dBA, except within a short range (within 2 000 metres) of the power station itself. This can be attributed to the fact that the noise climate has already been degraded by the operations at the Landau, Greenside and Kleinkopje Collieries, and traffic noise. The cumulative effects between the existing sources of noise and the noise generated by the power station operations will be minor. Furthermore, direct dry cooling uses approximately < 0.2 l of water per kWh generated.

A significant advantage of dry-cooling technology is the conservation of water, which is critical in a semi-arid country like South Africa. As South Africa is a water scarce country and wet cooling uses far greater volumes of water than dry cooling, it is recommended that the power station make use of direct dry cooling technology.

Should all possible noise mitigation measures be implemented, such as noise abatement technology, insulation, and increasing the buffer zone between the power station and adjacent noise sensitive receptors, then the impacts of direct dry cooling will be adequately mitigated to within acceptable district noise standards (SANS 10103). Furthermore, if the mitigation measures for visual impacts are implemented, the visual impacts would also be reduced for sensitive view receptors because the more sensitive residential receptors from the town of Witbank are mainly outside of the 6 km buffer zone. Consequently, Anglo American should base its choice of cooling technology on technical and cost factors.

With reference to air emission abatement, Anglo American has made a firm commitment that the design will ensure that the air pollution control equipment is installed to reduce the hourly concentrations of particulate emissions to within the IFC guideline of 30 µg/m³. Furthermore, the project will also ensure air pollution control equipment is installed to reduce the hourly concentrations of particulate emissions to within the IFC Guideline of 30 µg/m³.

Above ground ash disposal will result in a larger footprint being disturbed than other forms of ash disposal. However, wet in lagoon and in-pit ashing require the ash to be conveyed to the mine and may result in groundwater contamination and the preferred ash disposal site is not geotechnically suitable for a wet-lagoon design. Above-ground ashing is therefore recommended as the environmentally most acceptable ash disposal technique at this stage.

With regard to the relocation of the Tweefontein road (D 2257), Option 1 is the preferred route alignment and is supported by the provincial roads authority. The alignment of Option 1 allows for mobility and meets minimum prescribed geometric criteria, sight distances and access spacing.

The specialist studies and environmental impact assessment indicated that there are little differences in the sensitivity of the proposed transmission line routes since both routes cross similar habitats. From a visual impact Option 2 is the preferred option as it has less exposure to receptors and is more aligned with the exiting road infrastructure and therefore there would be less potential fragmentation of landscapes / agricultural areas.

In terms of combustion technology, CFB technology has the advantage of being able to burn colas with a wide range of properties and can cope with high ash and high sulphur coals as proposed for the power plant. The removal of sulphur from the coal during the combustion process is achieved in CFB boilers by the addition of limestone which acts as a sorbent.

It is proposed that CFB technology be implemented to ensure the power stations meet the air quality standards.

1.10. Way Forward

The next stage of this EIA process involves the review of the final EIR by the competent authority for consideration.

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GLOSSARY OF TERMS

Airshed	An airshed is a part of the atmosphere that behaves in a coherent way with respect to the dispersion of emissions. It typically forms an analytical or management unit and is also a geographic boundary for air quality standards
Base Load	Base load refers to the electricity generated to meet the continuous need for electricity at any hour of the day or night at all times and during all seasons
Environment	The surroundings (biophysical, social and economic) within which humans exist and that are made up of i. the land, water and atmosphere of the earth; ii. micro organisms, plant and animal life; iii. any part or combination of (i) and (ii) and the interrelationships among and between them; and iv. the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and wellbeing
Environmental Impact Assessment (ESIA)	A study of the environmental consequences of a proposed course of action.
Environmental Impact Report (EIR)	A report assessing the potential significant impacts as identified during the Scoping phase.
Environmental impact	An environmental change caused by some human act
Peaking or Peak Load	Peaking refers to the periods between approximately 06:00 and 09:00 in the mornings and 18:00 and 21:00 in the evenings when electricity usage “peaks”
Public Participation Process	A process of involving the public in order to identify needs, address concerns, in order to contribute to more informed decision making relating to a proposed project, programme or development
Mothballed	A power station withdrawn from service for an indefinite period.
Red Data Book (South African)	An inventory of rare, endangered, threatened or vulnerable species of South African plants and animals

Scoping	A procedure for determining the extent of and approach to an ESIA, used to focus the ESIA to ensure that only the significant issues and reasonable alternatives are examined in detail
Scoping Report	A report describing the issues identified during the scoping phase
Witbank	Now known as eMalahleni

ABBREVIATIONS

ACC	Air Cooled Condenser
AOL	Anglo American South Africa
AOLTC	Anglo American Thermal Coal
AEL	Air Emissions License
AHP	Analytical Hierarchy Process
AOL	Anglo Operations Limited
APPA	Atmospheric Pollution Prevention Act (No. 45 of 1965)
AQMP	Air Quality Management Plan
AsgiSA	Accelerated and Shared Growth Initiative for South Africa
BID	Background Information Document
Capex	Capital Expenditure
CARA	Conservation of Agricultural Resources Act (No. 43 of 1983)
CCR	Carbon Capture Ready
CCS	Carbon Capture Storage
CFB	Circulating Fluidised Bed)
CO2	Carbon Dioxide
CSLF	Carbon Sequestration Leadership Forum
CSP	Concentrated Solar Power
DEA	Department of Environmental Affairs (Waste and Environmental
DECC	Department of Energy and Climate Change
DEIR	Draft Environmental Impact Report
DMR	Formerly Department of Minerals and Energy, now Department of Mineral Resources (**DMR**)
DoE	Department of Energy
DSR	Draft Scoping Report
DSM	Demand Side Management
DR	District road

DWA	Department of Water Affairs (formerly the Department of Water Affairs and Forestry)
DX	Distribution in the Electricity sector
EAP	Environmental Assessment Practitioner
EAPSA	(Registered) Environmental Assessment Practitioner of South Africa
ECA	Environment Conservation Act (No. 73 of 1989)
ED	Electrodialysis
EDI	Electrodeionization
ESIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
EIR	Environmental Impact Report
EIUG	Energy Intensive User Group
ELM	eMalahleni Local Municipality
EMP	Environmental Management Programme
EMRP	eMalahleni Water Reclamation Plant
EMRP	eMalahleni Water Reclamation Plant
EOI	Expression of Interest
EWT	Endangered Wildlife Trust
FBC	Fluidised bed combustion
FGD	Flue gas desulphurisation
FSR	Final Scoping Report
GA	General Authorisation in terms of the National Water Act (No. 36 of 1998)
GAR	Gross as received
GCS	Groundwater Consulting Services
GGP	Gross Geographic Product
GN	Government Notice
GW	Giga Watts
GX	Generation in Electrisation Sector
ha	Hectare
HIA	Heritage Impact Assessment
HSV	High Speed Voltage
HV	High Voltage

I&AP	Interested and Affected Party
IDP	Integrated Development Plan
IEA	International Energy Agency
IEP	Integrated Energy Plan
IGCC	Integrated coal gasification combined cycle
IRP	Integrated Resource Plan
ISEP	Integrated Strategic Electricity Planning
IWULA	Integrated Water Use License Application
JV	Joint Venture
KK	Kleinkopje
km	Kilometre
kV	Kilovolt
kWh	Kilowatt hour
l	Litres
LM	Local Municipality
m	Metre
m^3	Cubic metre
mamsl	Metres above mean sea level
MCDA	Multi-criteria Decision Analysis
MDEDET	Mpumalanaga Department of Economic Development, Environment and Tourism
MM	Mott MacDonald
MTPPP	Medium Term Power Purchase Programme
MHI	Major Hazard Installation
MPa	megapascals
MPRDA	Mineral and Petroleum Resources Development Act (No. 28 of 2002)
MR	Minimum Requirements for Waste Disposal by Landfill (DWAF, 1998b)
Mt	Million tons
MTS	Major Transmission Substation
MYPD2	Multi-year Price Determination (2)
MW	Megawatt

NEMA	National Environmental Management Act (No. 107 of 1998)
NEM: WA	The National Environmental Management: Waste Act (No. 59 of 2008)
NEM:AQA	The National Environmental Management: Air Quality Act (No. 39 of 2004)
NERSA	National Energy Regulator of South Africa
NHRA	National Heritage Resources Act (No. 25 of 1999)
NIRP	National Integrated Resource Plan
NO_x	Oxides of nitrogen
NWA	National Water Act (No 36 of 1998)
NWRS	National Water Resources Strategy
OEM	Original Equipment Manufacturer
OCGT	Open Cycle Gas Turbines
PAIA	Promotion of Access to Information Act (Act 2 of 2000)
PAJA	Promotion of Administrative Justice Act (Act 3 of 2000)
PGDS	Provincial Growth and Development Strategy
PM_{10}	Particulates with a diameter of 10 µm or more
ppm	Parts per Million
pf	Pulverised fuel
PPP	Public Participation Process
REFIT	Renewable Feed-in Tariff
RFQ	Request for Quotation
ROM	Run-of-mine
RSA	Republic of South Africa
SANBI	South African National Botanical Institute
SANS	South African National Standards
SACE	South African Coal Estates
SAHRA	South African Heritage Resources Agency
SANRAL	South African National Roads Agency Limited
SANS	South African National Standards
SAM	Social Accounting Matrix

SIA	Social Impact Assessment
SCR	Selective Catalytic Reduction
SDF	Spatial Development Framework
SO_2	Sulphur dioxide
SO_x	Oxides of sulphur
SoE	State-owned Enterprises
SSF	Sasol Synthetic Fuels
ToR	Terms of Reference
TX	Transmission
UCG	Underground Coal Gasification
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States of America Dollar
VIA	Visual Impact Assessment
WESSA	Wildlife and Environmental Society of South Africa
WMA	Water Management Area
WWTW	Wastewater treatment works
WTW	Water treatment works
ZAR	South African Rand
ZLED	Zero Liquid Effluent Discharge

1 INTRODUCTION AND BACKGROUND

The purpose of this chapter is to provide the context to the project and to this Environmental Impact Assessment Report (ESIA Report). After a short introduction it describes the legal framework.

1.1. INTRODUCTION

Anglo American South Africa (AOL) has commenced with this project in order to procure their own dedicated supply for a portion of their electricity requirements via the Khanyisa IPP project. Such supply is aimed at increasing Anglo American's security of supply, as well as limiting the impact of electricity price increases. A key motivator for the project is that electricity generating capacity in South Africa is expected to remain constrained for a number of years. Pursuant to this, Eskom, currently the sole supplier of electricity, has been and will be increasing its tariffs at relatively high rates, with annual increases of ~25% for each year of the MYPD2 period (April 2010 to March 2013). It is expected that further significant increases will be granted well beyond this period.

Therefore, in an attempt to manage this risk, AOL intends contracting a third party to construct and operate a power station, fuelled by coal discard, as an Independent Power Producer (IPP). The electricity generated from the power plant will be sold exclusively to AOL and transmitted to various sites through the Eskom network. The power station will contribute to relieving the National/Eskom generation capacity shortages and will also enable Anglo American to continue production thus avoiding curtailing/shutting down when power rationing is implemented due to capacity shortages. The project is critical to future investment in the mining industry in South Africa and the concomitant creation of jobs.

The guiding document used to inform the conceptual design and feasibility assessment was the Draft Integrated Electricity Resource Plan for South Africa (IRP 2010), recently compiled by the Department of Energy (DoE), which aims to determine how long-term electricity demand should be met in terms of generating capacity, type, timing and cost. The evaluation process established a "Revised Balanced Scenario", representing a balance between certain key factors, including funding availability, new technology uncertainties, water usage and security of supply. Although the plan is subject to funding and other implementation constraints and is dependent on demand reduction initiatives, it acknowledges the high price of unserved energy and serves as a basis for future electrical generation initiatives.

The primary stimulus for the Khanyisa project is the availability of the discard coal, which, being a by-product of the long term mining operations within the SACE (South African Coal Estates) complex provides an estimated 130 million tonnes of available fuel source. However, as the discard coal is of relatively low quality, with high ash content (around 50%) and high sulphur content (2 to 3%), this study proposes that the power plant utilise Circulating Fluidised Bed (CFB) boilers. CFB technology has the advantage of being able to burn coals with a wide range of properties and can cope with high ash and high sulphur coals as proposed for this power project. The removal of sulphur from the coal during the combustion process is achieved in CFB boilers by the addition of limestone which acts as a sorbent. The sulphur becomes bound to the limestone enabling its removal and disposal. Additionally, the lower combustion temperatures of the CFB boiler result in lower emissions of nitrogen oxide (NOx) by reducing the production of thermal NOx within the furnace.

A key element of the project is that the power station will utilise waste coal and water. The projects water supply will be provided from the eMalahleni Water Reclamation Plant (EWRP), which treats reclaimed underground water from Anglo's collieries in the area, as well as from BHP Billiton and Xstrata mines. This is significant in that by utilising both waste coal and water the project significantly reduces its environmental impact on natural resources.

This Environmental Impact Assessment (ESIA) is for the proposed construction of a new 450 MW power generation facility in the eMalahleni (formerly known as Witbank) area, (refer to **Figure 1.1**) using recirculating fluidized bed technologies and coal discards as a fuel source.

The power station facility would include the power station buildings, administration buildings (administrative, medical, maintenance, services) and the high voltage yards amongst others. The likely associated infrastructure includes a water treatment works, a wastewater treatment works, access roads, transmission lines (as well as re-alignment of existing lines), water supply pipelines, a coal stockyard (silo), an ash disposal facility, a gypsum storage facility, a coal and ash conveyor system, substation, power and water supply for construction and a telecommunications tower.

The proposed substation, which is currently positioned on the north side of the power island, south of the re-aligned D2257 road, will connect to the existing Duvha – Matla Eskom grid via two 400kVa transmission lines. In this regard, two possible route alternatives have been identified and the relevant specialist studies were commissioned (visual and avifaunal studies being of particular relevance). Further information regarding the additional power lines may be referenced in **Section 3.4** of this report.

In terms of the National Environmental Management Act (No. 107 of 1998), (as amended), the proposed development triggers a suite of activities which require authorisation from the competent environmental authority before they can be undertaken. It has been ascertained that the competent authority is the national Department of Environmental Affairs (DEA), both waste and environmental sections (DEA waste & DEA environmental). DEA's decision will be based on the outcome of this ESIA process. This report serves to document the results and recommendations of the impact assessment investigation process of the ESIA phase (the ESIA process and sequence of documents produced as a result of the process is illustrated in Figure 1-2).

The purpose of this ESIA Report[3] is to:

- outline the legal and policy framework and national electricity situation;
- comprehensively describe the proposed project and its alternatives;
- describe the biophysical and socio-economic context of the proposed power station;
- describe the Public Participation Process (PPP) undertaken to date and the way forward;
- assess the significance of the potential impacts that were identified during the Scoping Phase of the ESIA process; and
- provide mitigation measures to reduce negative and enhance positive impacts;

A draft Framework Environmental Management Programme (EMP), which includes the recommended mitigation measures, is also attached to this report (**ANNEXURE J**).

[3] Section 28 of Regulation 543 of NEMA, as amended in 2010, lists the content required in an ESIA Report

A suite of specialist studies were commissioned to better understand the potential environmental impacts and to ensure a reasonable confidence in the assessment of significance.

The Environmental Impact Report (EIR) is the last phase in the ESIA Process. Accordingly, this EIR aims to collate, synthesise and analyse information from a range of sources to provide sufficient information for DEA to make an informed decision on whether or not the proposed power station is acceptable from an environmental perspective. Note that the term “environment” refers to biophysical, social and economic environments and is a defined term above.

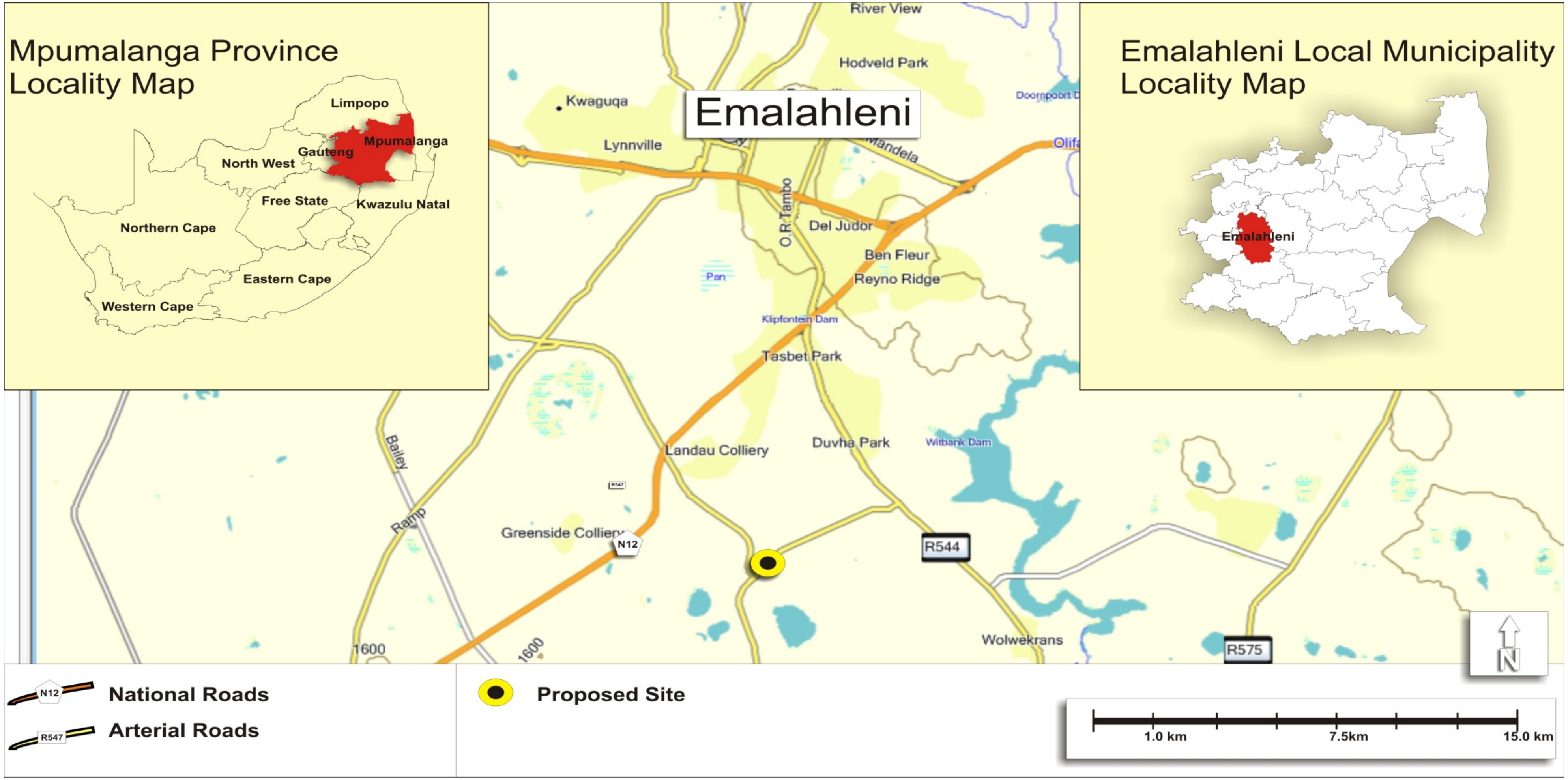

Figure 1-1: Location of the broad study area, indicating the proposed site alternative

1.2. LEGAL CONTEXT

1.2.1. Key Environmental Legislation

The Khanyisa application includes both the NEMA and NEM:WA listed activities which require environmental authorisation from the respective directorates. The DEA has indicated that an integrated environmental authorisation will be provided for both NEMA and NEM:WA listed activities as contemplated in Section 24L of NEMA.

The integrated environmental authorisation process as contemplated in section 24L of NEMA is currently only applicable in instances where the **Minister** is both the –

- competent authority for the environmental authorisation applied for in terms of NEMA and the ESIA Regulations, 2010; and
- the licencing authority for the waste management licence in terms of NEM:WA.

The environmental authorisation process prescribed for listed activities under Listing Notices 1, 2 and 3 published in Government Gazette Numbers R544, R545 and R546 respectively and the waste licensing process for listed activities contained in the Schedule in Government Notice 718, 2009 published in terms of section 19 of NEM:WA are as defined in the Environmental Impact Assessment (ESIA) Regulations made under section 24(5) of the National Environmental Management Act, 2008 (Act No. 107 of 1998) ("NEMA"). Please refer to **VOLUME 2 -ANNEXURE A** for the complete Legal Review Report.

j) National Environmental Management Act

Chapter 5 of NEMA, amongst other things, regulates the procedure and criteria relating to the submission, processing and consideration of, and decision on, applications for environmental authorisations for the commencement of activities in order to avoid detrimental impacts on the environment, or where it cannot be avoided, ensure mitigation and management of impacts to acceptable levels, and to optimise positive environmental impacts, and for matters pertaining thereto.

NEMA provides an overarching framework that seeks to provide for the administration and enforcement of environmental management legislation and co-operative governance by establishing institutions to promote co-operative governance and procedures for the coordination of environmental functions carried out by all spheres of government, as well as principles for decision-making on matters affecting the environment.

Section 2 sets out the National Environmental Management Principles which apply, amongst others, to the actions of organs of state that may significantly affect the environment. Furthermore, Section 28(1) 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.

AOL has the responsibility to ensure that the proposed activity as well as the ESIA process conforms to the principles[4] of NEMA. In developing the ESIA process Aurecon has been cognisant of this need, and accordingly the ESIA process has been undertaken in terms of NEMA and the ESIA Regulations promulgated on 21 April 2006, and amended in August 2010.

In terms of the ESIA regulations which were published in order to give effect to NEMA Chapter 5, certain activities are identified which require authorisation from the competent environmental authority (DEA) before commencing. Listed activities in Government Notice (GN) No. 545 require Scoping and ESIA whilst those in GN No. 544 require Basic Assessment (unless they are being assessed under an ESIA process). The summary below serves as a quick reference of the environmental authorisations required in terms of the ESIA Regulations:

Table 1-1: Listed activities to be authorised for the proposed power station[5]

Indicate the number and date of the relevant notice:	Activity No (s) (in terms of the relevant or notice) :	Describe each listed activity as per the detailed project description (and not as per wording of the relevant Government Notice):
R 544 Listing 1, 2010	2	On site bulk storage of more than 100 000 tons of coal which requires an atmospheric emissions license in terms of the National Environmental Management: Air Quality Act (Act No. 39 of 2004).

[4] NEMA Principles, Chapter 1, Sections 1-4

[5] Note that activities 1(f), (g), (o), (p), (r) and 1 (o) of GN No. 387 and (p) of GN No.386 have been removed as these activities are now included under the National Environmental Management: Waste Act (see Table 1.2 for more detail).

Indicate the number and date of the relevant notice:	Activity No (s) (in terms of the relevant or notice) :	Describe each listed activity as per the detailed project description (and not as per wording of the relevant Government Notice):
	9	Bulk Water/Effluent pipeline to/from Emalahleni Waste Treatment Works. Construction of infrastructure longer than 1000m for water or sewage which is not in a road reserve with a diameter of more than 0.36m or peak throughput of more than 120lt per second.
	10	Relocating the existing 132 kV Eskom powerlines to the boundary of the site.
	13	Storage of hazardous substances- Fuel and oil tanks of a combined volume of between 80m3-500m3
	22	Moving and constructing the new provincial roads (Tweefontein rd. realignment). Route determination of a road wider than 30m or with more than one lane in both directions.
	23	Transformation of undeveloped land (land that has not had any facilities, structures or infrastructure affected on it in previous 10 years) to industrial with an area of between 1-20 ha.
R545 Listing 2, 2010	1	Construction of infrastructure for the generation of more than 20MW.
	5	Construction of facilities or infrastructure for any process requiring an Air Emissions License – (release of emissions to atmosphere). Application for Emissions licence under AQA listed activity “category 1.1: Solid Fuel combustion Installation” triggers the activity that requires an ESIA for construction of any infrastructure where a license is required that deals with emissions or effluent. The requisite AEL (Air Emissions License) is being submitted as part of this ESIA process.

Indicate the number and date of the relevant notice:	Activity No (s) (in terms of the relevant or notice) :	Describe each listed activity as per the detailed project description (and not as per wording of the relevant Government Notice):
	6(iii)	Conveyors for the transportation of the ash to the ash dump. Construction of facilities for the bulk transfer of hazardous goods.
	8	The construction of the interconnection powerline to evacuate the 400kV electricity from the power station to the connection point on the Eskom grid.
	15	The physical alteration of undeveloped, vacant or derelict land for industrial use where the total area to be transformed is 20 hectares or more.
	18	Moving and constructing the new provincial roads (Tweefontein rd. realignment). Route determination of a road wider than 30m or with more than one lane in both directions.

k) National Environmental Management: Waste Act

The National Environmental Management: Waste Act (No. 59 of 2008) (NEM:WA) seeks to reform the law on waste management by making provision for various measures for the prevention of pollution and ecological degradation, as well as ecologically sustainable development in order to protect health and the environment. In this regard, NEM:WA provides for national norms and standards for regulating waste management in all spheres of government and provides for the licensing and control of waste management activities, as well as the remediation of contaminated land.

The objectives of NEM:WA include minimising the consumption of natural resources; avoiding and minimising the generation of waste; reducing, re-using, recycling and recovering waste; treating and safely disposing of waste as a last resort; promoting and ensuring the effective delivery of waste services; remediating land where contamination presents or may present a significant risk of harm to health or the environment and achieving integrated waste management reporting and planning.

Generally, the Act seeks to ensure that people are aware of the impact of waste on their health, well-being and the environment and to give effect to the constitutional right in order to secure an environment that is not harmful to one's health or well-being.

Therefore, in accordance with the National Environmental Management: Waste Act, 2008(Act No. 59 of 2008) this ESIA has identified, and included the waste management activities that require licensing as published in GN R718 on 3 July 2009. Primarily, the power station will be generating ash waste that requires disposal on an ash dump, but will also generate typical industry related hazardous and domestic wastes that will require disposal at an appropriately licensed facility. Furthermore, NEM:WA also identifies the proposed on-site effluent treatment plant as an activity requiring a waste license.

The NEM:WA requires that the power station report all hazardous and industrial waste generated on site and that it only be removed by a licensed operator. The ash waste may be removed from site by conveyors or pipeline, but it also may be removed from site by trucks depending on where the ash dump will be situated. The removal by truck would require the operator to be licensed by the local authority if they have commenced the licensing process.

Table 1-2: Listed waste management activities to be authorised for the proposed power station[6]

Indicate the no. & date of the relevant notice:	Activity numbers (as listed in the waste management activity list) :	Describe each listed activity (and not as per the wording of the relevant government notice):
GN718 Category A (3 July 2009)	Activity 1: Storage of more than 100m3 of general waste.	Storage of general waste that may be generated on site (General Waste is defined in NEM:WA).
	Activity 2: Storage of more than 35m3 of hazardous waste.	Storage of Waste on site-Fly ash and bottom ash and general and other hazardous waste that may be generated on site.

[6] Note that activities 1(f), (g), (o), (p), (r) and 1 (o) of GN No. 387 and (p) of GN No.386 have been removed as these activities are now included under the National Environmental Management: Waste Act

	Activity 18: Construction of facilities for activities in category A.	Storage facilities and infrastructure for Waste on site-Fly ash and bottom ash storage and management. Also other general waste and hazardous waste facilities
R718 Category B (3 July 2009)	Activity 7: Effluent treatment facility with throughput more than 15 000m3 per annum	Effluent treatment facility (Process dependent on volume, most likely B requiring Scoping and ESIA.)
	Activity 9: Disposal of any quantity of Hazardous waste to land	Ash Dump Waste management license
	Activity 11: Construction of facilities for activities in category B	Construction of Ash dump facility and effluent treatment plant

l) National Environmental Management: Air Quality Act (AQA)

The National Environmental Management: Air Quality Act (No. 39 of 2004) (NEM:AQA) was promulgated in February 2005, and came into full effect on 1 April 2010. NEM:AQA aims to reform current air quality legislation and provide national standards regulating the monitoring, management and control of air quality, while at the same time promoting justifiable economic and social development.

The South African standards for ambient air quality are included as Schedule 2 of NEM:AQA and were published in GN. No. 1210 on 24 December 2009 (Annexure A, Volume 2). This includes averaging periods, concentrations, permissible frequency of exceedances and timeframes for achieving compliance.

Listed Activities in terms of Section 21 of NEM:AQA were published in GN No. 220 on 26 March 2010 with effect on 1 April 2010. In terms of NEM:AQA, an electricity generation (any fuel using process using more than 50 MW fuel input) process is classified as a Listed Activity and as such requires an Atmospheric Emission Licence (**ANNEXURE K.2**) in order to operate. As the proposed power station is a Listed Activity it is required to apply for Atmospheric Emissions Licenses and comply with the new emission standards when they are promulgated.

A provisional AEL is required before construction starts, so an AEL application has been lodged in parallel with the ESIA application.

All types of atmospheric impacts from emissions, dust, smoke, noise and odours are included in the management mechanisms contained in the NEM:AQA. The management and issuing of emissions licenses have been delegated to local authorities (District and Metropolitan).

Although the project falls within the Highveld Priority area, the AQMP (Air Quality Management Plan) has not been drafted yet and as a result, there are currently no stricter emissions limits set, but the emissions limits for this project are expected to be considerably more stringent when they are set. Therefore, in order to ensure Air Quality compliance and best practice the relevant authorities were approached at the outset of the ESIA to ensure that the design capacity of the plant will achieve IFC/World Bank emission standards for degraded airsheds.

In the South African context, the proposed power station falls under subcategory 1-1 of the regulations and must meet emission standards as given in Table 1-3 below, unless stricter standards are set by the requirements of the Air Quality Management Plan at present being developed for the Highveld Priority Area in terms of section 19 of the Air Quality Act.

Table 1-3: Emission Standards for solid Fuel Combustion Installations

(1)Subcategory 1.1: Solid fuel combustion installations

Description:	Solid fuels (excluding biomass) combustion installations used primarily for steam raising or electricity generation.		
Application:	All installations with design capacity equal to or greater than 50 MW heat input per unit, based on the lower calorific value of the fuel used.		
Substance or mixture of substances		**Plant status**	**mg/Nm³ under normal conditions of 10% O_2, 273 Kelvin and 101.3 kPa.**
Common name	**Chemical symbol**		
Particulate matter	N/A	New	50
		Existing	100
Sulphur dioxide	SO_2	New	500
		Existing	3500
Oxides of nitrogen	NO_X expressed as NO_2	New	750
		Existing	1100

(a) The following special arrangement shall apply –

(i) Continuous emission monitoring of PM, SO_2 and NO_X is required.

However, as mentioned above, the proposed power station will be designed to meet the IFC emission limits for installations larger than 600 MW, for which the SO2 concentration is less than 200mg/Nm3. According to the IFC definitions, the Highveld would qualify as a degraded airshed (DA) and therefore the following emission requirements need to be met:

- Particulate matter less than 30 mg/ Nm3
- SO2 less than 400 mg/Nm3
- NOx less than 200 mg/Nm3

1.2.2. Other Applicable Legislation and Policies

a) National Water Act

The purpose of this Act is to redress the past injustices and ensure the equitable allocation of water for beneficial use, the redistribution of water and the sustainability of South Africa's water resources for the benefit of all users. Furthermore, the Act recognises the need to protect the quality of South Africa's water resources and the need for the integrated management of all aspects of water resources.

In terms of Section 21 of the National Water Act (No. 36 of 1998) (NWA), amongst others, the taking of water from a water resource, storing of water, impounding or diverting the flow of water in a water course, and the disposal of water which contains waste or has been heated through a power generation process are all considered water uses, which in general must be licensed, unless permitted as a Schedule 1 activity, or permissible in terms of a General Authorisation (GA) under Section 39 of the Act[7]. Schedule 1 activities relate mostly to small scale domestic usage of water and would therefore not be applicable to the proposed project.

Aurecon, as part of the ESIA, has applied for the requisite licenses and registrations from the Department of Water Affairs (DWA) on behalf of Anglo American and once the licence is issued will transfer these rights and responsibilities to the successful IPP bidder. Comments and inputs have been sought from the DWA, which will then be forwarded to DEA to consider during its decision-making process. (**ANNEXURE K.1** for proof of registration.)

Part 3 of the NWA deals with the Reserve, which is divided into the basic human needs Reserve and the ecological Reserve. The basic human needs Reserve provides for the essential needs of individuals served by the water resource in question and includes water for drinking, for food preparation and for personal hygiene. The ecological Reserve relates to the water required to protect the aquatic ecosystems of the water resource. The Reserve refers to both the quantity and quality of the water in the resource, and will vary depending on the class of the resource. In terms of Section 16 of the Act, as soon as reasonably practicable after the class of all or part of a water resource has been determined, the Minister must, by notice in the Gazette, determine the Reserve for all or part of that water resource. In terms of the NWA, the Reserve would have to be determined before DWA could issue a licence for a new water use. It

[7] GA's have been issued for water uses (a), (c), (e), (f), (h), (i) and (j) listed in Section 21 of NWA.

must however be noted that the power station will not undertake their own abstraction of water from a water resource, but will be supplied via a larger water supply scheme.

The Khanyisa power station will receive the full water allocation, both industrial and potable, from the eMalahleni Water Treatment Plant (EMWT). The availability and capacity has been confirmed by EMWT. Attached as ANNEXURE M is a copy of the draft water use agreement.

b) National Heritage Resources Act

The National Heritage Resources Act (No. 25 of 1999) (NHRA) provides for the management and protection of the country's national heritage resources, which includes heritage sites, national monuments, buildings older than 60 years, rock art paintings and sites of archaeological interest. The Act also provides for the protection and management of conservation worthy places and areas and includes measures for formal as well as general protection, such as heritage site status and permitting requirements respectively.

In terms of NHRA, any person who intends to undertake "any development … which will change the character of a site exceeding 5000 m2 in extent", "the construction of a road…powerline, pipeline…exceeding 300m in length" or "the rezoning of site larger than 10 000 m2 in extent…" must at the very earliest stages of initiating the development notify the responsible heritage resources authority, namely the South African Heritage Resources Agency (SAHRA) or the relevant provincial heritage agency. These agencies would in turn indicate whether or not a full Heritage Impact Assessment (HIA) would need to be undertaken.

Section 36(3) of NHRA covers the exhumation of graves, and Section 34(1) covers any archaeological artefacts that may be encountered during site clearing and construction.
Section 38(8) of the NHRA specifically excludes the need for a separate HIA where the evaluation of the impact of a development on heritage resources is required in terms of NEMA. Accordingly, since the impact on heritage resources would be considered as part of the ESIA process outlined here, no separate HIA would be required. SAHRA or the relevant provincial heritage agency would review the ESIA reports and provide comments to DEA, who would include these in their final Environmental Authorisation.

There are a number of graves within the area proposed to house the power station and authorisation from SAHRA would be required prior to damaging, destroying or removing and relocating the graves.

c) National Veld and Forest Fire Act

The National Veld and Forest Fire Act (No. 101 of 1998) aimed to reform the law regulating veld and forest fires, and seeks to prevent and combat veld, forest and mountain fires within South Africa by making provision for the establishment of fire protection associations who are tasked with all aspects of veld fire prevention and fire fighting and the establishment of a fire danger rating system which will prohibit the lighting of fires in open areas where the fire danger rating is high.

Once the IPP has purchased the sites, it will be required to comply with the National Veld and Forest Fire Act. The Act places a duty on landowners to prevent veld fires through the preparation and maintenance of firebreaks and to acquire equipment and have personnel available to fight fires in emergency situations.

d) Occupational Health and Safety Act

The Occupational Health and Safety Act (No. 85 of 1993) and the principally applicable Regulations promulgated there under seek to provide for the health and safety of persons at work and in connection with the use of plant and machinery. The Act imposes various duties on employers to ensure the health and safety of their employees, including taking steps as may be reasonably practicable to eliminate or mitigate any hazard or potential hazard to the health and safety of their employees, providing the necessary information, instructions, training and supervision, as well as not permitting any employee to do any work or to produce, process, use, store, handle or transport any article or substance or to operate any plant or machinery unless the precautionary measures have been taken.

Regulations promulgated in terms of the Occupational Health and Safety Act that may be applicable to the proposed power station include the Major Hazard Installation (MHI) Regulations (under Government Notice No. 692 of 30 July 2001) and the Hazardous Chemical Substances Regulations (under Government Notice No. 1179 of 25 August 1995). In terms of the MHI regulations an application for the proposed power station may be required, should the quantity or type of chemicals stored on site increase or change from the current proposal (see the MHI Risk Assessment in **VOLUME 2** in this regard).

In terms of the Hazardous Chemical Substances Regulations various provisions, to which the IPP will be required to comply, are stipulated. These include air monitoring, handling, control and disposal of hazardous substances.

e) Conservation of Agricultural Resources Act

The object of the Conservation of Agricultural Resources Act (No. 43 of 1983) (CARA) is to provide for the conservation of South Africa's natural agricultural resources by maintaining the production potential of the land, combating and preventing erosion and the weakening or destruction of our water sources, protecting the natural vegetation and combating weeds and invader plants.

In order to achieve these objectives, the Minister may prescribe control measures which land users must comply with. These may relate to the cultivation, utilisation and irrigation of land, as well as the prevention and control of veld fires.

f) Hazardous Substances Act

The Hazardous Substances Act (No. 115 of 1973) provides for the prohibition and control of certain substances which are deemed to be hazardous, as they may cause injury, ill health or result in death due to their toxicity, corrosiveness, strongly sensitizing nature, flammable nature, the generation of pressure in certain situations or their irritant nature.

These substances are divided into groups in relation to the degree of danger they pose. Depending upon their classification the Act may impose conditions prohibiting or controlling the import, manufacture, sale, use, operation, application, modification, and disposal or dumping of such hazardous substances and products.

As a number of hazardous substances will be used in the operation of the proposed power stations, e.g. chlorine, ammonia, caustic soda, sulphuric acid, antiscalant, biocides, petrol, diesel, fuel oil hydrogen, etc. The IPP will be required to comply with the conditions of this Act, where relevant. For example a licence may be required for the storage or use of Group III hazardous substances, or permission is required to acquire or import Group IV hazardous substances.

g) National Environmental Management: Biodiversity Act, 2004

The National Environmental Management: Biodiversity Act (No. 10 of 2004) provides for the management and conservation of biodiversity, including the protection of threatened species and ecosystems, in order to ensure that they maintain their ecological integrity.

The Act also seeks to ensure that our indigenous biological resources are used in a sustainable manner where bioprospecting takes place and that the benefits derived there from are distributed in a fair and equitable manner.

Other relevant section of the Act include Section 53 which considers listed ecosystems, although there are currently no ecosystems listed in term of the regulations, and Section 57 and 65 require a permit for restricted activities involving listed, threatened or protected species or alien species listed in terms of the Act.

h) National Environmental Management: Protected Areas Act

The National Environmental Management: Protected Areas Act (No. 57 of 2003) provides for the protection and conservation of ecologically viable areas which represent South Africa's biological diversity and its natural land and seascapes. The Act recognises several types of protected areas (e.g. special nature reserves, national parks and world heritage sites), which are to be managed in accordance with the national norms and standards detailed in the Act.

The Act also provides for intergovernmental cooperation and public consultation, particularly local community participation and involvement, in matters affecting protected areas. In this regard, the Act seeks to promote the sustainable utilisation of such areas for the benefit of people in a manner that would preserve the ecological character of the area for future generations.

As none of the candidate sites are located near protected areas, this Act is not relevant to the proposed project.

i) Town Planning and Townships Ordinance

The Town Planning and Townships Ordinance (No. 15 of 1986) seeks to consolidate and amend the laws regulating town planning and the establishment of townships, allowing for the co-ordinated and harmonious development of an area which will most effectively promote the health, safety, good order, amenity, convenience and general welfare of such area, as well as efficiency and economy in the process of such development.

The IPP will be required to apply for local authority approval in terms of the Ordinance for the rezoning of the sites from “Agriculture” to “Industrial 2", to allow for the construction of the proposed project, should a positive Environmental Authorisation be granted. This process will be initiated once the successful IPP concludes the necessary contracts with AOL.

Most of the area where the project is to take place is subject to mine surface rights, and in many areas undermining has also taken place. The Power plant will be situated in an area that is not undermined to ensure weight bearing stability. A suitably appropriate area with no undermining has been identified but it is located within a mineralized area. The surface area is still agricultural farmland and has not been impacted on by mining activities. Therefore, all potential future underground mining must be prevented, effectively sterilizing the mineral rights, and the surface area must be removed from the current mineralized area so as to reduce complexity related to liabilities that the current mine owners do not want.

The Ash Dump, possibly the coal washing plant and also the coal discard from the washing plant will be located in a previously disturbed mining area and therefore the EMPR of the host mine must be updated to incorporate the new infrastructure and identify the environmental impacts and also to mitigate those impacts.

1.2.3. Minerals and Petroleum Resources Development Act 28 of 2002

The identified sites for the proposed power station and ash dump are situated within current AOL mining areas and as such are subject to mine surface rights. Therefore, in order to secure the site for use as a power station all potential future underground mining must be prevented by sterilizing the mineral rights and removing the surface area from all future mining activities (current mineralized area).

The Ash Dump, coal washing plant and the coal discard from the washing plant will be located on previously disturbed mining area and therefore the EMPR of the host mine must be updated to incorporate the new infrastructure. The host mine (Klein Koppie Mine) has identified this need and is currently planning the required amendments.

1.2.4. Legislation of General Application

The following includes legislation that may be generally applicable, but does not contain any requirements (specifically permit and/or authorisation obligations in respect of national and provincial laws) relevant to the construction or operational phases for the proposed coal-fired power stations.

a) Constitution of the Republic Of South Africa (Act 108 of 1996)

The Constitution is the supreme law of South Africa, which is binding on all citizens and organs of state. The Constitution lays the foundations for an open and democratic society in which government is based on the will of the people and every citizen is equally protected by law. The purpose of the Constitution is therefore to establish a society based on democratic values, social justice and fundamental human rights (which are contained in the bill of Rights and includes the right to an environment that is not harmful to one's health or well-being).

b) Promotion of Access to Information Act (PAIA) (Act 2 of 2000)

PAIA was enacted in order to give effect to the constitutional right of access to any information held by the State and any information that is held by a private person and that is required for the exercise or protection of any rights. The PAIA thus seeks to foster a culture of transparency and accountability in both public and private bodies by giving effect to the right and actively promoting a society in which the people of South Africa have effective access to information to enable them to more fully exercise and protect all of their rights.

c) Promotion of Administrative Justice Act (PAJA) (Act 3 of 2000)

PAJA was enacted in order to give effect to the Constitutional right of administrative action that is lawful, reasonable and procedurally fair, as well as the right to be given written reasons for administrative action that has an adverse effect on one's rights. The purpose of PAJA is thus to promote an efficient administration and good governance and create a culture of accountability, openness and transparency in the public administration or in the exercise of a public power or the performance of a public function.

d) Transportation of Dangerous Goods and Substances (GNR 103 of 12 October 2001)

The Regulations prohibit the transportation of dangerous goods on public roads, unless such goods are transported in accordance with the provisions therein (and the applicable SANS). The proposed power stations' dangerous goods and substances would be delivered by a supplier and therefore these regulations are not relevant for the present purposes.

e) National Road Traffic Act, 1996 (Act 93 of 1996)

The Act deals with the registration and licensing of motor vehicles, driving licences as well as abnormal load route authorizations for transportation and delivery of heavy equipment. As such an authorisation will be required under this act. The Regulations pertaining to the transportation of dangerous goods were promulgated in terms of this Act.

The Roads Ordinance 22 of 1957 is still active in the Mpumalanga province. The ordinance provides the detail regarding changes to provincial and district roads. Section 5 and 5A details the closure, realignment or establishment of a new road. The change to any road must be published by notice in the provincial gazette, and include a sketch plan of the intended change. Any new route determination is also a listed activity under the ESIA regulations and requires an authorisation.

The power station will be situated over a provincial road currently traversing the proposed site and therefore this road will need to be realigned. The required process of submitting plans to the provincial authorities for approval and gazetting the amendment in the provincial gazette has been initiated by Jeffares & Green traffic engineers.
The environmental authorisation, if approved, will authorise the activities associated with the construction of the realignment while the administrative process of proclaiming the new section of road (including servitude registration) and the subsequent de-proclamation of the old section will rest with the Provincial Roads Authorities.

f) Electricity Act (Act 41 of 1987)

The Act provides for the continued existence of the Electricity Control Regulator and the control of the generation and supply of electricity.

g) Civil Aviation Act (No. 40 of 1988)

This Act allows for the control of many aspects of civil aviation. Of particular relevance to the proposed project is the requirement for approval of obstacles which could cause aviation accidents (e.g. stacks) as well as approval of the establishment of an airstrip and heliport.

1.2.5. Additional Policies, Plans and Regulations

a) The Kyoto Protocol

The United Nations Framework Convention on Climate Change (UNFCCC) attempted to initiate a process to develop a more specific and binding agreement on the reduction of greenhouse gas emissions. This led to negotiations with a particular focus on the commitments of developed countries, and culminated in the adoption of the Kyoto Protocol in 1997, which came into force in February 2005. The Kyoto Protocol elaborates the FCCC by placing more specific obligations on developed countries and Countries with Economies in Transition. Parties to Annex 1 of the FCCC (developed countries) are obliged to reduce their overall emissions of six greenhouse gases by at least 5 % below the 1990 levels between 2008 and 2012. Non-annex 1 Parties, i.e. developing countries, of which South Africa is one, do not have to make any comparable cuts unless they choose to (Glazewski, 2005).

In developing the Kyoto Protocol, the need to promote sustainable development was recognised. This means implementing policies and measures to, among others, enhance energy efficiency, protect and enhance sinks and reservoirs of greenhouse gases, promote sustainable forms of agriculture, increase the usage of new and renewable forms of energy and of advanced and innovative environmentally sound technologies. The Kyoto Protocol is a legally binding instrument. In response, South African policies are starting to place emphasis on cleaner technology and production, and a shift to sustainable development. By the end of the first commitment period of the Kyoto Protocol in 2012, a new international framework needs to have been negotiated and ratified that can deliver the stringent emission reductions the Intergovernmental Panel on Climate Change has clearly indicated are needed.

b) Carbon Capture Readiness

A power plant is designated as “Carbon dioxide (CO_2) capture-ready” when provisions are included during the plant development phase to accommodate installation of future CO_2 capture processes. Provisions are decided upon based on plant requirements and the transportation and permanent storage of the CO_2 captured from the plant. There is still some uncertainty about the definition of Carbon Capture Readiness (CCR) in South Africa; however, it is in the process of producing its own definition. Therefore, this section provides definitions from the EU, UK, and Global CCR Institute.

c) European Union

On the 23 April 2009, EU published the Directive 2009/31/EC relating to the geological storage of carbon dioxide which seeks to regulate the three aspects of CCS separately i.e. capture of CO_2, its transport by pipeline and its storage.

This Directive, under Article 33, provides provision to amend Directive 2001/80/EC (Large Combustion Plant) such that “[any] combustion plant with a rated electrical output of 300 megawatts or more for which the original construction licence…or operating licence is granted after the coming into force of Directive 2009/31/EC…have assessed whether…

- suitable storage sites are available;
- transport facilities are technically and economically feasible; and
- it is technically and economically feasible to retrofit for CO2 capture”.

The requirement for the assessment of carbon capture ‘readiness’ is mandatory for all new combustion plant applications contained in the above definition and must be addressed by developers in the design process.

This is to ensure that once CCS technologies become both technically proven and commercially viable it can be applied to all plants that the Directive describes as requiring such technology.

d) United Kingdom

In the UK, the Department of Energy and Climate Change (DECC) issued in November 2009 the Carbon Capture Readiness Guidance. The guidance requires that as part of the application process for planning that precedes any granting of Section 36 Electricity Act consent for a new power station at or over 300 MW, the developers should:

- demonstrate that they have sufficient space on or near the site to accommodate carbon capture equipment in the future;
- undertake an assessment into the technical and economic feasibility of retrofitting carbon capture technology;
- propose a suitable area of deep geological storage offshore for the storage of captured CO_2;
- undertake an assessment into the technical and economic feasibility of transporting the captured CO_2 to their proposed storage area.

e) Global CCS Institute

In 2010 the Global CCS Institute, in collaboration with the International Energy Agency (IEA) and Carbon Sequestration Leadership Forum (CSLF), established a definition of Carbon Capture and Storage Ready (CCSR) that provides a list of essential requirements that represent the minimum criteria that should be met before a facility can be considered CCSR. Under the definition, in order for a facility to be considered CCSR, the project developer should:

- carry out a site specific study in sufficient engineering detail to ensure the facility is technically capable of being fully retrofitted for CO_2 capture, using one or more choices of technology which are proven or whose performance can be reliably estimated as being suitable;
- demonstrate that retrofitted capture equipment can be connected to the existing equipment effectively and without an excessive outage period and that there will be sufficient space available to construct and safely operate additional capture and compression facilities;
- identify realistic pipeline or other route(s) to storage of CO_2;
- identify one or more potential storage areas which have been appropriately assessed and found likely to be suitable for safe geological storage of projected full lifetime volumes and rates of captured CO_2;
- identify other known factors, including any additional water requirements that could prevent installation and operation of CO_2 capture, transport and storage, and identify credible ways in which they could be overcome;
- estimate the likely costs of retrofitting capture, transport and storage;
- engage in appropriate public engagement and consideration of health, safety and environmental issues;

- o review CCSR status and report on it periodically.

f) Carbon Capture Readiness for Khanyisa

The requirements for CO_2 capture equipment have been identified and included in the proposal requirements for the IPP bidders to ensure their retrofit in the future. This means that should it become feasible and necessary to incorporate CO_2 capture technology on the proposed power station in the future, this would be possible.

Should CO_2 capture become necessary in the future the IPP would be required to undertake the necessary processes to obtain any relevant permits. At this point it is not possible to say which processes may be required since there is no legislation yet but it is possible that an ESIA process may be required.

International organizations have made very comprehensive progress in terms of how carbon capture and storage should be regulated, monitored, verified and reported- but these proposals need to be carefully assessed under South African legislation. For example:

- How will the CO_2 be classified under South African legislation and are there specific implications of this in terms of how it is handled?
- Who would own the rights to the pore space in the geological reservoirs deep underground (if any are identified)? How would those rights be permitted?
- Who will manage and how will long term liability of storage sites be treated?

Further development in this area is expected to take guidance from developments in the international climate change negotiations, for example, whether and when South Africa could adopt a national emissions cap, the success of various proposed international financing mechanisms and the successful demonstration of sufficient local storage capacity.

g) National Integrated Resource Plan (NIRP) – 2009

In order to understand Anglo American's electrical needs one needs insight into the current electrical status in South Africa today. In this regard the following has reference.

Electricity demand is expected to grow at an average 3,5% over the next five years alongside a recovery in global and national economic performance. There is some uncertainty regarding the timing of the turn around and the extent to which local industry will rebound. The impact of electricity price increases are included in this forecast, allowing for an increase in efficiency as high medium-term increases impact on industrial and other consumption patterns. Demand-side management programmes are also expected to reduce the overall demand growth marginally over this period.

For the purposes of the IRP Eskom is expected to continue with the current build programme of Medupi coal-fired power station (first unit to be commissioned in 2012), Kusile coal-fired power station (first unit commissioned in 2013), Ingula pumped-storage station (to be commissioned in 2013) and the finalisation of the return-to-service programme (RTS) of the previously moth-balled coal-fired power stations. In addition, the Renewable Feed-in Tariff programme (REFIT), Medium Term Power Purchase Programme (MTPPP) and the open-cycle gas turbine (OCGT) and independent power producers (IPP) are expected to provide additional capacity in the medium term.

From the demand side perspective the IRP incorporates known demand side management programmes with expectations of the success of these. Included in these programmes are commercial, industrial and residential programmes totalling a cumulative saving of more than 15TWh by 2019. The least-cost reference expansion plan would provide for the construction of coal-fired power stations to meet the demand over the planning horizon, with an OCGT power station providing peaking energy. This outcome is not surprising given the relatively low direct cost of coal-fired power stations and relatively high domestic reserves of coal to meet future demand.

While the reference plan indicates the least-cost alternative these costs do not include the inherent externalities involved in coal-fired electricity production, in particular growing concerns regarding greenhouse gas emissions as well as a security of supply imperative in diversifying the national energy base.

In the absence of a specific government target on greenhouse gas emissions the Long Term Mitigation Strategy was used to provide firstly, a firm target of emissions in 2025, and secondly, an alternate of a carbon tax as a mechanism to achieve this target. Scenarios were developed around these inputs, allowing for some regional shift in emissions and a potential delay in the implementation of the emission ceiling until 2025.

Additional policy adjustments were included in the proposed IRP after discussions with the Department of Energy. These included allowance for additional DSM projects (such as the million solar water geysers target), a nuclear fleet strategy and the inclusion of hydro capacity from the region. The final policy-adjusted IRP is presented in Table 1-4 below as the IRP that best meets the criteria of cost, emissions, diversity and risk, and the policy requirements of the Department of Energy.

To put the Khanyisa project in perspective, the project will fall under "New Build Options – Coal (PF, FBC, imports, own build)" for which 1000MW has been allocated for 2014-2015 (500MW in each year) as detailed in the IRP.

Table 1-4: Commitments before next IRP

	New build options							
	Coal (PF, FBC, imports, own build)	Nuclear	Import hydro	Gas - CCGT	Peak - OCGT	Wind	CSP	Solar PV
	MW	MW	MW	MW	MW	MW	MW	MW
2010	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	300
2013	0	0	0	0	0	0	0	300
2014	500[1]	0	0	0	0	400	0	300
2015	500[1]	0	0	0	0	400	0	300
2016	0	0	0	0	0	400	100	300
2017	0	0	0	0	0	400	100	300
2018	0	0	0	0	0	400[4]	100[4]	300[4]
2019	250	0	0	237[3]	0	400[4]	100[4]	300[4]
2020	250	0	0	237[3]	0	400	100	300
2021	250	0	0	237[3]	0	400	100	300
2022	250	0	1143[2]	0	805	400	100	300
2023	250	1600	118[2]	0	805	400	100	300
2024	250	1600	283[2]	0	0	800	100	300
2025	250	1600	0	0	805	1600	100	1000
2026	1000	1600	0	0	0	400	0	500
2027	250	0	0	0	0	1600	0	500
2028	1000	1600	0	474	690	0	0	500
2029	250	1600	0	237	805	0	0	1000
2030	1000	0	0	948	0	0	0	1000
TOTAL	6250	9600	2609	2370	3910	8400	1000	8400

Firm commitment necessary now

Final commitment in IRP 2012

1.3. Summary of Authorisations Required

The following is a reference of the environmental approvals required, not all of which will be informed by this process:

Table 1-5: Summary and reference of the environmental legal authorisation or obligation.

No	Legislation	Authorisation required	Responsibility
1	Electricity Regulation Act 4 of 2006	NERSA authorisation	IPP
2	eMalahleni Waste Management By-law	Notify local authority of waste generation Waste contractors must be licensed	IPP
3	Hazardous Substances Act 15 0f 1973	• Authorisation to use radioactive isotopes and spectrometers on site for example flow meters and density meters, if any.	IPP
4	Major Hazard Installation Regulations GN R 692, 30 July 2001	• Notification to Authorities required if the site is an MHI. To be determined following risk assessment.	IPP
5	Minerals and Petroleum Resources Development Act 28 of 2002	• EMPR amendment will be required for infrastructure (power plant, waste dumps, and washing plant) on mining land. • Closure plan may require amendment. • Excising of power plant and washing plant from mining area. • Sterilisation of minerals rights under the power plant.	Anglo American

No	Legislation	Authorisation required	Responsibility
6	ESIA Regulations published in terms of the National Environmental Management Act 107 of 1998	• ESIA for several listed activities Refer to Table 1-1).	Anglo American to transfer to IPP
7	National Environmental Management: Air Quality Act 39 of 2004	• Emissions License for power generation. • Emissions Licence for coal storage.	Anglo American to transfer to IPP
8	National Environmental Management: Waste Act	Waste Management Licenses for: • ash dump • effluent treatment plant • potential site waste storage facilities • Pollution control dams/lagoons	Anglo American to transfer to IPP
9	National Water Act 36 of 1998	• License for the disposal of waste on ash dump Section 21(g) • Registration of Effluent Treatment Plant • Dams with a safety risk needs to be registered (If free water may collect on top of ash dump).	Anglo American to transfer to IPP
10	Roads Ordinance 22 of 1957	• Authorisation from provincial roads agency and publication of change to road network in provincial gazette	Anglo American to transfer to IPP
11	Promotion of Access to Information Act 2 of 2000	• Section 51 Manual needs to be submitted	IPP

1.4. THE ESIA PROCESS TO DATE

The ESIA process is illustrated in Figure 1-2 below. As can be seen, the Application Phase and Scoping Phase have been completed and the ESIA Phase is underway. To date, the ESIA process has unfolded as follows:

- Submission of an Application Form to notify DEA of the project in September 2010. This represents the Initial Application Phase of the ESIA process.
- Distribution of the Background Information Document (BID) to inform Interested and Affected Parties (I&APs) of the proposed project and to invite I&APs to register on the database in November 2010;
- Placement of advertisements in a suite of national, regional and local newspapers to notify the broader public of the initiation of the ESIA and invite them to register as I&APs in November 2010;
- Meeting with key stakeholders (affected landowners, government authorities and Non-Governmental Organisations) in December 2010;
- Compilation and subsequent lodging of the Draft Scoping Report (DSR) in the public domain (eMalahleni public library, various Anglo American Collieries and on the Aurecon websites) in May 2011;
- Placement of adverts in local and regional newspapers to notify the broader public of the availability of the DSR and Open Houses and Public Meetings, as well as written notification of registered I&APs at the same time, in May 2010;
- Hosting a series of Open Houses and Public Meetings where the DSR was presented to I&APs and comments were elicited, in May 2011;
- Compilation of an Issues Trail that recorded all comments, questions and issues raised and the provision of a response to each question raised;
- Finalisation of the Scoping Report in light of I&AP comment and submission to DEA in July 2011; and
- Compilation and subsequent lodging of the Final Scoping Report (FSR) in the public domain (eMalahleni public library, various Anglo American Collieries and on the Aurecon websites) in July 2011;
- Obtaining approval of the Final Scoping Report and Plan of Study for ESIA from DEA in September 2011.
- Placement of adverts in local and regional newspapers to notify the broader public of the availability of the DEIR and Public Meetings, as well as written notification of registered

I&APs at the same time, in November 2011;Finalisation of EIR in light of the I&AP comments, questions and issues raised and the provision of a resonse to each question raised.

- Placement of adverts in local and regional newspapers to notify the broader public of the availability of the FEIR, as well as written notification of the regsiterd I&Aps at the same time, in February 2012.

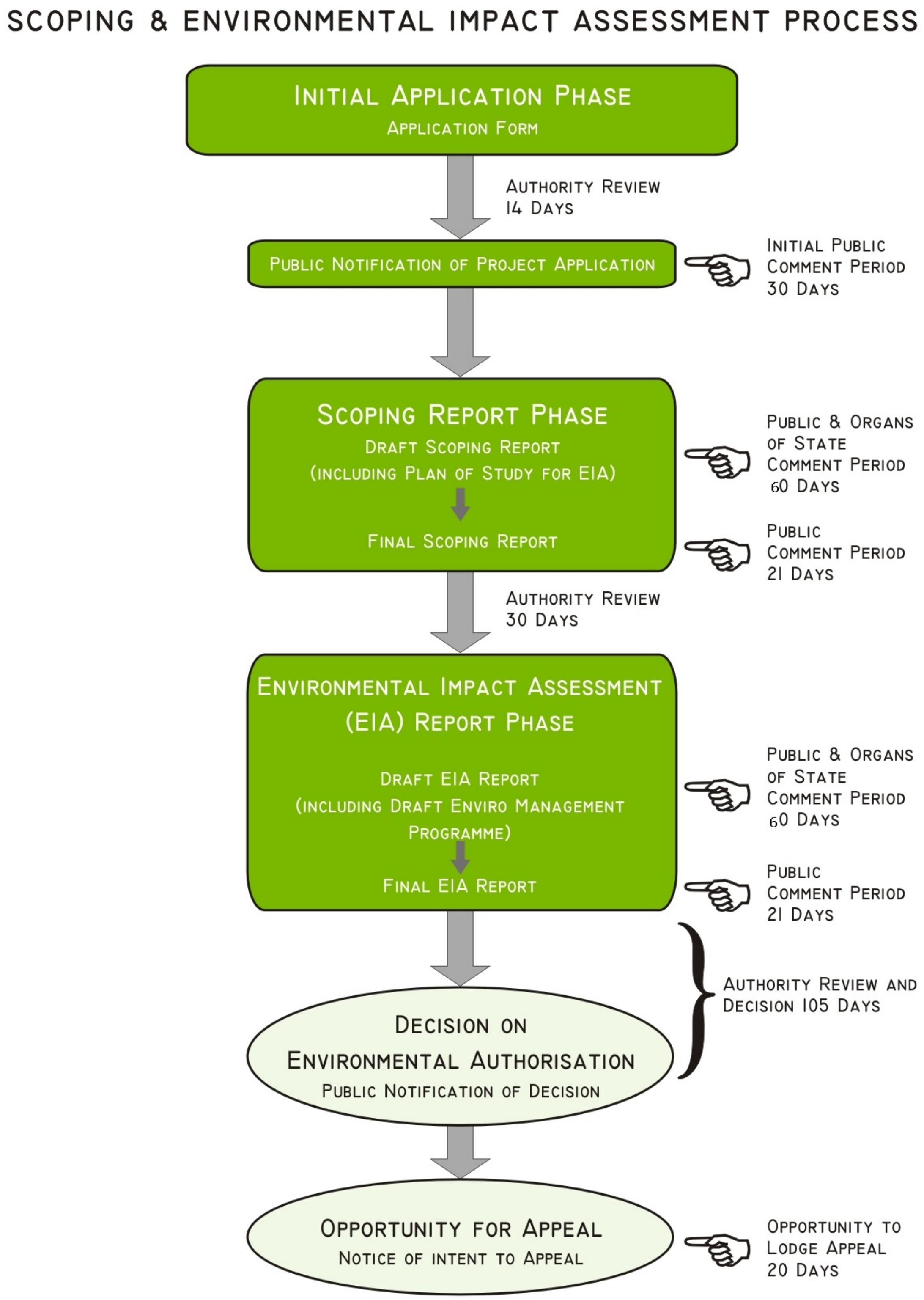

Figure 1-2 A typical ESIA process in terms of NEMA ESIA Regulations

The FSR outlined the full range of potential environmental impacts and feasible project alternatives and how these were derived. Moreover, it included a Plan of Study for ESIA, which outlined the proposed approach to the current ESIA phase, including the requisite specialist investigations to be undertaken. The FSR was received by DEA on 2 August 2011 and approval for the FSR was received on the 9th September 2011.

This ESIA process is informed by the series of national Environmental Guidelines where applicable and relevant:

- Information Series: Scoping (DEAT, 2002)
- Information Series: Stakeholder Engagement (DEAT, 2002)
- Information Series: Specialist Studies (DEAT, 2002)
- Information Series: Impact Significance (DEAT, 2002)
- Information Series: Cumulative Effects Assessment (DEAT, 2002)
- Information Series: Determining Alternatives in ESIA (DEAT, 2004)
- Information Series: Environmental Management Plans (DEAT, 2004)
- Information Series: Socio-Economic Impact Assessment (DEAT, 2004)
- Information Series: Environmental Impact Reporting (DEAT, 2004)
- Guideline 5: Assessment of Alternatives and Impacts in support of the Environmental Impact Assessment Regulations (DEAT, 2006).

1.5. APPROACH TO THE PROJECT

1.5.1. The ESIA Phase

As outlined in the reports produced during the Scoping phase, there are three distinct phases in the ESIA process, as required in terms of NEMA, namely the Initial Application, the Scoping Report and the ESIA phases. Figure 1-2 above summarises the process followed. This Report covers the final phase, viz. the EIR phase.

The purpose of the EIR is to describe and assess the range of feasible alternatives identified during the Scoping process in terms of the potential environmental impacts identified. The ultimate purpose of the ESIA Report is to provide a basis for informed decision making, by both the proponent, with respect to the option they wish to pursue, and the environmental authority regarding the environmental acceptability of the proponents' preferred option.

The approach to the ESIA phase entailed the following:

- Undertaking further review of relevant literature;
- Appointing various specialists to undertake the specialist studies (please refer to **VOLUME 2 - 4** for a copy of all the specialist reports) identified during the Scoping phase, namely:

    - Air quality impact assessment: AirShed Planning Professionals (Pty) Ltd
    - Noise impact assessment: Jongens Keet Associates
    - Visual impact assessment: Visual Resource Management Africa cc
    - Terrestrial ecology assessment Ecorex Consulting Ecologist cc
    - Surface Hydrology assessment: Aurecon (Pty) Ltd – Cape Town Water Unit
    - Geohydrological assessment: Aurecon (Pty) Ltd – Gauteng Water Unit
    - Major Hazard Installation: Riscom (Pty) Ltd
    - Archaeological impact assessment: Kudzala Antiquity (private consultant)
    - Social impact assessment: Ptersa Environmental Management Consultants
    - Land use planning study: Aurecon (Pty) Ltd – Environment & Advisory Unit
    - Traffic assessment: Endecon Ubuntu (Pty) Ltd
    - Land Capability assessment: Earth Science Solutions (Pty) Ltd
    - IWULA: Maleka Environmental Consulting cc
    - Legal Review: Green Gain Consulting

The results of these studies have been used to describe and assess the significance of the identified potential impacts associated with the proposed power station and associated infrastructure. This ESIA Report synthesises the key issues arising out of the specialist studies and the PPP to date, to provide a balanced view of the proposed activities and the implications for the environment.

1.5.2. Environmental Management Programme

The role of the EMP is to assist the power station operator/independent power producer in ensuring that the mitigatory and remedial requirements identified during the environmental process are effectively realised during project implementation. The EMP describes methods and plans used to reduce environmental impacts, as well as to identify indicators to assess with the progress of the EMP.

The EMP will be implemented from site preparation through to decommissioning, closure and post closure. Furthermore, there is a commitment to continuous and progressive rehabilitation as the project advances. In this regard, it is anticipated that monitoring and assessment of the on-going rehabilitation will occur on a regular basis (depending on aspect to be monitored). The EMP will be legally binding and will be used as a tool by contractors, employers, employees and management, to protect the physical and social environment.

Based on the impacts that have been identified in the ESIA section, the EMP outlines mitigation measures which aim to avoid, minimise or mitigate impacts that may be incurred as a result of the project. Where possible, project design alternatives were recommended to reduce the impact to I&AP's and the environment. Monitoring programmes are also outlined where relevant.

1.5.3. Authority Involvement

As indicated earlier, DEA will fulfil the role of the competent environmental authority for this project and will make a decision in light of the information presented in the final ESIA Report. However, given that the sites are located in Mpumalanga province, DEA will work closely with the Mpumalanga Department of Economic Development, Environment and Tourism (MDEDET) in the decision-making process.

There are other authorities who have a commenting role to play in the ESIA process. Their comments on the ESIA Report will help to inform DEA's decision making. These authorities include:

- Provincial Department of Public Works, Roads and Transport;
- Provincial Department of Mineral Resources;
- Provincial Department of Energy;
- South African Heritage Resources Agency;
- Department of Water Affairs;
- Provincial Air Quality Managemen;
- Provincial Pollution and Waste Management;

- Nkangala District Municipality; and
- eMalahleni Local Municipality.

1.5.4. Decision Making

Based on the information gathered during the ESIA Phase (including the specialist studies, the impact assessment, and the PPP) and the comments submitted by the commenting authorities, DEA will issue an Environmental Decision. The decision will either be to authorise the proposed activity (with certain conditions) or reject the application for the proposed activity. In addition DEA has the prerogative to request further information should they believe that insufficient information has been provided on which to base an informed decision.

Following the issuing of the Environmental Authorisation, DEA's decision will be communicated by means of letters to all registered I&AP's and there will be an appeal period within which I&AP's will have an opportunity to appeal to the Minister of Water and Environmental Affairs in terms of NEMA.

1.6. ASSUMPTIONS AND LIMITATIONS

Prior to submission of the scoping report a full Gap Analysis was initiated and carried out. During this analysis any potential gaps in information related to the proposed power station and the subsequent ESIA for the development thereof, were identified. Information deemed absolutely necessary for the successful compilation of the EIR has either been sourced or specialists have been appointed to facilitate the collection of the requisite data.

This Scoping Report presents a list of potential environmental impacts associated with the proposed activities as identified by the collective team, however, it must be noted that the ESIA team acknowledges that the scope of impacts presented in this report could change, should new information become available. The list may evolve due to submissions and recommendations made by registered I&AP's during the Public Participation Process, and therefore the team presents this list of impacts as indicative and not conclusive of potential impacts. The purpose of this section is therefore to highlight gaps in knowledge when the Scoping Report phase of the project was undertaken.

1.6.1. Assumptions

In undertaking this investigation and compiling the ESIA Report, the following has been assumed:

- This project level ESIA deals with a 450MW coal-fired power station in eMalahleni, and is unable to assess the policy level and strategic decision-making processes which led to this project.
- The information provided by the applicant and specialists is accurate and unbiased.
- The scope of this investigation is limited to assessing the environmental impacts associated with the proposed power station and associated infrastructure.
- The site selection process utilised to identify and screen potential sites is acceptable to DEA and the results therefore are considered a defendable starting point for the ESIA process.

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1.6.2. Gaps in Knowledge

This ESIA Report has identified the potential environmental impacts associated with the proposed activities. The purpose of this section is therefore to highlight gaps in knowledge when the ESIA phase of the project was undertaken, namely:

- Anglo American South Africa (AOL) will not construct and/or operate the proposed power station; rather, they have prepared a tender process in order to award the development of the 450 MW power plant to an international developer on an Independent Power Plant (IPP) basis. The project proposal, and hence the ESIA assessment, recognises that there are a number of additional technical solutions that bidders will be able to include in their bids which may differ from what is included within this assessment. However, it is important to note that although Anglo American has not prescribed the detailed design specifications for the project, they have included minimum functional specifications which describe the thresholds within which the plant must deliver which include the latest World Bank/IFC emission standards as well as the Equator Principles. The plant must also have a high thermal efficiency and offer exceptional reliability and availability.
- This ESIA process forms a part of the suite of feasibility studies, and as these studies progress, more information will become available.

- This will require the various authorities, and especially DEA, to issue their comments and ultimately their Environmental Decision, to allow for the type of refinements that typically occur during these feasibility studies and detailed design phase associated with complex projects. Undertaking the ESIA process in parallel with the feasibility study does however have a number of benefits, such as facilitating the incorporation of environmental aspects into the site selection, layout, and design and therefore ultimately encouraging a more environmentally sensitive and sustainable development. Furthermore, refinement of the project in the detailed design phase is unlikely to affect environmental decisions made on the basis of this report.

1.7. INDEPENDENCE

The requirement for independence of the environmental consultant is aimed at reducing the potential for bias during the environmental investigation process. Neither Aurecon nor any of its sub-consultants are employed or related to Anglo American. Furthermore, Aurecon does not have any interests in secondary or downstream developments that may arise out of the authorisation of the proposed project. (Please refer to **ANNEXURE I** for a declaration of independence by the EAP).

1.8. DETAILS OF THE ENVIRONMENTAL ASSESSMENT PRACTITIONER

The project Manager, Mr Iain Garratt as well as the environmental assessment practitioners Mr Steven Henwood and Mrs Leandri Joubert, are appropriately qualified. Mr Lawson is a certified Environmental Assessment Practitioner of South Africa (EAPSA), and is registered as a Professional Natural Scientist with the South African Council for Natural Scientific Professions. Mr Garratt is also a certified Environmental Practitioner of South Africa (EAPSA) and has a Master's Degree in Environmental Management. Consequently Aurecon is bound by the codes of conduct for EAPSA and the South African Council for Natural Scientific Professions. Mr. Steven Henwood and Mrs Leandri Joubert hold the following qualifications. Mr. Henwood - *Nat. Dip. Nature Conservation* and Mrs Joubert .The CV summaries of the key Aurecon staff as well as the key public participation consultants are included in the Plan of Study for ESIA contained in **Chapter 6**.

1.9. CONTEXT AND STRUCTURE OF THIS REPORT

As outlined above, the ESIA process undertaken to date has culminated in the production of a comprehensive Environmental Impact Report, which provides detailed information relevant to the project. However, for the sake of being succinct, information contained within the Scoping Report is not repeated within this ESIA Report unless it has direct bearing on the issues under discussion.

Accordingly, to ensure a holistic understanding of the project, the nature of the activities and the substance of the ESIA process, it is critical that this ESIA Report is read in conjunction with the FSR (Aurecon, 2011).

The structure of this ESIA Report has been informed by the requirements of Regulation 543 of NEMA, to facilitate informed decision making by the proponent and the competent environmental authority. Additionally the ESIA Report contains the following information, as is required in terms of Regulation 31(2) of Regulation 543 of NEMA:

Table 1-6 Requirements of the EIR as outlined in NEMA, Regulations 543

Regulation	Content as required by NEMA	Chapter/Annexure
31 (2) (a)	Details of (i) the EAP who compiled the report; and	Chapter1.7
	Details of (ii) the expertise of the EAP to carry out an environmental impact assessment;	Chapter 1.7
31 (2) (b)	A detailed description of the proposed activity;	Chapter 3
31 (2) (c)	a description of the property on which the activity is to be undertaken and the location of the activity on the property, or if it is –	Chapter 3.1
	(i) a linear activity, a description of the route of the activity; or	Chapters 3.1 and 4.3

Regulation	Content as required by NEMA	Chapter/Annexure
	(ii) an ocean-based activity, the coordinates where the activity is to be undertaken;	N/A
31 (2) (d)	a description of the environment that may 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;	Chapters 6-8 and Volume 2 for specialist reports
31 (2) (e)	details of the public participation process conducted in terms of subregulation (1), including –	Chapter 5
	(i) steps undertaken in accordance with the plan of study;	Chapters 5 and 6
	(ii) a list of persons, organisations and organs of state that were registered as interested and affected parties;	Volume 1, Annexure F
	(iii) a summary of comments received from, and a summary of issues raised by registered interested and affected parties, the date of receipt of these comments and the response of the EAP to those comments; and	Issues Response Report (IRR) Volume 1, Annexure H of the fEIR
	(iv) copies of any representations, objections and comments received from registered interested and affected parties;	Volume 1, Annexure G of fEIR
31 (2) (f)	a description of the need and desirability of the proposed activity	Chapter 2

Regulation	Content as required by NEMA	Chapter/Annexure
31 (2) (g)	A description of the identified potential alternatives to the proposed activity, including advantages and disadvantages that the proposed activity or alternatives may have on the environment and the community that may be affected by the activity;	Chapter 4
31 (2) (h)	An indication of the methodology used in determining significance of potential environmental impacts;	Chapter 6
31 (2) (i)	A description and comparative assessment of all alternatives identified during the environmental impact assessment process;	Chapters 7, 8 and 9
31 (2) (j)	A summary of the findings and recommendations of any specialist report or report on a specialised process;	Chapter 10
31 (2) (k)	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;	Chapters 7, 8 and 9
31 (2) (l)	An assessment of each identified potentially significant impact, including;	Chapters 7, 8 & 9
	(i) cumulative impacts;	
	(ii) the nature of the impact;	
	(iii) the extent and duration of the impact	
	(iv) the probability of the impact occurring;	
	(v) the degree to which the impact can be reversed;	

Regulation	Content as required by NEMA	Chapter/Annexure
	(vi) the degree to which the impact may cause irreplaceable loss of resources; and	
	(vii) the degree to which the impact can be mitigated;	
31 (2) (m)	a description of any assumptions, uncertainties and gaps in knowledge;	Chapter 1.5
31 (2) (n)	A reasoned 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;	Chapter 10.3
31 (2) (o)	an environmental impact statement which contains –	Chapter 10
	(i) a summary of the key findings of the environmental impact assessment; and	Tables 10.2 and 10.3 Summary table of impact significance
	(ii) a comparative assessment of the positive and negative implications of the proposed activity and identified alternatives;	Chapter 10 and Tables 10.2 & 10.3 Summary table of impact significance
31 (2) (p)	a draft environmental management plan that complies with regulation **33**;	Volume 1, Annexure J
31 (2) (q)	copies of any specialist reports and reports on specialised processes complying with regulation **32**; and	Volume 2
31 (2) (r)	any specific information that may be required by the competent authority.	Refer to DEA's letter of acceptance of the POS for ESIA in Volume 1, Annexure D

This ESIA Report is structured as follows:

Chapter One:	Provides the introduction, legislative framework and details of the ESIA process
Chapter Two:	Provides strategic overview of the electricity demand in South Africa (the need for the project) and contextualises the need for the project.
Chapter Three:	Describes the project proposal, including alternatives and identified impacts
Chapter Four	Describes the project location and components
Chapter Five:	Describes the public participation process
Chapter Six:	Describes the assessment methodology
Chapter Seven:	Discusses and assesses the identified potential impacts and mitigation measures of the Operational Phase
Chapter Eight:	Discusses and assesses the identified potential impacts and mitigation measures of the Construction Phase
Chapter Nine:	Discusses and assesses the identified potential impacts and mitigation measures of the Decomissioning Phase
Chapter Ten:	Concludes the report, provides recommendations and describes the way forward

2. NEED AND DESIRABILITY

2.1. OVERVIEW OF SOUTH AFRICAN POWER SECTOR

Strong economic growth in South Africa (4.1% per annum over the decade 1999 – 2008) drove strong electricity demand, as electricity prices remained amongst the lowest in the world. In November 2007, electricity supply disruptions started affecting RSA. The intensity and frequency of these interruptions increased in early 2008 and, in January 2008, Eskom announced that it lacked the spare capacity to meet peak demand. Eskom instituted a brown-out policy. It is reported by Eskom that its reserve margin was as low as 5% in January 2008, although this improved to about 14% in January 2009.

2.1.1. ESKOM

Eskom is South Africa's monopoly electricity utility. It owns and operates most of South Africa's approx. 45 GW of installed capacity. Peak demand in South Africa is around 39GW (according to the draft IRP2010). Coal currently accounts for around 85% of the electricity energy mix. According to the draft IRP2010, South Africa requires approx. 41 GW of new capacity by 2030.

Historically, Eskom's tariffs have been amongst the lowest in the world and over the past two decades have increased at less than inflation. When Eskom applied for its MYPD2 tariff increases in 2009, NERSA awarded a c.25% p.a. increase for the 3 years of the MYPD2 tariff. Note that Eskom had requested a c.45% per annum increase (under its preferred increase structure), followed by an amended application of c.35% per annum effective increase. In addition, Eskom's Financial Director has stated in Parliament that it requires at least a further two 25% p.a. increases followed by at least inflationary increases. The recently released draft IRP2010 energy plan points towards more above-inflation increases until at least 2021.

2.1.2. Supply / Demand Analysis - IRP2010

The IRP is a rolling 20-year electricity plan to secure SA's energy future. The IRP2010 is an initial scenario analysis undertaken to inform stakeholders and interested parties ahead of a public consultation process in December 2010 to determine the final IRP2010. The draft

IRP2010 shows that South Africa's electricity tariff path will undergo real increases until at least 2021, resulting in a significantly higher tariff path than previously expected.

IRP2010 aims to clarify the future of South Africa's electricity landscape, including the estimate of an additional 41 GW of new capacity required by 2030. Tariffs are expected to rise sharply to ensure cost recovery and to fund this new capacity. Private sector participation has been identified as the preferred vehicle to deliver on the required new build programme, though all regulatory challenges have not yet been fully resolved.

Electricity sector reforms – the introduction of IPPs
Over the past decade, there has been increasing support from most public stakeholders and society for greater private sector participation in the SA power sector. Although some progress has been made, the development of a supporting regulatory framework has lagged this support.

The required "wheeling" (use of transmission and distribution network systems by third parties) framework and the risks facing the Khanyisa IPP and Anglo American are dependent on many of the decisions undertaken as part of this overall reform process. In particular, the identification of separate cost allocation between the GX, TX and DX divisions of Eskom in order to establish transparent use of system tariffs, as well as the finalisation of a transparent grid code governing third party connection, where appropriate. On-going use of system discussions between the Energy Intensive User Group (EIUG) and individual companies, such as Anglo American, and the Government stakeholders (Eskom, DoE, and National Treasury) is rapidly progressing this framework. The potential for shortfalls as highlighted under the IRP2010 has injected greater urgency to resolve outstanding issues and support planned own-build projects such as the Khanyisa IPP.

2.2. PROJECT MOTIVATION

Electricity demand in RSA is fast outstripping supply and the lack of major investments in new electricity GX over the past few years raises the concern that RSA will not be able to meet its future energy demands. Eskom's reserve margin was as low as 5% in January 2008, although it improved to about 14% in January 2009, which is still considered very low by international standards and the reserve margin is expected to fall further. The reserve margin is biased towards very expensive peaking power plants, which is not a cost effective buffer for the country. There is a risk that Eskom will not be able to ensure long-term stability of supply due to the sheer scale of the investment needed (ZAR 693bn / USD92 bn will need to be invested by 2016/17) which almost certainly confirms that the time and place for IPPs and self-supply has arrived in RSA.

This Project carries huge value for Anglo American in addressing the security of supply objectives, noting the severe impact that might result from Eskom's inability to meet demand. Simply put, with security of supply, Anglo American Offtaker can hedge against many of the implications of load shedding. For instance, Anglo American can be more certain of capacity and thus forecasted production and earnings. This, in turn, will assist Anglo American in retaining current staff as, if operations are required to be shut down or permitted at far reduced capacity, there is a real risk that jobs will be lost.

Considering that Anglo American will also expand certain operations over time, this security of supply may provide additional confidence in their ability to operate the facilities according to their expectations and strategies and to not be susceptible to the impact of national supply demand disparity to the full extent. Further, Anglo American is in a position to achieve asset optimisation by utilising discard coal as a fuel source for the IPP.

Starting in November 2007, supply shortages of electricity resulted in supply disruptions in RSA. The intensity and frequency of these interruptions increased in early 2008 and on January 24 2008 Eskom announced that it lacked the spare capacity to meet peak demand and appealed to electricity users to lower demand to prevent a total collapse of the electricity system. Eskom also implemented a policy of shutting-down electricity supply to certain parts of the country on a rotational basis.

The idea of introducing Independent Power Producers (IPPs) has been a longstanding debate and traditionally it was argued that IPPs would result in higher energy costs compared to Eskom's own GX. The argument used is that the private sector requires higher returns than state-owned enterprises. While this price disparity may have been the case in the past, ironically the cost of new-build to Eskom is proving that IPPs could actually be a more cost-effective / less expensive option relative to Eskom's new-build programme (NBP). According to Eskom, the Medupi and Kusile plants are expected to cost ZAR 125 bn (USD16.5bn) and ZAR 145 bn (USD19bn) respectively – each with a gross rated capacity of 4,800MW (but net capacity of 4.4GW and 4.3GW respectively). At USD3.5mn and USD4mn per gross MW respectively, these plants will become the benchmark for comparison for both base-load and Renewable Energy IPPs in South Africa.

There is a risk that Eskom will not be able to ensure long-term stability of supply due to the sheer scale of the investment needed (ZAR 693 bn (USD92bn) which will need to be invested by 2016/17, noting that further delays to these projects will result in still increased Interest during Construction costs). In his presentation on 4 May 2010, to the DPE Portfolio Committee, the FD of Eskom indicated that Eskom is facing a ZAR190bn (USD25bn) funding shortfall over the same period, notwithstanding Eskom’s assumed base tariffs of ZAR1.09 kWh by 2015,which almost certainly confirms that the time and place for IPPs and self-supply has arrived in RSA. From a regional perspective, the power shortages in RSA have resulted in a spill-over effect on its immediate neighbours with countries like Botswana, Namibia and Zimbabwe feeling the effects the most. One of the consequences of this is that IPPs are being fast-tracked in these countries to ensure that when the Eskom supply contracts from RSA come to an end, these countries do not find themselves facing electricity shortages.

3. ALTERNATIVES CONSIDERED

A requirement of NEMA is the due consideration of reasonable and feasible alternatives. Not all alternatives need to be investigated in the same level of detail, and the assessment is typically dependent upon the nature of the proposed project. Therefore all potential alternatives were identified and screened in the Scoping Phase to derive a list of feasible alternatives. Potential alternatives identified in the Scoping Report included activity alternatives, location alternatives, process alternatives, power line route alternatives, ash disposal alternatives, ash transportation alternatives, site layout alternatives and access road alignment alternatives.

The purpose of this section of the report is to provide an overview of the alternatives identified for the proposed project which are addressed in the ESIA Report. Note that activity alternatives, though not proposed for further assessment, were evaluated in the scoping report and therefore only a brief contextualising reference is provided in this section.

3.1. ACTIVITY ALTERNATIVES

DEA defines an alternative as "A possible course of action, in place of another, that would meet the same purpose and need' (DEAT, 2004). The purpose of the proposed project is to provide base load power to Anglo American operations to ensure availability of electricity for its operations. The intention is to contract a third party (IPP) to construct and operate the power station which will be fuelled by coal discard. The electricity generated from the power plant will be sold exclusively to AOL and transmitted to various sites through the Eskom network. The power station will contribute to relieving the National/Eskom generation capacity shortages and will also enable Anglo American to continue production when power rationing is implemented due to capacity shortages. The project is critical to future investment in the mining industry in South Africa and the concomitant creation of jobs. It is therefore critical to bear the need for the project in mind, when considering reasonable and feasible activity alternatives.

3.1.1. Renewable and Other Energy Alternatives

A number of renewable energy alternatives exist for the generation of electricity. These include solar (including solar panels and concentrated solar power (CSP)), wind and hydro power, amongst others.

Some renewable technologies such as hydro are base load if there is a sufficient and constant flow of water, however these are not considered to be feasible alternatives in the South African context. South Africa is a water scarce country and hence does not have large rivers required to harness this energy source.

CSP at this stage is a new technology. Parabolic trough CSP is a commercially operated plant and has relatively low load factors. Eskom has elected to demonstrate the CSP Central Receiver technology in the Northern Cape which has the potential for longer storage and therefore higher load factors. CSP is not a mature technology and at most can be considered only for future proposals.

Wind farms operate at an annual generation load factor of 20 to 30 %, in comparison to coal-fired power stations, which can achieve annual generation load factors of up to 90 %. The amount of installed capacity would therefore have to be significantly greater, to meet the same need as the proposed coal-fired power stations, to compensate for the low load factors. Furthermore, given the variability in the operation of a wind facility, significant electricity storage facilities would be required to meet the base load demand of commerce and industry. Although studies are being undertaken to develop storage mechanisms for wind energy (e.g. compressed air, pumped storage) these are only at a research level and have not yet reached a commercially feasible level. Therefore, at present, wind energy cannot be relied on for base load supply.

Solar panels only operate during daylight hours and hence also have a very low load factor. Furthermore the same problem of storage mechanisms is experienced as with wind.

Though not a renewable energy, but a cleaner energy than coal, there is progress towards pursuing Integrated Coal Gasification Combined Cycle (IGCC) technology by exploring Underground Coal Gasification (UCG) coupled with a combined cycle plant, which is effectively UCG-IGCC.

A study conducted by Electric Power Research Institute "Clean coal technology roadmap for South Africa" suggests that the IGCC option will be at technological maturity and based on cost will become one of the primary choices only starting from the period of 2020-2025. However, within the South African context, the coal quality application needs to be critically assessed based on high ash content impact on gasifier technology. Entrained flow gasifiers are potentially a technology option to address the high ash coal issues, however further research and tracking of technology maturity needs to be conducted.

It is therefore necessary to include coal and nuclear technologies in order to provide base load energy as well as to provide sufficient energy to meet future projected demands (the predicted growth in demand will require an additional 20 GW of power by 2025, assuming an average annual economic growth of 4 %, a portion of which may need to come from coal technology).

For the purposes of this project-specific environmental assessment process, the evaluation of alternative technologies like those considered above is neither reasonable nor feasible.

With respect to energy efficiency and conservation, the Government and Eskom are placing a significant emphasis on the Power Conservation Program, which aims to achieve a 10 % reduction in electricity usage. Energy efficiency and conservation is a critical aspect of energy planning and development in South Africa. However it is not considered an alternative, but rather an activity that must and will happen in parallel with other developments. A successful demand side management programme will delay the need for the next power station.

3.1.2. Energy Mix Planning

With respect to energy planning, a number of planning documents have been compiled by the relevant Ministries, NERSA and Eskom as described in Chapter 3. These include the IEP, NIRP, ISEP and the IRP. This has been developed in order to identify sustainable solutions for future electricity provision in South Africa. These documents conclude that coal will remain a major fuel for generating electricity over the next 20 years and that additional energy generation activities has been required since 2007.

In this regard Eskom is currently researching and commissioning a number of alternative electricity sources including coal, hydro, nuclear, natural gas, liquid fuels, renewable technologies and power purchases from neighbouring countries. These policies, apart from Eskom's ISEP, were subject to public participation, and therefore were subjected to an open and transparent process.

The IRP which is currently being developed describes the approach to selecting different technologies and includes coal-fired power stations as a base load option. More information can be obtained from the DoE website (http://www.doe-irp.co.za/) as the IRP is updated.

3.1.3. Conclusion

The test of reasonableness and feasibility must be factored into the consideration of alternatives, as noted in Regulation 31(2)(g) of the NEMA ESIA Regulations. As such the activities considered in this Section (described above) cannot be presented as alternatives to the proposed project as they are not considered to be reasonable and feasible in the present circumstances. Furthermore, a range of high-level policy and planning work took place prior to the commencement of the ESIA process, the purpose of which was to set the strategic planning and guidance to ensure electricity supply for the Anglo American's operations.

3.2. SITE LOCATION ALTERNATIVES

Site selection is a complicated and multi-faceted issue which is essential to the success of this application and ultimately to the proper, responsible and sustainable operation of the proposed power station

This project will require a larger than normal site due to the higher than normal ash and sulphur content of the fuel. Based on typical values and assumptions for a power station the following site sizes would appear to be necessary:

Table 3-1: Typical Total Land Requirements in Hectares (ha) for the Discard IPP Plant Size Scenarios based on 60% Ash and 4% Sulphur Coal

	300 MW	450 MW	600 MW
Size of power island (the generating equipment and ancillary buildings)	17 ha	21 ha	24.4 ha
Ash Yard (25 years storage)	93 ha	140 ha	186 ha
Coal Yard (15 days storage)	3.7 ha	4.5 ha	5.3 ha
Temporary Construction Area	26 ha	31.5 ha	36.6 ha
Total Land Area Required	140 ha	197 ha	252 ha

However, due to extensive undermining it has not proved possible to identify 197 hectares of geotechnically stable land in a single block in the Witbank area. Therefore the site selection study has concentrated on securing a geotechnically stable site for the power island with suitable land adjacent which could be used for coal storage, temporary area during plant construction and ash disposal.

3.2.1. Power Station

Once the need for the new coal-fired power stations was established, Anglo American undertook a process to identify suitable areas within their current mining operations. The initial selection process identified 6 candidate sites (Figure 4.1 below) based on size and proximity to the discard coal dumps.

The proposed siting options for the plant were evaluated against key aspects necessary for the proper, feasible and responsible functioning of the facility. Due to the disturbed nature of the site environmental sensitivities (factors) were not relevant, therefore, the key aspects include the following:

- sufficiently large size with contiguous construction area,
- reasonable and known ground conditions,
- generally flat,
- currently unused/greenfield,
- uncontaminated,
- a single entity with no services passing over, through or beneath,

- simple access and egress,
- secure site,
- control can be completely passed to the IPP, and
- good access to services such as telephone, water, road and electricity.

It is also important that the construction workforce be accommodated locally.

As can be seen from Table 3-1 the dominant factor in the land area requirements is the area required for ash disposal. MM estimates that a 450MW plant, using discard coal, would produce approximately 35 million tonnes of ash and 20 million tonnes of gypsum and unreacted limestone over 25 years depending upon load factor, fuel quality, sulphur content of the coal and the limestone quality.

These figures have been produced assuming the worst likely fuel and limestone quality, plus a 100% despatch factor for the plant (that is the plant operates at full output at all times when it is available to generate electricity).

After evaluating the 6 sites the technical advisors (MM) concluded that all the sites considered (Sites 1 to 6) are to varying degrees compromised by undermining, and that treatment options will prove too complex or expensive to make them a practical option for an IPP. The technical advisors proposed a range of foundation treatments which are available for geotechnically unstable areas such as raft foundations and ground stabilisation. A desktop analysis of two foundation treatment options was undertaken:

Option 1 - Completely fill the mine workings by installing a perimeter barrier and then filling with a grout slurry designed to spread out and fill the mine.

Option 2 - Aim for partial filling only which essentially adds support to the existing pillars using grouting cones.

An initial cost estimate of these two options has been developed based on the assumption that a minimal area is stabilised beneath the location of the power island and that the mine seam is 7m thick and the remaining pillars occupy approximately 60% of the volume of the mine workings.

A summary of the calculations is presented in the tables below.

Table 3-2: Cost estimate for the two proposed ground stabilisation options

Cost Estimate for Option 1 - Grout fill of mine volume	
Site Area Required for 300 MW Power Island	17 ha
Seam Thickness	7 m
Percentage of Mine Working Volume Occupied by Pillars	60 %
Volume to be Grouted	476,000 m3
Cost of Grouting	2,500 ZAR/m3
Total Cost of Grouting	ZAR 1,190 million ($ 153.6 million)
Cost Estimate for Option 2 – Pillar support using grouting cones	
Site Area Required for 300 MW Power Island	17 Hectares
Grouting Grid	12 m
Seam Thickness	7 m
Percentage of Mine Working Volume Occupied by Pillars	60 %
Percentage of Pillars to Support	75 %
Volume to be Grouted	357,000 m3
Cost of Grouting	1,200 ZAR/m3
Total Cost of Grouting	ZAR 428.4 million ($ 55.3 million)

As can be seen from the analysis the cost of the full fill grout is estimated to be approximately ZAR 1.2 billion and the cone grout fill is estimated to cost ZAR 428 million.

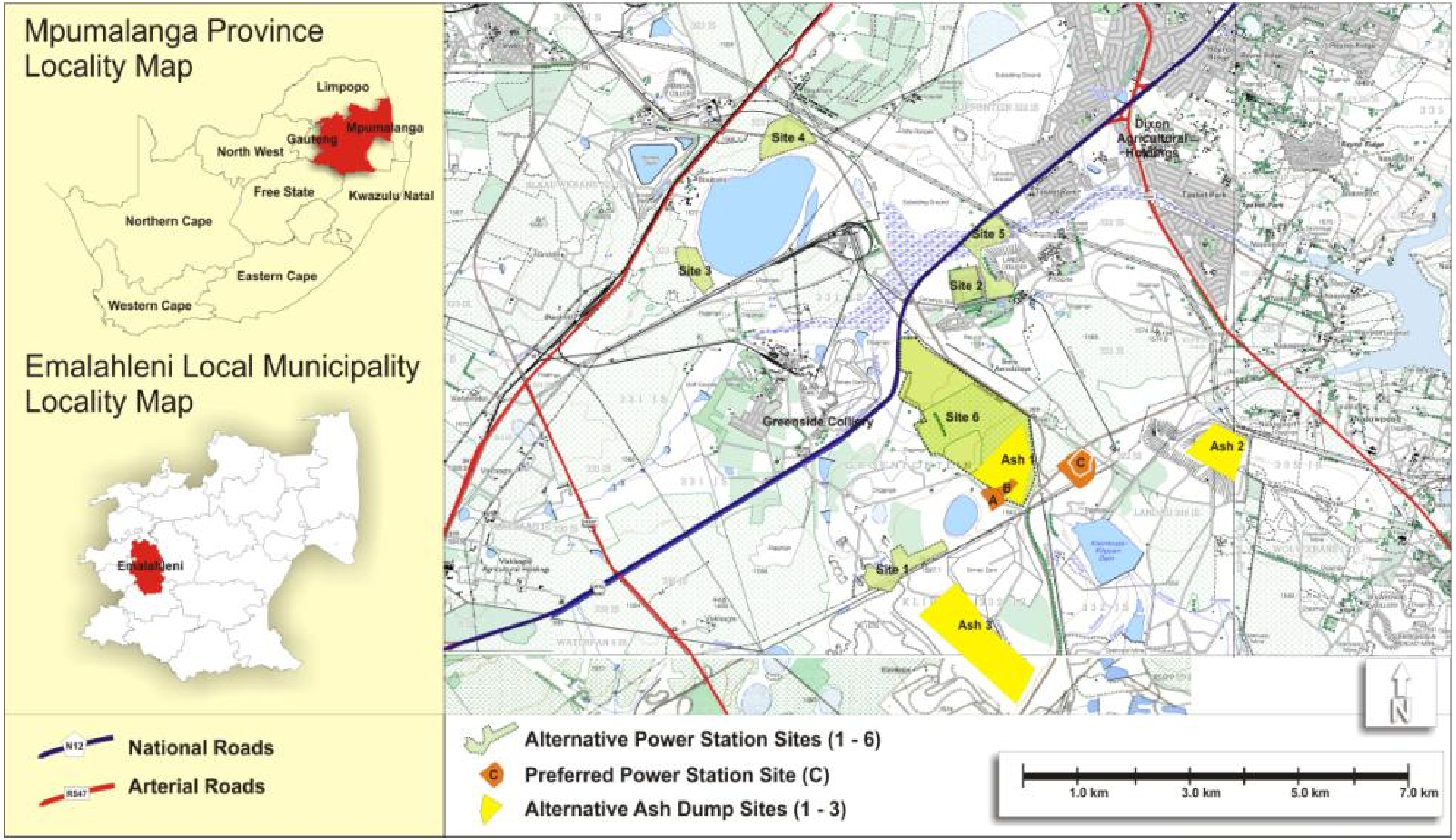

Figure 3-1: Locality of 6 potential power station sites

It is possible these costs could be reduced by more targeted grouting and better information on the assumptions. However, cone grouting would require detailed knowledge of the underground workings and some analytical models to be developed to ensure adequate support. It is also assumed that the loads from the structure are not going to affect the roof stability. This may introduce delays into the project programme.

Although Option 2 is cheaper it demonstrates that ground treatment works are still very expensive and therefore, the option to locate the power island on undermined areas has been rejected.

Only Site 6C is sufficiently large enough to accommodate the power station island without undermining and is therefore proposed as the only site option (preferred option).

3.2.2. Ash Disposal Site

Three site alternatives were identified for the ash waste disposal site, indicated in Figure 4.2 (below) as Ash 1, 2 and 3 respectively. During the initial feasibility investigations AOL proposed the use of rehabilitated open cast mine workings because this option has the advantage of sites which are both proximal and brownfield land areas, and hence more suitable from an environmental sensitivity perspective. The three sites were evaluated by MM from a technical perspective, and all the specialists within the environmental assessment team from an environmental perspective.

In terms of the Minimum Requirements for Waste Disposal by Landfill (MR) (DWAF, 1998b), there are several criteria that must be applied to consideration of site selection including:

- Areas in proximity to significant surface water bodies;
- Sensitive ecological and/or historical areas;
- Catchment areas for important water resources such as dams;
- Areas overlying or adjacent to important or potentially important aquifers;
- Areas overlying or adjacent to major fault zones;
- Areas with highly permeable soils;
- Areas associated with steep slopes; and
- An area in close proximity to land uses which are incompatible with waste disposal.

With regards to the proposed waste sites, none are near to significant surface water bodies[1], sensitive ecological and/or historical areas, steep slopes, highly permeable soils, land uses which are incompatible with waste disposal or in areas important for water resources such as dams, overlying or adjacent to important or potentially important aquifers, or overlying or adjacent to major fault zones.

The following factors, which are a combination of biophysical, economic and social criteria, were applied as the basis for evaluating the suitability of the three proposed ash sites:

- Geotechnical stability
- Size
- Proximity to the ash source
- Biophysical sensitivity of the site
- Visual impact on surrounding landscape

a) Ash Option 1

The presence of mine workings below Ash Site 1 introduces the potential risk of subsidence occurring in the future. The extent, nature and distribution of this subsidence is likely to be governed by the condition of the mine workings and the structure of the overlying rock and is therefore likely to be unpredictable. Any subsidence within the ash storage area is likely to result in differential settlement which is likely to disrupt any impermeable membrane below the storage area.

b) Ash Option 2

Site 2 is an existing, operating open cast mine which was initially investigated because it was assumed that the life of mine was nearing finality. However, discussions with the relevant mine managers indicated that the life of mine may be extended, and therefore this sites availability is uncertain. Furthermore, site 2 abuts a farming community that is very opposed to this site being proposed as a potential ash disposal site.

[1] Note that a small pan is a minimum of 100 m away, the minimum buffer width recommended by the hydrologist,

c) Ash Option 3

Ash site is a former opencast site which has since been rehabilitated and backfilled with opencast material from the excavation, with a maximum depth of approximately 25m to 35m. It is currently covered with long grass and has historically been utilised for agricultural production, or utilised as livestock grazing lands since having been extensively mined.
The proposed ash disposal area is approximately 3500m long and 600m wide, which is approximately 2,100,00m² (210 hectares) in size.

Having evaluated the three sites against the criteria described above, ash site three was identified as the preferred alternative on the following basis;

- Geotechnically stable basal subgrade. The proposed site is a rehabilitated opencast quarry, with no possibility of future undermining at the site. The rehabilitation was undertaken at least fifteen years ago;
- The area is large enough to receive a large volume of ash. The ash dump is relatively flat and expands 600m by 3500m, providing enough space to receive the projected ash for at least twenty five years. The material on site can potentially be used as cover material during the operation of the landfill;
- Proximity to the source of ash. The proposed site for the ash dump is located ± 2.7 km south-west of the power station site. Its proximity to the power station reduces the environmental risk during transportation of ash and also reduces operational costs;
- Utilisation of brownfield site. The site is a former mining site, which has been rehabilitated. Being located within the coal mining field area, it is not likely to be used for any other meaningful development purposes. As such, development of an ash dump is appropriate given the historic and current mining related land uses surrounding the site; and
- The proposed development will cause minor visual disturbance to the surrounding landscape, as the location of the proposed ash disposal site is dominated by mining activities and as such is not aesthetic in nature and not deemed sensitive to visual impact.

On this basis, Ash 3 (Former Opencast site) has been selected as the preferred alternative.

Conceptual design reports and preliminary designs for the proposed waste site have been compiled by MM (Thermal Coal Ash Disposal Liner –Feasibility Study, June 2011) and is attached as **VOLUME 4.**

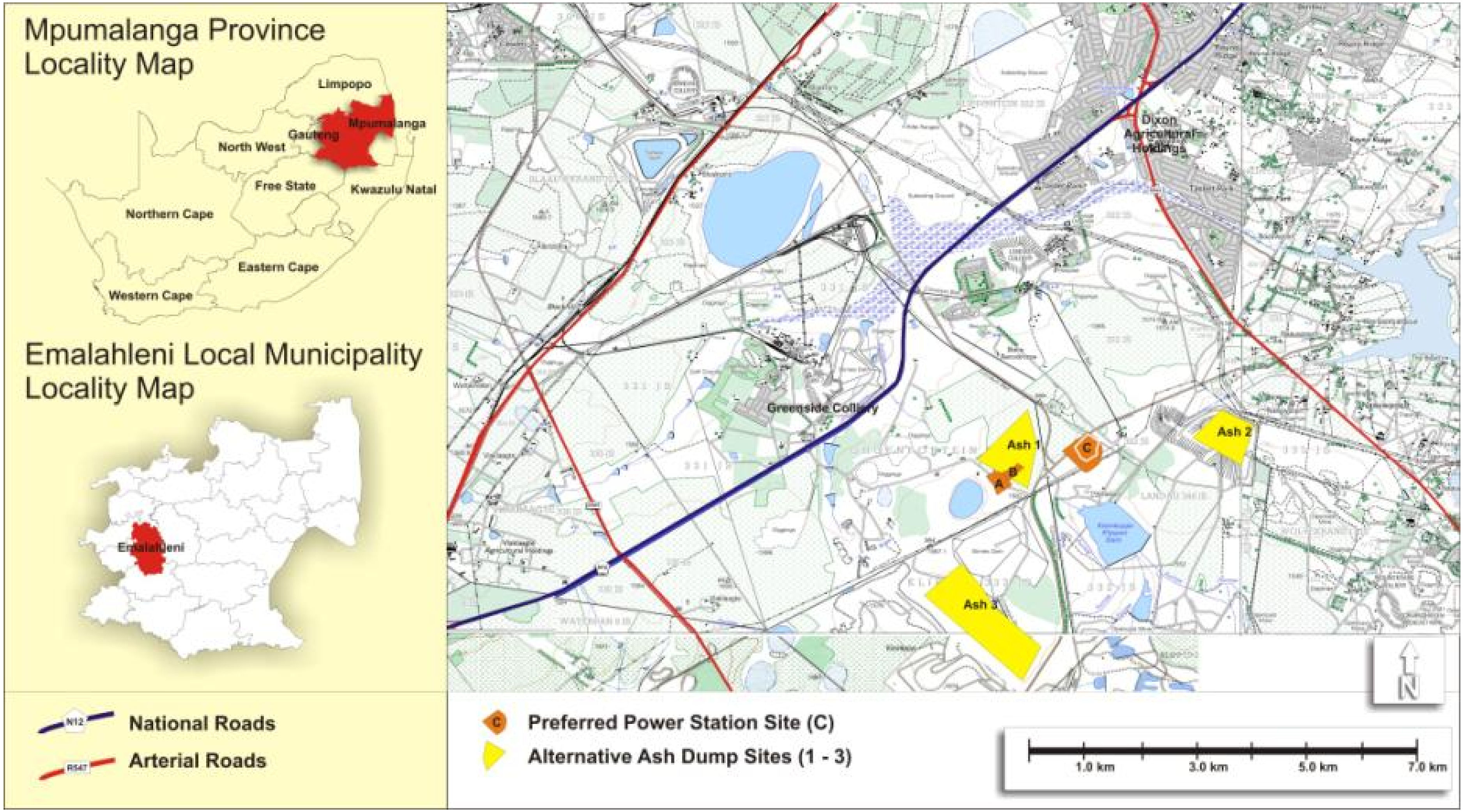

Figure 3-2: Locality of 3 potential ash dump sites

3.3. POWERLINE ROUTE ALTERNATIVES

AOL and MM initiated the process of an application for an interconnection with Eskom and the substation and line plans are at an advanced stage. Given the location of Site 6C, MM initially made a working assumption that the power will be evacuated by way of the adjacent 400 kV transmission lines. Eskom have since confirmed that this 400 kV line is unavailable for power evacuation and have proposed the following two power evacuation options:

- **Alternative 1** – will exit the power station site on its north-western tip and run north-west for a short period before turning north –east. It is anticipated that the line will run for approximately 3.25 km before linking into the existing Duvha – Matla line.
- **Alternative 2** – will exit the power station precinct close to its north-eastern tip and run north-east for about 1.5 km before turning slightly further to the east and terminating at the existing Duvha – Matla line.

The specialist studies indicated that there is little difference in the sensitivity index (loss of agricultural land, impact on avian fauna and visual impact) of the two proposed transmission line routes, since both routes occur in the same quarter-degree grid and cross similar habitat. However, Option 2 does lie closer to, and along similar alignments to existing transmission lines and would thus be less of an impact than Option 1.

Option 2 is thus the preferred route alternative.

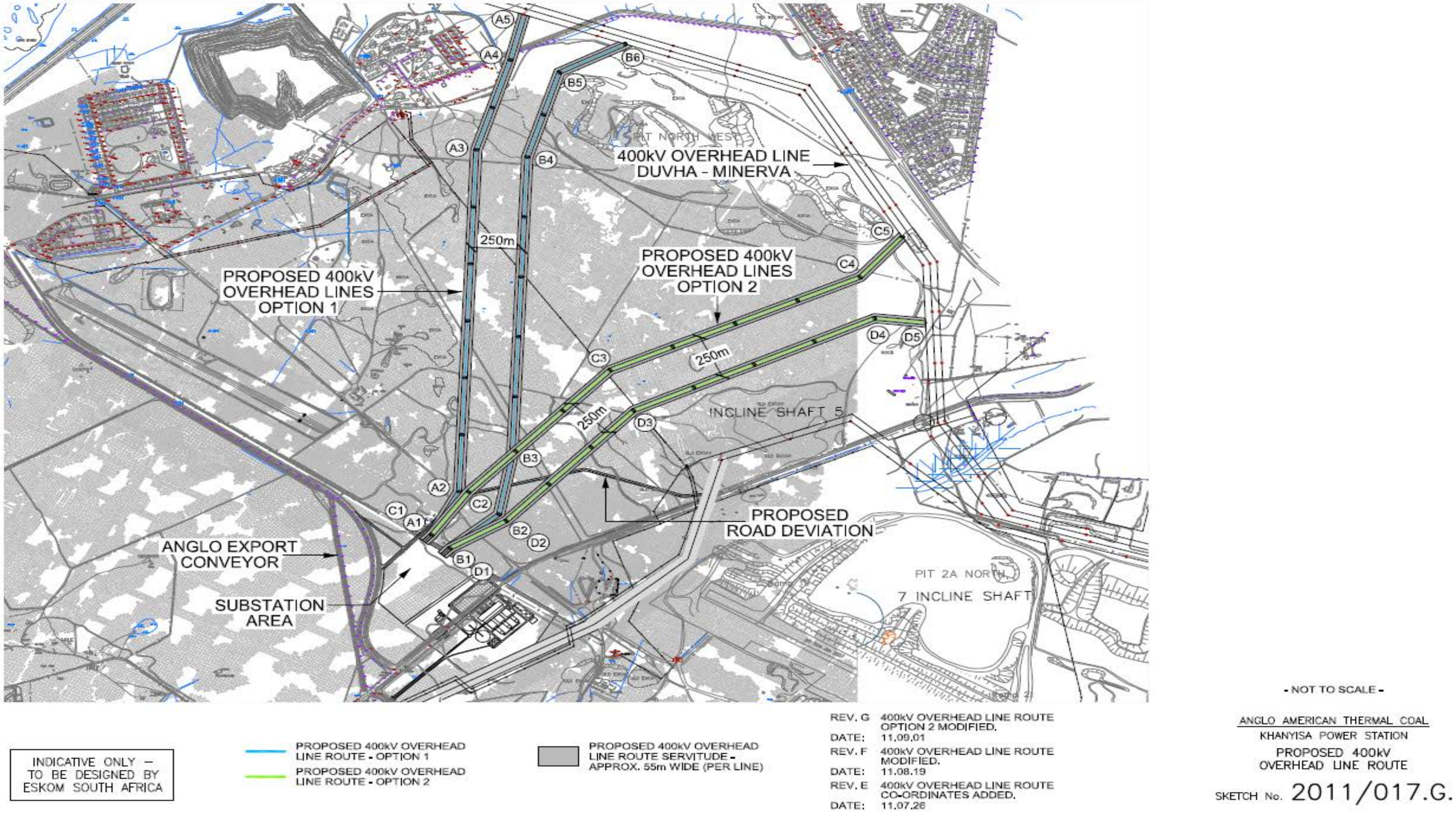

Figure 3-3: Locality and route map for the power line alternatives

3.4. PROCESS ALTERNATIVES

Process alternatives relate to alternative technologies that could be implemented at the new coal-fired power station, and include combustion, cooling and atmospheric emission control technology alternatives and ash disposal alternatives. Each of these is discussed below.

3.4.1. Combustion Technology Alternatives

There are a suite of combustion technology options potentially available for the proposed coal-fired power station. Anglo American is proposing to utilise fluidised bed combustion (FBC) boiler technology. This and other potential combustion technologies are described below.

a) Fluidised Bed Combustion Boiler (Preferred Alternative)

A fluidised bed is a layer of solid particles kept in turbulent motion by bubbles of air being forced into the bed from below, to which coal is then added and burned. The velocity of the air is sufficient to cause the fuel and bed material particles to become entrained and flow up the furnace. The "fluidised bed" creates an effective heat transfer environment promoting rapid combustion. Heat transfer to the water and steam in the tubes takes place from the hot solids and gases. Using a limestone bed can capture the sulphur in the coal to produce calcium sulphate as a waste product. As the bed operates at less than 900ºC, thermal nitrogen oxide emissions are reduced.

This technology has been available for some years with a number of units throughout the world. However this technology is internationally unproven in unit sizes greater than 300 MW. To obtain the economies of scale required for this project, the individual station unit sizes need to be between 150 MW and 300 MW.

One of the primary motivations for proposing Circulating Fluidised Bed (CFB) technology is due to the relatively low quality of the discard coal, which has both a high ash content (around 50%) and high sulphur content (2 to 3%). CFB technology has the advantage of being able to burn coals with a wide range of properties and can cope with high ash and high sulphur coals as proposed for this power project.
The removal of sulphur from the coal during the combustion process is achieved in CFB boilers by the addition of limestone which acts as a sorbent. The sulphur becomes bound to the

limestone enabling its removal and disposal. Additionally, the lower combustion temperatures of the CFB boiler result in lower emissions of nitrogen oxide (NOx) by reducing the production of thermal NOx within the furnace.

This technology is thus the preferred technology alternative.

b) Pulverised fuel combustion boiler

With pulverised fuel combustion technology, the coal is first pulverised into a very fine dust, and then blown into the boiler where it is burned much in the manner of a combustible gas.

Due to the large costs involved in sourcing coal for fuel as well as the relatively large carbon foot print created by utilising this method, the pulverised fuel combustion boiler technology will not be considered and therefore is not evaluated in this report.

c) Coal gasification technologies

Coal gasification involves the creation of a combustible synthesis gas (syngas) through the partial oxidisation of coal. The syngas can then be used as fuel for power generation or other applications. Integrated coal gasification combined cycle (IGCC) power plants and underground coal gasification (UCG) are two such technologies.

IGCC power plants convert the coal to gas and then burn the gas to create electricity. UCG technology partially oxidises the coal in situ before the syngas is extracted and co-fired with coal to generate electricity. Eskom has established a UCG demonstration plant at the Majuba power station and the gas that is currently produced is being flared. Eskom is investigating the up scaling of the demonstration plant and the development of a commercial plant. However, neither of these technologies is commercially proven for a plant of the desired magnitude (i.e. 450 MW units).

Based on the above, coal gasification technology is not considered to be a viable option for this power station, and accordingly will not be considered further in this ESIA.

3.4.2. Cooling Technology Alternatives

As mentioned earlier in this document the steam used to drive the turbine has to be condensed back into water on exiting of the turbine to enable the thermodynamic cycle to repeat itself. A primary (main) cooling process is required to facilitate the condensation of steam in the circuit.

Cooling options include wet cooling, and direct or indirect dry cooling, and are explained below. Note that FGD is not included in the description of the cooling options below. FGD would increase the water consumption of the power station and has therefore been eliminated as a feasible alternative.

a) Indirect Dry Cooling

An indirect dry-cooling system works similarly to the wet-cooled system, with the primary difference being that the heat is dissipated in the cooling towers via water-to-air heat exchangers, rather than evaporation of the cooling water. Dry cooling uses approximately < 0.2 l of water per kWh sent out. A significant advantage of dry-cooling technology is the conservation of water, which is critical in a semi-arid country like South Africa.

Another advantage is the lack of wet plumes (steam) from the cooling towers. However, with dry-cooling, the turbine output deteriorates significantly at higher ambient temperatures, decreasing the amount of energy sent out of the process. A reduction of 60 MW could be expected over an ambient temperature increase of 25ºC.

b) Stack-in-tower system of indirect dry cooling

In a stack-in-tower system of indirect dry cooling, steam is condensed in a water cooled condenser (Figure 3.4) and warm cooling water is cooled in a water-to-air heat exchanger (Figure 3.6) in a closed loop. This system is more efficient than other direct cooling technologies when the ambient temperature is higher and it also produces less noise than direct air cooling.

Figure 3-4: Photograph showing a power station with the dry cooling tower of the Stack-in-Tower system of indirect dry cooling technology

Figure 3-5: Photograph showing a power station with the water-to-air heat exchangers of the Stack-in-Tower system of indirect dry cooling technology

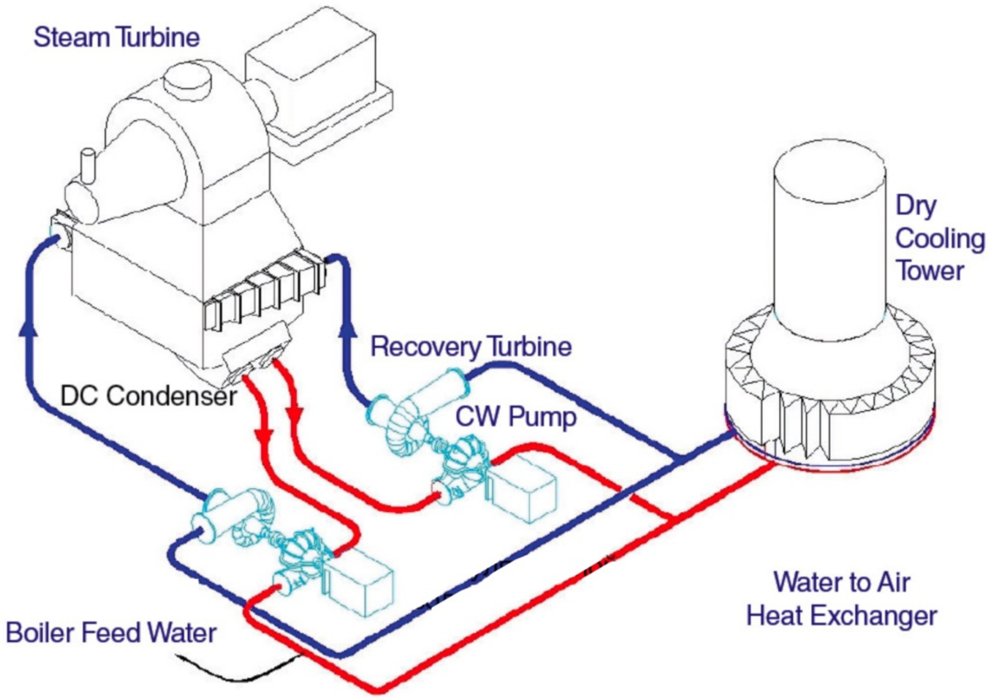

Figure 3-6: Schematic of the stack-in-tower system of indirect dry cooling system

The system is particularly useful when flexibility in cooling tower siting is required, and further can result in lower ground level concentration of airborne pollutants, having a positive on ambient air quality and community health.

As South Africa is a water scarce country and wet cooling uses far greater volumes of water than dry cooling, wet cooling will not be considered as an alternative in this ESIA.

c) Indirect Wet Cooling

Wet cooled systems utilise a circulating cooling water system, which absorbs heat during the steam condensation process and expels the heat to the atmosphere by the evaporation of some of the cooling water through the cooling towers. A wet cooling system uses approximately 1.8 l water per kWh sent out. Wet cooling uses approximately nine times the volume of water as is used by dry cooling.

Again, due to the impact on water resources, wet cooling will not be considered as a feasible alternative in this ESIA

d) Direct dry cooling

In a direct dry-cooling system, the steam is condensed directly by air in a heat exchanger and the condensate is returned to the boiler in a closed loop. The air flow for the condensation process is induced solely by mechanical fans, rather than through the updraft induced by cooling towers. As stated above, dry cooling utilises approximately < 0.2 l of water per kWh sent out. A further advantage of direct dry cooling is the lack of cooling towers, which reduces the visual impact and capital cost of the project.

Potentially, a hybrid cooling tower is able to produce a lower condenser pressure, extracting more heat from the steam expanded in the low pressure turbine. This is because its performance approaches the ambient wet bulb temperature whereas ACC performance only approaches the ambient dry bulb temperature. The relative humidity data for the Witbank area suggests that there is little difference between the wet and dry bulb temperatures during periods of peak ambient temperature.

Water is lost from a hybrid cooling tower due to:

- Drift: part of the circulating water is carried over by the air flow in the form of mist and tiny droplets. This carry-over is specified as a fraction of the circulating water;
- Cycle of concentration and blowdown: the concentration of compounds in circulating water systems must be controlled to a reasonable level in order to prevent scaling and corrosion. The desired concentration level is based on the quality of the makeup water; and
- Evaporation.

In the case of hybrid cooling tower, the following assumptions were made:

- Rate of evaporation from the tower was assumed to 1.2% of the tower flow;
- Blowdown rate of 6% was considered based on cycle of concentration of 1.2; and
- Rate of cooling tower drift of 0.001%.

Table 3-3: Comparison of Water Use (Hybrid Cooling Tower and ACC)

Assumptions		Hybrid Cooling Tower (2)		Air Cooled Condenser (AOLC)	
		1 x 300MW	3 x 150 MW	1 x300 MW	3 x 150 MW
Blowdown of the Water-Steam Cycle	% of the steam mass flow	2	2	2	2
Cooling Tower Drift	%	0.001	0.001	N/A	N/A
Cooling Evaporation Rate	% of the total tower flow rate	1.2	1.2	N/A	N/A
Cycle of Concentration		1.2	1.2	N/A	N/A
Cooling Tower Blowdown Rate	% of total tower flow	6	6	N/A	N/A
OUTPUTS:					

HRSG Blowdown	t/h	20	30	20	30
Cooling Tower Demand	t/h	3060	4591	0.0	0.0
Total Water Requirements (HRSG Blowdown + and Cooling Tower Makeup)	t/h	3080	4621	20	30
Total Water Rejection	t/h	2534	3802	20	30

Therefore, the difference in estimated water consumption between an ACC and hybrid cooling tower for the 450 MW plant would be:

- ACC- approximately 20 (30) tonnes per hour (peak) or 150,000 (225,000) tonnes per annum or 500,000 (750,000) litres per day, and
- Cooling towers - an additional 3,060 (4,591) tonnes per hour equivalent to 73 (110) million litres per day

It is therefore proposed that the plant use ACCs instead of cooling towers as this will significantly reduce the plant's water requirements.

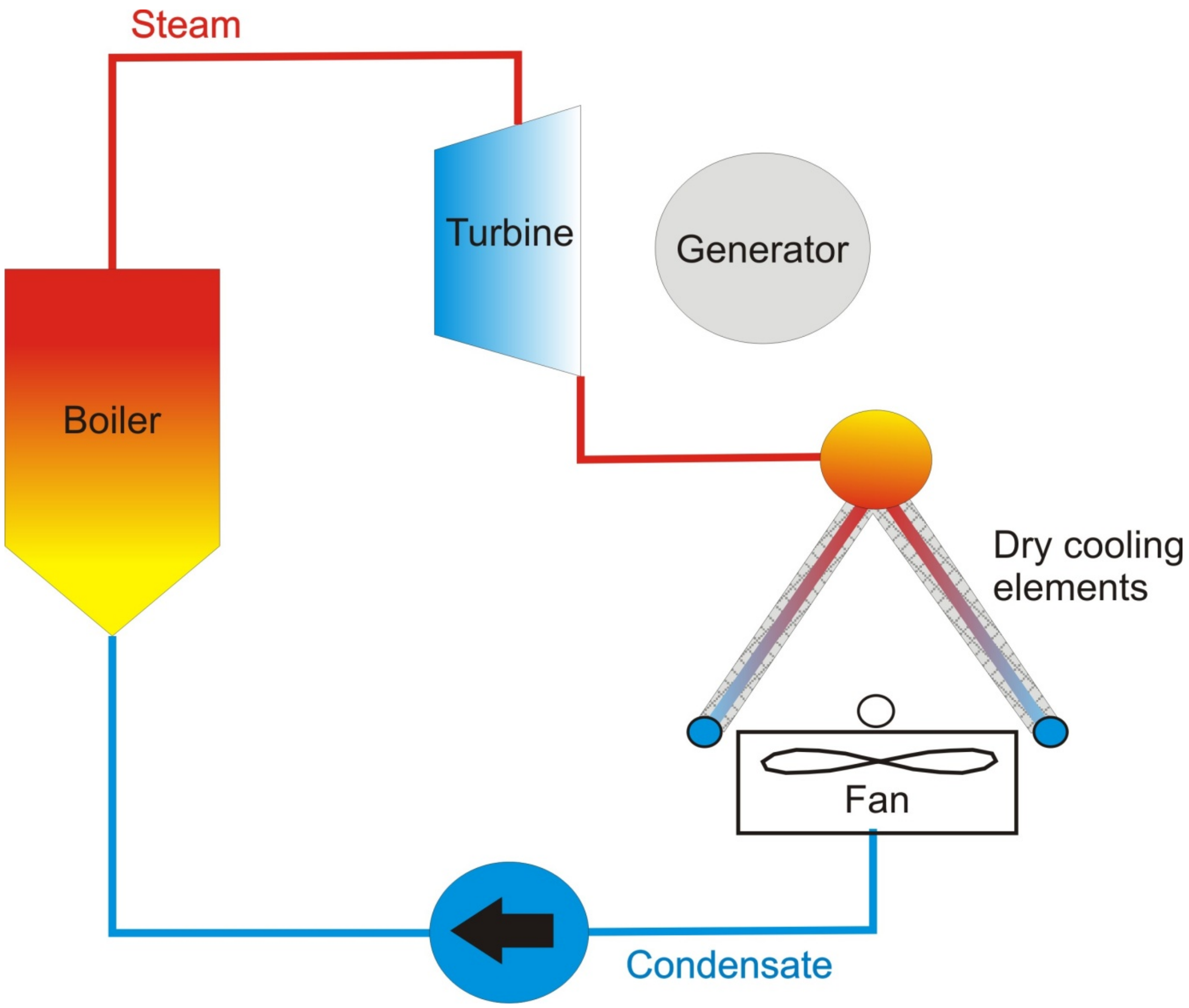

Figure 3-7: Schematic of the direct dry cooling process

Figure 3-8: Photograph showing a power station with indirect dry cooling technology

Figure 3-9: Photograph showing a power station with direct dry cooling technology

3.5. ASH DISPOSAL ALTERNATIVES

This project will utilise above-ground ash dumping. This process involves the disposing of ash by means of stacking and spreading on a piece of ground, so as to create an ash dump. The operational dump site would be built in stages (cells) which will be continuously rehabilitated with topsoil and re-vegetated as it develops, until it reaches the end of its life. Based on an ash pile height of 40m, the life time (25 years) ash disposal area is estimated to be 186 ha.

A total of four ash disposal methods have been identified in relation to this project. These are as follows:

3.5.1. Dry Ash Mound above Ground

Of the four potential ash disposal options, the dry ash mound above ground option has been selected as the preferred option, both from the ash transportation consideration and suitability of the available site. Having disqualified ash transportation by trucks (excepting in emergency situations) on environmental grounds, the ash is to be transported by conveyor.
Typically dry ash is placed in the ash dump by a moveable boom stacker conveyor and the consequent ash piles are distributed around the dump by a bull dozer. Alternatively, the ash is temporarily stockpiled within the ash dump site and trucked to the individual cells.

The initial ash disposal area is approximately 1,102,374m² (101.23 hectares) in size. It is proposed to divide the ash disposal liner into 20 individual cells, with the footprint approximately 40,000 m² (4 hectares). The total landfill footprint is approximately 80 hectares, leaving approximately 21 hectares of the area as reserve for future disposal area development and/or source for landfill cover material. The site layout plan is shown on Drawing 289348-SHF-001 in **VOLUME 2**. The ash disposal liner will be constructed to accommodate the ash generated over a 20 year period. The ash will be stored in cells with each cell having the capacity to accommodate a year’s ash requirement. The cell layout plan and site infrastructure are presented on Drawing 289348-SHF-002 in **VOLUME 2.** The cell construction and operation will be a phased approach, where cells 1 to 10 are Phase 1 and cells 11 to 20 in Phase 2.

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3.5.2. Wet Disposal in a Lagoon

The use of wet disposal is thought to be impractical due to the volumes of water which would be lost to evaporation and therefore is not a feasible alternative.

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3.5.3. Dry Ash in a Pit or Hole

In-pit ashing is the process whereby ash is placed directly into the coal mine pit (excavated area). This could be accomplished by either mixing the ash and the mine discard materials (overburden and intraburden) before backfilling into the pit or by backfilling into the pit in alternate layers of ash and mine discards. The layering option requires that the first layer of ash is backfilled on top of the discard above the natural water table level. In using the mixing methodology the ash fills in the voids in the mine discards and hence does not increase the overall volume. Therefore there is little disturbance to the above ground contours. The overburden and topsoil are placed onto the ash before the land is rehabilitated.

The base of the open cast site is likely to be uneven and possibly partly rehabilitated by the uncontrolled placing of material over the base of the excavation.

Before placing a lining over the base it would be necessary to remove this material and replace it with an engineered fill (it may be possible to use the excavated material provided the particle size is sufficiently uniform and it is placed and compacted in a controlled manner) so that the impermeable liner is not damaged.

Due to the fact that no proximal pits are available, this option is not economically viable.

3.5.4. Pumped Into Worked Out Below Ground Mine Workings

A potential new option is the use of ash in combination with cement to fill underground mine workings. This may be practical but the environmental implications will require more detailed study. Furthermore, the use of any non-standard ash disposal options would create a liability with regards to ash disposal management and control and the economic implications of mixing the ash with cement disqualifies this option as a feasible alternative.

3.6. ASH TRANSPORTATION

Ash can be transported by one of three methods; wet slurry by pipeline, dry on a conveyor or dry in trucks. Some systems for pneumatic transport of fly ash exist but these systems can be prone to unreliability and are usually used for very short distances.

The preferred ash disposal site is not capable of supporting a lagoon for dewatering ash transported by slurry therefore ash will be dumped in a dry (typically 15% moisture) state. If a wet slurry transport system is to be used it will require mechanical dewatering at the ash disposal site. The environmental impact of road transport of ash to the disposal site either through the mine or via a new entrance from the Tweefontein road will be high and this option has been discounted as the primary disposal route, although it could be a practical back up /emergency option.

Transporting ash by conveyor will require careful design to minimise dust issues. The typical solution is to use pipe conveyors which provide a closed transport solution. Pipe conveyors are closed systems and offer the most effective means of mitigating fugitive dust emissions. The cross section of a pipe conveyor can be seen in Figure 3-10. Figure 3-11 shows the closing of a pipe conveyor from the open state.

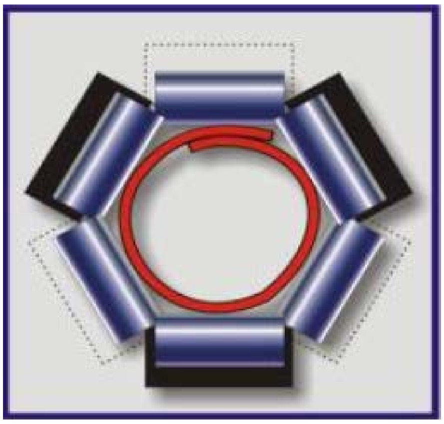


Figure 3-10: Cross section of a pipe conveyor[9]

Figure 3-11: A pipe conveyor closing over[10]

[9] Source - MM
[10] Source - MM

The route for the ash conveyor (or pipeline) would be to run within the D 2769 road servitude as shown of **Figure 3-12**. The ash conveyor will run adjacent to the coal conveyor. The route requires the crossing of the mine access road and the export conveyor at the junction with the Tweefontein Road. The conveyor will then continue under the mine access road and over the export conveyor.

Figure 3-12: Location of Principal Fuel Sources and Layout of Conveyor Routes[11]

[11] Source: MM, Google Earth Used Under Licence

Figure 3-12 indicates the location of Site 6C (the preferred power plant site location) with Greenside colliery to the north-west, Kleinkopje colliery to the south and Landau colliery to the north.

3.7. SITE LAYOUT ALTERNATIVES

As already discussed, only site 6C is not undermined and large enough to accommodate the power station and the lay-down areas associated with the construction phase. The southern corner of Site 6 is characterised by rock dams and is therefore likely to be suitable for the temporary areas.

The site is also crossed by a single 400 kV overhead power line mounted on lattice transmission towers and two 132 kV pole mounted overhead transmissions lines all owned and operated by Eskom. It is also crossed by the Tweefontein Road and has a small graveyard in the South corner. These can be seen in Figure 4-1. The Tweefontein Road and the overhead transmission lines will be relocated prior to the IPP's arrival on site.

A critical requirement for the proposed site is the need to accommodate the Eskom sub-station. Although the area is constrained due to undermining Figure 3-13 indicates that the site is able to accommodate the sub-station requirements. Figure 4.14 is an indicative layout and serves to confirm that a 450MW plant and associated infrastructure can be adequately accommodated Although this layout is constrained in terms of space, the indicative layout includes all the essential ancillary components. An Air Cooled Condenser (ACC) has also been included as this has a larger footprint than hybrid cooling towers but requires less water. Alternative site layouts have not been investigated because the final configuration of the power station components within site 6C will not create any significant impacts. The site is transformed land and contains no environmental sensitivities and the constrained nature of the site implies that the entire 17ha which is not undermined will be developed and/or transformed

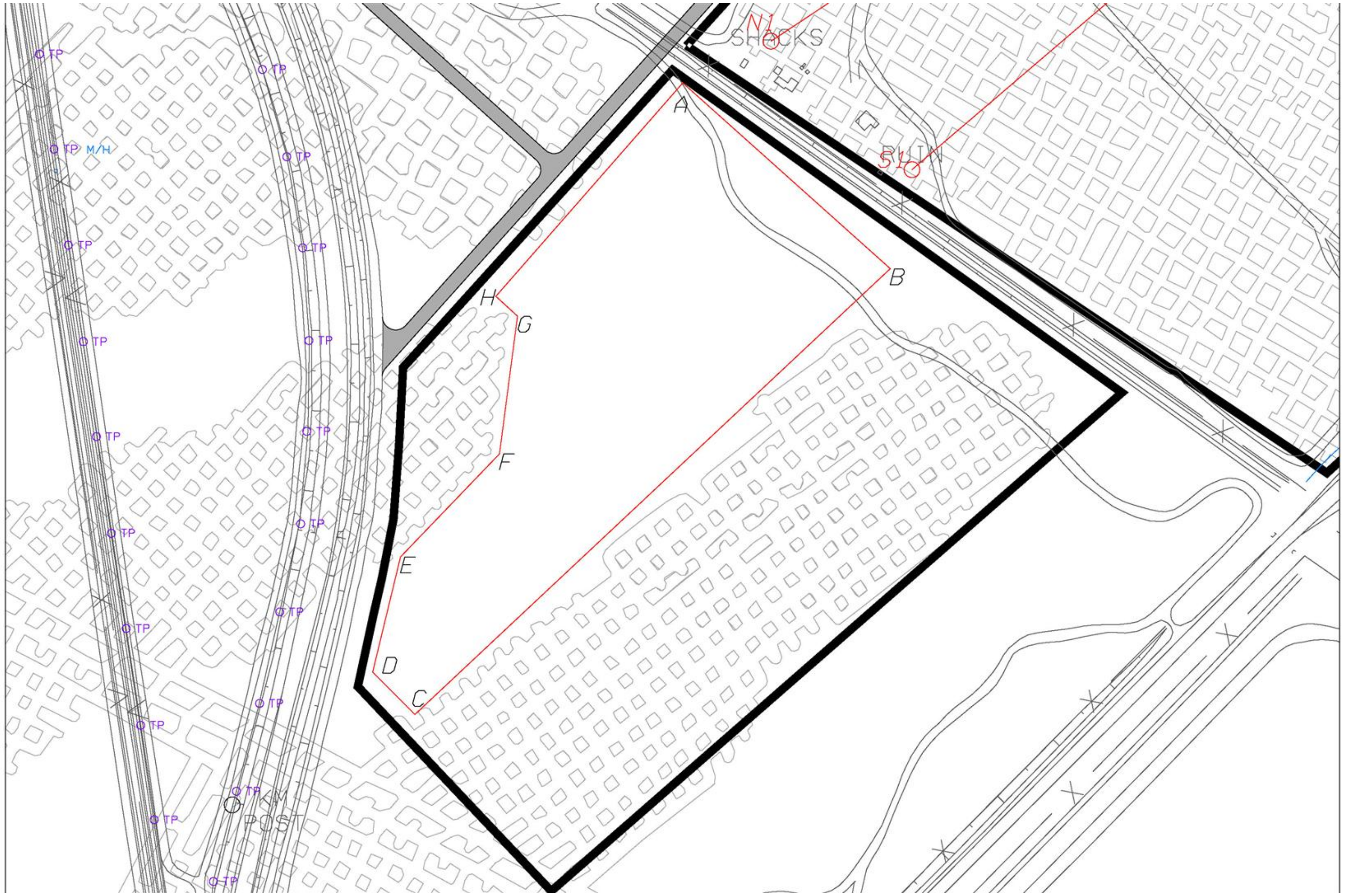


Figure 3-13: Eskom substation yard

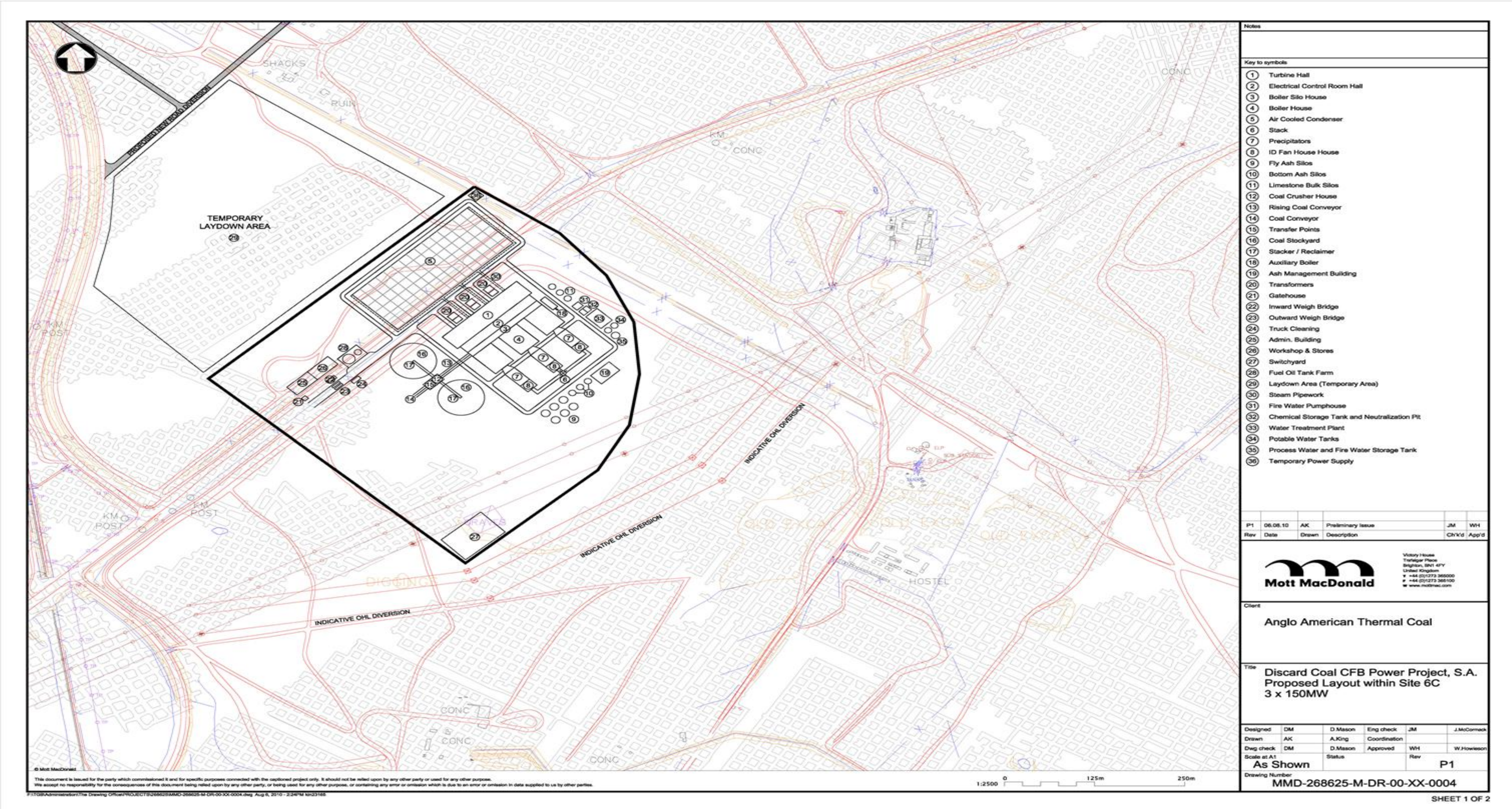


Figure 3-14 Indicative layout of a 450MW plant

3.8. ACCESS ROAD ALTERNATIVES

The Tweefontein Road is a public highway which directly crosses Site 6C and will require relocation in order for the site to be used. A detailed traffic impact assessment was undertaken as part of the ESIA to investigate the most suitable diversion option as well as to evaluate the expected traffic phenomena associated with the proposed power plant in order to ensure safety and mobility along the provincial roads.

3.8.1. OPTION 1

a) Advantages

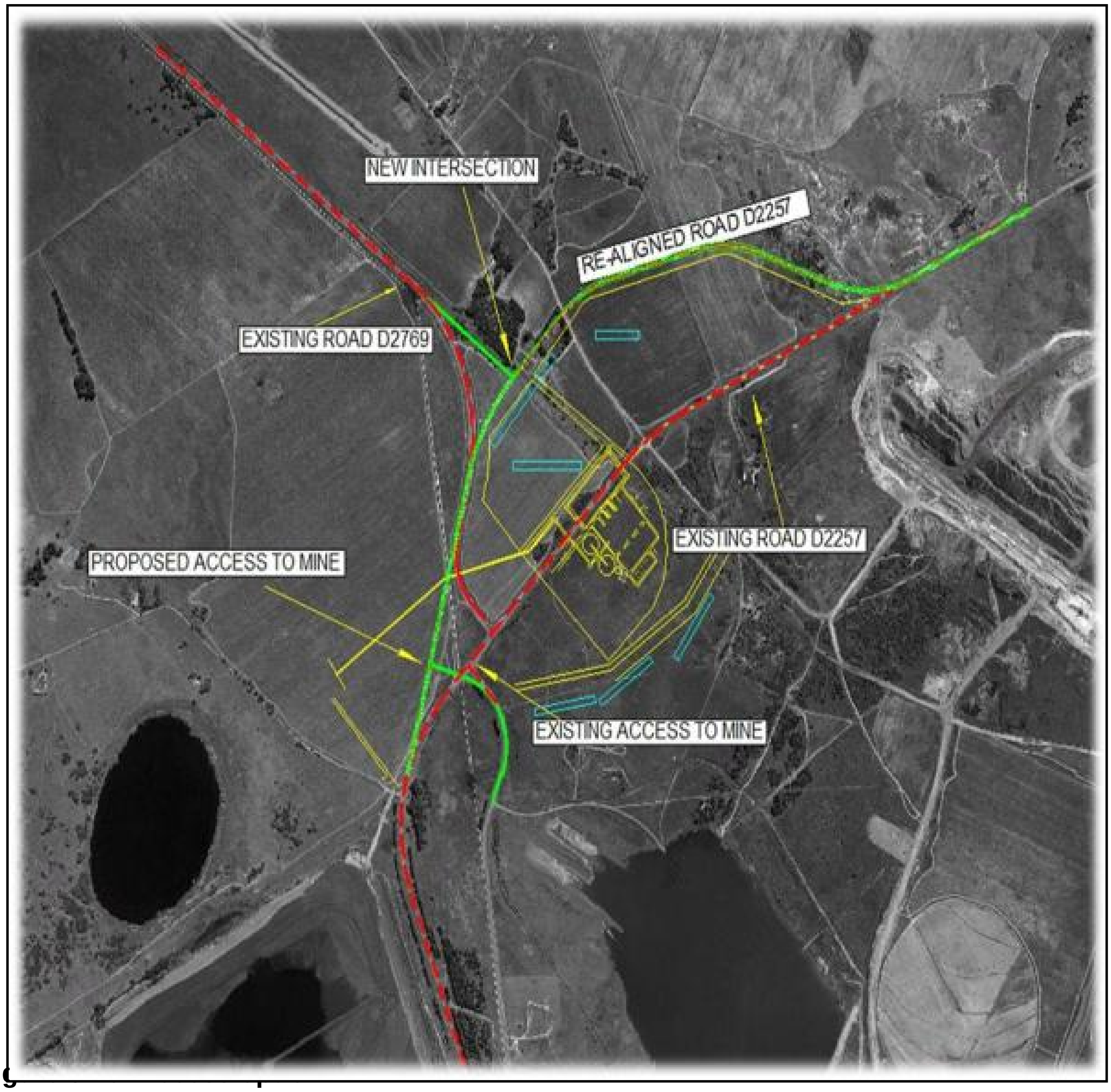
- Preferable horizontal alignment that provides mobility along D2257;
- Eliminate poor existing intersection spacing between D2769 and Klipkopje mine access;
- Eliminate the existing dangerous "S" curve on D2769;
- Safe sight distances are obtained at the new intersection positions;
- A small portion of the existing road D2769 (150m) is utilized in order to reduce cost as far as possible;
- The existing access to Kleinkopje main entrance will be relocated by using the existing overpass over the existing conveyor for Road D2257;
- Proposal will conform to the Department of Public Works: Roads & Transport traffic guidelines.

b) Disadvantages

- The existing conveyor belt needs to be accommodated – probably underpass with new culvert structure to be provided;
- More cost intensive than option 2

The alignment option 1 allows for mobility along the Road D 2257 and meets minimum prescribed geometric criteria for a design speed of 80km/h in terms of horizontal radii, horizontal and vertical curve lengths, sight distances and access spacing.

Therefore, Option 1 is the preferred alternative.



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3.8.2. OPTION 2

a) Advantages

- Existing conveyor is accommodated – no need to spend extra on this;
- Access to Kleinkopje mine is also accommodated with no interference with the conveyor;
- Shorter route than option 1 and therefore less capital intensive.

b) Disadvantages

- Dangerous "S" curve needs to be provided which impose an immediate safety risk on the motorist;
- Sight distance at the access to Kleinkopje mine is short (but prescribed to min criteria for 80km/h design speed);
- Existing road D2769 is not utilised as is the case with the other two options;
- This option will not meet the South African National Roads Agency geometric design requirements.

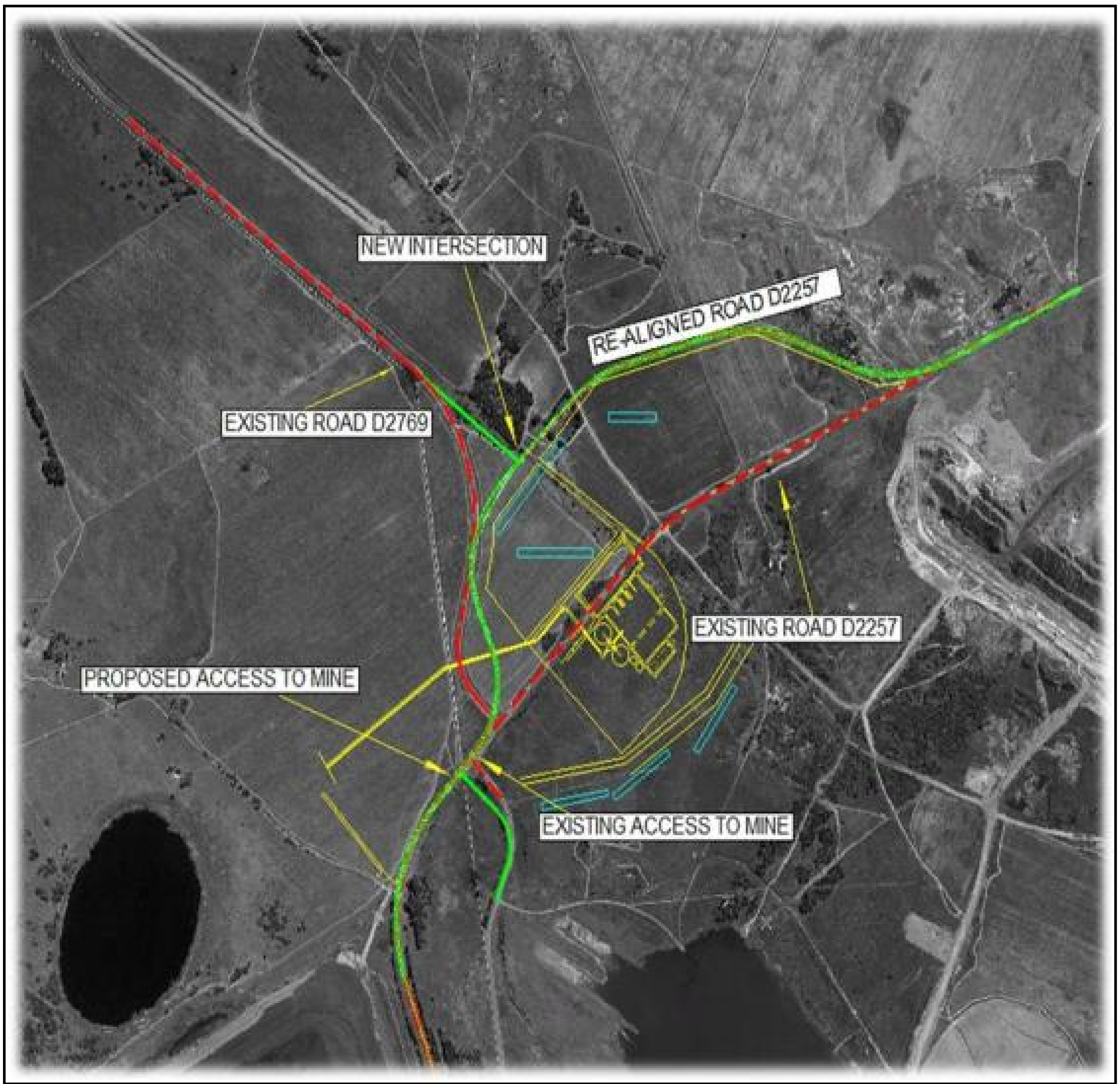


Figure 3-16: Access option 2

3.9. NO GO OPTION

The ‘no-go’ alternative is the option of not establishing new coal-fired power station at the proposed site. As described earlier in this document, the electricity demand in South Africa is placing increasing demand on the country’s existing power generation capacity. South Africa is expected to require additional baseload generating capacity by 2014 and beyond, dependent on the average growth rate. The ‘no-go’ alternative will result in the electricity demand for Anglo American’s mining operations not being met, with the concomitant potentially significant negative impacts from an economic and social perspective for South Africa and is not explicitly assessed in the EIR phase. It is however, implicitly assessed in the EIR as it effectively represents the baseline or status quo against which all of the potential impacts will be assessed.

4. PROJECT DESCRIPTION

4.1. PROJECT LOCATION

4.1.1. Regional Setting

The proposed Khanyisa Power Plant is located within the eMalahleni Local Municipality (ELM), which includes towns such as Kriel, Matla, Ogies, Balmoral and Kendal as well as numerous rural area/farms around these towns. Together with Highlands, Steve Tshwete (Middleburg), Delmas, Dr. J.S. Moroka, and Thembisile – ELM falls within the District Municipality of Nkangala.

In terms of the regional setting of Khanyisa, it is imperative to note that the proposed power station is situated, regionally, in an environment that is highly sensitive with regards to air quality. In short there are a number of other existing or planned power stations located in close proximity to the planned Khanyisa Power Station. Despite this the proposed Khanyisa plant will be situated within land associated with Anglo American's mining operations and thus may be termed a brown-fields development.

4.1.2. Local Setting

The proposed Khanyisa Power Station is situated within the Witbank Coalfield area, which similarly houses a number of coal mines and coal fired power stations.

The study area falls within the eMalahleni Local Municipality, approximately 10 km from the town centre of Witbank (officially renamed eMalahleni in 2006). The site locality map shows the site situated south of the town centre between the N12 and the R544 and centrally within the extensive mining activity which dominates the area.

The site is crossed by a single 400 kV overhead power line mounted on lattice transmission towers and two 132 kV pole mounted overhead transmissions lines all owned and operated by Eskom. It is also crossed by a public highway (Tweefontein Road) and has a small graveyard in the South corner (Figure 4-1). The legislative and approval process for the relocation of the Tweefontein Road and the overhead transmission lines has commenced and will be completed prior to the Contractor's arrival on site. The land occupied by the graveyard will be excluded from the part of the land occupied by the power island.

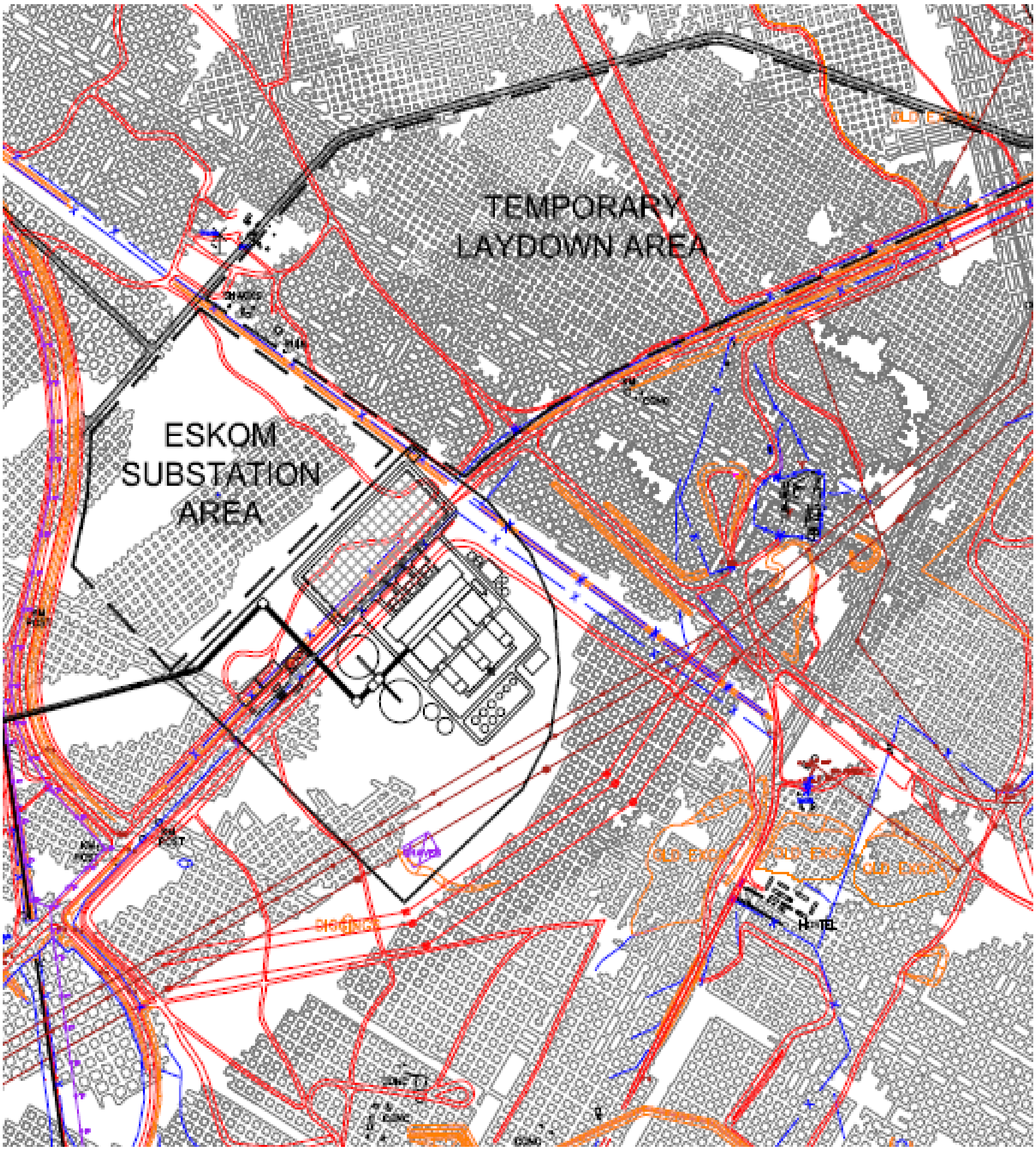


Figure 4-1: Existing site infrastructure

eMalahleni Municipality forms part of the western regions of Mpumalanga Province. Witbank was established in 1890 and coal mining in the area commenced in 1889 as this area has rich deposits of coal reserves. It was proclaimed a town in 1903 and became a municipality in 1914. There are more than 22 collieries in the municipal radius.

Mining occurs throughout the central and southern portions of the eMalahleni Municipal area, with large sections affected by shallow undermining and/or mineral rights. Kendal Power station (32 km from the town) is currently the largest coal fired power station in South Africa with a capacity of 4 032 MW.

The areas between the mining activity, the power station and the residential areas of eMalahleni Municipality are mostly utilised for agricultural purposes. Agricultural land around the settlements in the eMalahleni area is increasingly under threat, due to the need for urban expansion.

The constraints posed by undermined land further increases the attractiveness of agricultural land for development. Currently dairy, potatoes, maize, sheep and sweet potatoes are farmed.

4.1.3. Land Tenure

a) Power Station

The proposed power station will be situated on a part of the Remaining Extent of the farm Groenfontein 331-JS, district eMalahleni (Witbank) and which is currently being used for coal mining purposes by the land owner Anglo Operations Ltd.

The current zoning of the land is "**Agricultural**" in terms of the eMalahleni Land Use Management System 2010. The land is currently undeveloped and vacant land which is subject to mining rights, therefore, the current use thereof is governed by the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002).

It is Anglo American's intention to excise the mining rights on this parcel of land in order to give consent to the IPP to use the land for other purposes.

If the Minister of Agriculture gives consent for the agricultural land to be used for purposes other than mining, the land will be subject to the eMalahleni Land Use Management System in terms of which the land is zoned for agricultural purposes. The land will then be rezoned to align with the local Land Use Management System (Town Planning Scheme for the purposes associated with the power station) in accordance with municipal town planning regulations.

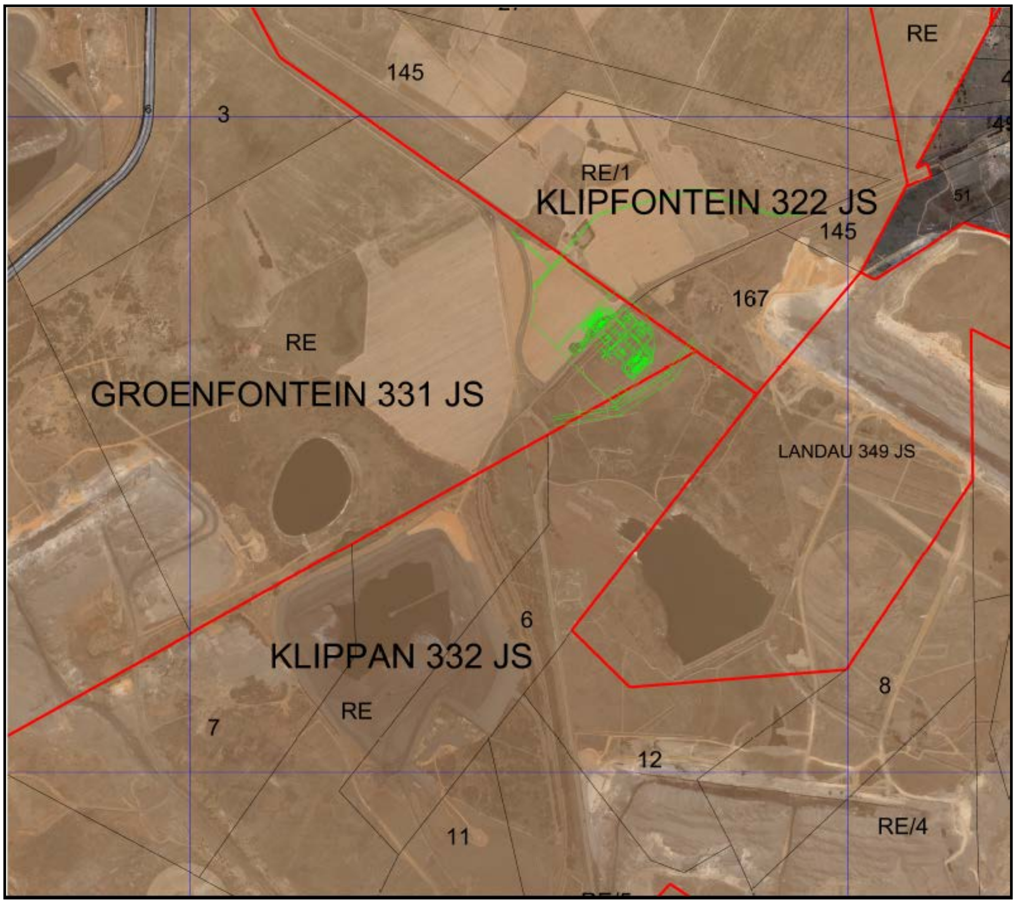


Figure 4-2: Farm Portions for the Power Station

The surrounding land is mostly vacant, undeveloped land, used for mining / agricultural (grazing) purposes. The Duvha Power Station is approximately 11km to the east. The site is approximately 3.7km from the nearest residential area (Duvha Park) and 1km from the nearest open mine.

The proposed land use, in relation to the surrounding land uses is considered to be generally acceptable for the following reasons:

- Most of the surrounding land is used for open pit mining, agricultural or related purposes which will not be adversely affected by the proposed power station.
- The Duvha Power Station to the east is basically in the same type of location although 8.75 km from the nearest residential development. The proposed power station will be on a much smaller scale than Duvha Power Station.

From a Town Planning point of view, the proposed land use fits in with the coal mining and other power station land use in the immediate vicinity. The site has good access and the necessary engineering services will be installed by the IPP. The location of the proposed power station in relation to the current residential area is acceptable and the proposed development should not affect the residential area adversely.

The process required for Anglo American to subdivide the land and make it available for transfer to the IPP company would include the following steps:

- Apply and obtain the consent of the Minister of Mineral Resources and all the mineral, mining and surface rights holders;
- Apply and obtain the consent of the Minister of Agriculture in terms of the stipulations of the Subdivision of Agricultural Land Act, 1970 (Act No. 70 of 1970), as amended, for the subdivision, change of land use and the disposal of the property;
- In order to use the land legitimately for a power station, it will be necessary to apply to the Local Municipality for consent to use the land for the purposes of a power station, i.e. rezoning of the portion.

b) Ash Disposal

The property that was identified for the purpose of an ash disposal site is situated on parts of Portions 7, 11 and the Remaining Extent of the Farm Klippan 332-JS (Figure 4-3), to the south of eMalahleni (Witbank) and which is currently being used for coal mining purposes by the land owner, Anglo Operations Ltd. The current zoning of the land is "**Agricultural**" in terms of the eMalahleni Land Use Management System 2010.

The land is currently stabilised / rehabilitated open cast mining land which is undeveloped / vacant / unused land.

If the Minister of Agriculture gives consent for the agricultural land to be used for other purposes, the land will be subject to the eMalahleni Land Use Management System in terms of which the land is zoned for agricultural purposes. As it is the intention to use the land for the purposes of an ash disposal site (storage area / industrial land use), the land (or parts affected) will have to be rezoned for that purpose to align with the local Land Use Management System (Town Planning Scheme).

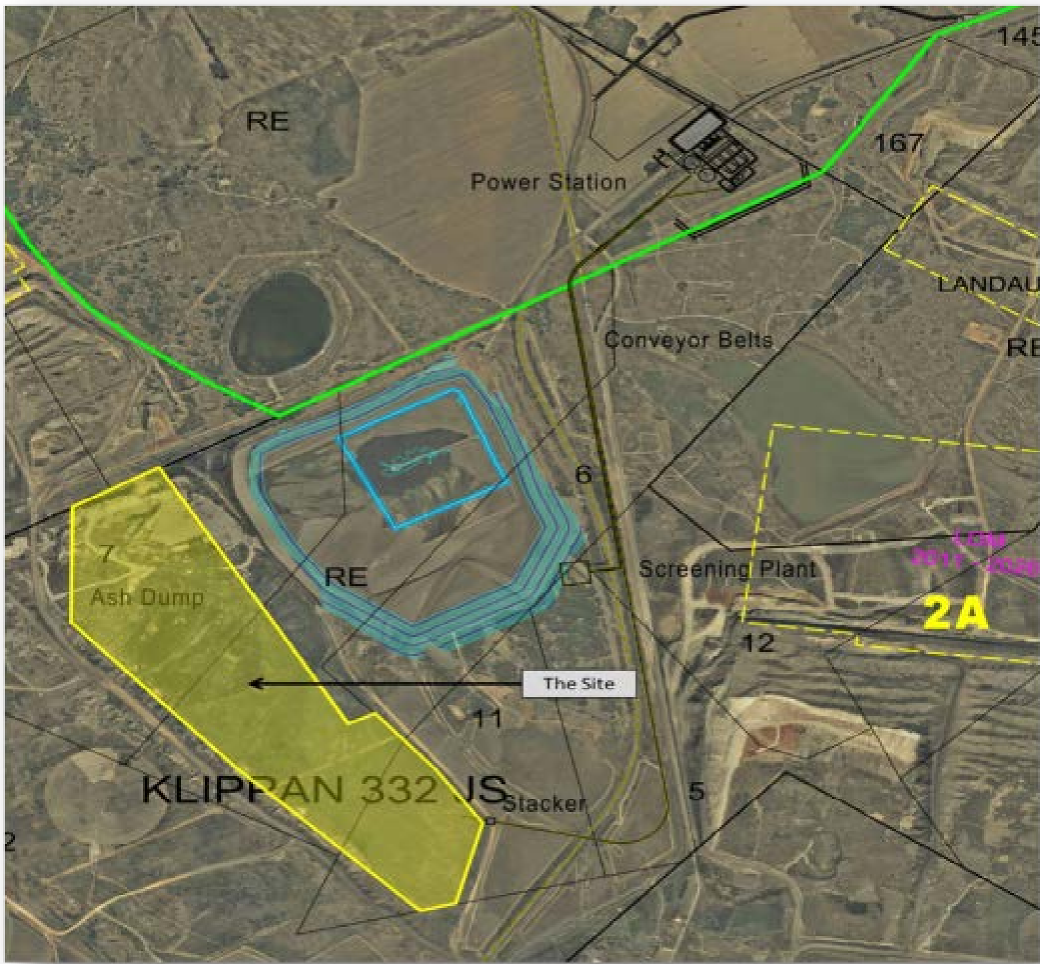


Figure 4-3: Farm portions for ash disposal

From a Town Planning point of view, the proposed land use fits in with the coal mining and other related power station land use in the immediate vicinity. The site has good access and the necessary engineering services will be installed and provided by the developer. The location of the proposed ash disposal site in relation to the current residential area is acceptable and the proposed development should not affect the residential area adversely.

The process required for AOLTC to subdivide the land and make it available for transfer to the IPP company includes the following steps:

- Apply and obtain the consent of the Minister of Mineral Resources and all the mineral, mining and surface rights holders.
- Apply and obtain the consent of the Minister of Agriculture in terms of the stipulations of the Subdivision of Agricultural Land Act, 1970 (Act No. 70 of 1970), as amended, for the subdivision, change of land use and the disposal of the property.
- In order to use the land legitimately for an ash disposal site, it will be necessary to apply to the Local Municipality for consent to use the land for the purposes of an ash disposal site, i.e. rezoning of the portion.

4.2. PROJECT DESCRIPTION

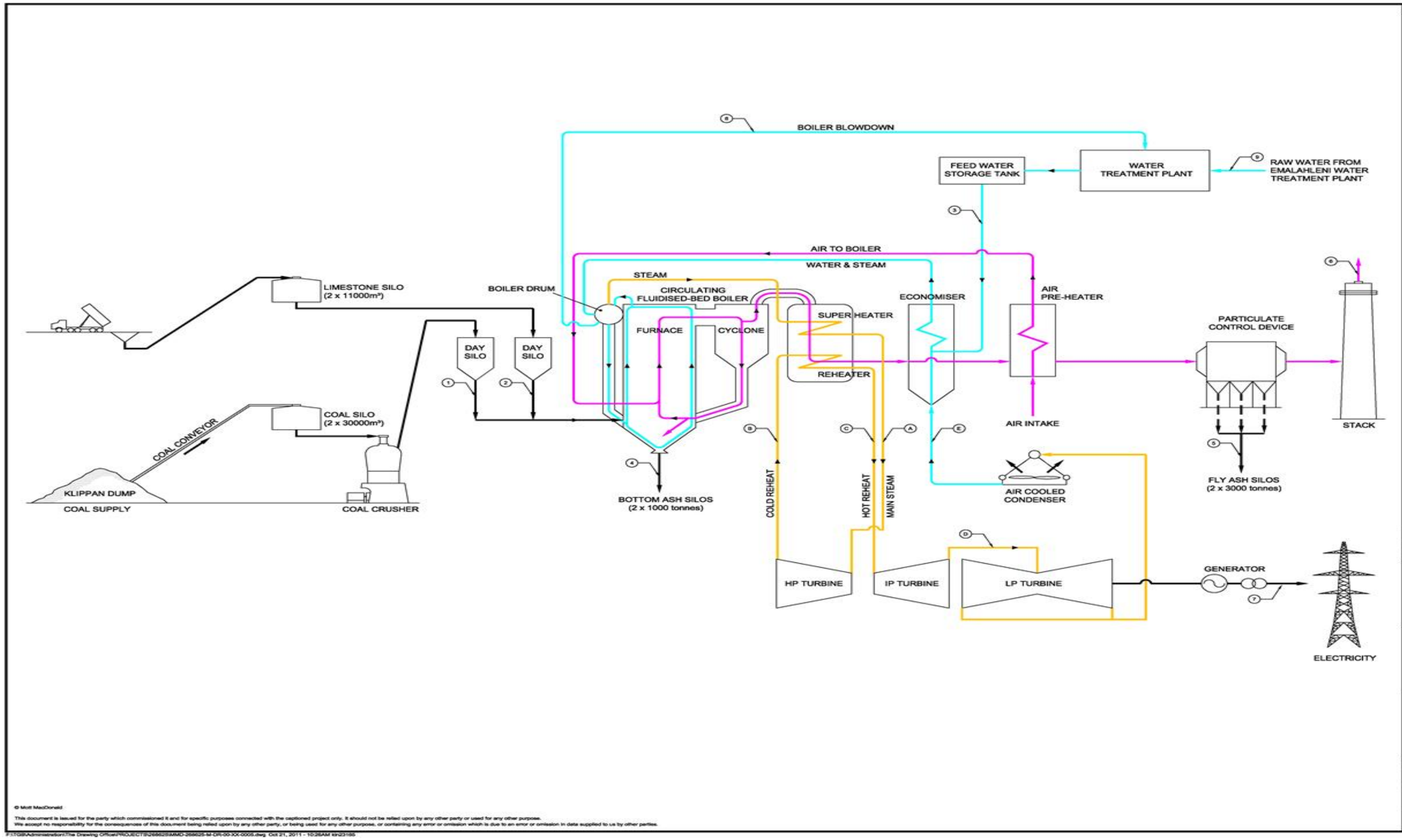
4.2.1. Proposed Power Plant Infrastructure

The project comprises the design, construction, and operation of a coal-fired power station (and associated infrastructure) using discard coal as the fuel source and circulating fluidised bed technologies. The power station would need to deliver a nominal electricity generation capacity of approximately 450 MW. Apart from the power station buildings themselves, the ancillary infrastructure will include the following:

- Coal silo and sorbent stock yards;
- Coal, ash, sorbent and gypsum conveyors;
- A High Voltage (HV) yard within the power station precinct;
- Water and wastewater treatment facilities;
- Ash and spent sorbent disposal systems and dump site;
- Gypsum (sorbent) storage facility;
- Access roads (temporary and permanent, and external and internal roads);
- Maintenance, medical, administration, services, control buildings;
- Water supply pipeline for construction and operation phase;
- Raw water pipeline and reservoirs;
- Dams for storage of “clean” and “dirty” water;
- Power supply for the construction phase;
- Communication mast/telecommunication facilities;

- General and hazardous waste storage and handling facilities (temporary and permanent);
- Batching plant (including concrete and asphalt); and
- Construction accommodation.

An illustration of the process flow with respect to the proposed Khanyisa Power Plant process is indicated in the Figure 4-4 below



Indicative Boiler Cycle Flows (Whole Plant)			
Reference	Parameter	Value	Unit
1	Coal Feed [1]	385	tonnes per hour
2	Limestone Feed [2]	51	tonnes per hour
3	Feed Water Make-up Flow	30	tonnes per hour
4	Bottom Ash Rate [3]	48	tonnes per hour
5	Fly Ash Rate [3]	143	tonnes per hour
6	Flue Gas Flow	2290	tonnes per hour
6	Flue Gas Temperature	125	°C
7	Electrical Power	450	MW
8	Boiler Blowdown	30	tonnes per hour
9	Boiler Make-up Water	1.5	tonnes per hour

1. The rate of coal consumption depends upon the heat content of a tonne of coal. This value is calculated using typical and not end of range values.
2. The rate of limestone consumption depends upon the sulphur content of the coal burned.
3. The balance between fly ash and bottom ash flow rates is dependant upon the boiler design and fuel used.

Indicative Steam Cycle Flows (Single 150MW Unit)			
Reference	Parameter	Value	Unit
A	Main Steam	150	kg/S
B	Cold Reheat	124	kg/S
C	Hot Reheat	125	kg/S
D	LP Turbine Inlet	120	kg/S
E	Final Feedwater Flow Rate	149	kg/S

Rev	Date	Drawn	Description	Ch'k'd	App'd
P2	29.03.11	AK	Major Revisions	DM	WH
P1	29.11.10	AK	Preliminary Issue	DM	WH

Mott MacDonald

Client: Anglo American Thermal Coal

Title: Indicative Power Plant Process Diagram
150MW Net Plant Output Unit

Designed	DM	D.Mason	Eng check	JM	J.McCormack
Drawn	AK	A.King	Coordination		
Dwg check	DM	D.Mason	Approved	WH	W.Howison

Scale at A1: NTS | Status: Pre | Rev: P2

Drawing Number: MMD-268625-M-DR-00-XX-0005

Figure 4-4: Khanyisa Process Diagram

4.2.2. Fuel Supply Strategy

Discard coal from Anglo American mines in the area will be used as the fuel for the power plant. Due to historical long-term mining operations within the SACE complex there is approximately 130 million tonnes of discard coal available. The raw discard coal has high sulphur content and therefore significant quantities of limestone will be required as a sorbent to reduce sulphur dioxide emissions from the boiler to within acceptable environmental limits. The key driver of the fuel delivery strategy is the availability and price of limestone.

There are no suitable limestone deposits in the Witbank area and therefore this will incur significant transport costs as the limestone has to be transported from remote deposits. A cost benefit analysis of coal washing versus not washing has been performed using the Standard Bank financial model. The results suggest that the washing option is better than not washing due to the cost savings from reduced limestone consumption. MM calculations show that producing a blend of coal at 16 MJ/kg (GAR) for feed to the boilers based on washing discard at a density of 2.0 provides the optimum reduction in sulphur.

A number of potential discard coal sources were evaluated. Discard coal from the Klippan and Blauwkrans dumps are considered to be the principal sources of fuel. Greenside arisings, though of a high quality, also have high sulphur content and would therefore require excessive quantities of limestone in order to meet environmental regulations for sulphur dioxide emissions. Kleinkopje arisings have also been discounted due to their high sulphur content and potential unavailability after the planned sale of the mine.

The principal fuel supply plan is:

- Production will commence using Klippan dump coal.
- Washing of the Klippan dump coal will be carried out at a relative density of 2.0. A new wash plant will be constructed at Kleinkopje for this purpose.
- Approximately 60% of the discard coal to the plant will be washed. It will be blended with unwashed discard coal to produce a blend of 16 MJ/kg.
- When the Klippan dump is exhausted, the Blauwkrans dump will be used.
- Washing of the Blauwkrans dump coal will be carried out at a relative density of 2.0.
- A new wash plant will be constructed at Blauwkrans specifically designed for that coal.

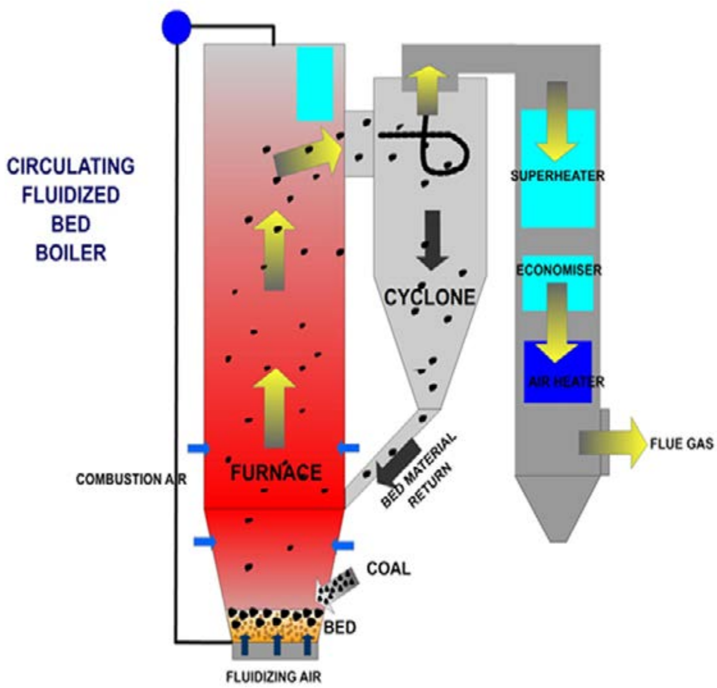
The most appropriate site for the Klippan Wash plant is on an unused portion of the Klippan Dump site adjacent to the Tweefontein Road, (subject to confirmation that the ground conditions are appropriate). Coal will be moved by conveyor directly to the power station site and truck haulage will be used as a back-up system.

Secondary discard from the Klippan and Blauwkrans beneficiation plants will be retained on the Klippan and Blauwkrans dumps respectively in separate stockpiles. A small short term new discard dump area will be required at both locations during initial reclaim, however, these areas need to be determined once the IPP is identified.

4.2.3. CFB Technology

As the discard coal is of relatively low quality, with high ash content (around 50%) and high sulphur content (2 to 3%), it is proposed that the power plant utilise Circulating Fluidised Bed (CFB) boilers. CFB technology has the advantage of being able to burn coals with a wide range of properties and can cope with high ash and high sulphur coals as proposed for this power project. The removal of sulphur from the coal during the combustion process is achieved in CFB boilers by the addition of limestone which acts as a sorbent. The sulphur becomes bound to the limestone enabling its removal and disposal. Additionally, the lower combustion temperatures of the CFB boiler result in lower emissions of nitrogen oxide (NOx) by reducing the production of thermal NOx within the furnace.

Sub- or super-critical CFB boilers could be used at the Khanyisa plant provided that suitable references can be provided by suppliers which indicate the boilers reliable operation. MM notes that there are currently few suitable references for super-critical CFB boilers as the first supercritical boiler (460 MW) was only commissioned at the Łagisza power plant in Poland in 2009. However, there are many references from multiple suppliers for sub-critical CFB boilers, which MM considers as a well proven technology.



At the bottom of the boiler there is a bed of inert material where the coal or fuel spreads. Air is supplied from under the bed at high pressure lifting the bed material and the coal particles and keeping it in suspension. The coal combustion takes place in this suspended condition allowing a more effective combustion and heat transfer. This is the Fluidized bed.

Fine particles of partly burned coal, ash and bed material are carried along with the flue gases to the upper areas of the furnace and then into a cysclone. In the cyclone the heavier particles separate from the gas and falls to the hopper of the cyclone. This returns to the furnace for recirculation. Hence the name Circulating Fluidized Bed combustion. The hot gases from the cyclone pass to the heat transfer surfaces and go out of the boiler.

4.2.4. Output

The technical review performed by MM of the analysis of the electricity demand for AOL operations shows that there is sufficient demand to operate a 300 MW plant at baseload for 100% of the year and a 450 MW plant at baseload for 95% of the year. Therefore, a plant output of 450 MW has been identified as the optimal functional specification based on the following assumptions:

- Site 6C could conceivably host a 600 MW power plant built in a single phase and designed for a very constrained layout. However, a 450 MW power plant layout is considered more feasible.
- Evaluating the fuel strategy suggests that sufficient fuel is available to support a 450 MW plant capacity. A 600 MW plant had also been considered, however the envisaged initial capacity of plant of 450 MW represents considerably less risk with respect to the fuel supply scenario. The coal consumption of a 600 MW plant would necessitate several supply sources being available at the same time.
- For the 5% of the year when there is not sufficient demand to operate the 450 MW plant at baseload, surplus capacity could be sold to other Anglo American operations. MM also understands that the electricity demand of Anglo American is expected to rise over the forthcoming years and consequently it is likely that 450 MW of demand will be available for 100% of the year by the time of plant completion.

4.2.5. Unit Size

Three 150 MW size units have been chosen for the project for the following reasons:

- Modelling using GateCycle power plant modelling software has shown that there is little efficiency advantages from utilising units of greater than 150 MW.

- 150 MW units are a standard size for many manufacturers allowing the use of standard components which have a proven operating history and a standard design and layout.
- Multiple smaller units will reduce the impact of any single event of shortfall in performance and associated financial penalties from Eskom.

There are economies of scale to be derived from the use of larger units but there is a limited operating history for CFB boilers (both sub- and super-critical) for units of greater than 200 MW. The balancing of these factors makes the use of 150 MW units the preferred option.

4.2.6. Cooling Method

The heat generated from the combustion in the boiler is used to convert water into steam, which is used to drive a turbine coupled to a generator. To increase efficiency the plant would use reheat technology which involves returning partially expanded steam from the turbine to the boiler for reheating and returning it to the turbine where it will be expanded further to produce additional electrical energy The boilers would operate within Original Equipment Manufacturer (OEM) design parameters, the most important of which being pressure and temperature. Each of the boilers would heat water to produce steam within a pressure and temperature range of 17MPa – 20 MPa and 540°C – 568°C respectively. Operation at the higher pressure and temperature range allows for increased efficiency (reduction in coal consumption and associated emissions by some 5 % to produce the same amount of energy).

A hybrid cooling tower has the potential to produce a lower condenser pressure, extracting more heat from the steam expanded in the low pressure turbine, hence allowing a higher overall plant efficiency. However, MM has estimated that a plant with hybrid cooling towers would require approximately 4,600 t/h of water, whereas a plant with Air Cooled Condenser (ACC) would require approximately 30 t/h.

Due to the limited availability of water on site, and the significantly reduced water requirements, it is proposed that an ACC be used as the cooling method. All process water will be supplied from the eMalahleni Water Treatment Plant via pipelines.

4.2.7. Efficiency

Using GateCycle, MM has estimated that the plant should be capable of a net efficiency of 35.5% at average ambient conditions. The use of an ACC creates a high auxiliary power demand which has depressed the efficiency from more typical designs.

4.2.8. Unit Availabilities

The availability of a plant (the number of hours the plant is available to generate electricity in a year) is determined by two components: planned maintenance and forced outages. Both these factors can be minimised by effective plant design at a cost. To ensure the plants optimal availability the bid evaluation process will reward bidders who offer a plant with a higher availability.

Typical long term availability for a plant of this type will be around 88% with 7% average annual planned maintenance combined with a forced outage rate of 5%. Assuming a despatch factor of 95%, the minimum load factor required from the IPP is 85%

4.2.9. Sulphur Reduction Technology

Sulphur can be removed from the flue gas either by a post combustion Flue Gas Desulphurisation (FGD) plant or in CFB boilers through the injection of a sorbent (limestone) with the fuel. CFB boilers require a higher Calcium/Sulphur ratio compared to wet FGD systems thus requiring larger volumes of limestone. However, a wet FGD system would require significant quantities of fresh water which are believed to be unavailable in the Witbank area and would involve significant additional capital costs and some additional land area. It would also reduce the thermal efficiency of the plant.

The volumes of limestone required will be determined by:

- operating regime of the plant,
- sulphur in the coal,
- any coal processing to remove sulphur, and
- reactivity and quality of the limestone.

Initial estimates suggest that for a 450 MW plant consuming coal with an average sulphur content of 4% and a CV of 11.86 GJ/tonne would require approximately 580,000 tonnes of limestone per year. Therefore, the working assumption is that sulphur removal will be via directly injected limestone. An alternative option of a dry FGD system requires the use of large quantities of salt which may not be available in the Witbank area although this has not been investigated.

The working assumption is that sulphur removal will be via directly injected limestone.

4.2.10. Power Evacuation

Currently Anglo American is in the process of an application for an interconnection with Eskom. Eskom have confirmed that this 400 kV transmission line adjacent to the site is unavailable for power evacuation and have proposed the following two power evacuation options:

- Transmission, via a new local 400 kV substation and connections to the Duvha – Minerva (future Kusile – Vulcan MTS) 400kV line by building 6 km incoming and 6 km outgoing 400kV lines.
- Distribution, via a new local 132 kV substation and 2 twin 132 kV lines to both HSV1 and HSV2, each approximately 17 km long.

The transmission option is the preferred option due to likely lower losses, higher reliability and possibly lower use of system charges.

4.2.11. Ash Disposal

As described in section 3.2.2 above, the remediated open cast mine workings adjacent to the Klippan Dump (ash 3) has been proposed as the potential ash disposal site (Figure 3-2). Whilst this has some advantages, the settlement of remediated ground produces settlement issues which need to be investigated to ensure the integrity of the impermeable membrane which will used to prevent leachate from the stored ash entering the groundwater. MM has undertaken a review of the site and concluded that the proposed site is feasible subject to confirmation of the assumptions used in the geotechnical model.

4.2.12. Carbon Capture Readiness

Anglo American has requested MM to review the impact of requiring that the plant is Carbon Capture Ready (CCR). The constrained nature of Site 6C means that additional land would be required to comply with CCR. Additional land is required on site for the equipment necessary for CO2 capture, additional interface equipment as well as space for the construction works during the retrofit. It is estimated that approximately 4 hectares of additional land would be needed, not including any space for additional flue gas desulphurisation and NOx reduction equipment. There is also the potential to use any CO2 pipelines from the nearby Eskom Kusile plant.

At this stage it appears likely that undermined land would be required to provide the total footprint required, however, this land could be made geotechnically stable through grouting.

4.2.13. Waste Management

As depicted in Table 4-1 below, the following waste streams have been identified during this study. These anticipated waste streams should however not be considered as final or conclusive as the intension is to update this waste inventory as the project progresses.

The site of disposal of various waste types is governed by the DWAF's *Minimum Requirements for waste disposal by landfill, Second Edition (1998).* Hazardous waste of all hazard rating can be disposed of at a **H:H** landfill. Waste with a hazard rating of 3 and 4 as well as general waste can be disposed of at a **H:h** landfill site. Waste known or proven to be non-hazardous may be classified as **general** waste and disposed of at a general waste landfill.

Table 4-1: List of identified waste streams expected to emanate from the operation of the proposed Khanyisa Power Station

Waste Stream	Estimated classification	Comments
Coal Ash	Hazardous (H:H or H:h)	Once in operation, ash samples must be tested to determine whether it can be de-listed as Hazardous
Domestic waste	General	General Waste
Waste Paper	General	General Waste: Recycled
Kitchen waste	General	General Waste
Printer cartridges	SANS 0228 3.2 (H:h)	Pyrrolidone containing. May be recycled.
Garden waste	General	General Waste : Organic - where it is disposed on site, composting should be considered
Fluorescent tubes and CFL'	SANS 0228 8 (H:H)	Mercury containing
Waste paint	SANS 0228 3.3 (H:h)	Aliphatic solvent
Construction waste	General	General Waste
Asbestos	SANS 0228 9 (H:H)	Asbestos fibres
Medical & Sanitary waste	SANS 0228 6 (H:H)	Infectious waste
Sand/ shot blast waste	SANS 0228 6 (H:H or H:h)	Uncertain leachability - TCLP leach test required for accurate classification
Oily rags/ oil contaminated saw dust	SANS 0228 3.3 (H:H or H:h)	Assumed flammable

Waste Stream	Estimated classification	Comments
Waste herbicides/ pesticides	SANS 0228 6 (H:H or H:h)	Assumed to be toxic
Used oil & Lubricants (incl. PCB's)	SANS 0228 3.3 & 8 (H:H or H:h)	Assumed flammable
Scrap metal	General	Assumed to be free of oils
Lead acid & other batteries	SANS 0228 8 (H:H or H:h)	Assumed to be Lead/ Nickel/ Cadmium containing
Sewage	Hazardous	Assumed to be hazardous

a) Power Station

Sewage treatment

The poor management of sewage waste in South Africa has reached critical proportions with many local municipal sewage works being poorly maintained and design capacity criteria exceeded. This results in biological contamination and super nitrification of surface and ground water resources which is impacting on environmental, economic and domestic aspects of South African life.

Although the planned Khanyisa Power Station would require a sewage treatment plant significantly smaller in capacity than those used by municipalities, poor design and management can result in considerable detrimental impacts on the receiving environment. In this regard, a complete raw water treatment plant will be provided including flocculation and sedimentation devices and a filtration disinfection system for potable water.

Although there is a number of sewage treatment options, MM reported that polishing plants using ion exchange systems are becoming less popular with IPPs due to their chemical use. Furthermore, due to the increased reliability of industrial scale electronic systems developed for the semi-conductor industry, systems such as Membrane Deionisation (MDI) or Electronic Deionisation (EDI) Systems are preferred. These systems produce demineralised water by a reverse osmosis process, followed by a polishing ion exchange or an MDI/EDI system. High-purity water production has traditionally used a combination of membrane separation and ion exchange processes. One well-known membrane separation concept is electrodialysis (ED), which uses an electrical potential to transport and segregate charged aqueous species.

EDI is a further refinement of electrodialysis in that it combines the semi-permeable membrane technology with ion-exchange media to provide a high efficiency demineralization process. While the fundamental concept is somewhat simple with the basic desalting unit being an ED dilute cell filled with mixed-bed ion-exchange resin, some complex chemical reactions take place within the resin-filled cell. It is these reactions that help to produce the very high purity water required.

When flow enters the resin-filled diluting compartment of an EDI stack, several processes are set in motion. Strong ions are scavenged out of the feed stream by the mixed bed resin. Under the influence of the strong DC field applied across the stack of components, charged ions are pulled off the resin and drawn toward the respective, oppositely charged electrodes, cathode or anode. As these strongly charged species, such as sodium and chloride, migrate toward the ion-exchange membrane, they are continuously removed and transferred into the adjacent concentrating compartments (see Figure 4-5).

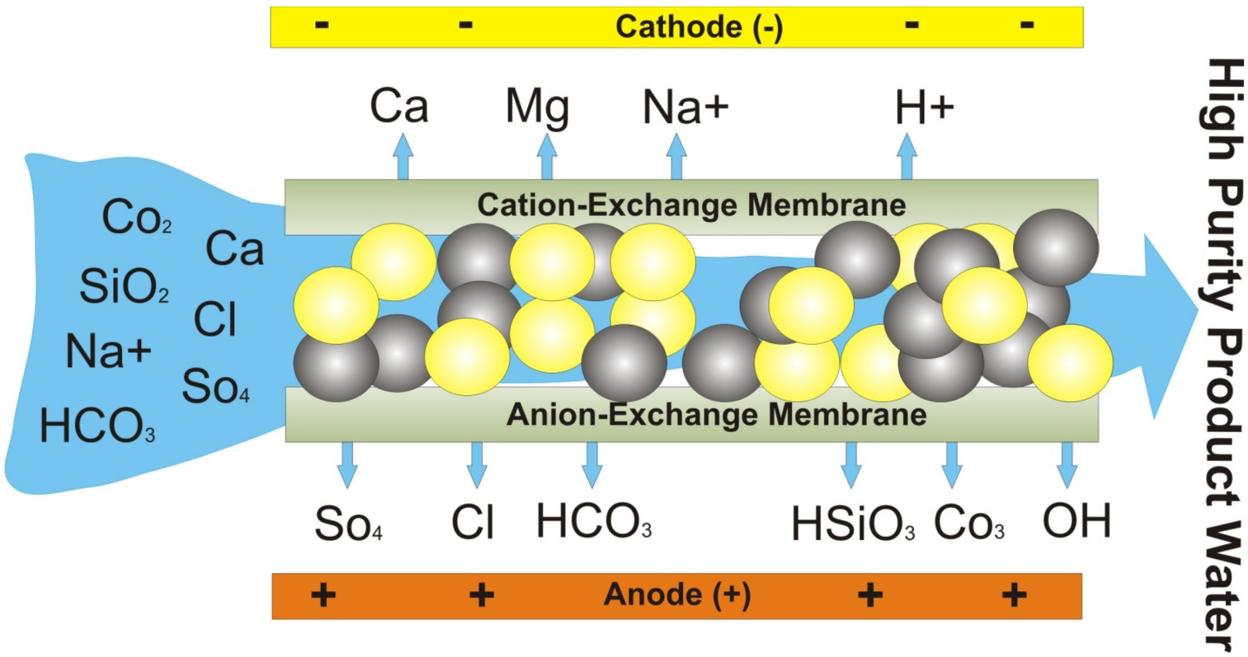


Figure 4-5: EDI Chemical Reaction Process

As the strong ions are removed from the dilute process stream, the conductivity becomes quite low. This relatively pure water helps to set the stage for further chemical reactions. The electrical potential splits water at the surface of the resin beads, producing hydrogen and hydroxyl ions.

These act as continuous regenerating agents of the ion-exchange resin. These regenerated resins, in turn, act as micro-regions of high or low pH permitting ionization of neutral or weakly ionized aqueous species such as carbon dioxide or silica.

Once these species acquire a charge through this ionization process, they become subject to the influence of the strong DC field and are removed from the diluting compartment through the ionexchange membranes (see Figure 4-6).

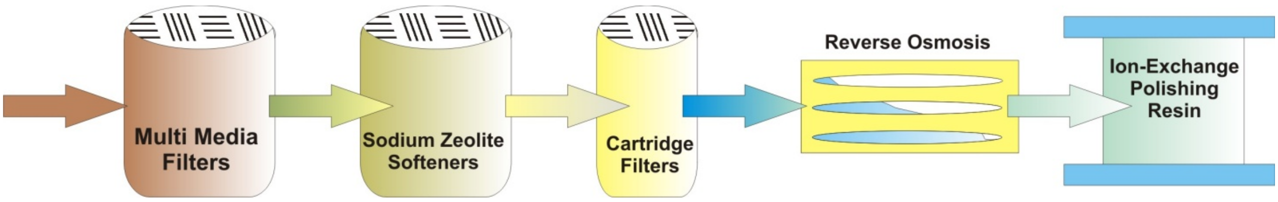


Figure 4-6: EDI Process Cycle

The membranes used in EDI stacks are flat sheet, homogeneous, ion exchange membranes which help to provide efficient ion transfer.

Processed wastewaters consisting of filter backwash, reverse osmosis reject and regeneration wastewater will be collected, and treated. Once treated, water will be delivered to all water points by the raw water pump. The following infrastructure will constitute the water treatment facility:

- Pump house and distribution pipelines to the proposed Project site and storage;
- Raw water storage tank at the proposed Project site;
- Reverse osmosis (RO) plant; and Wastewater treatment system.

Sewage treatment will be accomplished using a biological treatment process. Sewage solids will be dewatered and disposed to the ash dump. Wastewater that cannot be reused will be disposed to the effluent/evaporation pond. The plant will be designed as a Zero Liquid Effluent Discharge (ZLED) facility.

Storm Water

As part of the ESIA process Mott MacDonald Limited (MM) were commissioned by Anglo American (AOL) to prepare a conceptual Plant Drainage Systems Philosophy for the proposed Khanyisa 450MW Coal Fired Power Station. The detailed Storm water management report is attached as **Volume 4, Annexure O**.

The Plant Drainage Systems Philosophy compiled for the proposed Khanyisa power station outlines the proposed management of storm, foul and process drainage systems and include the following anticipated drainage systems:

- Storm Water
- Foul Water
- Process Water
    - Oily water drainage for Fuel Oil Tank area; Workshops; EDG Building; Turbine Building; Air Compressor Building; Plant floor drains; Fuel Oil Pumphouse etc.
    - Transformer oil / oil-water drainage.
    - Lube oil drainage.
    - Chemical / Industrial wastewater from Demin Plant; Battery rooms; Water and Wastewater Treatment Plant etc.
    - Boiler washwater; Boiler Blowdown

This Plant Systems Drainage Philosophy provides a stormwater management system which meets the Department of Water Affairs and Forestry (DWAF, now known as Department of Water Affairs) guidelines during the construction and operational phases of the Power Plant. This Plant Drainage Philosophy can be developed further as the Project progresses to ensure that the design of the Plant makes sure that there are acceptable methods to address with the anticipated Plant Drainage systems. The Plant Systems Drainage Philosophy is to be read in conjunction with the Conceptual Storm Water Management Plan for the Ash Disposal Site (**Volume 4, Annexure O**) which provides the details of the ash dump stormwater management system.

The Plant Drainage Systems Philosophy has been developed in accordance with the following Department of Water Affairs and Forestry guidance, deemed to meet the legal requirements.

- Best Practise Guideline – G1: (BPG – G1) Storm Water Management; and

- Best Practise Guideline – H3: (BPG-H3) Water Reuse and Reclamation.

As explained above, the following four general principles outlined in BPG-G1[3] have been considered and used in developing this SWMP, as necessary:

- Principle 1: Keep clean water clean;
- Principle 2: Collect and contain dirty water for treatment;
- Principle 3: Sustainability over power station life cycle; and
- Principle 4: Consideration of Regulations and Stakeholders.

Part of the SWMP is to store and reuse storm water for process purposes and to suppress ash dust on the site. However, the daily water requirements over the operation life of the power station cannot be met by the storm water runoff alone. Provision will therefore be made to use an off-site water supply to serve as an additional source of process water.

The basic concept of the Plant storm water system design is to collect the surface storm water and other process non-contaminated water through a network as described below to a storm water storage and re-use facility (Figure 4-7). It is envisaged that the storm water drainage system for the power station will consist of the following:

- Filter drains, ditches and/or culverts along the perimeter of the site;
- Filter drains, ditches and/or culverts along access roads and hard standing, vehicle parking areas etc;
- Roof drainage systems; and
- Drainage network (pumped or gravity as necessary) to discharge / storage location.

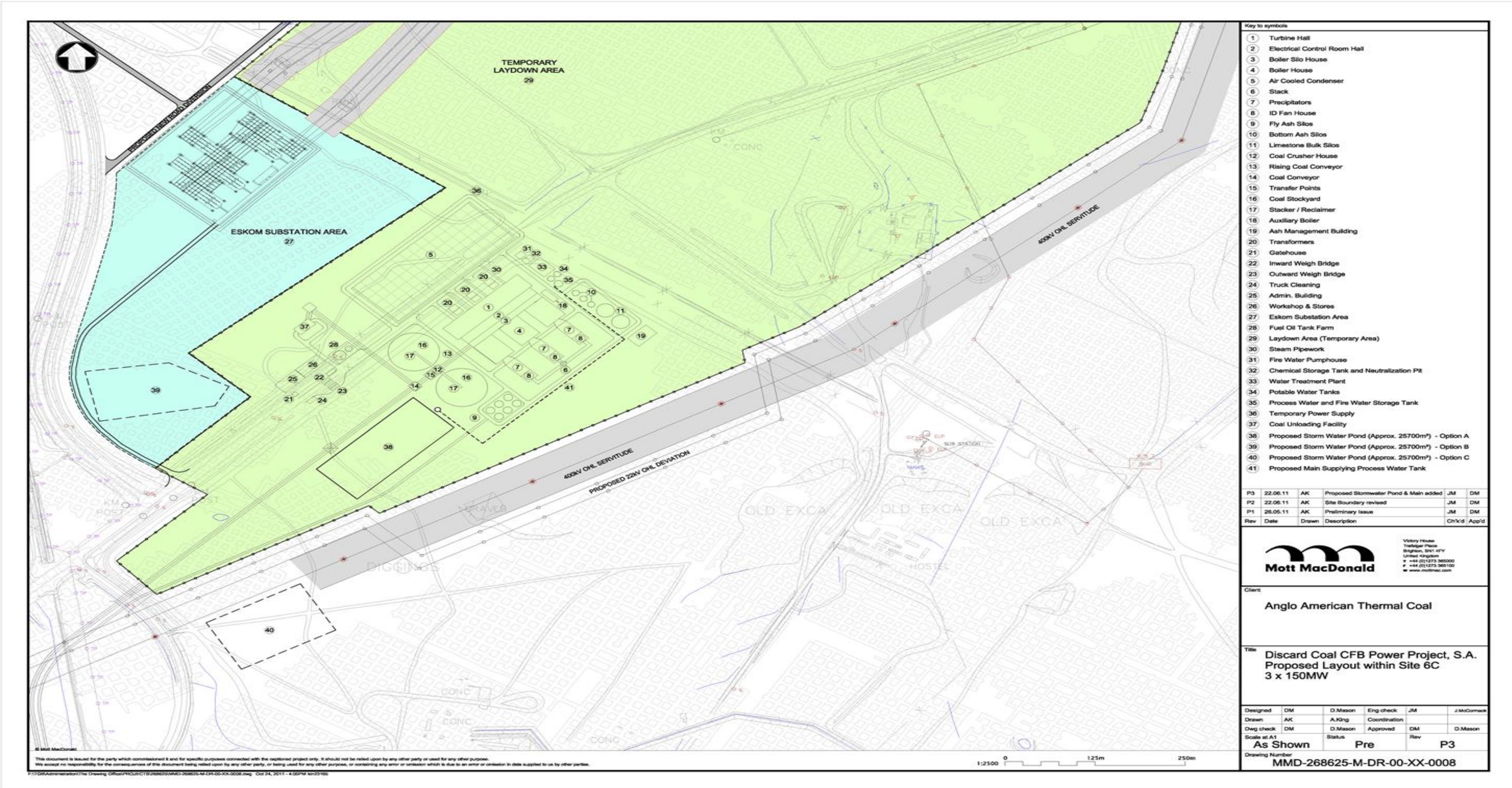


Figure 4-7 Stormwater collection ponds

Solid waste

The removal of solid waste material, during both construction and operational phases, will be contracted to a certified service provider such as Roshcon (PTY) Ltd.. Roshcon is currently contracted to AOL for the Klein Koppie mine waste removal and is certified for both general and hazardous waste removal. Roshcon have confirmed that they are able to perform the waste removal responsibility for the IPP.

Ash Dump

Ash

Coal is a complex combustible rock made up of organic and inorganic mineral components which contain many elements. During combustion, elements present in the organic and mineral components of coal are redistributed, as a result of high temperatures, into new gaseous and solid phases. In the new solid phases or coal combustion products (CCPs), the elements may be uniformly distributed throughout a grain, enriched in certain grains or areas of grains, or present as coatings on grains or adsorbed onto grain surfaces. Particle size, coal rank, amount of ash, coal mineralogy and the trace element content are important variables controlling the combustion and mobility of elements in coal. For fly ash, the original composition of the feed coal, the combustion conditions, the size of the fly ash particles, and the fly ash mineralogy influence the distribution and mobility of trace metals.

Determination of elements in feed coal is important because the content, distribution, and behaviour of elements during and after combustion depend in large part on the content and distribution of trace elements in the feed coal. Elements of environmental interest are important because they can be potentially released into the environment during coal utilization.

Studies of feed coal are important because the greater the variability within the feed coal, the greater the variability in the fly ash and the more difficult it is to predict the properties of the fly ash, including modes of occurrence of trace elements in fly ash.

Determination of minerals in coal and fly ash is important because minerals affect coal and fly ash utilization, and the location and leachability of elements, as well as control the acidity (pH) during interaction with water. Coal mined for use in power plants contains common rock-forming minerals, primarily well-crystallized quartz and kaolinite. Chromium, nickel and cobalt are also elements of environmental concern.

Leaching Studies

Coal and coal combustion products (CCPs) can alter the composition of solutions they come into contact with through water-rock interactions. This can be a significant environmental consideration in the use of coal for energy production, especially because CCPs can be used in building materials and as soil amendments, and are also disposed of in surface impoundments. These water-rock interactions can be characterized by techniques that (1) allow mixing of solids and leaching solutions that simulate environmental conditions and (2) determine modes of occurrence of trace elements in coal and CCPs.

Leaching experiments range in duration and severity of chemical treatment. Different types of leaching tests provide different types of valuable information on the leaching behaviour of coal and CCPs. Reactions between the solid phase, such as fly ash, and the solution change the solution composition, which affects the pH and the mobility of trace elements. The physical and mineralogical properties of the solid phase help identify reactants that could substantially change solution composition. The pH dependency of trace metal mobility emphasizes the importance of solution-solid phase interaction in controlling trace element mobility.

Many factors contribute to and control how coal and fly ash will affect the environment and the solutions that they contact. Particle size, coal rank, amount of ash, coal mineralogy, and the trace element content are important variables controlling the combustion and leaching of coal. For fly ash, the original composition of the feed coal, the combustion conditions, the size of the fly ash particles, and the fly ash mineralogy all influence the distribution and mobility of trace metals. Coal waste/environmental studies should, thus, focus on the variability of feed coal quality in order to assess the environmental impact.

Ash dump design

The potential ash disposal site (Ash 3, Figure 4-9) is a former backfilled opencast pit which is currently owned by Anglo Operations Limited. It is located 2.7km to the south west of the proposed Khanyisa Power Station on Portions 7, 11, and the Remaining Extent of the Farm Klippan 322.

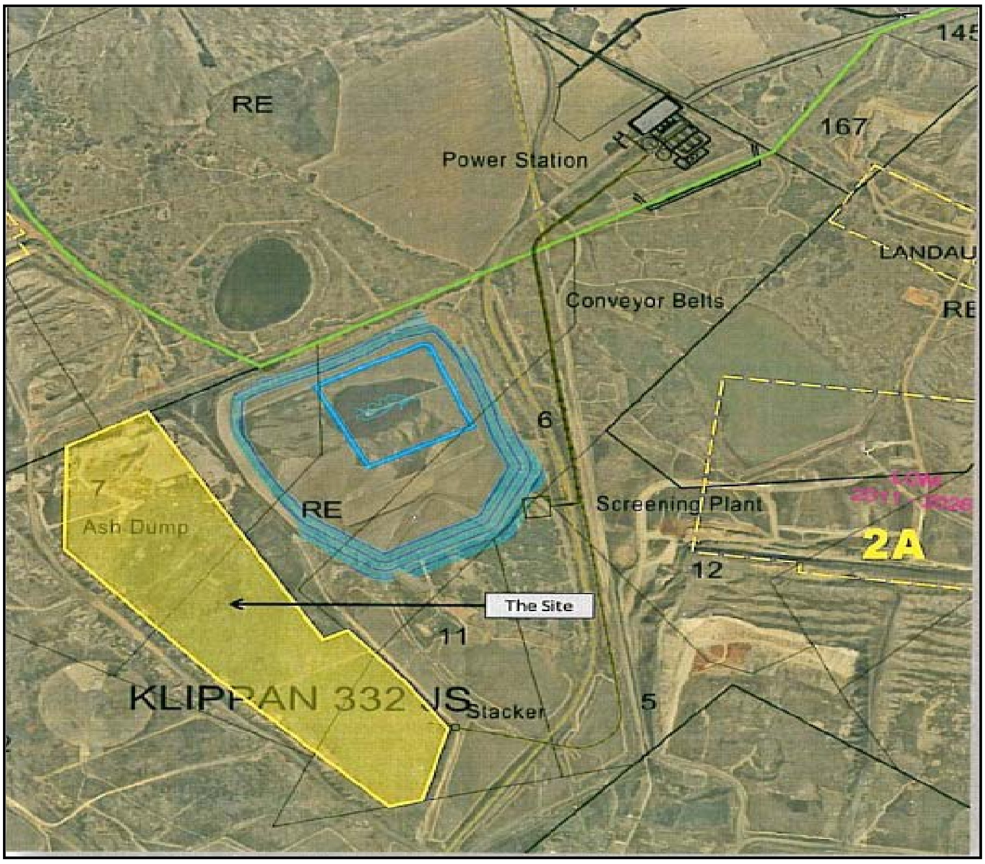


Figure 4-8: Locality of Ash Disposal Site

The disposal of ash has the potential to pollute water resources, including the contamination of groundwater from leachate and the contamination of surface water from discharge of ash pond effluent, and therefore the effective management of this impact has been prioritized within this assessment. As part of this ESIA, a conceptual Storm Water Management Plan (SWMP) was developed and is appended to this report (**Volume 4, Appendix O**). The storm and waste water systems for the proposed ash disposal liner and related infrastructure are designed to South African GN704 Regulations.

There are two fundamental design requirements for the landfill:

- Anglo American requires that the power stations landfill site be able to accommodate the ash generated over a 20 year operating period, which would be expected to generate a total of approximately 28 million tonnes (or 2.3 million m^3) of ash.

- Based on the classification of the waste stream in Section 3 and in accordance with the “Minimum Requirements”(2), the proposed landfill shall be suitable for the acceptance of hazardous (H:H) waste.

In order to address these basic requirements, a conceptual design has been prepared based on a total ash disposal area of approximately 1,680,000m² (168 hectares) being made available through Anglo American, as shown on Figure 3.5 below.

In principle, it is proposed that the landfill be developed in cells (Figure 3.6) with each cell having the capacity to receive ash for a year. The rationale for this approach is the progressive deposition and capping of the ash waste to spread the capital expenditure costs and minimise leachate generation / treatment. Accordingly, it is proposed to divide the ash disposal liner into 20 individual cells, with the footprint of each cell comprising approximately 40,000 m² (4 hectares). The total landfill footprint is approximately 80 hectares and the area available as reserve for future liner development and/or source for landfill cover material is approximately 36 hectares. Each cell would be able to accommodate approximately 1.4million tonnes of waste on average.

The conceptual design of each cell has been prepared based on it being partially constructed beneath the existing restored level of the opencast backfill, but with the majority of the waste placed above the restored level in the manner of a traditional land-raise landfill. The rationale for this approach is as follows:

- Partial burial of the landfill waste would reduce the depth of opencast backfill beneath the liner, such that potential settlements that could affect the integrity of the lining system are reduced;
- The excavated material would be used as daily cover for the waste, with the cell sized such that enough was won to avoid the need to import material; and
- Partial burial would reduce the visible height and hence visual intrusion of the landfill.
- Based on these principles, which are amplified in more detail in the following sections, the conceptual cell layout plan and indicative site infrastructure requirements are presented in Figure 3.6 to 3.8 below.
- The cell construction and operation will be a phased approach, where cells 1 to 10 are in Phase 1 and cells 11 to 20 in Phase 2 (Figure 3.6 to 3.8)

Cover requirements

Ash is classified as hazardous waste and must be covered overnight, to avoid contact with the public and to prevent dust pollution. Section 8.2.2 of the Minimum Requirements[12] clarifies that daily cover should be used as part of landfill operation. It is considered that the opencast material is acceptable material for cover, given that the material was used to rehabilitate the surrounding area.

The volume of material required to be won from the cell excavation was calculated taking into account the soil required for berms, daily cover and final cover. The total air space was calculated by quantifying the volume of cover material available and using a cover to waste ratio of 1:10, which was determined from the shape of the final landform. On this basis the total volume of cover required is approximately 2,000,000m³, based on a daily cover thickness of 300mm. Initial estimates indicate that the volume of material required can be obtained from cell excavation to formation level. If more material is required, an additional 36 hectares of land is available as a source of additional cover material and for future liner development.

The top 200mm of the final cover will be imported topsoil. For an estimated average cell area of 47,000m², the volume of topsoil required per cell is approximately 10,000m³. Since only half the cell is permanently capped whilst the other half is temporarily capped, the volume of topsoil required per year would appear to be approximately 5,000m³. On-site storage of topsoil is available within the 36 hectares of land to the north of the site area.

The primary leachate collection system for each cell will comprise a network of perforated smooth bore (minimum 200mm diameter) pipes (typically high density polyethylene or polypropylene) embedded in the upper 300mm thick Leachate Collection layer, a collection sump and a side slope riser. The slope riser was adopted to avoid the high construction and maintenance cost of vertical chamber. The secondary leachate collection system is similar to the primary, but with a smaller side slope riser. Conceptual design of the leachate riser and drainage collection chamber are shown in Figure 4-9 below.

The capacity of the proposed leachate collection sump (drainage collection chamber) is approximately 80m³, which is considered to be adequate given the additional storage capacity within the leachate drainage layer. Further detail regarding the proposed ash disposal site can

[12] Department of Water Affairs and Forestry, The Minimum Requirements for Waste Disposal by Landfill, Second Edition, 1998

be referenced in the following documents – *Thermal Coal Ash Disposal Site, Feasibility Study (MM, 2011*), **VOLUME 4**.

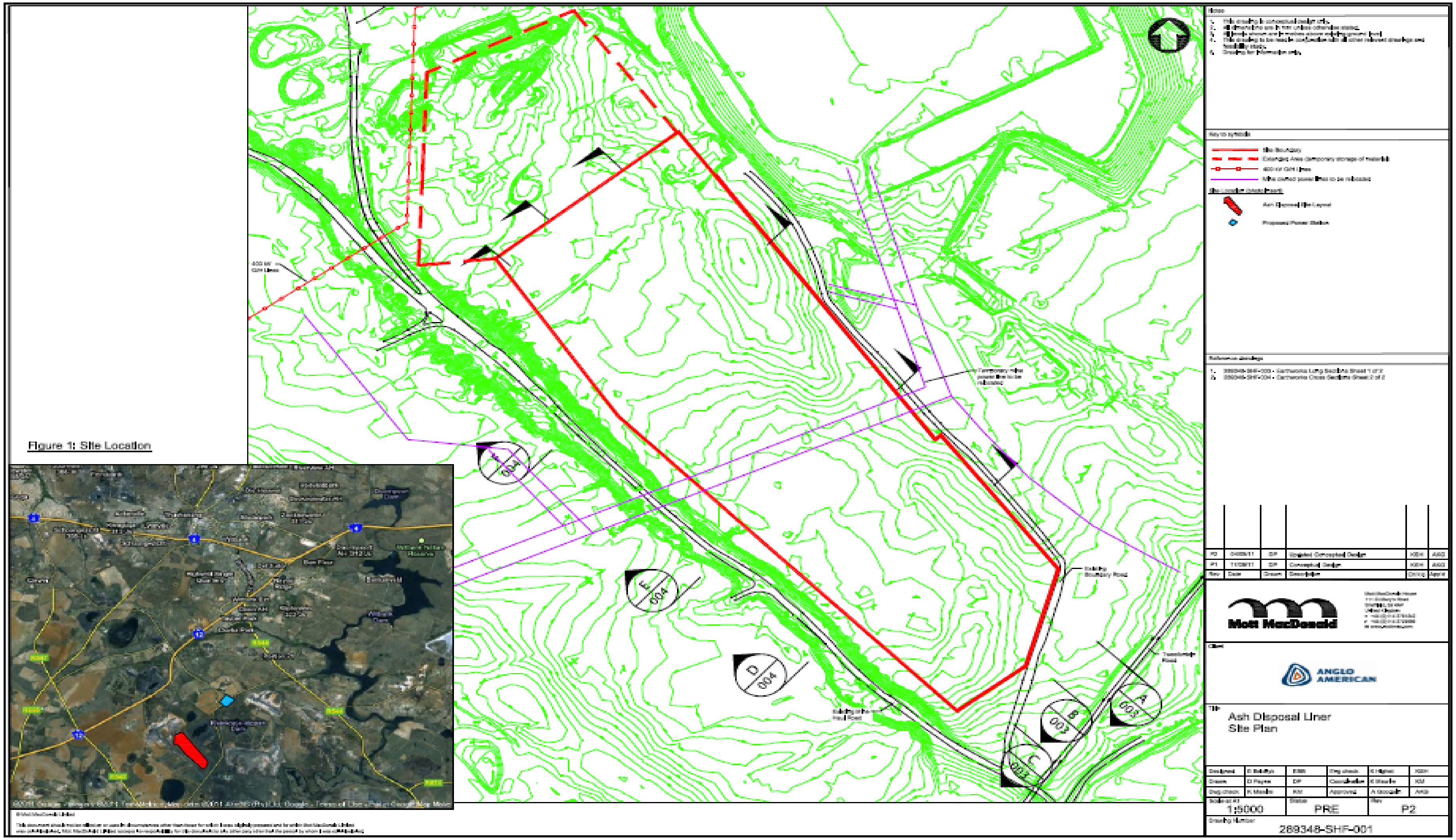


Figure 4-9: Ash Disposal – Site Plan

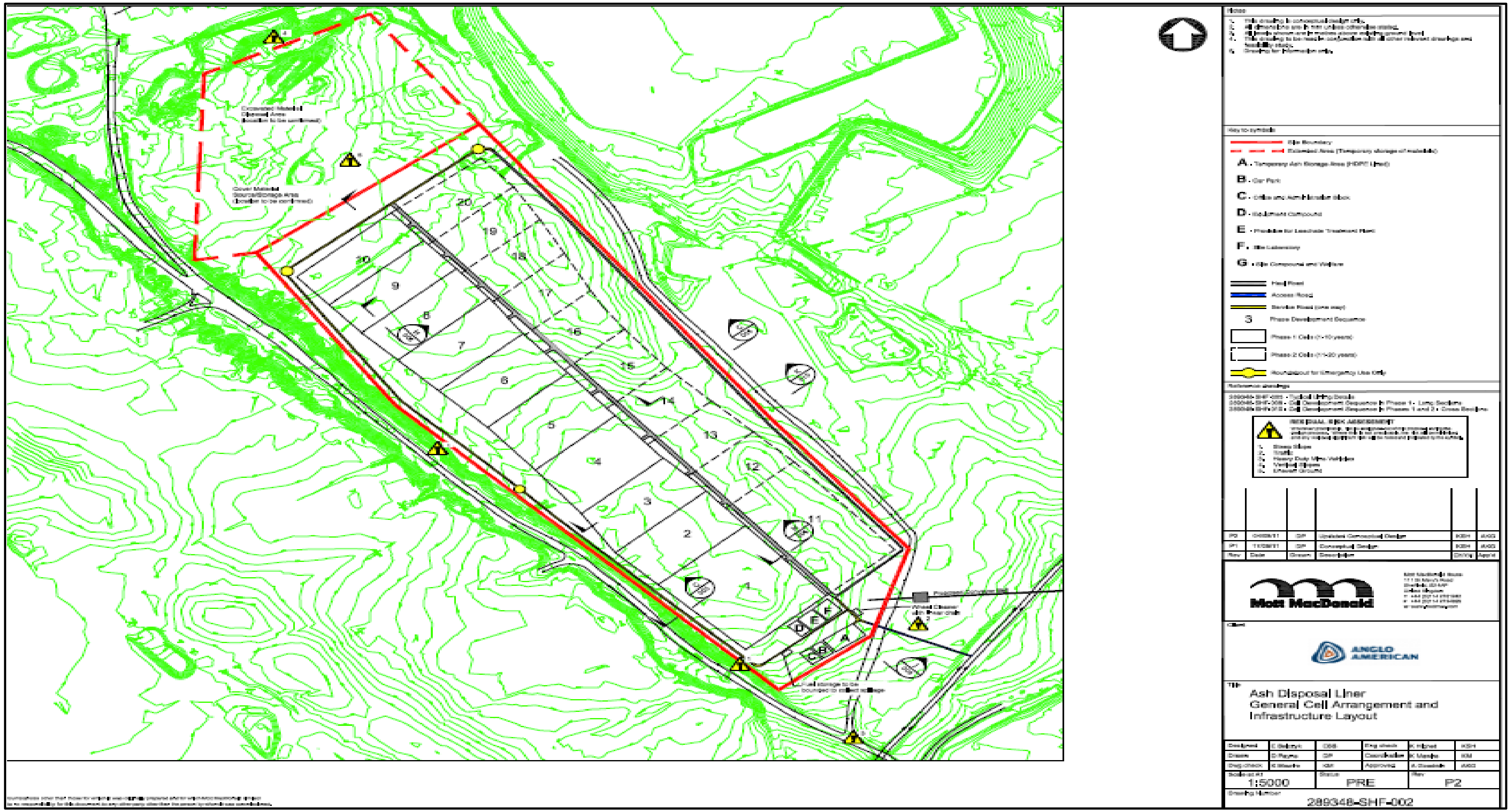


Figure 4-10: General cell arrangement

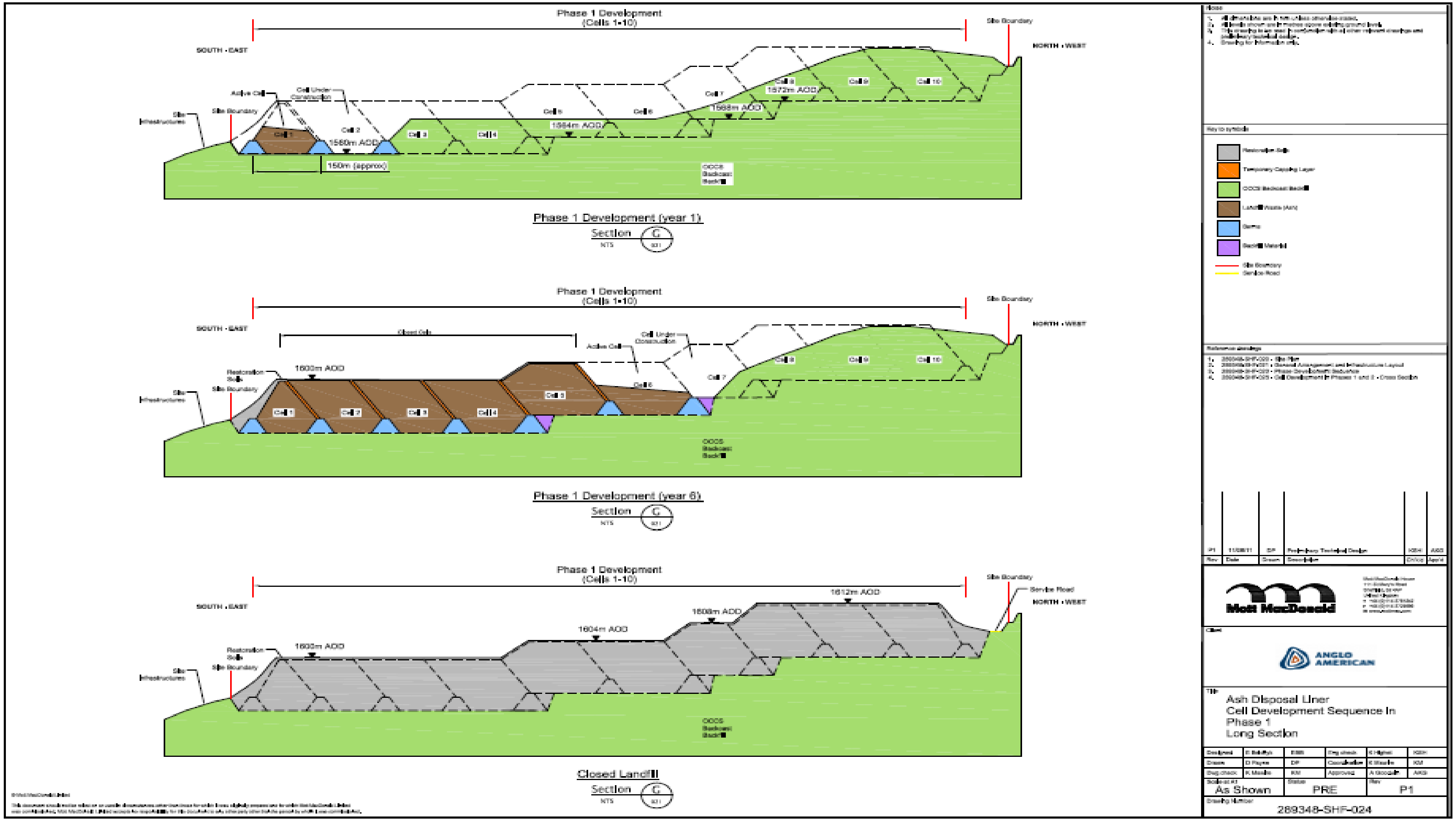


Figure 4-11: Ash Liner Cell Development – Phase 1

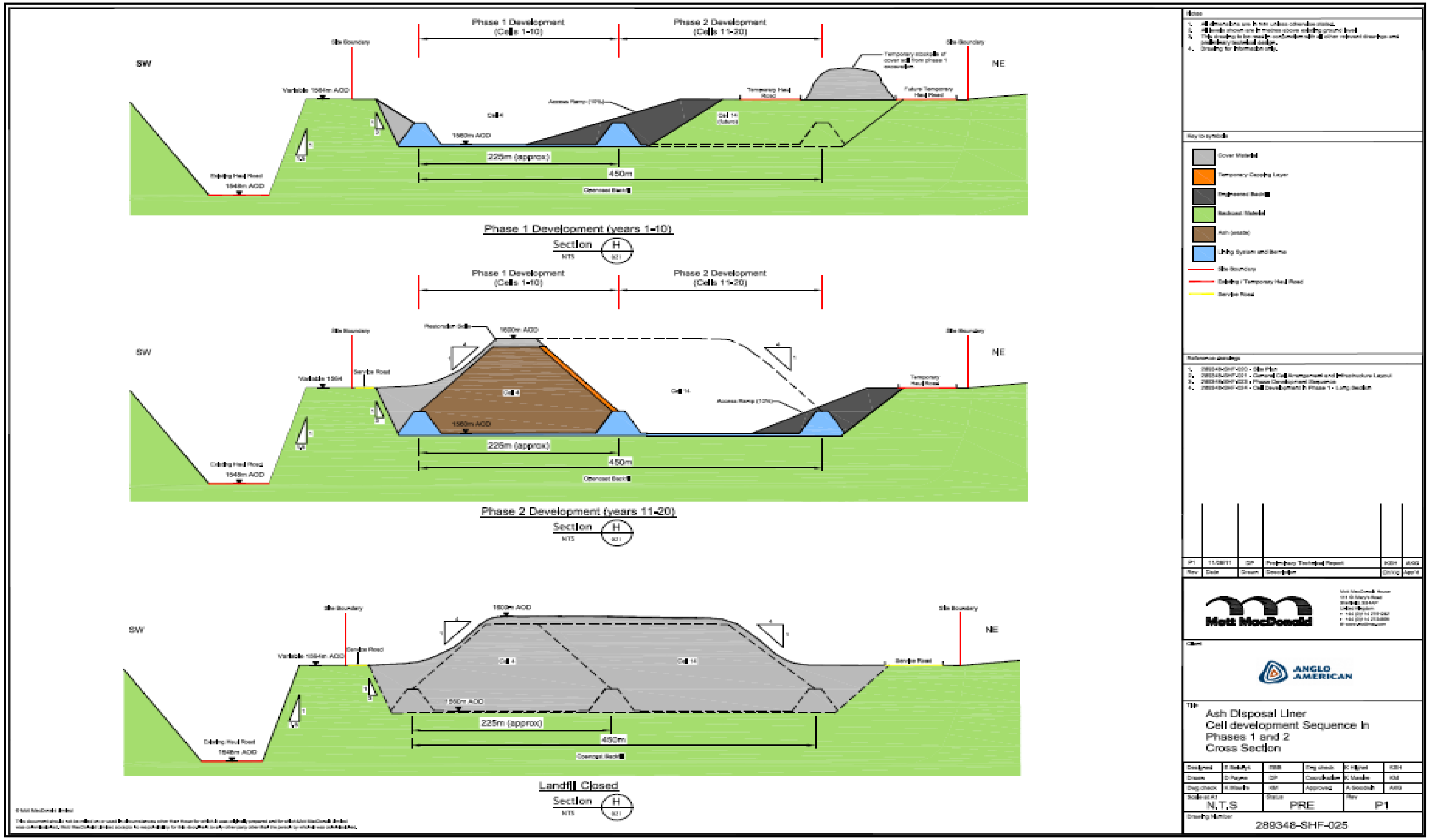


Figure 4-12: Ash Liner Cell Development – Phase 1 & 2

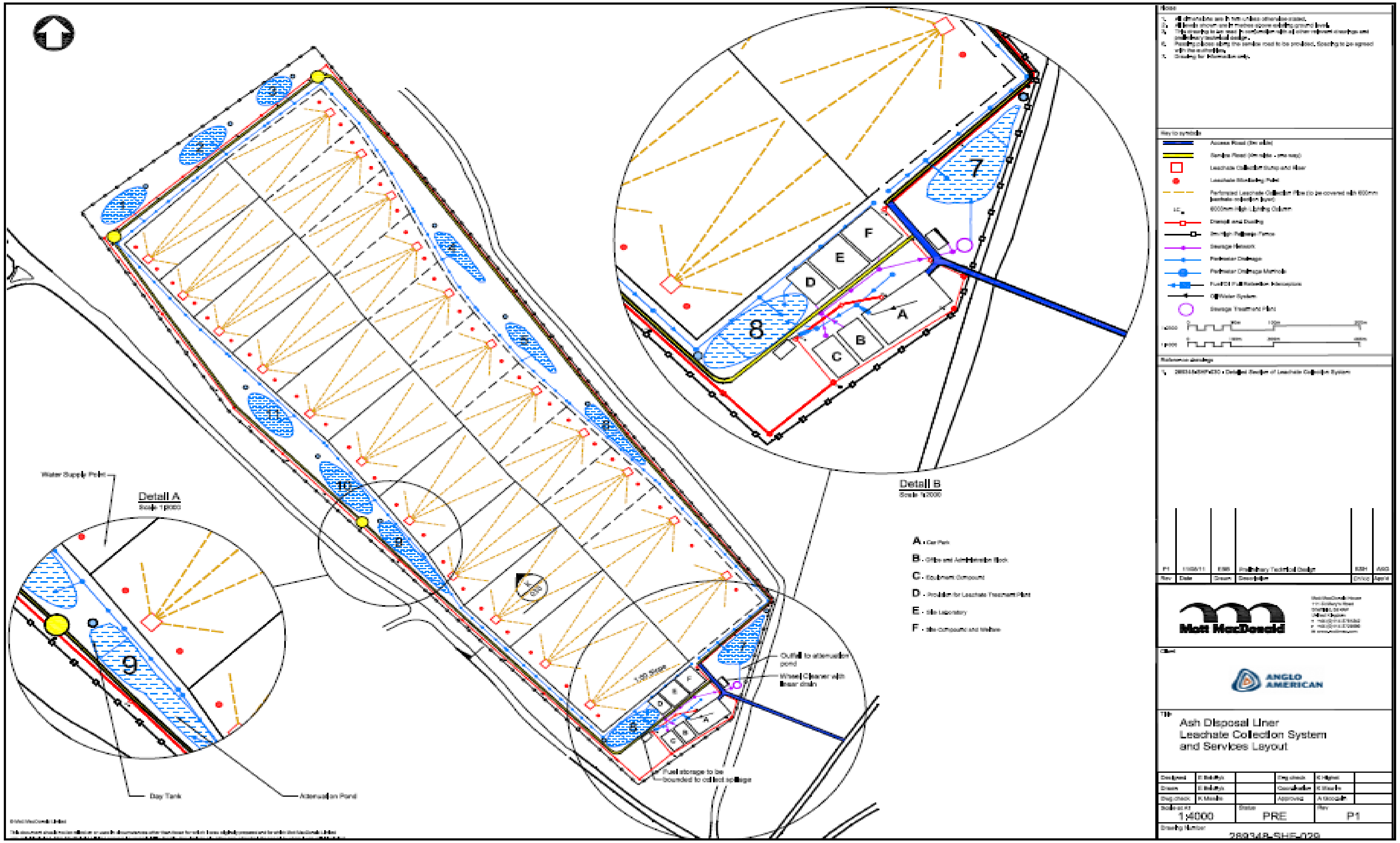


Figure 4-13: Ash Liner Leachate Collection System

Storm water management

Significant amount of water will be required daily during landfill operation to suppress ash dust. It is therefore planned that any runoff on site be stored and reused. The runoff is considered to be clean water and of sufficient quality for dust-suppression purposes.

The following section describes and outlines the storm water storage requirements, the estimated daily water demand for dust suppression and how the storage tanks for storm water interface with those for dust-suppression. The section concludes by considering storm water discharge in the post-closure phase, and the necessary maintenance requirements.

- Clean Water Storage
  In addition to the landfill area, the runoff within area around the site infrastructure is also considered to be clean water. The runoff is separated from the dirty water and rerouted to the storage tanks for reuse.

- Perimeter drainage system
  The perimeter drain comprises the eleven sections of drain from the catchment areas. However, the gradient of the perimeter drain will be dictated by the design capacity of each pipe length to convey the water to the storage ponds. Details are given in VOLUME 1, ANNEXURE C on Drawing No. 289348-SHF-013.

- Storage
  The storm water storage requirements have been assessed and as such, eleven storage ponds are required to contain the storm water. It is noted that the demand for storage is spread over twenty years and the tanks will be built accordingly.
  For safety and maintenance reasons, it is proposed to limit the pond depths to approximately 1.5m. The resulting area provides potential for evaporation, which is required during post closure phase.

Table 4-2: Summary of the estimated peak floods and volumes by catchment area

Catchment No.	Catchment Area (ha)	Peak Flow (m^3/sec)	Estimated Volume (m^3)	Indicative maximum pipe size (mm)
1	8.4	4.1	11600	1500
2	8.74	5.6	12100	1500
3	6.0	2.7	8300	1200
4	6.65	4.1	9200	1500
5	6.94	4.3	9600	1500
6	6.69	4.4	9300	1500
7	6.69	4.3	12900	1500
8	9.08	4.4	12600	1500
9	9.44	5.4	13100	1500
10	10.5	6.2	14500	1500
11	9.47	5.6	13100	1500

Maximum pond storage capacity is 14,500m3 and the depth is limited to 1.5m. Therefore, the Dam Safety Regulations4 which apply to dams with a maximum wall height that exceeds 5,0 m and with a storage capacity of more than 50 000 m3 are considered inapplicable. In accordance with Section 2 of the Dam Safety Regulations, the largest pond is unclassified since the lowest class (small) applies to minimum dam height of 5m. The hazard potential to loss of life is “none” and “minimal” to potential economic loss.

Along the western boundary of the landfill, the ponds are positioned as far away from the existing slope as space allows so as minimising the risk of slope instability. The closest storage pond to the edge of the slope is approximately 40m away. Storage has been designed in the form of ponds and located as shown in Figure 3.10 below. Detailed drawings can be referenced in **VOLUME 1**, **ANNEXURE C** - Drawing 289348-SHF-012 & 013

- Estimation of Daily Water Demand for Dust-Suppression

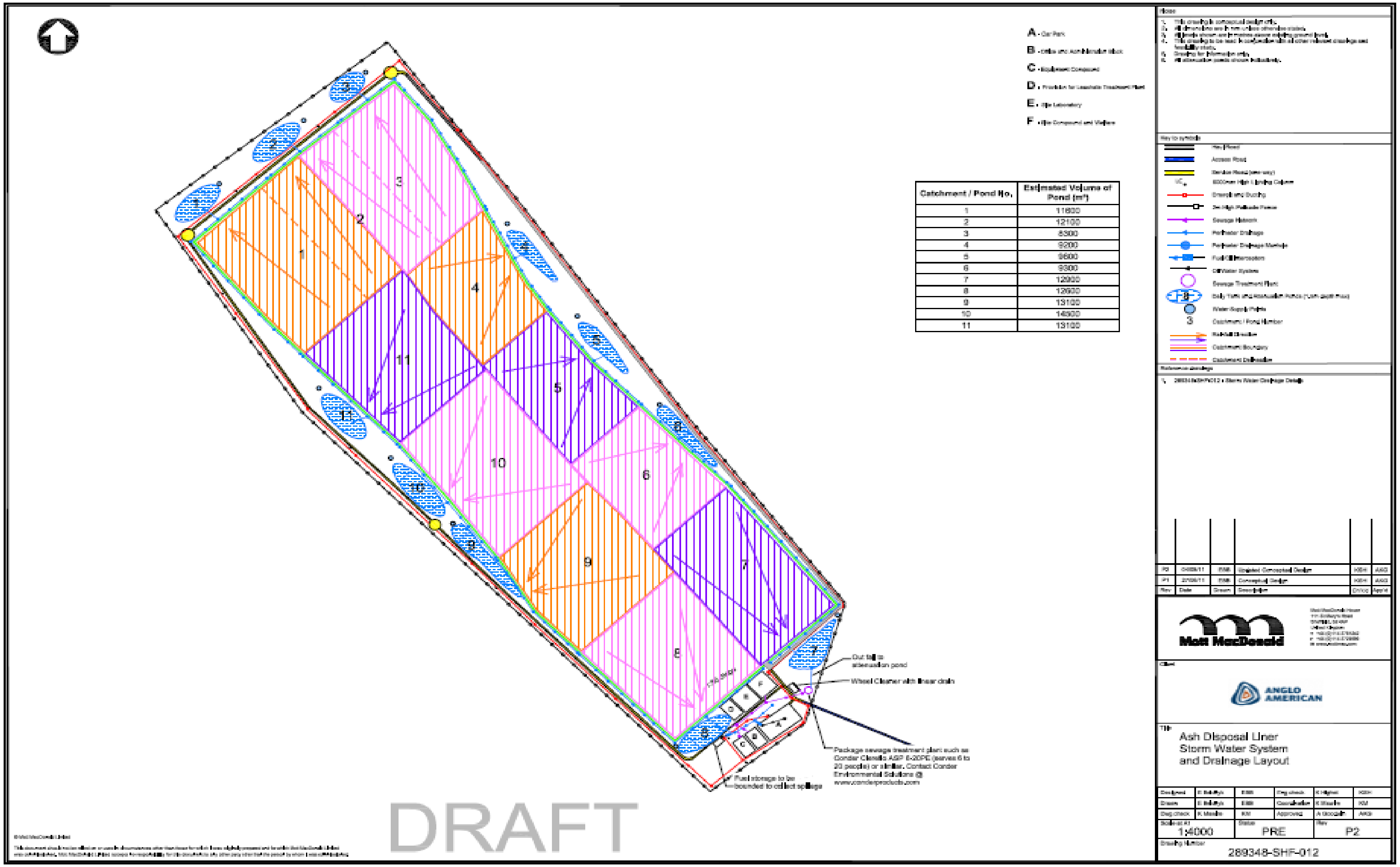
  The water storage tank for dust suppression is herein referred to as the “day tank”. The capacity of the day tank will depend on the daily water demand, which is a function of the daily weather conditions. In principle, a minimum reserve of 1-day storage capacity is provided.

  Assuming a dust suppression demand of approximately 200mm every day for a single cell (a figure slightly higher than the highest monthly average evaporation rate), the estimated water requirement is about 350-400m3 per day. A day tank storage capacity of 500m3 is required.

  The sprinkler irrigation method for dust suppression is proposed for the following reasons:

  - It is effective in that it covers a large area simultaneously;
  - It requires less labour input;
  - It eases traffic management within the cells; and
  - Reducing the number of vehicles within the cell reduces pollution at the wheel wash.

  It is considered that water collected from storm water will not be sufficient for dust suppression; therefore, an off-site water source will need to be provided to augment this system. The available water for dust suppression will be pumped from the mining operations, but will require pre-treatment as is the case with water used at the mine.



Catchment / Pond No.	Estimated Volume of Pond (m³)
1	11600
2	12100
3	8300
4	9200
5	9600
6	9300
7	12900
8	12600
9	13100
10	14500
11	13100

Figure 4-14: Ash Liner Storm water system

- Water Storage

  For convenience, it is considered to have the day tanks as extensions of the storm water storage tanks, but separated by a wall. The advantages of this design solution include:

  - The two can be constructed as integral units;
  - Convenient maintenance during landfill operation; and
  - The middle wall will be removed after landfill closure to increase the capacity of the storm water storage tanks, which will operate as attenuation/evaporation tanks/ponds thereafter.

  Therefore eleven daily tanks are proposed, to mirror the number of storm water ponds. In addition, local water supply points have been proposed, to supply water from off-site for dust suppression, as and when runoff water is depleted.

4.2.14. Water Consumption

Water for the proposed power station will be provided by the eMalahleni Water Treatment Plant (EWTP) via pipelines directly to the site. The water pipeline will be placed within the D2769 road servitude and run directly to the proposed site (
Figure 4-15). The required water quantity is approximately 91 m³/hr and is available in three different forms from EWRP, namely potable water, permeate water and process water. Each of these three water forms has a different quality and will be used for different purposes.

High quality water for the boiler will probably be based on the permeate water supply and will be treated on site to the required quality in the on site demineralisation plant.

The power station will require water for human use (potable), process water for the boiler plant, cooling and cleaning purposes. Typically, the largest water consumer within a power plant is the cooling of the turbine condenser. However, due to the water scarcity in South Africa, and more particularly within the Highveld region of Mpumalanga, this project proposes the use of air cooled condensers (ACC) instead of hybrid cooling towers. A more detailed explanation of the alternative assessment can be found in section 3.

Figure 4-15 Proposed water pipeline route from EWRP

a) Boiler Feed water

It has been ascertained that a 450 MW plant is assumed to require approximately 30 tonnes of water per hour as make up to the boiler feed water system to cover for the losses due to boiler blowdown. The design specifications prescribe a zero plant discharge requirement and therefore most of this water will be retained on site, treated and reused as boiler water. It is estimated that approximately 95% of boiler blowdown can be treated and reused meaning that the water supply is reduced from 720,000 litres to 36,000 litres per day.

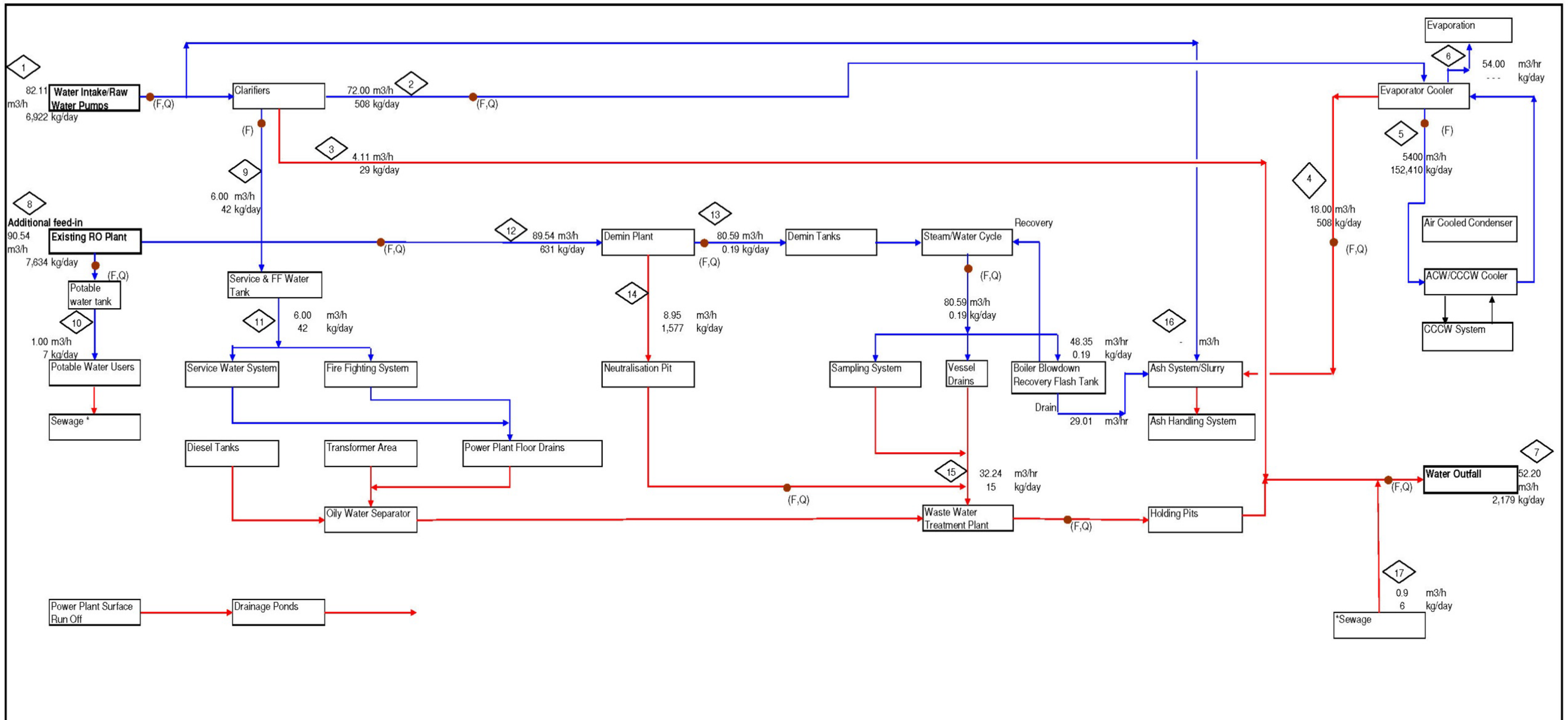
Boiler water quality is maintained through the addition of certain chemicals and a constant purge process to remove impurities. This purge flow or blowdown will be retained on site for ash conditioning following appropriate treatment. The waste generated from the demineralisation plant will be neutralised in the neutralisation pit. Contaminated waste will be removed from site by a specialist contractor to a licensed disposal facility.

The process water of approximately 82 m3/hr will be used in some auxiliary plant coolers, fire fighting, wash water and other services. The raw process water would be passed through clarifiers to remove any particulate matter and impurities. The clarified water will be transferred to service water tanks where the water will be stored for its usage to fire fighting system and other services like HVAC, wash water etc. The waste generated from clarifiers will be transferred to holding pits and removed from site by a specialist contractor to a licensed disposal facility. Grey water will be collected from buildings and covers and will be used in toilets and other suitable uses.

b) Human Consumption

High quality water for the boiler will be based on the permeate water supply and will be treated on site to the required quality in the on site demineralisation plant. It is assumed that each person on site (Full Time Equivalent) would consume approximately 100 litres per day. For a staff complement of 120 this equates to 12,000 litres per day.

Climatic Water Balance



		Flow Line	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
			Water Intake	Clarified Water to ACW cooler	Clarifier Sludge	ACW Cooler Blow Down	ACW water	Evapourati on loss	**Water Outfall**	**Additional feed-in to existing RO plant**	Service Water Supply	Additional Potable Water Usage	Service Water to Users	Demin Plant Supply	Demin Water to Plant	Demin Plant Waste	Stm/Wtr Cycle Waste	Ash System Supply	Sewage
Parameter		Unit																	
Flow		m3/h	**82.1**	72	4.11	18.0	5,400	54.0	**52.2**	**90.54**	6.00	1.00	6.00	89.54	80.59	8.95	32.24	0	0.90
TDS		mg/l	**3,513**	294	294	1,176	1,176	- - -	**1,739**	**3,513**	294	294	294	294	0.1	7,340	20	294	294
TDS		kg/day	**6,922**	**508**	**29**	**508**	**152,410**	- - -	**2,179**	**7,634**	**42**	**7**	**42**	**631**	**0**	**1,577**	**15**	**0**	**6**
Temperature		Deg C	**15**	15	15	17.84	17.84	- - -	**61.3**	**15**	15	15	15	15	15	15	90	15	15
								ΔT =	**46.3**										

Note:Flow Line 4 — Temperature is based on Wet Bulb 12.84 Deg C and 5 Deg C for Approach temperature and CR of 4

Note:Flow Line 10 — Assumed 100 litres per person per day, 240 staff on site

Note:Flow Line 8, 13 &10 — The existing RO plant to capable enough to supply water demand to Demin plant (with its very low TDS content) and potable water usage. Only Additional feed to existing RO plant.

Note:Flow Line 18 — The ash can go to ash disposal in a slurry but cannot be stored wet due to the ground conditions and so would require mechanical dewatering.
The assumption is it will go in an almost dry state in a closed or "pipe" conveyor belt. However, to maintain its cohesivity during transportation it is assumed that 15% moisture will be there in ash.
The water requirement would be apprx 47.01 m3/hr which would be supplied from ACW cooler blowdown and drains from steam cycle blowdown recovery tank.
Therefore, no additional water (make up) envisaged for Ash handling.

Note:Flow Line 17 — It is assumed that boiler blowdown of 3% to be dumped into blowdown recovery system, apprx 60% of flow will be drained from blowdown recovery system (flash tank).
The temperature of waste assumed to be 90 C, close to saturation temperature of sampling steam condensate waste.

Flow Line Number

Dirty Water
Clean Water
m3/hr (Flow)
kg/day (TDS)

(F,Q) Flow/Quality Measurement

Mott MacDonald
Victory House
Trafalgar Place
Brighton BN1 4FY
United Kingdom
Tel +44 (0)1273 365000
Fax +44 (0)1273 365100
Web www.mottmac.com

Client: **Anglo American**

Title:
Anglo American - 450 MW Coal Fired Station
Water & Salt Balance (TDS based) Diagram
(@ 17 C atm temp.)
Intake Water **15** deg C
Intake TDS **3,513** mg/l
Boiler Blowdown **5** %
Cooling Tower CR **4**

Designed			Eng Chk		
Drawn			Coord		
Dwg Chk			Approved		

Drg No: **MML/PFD/001 Sheet 1/1** | Rev: **A**

Figure 4-16: Climatic water balance

4.2.15. Access to the Plant

The proposed site (6C) extends over the Tweefontein district road and requires relocation prior to the commencement of construction activities (Figure 4-17: Site Access. The Tweefontein road links up with the R544 Provincial Road between eMalahleni and Springbok (3.32km). This road in turn links up with the N12 to Johannesburg (4.85 km) and the N4 to Pretoria (8.71 km). The application process for the road relocation has been initiated and the proposed alignment allows for mobility along the Road D 2257 and meets minimum prescribed geometric criteria for a design speed of 80km/h in terms of horizontal radii, horizontal and vertical curve lengths, sight distances and access spacing. The site is approximately 11.82 km from eMalahleni (CBD) and approximately 19.66 km from Ogies. The site is approximately 3.46 km from the nearest residential area (Dhuva Park).

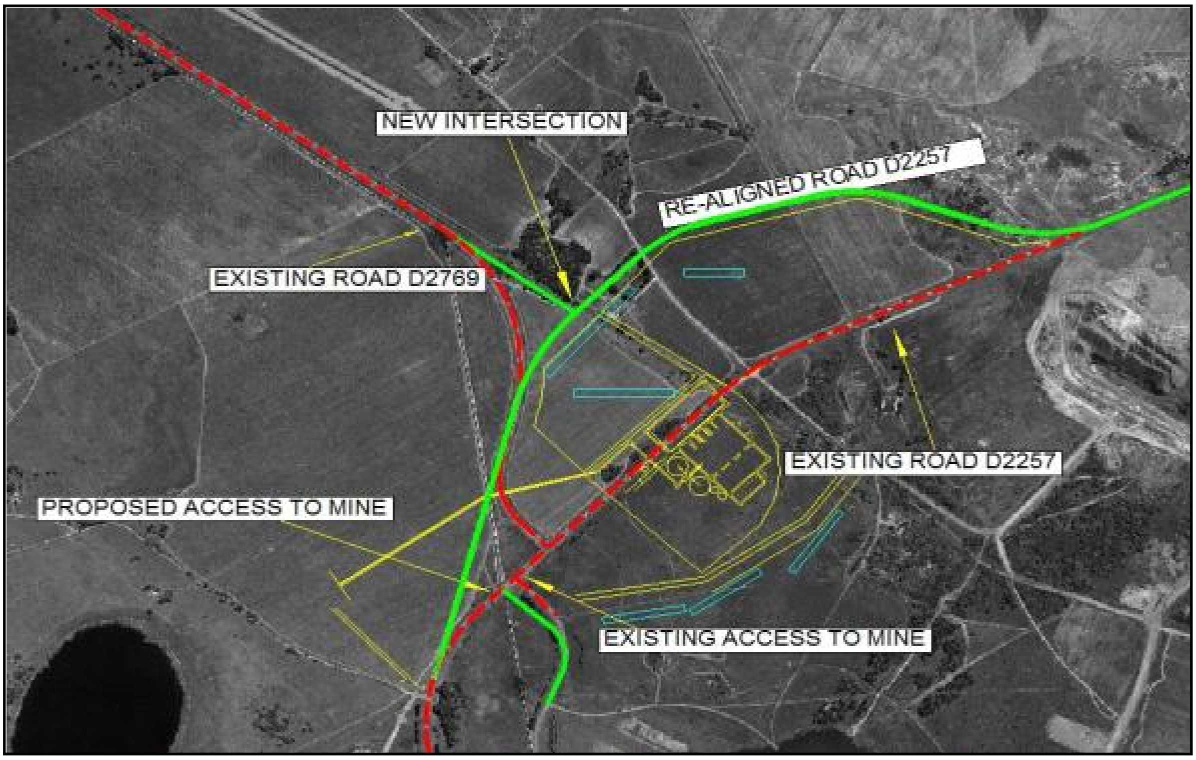


Figure 4-17: Site Access

4.2.16. Operating Regime

a) Electricity Demand

The plant operating regime will be important to the design of the plant as a plant which undergoes a considerable number of start-ups and shut downs during a year requires a different design to a baseload operating plant. It has been assumed that this plant will operate at baseload for the facilities' entire life span, due to the low coal costs and available demand.

Statistics in the table below show that there is sufficient demand to operate a 450 MW plant at baseload for 95% of the year. The surplus 5% has been factored in so as to cater for an inevitable increase in the electricity demand of Anglo Platinum and consequently it is likely that 450 MW of demand will be available for 100% of the year by the time of plant completion.

Table 4-3: Anglo Platinum Operations - Electricity demand

% Of time where demand exceeds the given amount	All Anglo Platinum Operations (including JV's) (MW)
100%	315
99%	398
95%	463
90%	528
80%	568
75%	580
50%	624
25%	665
20%	694
10%	710
1%	731
0%	798

Based upon the above table, a 450 MW plant would be expected to generate approximately 3,300 GWh per annum i.e. the 450 MW plant generates 48% more electricity than a 300MW plant.

Construction phase Electricity Supply

All electrical requirements for construction related activities (construction phase) will be supplied by portable generators. The generators will vary between 2.5 kVA to 20 kVA and will be conveniently transported around the site via pickup trucks. However, there may be a need for larger generators for short periods of time if the need arises.

The primary reason for motivating the use of transportable generators is that if a permanent supply mat is laid the cables are usually dug up, driven over and/or damaged or are in the wrong place so need to be moved. The use of portable generators is altogether safer, easier and practical considering the works envisaged in relation to the site conditions.

4.2.17. Employment Opportunities

It is estimated that at peak construction time (a period of six to eight months) approximately 1200 people will be employed, with approximately 900 people during the construction period. During operation approximately 120 people will be employed. There are high levels of unemployment in the area. A large number of the population are semi-illiterate or literate and have limited skills. Issues surrounding employment can have positive or negative social impacts in the study area. Construction will be done by specialist contractors that will bring in a number of their own staff given the specialist nature of the work. Opportunities for local labour will therefore be limited to work that does not require specialised skills. It must be acknowledged that there is some skilled labour available in the area due to similar projects that have been implemented in the past. The work opportunities during the construction period will be short term. Another issue to consider is that the recruitment protocol that will be followed is not known at this stage, since the IPP has not been identified at the time of compiling this report.

5. PUBLIC PARTICIPATION PROCESS

The purpose of this chapter is to provide a outline of the Public Participation Process to date and the way forward with respect to the process as part of the ESIA phase of this project. A summary of the key issues raised by I&APs to date is also provided.

Engagement and consultation with I&APs forms an integral component of the ESIA process and enables *inter alia* potentially directly affected landowners, neighbouring landowners and communities, as well as authorities and key stakeholders, to provide input into the study. During the Scoping Phase, I&APs assisted with the identification of issues and concerns that needed to be addressed as part of the EIR. The approach to this PPP has taken cognisance of the minimum requirements for public participation as stipulated in Regulation 54 of Regulation GN 543 of NEMA, as well as the draft DEA guideline on Stakeholder Engagement, series 7 (DEA, 2010).

The PPP has been separated into the following phases:

Initiation of the PPP

- Submission of an Application Form to notify DEA of the project in September 2010. This represents the Initial Application Phase of the ESIA process.
- Distribution of the Background Information Document (BID) to inform Interested and Affected Parties (I&APs) of the proposed project and to invite I&APs to register on the database in November 2010;
- During this phase potential I&APs were notified of the initiation of the application to apply for authorisation for the proposed project and were asked to register if they wanted to participate further in the ESIA process, and to raise any issues or concerns they believed required investigation during the ESIA process.
- Placement of advertisements in a suite of national, regional and local newspapers to notify the broader public of the initiation of the ESIA and invite them to register as I&APs in November 2010;
- Meeting with key stakeholders (affected landowners, government authorities and Non-Governmental Organisations) in December 2010;

Comment on the DSR

- During Scoping Phase, registered I&APs were notified of the availability of the DSR for comment. The DSR was lodged at a range of suitable locations, and public meetings held.

Comment on the Draft EIR Report

- During this phase, registered I&APs are provided with an opportunity to comment on the Draft EIR. This is enabled by the lodging of the ESIA Report at identified suitable locations.

Comment on the Final EIR Report

- During this phase, registered I&APs are provided with an opportunity to comment on the Final EIR. This is enabled by the lodging of the ESIA Report at identified suitable locations.

Decision and Appeal period

- This is the final phase of the PPP. Once the competent authority has issued their decision, the applicant and registered I&APs will be notified of the decision and provided with an opportunity to appeal to the Minister for Environmental Affairs.

Progress with respect to these various stages for the current project is discussed in more detail below. It should be noted that the public process developed for this investigation meets and, in some instances, exceeds the minimum requirements of NEMA. The process to date includes the following:

- Submission of a combined Application Form to notify DEA, both waste and environmental sections, of the project was submitted on 26 October 2010. This represents the Initial Application Phase of the ESIA process. An acknowledgement of receipt of the Application Form was received from DEA dated 11 November 2010. Both the Application Form and DEA's letter of acknowledgement are included in **VOLUME 1, ANNEXURE D**;
- Distribution of the Background Information Document (BID) (included in **VOLUME 1, ANNEXURE E.1**) on 15 November 2010 to inform Interested and Affected Parties (I&APs) of the project and to invite I&APs to register on the database;
- Advertisements were placed in a suite of national, regional and local newspapers notifying the broader public of the initiation of the ESIA (see Table 5-1 below) and

inviting them to register as I&APs from 15 November 2011 (the advertisements are included in **VOLUME 1, ANNEXURE E.2**);

- Broad authority consultation, via an Authority Meeting on 26 October 2010
- General Public Meetings were held with key stakeholders (directly affected landowners and their neighbours) on 29 November 2010 and 8 December 2010 at the Protea Hotel, Witbank and the Matimba Community Hall respectively (Attendance registers and notes of the meetings are included in **VOLUME 1, ANNEXURE E.3**).

Table 5-1: List of newspapers used for publication

Newspaper Publication	Readership	Publication Language	Date of Publication
Sunday Times	National	English	Sunday 14th November 2010
Beeld	Regional	Afrikaans	Friday 12th November 2010
Star	Regional	English	Saturday 13th November 2010
Middleburg Observer	Local	English and Zulu	Friday 12th November 2010
Witbank News	Local	English	Friday 3rd December 2010

5.1. INITIATION OF THE PUBLIC PROCESS

To ensure that potential I&APs were made aware of the project and given the opportunity to participate, the project team believed it was appropriate to ensure that the initial advertising was as thorough as possible. Consequently, the following tasks were undertaken:

- ***Notice of commencement of the ESIA Process***: The ESIA process commenced with the submission of an Application Form to notify DEA of the project in September 2010. This represents the Initial Application Phase of the ESIA process. Distribution of the Background Information Document (BID) to inform Interested and Affected Parties (I&APs) of the proposed project and to invite I&APs to register on the database in November 2010. The commencement of the ESIA process for the proposed project was advertised in local, regional and national newspapers. Refer to **VOLUME 1, ANNEXURE E.2** of the FSR for a copy of the advertisements placed in the newspapers as indicated in Table 5-1.
  The newspaper advertisements provided details of the activity proposed by the applicant, requested I&APs to register and to become involved in the ESIA process of

the proposed project. The closing date for submission of comments by I&APs was also indicated.

- ***Site Notice Board of the ESIA Process for the Project***: In terms of NEMA ESIA Regulations, 2010, the commencement of the ESIA process for the proposed activity was advertised by fixing 5 notice boards in conspicuous places at Emalahleni Public Library, Tasbet Spar, close to the Anglo Coal Kleinkoppjie Collery entrance, the Tweefontein road junction and in close proximity to the Anglo American Greenside Colliery entrance. (Please refer to **VOLUME 1, ANNEXURE E.3** for the Proof on the site notices.)
- ***Compilation of an I&AP database***: The initial database included directly affected landowners, relevant district and local municipal officials, relevant national and provincial government officials, and stakeholders (including those from the surrounding communities of the project area) from previous studies. This database was augmented via chain referral, and was continually updated as new I&APs were identified throughout the project. A complete list of I&APs is included in **VOLUME 1, ANNEXURE F**.
- ***Written Notices of commencement of the ESIA Process for the Project***: Written notices in terms of NEMA ESIA Regulations, 2010 were given to I&APs informing them of the commencement of the ESIA process for the proposed project. Written notices were sent to the following I&APs:

  - owners and occupants of land adjacent to the proposed site;
  - the Emalahleni Local Municipality;
  - the Municipal Ward Councillors; and
  - the Nkangala District Municipality;
  - ESKOM;
  - NERSA;
  - South African Wind Energy Association;
  - SANBI (Working for Wetlands)
  - Wildlife and Environmental Society of South Africa: Northern Region;
  - Endangered Wildlife Trust

In addition written notices were sent to the following authorities:

  - Department of Water Affairs (DWA);

- Department of Minerals’
- Department of Energy;
- Department of Public Works Roads and Transport
- SANRAL
- Department of Land Affairs

All I&AP information (including contact details), together with dates and details of consultations, and a record of all issues raised were recorded within a comprehensive database of I&APs. This database has been updated on an on-going basis throughout the environmental process.

Special attention was paid to consultation with potentially affected landowners within the study area. Networking with I&APs continued through-out the duration of the Scoping and EIR phases of the project.

- ***Issues and Response Report***: Issues, comments and concerns raised during the public participation process were compiled into an Issues and Response Report (refer to **ANNEXURE H**). This report provides a summary of the issues raised, as well as responses which were provided to I&APs. This information was also used for the evaluation of environmental impacts.

  The approach adopted for the current investigation was to identify as many I&APs as possible initially, through a suite of activities, including placing public notices in national, regional and local newspapers, stakeholder meetings (refer to the Table 5-2 below) and identifying I&APs from other databases in the area. Posters were also placed on site and at various positions that would be frequented by the various I&APs. Thereafter, the remainder of the communications were focused on registered I&APs and on regional advertising. Consequently, the initial advertising campaign was broad and thorough and invited the members of the public to register as I&APs.

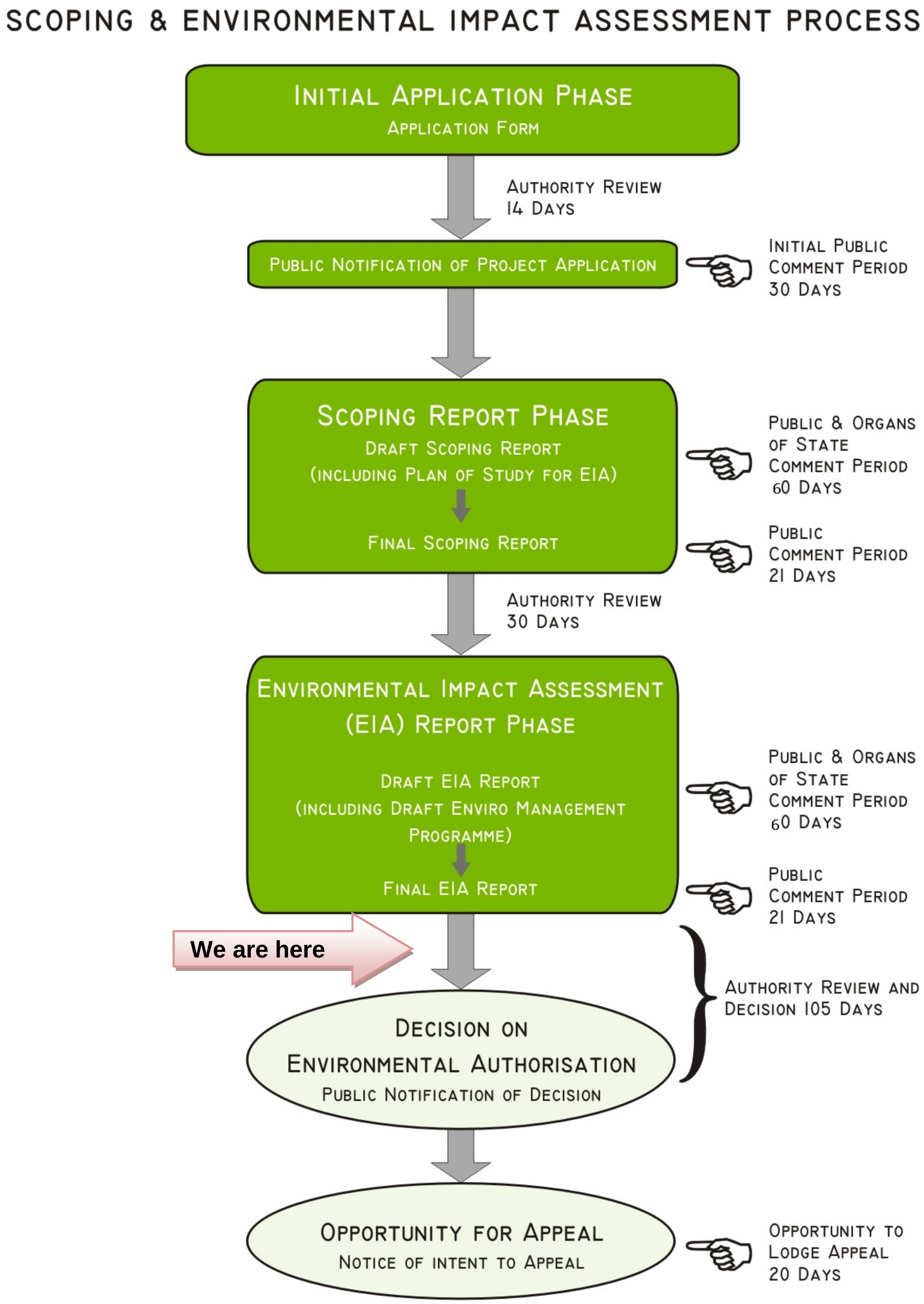


Figure 5-1: ESIA process to date.

- Public meetings

  Detailed notes were taken during the focus group meetings in order to capture the issues and concerns raised. Thereafter, notes of the meetings were compiled and distributed to the relevant meeting attendees. Copies of the presentations given at the meetings and copies of the attendance lists were attached and distributed with the meeting notes. The notes of these meetings are included in **VOLUME1, ANNEXURE E.3.**

Table 5-2: List of meetings held during the announcement of the ESIA

Date	Venue	Time	Attended by
Monday 29 November 2010	Protea Hotel, eMalahleni	11:00 - 14:00	I&APs, NGO's and Governmental departments.
Wednesday 8 December 2010	Matimba Community Hall	10h00 – 12h00	Agricultural sector and Landowners Focus group
Wednesday 8 December 2010	Matimba Community Hall	14h00 – 16h00	Community Focus group

5.2. COMMENT ON THE DRAFT REPORTS

Copies of the DEIR have been lodged in the following locations and on Aurecon's (www.aurecongroup.com) website, under the "public participation" link from 25 October 2011:

- eMalahleni Public Library;
- Kleinkopje Colliery Environmental Office (Janel Hayes);
- Kleinkopje Community Development Office (Delani Ngcobo);
- Greenside Colliery Environmental Office (Erika Prinsloo);
- Landau Colliery Environmental Office (Sipho Mabuza & Francis Nkosi);
- Anglo American Public Affairs Regional Office (Community Development Manager: Mokhine Makgalemele);

Registered I&APs and the relevant authorities were notified of the availability of the draft Scoping Report by means of letters sent by e-mail, fax and registered post as well as telephone conversations, where applicable, on 13 May 2011.

The public was given 60 days to review the report and to submit comments. The deadline for comments on the draft scoping report was Monday 27 June 2011. A record of all I&AP comments and issues raised were consolidated into an Issues and Response Report, and included into the final Scoping Report.

All I&APs were notified of the meetings at the Matimba community hall. Where appropriate transportation was provide to ensure that all interested parties were able to attend. The aim and objective of the Scoping phase meeting was twofold:

- To provide the I&APs the opportunity to raise question/concerns
- To present the content of the Scoping Report

The Scoping meetings were held with the same agenda in both English and Zulu to cater for and accommodate a diverse I&AP group.

Table 5-3: List of meetings during the Scoping phase

Date	Venue	Time	Attended by
Tuesday, 31 May 2011	Matimba Community Hall	10:00-12:00	English speaking representatives of the community
Tuesday, 31 May 2011	Matimba Community Hall	14:00 – 16:00	Zulu speaking representatives of the community

The issues raised through the public process during the scoping phase are recorded in the Comments and Response report. A summary of the key issues raised is presented below.

- Impact on the groundwater resources
- Impact on ambient air quality
- Impact on heritage resources
- Impact on livelihood and security
- Impact on agricultural potential
- Relocation of community members residing on the site
- Localised workforce

An updated version of all comments received to date is included in ANNEXURE H:

5.3. CONSIDERATION OF THE FINAL SCOPNG REPORT

The Final Scoping Report and associated PoS were submitted to the DEA in August 2011 for consideration and decision making purposes. Based on the documentation presented, the DEA approved the Final Scoping Report and associated PoS in September 2011, thereby allowing the environmental process to progress to the EIR phase (Refer to **ANNEXURE D**).

5.4. COMMENT ON THE DRAFT EIR

The public were provided with a 60 day commenting period to review the DEIR. Letters were sent to all registered I&APs on 24 October 2011 informing them of the availability of the draft EIR for their review and comment (Refer to **Annexure D**). Copies of the Draft EIR were lodged in the following locations and on the Aurecon (www.aurecongroup.com)(follow the public participation links) website from 24 October 2011:

- eMalahleni Public Library;
- Kleinkopje Colliery Environmental Office (Janel Hayes);
- Kleinkopje Community Development Office (Delani Ngcobo);
- Greenside Colliery Environmental Office (Erika Prinsloo);
- Landau Colliery Environmental Office (Sipho Mabuza & Francis Nkosi);
- Anglo American Public Affairs Regional Office (Community Development Manager: Mokhine Makgalemele);

The public had until 18 January 2012 to submit written comment on the Draft EIR to Aurecon. Cognisance was taken of all comments in compiling the final report, and these comments, together with the study team and applicant's responses thereto are included in ANNEXURE F & G. Various authorities were also be requested to comment on the Draft EIR.

Registered I&APs were also notified of the Public Meetings/Open Houses being held to discuss the findings of the ESIA Report as follows:

Table 5-4: List of meetings during the ESIA phase

Date	Venue	Time	Event
17 November 2011	Matimba Community Hall	10:00 – 12:00	Public Meeting
17 November 2011	Matimba Community Hall	14:00 – 16:00	Public Meeting

Various authorities have been provided with an opportunity to comment on the Draft EIR. These include:

- Emalahleni Local Municipality;
- Nkangala District Municipality;
- Department of Mineral Resources;
- Department of Energy;
- Mpumalanga DEDET;
- DEA various directorates including Environmental Impact Management, Pollution and Waste Permitting, Air Quality
- DWA;
- Department of Agriculture;
- South African Heritage Resources Agency;
- Department of Transport.

5.5. COMMENT ON THE FINAL EIR

The Final EIR has been made avalible to the public for a 21-day commenting period from 17 February 2012 – 9 March 2012. The report was again made available at the following locations and on the Aurecon (www.aurecongroup.com)(follow the public participation links) website.

- eMalahleni Public Library;
- Kleinkopje Colliery Environmental Office (Janel Hayes);
- Kleinkopje Community Development Office (Delani Ngcobo);
- Greenside Colliery Environmental Office (Erika Prinsloo);
- Landau Colliery Environmental Office (Sipho Mabuza & Francis Nkosi);

5.6. DECISION AND APPEAL PERIOD

Once the Final EIR has been completed, and all I&AP comments have been incorporated into the report, the document will be submitted to the DEA. The DEA must within 60 days after acknowledging receipt of the report:

- Accept the report;
- Notify the applicant whether the report has been referred for specialist review;
- Request amendments to the report (if required)
- Reject the report if it does not materially comply with regulations.

If the report is accepted DEA must within 45 days:

- Grant authorisation in respect of all or part of the activity applied for; or
- Refuse authorisation in respect of all or part of the activity.

Once the DEA have made their decision on the proposed project, all registered I&APs on the project database will be notified of the outcome of the decision within ten calendar days of the environmental authorisation having been issued. Should anyone (a member of public, registered I&AP or the proponent) wish to appeal DEAs decision, an Intent to Appeal Notification in terms of Section 43 of the National Environmental Management Act (No. 107 of 1998) must be lodged with the Minister within 10 calendar days of the I&AP being notified.

6. ENVIRONMENTAL IMPACT METHODOLOGY

The purpose of this Chapter is to describe the assessment methodology that is applied to the assessment of the impacts. The assessment context and cumulative impacts are also discussed in this chapter.

6.1. INTRODUCTION

The purpose of this chapter is to describe the assessment methodology utilised in determining the significance of the construction and operational impacts of the proposed coal-fired power station, and where applicable the possible alternatives, on the biophysical and socio-economic environment. The methodology was developed by Aurecon (previously Ninham Shand) in 1995 and has been continually refined based on our experience of its application to over 300 ESIA processes. The methodology is broadly consistent with requirements of Regulation 31(2)(l) of Regulation GN 543. Furthermore, the methodology is consistent with that described in the DEAT Guideline Document on the ESIA Regulations (1998). The methodology was outlined in the Plan of Study for ESIA and in accepting the FSR, DEA has ratified this approach.

6.2. ASSESSMENT METHODOLOGY

This section outlines the proposed method for assessing the significance of the potential environmental impacts outlined below, these include both operational and construction phase impacts.

For each impact, the EXTENT (spatial scale), MAGNITUDE and DURATION (time scale) are described. These criteria will be used to ascertain the SIGNIFICANCE of the impact, firstly in the case of no mitigation and then with the most effective mitigation measure(s) in place. The mitigation described in the EIR represents the full range of plausible and pragmatic measures but does not necessarily imply that they will be implemented.[13]

[13] The applicant will be requested to indicate which alternative and mitigation measures they are prepared to implement.

The tables on the following pages show the scale used to assess these variables, and defines each of the rating categories.

Table 6-1: Assessment criteria for the evaluation of impacts

Criteria	Category	Description
Extent or spatial influence of impact	Regional	Beyond a 30 km radius from the boundary of the candidate site.
	Local	Within a 30 km radius from the boundary of the candidate site.
	Site specific	On site or within 100 m of the candidate site.
Magnitude of impact (at the indicated spatial scale)	High	Natural and/ or social functions and/ or processes are *severely* altered
	Medium	Natural and/ or social functions and/ or processes are *notably* altered
	Low	Natural and/ or social functions and/ or processes are *slightly* altered
	Very Low	Natural and/ or social functions and/ or processes are *negligibly* altered
	Zero	Natural and/ or social functions and/ or processes remain *unaltered*
Duration of impact	Construction period	Up to 10 years
	Medium Term	Up to 10 years after construction
	Long Term	More than 10 years after construction

The SIGNIFICANCE of an impact is derived by taking into account the temporal and spatial scales and magnitude. The means of arriving at the different significance ratings is explained in Table 6-2.

Table 6-2: Definition of significance ratings

Significance Ratings	Level Of Criteria Required
High	• High magnitude with a regional extent and long term duration • High magnitude with either a regional extent and medium term duration or a local extent and long term duration • Medium magnitude with a regional extent and long term duration
Medium	• High magnitude with a local extent and medium term duration • High magnitude with a regional extent and construction period or a site specific extent and long term duration • High magnitude with either a local extent and construction period duration or a site specific extent and medium term duration • Medium magnitude with any combination of extent and duration except site specific and construction period or regional and long term • Low magnitude with a regional extent and long term duration
Low	• High magnitude with a site specific extent and construction period duration • Medium magnitude with a site specific extent and construction period duration • Low magnitude with any combination of extent and duration except site specific and construction period or regional and long term • Very low magnitude with a regional extent and long term duration
Very low	• Low magnitude with a site specific extent and construction period duration • Very low magnitude with any combination of extent and duration except regional and long term
Neutral	• Zero magnitude with any combination of extent and duration

Once the significance of an impact has been determined, the PROBABILITY of this impact occurring as well as the CONFIDENCE in the assessment of the impact will be determined using the rating systems outlined in Table 6-3 and Table 6-4 respectively. It is important to note that the significance of an impact should always be considered in concert with the probability of that impact occurring. Lastly, the REVERSIBILITY of the impact is estimated using the rating system outlined in Table 6-5.

Table 6-3: Definition of probability ratings

Probability Ratings	Criteria
Definite	Estimated greater than 95 % chance of the impact occurring.
Probable	Estimated 5 to 95 % chance of the impact occurring.
Unlikely	Estimated less than 5 % chance of the impact occurring.

Table 6-4: Definition of confidence ratings

Confidence Ratings	Criteria
Certain	Wealth of information on and sound understanding of the environmental factors potentially influencing the impact.
Sure	Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.
Unsure	Limited useful information on and understanding of the environmental factors potentially influencing this impact.

Table 6-5: Definition of reversibility ratings

Reversibility Ratings	Criteria
Irreversible	The activity will lead to an impact that is in all practical terms permanent.
Reversible	The impact is reversible within 2 years after the cause or stress is removed.

6.3. SUBJECTIVITY IN ASSIGNING SIGNIFICANCE

Despite attempts at providing a completely objective and impartial assessment of the environmental implications of development activities, ESIA processes can never escape the subjectivity inherent in attempting to define significance.The determination of the significance of an impact depends on both the context (spatial scale and temporal duration) and intensity of that impact. Since the rationalisation of context and intensity will ultimately be prejudiced by the observer, there can be no wholly objective measure by which to judge the components of significance, let alone how they are integrated into a single comparable measure.

This notwithstanding, in order to facilitate informed decision-making, ESIAs must endeavour to come to terms with the significance of the potential environmental impacts associated with particular development activities. Recognising this, Aurecon have attempted to address potential subjectivity in the current ESIA process as follows:

- Being explicit about the difficulty of being completely objective in the determination of significance, as outlined above;
- Developing an explicit methodology for assigning significance to impacts and outlining this methodology in detail in the Plan of Study for ESIA and in this ESIA Report. Having an explicit methodology not only forces the assessor to come to terms with the various facets contributing towards the determination of significance, thereby avoiding arbitrary assignment, but also provides the reader of the ESIA Report with a clear summary of how the assessor derived the assigned significance;
- Wherever possible, differentiating between the likely significance of potential environmental impacts as experienced by the various affected parties; and
- Utilising input from specialists, a team approach, and internal and external peer review of the assessment to facilitate a more rigorous and defendable system.

Although these measures may not totally eliminate subjectivity, they provide an explicit context within which to review the assessment of impacts.

6.4. CONSIDERATION OF CUMULATIVE IMPACTS

Section 31 (2) (l) of the Regulation 543 requires the consideration of cumulative impacts as part of any environmental assessment process. ESIA's have traditionally, however, failed to come to terms with such impacts, largely as a result of the following considerations:

- Cumulative effects may be local, regional or global in scale and dealing with such impacts requires co-ordinated institutional arrangements; and
- ESIA's are typically carried out on specific developments, whereas cumulative impacts result from broader biophysical, social and economic considerations, which typically cannot be addressed at the project level.

However, when assessing the significance of impacts in the next chapter, cumulative effects have been considered as far as possible. Furthermore, a comment on cumulative impacts is included for each of the impacts assessed, where appropriate.

7. OPERATIONAL PHASE IMPACTS ON THE BIOPHYSICAL AND SOCIO-ECONOMIC ENVIRONMENT

The following three chapters form the focus of the EIR. They contain a detailed assessment of the operational (or long-term) impacts as well as the construction and decommissioning phase impacts on the biophysical and socio-economic environment using the methodology described in Chapter 6. A summary of the assessment is contained in Chapter 10. The impact assessment is broken up into chapters as follows:

Chapter 7

- Operational phase impacts on the socio-economic and biophysical environment

Chapter 8

- Construction phase impacts on the socio-economic and biophysical environment

Chapter 9

- Decommissioning phase impacts

7.1. INTRODUCTION

This Chapter describes the potential operational phase impacts on the biophysical and socio-economic environments, which may occur due to the proposed activities described in Chapter 3. These include potential impacts which may arise during the operation of the power station and its associated infrastructure (i.e. long term impacts).

The potential impacts identified during the Scoping Phase of this project include the following:

- Operational phase impacts on the biophysical environment:
    - Impact on terrestrial fauna and flora;
    - Impact on ambient air quality;
    - Impact on climate change;
    - Impact on groundwater resources: and
    - Impact on founding conditions;

- Operational phase impacts on the social environment:
  - Visual impacts;
  - Impact on ambient noise quality;
  - Impact on health of surrounding communities;
  - Social risks/ vulnerability;
  - Impact on heritage resources;
  - Impact of increased vehicular traffic;
  - Impact on local socio-economic conditions;
  - Impact on agricultural potential of the region.

Each of these impacts is assessed in detail, and the significance of the impact is determined in the following sections. The methodology used to assess the potential impacts is detailed in Chapter 6 of this report. The terms "No Mit" and "Mit" reflected in the assessment tables in this chapter refer to the impact with no mitigation and with potential mitigation[14], respectively.

Cumulative impacts are also discussed. This refers to the synergistic impact of other potential developments such as the current and new a coal mine operations within the project area (SACE), and other unknown potential developments which may occur in the area. Detailed ToR (Terms of Reference) for each specialist study are included within each report in **VOLUMES 2 – 4.**

7.2. IMPACT ON TERRESTRIAL FAUNA AND FLORA

7.2.1. Impact Statement

The establishment of the power station and associated infrastructure could result in the damaging, destruction or displacement of important indigenous terrestrial fauna and flora.

7.2.2. Discussion

A specialist terrestrial fauna and flora investigation was undertaken by Warren McCleland of Ecorex Consulting Ecologists to determine the ecological sensitivity of the vegetation and animals in the area, to identify any protected and endangered species on the sites, and to

[14] Note that this does not imply that mitigation should or would be undertaken, but merely indicates the extent to which mitigation could change the significance of the impact where it is to be implemented.

recommend mitigation measures to prevent and or reduce the potential impact on sensitive vegetation or animals. The methodology for this investigation included a literature survey of relevant published sources of information, a field survey to determine the vegetation characteristics, vegetation condition and presence of terrestrial animals. The full report is included in **VOLUME 2**. A summary of the findings of the investigation is given below.

The study area is indicated in Mucina & Rutherford[15] (2006) as being situated within **Eastern Highveld Grassland**. Eastern Highveld Grassland is mostly confined to Mpumalanga and western Swaziland, occurring marginally as well into Gauteng. The conservation status of this vegetation type is **Endangered**, and whilst the conservation target is 24%, only a small fraction (<1%) is currently protected and 44% is considered to be transformed, mostly by cultivation, forestry, mines, dams and urbanisation. However, due to the high levels of habitat transformation and fragmentation, most of the project area has been classified as least concern or no natural habitat remaining by the Mpumalanga Biodiversity Conservation Plan (MBCP).

The MBCP (Ferrar & Lötter, 2009) is a spatial assessment of the conservation value of land in Mpumalanga and a decision support tool to assist planners and decision makers in sustainable land-use planning. The MBCP is regarded as the foundation for a provincial Biodiversity Conservation Strategy, as required by law.

The ash pit site (Ash 3) was rated as Important and Necessary in error, most likely because it was already rehabilitated and appeared to be untransformed grassland from the aerial images used to compile the MBCP. As is expected on projects of this magnitude, ground-truthing is required to verify literature references and previous study findings such as the MBCP. This should be changed to Least Concern because rehabilitated grassland does not have the potential to return to the floristic diversity of its pre-transformation state (Prof. Braam Van Wyk, *pers.comm*.).

One mammal with provincial status of Near Threatened (NT) was confirmed to occur on the property, namely Aardvark (*Orycteropus afer*). One nationally Near Threatened mammal has been collected on the adjacent Klikopje property, namely Highveld Golden Mole (*Amblysomus septentrionalis*). Another NT species has a High likelihood of occurring within untransformed grassland at the power plant site: Serval (*Leptailurus serval*). One Near

[15] Based on Mucina & Rutherford, 2006

Threatened bird species has a High likelihood of feeding in the power plant area, namely Lanner Falcon (*Falco biarmicus*). No Red Data bird species were confirmed during fieldwork.

Very few invertebrate species currently considered of conservation concern are likely to occur within the project area. No protected or threatened species were confirmed during fieldwork.

a) Potentially Occurring Threatened Flora

Eleven species that are listed in the latest Red List publication as having conservation concern[16] have been recorded in the quarter-degree grids 2529 CC, 2529 CD, 2629 AA and 2629 AB (Table 7-1). Five of these are considered to be threatened[17], of which one has a status of **Critically Endangered** (Middelburg Cycad - *Encephalartos middelburgensis*), the highest threat status that can be allocated, and four are classified as **Vulnerable**. Two are associated with rocky hillslopes of the Olifants River valley (*Encephalartos middelburgensis, Olifants River Cycad - Encephalartos lanatus*) and do not occur in the study area. *Pavetta zeyheri* subsp*. Middelburgensis* (Grey- leaved Brides Bush) occurs on wooded rocky outcrops, while *Frithia humilis* (Fairy Elephants feet*)* occurs on flat sandstone sheets with shallow beds of fine sand. Neither of these occur in the study area either. The remaining threatened species (*Pachycarpus suaveolens*) is unlikely to occur because it's extreme rarity (only a few specimens ever collected) and the limited amount of untransformed grassland in the study area.

The remaining six species have been allocated a conservation status of **Declining**. One of these, *Callilepis leptophylla* (Bergbitterbossie), has been confirmed to occur in untransformed grassland in the southern part of the power plant site. A *Crinum* species (most likely *Crinum macowanii* (Lilly *sp.)* was found scattered throughout the power plant site, but identification could not be confirmed as no plants were flowering.
The other *Crinum* species likely to occur is *Crinum bulbispermum* (Orange River Lily), which prefers wetlands and wetland-grassland ecotones. *Ilex mitis* (Cape Holly) is a tree of riverine forest and does not occur in the study area.

[16] We follow the terminology of Raimondo *et al*. (2009); species of conservation concern are those that are important for South Africa's conservation decision-making processes and comprise all threatened species, as well as those with a status of Data Deficient, Near Threatened, Critically Rare, Rare and Declining.
[17] We follow the terminology of Raimondo *et al*. (2009); threatened species are those facing a high risk of extinction and are placed in the categories Critically Endangered, Endangered or Vulnerable.

The two remaining Declining species have a Moderate likelihood of occurring because of the limited untransformed habitat remaining: *Hypoxis hemerocallidea* (Gifbol) and *Eucomis autumnalis* subsp. *Clavata* (Pineapple flower). Neither were located during fieldwork.

Vegetation Communities

Four vegetation communities were identified in the proposed power plant site and new ash pit site:

- Transformed Grassland (Ash Pit site) (Photos 1 and 2)

  This community covers the proposed new Ash Pit site and covers an area of approximately 144 ha and represents a rehabilitated waste rock dump (Sidney Sekhukhune *pers.comm*.). Vegetation structure has been classified as Low Closed Grassland (*sensu* Edwards, 1983). The grassland had been recently burnt prior to fieldwork, making it difficult to identify grass species. Only 18 plant species were recorded in this entire vegetation community, of which five (28%) are invasive alien species. Species richness in sample quadrats ranged from 6-11 species per 100m² (n=3), considerably lower than typical untransformed Highveld grassland.

  The low overall species list and very low species richness per 100m² reflects the transformed and degraded nature of this site. The floristic composition is not in any way representative of Eastern Highveld Grassland.
  No species of conservation concern were recorded, and none are likely to occur. This vegetation community has a **Low** significance for plant species of conservation importance (Table 7-2).

- *Seriphium – Imperata* Secondary Grassland (Power Plant Site) (Photos 3 & 4)

  This community represents the dominant vegetation type at the power plant site, covering an area of approximately 44 ha and appears to represent secondary grassland on old cultivated lands. Vegetation structure is Low Closed Grassland to Low Closed Shrubland (*sensu* Edwards, 1983).

  The invasive indigenous shrub, *Seriphium plumosum*, is dominant in many parts of this community, sometimes even forming closed shrubland. Elsewhere, *Imperata cylindrica* is dominant, often in association with *Helichrysum aureonitens*; this species association often indicates temporarily / seasonally wet soils. *Eragrostis curvula* is also very common, also indicating past disturbance. Only 24 species were recorded in this vegetation community, of which 4 (17%) are invasive alien species. Species richness in sample quadrats varied from 8-11 species per 100m² (n=2), which is much lower than typical untransformed Highveld grassland.

The low overall species list, low species richness per 100m² and the dominance of *Seriphium plumosum* reflects the transformed and degraded nature of this site. The floristic composition is not in any way representative of Eastern Highveld Grassland. The only species of conservation concern recorded was a *Crinum* species that could not be identified with certainty as it was not in flower. However, both the likely species (*Crinum macowanii* and *Crinum bulbispermum*) have a status of **Declining** and thus are of conservation concern. Even so, since the vegetation community is not representative of a threatened grassland type, and shows evidence of a long history of degradation, it is only allocated a **Low-Medium** significance for plant species of conservation importance.

- *Themeda - Tristachya* Untransformed Grassland (Photo 5)

  This vegetation community is confined to the southern half of the power plant site and covers approximately 21 ha and does not appear to have been transformed historically. Vegetation structure is also Low Closed Grassland (*sensu* Edwards, 1983). The dominant grasses are *Themeda triandra, Tristachya leucothrix, Harpochloa falx* and *Eragrostis curvula*, while other common grasses include *Melinis repens, Brachiaria serrata, Digitaria tricholaenoides, Elionurus muticus, Eragrostis racemosa* and *Loudetia simplex*.

  A much higher proportion of forbs and geophytes are present in comparison with other vegetation communities in the study area. These include *Felicia muricata, Helichrysum rugulosum, Hypoxis rigidula, Kohautia amatymbica, Haplocarpha lyrata* and *Pygmaeothamnus zeyheri*. Forty species were recorded in this vegetation community, of which one (2.5%) is an invasive alien species. Species richness in the single sample quadrat was 28 species per 100m², which is more typical of untransformed Highveld grassland.

  Even though the overall species list for this community is quite low, species richness per 100m² was high. The floristic composition is representative of Eastern Highveld Grassland, with three of the four dominant grasses being listed as dominant species in Eastern Highveld Grassland by Mucina & Rutherford (2006). Two species of conservation concern were confirmed during the site assessment. The first is a *Crinum* species that could not be identified with certainty as it was not in flower. However, both the likely species (*Crinum macowanii* and *Crinum bulbispermum*) have a status of **Declining** and thus are of conservation concern. The second is the Ox-eye Daisy *Callilepis leptophylla*, which also has a status of **Declining** (Raimondo *et al*., 2009). Even though no threatened plant species were discovered, this community is representative of an Endangered vegetation type and a listed threatened ecosystem. It is thus allocated a **Med-High** significance for plant species of conservation importance.

- Fuirena-Helichrysum Wetland (Photo 6)

This vegetation community is confined to the south-western corner of the power plant site and covers approximately 6.4 ha and does not appear to be have been historically transformed. Again, the vegetation structure is Low Closed Grassland (*sensu* Edwards, 1983). Sedges were noticeably dominant, particularly *Fuirena pubescens*, and the small herb *Helichrysum aureonitens* is co-dominant. The dominant grass is *Imperata cylindrica*, while other common species near the wetland edge are terrestrial species such *Tristachya leucothrix* and *Harpochloa falx*.
A high proportion of forbs are present, including *Haplocarpha lyrata, Hypericum lalandii, Helichrysum appendiculatum, Monopsis decipiens, Rumex crispus* and *Senecio inornatus*. Only 19 species were recorded in this vegetation community, of which one (*Rumex crispus*) is an alien species, although not invasive. Species richness in the single sample quadrat was 13 species per $100m^2$, which is fairly typical of sedge wetlands in Highveld grassland.

Even though the overall species list for this community is quite low, this is typical of untransformed sedge wetlands on the Highveld. The floristic composition contains elements of Eastern Highveld Grassland, including one species that is considered dominant in Eastern Highveld Grassland by Mucina & Rutherford (2006). No species of conservation concern were located, although *Crinum bulbispermum* could possibly occur. Even though no plant species of conservation concern were discovered, this community is contains elements of an Endangered vegetation type and a listed threatened ecosystem, and is a functional wetland. It is thus allocated a **Medium-Low** significance for plant species of conservation importance.

In addition to the above vegetation communities, there are also scattered Low Thickets around the periphery of the power plant site. The thickets are dominated by the invasive alien *Acacia mearnsii*, as well as alien *Eucalyptus* species. Overall species richness is very low and the community has **Low** significance for species of conservation importance.

Table 7-1: Plant species of conservation concern potentially occuring in the study area

Species	Red Data Status	Growth Form	Habitat	Likelihood	Reason
Crinum bulbispermum	Declining	Geophyte	Along rivers or streams, wetlands	Moderate	Limited habitat present
Crinum macowanii	Declining	Geophyte	Grassland	High	Much habitat present
Pachycarpus suaveolens	Vulnerable	Herb	Grassland	Unlikely	No habitat present
Ilex mitis var. mitis	Declining	Tree	Riverine forest	Unlikely	No habitat present
Callilepis leptophylla	Declining	Herb	Grassland	Confirmed	
Eucomis autumnalis subsp. clavata	Declining	Geophyte	Grassland, wetlands	Moderate	Limited habitat present
Hypoxis hemerocallidea	Declining	Geophyte	Grassland, wetland edge, open woodland	Moderate	Limited habitat present
Frithia humilis	Vulnerable	Succulent	Flat sandstone sheets with shallow beds of fine sand	Unlikely	No habitat present
Pavetta zeyheri subsp. middelburgensis	Vulnerable	Shrub	Wooded rocky outcrops	Unlikely	No habitat present
Encephalartos lanatus	Vulnerable	Shrub	Rocky hill slopes along major river valleys	Unlikely	No habitat present
Encephalartos middelburgensis	Critically Endangered	Tree	Rocky hill slopes along major river valleys	Unlikely	No habitat present

Table 7-2: Associated Flora Indices for vegetation communities in the study area

Species	Red Data	Protected	Ash Pit	Power Station		
			Transformed Grassland	Secondary Grassland	Untransformed Grassland	Wetland
Callilepis leptophylla	Declining				3	
Crinum macowanii / bulbispermum.	Declining	MNCA		4	6	4
AFI Subtotal	2	1	0	4	9	4
Threatened Vegetation Weighting			1.8	1.8	1.8	1.8
Functional Value Weighting			1.0	1.0	1.5	1.8
AFI TOTAL			0	7.2	24.3	12.96
AFI Significance			LOW	LOW-MED	MED-HIGH	MED-LOW

MNCA = Mpumalanga Nature Conservation Act

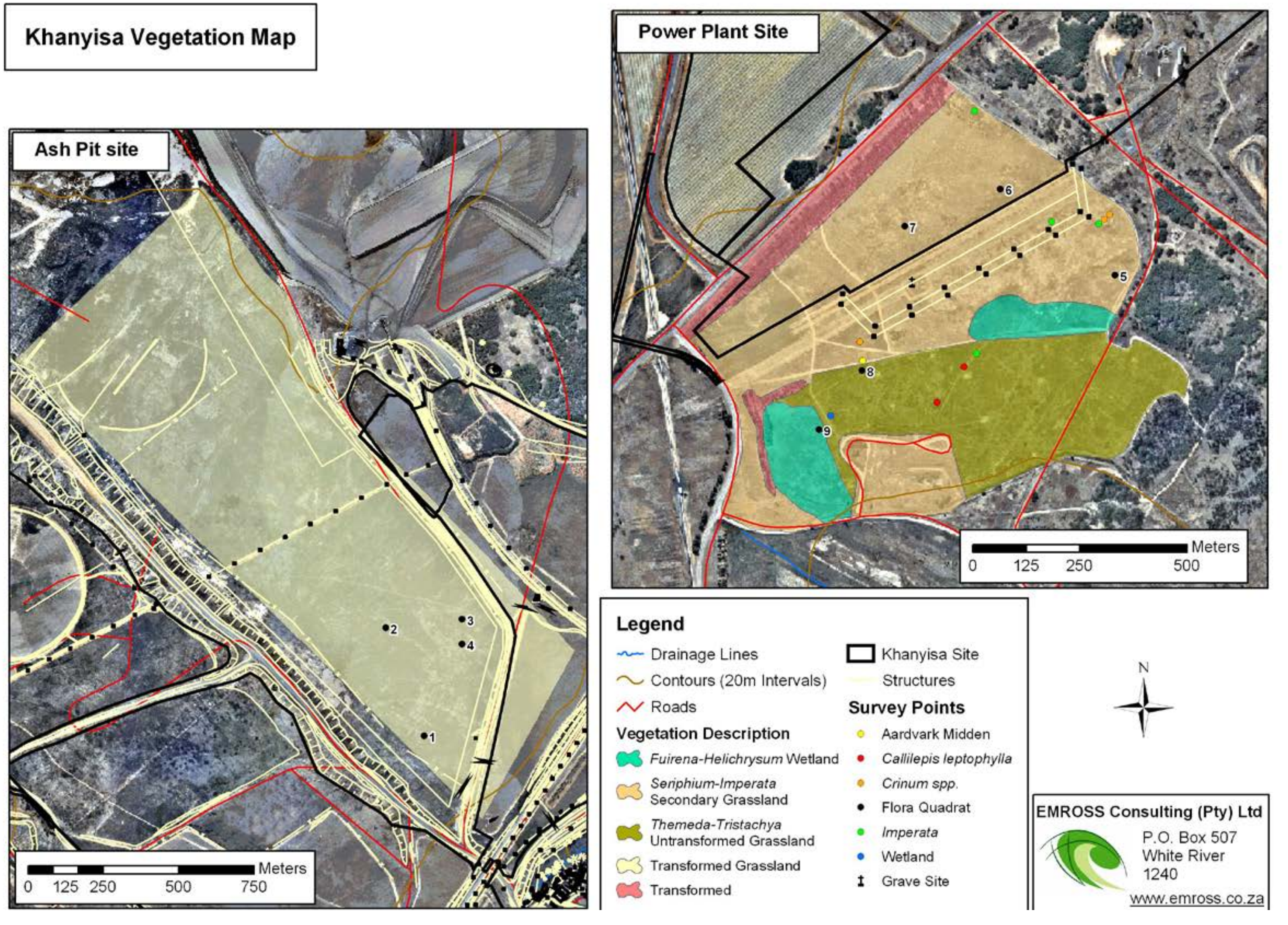


Figure 7-1: Vegetation communities represented in the study area

<table>
<tr><td></td><td></td></tr>
<tr><td>Photo 1. Transformed Grassland on Ash Pit Site</td><td>Photo 2. Transformed Grassland on Ash Pit Site</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Photo 3. Secondary Grassland on Power Plant Site</td><td>Photo 4. Secondary Grassland on Power Plant Site</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Photo 5. Untransformed Grassland on Power Plant Site</td><td>Photo 6. Wetland on Power Plant Site</td></tr>
</table>

7.2.3. Description and Significance of Potential Impact

The key potential impacts associated with the operational phase of the power plant are on the terrestrial biota and include the following:

Impacts on Flora

- Loss of Threatened Vegetation Type
- Loss of conservation-important plant species
- Increased invasion by alien plants
- Decrease in habitat quality through dust production

Impacts on Vertebrate Fauna

- Disruption of animal movement
- Impoverishment of populations of conservation-important species through collisions with powerlines and electrocutions

Impacts on Invertebrate Fauna

- Loss of invertebrates through provision of artificial lighting

a) Loss of threatened vegetation type

Description of Impact

The area of untransformed grassland in the vicinity of the power plant site is moderately representative of Eastern Highveld Grassland, a threatened vegetation type that has been classified as Vulnerable. Destruction of this fragment of vegetation would increase the cumulative impact of fragmentation of this vegetation type. Untransformed Eastern Highveld Grassland is listed as a Vulnerable ecosystem under Notice 1477 of Government Gazette No. 32689 (6 November 2009)[18]. This means that the ecosystem has a high risk of undergoing significant degradation of ecological structure, function or composition as a result of human intervention, and has been listed in order to **prevent further degradation** and loss of function, structure and composition. Destruction of this fragment within the study area would represent further degradation, however, because the plant community is situated on undermoned land which cannot be developed, the significance of the impact is rated as **Low [-ve].**

[18] SANBI & DEAT, 2009

Mitigation Measures

As it is impossible to rehabilitate temperate grassland to its original floristic diversity, since this is a product of evolution over millennia (Prof. A.E. van Wyk, pers.comm.), there is no reasonable mitigation for the destruction of untransformed grassland within the study area. It is recommended that the impact footprint be confined to transformed areas and that the untransformed grassland be fenced off to prevent heavy vehicle access and subsequent habitat destruction.

Table 7-3: Impact - Loss of Threatened Vegetation Type (Site 6C)

Impact of proposed power station surface infrastructure on the terrestrial fauna and flora		
SITE 6C		
	No mitigation	Mitigation
Extent	Site	Site
Magnitude	Medium	Low
Duration	Long term	Long term
SIGNIFICANCE	Medium (-)	Low (-)
Probability	Probable	Unlikely
Confidence	Sure	Sure
Reversibility	Irreversible	Reversible

Table 7-4: Impact – Loss of Threatened Vegetation Types (Ash 3)

Impact of proposed power station surface infrastructure on the terrestrial fauna and flora		
Ash 3		
	No mitigation	Mitigation
Extent	Site	Site
Magnitude	Medium	Low
Duration	Long term	Long term
SIGNIFICANCE	Low (-)	Low (-)
Probability	Probable	Unlikely
Confidence	Sure	Sure
Reversibility	Irreversible	Reversible

Loss of conservation important plant species

Description of Impact

The area of untransformed and secondary grassland in the vicinity of the power plant site was confirmed to support two plant species of conservation concern, namely *Callilepis leptophylla* and a *Crinum* sp. (most probably *C.macowanii*, but not flowering at the time of fieldwork). Both of these species are classified as Declining. The plants growing in untransformed grassland are unlikely to be impacted if the recommendation not to intrude into untransformed grassland is met. The *Crinum* plants growing in secondary grassland will be destroyed during construction of the power plant if no mitigation measures are applied. The significance is rated as **Low [-ve].**

Mitigation Measures

It is recommended that the impact footprint be confined to transformed areas and that the untransformed grassland be fenced off to prevent heavy vehicle access and subsequent habitat destruction. Plants of conservation concern that are growing in secondary grassland should be carefully removed under the supervision of a botanist with horticultural experience and transplanted in adjacent untransformed grassland. A holding nursery for the rehabilitation of the ash pit is unlikely to be a viable option if the life of the ash pit is longer than 10 years.

Table 7-5: Impact - Loss of conservation-important plant species (Site 6C)

Impact of proposed power station surface infrastructure on the terrestrial fauna and flora		
SITE 6C		
	No mitigation	Mitigation
Extent	Site	Site
Magnitude	Medium	Low
Duration	Long term	Long term
SIGNIFICANCE	Medium (-)	Low (-)
Probability	Probable	Unlikely
Confidence	Sure	Sure
Reversibility	Irreversible	Reversible

Table 7-6: Impact - Loss of conservation-important plant species (Ash 3)

Impact of proposed power station surface infrastructure on the terrestrial fauna and flora		
Ash 3		
	No mitigation	Mitigation
Extent	Site	Site
Magnitude	Medium	Low
Duration	Long term	Long term
SIGNIFICANCE	Low (-)	Low (-)
Probability	Probable	Unlikely
Confidence	Sure	Sure
Reversibility	Irreversible	Reversible

Increased invasion by alien plants

Description of Impact

Strip-clearing of vegetation during construction will provide a base for invasion of alien plants, most of which are pioneer species that thrive on bare soil. This could develop into a significant negative impact on biodiversity if unmanaged, particularly areas adjacent to the untransformed grassland. Unmanaged alien plant invasions have the capacity to change the structure and dynamics of vegetation communities and out-compete indigenous species, thus lowering species diversity. The significance prior to mitigation is rated as **Low [-ve].**

Mitigation Measures

It is imperative that an alien plant control strategy is included in a Biodiversity Action Plan for the power plant. This strategy should be drawn up by suitably experienced specialists and should include a timeline and staff implementation plan. A small team of labourers should be trained and equipped to manage invasions of alien plants during the life of the power plant. Adequate budget should be set aside for purchasing of herbicides and maintenance of equipment such as knapsack sprayers. The strategy should include a monitoring component in order to detect invasions at an early stage. This is particularly important in the areas adjacent to untransformed grassland and at the topsoil stockpiles, which are important for successful rehabilitation of transformed habitat and need to be kept clear of invasive alien plants.

Table 7-7: Impact - Increased invasion by alien plants (Site 6C)

Impact of the proposed power station and associated infrastructure on the terrestrial fauna and flora		
SITE 6C		
	No mitigation	Mitigation
Extent	Site	Site
Magnitude	Low	Low
Duration	Long term	Long term
SIGNIFICANCE	Low (-)	Low (-)
Probability	Probable	Unlikely
Confidence	Sure	Sure
Reversibility	Irreversible	Reversible

Table 7-8: Impact - Increased invasion by alien plants (Ash 3)

Impact of the proposed power station and associated infrastructure on the terrestrial fauna and flora		
Ash 3		
	No mitigation	Mitigation
Extent	Site	Site
Magnitude	Medium	Low
Duration	Long term	Long term
SIGNIFICANCE	Medium (-)	Low (-)
Probability	Probable	Unlikely
Confidence	Sure	Sure
Reversibility	Irreversible	Reversible

Decrease in habitat quality through dust production

Description of Impact

The power station will require a regular supply of limestone for the removal of sulphur from the flue gases. Initial estimates indicate that approximately 580,000 tonnes per annum will be required. Although the final access route for the limestone deliveries is not known as yet, this regular heavy vehicle movement can have significant impacts on the level of dust present in the atmosphere. Vegetation along roads is likely to be coated with dust, which could inhibit life-sustaining processes of plants such as photosynthesis and transpiration.

Over extended periods of time, this could result in vegetation die-off in areas of heaviest dust deposition. The significance prior to mitigation is rated as **Low [-ve].**

Mitigation Measures

Dust-producing areas such as haul roads and primary access routes for the lime stone (gypsum) should be periodically lightly sprayed with water using water bowsers. This is particularly important during the dry season, or even in the wet season in weeks when no rain has fallen. It is important that these areas are not over-sprayed causing water run-off and subsequent sediment loss into adjacent waterways.

Table 7-9: Impact - Decrease in habitat quality through dust production

Impact of the proposed power station and associated infrastructure on the terrestrial fauna and flora		
SITE 6C and Ash 3		
	No mitigation	Mitigation
Extent	Site	Site
Magnitude	Medium	Low
Duration	Long term	Long term
SIGNIFICANCE	Medium (-)	Low (-)
Probability	Definite	Probable
Confidence	Sure	Sure
Reversibility	Irreversible	Reversible

Disruption of animal movement

Description of Impact

The location of the power plant, offices and associated infrastructure (particularly the transmission lines) could have a minor disruptive impact on animal movement.
The significance is rated as **Low [-ve].**

Mitigation Measures

Very little is possible in terms of mitigation of the location of the power plant as this has been determined largely by the availability of substrate that has not been undermined. Location of the transmission lines should be along existing linear features where possible, rather than crossing expanses of open land where large bird movement could be impacted. The impact of the powerlines is discussed in more detail in the next impact discussion (below).

Table 7-10: Impact - Disruption of animal movement

Impact of the proposed power station and associated infrastructure on the terrestrial fauna and flora		
SITE 6C and Ash 3		
	No mitigation	Mitigation
Extent	Site	Site
Magnitude	Medium	Low
Duration	Long term	Long term
SIGNIFICANCE	Medium (-)	Low (-)
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Irreversible	Irreversible

Impact on avian fauna through collisions with powerlines and electronics

Description of Impact

The project requires the construction of new 400kV transmission lines to evacuate the power from the power plant to the existing Duvha-Minerva line to the north. The total length of the two proposed routes is 6 km. This impact analysis focuses on the assessment of the impacts of the transmission lines on birds.

Overhead powerlines have been shown to have a significant impact on mortality of large flying birds, particularly cranes, bustards and birds of prey. Impacts are primarily through collisions with the thin earth wire. Towers used for transmission lines larger than 132kV usually have large gaps between live and earth components and between the different live components, making electrocution highly unlikely. Most species at risk are threatened or near-threatened, increasing the significance of this impact. The significance is rated as **High [-ve]** without mitigation and **Medium [-ve]** with mitigation.

Overview of Impacts on Birds

The three main impacts of transmission lines on birds are collisions with the earth wire, electrocution and habitat disturbance during construction. These three impacts are described in more detail below:

- Collisions with the Earth Wire
  This is considered to the most significant single threat posed by transmission lines to large birds in South Africa (van Rooyen, 2004). Most collisions are with the much thinner earth wire, and 400kV lines are considered to hold the highest risk for bird collisions (Anderson, 2001). Large-bodied birds that are not able to take rapid evasive action in flight are the species most likely to collide with transmission lines. These include large waterbirds, birds of prey, and large terrestrial species such as cranes, bustards, korhaans and storks. Many of these species are also threatened and, for some, the primary cause of decline in population numbers is collisions with transmission lines.
- Electrocution
  This usually happens when large birds either attempt to land on or take off from the transmission line towers, making a short circuit between the live conductors or between live conductors and the earth wire. Species most at risk with this impact are species with large wingspans such as vultures or large birds of prey (e.g. Martial Eagle). This is not considered a significant threat in this study since the towers used for large transmission lines (220kV – 765kV) have the live components widely spaced apart, reducing the risk of electrocution significantly (van Rooyen, 2004).
- Habitat Disturbance
  This is mostly a short-term disturbance that takes place during construction. Habitat disturbance will take place at the site of erection of towers and construction of access roads. Many species not necessarily at risk of collision or electrocution will be disturbed in this way, but are likely to return shortly after construction is complete.

Species Impacted by Transmission Lines

Since the species impacted by habitat disturbance during erection of towers are likely to return to the site after the construction phase, the focus of this assessment is species likely to be impacted through collisions and electrocutions. A list of twelve Red Data species that are at highest risk of collision and / or electrocution is provided in Table 7-11. Five species have a status of Vulnerable, of which two are low-flying species with a lower risk of collision or electrocution (African Grass Owl, African Marsh Harrier). Of the remaining three Vulnerable species, Southern Bald Ibis has been reported from all four grids at higher reporting rates than any of the other Red Data species and should be considered to have a High risk of collision. Only three of the seven Near Threatened species in Table 7-11 have been reported in the same grid as the study area. One of these is listed in the top five species impacted by transmission lines in South Africa (unpublished EWT data given in van Rooyen, 2006), namely Greater Flamingo. This species was reported from the same grid as the study area and from two adjacent grids during SABAP2, although at low reporting rates. Some suitable habitat is present nearby (natural pans, large dams) and the possibility of this species flying across the study area should be considered to be Moderate. The other two species, Peregrine Falcon and Secretarybird, have also been recorded at low reporting rates, but are far-ranging species and thus have a Moderate likelihood of occurring in the vicinity of the transmission line routes.

Many bird species that do not have Red Data status, but are nonetheless sensitive to transmission line impacts, occur in the study area, particularly large species such as water birds, raptors and large terrestrial species such as White Stork and Black-headed Heron. An additional 50 species are listed in Table 7-12, indicating which impacts are most likely to affect each species. One of these is listed in the top five species impacted by transmission lines in South Africa (unpublished EWT data given in van Rooyen, 2006), namely White Stork. This species has been reported from adjacent grids during SABAP2 and suitable habitat exists in the area crossed by both route options. Other species included in the list in van Rooyen (2006) that are confirmed to occur within the vicinity of the study area are Black-headed Heron, Grey Heron, Cattle Egret, Jackal Buzzard, White-faced Duck, Yellow-billed Duck, Greater Kestrel, Egyptian Goose, Spur-winged Goose and African Sacred Ibis.

Table 7-11: Priority species potentially impacted by transmission lines in the study area

Species	Threat Status	Threat Score	2529CC	2529CD	2629AA	2629AB
African Grass Owl	VU	1.5			17.25	7.5
African Marsh Harrier	VU	1.5		0.9	11.55	
African Openbill	NT	1.2		0.36		
Greater Flamingo	NT	1.2	3.12	0.36	4.56	
Lanner Falcon	NT	1.2			4.56	
Lesser Flamingo	NT	1.2		0.36		
Lesser Kestrel	VU	1.5		2.85		
Pallid Harrier	NT	1.2		0.36		
Peregrine Falcon	NT	1.2	3.12			
Secretarybird	NT	1.2	3.12			
Southern Bald Ibis	VU	1.5	3.9	45.6	5.7	7.5
White-bellied Korhaan	VU	1.5		0.9		
Sensitivity Score			13.26	51.69	43.62	15
Sensitivity Ranking			4	1	2	3

* Column 2529CC is highlighted as the grid in which the study area is located

Table 7-12: List of species with a moderate to high risk of collision with transmission lines in the study area

Species	Threat Status	Risk		2529CC	2529CD	2629AA	2629AB
		Collision	Electrocution				
Abdim's Stork		M	L		x		
African Black Duck		M		x	x		x
African Darter		M		x	x	x	x
African Fish Eagle		M	M		x		
African Grass Owl	VU	L				x	x
African Harrier-Hawk		L	L	x	x		
African Hawk Eagle		L	L		x		
African Marsh Harrier	VU	L	L		x	x	
African Openbill	NT	M	L		x		
African Sacred Ibis		H		x	x	x	x
African Spoonbill		M		x	x	x	x
Amur Falcon		M		x	x	x	x
Barn Owl		L			x	x	
Black-chested Snake Eagle		M	M	x			
Black-headed Heron		H	L	x	x	x	x
Black-shouldered Kite		M		x	x	x	x
Brown Snake Eagle		M	M		x		
Cape Shoveller		M			x	x	x
Cape Teal		M			x	x	x
Cattle Egret		H		x	x	x	x
Comb Duck		M			x		
Egyptian Goose		H		x	x	x	x
Fulvous Duck		M			x	x	
Glossy Ibis		M		x	x	x	x
Goliath Heron		M	L		x	x	x
Greater Flamingo	NT	H		x	x	x	

Species	Threat Status	Risk		2529CC	2529CD	2629AA	2629AB
		Collision	Electrocution				
Greater Kestrel		H		x	x		x
Grey Heron		H		x	x	x	x
Hottentot Teal		L			x	x	
Jackal Buzzard		H	L	x			
Lanner Falcon	NT	H				x	
Lesser Flamingo	NT	H			x		
Lesser Kestrel	VU	M			x		
Long-crested Eagle		M	L	x			
Maccoa Duck		L		x		x	x
Marsh Owl		L		x	x	x	x
Montagu's Harrier		M	L				x
Northern Black Korhaan		M		x		x	
Pallid Harrier	NT	M			x		
Peregrine Falcon	NT	M		x			
Pied Crow		M		x	x	x	x
Purple Heron		M		x	x	x	x
Red-billed Teal		M		x	x	x	x
Red-footed Falcon		M			x		
Reed Cormorant		M		x	x	x	x
Rock Kestrel		M		x	x		x
Secretarybird	NT	H	L	x			
South African Shelduck		H				x	
Southern Bald Ibis	VU	H		x	x	x	x
Southern Pochard		M		x	x	x	x
Spotted Eagle Owl		L			x		
Spur-winged Goose		H	M	x	x	x	x
Steppe Buzzard		M		x	x	x	x
Verreaux's Eagle		M	M		x		
White Stork		H	L		x	x	

Species	Threat Status	Risk		2529CC	2529CD	2629AA	2629AB
		Collision	Electrocution				
White-bellied Korhaan	VU	M			x		
White-breasted Cormorant		M		x	x	x	x
White-faced Duck		H		x	x	x	x
Yellow-billed Duck		H		x	x	x	x
Yellow-billed Kite		M	L		x		
VU = Vulnerable							
NT = Near Threatened							
H = High Risk							
M = Moderate Risk							
L = Low Risk							

Potentially Important Bird Habitats in the vicinity of the Study Area

A number of habitats attractive to large-bodied birds are present within the general vicinity of the proposed transmission line routes. It can be expected that these habitats could attract species to cross the area covered by the proposed routes, thereby putting these species at risk of collision. The habitats are:

- Cultivated Lands

  A number of large-bodied birds forage regularly in cultivated lands, particularly species such as White Stork, Black-headed Heron, Spur-winged and Egyptian Geese, Cattle Egret and Southern Bald Ibis. Food sources include insects disturbed through ploughing or the seedlings of the crops that have been planted.

  These species would be at risk of collision with transmission lines while flying to and from these habitats, which are present around the proposed line routes. White Stork is already indicated as a High risk species for collisions with transmission lines and has a high reporting rate in cultivated lands (Harrison et al., 1998).
- Natural Pans

Natural, endorheic pans are a feature of shallow depressions of the Highveld topography and comprise shallow, circular open waterbodies with a narrow fringe of flooded grassland. A number of these pans are present in the general vicinity of the study area, the closest being a small pan of about 25 ha in extent situated 1.4 km west of the power plant site, and another much larger pan of 220 ha situated 6 km north-west of the power plant site. These pans could occasionally have small numbers of Greater and Lesser Flamingos, and will regularly support larger numbers of smaller waterfowl species such as Yellow-billed Duck, White-faced Duck, Cape Shoveller and Southern Pochard, all of which could be at risk of colliding with transmission lines when crossing between these pans and other waterbodies in the area. The two flamingo species should be considered to be the highest risk species in this regard.

- Wetlands

  This habitat is characterised by seasonally or permanently flooded vegetation on hydromorphic soils, and can be in the form of as channelled or unchannelled wetlands along valley floors or unchannelled seepage wetlands along hillsides. Small examples of unchannelled wetlands are scattered within the general vicinity of the study area, the largest being a *Phragmites* wetland 4 km northwest of the study area along the N4 highway.

  A number of species at risk of collision with transmission lines forage and / or breed in this habitat, such as Black-headed and Grey Herons, Cattle Egret, Spur-winged and Egyptian Geese, Yellow-billed and White-faced Ducks, Red-billed Teal, African Sacred and Glossy Ibises, and African Darter. African Grass Owl and African Marsh Harrier are almost confined to this habitat, although both are likely to be low risk species for collisions.

- Dams

  This refers to man-made impoundments and varies in size from small farm dams to large waterbodies such as the nearby Witbank Dam, which covers approximately 900 ha. These dams are likely to support a similar waterbird fauna to that of natural pans, although only the larger dams would have Greater and Lesser Flamingos.

  A potential moderate risk flyway for large waterbirds would be between the natural pans west of the study area and the Witbank Dam to the north-east, which crosses the proposed transmission line routes.

Sensitivity Assessment

Both powerline routes fall within the same grid and have equal sensitivity based on the above assessment. However, several other factors can be taken into account when assessing sensitivity, such as proximity to other transmission line routes and proximity to high concentrations of birds. An existing transmission line route runs just to the south of the proposed Option 2, whereas Option 1 crosses an open area that does not have any transmission lines, only a conveyor line. By using Option 1 an additional impact will be created, while Option 2 will merely cluster an additional line along an existing one. A potential waterbird flyway exists between the pans to the west and north-west of the study area and the Witbank Dam, and transmission lines aligned perpendicular to this flyway would pose a risk of bird collisions. While the Duvha-Minerva line is already aligned perpendicular to this potential flyway, Option 1 would increase this impact, while Option 2 runs more perpendicular to the flyway until it connects to the Duvha-Minerva line. Option 2 is thus the preferred transmission line route to use from a bird impact perspective.

Preferred Route Option

As indicated, there is little difference in the sensitivity index of the two proposed transmission line routes, since both routes occur in the same quarter-degree grid and cross similar habitat. However, Option 2 does lie closer to and along similar alignments to existing transmission lines and would thus be less of an impact than Option 1. Option 2 is also less likely to impact on a potential waterbird flyway across the study area and is therefore the preferred route. Therefore, based on this investigation option 2 is the preferred alignment.

Mitigation Measures

Very little is possible in terms of mitigation of the location of the power plant as this has been determined largely by the availability of substrate that has not been undermined. However, as mentioned above, the preferred alignment of the transmission lines should be along existing linear features where possible, rather than crossing expanses of open land where large bird movement could be impacted (Option 2).

Dynamic devices, also known as “bird flappers”, have been shown to be effective in reducing collisions with the transmission lines. These should be attached to the earth wire, but the lines should be checked every two to three years for wear-and-tear damage to the dynamic devices and these should be replaced where necessary.

Reflective devices, usually reflective metal balls, should be fitted to the earth wire in addition to the dynamic devices, particularly where the lines cross a dark background. The marking method and spacing of markers should be according to the specifications in the Eskom guidelines (Vosloo & van Rooyen, 2006).

It is not considered necessary for towers to be fitted with Bird Guards to prevent birds from perching above live conductors as the risk of electrocution should be very low.

Table 7-13: Impact – Proposed power line on Avi-fauna

Impact of the proposed power station and associated infrastructure on the avi-fauna		
SITE 6C		
	No mitigation	Mitigation
Extent	Regional	Regional
Magnitude	Medium	Medium
Duration	Long term	Long term
SIGNIFICANCE	High(-)	Medium (-)
Probability	Probable	Probable
Confidence	Certain	Certain
Reversibility	Irreversible	Reversible

Loss of invertebrates through provision of artificial lighting

Description of Impact

After habitat destruction, light pollution is probably the next most significant potential impact, but, in the operational phase at least, it may be manageable to some extent. The impacts of artificial lighting on insect populations can be very significant, resulting in the deaths of many thousands of individuals every night, and causing a very substantial drain effect ("population sink") on surrounding populations. Other impacts may include interference with normal foraging and mating behaviours, resulting in less immediate but equally significant reductions in natural population levels. The consequent knock-on effects, given the vital role that invertebrates play in ecosystem functioning, may affect virtually every component of the surrounding ecosystem (Rich & Longcore 2005).

Direct impacts of artificial lights such as high pressure mercury vapour streetlamps may extend up to 600 m or more from the source (Eisenbeis 2005), and the drain effect resulting from continual depletion of the populations within this zone will probably cause a significant decline in population density of affected species to at least double and possibly up to several times this distance. High level unshielded lighting could thus extend the area of direct impact to over 600 ha, with lower intensity indirect impacts potentially being significant over an area of more than 1200 ha. These impacts would be continuous throughout the life of the project.

Due to the changing "landscape" within the development footprint as well as the need for strong lighting if construction/excavation continues at night, light pollution is often particularly difficult to control during the construction phase, and this is where the greatest impacts are to be expected. Any external lighting used will continue to have an impact throughout the operational life of the project. Impacts during decommissioning will depend on the process followed and so this cannot be fully assessed at present. This impact is considered **High [-ve]** before mitigation and **Medium [-ve]** with mitigation.

Mitigation Measures

Externally visible lighting should be kept to an absolute minimum, and wherever possible long-wavelength light sources (i.e. yellow/orange) should be used:

- If external lighting of structures is essential (e.g. for security reasons), light sources should be directed inward so as to light up the structure and result in this becoming a large diffuse light source, rather than having bright point sources directed outward into the natural environment.
- Long-wavelength light sources should be used (at least 550 nm, preferably longer than 575 nm), preferably low-pressure sodium vapour, or yellow LEDs, as these result in very low disturbance of insect populations. Less preferable, but still better than mercury vapour or halogen lamps, would be high pressure sodium vapour or warm white LEDs. LED options, while initially more costly, may prove more economical and environmentally friendly in the long term, as a 20-year life span at 12 hours usage per day is achievable, with efficiency comparable to fluorescent lighting. Another alternative is to use ultraviolet (UV) filters which can reduce insect attraction to high pressure mercury vapour lamps to below that of high pressure sodium vapour lamps. Fluorescent lights, including compact versions, should not be used outdoors,

as a significant amount of UV light is emitted by these, and this is highly attractive to insects.

Due to the need for lighting of operations in the open pits and haul routes, it is not easy to effect a high level of mitigation for an operation of this nature, but a substantial reduction in impacts is attainable if all recommended measures are fully implemented.

Table 7-14: Impact – Artificial lightning on invertrates (Site 6C)

Impact of the proposed power station and associated infrastructure on the terrestrial fauna and flora		
SITE 6C		
	No mitigation	Mitigation
Extent	Local	Local
Magnitude	Medium	Medium
Duration	Long term	Long term
SIGNIFICANCE	High (-)	Medium (-)
Probability	Definite	Probable
Confidence	Sure	Sure
Reversibility	Irreversible	Reversible

Table 7-15: Impact - Artificial lighting on invertrabrates (Ash 3)

Impact of the proposed power station and associated infrastructure on the terrestrial fauna and flora		
Ash 3		
	No mitigation	Mitigation
Extent	Local	Local
Magnitude	Medium	Low
Duration	Long term	Long term
SIGNIFICANCE	Medium(-)	Low(-)
Probability	Probable	Probable
Confidence	Certain	Certain
Reversibility	Irreversible	Reversible

7.2.4. Comment on cumulative impacts

The cumulative impacts of the coal-fired power plant and associated infrastructure would be negligible to very low on the ecosystem services. The Mpumalanga Biodiversity Conservation Plan has classified much of the general vicinity of the study area as least concern or no natural habitat remaining, primarily due to the high levels of habitat transformation and fragmentation related to mining activities. The areas of natural grassland, which have been classified as Important and Necessary, such as the untransformed grasslands south east and west of the power station footprint, will remain undeveloped and therefore the ecosystem's processes should continue to operate as they currently do.

Even though the area has been highly transformed, the areas that could contribute to sustaining overall invertebrate biodiversity levels must be supported. Therefore, effective rehabilitation of areas disturbed by the project, as well as unused portions of the sites, must be of high priority in order to maintain the current functioning of the undeveloped grassland.

7.3. IMPACT ON AMBIENT AIR QUALITY

7.3.1. Impact Statement

The establishment of a 450 MW power station would be associated with emissions of various common pollutants such as sulphur oxides (SO_X), nitrogen oxides (NO_X), particulate matter and trace emissions of various heavy metals. The proposed power station is located within the Highveld Priority Airshed (HPA), an area characterised by poor air quality and exceedances of pollutant limits set in South African legislation. If uncontrolled, the proposed power station could impact significantly on air quality in the eMalahleni (Witbank) region and potentially further afield.

7.3.2. Discussion

Given the potential impacts on ambient air quality and location of the proposed power plant (i.e. within the HPA), a specialist study was undertaken by Airshed Planning Professionals and is included in **VOLUME 2.** The methodology used for the investigation included reviewing and using existing information such as air quality measurements, reviewing and compiling emission inventories for existing sources, and undertaking atmospheric dispersion modelling using the ADMS 4 model for the predictions of ambient air concentrations. Dispersion modelling was used to develop spatial and temporal concentrations for the current baseline air pollutant concentrations. Furthermore, predictions of incremental cumulative air pollutant concentrations as a result of the proposed power station were also modelled and addressed.

Ambient air pollutant concentrations predicted to occur as a result of the proposed power station, taking into account existing air pollution levels, is compared to the not only the South African legal requirements (existing and proposed) for ambient air quality but also the IFC standards. The potential for non-compliance with air quality limits due to emissions of the aforementioned pollutants are discussed in this section. The main pollutants of concern from power generation facilities include:

- Particulate matter (PM), specifically PM_{10} which is particulate matter with a diameter of 10 micrometers (μm);
- Sulphur Dioxide (SO_2);

- Oxides of nitrogen (as Nitrogen Dioxide [NO_2]); and
- Carbon Monoxide (CO).

Based on the combustion technology (Circulating Fluidised Beds) and quality of fuel proposed, the above mentioned pollutants will be assessed. However, heavy metals are also usually associated with particulate emissions with lead (Pb) and mercury (Hg) being the key elements of concern. Other substances include hydrogen sulphide (H_2S), sulphuric acid (H_2SO_4), Total Reduced sulphur (S) and fluorides. Since ambient air quality is applicable to off-site locations, sensitive receptors were identified and the predicted impacts evaluated at these locations. The closest sensitive receptor was a residential area located in the eMalahleni region, approximately 10 km north of the site boundary.

a) Legal framework

Ambient air quality standards indicate safe daily exposure levels for the majority of the population, throughout an individual's lifetime. In South Africa, air pollution is governed by the NEM:AQA. The ambient air quality standards (minimum emission standards) were published in Government Gazette 32816 of 24 December 2009 with limits for various pollutants effective by specified dates. Ambient air quality standards, included in a schedule to the NEM:AQA, represent air pollution concentration levels that are to be achieved through the management of air pollution sources. In addition, cumulative air pollutant concentrations, arising due to the emission of all sources, must be managed to within the required limits. An annual number of permissible exceedances of the limit are allowed.

Power Generation is a listed activity in terms of the NEM:AQA. Minimum national emission limits have been established for combustion installations with a design capacity of greater than or equal to 50 MW heat input per unit. All existing and new applications are subject to a new Atmospheric Emissions License. The minimum emission standards apply to normal operating conditions (i.e. at a specified ozone [O_3] concentration [10 %], temperature [273 Kelvin] and pressure [101.3 kilopascals]). The emissions standards are tabulated below and only reflect the minimum standards for new facilities.

Table 7-16: Emission limits for combustion installations applicable to the propsed power station (under normalised conditions of 10 % O3, 273 K and 101.3 kPa)

Substance or mixture of substances		
Common name	Chemical symbol	mg/Nm^3 (new facility)
Particulate matter (PM_{10})	N/A	50
Sulphur dioxide	SO_2	500
Oxides of nitrogen	NO_x expressed as NO_2	750

However, further to the legislative requirements as per the NEM: AQA, international standards for emission concentrations associated with power stations are tabulated below (Table 7-17, Table 7-17, Table 7-18 and Table 7-19). Comparisons between the European Union (EU) and World Bank Thermal Power Guideline provide a good representation of international standards.

Based on a comparative analysis of international standards (in terms of PM_{10}, SO_2, NO_X), it is apparent that South African standards are equivalent to that of the EU, and far exceeds that of the World Bank Thermal Power Guideline.

Table 7-17: Air Quality Guidelines and Standards for CO

Authority	Maximum 1-hourly Average ($\mu g/m^3$)	Maximum 8-hour Average ($\mu g/m^3$)
SA standard	30 000(b)	10 000(b)
Australian standards	-	10 000 (c)
European Community (EC)	-	10 000(d)
World Bank	-	-

Table 7-18: Air Quality guidelines and standards for PM_{10}

Authority	Maximum 24-hour Concentration (µg/m³)	Annual Average Concentration (µg/m³)
SA standards	75[(b)] (120 until end 2014) 50[(c)]	40[(d)](60 until end 2014) 30[(e)]
Australian standards	50[(f)]	-
European Community (EC)	50[(g)]	30[(h)] 20[(i)]
World Bank (General Environmental Guidelines)	70[(j)]	50[(j)]
World Bank (Thermal Power Guidelines)	150[(k)]	50[(k)]
United Kingdom	50[(l)]	40[(m)]
United States EPA	150[(n)]	50[(o)]
World Health Organisation	150[(p)] 100[(q)] 75[(r)] 50[(s)]	70[(p)] 50[(q)] 30[(r)] 20[(s)]

Table 7-19: Air quality guidelines and standards for NO_2

Authority	Instantaneous Peak (µg/m³)	Maximum 1-hourly Average (µg/m³)	Maximum 24-hour Average (µg/m³)	Maximum 1-month Average (µg/m³)	Annual Average Concentration (µg/m³)
SA standards	-	200[(b)]	-	-	40[(b)]
Australian standards		226[(c)]			56
European Community (EC)	-	200[(d)]	-	-	40[(e)]
World Bank (General Environmental Guidelines)	-	-	150 (as NO_x)[(f)]	-	-
World Bank (Thermal Power Guidelines)			150[(g)]		100[(g)]
United Kingdom	-	200[(h)]	-	-	40[(i)] 30[(j)]
United States EPA	-	-	-	-	100[(k)]
World Health Organisation	-	200[(l)(m)]	150[(l)]	-	40[(l)(m)]

Table 7-20: Air quality guidelines and standards for SO_2

Authority	Annual average (µg/m³)	Maximum 24-hour average (µg/m³)	Maximum 1-hour average (µg/m³)
Revised SA Standard	50	125	350-
WHO (2000)	50 (1), 10-30 (2)	125 (3)	350
EC	20 (4)	125 (5)	350 (6)
US-EPA	80	365	-

The International Finance Corporation (IFC) maintains standards that are equivalent to or more stringent than, World Bank, EU and South African legislative requirements. Table 7-21 below summarises the Air Quality Guidelines outlined by the IFC, for a one hour average basis. Furthermore, the ambient air concentration values provided below are specifically for degraded airsheds, and are thus applicable to the HPA. **For the purposes of this assessment, it is assumed that the proposed power station will be designed to meet the emissions standards for degraded airsheds provided by the IFC.**

Table 7-21: IFC Emissions Guidelines for boilers

Maximum 1 hourly average (mg/ Nm3)	PM_{10}	SO_2	NO_X
IFC Standards (for degraded airsheds)	30	400	200

Local dust-fall is evaluated according to the criteria formerly published by the DEA. In terms of these criteria dust-fall is classified as follows:

- SLIGHT: less than 250 mg/m^2/day
- MODERATE: 250 to 500 mg/m^2/day
- HEAVY: 500 to 1200 mg/m^2/day
- VERY HEAVY: more than 1200 mg/m^2/day

The Department of Energy (DE) uses the 1 200 mg/m^2/day threshold level as an action[19] level. In the event that on-site dust-fall exceeds this threshold, the specific causes of high dust-fall should be investigated and remedial steps taken. "Slight" dust-fall is barely visible to the naked eye. "Heavy" dust-fall indicates a fine layer of dust on a surface; with "very heavy" dust-fall being easily visible should a surface not be cleaned for a few days.

Dust-fall levels of > 2000 mg/m^2/day constitute a layer of dust thick enough to allow a person to "write" words in the dust with their fingers. The following is a tabulated version of the dust fall rates proposed for adoption by South Africa:

Table 7-22: Bands of dust fall rate propsed for adoption

BAND NUMBER	BAND DESCRIPTION LABEL	DUST-FALL RATE (D) (mg m^{-2} day^{-1}, 30-day average)	COMMENT
1	RESIDENTIAL	D < 600	Permissible for residential and light commercial
2	INDUSTRIAL	600 < D < 1 200	Permissible for heavy commercial and industrial
3	ACTION	1 200 < D < 2 400	Requires investigation and remediation if two sequential months lie in this band, or more than three occur in a year.
4	ALERT	2 400 < D	Immediate action and remediation required following the first exceedance. Incident report to be submitted to relevant authority.

Suspended particulate matter

Air quality guidelines for particulates are given for various particle size fractions, including total suspended particulates (TSP), inhalable particulates or PM10, and respirable particulates of $PM_{2.5}$ (i.e. particulates with an aerodynamic diameter of less than 2.5 µm).

Although TSP is defined as all particulates with an aerodynamic diameter of less than 100 µm, an effective upper limit of 30 µm aerodynamic diameter is frequently assigned. However, PM_{10} and $PM_{2.5}$ are associated with potential health impacts as fine particles are able to be deposited in, and are damaging to, the lower airways and gas-exchanging portions of the lung. The focus of suspended particulate matter is mainly on the size fractions and 10 µm less due to the associated health effects.

[19] Should the dust concentrations exceed the suggested threshold, the DOE will intervene and implement mitigation to reduce the concentration levels to acceptable levels.

SO_2

SO_2 is damaging to the human respiratory system, as prolonged exposure to SO_2 concentrations above certain threshold levels increases the prevalence of chronic respiratory disease and the risk of acute respiratory illness. Due to it being highly soluble, SO_2 is more likely to be absorbed in the upper airways rather than to penetrate to the pulmonary region.

NO_x

NO_x, primarily in the form of nitrogen oxide (NO), is one of the primary pollutants emitted during combustion. Nitrogen dioxide (NO_2) is formed through oxidation of these oxides once released in the air. NO_2 is an irritating gas that is absorbed into the mucous membrane of the respiratory tract with the most adverse health effect occurring at the junction of the conducting airway and the gas exchange region of the lungs. The upper airways are less affected because NO_2 is not very soluble in aqueous surfaces. Exposure to NO_2 is linked with increased susceptibility to respiratory infection, increased airway resistance in asthmatics and decreased pulmonary function.

CO

CO absorbed through the lungs reduces the blood's capacity to transport available oxygen to the tissues. Approximately 80 % - 90 % of the absorbed CO binds with haemoglobin to form carboxyhaemoglobin (COHb), which lowers the oxygen level in blood. Since more blood is needed to supply the same amount of oxygen, the heart needs to work harder. These are the main causes of tissue hypoxia (deficiency in the amount of oxygen reaching body tissues) produced by CO at low exposure levels. At higher concentrations, the rest of the absorbed CO binds with other proteins such as myoglobin and with cytochrome oxidase and cytochrome P-450. CO uptake impairs perception and thinking, slows reflexes and may cause drowsiness, angina, unconsciousness or death.

Table 7-23: Summary of South African emissions limits

Averaging period	Concentration (µg/m^3)	Frequency of exceedances
PM_{10}[20]		
24 hour	120	4
1 year	50	0
SO_2		
10 minutes	500	526
1 hour	120	88
24 hour	75	4
1 year	50	0
NO_2		
1 hour	200	88
1 year	40	0
CO		
1 hour	30	88
8 hour (calculated on 1 hourly averages)	10	11

Heavy Metals

Mercury emissions from coal fired power stations have become an issue of concern due to associated physiological impacts. Organically bound mercury is generally ingested through fish, after being deposited into the aquatic environment. The World Health Organisation has set a direct inhalation exposure guideline of 1 µg/m^3 and an allowable elemental mercury vapor concentration guideline of 0.2 µg/m^3. No standards have been set by South Africa.

Baseline air quality in the region

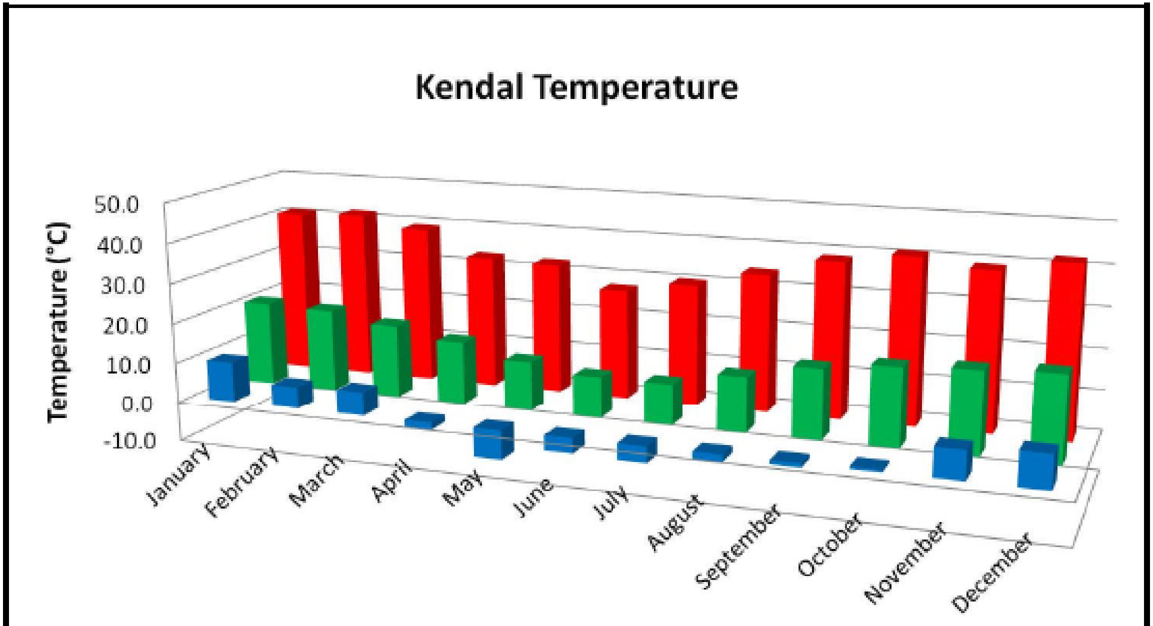
[20] To come into effect in 2015.

The proposed site is located within an existing Anglo-American Kleinkopje Coal Mine, 10 km south of eMalahleni. The towns of Ogie and Phola are located 17.5 km to the south west. The fuel for the proposed power station will be sourced from two existing coal mines (i.e. Kleinkopje and Greenside).

Based on the spatial variability in the wind field, it is evident that easterly and west north-westerly winds are the dominant winds. The variations experienced at an annual level are limited. Winds from the north-westerly sector are predominant during the day, whereas night-times are characterised by an increased frequency of calms, (as typical of the night-time flow regime in most regions on the Highveld). Night time conditions are associated with easterly winds and unstable atmospheric conditions in Khanyisa.

Limited vertical dispersion occurs under stable conditions, and therefore near ground level releases can result in relatively high ground level concentrations during the night. Elevated releases will affect further downwind with lower ground level concentrations, as compared to lower level releases which will likely increase ground level concentrations. The air temperature is important, for determining the development of the mixing and inversion layers and for determining the effect of plume buoyancy[21]. The diurnal temperature profile for Kendal (2004-2008) is tabulated below:

[21] The larger the temperature difference between the plume and the ambient air, the higher the plume is able to rise.



	January	February	March	April	May	June	July	August	Septemb er	October	Novemb er	Decembe r
Min	10.1	5.4	5.9	-1.7	-7.3	-3.7	-4.1	-1.7	-1.0	0.5	7.1	8.2
Mean Temperature	21.0	20.5	18.1	15.5	12.2	10.1	10.0	13.6	17.2	19.3	20.2	21.1
Max	41.0	41.8	39.2	33.0	32.6	27.4	30.2	34.1	38.6	41.0	39.1	42.1

Figure 7-2: Monthly Temperature Profile at Kendal 2004 - 2008

The highest mean monthly temperature is December (21.1°C) while the coldest month is July (10°C). Maximum daytime temperatures reach 42.1°C in December, while the coldest temperature recorded was -7.3°C in May. Precipitation acts as an effective removal mechanism of atmospheric pollutants as it reduces wind erosion potential by increasing the moisture content of materials. Rainfall in this region is primarily limited to showers and thunderstorms, which are generally experienced between October to March. Maximum rainfall is experienced during the summer months, with 85% of the total rainfall. Winter months are normally dry, with an average number of 90 rain days experienced per year.

For the purposes of the air quality impact assessment, six specific sensitive receptors were identified within the closest residential development (i.e. eMalahleni). The receptor sites are located approximately 250 m apart from each other.

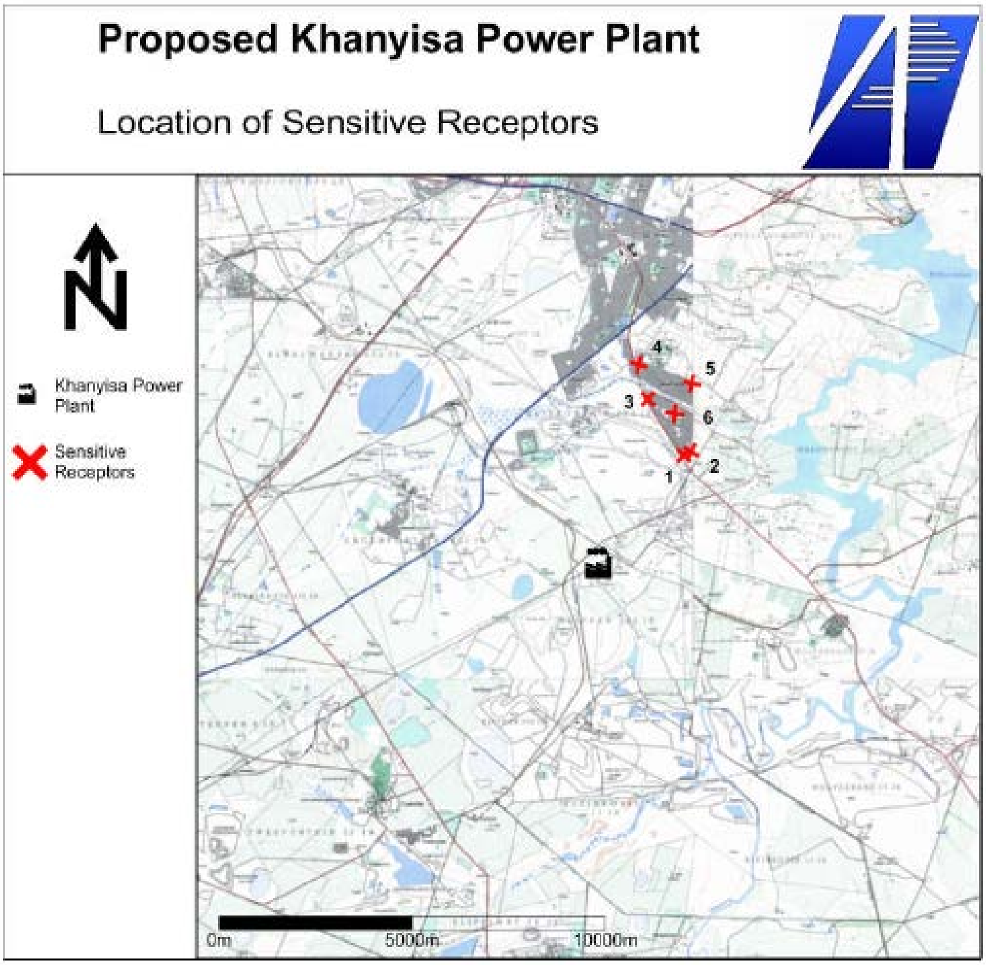


Figure 7-3: Location of sensitive receptors in the vicinity of the proposed site

- Emission sources

  The identification of existing sources of emission in the region and the characterization of existing ambient pollutant concentrations is fundamental to the assessment of the potential for cumulative impacts and synergistic effects. The HPA has frequently been the focus of air pollution studies, as it has been associated with elevated air pollution concentrations. In addition, various elevated sources of emission located in this region have been associated with long-range transportation of pollutants and with the potential for impacting on the air quality of adjacent and more distant regions.

  A comprehensive emissions inventory was recently completed for the region as part of the HPA Baseline Study. The results of this inventory were then used to undertake a comprehensive dispersion modeling study, using the CALPUFF model.

It should be noted that in addition to the emissions inventory, the DEA currently operates five ambient air monitoring stations in the HPA (viz. at Ermelo, Hendrina, Middelburg, Secunda and eMalahleni). The eMalahleni monitoring station is the closest monitoring station to the proposed site. The ambient concentrations measured for PM_{10}, SO_2, NO_X and CO at the eMalahleni station were also included in the dispersion modelling exercise. However, the ambient concentrations measured at the eMalahleni monitoring station are not representative of the baseline ambient levels at the proposed power plant site as local source emissions near eMalahleni are likely influencing background levels.

- Measured current baseline air quality

  From the measured data and modelled baseline ambient SO_2, NO_2 and PM10 concentrations at the 6 sensitive receptors, the average concentrations levels are as follows:

  - SO_2: Average hourly daily SO_2 ground level concentrations of 640 µg/m³ at the sensitive receptor sites, confirmed modelled data in the sense that frequent exceedances of the National Ambient Air Quality (NAAQ) limits of 120 µg/m³ occur, but more frequently during the winter season. Sources that may contribute to the SO_2 levels in the area include power generation, industrial and mining activities and domestic fuel burning.
  - NO_2: Average annual ground level concentrations of NO_2 concentrations of 40 µg/m³ at the sensitive receptor sites comply with the ambient standards, although measured exceedances of the one hour NO_2 standard of 200 µg/m³ do occur.
  - PM_{10}: Measured daily PM_{10} ground level concentrations of 210 µg/m³ at the sensitive receptor sites confirmed modelled data in the sense that frequent exceedances of the NAAQ daily limit of 120 µg/m³ applicable immediately and of the post – 2014 standard of 75 µg/m³ occur, and mainly during the winter season. Sources that may contribute to the PM_{10} levels in the area include power generation, industrial and mining activities, domestic fuel burning, vehicle entrainment on road surfaces, biomass burning, wind-blown dust from open areas and stockpiles as well as particulates from adjacent countries due to the trans-boundary transportation of pollutants.

Table 7-24: Avarage concentrations at the sensitive receptor sites

Pollutant	Concentration (µg/m³)
SO_2	
Highest hourly	640
Highest daily	170
Annually	30
NO_2	
Highest hourly	> 200
Annually	< 40
PM_{10}	
Highest daily	210
Annually	45
CO	
Highest hourly	< 30 000
Highest 8-hourly	< 10 000

Based on the Table 7-24 above, it is apparent that the hourly average of the baseline air quality for both SO_2 and PM_{10} concentration levels currently exceed that of the NAAQ standards. These exceedances are primarily related to industrial and mining activities in the region. The extent and frequency of these exceedances vary, with higher levels of concentration experienced during the winter months. Subsequently, it is evident that baseline conditions currently exceed that of the NAAQ standards and thus any contribution resulting from the proposed project would in fact contribute to exceeding the legal concentration levels for the aforementioned pollutants during the winter periods.

7.3.3. Description and Significance of Potential Impact

Sources of emissions associated with the operational phase of the proposed power station include particulate and gaseous emissions from the power station and materials handling and ash-disposal facilities. Pollutants released would include particulates, sulphur dioxide, oxides of nitrogen, various trace metals, carbon dioxide and nitrous oxide.

In simulating and assessing ambient air pollutant concentrations occurring due to the proposed power station, *cumulative* concentrations arising due to the proposed power station emissions and releases from existing sources were accounted for. In order to more accurately determine the cumulative impact of the proposed power station on ambient air quality, air dispersion modelling was simulated taking into account the projected increase in coal consumption, and hence emissions.

One emissions scenario was simulated based on the expected emissions from the boiler and material handling and transfer. The simulation assumed a stack height of 150 m and that sufficient lime will be added to the CFB Units to maintain stack emission concentrations of SO_2 and NO_X within IFC Guidelines, which are 400 μg/m³ and 200 μg/m³ respectively. It is also assumed that air pollution control equipment will be installed to reduce the particulate emissions concentrations to less than IFC Guideline of 30 μg/m³. This IFC Guideline is specifically for degraded airsheds and the suggested guideline values represent an hourly average concentration level.

Based on the dispersion modelling undertaken, the predicted contributions of the proposed power station and associated ash dump at the six identified receptor sites, are tabulated below.

Table 7-25: Predicted pollutant contributions (µg/m³)

	Annual			Highest daily		8-hourly	Highest hourly		
Receptor	PM_{10}	NO_2	SO_2	PM_{10}	SO_2	CO	NO_2	SO_2	CO
Witbank res. (Highest)	0.02	0.15	0.15	0.36	2.31	18.1	18.4	18.4	56.4
Witbank res. (Lowest)	0.02	0.12	0.12	0.31	2.10	16.0	15.0	15.0	46.0
Farmstead	0.08	0.7	0.7	0.70	6.0	60	40.0	40.0	250

Table 7-26: Predicted pollutant contributions: Coal and Ash Handling (µg/m³)

Receptor	Greenside			Kleinkopje		
	PM_{10} Annual	PM_{10} Daily	TSP Annual	PM_{10} Annual	PM_{10} Daily	TSP Annual
Witbank res. (Highest)	0.17	1.59	0.03	0.37	4.71	0.09
Witbank res. (Lowest)	0.12	1.25	0.02	0.26	3.66	0.05

Based on the predicted concentration levels at the sensitive receptor sites, the ambient air quality for pollutants and airborne particulate matter from the proposed power station alone will not exceed the standards outlined in the NAAQ standard. The proposed project itself will contribute minimally to the existing baseline conditions. However, it should be noted that current baseline conditions of ambient air concentrations exceed the South African NAAQ standards from a cumulative perspective. The predicted cumulative concentrations are tabulated below:

Table 7-27: Predicted cumulative concentrations (µg/m³)

	Annual			Highest daily		8-hourly	Highest hourly		
Receptor	PM_{10}	NO_2	SO_2	PM_{10}	SO_2	CO	NO_2	SO_2	CO
Witbank res. highest	45.5	< 40	30.2	215	172	< 10 000		685	< 30 000
Witbank res. lowest	45.2	< 40	30.2	214	172	< 10 000	> 200	655	< 30 000
Farmstead	45.2	<40	30.7	211	176	< 10 000	>200	680	< 30 000

a) Oxides of Nitrogen

A maximum annual NO_2 concentration of 0.15 µg/m³ is predicted at the sensitive receptors when only the proposed power station emissions are considered and <40 µg/m³ when cumulative emissions are considered. Predicted NO_2 concentrations are less than 50 % of the hourly limit at the point of maximum impact. Predicted annual average concentration contributions are a small fraction of the annual average limit. At the sensitive receptors, the contribution of NO_x is minimal, and despite poor baseline conditions, would not exceed the South African standards from a cumulative perspective either. The potential impact of the proposed power station's NO_2 emissions is considered to be low, with a long-term duration and local extent. The significance of this impact is consequently considered to be **low (-ve)**.

Particulate Matter

A maximum annual PM_{10} concentration of 0.02 µg/m³ is predicted when only the proposed power station emissions are considered and 45.5 µg/m³ at the sensitive receptors when cumulative emissions are considered.

The expected PM_{10} concentrations at the sensitive receptor sites resulting from the proposed power plant are below the South African Standards (current and post 2014 standards) in terms of hourly, daily and annual averages. However, predicted ground level PM_{10} concentrations from the existing Greenside and Kleinkopje Coal Mines indicate that small localised areas, mainly in the coal and ash handling facilities, would experience daily and annual average values that exceed the SA limit values (refer to Figure 7-4 and Figure 7-5 below). The frequency of exceedances of the daily standard also exceeds the allowed 4 exceedances as per the NAAQ standards. These impacts do not however extend to the sensitive receptors and are limited to the site itself. Both the highest daily and annual average concentrations of the particulate matter from the stack are a small fraction of the respective limit. From a cumulative perspective, current PM_{10} concentrations exceed the South African Standards, due to elevated background values experienced in the region. The potential impact of the proposed power station's PM_{10} emissions is considered to be low, with a long-term duration and local extent. The significance of this impact is consequently considered to be **low (-ve)**.

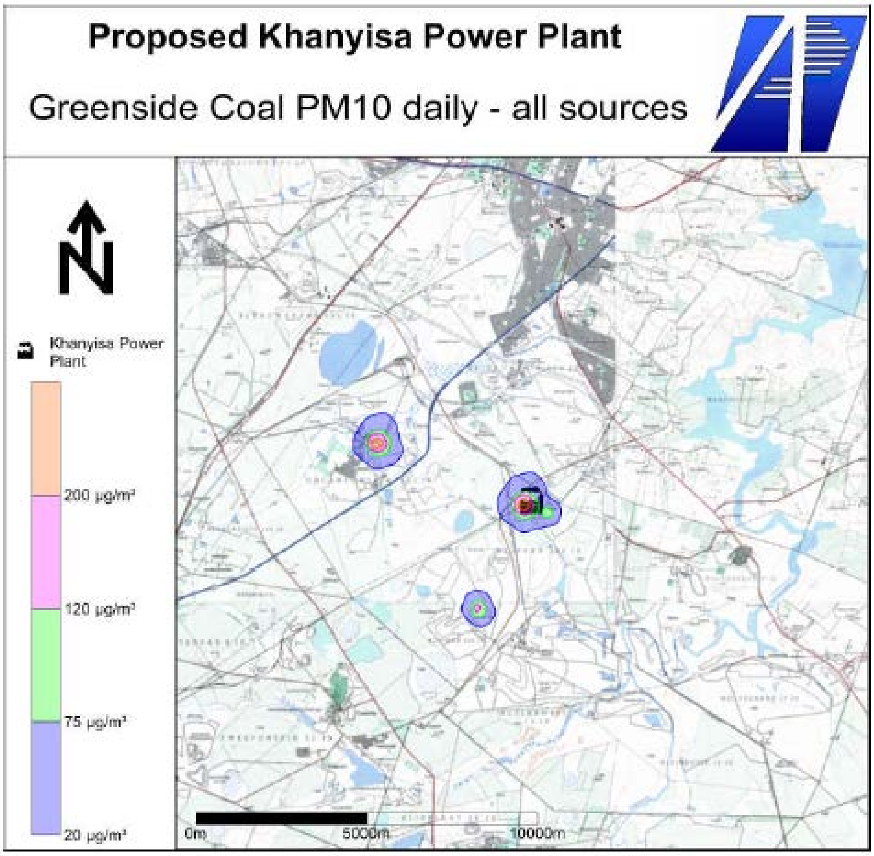


Figure 7-4: Predicted highest daily ambient PM10 concentration due to coal and ash handling. Comparison value: SA post-2014 limit of 75 µg/m³.

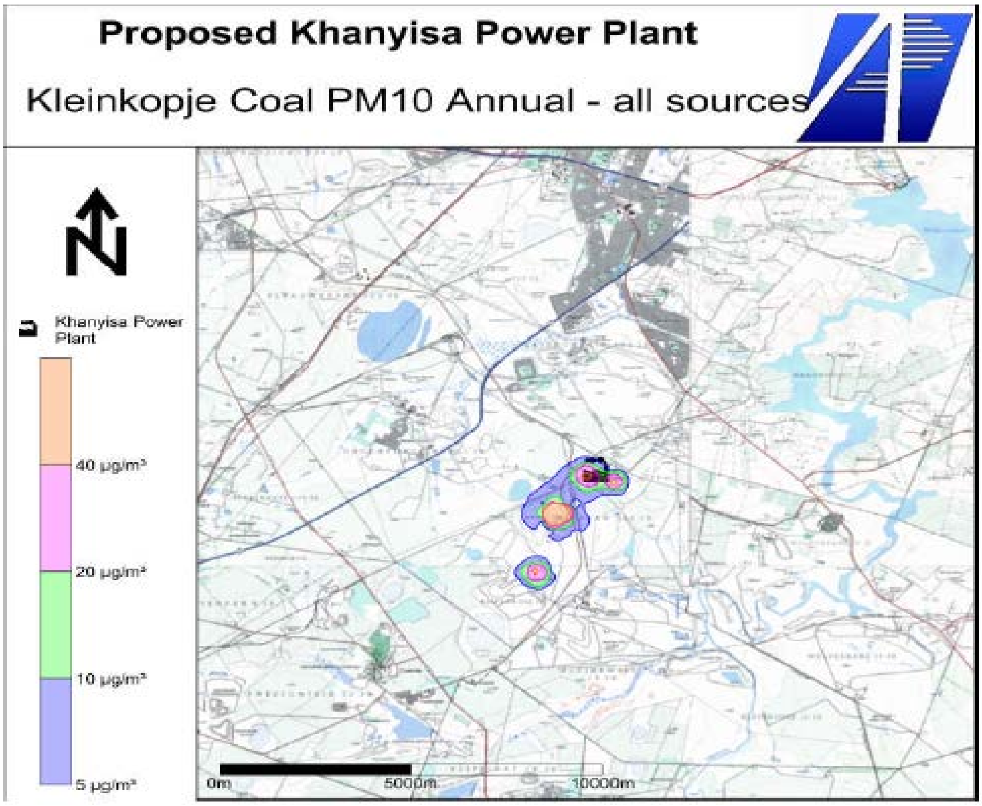


Figure 7-5: Predicted annual average ambient PM10 concentration due to coal and ash handling. Comparison value: SA post-2014 limit of 75 µg/m³

Carbon Monoxide

A maximum hourly CO concentration of 56 µg/m³ is predicted at the sensitive receptors when only the proposed power station emissions are considered and < 30 000 µg/m³ when cumulative emissions are considered. The predicted contribution of CO emissions from the proposed project alone on ambient concentrations is minimal at all receptors. From a cumulative perspective the contribution of CO from the proposed project is minimal at the sensitive receptors, despite poor baseline conditions, and would not exceed the South African standards either. The potential impact of the proposed power station's CO emissions is considered to be low, with a long-term duration and local extent. The significance of this impact is consequently considered to be **low (-ve)**.

Sulphur Dioxide

Of the six sensitive receptors, a maximum SO_2 concentration of 0.15 µg/m³ is predicted at the sensitive receptors when only the proposed power station emissions are considered and 30.2 µg/m³ when cumulative emissions are considered. Maximum SO_2 concentrations of the proposed project, as modelled for the receptor sites, are less than 50% of the hourly limit and less than 20% of the daily limit. Predicted annual average concentration at receptor sites are a small fraction of the annual average limit.

Whilst the increase in sulphur dioxide concentrations caused by the proposed project at the sensitive receptors is negligible, cumulative values will continue to exceed South African standards, due to existing elevated baseline concentrations in the area. The potential impact of the proposed power station's SO_2 emissions is considered to be low, with a long-term duration and local extent. The significance of this impact is consequently considered to be **low (-ve)**.

Mitigation measures

- Dust deposition and PM_{10} monitoring should be carried out to confirm the modelling and provide trend values. This will also allow tracking of the efficiency of management measures that may be instituted.
- A dust control programme, including dust monitoring stations at the boundaries of the site, should be designed with the aid of an air quality specialist and implemented to ensure compliance with the relevant South African standards. Where necessary, dust control measures such as watering of ash dumps and roads, covering coal and ash loads during transport, etc should be implemented to ensure compliance with South African standards.
- Coal recovery and transport facilities, as well as the ash disposal facilities, should be designed to minimise dust emissions.
- Design the proposed project such that hourly concentrations of SO_2 and NO_X from the stack are within IFC Guidelines, which are 400 µg/m³ and 200 µg/m³ respectively.
- Ensure air pollution control equipment is installed to reduce the hourly concentrations of particulate emissions to within the IFC Guideline of 30 µg/m³.
- Water sprays or chemical suppressants on all on-site unpaved roads.
- Water sprays or chemical suppressants on all material transfer points.
- Vegetation cover on the ash dumps to reduce the potential for windblown dust.
- Continuous monitoring of SO_2, NO_x and PM_{10} in stack emissions should take place.

- Aims, objectives and regulations as per the proposed Air Quality Management Plan for the HPA should be complied with.

Table 7-28: Impact - SO_2 emissions

Impact of SO_2 emissions on ambient air quality and legal compliance		
Site 6C & Ash 3		
	No mitigation	Mitigation
Extent	Local	Local
Magnitude	Low	Low
Duration	Long term	Long term
SIGNIFICANCE	Low(-)	Low(-)
Probability	Definate	Definate
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

Table 7-29: Impact - NO_2 emissions

Impact of NO_2 emissions on ambient air quality and legal compliance		
Site 6C & Ash 3		
	No mitigation	Mitigation
Extent	Local	Local
Magnitude	Low	Low
Duration	Long term	Long term
SIGNIFICANCE	Low(-)	Low(-)
Probability	Definate	Definate
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

Table 7-30: Impact – PM_{10} emissions

Impact of PM_{10} emissions on ambient air quality and legal compliance		
Site 6C & Ash 3		
	No mitigation	Mitigation
Extent	Local	Local
Magnitude	Low	Low
Duration	Long term	Long term
SIGNIFICANCE	Low(-)	Low(-)
Probability	Definate	Definate
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

Table 7-31: Impact – CO emissions

Impact of CO emissions on ambient air quality and legal compliance		
Site 6C & Ash 3		
	No mitigation	Mitigation
Extent	Local	Local
Magnitude	Low	Low
Duration	Long term	Long term
SIGNIFICANCE	Low(-)	Low(-)
Probability	Definite	Definite
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

7.3.4. COMMENT ON CUMULATIVE IMPACTS

Due to the nature of modelling air quality impacts, the cumulative impacts on ambient air quality have already been considered, through the creation of a modelled base case scenario, which predicts what the current ambient air quality will be (the baseline) and considers the impact of the proposed power station in addition to the baseline scenario.

While the power station PM_{10} emissions are fractional when compared to the NAAQ standards and can be managed and mitigated successfully, the two existing coal mines (Kleinkopje and Greenside) will add to the PM_{10} concentrations in the immediate area, on-site. The increased coal mining activities may increase the airborne particulate matter in the atmosphere, the extent of which would be determined by the type of mining that is undertaken. However, cognisance should be taken of the existing elevated PM_{10} baseline concentrations that exceed the NAAQ Standards.

Based on the combustion technology proposed for the power plant, the addition of sufficient lime will reduce SO_2 emissions from the stack.
Subsequently, the emissions concentrations of SO_2 from the proposed power plant will remain well below the NAAQ standards. However, cumulative values may continue to exceed South African standards, due to elevated background values being experienced in the area.

In terms of Section 19 of the NEM: AQA, an Air Quality Management Plan is currently being drafted for the HPA. The proposed management plan will endeavor to ensure that cumulative ambient air concentrations for the region remain within the legal standards through the implementation of aims and objectives. In addition, the proposed Air Quality Management Plan will provide recommendations to reduce cumulative exceedances of ambient air concentrations. In doing so, this would likely result in all polluters having to reduce their emissions in order to remain below the ambient air concentrations for the region, from a cumulative perspective.

The anticipated cumulative impacts on climate change will be dicussed in 7.4.4 below.

7.4. IMPACT ON CLIMATE CHANGE

7.4.1. Impact statement

The establishment of a new coal-fired power station will emit greenhouse gases to the atmosphere, adding to the greenhouse effect on a regional, national and international scale.

7.4.2. Discussion

Gases which contribute to the greenhouse effect are known to include carbon dioxide (CO_2), methane (CH_4), water vapour, nitrous oxide, chloroflurocarbons (CFC's), halons and peroxyacylnitrate (PAN). All of these gases are transparent to shortwave radiation reaching the earth's surface, but trap long-wave radiation leaving the earth's surface, acting like a greenhouse. This action leads to a warming of the earth's lower atmosphere, with changes in the global and regional climates, rising sea levels and extended desertification. This in turn is expected to have severe ecological consequences and a suite of implications for humans. Total greenhouse gas emissions reported to be emitted within South Africa and globally for a year is approximately 433 million metric tons of CO_2 and 29 319 million metric tons of CO_2 in 2007 (UN Statistical division, 2010), respectively.

Greenhouse gases released from a coal-fired power station are primarily CO^2 with minor amounts of nitrous oxide (N_2O). The proposed power station is likely to contribute about 4.3 million metric tons of CO_2 per year (assuming the operation of a 450 MW power station with an emission factor of 1100 g CO2 per kWh sent out, operating with FGD on Kleinkopje discard for 8700 h per year). (Mott McDonald, 2011)

Table 7-32: Appropriate annual South African emisisons expected in 2018[22]

	Annual emissions (million metric tons of CO_{2})
South Africa 2007 (UN Statistical Division, 2010)	433
Medupi Power Station (under construction 4 800 MW	29.9
Kusile Power Station 4 800MW (under construction)	29.9
TOTAL emissions	502.8

7.4.3. Description and significance of potential impact

The emissions from Khanyisa power station would increase South Africa's CO_2 equivalent emissions by some 0.85 % and would increase the country's contributions to global emission of greenhouse gases by some 0.01 %. This is a limited increase in greenhouse gas emissions, given the aims of the Kyoto Protocol, which aims to reduce overall emission levels of the six major greenhouse gases to 5 % below the 1990 levels, between 2008 and 2012 in developed countries. While South Africa, as a developing country, is not obliged to make such reductions, the increase in greenhouse gas (GHG) emissions must be viewed in light of global trends to reduce these emissions significantly.

The proposed station has a slightly higher emission factor than that of the average Eskom coalfired power station (approx. 1100 g/kWh vs 1065 g/kWh) but it should be taken into account that the proposed station includes an emission premium for FGD of approximately 50 g/kWh and will replace power generation from Eskom's marginal (not average) station. The latter may be expected to have a considerably higher GHG emission factor than the average. The proposed station will therefore have a neutral or slightly positive effect on GHG emissions.

Mitigation measures

CCS is a way of mitigating the contribution of fossil fuel emissions to global warming, based on capturing CO_2 from large point sources such as power stations and storing it away from the

[22] Note that the total annual South African emissions for 2018 are likely to be under estimated. This is because growth of emissions since 2007 has not been included, other than for new coal-fired power station which are currently under construction.

atmosphere. Carbon dioxide is concentrated through various options and then stored permanently. In the case of coal-fired power station the simplest method of capturing CO_2 is post-combustion. Here, CO_2 is captured from flue gases at the power station.
The technology is well understood and is currently used in other industrial applications, although not at the same scale as might be required in a commercial scale power station. Coal is often burnt in oxygen instead of air in order to simplify the capture process.

The best researched carbon dioxide option is geological storage: This method involves injecting carbon dioxide directly into underground geological formations. Oil fields, gas fields, saline formations, unminable coal seams, and saline-filled basalt formations have been suggested as storage sites. Various physical (e.g. highly impermeable rock) and geochemical trapping mechanisms would prevent the CO_2 from escaping to the surface. The CSIR undertook a study into the potential for CO_2 storage in South Africa (2004).

The study concluded that the storage of CO2 in depleted gas fields, coal mines or gold mines is very limited. Deep saline reservoirs offer the highest potential for the geological storage of CO2. The Karoo Super Group sediments offer the highest potential, and within that, the Vryheid Formation in the north and the Katberg Formation near Burgersdorp/Molteno offer the biggest potential.

However, due to a lack of information about the porosity and permeability of these of reservoirs, significant work is required, before CO_2 sequestration into geological formations will be possible (CSIR, 2004). The South African CCS Atlas, identified at a theoretical level that South Africa had about 150 Gigatons (Gt) of storage capacity. Less than 2% of this is onshore. A significant limitation of CCS is its energy penalty. The technology is expected to use between 10 – 40 % of the energy produced by a power station to capture the CO2 (IPCC, 2005). Wide scale adoption of CCS may erase efficiency gains of the last 50 years, and increase resource consumption by one third. However even taking the fuel penalty into account overall levels of CO2 abatement remain high, at approximately 80 - 90% compared to a plant without CCS.

In view of the above, and in the light of the difficulties imposed by the site, it is unlikely that CO_2 capture and storage will in the short and medium turn become viable for the Khanyisa project.

A number of CCS methods are under investigation and some of the more common and most relevant are considered here.

Mineral storage: This method involves reacting CO_2 with naturally occurring magnesium (Mg) and calcium (Ca) containing minerals to form carbonates. This has many unique advantages, including that carbonates have a lower energy state than CO_2, which is why mineral carbonation is thermodynamically favourable and occurs naturally (e.g. the weathering of rock over geologic time periods) and the raw materials such as Mg based minerals are abundant.
Finally, the carbonates are unarguably stable and thus re-release of CO_2 into the atmosphere is not an issue. However, conventional carbonation pathways are slow under ambient temperatures and pressures. The significant challenge to be addressed in developing mineral storage is to identify an industrially and environmentally viable carbonation route that will allow mineral sequestration to be implemented with acceptable economics (Goldberg *et al*, 2007).

A major concern with CCS is whether leakage of stored CO_2 will compromise CCS as a climate change mitigation measure. For well-selected, designed and managed geological storage sites, IPCC (2005) estimates that CO_2 could be trapped for millions of years, and although some leakage occurs upwards through the soil, well selected stores are likely to retain over 99 % of the injected CO_2 over 1 000 years. Leakage through the injection pipe is a greater risk. Although injection pipes are usually protected with non-return valves (to prevent release on a power outage), there is still a risk that the pipe itself could tear and leak due to the pressure.

In 1986 a large leakage of naturally sequestered carbon dioxide rose from Lake Nyos in Cameroon and asphyxiated 1 700 people. While the carbon had been sequestered naturally, some point to the event as evidence for the potentially catastrophic effects of sequestering carbon.

Another limitation of CCS is its energy penalty. The technology is expected to use between 10 – 40 % of the energy produced by a power station to capture the CO_2 (IPCC, 2005). Wide scale adoption of CCS may erase efficiency gains of the last 50 years, and increase resource consumption by one third. However even taking the fuel penalty into account overall levels of CO_2 abatement remain high, at approximately 80 - 90% compared to a plant without CCS.

Lastly there is the issue of cost, which is due to several reasons. The increased energy requirement of capturing and compressing CO_2 significantly raises the operating costs of CCS-equipped power plants. In addition there is added investment or capital costs. The process would increase the fuel requirement of a plant with CCS by about 25 % for a coal-fired plant

(IPCC, 2005). The cost of this extra fuel, as well as storage and other system costs are estimated to increase the costs of energy from a power plant with CCS by 30 - 60%, depending on the specific circumstances (McKinsey, 2008).

Recycling CO_2 is likely to offer the most environmentally and financially sustainable response to the global challenge of significantly reducing greenhouse gas emissions from major stationary (industrial) emitters in the near to medium term.

This is because newly developed technologies, such as Bio CCS Algal Synthesis can use captured, pre-smokestack CO_2 (such as from coal-fired power station) as a feedstock in the production of oil-rich algae, to produce oil for plastics and transport fuel (including aviation fuel) and nutritious stockfeed for livestock. The CO_2 and other captured greenhouse gases are injected into membranes containing wastewater and select strains of algae causing, together with sunlight or UV light, the oil rich biomass to double in mass every 24 hours. The Bio CCS Algal Synthesis process holds a number of key advantages over conventional CCS in that it is based on well established earth science photosynthesis, the technology is entirely retro-fittable and co-located with the emitter (e.g. alongside a power station) and the capital outlays offer a return upon investment due to the high value commodities produced (oil for plastics, fuel and feed). Another advantage of Bio CCS Algal Synthesis is that it offers consumption of the full mixture of greenhouse gases normally found in smokestack emissions, not just CO_2 as is the case with most CCS proposals (Graham-Rowe, 2008).

As can be seen from the above, while there are a number of promising measures for mitigating CO_2 emissions there are currently no feasible directly applicable measures that can be implemented at the project level at this point. However, strategic mitigation measures to reduce carbon emissions include increasing the mix of renewable energy, nuclear and to a lesser extent gas technologies within South Africa's power generation capacity.
Offset mitigation measures are also considered to be potential mitigation measures. It should be noted that the implementation of screening with trees as a mitigation measure for visual impacts is also considered an offset measure for greenhouse gases with each mature tree sequestering 1.5 tons of CO_2 over a 30 year period. This is however insignificant in comparison to the 33.6 million metric tons of CO_2 emitted per power station per year.The detailed results of the air quality impact assessment are contained in Volume 2.

Table 7-33: Impact – Climate change

Impact of proposed power station on climate change		
SITE 6C		
	No mitigation	Mitigation
Extent	Regional	Regional
Magnitude	Low	Neutral – Very Low
Duration	Long	Long
SIGNIFICANCE	Medium (-)	Neutral – Very Low (-)
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Irreversible	Reversible

7.4.4. Comment on cumulative impacts

It should be noted that the addition of coal-fired generating capacity to South Africa's energy mix effectively commits South Africa to increased CO_2 from the energy sector for the next 50 years (i.e. the life of the plants) or until a viable carbon sequestration technology is commercialised. However, it should be noted that older coal-fired power station would be decommissioned during this period so it would still be possible to reduce South Africa's carbon emissions, due to the greater efficiency (and hence lower emissions per MW) of new coal-fired power stations.

7.5. IMPACT OF GROUNDWATER RESOURCES (GEOHYDROLOGY)

7.5.1. Impact Statement

Raw materials such as process chemicals and liquid fuels used at the proposed power station, as well as liquid and solid waste (ash) products from the operation of the proposed power station, could contaminate the groundwater resources in the area, having an effect on current and potential future groundwater users.

7.5.2. Discussion

In order to understand the geohydrological environment of the proposed sites, and to identify and quantify potential impacts the proposed power station may cause, Aurecon were appointed to undertake a detailed geohydrological assessment as part of the ESIA. The geohydrological investigations indicated that groundwater within the proposed sites is not used as a source of potable water due to poor quality water. This poor quality water is as a result of historical mining within the region pertaining to open cast and underground mining and its related activities. Thus, the existing boreholes in the area are mainly used for monitoring purposes. A hydrocensus of existing boreholes (data received from Kleinkopje Colliery) was performed within the project area and found that a number of boreholes on the database are either destroyed /dry or have collapsed.

Furthermore, most of the existing boreholes are located at such a distance from the investigation sites that they extend beyond the zone of impact and model boundaries, making the data irrelevant to the study.

The following objectives were stated for the investigation:

- Describe the baseline geohydrological conditions within the zone of influence.
- Predict the environmental impact of the proposed development on the geohydrological regime of the area. This includes the description of possible negative impacts during construction, operation, decommissioning and after closure.
- Design and implement a groundwater management framework, monitoring programs and rehabilitation measures based on physical, hydraulic and hydro-geochemical information as gathered and predicted in the preceding phase.

The methodology to this study included:

- The desk-top study entailed collating all existing relevant data from the client and published data in the public domain (sourced from DWA records etc.). Aerial photos and geological maps were studied to identify possible structural features.
- A hydrocensus was performed on and around the area (within a scientifically defined distance), earmarked for the project to identify legitimate groundwater users and the groundwater sphere of influence.

- Geophysical survey was envisaged along the perimeter of the area earmarked for construction of the ash dam (Ash 3) to identify and confirm possible dykes, faults and /or fracture zones which may act as groundwater flow barriers or pathways.
- Development of a numerical flow and transport model to assess impacts on the groundwater regime caused by the proposed project.
- To determine water level head distribution and establish and monitor the groundwater quality in:
  - the rehabilitated opencast underlying the proposed ash dump; and
  - The fractured Ecca aquifer and the near surface weathered Ecca aquifer underlying the proposed Power Plant (Site 6C).

The detailed methodology and results of the geohydrological assessment are contained in **VOLUME 2** of this report.

From a hydrogeological viewpoint, the mined areas are situated in fractured Karoo Bedrock with a very low hydraulic conductivity. Borehole yields in this formation are less than 1 ℓ/s (litre/second), and statistically the majority of boreholes were expected to be dry. In contrast, the hydraulic conductivity of a rehabilitated opencast area is very high and pump tests will barely result in measurable drawdown (due to the ease with which water moves). In addition, the opencasts are all connected to the remaining underground mine voids; with extremely high conductance, comparable with large diameter pipes rather than typical aquifer material.

The ash itself is expected to present with intermediate hydraulic conductivity levels, typically between the bedrock and the backfilled opencast material (closer to the bedrock if anything).Thus, flow of water (and associated pollutants) is expected to be slowly vertical through the ash to the opencast. From the water level in the opencast, flow will mostly be horizontal at an accelerated velocity as the larger flow regime is joined, until an underground mine structure is entered. In other areas the flow infiltrating into the bedrock can be expected to flow mostly vertical until an underground section is reached, from where flow would be horizontal down gradient. However, it is prudent to mention at this stage that it was found in this study that the flow from the ash dam is mostly in a southerly direction in the opencast material.

Furthermore, the undisturbed bedrock is covered by a weathered soil layer of several metres thickness (described as the “Ecca Weathered Aquifer”). The hydraulic conductivity of this material is higher than the bedrock and probably comparable to the ash. Groundwater in this upper soil layer is inconsistent both spatially and temporal. Lower lying areas could be permanently saturated, while higher lying areas could contain seasonal perched groundwater at most, as is seen on site currently in places. Figure 7-6 illustrates the geohydrological flow discussed above.

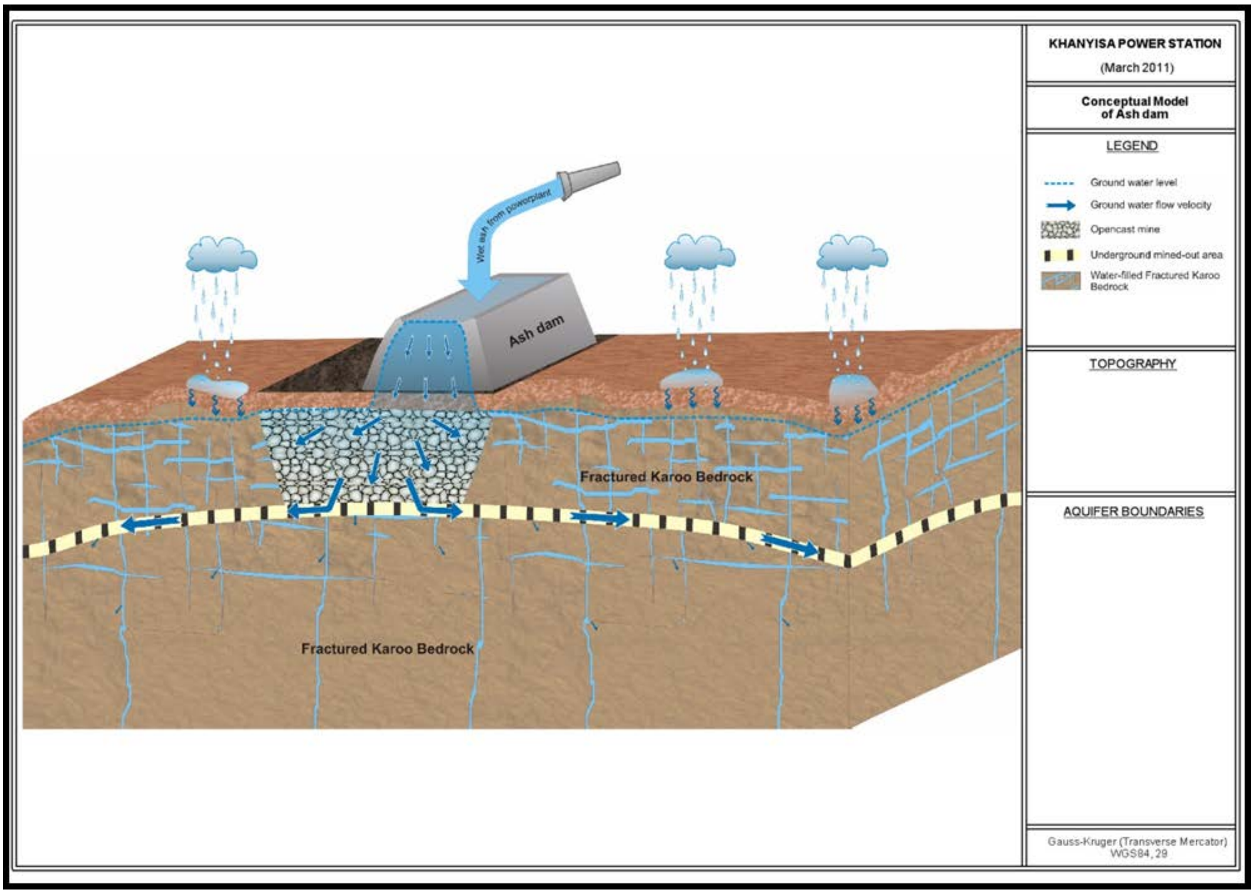


Figure 7-6: Conceptual model of the ash dam on a rehabilitated opencast

Water levels were measured on 7 July 2011, in all accessible boreholes identified during the hydrocensus (6), as well as in the newly drilled boreholes (7). Measured static water levels (SWL) in the study area varied between 2.03mbgl and 74.57mbgl (meters below ground level). Under undisturbed conditions, a linear relationship can be expected to exist between groundwater levels and surface topography. This is however not the case in the project area as historical and current opencast and underground mining, mine dewatering and rehabilitation activities has altered the static water level and natural groundwater flow directions significantly. Water levels in each of the measured boreholes must be interpreted in context of the area they are located as indicated in Table 7-34 and Figure 7-7

Table 7-34: Borehole water levels

BH nr.	Coordinates (WGS84)	Static water level (mbgl)
GUW002	S 25.96269 E 29.20405	74.57
KKW05	S 26.01289 E 29.21312	21.93
KKW13	S 25.99267 E 29.22051	2.92
KKW14	S 25.99684 E 29.22091	3.50
KKW42	S 25.97779 E 29.22099	0.68
KHBH1	S 26.00763 E 29.21698	Dry
KHBH2	S 26.00609 E 29.21815	Dry
KHBH3	S 25.99231 E 29.20280	Dry
KHBH4D	S 25.97064 E 29.22385	8.41
KHBH4S	S 25.97069 E 29.22376	No access
KHBH5D	S 25.97443 E 29.22721	2.3
KHBH5S	S 25.97426 E 29.22735	2.03

The deep water level (74.57 mbgl) caused by mine dewatering in borehole GUW002 depicts the water level in the underground workings it was drilled into. Boreholes drilled into the rehabilitated opencast (KHBH1, 2 & 3) underlying the proposed Ash dump site (Ash 3) are dry. This can be expected due to mining of the north-west dipping coal seam and associated dewatering. The water level in the boreholes (KHBH4D&S and KHBH5D&S) drilled up and downstream of the proposed Power Plant site (Site 6C) varies between 2 and 9 meters and confirms the presence of a perched aquifer. These boreholes were not drilled into disturbed strata and are a more realistic reflection of the natural static groundwater level. Mine dewatering would however also have an influence on these water levels, but not to the same extent as boreholes drilled into disturbed areas.

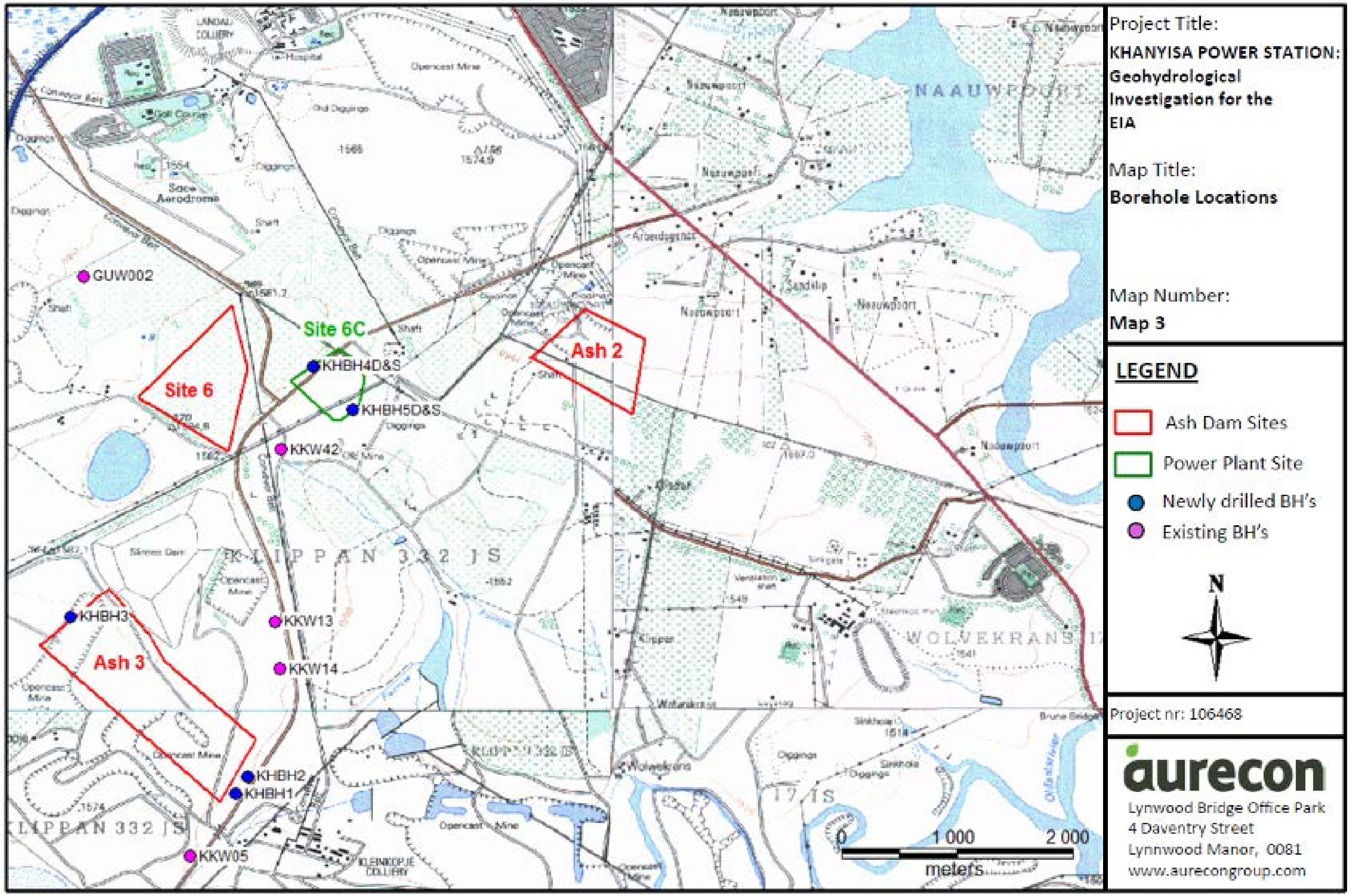


Figure 7-7: Borehole locations in relation to the propsed sites identified for the ash dump and power statio

a) Baseline Groundwater Quality

Groundwater samples were collected for chemical analysis during the hydrocensus from selected existing production boreholes, as well as from the recently drilled boreholes on the 7 July 2011. The chemical results were compared with the SABS drinking water standards (SANS 241:2006, edition 6.1) and the following conclusions were drawn:

- The wide range of values indicates that the groundwater in certain areas have been impacted upon by underground and /or opencast coal mining.
- Except for boreholes GUW002, KKW42 and KHBH4D all of the sampled boreholes exceed the maximum allowable SABS drinking water standards, indicating poor water quality within the project site. The remaining boreholes can be classified as Class 2 water (maximum allowable concentration for short term use only). None of the boreholes can be classified as Class 1.
- The impact of mining operations cannot clearly be seen on boreholes GUW002, KKW42, KHBH4D and KHBH5D & S. Although water originating from borehole GUW002 is drilled into old underground workings, it seems largely unaffected by the mining operations. The reason therefore could be that the workings were flooded shortly after mining in this areas ceased, leaving little time for pyrite oxidation to take place.
- Boreholes KKW05, 13 and 14 are clearly impacted upon by mining operations (low pH, high concentrations of SO_4 and Mn /Fe).

Table 7-35: Chemical parameters compared to SANS 241:2006 (edition 6.1) drinking water standards

Sample Nr.	GUW002	KKW05	KKW13	KKW14	KKW42	KHBH4D	KHBH5D	KHBH5S	Class I	Class II
Ca	21.78	198.00	313.00	349.00	61.32	9.34	4.66	65.22	150	300
Mg	11.61	104.00	222.00	77.00	54.39	5.94	2.15	47.91	70	100
Na	18.31	16.60	20.85	7.87	39.50	12.80	7.11	33.04	200	400
K	2.58	11.80	10.03	4.11	0.97	3.48	2.26	408.25	50	100
Mn	0.12	2.72	3.12	1.23	0.06	0.05	0.19	2.19	0.1	1
Fe	0.10	0.26	0.11	0.03	0.25	0.23	3.19	9.12	0.2	2
F	0.36	0.50	1.91	1.61	0.25	0.31	1.32	2.00	1	1.5
NO_3-N	0.11	8.62	1.45	1.57	2.96	2.01	0.16	0.14	10	20
NH_4-N	1.22	0.09	1.20	0.05	0.05	0.06	0.08	0.78	0.94	1.87
Al	0	0	3.304	4.291	0.009	0.01	0	0	0.3	0.5
Cl	7	9	5	2	6	0	11	602	200	600
SO_4	20	707	1585	1158	227	8	6	20	400	600
pH	7.18	6.57	4.50	4.65	6.98	8.02	6.30	6.31	5.0 - 9.5	4.0 - 10.0
EC	24	120	194	151	65	13	7	213	150	370

Notes
Yellow = Class I
Tan = Class II
exceeds maximum allowable drinking water standard
na- not analysed
0 = below detection limit of analytical technique

7.5.3. Description and significance of impact

The proposed power station will comprise several components or processes that may have an impact on the groundwater environment. The most significant impacts related to groundwater contamination include:

- Contamination from the ash dump (leachate)
- Artificial recharge and contamination from the ash dumps drainage channels and toe dams, through seepage, spillage, and overflow; and
- Infiltration of various grades of oil, including bunker fuel oil storage areas, into the groundwater system

The current groundwater level in the mining area has been artificially lowered by pumping during mining excavations. Groundwater (SWL) recovery is expected when this pumping ends, potentially leading to wetting of the opencast backfill from below. It is understood though that extensive deep mining in the area is likely to continue for at least another 20 years and that once the pumps are switched off recovery is likely to be slow.

The geohydrological study included the assumption that ash will be deposited while opencast mining at the Kleinkopje Colliery is still in progress. Furthermore, it is accepted that the ash dam will be lined and the risk of leaking would be very low during the initial years of operation. For the purpose of this study, it was thus supposed that the risk of environmental damage posed by the ash dam will be present well beyond the lifetime of the opencast.

Based on the field work, interpretation of available and newly acquired data and results of the numerical model it can be concluded that the proposed power station and associated ash dump will have **a low (-ve) to very low (-ve)** impact on the investigated geohydrological environment, given that sound environmental infrastructure and management procedures are put in place as proposed in the Project Concept Report by Mott MacDonald Consultants (**VOLUME 4**).

a) Ash disposal

The disposal of ash has the potential to pollute water resources, including the contamination of groundwater from leachate and the contamination of surface water from discharge of ash dump effluent. Literature review also confirms that indirect human intake of ash dump effluent contaminants (e.g. selenium) can result from the consumption of livestock that has ingested water or pasture contaminated by ash slurry. In order to effectively mitigate this risk, it is imperative that leachate from the ash dump be securely prevented from permeating into the groundwater aquifer. Therefore, the focus of this impact discussion relates to effective leachate management.

Based on the classification of the waste stream and in accordance with the Minimum Requirements for Waste Disposal by Landfill (Second Edition, 1998), the proposed landfill shall be designed for the acceptance of hazardous (H:H) waste. This is a legislative requirement which must be enforced as a condition of the final environmental approval because if the proposed landfill dump is not designed and constructed in terms of the Minimum Requirements for Waste Disposal by Landfill, then pollution from released contaminants (such as leachate) may impact on surface water resources.

Leachate Management

The potential for leachate generation is determined using the Climatic Water Balance and is used to assess the need for containment at newly proposed sites. However, it is a requirement that all landfills classified as Hazardous (H.H) must be designed and operated as containment landfills. According to the Precautionary Principle (see text below) as described in the Classification and Disposal of Hazardous Waste (Department of Water Affairs and Forestry 2nd Edition), it is the responsibility of the IPP to demonstrate the motivation for the classification of waste streams.

"The Precautionary Principle assumes that a waste or an identified contaminant of a waste is both highly hazardous and toxic until proven otherwise. Since the legislation is stricter for highly hazardous and toxic wastes, the costs for their treatment and disposal are consequently higher than for waste of low hazard. It is therefore obviously in the generator's interest to obtain the necessary information to prove that the material or waste product is of a lesser hazard. The burden of proof shall always be on the generator of the waste in question."

Based on this "precautionary principle" in the Hazardous Waste Classification, the proposed ash waste has been classified as Hazardous waste (H:H) for all design criteria as noted above. As such, containment as if the ash were hazardous is a prerequisite regardless of the climatic water balance and assumed final quality.

The construction and operation of the proposed liner does not involve handling or storage of dirty or contaminated water at ground surface. The dirty water from the site infrastructure area will be managed as discussed within the drainage system, Section 6.5.3 (**VOLUME 2**). The contaminated water generated from the liner is leachate, but is contained within the liner and will be managed in the manner proposed below. As such, the adoption of pollution control dams is not applicable.

Lining System for Hazardous Waste (H:H) (Discussed in Chapter 3, project description)

The basal lining system is to be anchored at the top of a minimum 1.5m high perimeter bund, with internal and external slopes of 1(v):3(h). The proposed basal lining system comprises the following elements in the following succession from top to bottom:

- 300mm Leachate Collection Layer;
- 150mm Soil Protection Layer (or Protective Geotextile);
- 1 No. layer of 2mm FML /HDPE Geomembrane (double textured);
- 1 No. layer of Geosynthetic Clay Liner (GCL);
- 100mm thick silt /sand support layer;
- 1 No. layer of Protective Geotextile (Geotextile Layer);
- 150mm Leakage Detection and Collection Layer;
- 1 No. layer of Geosynthetic Clay Liner (GCL);
- 150mm Base Preparation Layer; and
- *In situ* Soil (OCCS backfill material).

The proposed lining system comprises two leachate layers, the primary for leachate collection and the secondary layer for leachate detection. Typical lining sections are illustration on Drawing 289348-SHF-005 in **ANNEXURE C**.

Leachate generation

The "Minimum Requirements"[23] provides guidance on Climate Water balance to determine the potential for leachate generation from a landfill, but does not provide guidance on leachate generation. The method used to estimate leachate generation is provided in the revised draft version of "Minimum Requirements for Waste Disposal by Landfill, Third Edition, 2005".

In estimating leachate generation, consideration was given to the fact that placed ash is relatively impermeable, with a permeability coefficient of the order of 10^{-7}m/s. (Lindon KA Sear)" states in part,
"Experience has shown that if fly ash is well compacted and is subsequently subjected to heavy rain, it will slowly absorb moisture, the top surface may become saturated and the majority of the rain will be shed. There will only be slow penetration of water into the fly ash and studies from several ash disposal sites have indicated that there is no conclusive evidence on percolation through the mounds".

In view of the above and given that the ash mound at the proposed site is approximately 40m high, it is considered likely that 80% of the storm water will run off. On this basis, it is estimated that without pumping out liquid, approximately 130mm of leachate will accumulate at the base of the cell per month.

As discussed in the next Section, the proposed leachate drainage layer is 300mm, indicating that the drainage layer has at least twice the storage capacity of monthly leachate production. The levels of leachate production are considered too low to warrant construction of a leachate balancing pond.

Leachate Collection System

A leachate management system is required for the hazardous waste disposal sites. The design includes the containment system outlined in Volume 4, leachate monitoring, collection and delivery system. Typically, four monitoring wells will be installed in each cell. Details of the leachate monitoring system are provided in **VOLUME 4**.

[23] Department of Water Affairs and Forestry: Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste, Second Edition (1998).

Stormwater management

Stormwater management and drainage planning are critical components of managing run-off water emanating from a site and preventing downstream contamination of natural surface water resources.

In order to manage stormwater at the ash disposal site and the anticipated pollutants from the operational aspects of the power plant, Mott MacDonald prepared a conceptual stormwater management plan which details the minimum specifications and technical design criteria required to meet the 'best practice' and legislated standards. (Mott MacDonald, August 2011.)(**VOLUME 4**)

Due to the fact that the proposed ash disposal site does not fall within any of the active mine operations, and because the anticipated surface water drainage pattern for the site results in natural runoff of stormwater without ponding, the runoff water will not be polluted and therefore the site does not require the use of pollution control dams. However, stormwater storage ponds will be required to manage extreme storm events. The closed landfill will form a mound (topographical high), which dictates that stormwater storage ponds will be built around the landfill. Upon landfill closure, the stormwater storage ponds will serve as attenuation ponds. The proposed storm and waste water drainage system is detailed in the Conceptual Stormwater Management Plan (SWMP) (**VOLUME 4**).

In simple terms the clean water (stormwater) is to be separated from the contaminated water (dirty water) into two separate systems. The concept of the stormwater design is to collect the stormwater for re-use and to process non-contaminated water through a pipe network and route to a water collection tank for reuse for dust suppression. A summary of the plan is as follows.

The SWMP has been developed in accordance with the following guidance, deemed to meet the legal requirements:

- Best Practise Guideline – G1: Stormwater Management; and
- Best Practise Guideline – H3: Water Reuse and Reclamation.

The majority of stormwater runoff on the ash disposal site is “clean” water and will be stored for reuse for dust suppression without treatment. This requirement is in line with best management practices and water conservation policies of DWA.

The demand for dust suppression water is calculated to be more than the supply from stormwater runoff, (limited to seasonal supply). Therefore, additional water will be sourced offsite. The points for additional water supply for dust suppression have been optimised to minimise water loss during reticulation. The day tanks for dust suppression are strategically positioned close to the stormwater storage tanks to facilitate the supply of water as required. The day tanks are designed to have an extra one-day storage capacity.

The stormwater drainage system will comprise the following components:

- 300mm -1,500mm diameter stormwater drain along the perimeter of the ash disposal liner and the compound area;
- Eleven stormwater attenuation ponds and day tanks located around the liner;
- Filter drains along access, service and haul roads; and
- Gutter water collection from roofs of buildings and run-off areas.

A waste water system within the site compound area will be provided to serve the following areas:

- The administration block;
- Welfare facilities building;
- Leachate treatment plant area; and
- Site laboratory.

Wastewater will be collected and treated using a suitable package sewage treatment plant. Effluent from the treatment plant will be passed to the adjacent attenuation pond for use in dust suppression or evaporation as appropriate. Details of the proposed sewage treatment plant are discussed in Chapter 4.

Pipes at all crossings and paved areas which are likely to have traffic shall be protected by concrete encasement designed for site specific vehicular loading.

An outline of the proposed system is illustrated on Drawing 289348-SHF-012 and typical stormwater details are illustrated on Drawing 289348-SHF-013 in Section 3.2.2 (and presented in **ANNEXURE C**).

Mitigations

Mitigations measures are noted comprehensively in the framework EMP in **ANNEXURE J**. They include:

Ash dump

- Establishment of the coal silo, lime storage and ash dump on suitably prepared surface to prevent leaching into groundwater. In this regard, it is recommended that the attached report (Mot Macdonald, 2011) be used as a minimum specification in terms of the liner design.
- This technical design report has been compiled in accordance with (DWAF, 1998): The Minimum Requirements for Waste Disposal by Landfill, second edition, 1998. Department of Water Affairs and forestry.

Based on the classification of the waste, as set out in the document above, the proposed landfill must be suitable for the acceptance of hazardous waste (H:H) and the design of the lining system must be suited to protect the environment from the negative effects of waste. Together with this the following objectives were also required:

- Stability of the lining
- Leachate generation, control and management. Provision has been made in the design for on-site treatment of Leachate. It is proposed that the Leachate be pumped and transported in tankers to an on-site treatment facility.
- Monitoring requirements
- Technical design recommendations and provision of technical design drawings.
- Monitor the water quality and water levels of the sampling points as mentioned in the EMP in **ANNEXURE J**.
- Assess the groundwater water quality inside, upstream and downstream of the ash dam annually, and recommend mitigation measures if needed.
- Audit the suitability of monitoring network annually.

Surface water

- A wheel cleaner must be provided near the site exit to prevent mud and ash from being carried out onto the public road.
- Surface water collected from the compound area must be used for dust suppression. However to ensure that water collected from this area is not contaminated the following measures must be implemented:
  - All gullies must be trapped;
  - A petrol /oil interceptor must be provided;
  - Silt trap manholes must be provided; and
  - All fuel tanks must be bunded.

These measures will require occasional maintenance to continue their efficacy.

- Wastewater will be collected and treated using a suitable package sewage treatment plant (Section 3.2.5 of the Storm water management plan in **VOLUME 4** discusses the MDI /EDI system). Effluent from the treatment plant should be passed to the adjacent attenuation pond for use in dust suppression.
- The Stormwater Management Plan (SWMP) which has been developed in accordance with the guidelines developed by the Department of Water Affairs (DWA) must be adopted as a minimum design specification because these have been designed specifically to meet the requisite legal requirements, they are:
    - Best Practice guideline: G1 (BPG-G1): Stormwater management; and
    - Best Practise Guideline: H3 (BPG-H3): Water Reuse and reclamation.

Table 7-36: Impact of power station and associated infrastructure on groundwater

Impact of power station and associated infrastructure on groundwater		
SITE 6C and Ash 3		
	No mitigation	Mitigation
Extent	Site	Site
Magnitude	Low - Medium	Very Low
Duration	Long	Long
SIGNIFICANCE	Low - Medium (-)	Very Low (-)
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

7.5.4. Cumulative Impact Discussion

Based on the detailed geohydrological assessment, it can be concluded that the proposed power station and associated ash dam will have a “low to very low” impact on the investigated geohydrological environment, given that the proposed sound environmental infrastructure and management procedures are put in place.

The pollutant levels from the ash dump are expected to be lower than those of the neighbouring opencast mines. Pollutant levels of sulphate from ash dams, is typically 1 000 mg/L. Opencast miness can be expected to render water with sulphate levels in the order of 2 000 to 3 000 mg/L, if not higher, depending on acid generating capacity. What could be even more important is that the pH of ash dam water is characteristically higher than that of an opencast mine (more alkaline). In addition, the proposed limestone will further ensure that the ash would have a relatively high pH. It is thus very likely that the water draining from the ash dam would be of better quality than those of the opencast below to which it will drain.

Therefore, the localised extent of the potential impacts on groundwater means that the all potential impacts are likely to be contained within the site. As such no cumulative impacts would result from the proposed power station.

7.6. IMPACT OF FOUNDING CONDITIONS ON THE POWER STATION

7.6.1. Impact Statement

Geological conditions at any site could pose a technical constraint, potentially rendering a site unfeasible for the construction of a power station and associated infrastructure, or may necessitate very expensive remediation of foundations.

7.6.2. Discussion

In order to ascertain the suitability of the sites and to confirm that no fatal flaws exist at the sites a high level preliminary geotechnical study was undertaken in April 2010 by Mott MacDonald. Six potential sites in the vicinity of Landau, Greenside and Klein Koppie coalmines were assessed based on a high level geotechnical review of mining data supplied by AOL. The predominant geotechnical risk across all sites is the potential for instability from historical mining to affect the power station structures located on the surface. A review of the data supplied by AOLhas been carried out to present the relative risks of 6 potential sites.

The methodology included a literature review of published geological data, especially exploratory boreholes and detailed coal mine plans which were made available by AOL, interpretations of aerial photography and satellite images and surface observations of geological and soil distributions and a site specific geotechnical investigation. This report has been based primarily on site specific information made available by AOL including:

- Topographic plan of the sites but which covers sites 2, 5 and Contour plans showing the level, depth and thickness of each of the coal seams below the area.

- It is understood that this is based on exploratory borehole information corroborated by observations from underground mining where available.
- A plan showing the areas which have been undermined
- A plan showing the detailed layout of the pillars and the calculated safety factors of the bord and pillar workings were made available for part of site 6 only. If any of the other sites are to be considered further, then it is recommended that similar plans for these sites are obtained.
- Exploratory borehole logs have been made available for sites 4 and 6.
- This information has been supplemented by a site visit and discussions with AOL staff on 31 March 2010 and background information such as geological maps and technical papers.

The site comprises the Ecca Group, Dwyka and Vryheid Formations. The sediments of the Vryheid Formation overlie an uneven Dwyka floor, which is controlled by the topography of the pre-Karoo platform upon which the Karoo sediments were deposited. The Vryheid Formation, which is present throughout the Witbank Area, attains some 140 meters at the thickest point and contains a number of coal seams, of which four (No. 1, 2, 4 & 5 Seams) are considered to have economic potential. The deposition of the Vryheid Formation sediments is largely controlled by the irregular pre-Karoo platform on which they were deposited. The pre-Karoo rocks, consisting mainly of felsites of the Bushveld Igneous Complex, have been glacially sculptured to give rise to uneven basement topography.

The thin veneer sediments of the Dwyka Formation, which overlies the pre-Karoo, are generally not thick enough to improve the irregularities in the placated surface, which therefore affected the deposition of the younger Vryheid Formation sediments. The Ecca sediments consist predominantly of sandstone, siltstone, shale and coal. Combinations of these rock types are found in the form of interbedded siltstone, mudstone and coarse grained sandstone. Typically, coarse-grained sandstones are a characteristic of the sediments in the Witbank Area. The overburden thickness and preservation of the coal seams is dependent on the surface geomorphology and the subsurface pre-Karoo basement floor.

Dolerite intrusions in the form of dykes and sills are present within the Ecca Group. The sills usually precede the dykes, with the latter being emplaced during a later period of tensional forces within the earth's crust. Tectonically, the Karoo sediments are practically undisturbed.

Faults are rare. However, fractures are common in competent rocks such as sandstone and coal.

The survey area is characterised by a variety of soil textures, structures, depths and chemical composition, varying from moderately shallow to shallow and highly sensitive soils that directly overlie a hard pan ferricrete layer of varying thickness and density (laterite or Ouklip), to deep sandy loam soils that are moderately low in clay (<12%), and that returned low organic carbon contents, low water holding capabilities (high permeability rates) and a moderately high erosion index. These two extremes are associated with a range of transition states, with soils with varying clay contents, a range of effective rooting depths and structural characteristics. These variations result in a variety of soil forms and land capabilities and are directly related to the sensitivity and vulnerabilities of the materials that are to be disturbed. These materials are found both in-situ (greenfields area POWER LINE ROUTE and POWER PLANT) as well as cover materials that have been used to rehabilitate the area that is proposed for the Ash Dump (Brownfields).

The ferricrete layer mapped is of importance to both the sensitivities and vulnerabilities of the materials described, with this layer forming a moderately impermeable barrier between the soils and the groundwater environment, restricting the vertical infiltration of surface and soil water through the vadose zone.

7.6.3. Description and Significance of Potential Impact

The scope of the detailed ground investigation, which was specified by Mott MacDonald, comprised rotary open hole percussion drilling, rotary core drilling, *in-situ* testing, mechanically excavated trial pits and geo environmental laboratory testing. The investigation was carried out in accordance with all relevant standards and the contract specification. The site assessment results can be summarised as follows:

Table 7-37: Geotechnical findings summary

Site number and findings	Development risk
Site 1	
Site 1 lies on a natural rise in the coal seams and is possibly underlain by Dwyka tillite which underlies the coal bearing Ecca Formation. This would	Low

Site number and findings	Development risk
appear to indicate it has the lowest risk of all of the sites from a mining stability perspective.	
Site 2	
Site 2 is indicated to have been undermined at shallow depth and this area is assessed to be high risk.	High
Site 3	
Site 3 has been partially undermined and the rest of the site lies within 100m of undermined areas which have been mined at depths of around 40-50m. Any instability of these mines may impact any development on the site. This site is considered medium risk.	Medium
Site 4	
Site 4 is indicated to have been undermined at medium depth (40-60m BGL) and the seam thickness to overburden ratio is around 6.5 which is medium risk. Shallower and multi level mining has also been carried out adjacent to the site.	Medium
Site 5	
Site 5 can be split into two sections. The northern section is located partly on a marshy area adjacent to the N12 which will possibly be designated a wetland and it will therefore be more difficult to obtain necessary environmental permissions for development. This section of the site has not been undermined. The southern section is behind the Landau dump and has been undermined at shallow depth	High

Site number and findings	Development risk		
and should be considered high risk for development.			
Site 6			
	Site 6A	Site 6B	Site 6C
Site 6 is the largest site and the most complex as the entire site has been undermined. Areas to the north west of the site have been mined at multiple levels and at reasonably shallow level making this area of the site high risk for development. This area has also been earmarked for open cast extraction. The south eastern part of the site has been mined at a deep level (>90m) and would be appear to be low risk. However, the detailed mining stability assessment indicates that the mine safety factor is far lower than normally considered acceptable and suggests the mines may be inherently unstable if they have not already collapsed. Given the deep levels of mining it is not clear what the risk to surface structures would be. 'Islands' where no mining have taken place do exist but within site 6 these are within 100m of mined areas with low safety factors. Two alternative sites have been identified close to site 6 where the risk of mining instability appears to be lower. One area (site 6C) to the east of site 6 has not been undermined and an area between site 6 and the pan to the south west (Site 6B) has higher mine	Higher risk due to deeper mining	Higher risk due to deeper mining	No undermining very little risk

Site number and findings	Development risk		
safety factors and deep mining.			

The potential impact of founding conditions on site 1's suitability is considered to be of low magnitude, long term and limited to the site and therefore of **low (-)** significance, with and without mitigation. The impact on sites 3 and 4 is considered to be of medium magnitude, long term and limited to these sites and therefore of **medium (-)** significance, with and without mitigation. Further to this the potential impact of founding conditions on sites 2 and 5, regarding suitability is considered to be of high magnitude, long term and limited to these sites and therefore of **high (-)** significance for sites 2 and 5, with and without mitigation.

Finally the impact on site 6 (site 6 was divided into three sub sites A, B and C) is considered to be the following, with and without mitigation:

a) Site 6A

- founding conditions on site 6A's suitability is considered to be of very high magnitude, long term and limited to the site and therefore of **very high (-)** significance for site 6A

Site 6B

- founding conditions on site 6B's suitability is considered to be of high magnitude, long term and limited to the site and therefore of **high (-)** significance for site 6A

Site 6C

- founding conditions on site 6C's suitability is considered to be of very low magnitude, long term and limited to the site and therefore of **very low (-)** significance for site 6C

Only site 6C is geotechnically suitable for the proposed power station due to undermining on sites 1- 6A &B.

Mitigation measures

It is not easily possible to overcome geotechnical constraints of this type (undermining) with readily available and affordable but appropriate geotechnical measures and thus no specific mitigation measures are applicable or discussed herein. Moreover choosing to utilise any of sites 2, 3, 4, 5, 6A or 6B would entail excessive increase in cost[24]. Due to the inherent suitability of site 6C, as it is geotechnically stable, no major mitigatory measures are required.

7.6.4. Impact assessment results

The results of the impact assessment are contained in the tables below.

Table 7-38: Impact – Founding conditions on site suitability (Sites 1 -6)

Impact of founding conditions on site suitability		
SITE 1		
	No mitigation	Mitigation
Extent	Site	Site
Magnitude	Medium	Low
Duration	Long	Long
SIGNIFICANCE	Low (-)	Low (-)
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

[24] Financial costs associated with ground stabilization options are discussed in Section 4.2 –Layout Alternatives

SITES 3 & 4		
	No mitigation	Mitigation
Extent	Site	Site
Magnitude	Medium	Medium
Duration	Long	Long
SIGNIFICANCE	Medium (-)	Medium (-)
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

SITES 2 & 5		
	No mitigation	Mitigation
Extent	Site	Site
Magnitude	High	High
Duration	Long	Long
SIGNIFICANCE	High (-)	High (-)
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

SITE 6A		
	No mitigation	Mitigation
Extent	Site	Site
Magnitude	Very High	Very High
Duration	Long	Long
SIGNIFICANCE	Very High (-)	Very High (-)
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

SITE 6B

	No mitigation	Mitigation
Extent	Site	Site
Magnitude	High	High
Duration	Long	Long
SIGNIFICANCE	High (-)	High (-)
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

SITE 6C

	No mitigation	Mitigation
Extent	Site	Site
Magnitude	Very Low	Very Low
Duration	Long	Long
SIGNIFICANCE	Very Low (-)	Very Low (-)
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

7.6.5. Comment on Cumulative Impacts

There are no potential cumulative impacts for founding conditions.

7.7. IMPACT SOILS AND LAND CAPABILITY

7.7.1. Impact Statement

The operational phase will result in specific impacts to the soil and land capability (erosion, chemical spills, soil loss, soil sterilization and loss of nutrient pool, compaction, contamination by product and by-product spillage etc.), that will need to be mitigated and managed.

7.7.2. Discussion

With land and water being limited resources; it was considered important to determine the agricultural potential and value of the candidate sites. Consequently a Soil and Land capability study was undertaken by Earth Science Solutions. The full report is contained in **Volume 2**.

The methodology of the soil and land capability study included a literature review including maps, site inspections, a systematic soil survey, classification of soils using the South African Soil Classification Taxonomic System and chemical soil analysis.

The survey area is characterised by a variety of soil textures, structures, depths and chemical composition, varying from moderately shallow to shallow and highly sensitive soils that directly overlie a hard pan ferricrete layer of varying thickness and density (laterite or Ouklip), to deep sandy loam soils that are moderately low in clay (<12%), and that returned low organic carbon contents, low water holding capabilities (high permeability rates) and a moderately high erosion index. These two extremes are associated with a range of transition states, with soils with varying clay contents, a range of effective rooting depths and structural characteristics. These variations result in a variety of soil forms and land capabilities and are directly related to the sensitivity and vulnerabilities of the materials that are to be disturbed. These materials are found both in-situ (greenfields area power line route and power plant) as well as cover materials that have been used to rehabilitate the area that is proposed for the Ash Dump (Brownfields).

The ferricrete layer mapped is of importance to both the sensitivities and vulnerabilities of the materials described, with this layer forming a moderately impermeable barrier between the soils and the groundwater environment, restricting the vertical infiltration of surface and soil water through the vadose zone. These zones are often associated with relic landforms and although of sensitivity with regards to the biodiversity, the occurrence of sensitive ecology will be the telling issue when considering sensitivity and utilization potential considerations.

The in-situ soils derived from the host rock lithologies are intricately interspersed with colluvial derived soils and small areas of alluvial derived soils.

This range of different depositional agents and environments coupled with the climatic and mechanical weathering results in a set of soil forms and families which are typical of the sedimentary lithologies that make up the coal fields of the area.

The current land capability ranges from poor quality grazing lands and conservation lands to moderate arable land as classified on the S.A. Chamber of Mines Guidelines (1991) rating system. "Grazing Land" is the dominant land use option for the area.

The term conservation is used to convey the broad group of land capability that is not arable land, grazing land nor wetland, and implies the need for "careful" utilization of, or on these areas.

The semi-arid climatic conditions (moderately low rainfall, high evaporation) that characterise the Khanyisa Project area combined with the geomorphology of the sites has resulted in the formation of a unique pedogenetic signature that has a significant influence and function on the ecological sustainability of the area as a whole. The distribution and character of the soils are further influenced by the topography and geological structure (faulting and fracturing) that has affected the host lithologies.

The presence of good quality coal that has already been mined out and the potential for further coal close to surface has influenced the position of the proposed power generation facilities/structures and activities planned. It is important that the findings of these specialist studies are read in conjunction with the biodiversity studies and ecological baseline assessments if the "End Land Use" is to be understood, and a viable rehabilitation plan developed for closure.

The dominant soil (>80% of a polygon) forms encountered include the Hutton, Griffin, Clovelly, Avalon, Glencoe and Fernwood Forms on the greenfields area, while the rehabilitated nature of the proposed AD site renders all of the soils Witbank Forms (Man Made), the depth and consistency of the soil profile being of greater importance to the understanding of the site conditions. These materials are generally moderately shallow (450mm to 600mm), with significant stone and rock inclusions, and an environmentally stable composition for the most part. Erosion of the side slopes are of concern and will be an issue that is discussed in more detail as part of the long term sustainability of the site as a possible consideration for the deposition of ash.

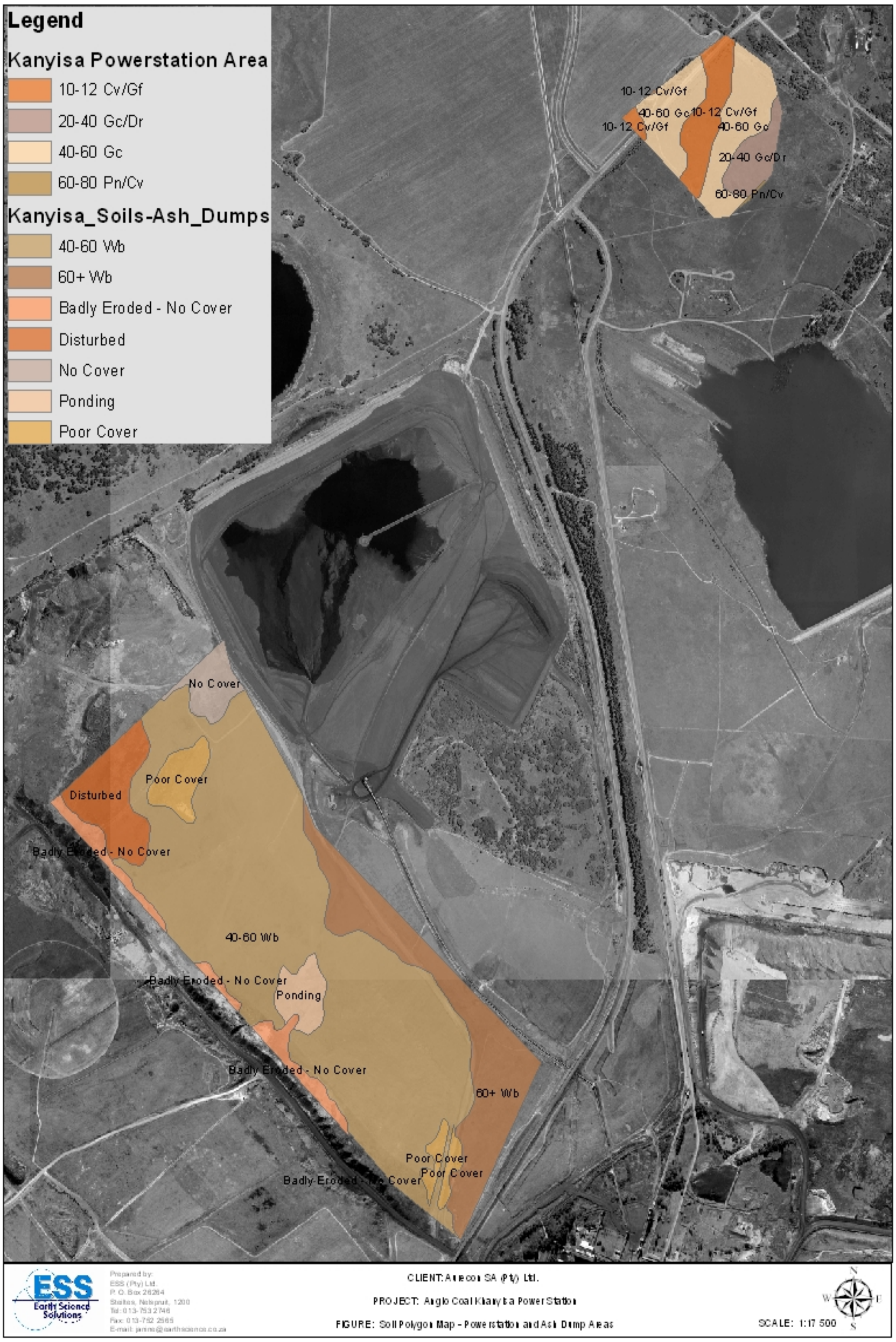


Figure 7-8: Dominant soil – Power station and Ash dump

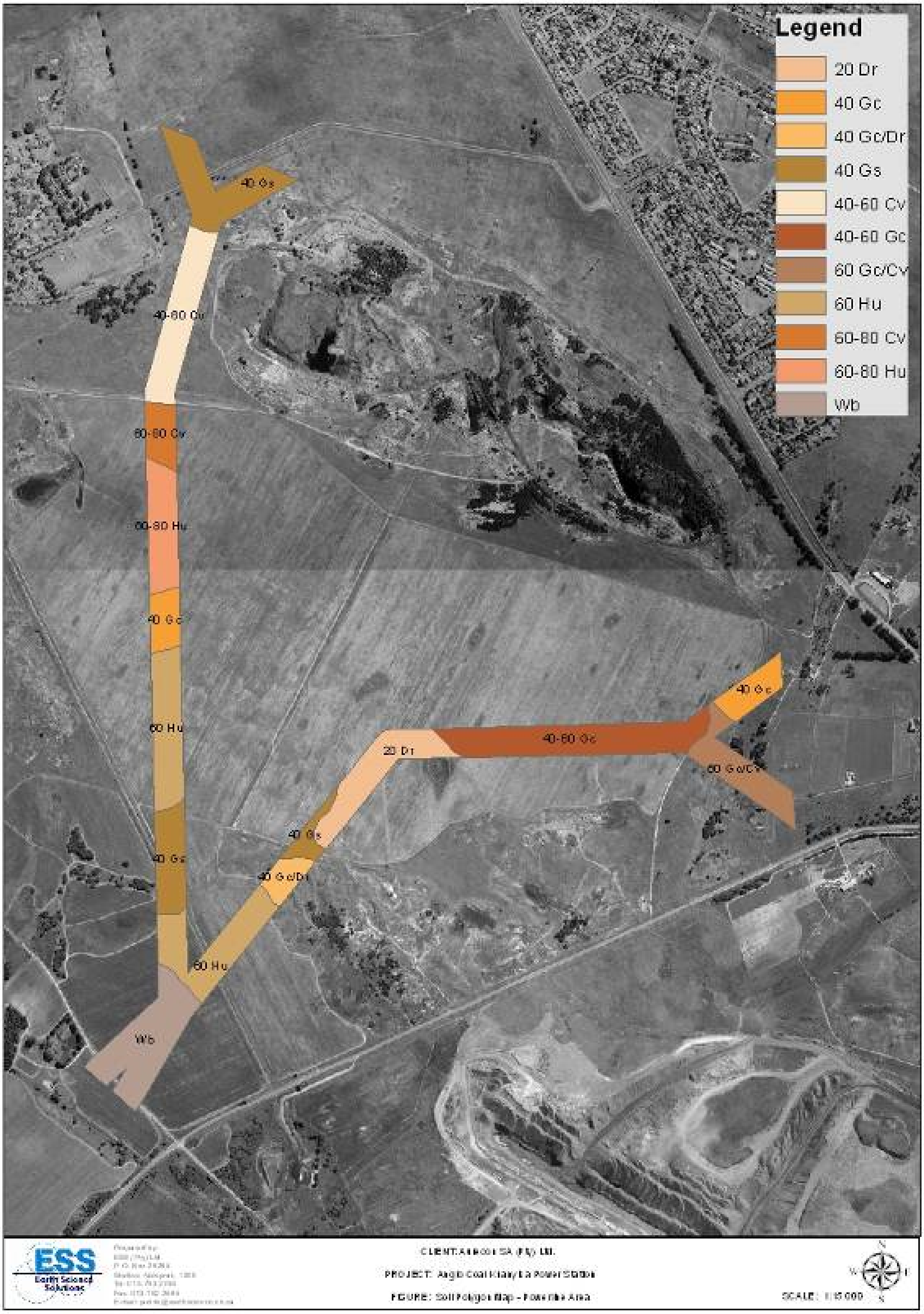


Figure 7-9: Dominant soil – power line site

In general, the land capability (soils, climate, ground roughness etc.) ranges from very low intensity (poor quality) grazing lands with little to no significant economic potential, to at best moderate arable land. However, it must be noted that all of these soils require better than average management.

a) Physical Characteristics

- Topsoil clay percentages range from as low as 8% on the sandy loams and silty shale derived materials, to more than 18% depending on the host/parent geology from which the soils are derived, and their position in the landscape/topography.
- Subsoil clays that range from less than 15% to as high as 28%;
- Very high infiltration/permeability rates are associated with the sandy loams and well sorted but poorly compacted materials associated with the colluvial derived soils and on the rehabilitated sites;
- Moderate to high in-situ permeability rates on the more clay rich loams and sandy clay loams associated with the shallower soils and materials associated with the ferricrete base;
- Moderate to good intake (infiltration) rates, depending on the type of clay present;
- Moderate to poor water holding capacities for all but the more clay rich materials, and
- Poor to unsuitable agricultural potential ratings (water holding capabilities and nutrient status) for all but the more clay rich materials.

The physical characteristics are highly influenced by the parent materials from which the soils are derived, as well as their relative position in the topography, albeit that a significant percentage of the soils that are likely to be disturbed are associated with the flat to undulating arid plains and colluvial deposits within the relict waterways of the ferricrete land surface, all of which are relatively young in pedological age, and are the product of the various geologies and historical erosion surfaces that make up the area of study.

The structure of the soils varies from those with a very loose and single grained structure for the majority of the sandy loams as already described (sediments), to apedel, and weak blocky structures on the more silty loams and clay loams. The importance of understanding the workability and relative sensitivities relating to these textures and structure will influence the quality of the end land use and sustainability of the rehabilitation effort. The sandy materials are moderately easily worked, but will easily erode if not adequately protected, while the clay extreme will form clods that will be very difficult to cultivate and establish any form of vegetative growth if worked in the wet state.

In addition, compaction is a concern to be noted and managed in the natural environment, albeit that it is of greater consequence to the successful implementation of any rehabilitation plan. Compaction on all but the very fine silty (low clay) materials is for the most part quite good in terms of founding conditions, but will be of negative consequence to water infiltration, and will result in increased overland flow.

Retention of the “Utilizable” soils (relatively more nutrient rich topsoil and subsoil) will be imperative if any rehabilitation is to be successful, while the “ferricrete” layer will need to be recognised as a fundamental contributor to the success of the ecological balance in the area if the wet soils status is to be recognised as an important contributor to the ecological status.

The structure of the rehabilitated areas proposed for the ash dump (old open cast mine) are similar throughout, with some areas of slightly more structure associated with the wet based soils and ferricrete derived materials that have been used in the rehabilitation mix. The depths of this cover is variable, with the majority of the old dump having been covered with at least 400mm of good cover, and a significantly large area being covered with at least 600mm. There are a few areas, significant in terms of the resultant outwash of discard material and the erosion hazard, but not of a consequence that degradation of the downstream environment has been impacted yet.

Chemical Characteristics

The chemistry of the soils is typical of the weathered product of the underlying (in-situ) geology or transported colluvial materials typical of the upslope environs from which they are derived. The mix of colluvial derived materials (downhill wash) that are part of the active outwash environs, and the alluvial derived stratified deposits comprised of recent sediments that exhibit poor nutrient pools (highly leached, well sorted and little to no organic carbon), contrast with the in-situ derived soils that exhibit better nutrient stores in the utilizable soil (B2/1), slightly better carbon pools and for the most part better clay contents, with the intrusive lithologies contributing significantly higher clays and better than average supplies of the base minerals to the nutrient pool.

The soils associated with the ferricrete have been highlighted on more than one occasion, as they are part of a highly sensitive zone that is responsible (in a pristine state) for soil water stores and contributions of soil water to the natural environment.

They are often, but not always, associated with areas of wetland status, and as such will need to be considered as "Highly sensitive" environments that have a biodiversity status that requires further study and understanding.

The rehabilitated area proposed for the ash dump disposal comprises a mixture of the stored soils that have been used in covering the discard dump (old mine discards). The mapping of these soils can be best undertaken on depth and chemical composition, the naming of disturbed or man induced soils being covered as Witbank Form nomenclature. The chemical results of the soil cover returned results that concur with the in-situ materials analysed, albeit that the stores of carbon, calcium and magnesium are lower (leaching during storage), while the potassium, sodium and phosphorous levels that are generally low in the soils natural state, are somewhat elevated. This is a sign of fertilization (possibly) during the rehabilitation stage.

These soils are characteristically:

- Neutral to slightly acid in pH, with a wide range of between 4.8 on some of the rehabilitated area soils, to 7.6 for the majority of the in-situ sediments. The more basic derived materials returned pH readings of between 6.4 and 6.8;
- Higher than average amounts of calcium and sodium for the materials associated with the sandstone lithologies and most of the colluvial derived soils, with elevated iron and manganese for the more basic derived soils;
- Low to moderate reserves of calcium and magnesium associated with the shale's and silty loams;
- Moderate reserves of magnesium, zinc, and aluminium;
- Moderate to low clay contents (9% to 16%) associated with the rehabilitated soils and moderate clay contents for the in-situ derived materials (8% to 26%), and
- Very low to low organic carbon (0.09C % – 0.32C %) for all but the chemically altered soils.

As a result, these soils require significant amounts of essential nutrients as additives/input if they are to be used as a growing medium (rehabilitation).

Baseline Conclusions and Observations

The majority of the proposed power plant development and associated infrastructure that is planned will impact on soils with a prominent ferricrete "C" horizon and/or areas with wet horizons at their base. The depth to the wet horizon (mottled) is generally greater than 800mm which renders these soils non wetland status in terms of the delineation classification for wetland soils, but should be noted in terms of the founding conditions and engineering requirements (Refer to 2010 Study undertaken by Aurecon – Report No. AUR 10-08). These soils should be considered as sensitive to moderately sensitive for the most part, with the potential to be difficult to work in the wet state. The presence of hard plinthic material at depth within the POWER PLANT study area is indicative of a relic landform when observed in the topographic positions mapped, and although sensitive are only of concern if they support biodiversity that is of concern.

In contrast, the Ash Dump site (proposed alternative 3) comprises rehabilitated materials on the discard dump, with sandy loams and silty clay loams, apedel to weak crumby structure and generally good rooting depths. These soils have been recently worked (geological time) and as such are prone to erosion and compaction, and will be lost permanently if not well protected. The use of this surface area as a disposal site for the ash by-product from the proposed power station will sterilize these soils if they are not removed.

Any waterways and non-perennial streams associated with the proposed POWER PLANT area will need to be mapped out on a detailed topographic survey, and the development of these areas discussed with the relevant authorities in terms of the ESIA and listed activity implications, while the planned Ash Dump will need to be engineered around the use of the soils as the foundation to the new dump. This would require that the existing land surface is contoured to levels that would accommodate the deposition of the Ash by-product.

If the soils are not required as a lining to the Ash Dump (ash to be deposited directly onto the discard) then the soils should be removed and stockpiled for future use as capping to the Ash Dump/Storage Facility.

The variation in soil structure, texture and clay content of the soils combined with the presence of the prominent ferricrete layer at the base of many of the soil profiles ("C" Horizon) associated with the power plant site and power evacuation route, all make for a complex of natural conditions that are going to be extremely difficult to replicate at closure.

The possible resultant loss of sub surface water when the ferricrete is removed will need to be assessed and understood as a function of the ecological balance and wetland “reserve”.

The low levels of organic carbon and relatively low nutrient stores of some important nutrients within the utilizable soil profile will require that a sound management plan is adopted based on the best impact assessment information. The concept of “**utilizable soil**” storage will be tabled as a basic management tool.

7.7.3. Description and Significance of Potential Impact

a) Power Station

Loss of utilizable soil resource (Sterilization and erosion), compaction, de-nutrification and contamination or salinization.

The operation of the power station and its associated infrastructure (Ash Dump and Water related activities) will see the impact of transportation of materials into and waste products out of the area, the potential for spillage and contamination of the in-situ and stockpiled materials due to dirty water run-off and/or contaminated dust deposition/dispersion, the de-nutrification of the stockpiled soils due to excessive through flow of rain water on unconsolidated and poorly protected soils and the flushing of the nutrient pool, the compaction of the in-situ materials by uncontrolled vehicle movement and the loss to the environment (down-wind and downstream) of soil by wind and water erosion over un-protected ground.

In summary, the operation of the power plant industrial complex will result in:

- The sterilization of the soil resource on which the facilities are constructed. This will be an on-going loss for the duration of the operation;
- The creation of dust and the possible loss (erosion) of utilizable soil down-wind and/or downstream;
- The compaction of the in-situ and stored soils and the potential loss of utilizable materials from the system;
- The contamination of the soils by dirty water run-off and or spillage of hydrocarbons from vehicle and machinery or from dust and emissions from the process;

- Contamination of soils by use of dirty water for road wetting (dust suppression) and irrigation of the stockpile vegetation;
- Potential contamination of soils by chemical spills of reagents being transported to site;
- Contamination of soil resource by dust and emission fallout;
- Sterilization and loss of soil nutrient pool, organic carbon stores and fertility of stored soils;
- Impact on soil structure and soil water balance.

Un-managed soil stockpiles and soil that is left uncovered/unprotected will be lost to wind and water erosion, will loss the all-important, albeit poor nutrient content and organic carbon stores (fertility) and will be prone to compaction.

Of a positive impact, will be the rehabilitation of the temporary infrastructure used during the start-up and construction phase.

Mitigation measures

The result of the operations associated with the power station on the soil resource will definitely have a negative intensity potential that is MEDIUM, that will last for the life of the operation (permanent to irreversible if not rehabilitated) and be confined to the immediate site or immediate vicinity.

In the un-managed scenario the frequency is likely to be continuous resulting in a significance rating of **Medium** to **High**.

It is inevitable that some of the soils will be lost during the operational phase if they are not well managed and a mitigation plan is not made part of the general management schedule.

The impacts on the soils during the operational phase (stockpiled, peripheral soils and downstream (wind and water) materials) may be mitigated with management procedures including:

- Minimisation of the area that can potentially be impacted (eroded, compacted, sterilized or de-nutrified);
- Timeous replacement of the soils so as to minimise/reduce the area of affect and disturbance;

- Effective soil cover and adequate protection from wind (dust) and dirty water contamination – vegetate and/or rock cladding;
- Regular servicing of all vehicles in well-constructed and bunded areas;
- Regular cleaning and maintenance of all haulage ways, conveyencing routes and service ways, drains and storm water control facilities;
- Containment and management of spillage;
- Soil replacement and the preparation of a seed bed to facilitate and accelerate the re-vegetation program and to limit potential erosion on all areas that become available for rehabilitation (temporary servitudes), and
- Soil amelioration (rehabilitated and stockpiled) to enhance the growth capability of the soils and sustain the soils ability to retain oxygen and nutrients, thus sustaining vegetative material during the storage stage.

It will be necessary as part of the development plan to maintain the integrity of the stored soils, so that they are available for rehabilitation at decommissioning and closure. If the soil quantities and qualities are (utilizable soils) managed through the operational phase, rehabilitation costs will be reduced and natural attenuation will more easily and readily take effect and a sustainable “End Land Use” achieved.

Powerline

Loss of utilizable resource (Sterilization and erosion), compaction, de-nutrification and contamination or salinization.

The operation of the Power Line will see the impact of service vehicles only, while any stockpiled or stored soils will need to be managed. During this phase, the electrical supply as such is unlikely to impose any major negative impacts.

Contamination of the soils (both in-situ and stockpiled) by dirty water runoff from the roads, dust fallout and the spillage of hydrocarbons will be a concern, but is likely to have a very minor negative impact on the soils environment.

In addition, the potential for de-nutrification of the stockpiled soils due to excessive through flow of rain water on unconsolidated and poorly protected soils and the flushing of the nutrient pool is a probability if not managed.

In summary, the operation of the power line will result in:

- The sterilization of the soil resource. This will be an on-going loss for the duration of the operation and most probably into the future;
- The creation of dust and the possible loss (erosion) of utilizable soil down-wind and/or downstream;
- The compaction of the in-situ and stored soils and the potential loss of the utilizable resource as a result;
- The contamination of the soils (in-situ and stored) by dirty water run-off and/or spillage of hydrocarbons;
- Contamination of soils from the use of dirty water for road maintenance and irrigation of the stockpile/stored vegetation;
- Sterilization and loss of soil nutrient pool, organic carbon stores and fertility of stored soils during the extended time in storage;
- Impact on soil structure and soil water balance.

Un-managed soil stockpiles and soil that is left uncovered/unprotected will be lost to wind and water erosion, will lose the all-important, albeit poor nutrient content and organic carbon stores (fertility), and will be prone to compaction.

The rehabilitation of the temporary infrastructure used during the start-up and construction phase will be a positive impact.

The result of the operations associated with the power line on the soil resource will have a impact potential that is **LOW**, that will last for the life of the operation and should be considered permanent to irreversible if not rehabilitated, and will be confined to the immediate site or immediate vicinity (PL Route).

In the un-managed scenario the frequency is likely to be continuous resulting in a significance rating of **LOW** to **MEDIUM**.

It is inevitable that some of the soils will be lost during the operational phase if they are not well managed and a mitigation plan is not made part of the general maintenance and management schedule.

The impacts on the soils should be mitigated with management procedures including:

- Minimisation of the area to be impacted (eroded, compacted, sterilized or de-nutrified);
- Timeous replacement of the soils so as to minimise/reduce the area of affect and disturbance – any areas that are no longer needed (temporary access routes etc.);
- Effective soil cover and adequate protection from wind (dust) and dirty water contamination – vegetate and/or rock cladding and construction of adequate drainage;
- Regular servicing of all road and utility maintenance vehicles;
- Containment and management of accidental spillage (prevision for “Quick Response Unit” – accidents and environmental incidents);
- Soil replacement and the preparation of a seed bed to facilitate and accelerate the re-vegetation program on rehabilitated and managed areas, to limit potential erosion on all areas that become available for rehabilitation (temporary servitudes etc.), and
- Soil amelioration (rehabilitated and stockpiled) to enhance the growth capability of the soils and sustain the soils ability to retain oxygen and nutrients, thus sustaining vegetative material during the storage stage.

It will be necessary as part of the development plan to maintain the integrity of any stored soils, so that they are available for rehabilitation during decommissioning and closure. If the soil quantities and qualities (utilizable soils) are managed through the operational phase, rehabilitation costs will be reduced and natural attenuation will more easily and readily take effect, and a sustainable “End Land Use” achieved.

The impacts on the soil resource during the decommissioning and closure phase are both negative and positive, with:

- The loss of the soils’ original nutrient store and organic carbon due to leaching of the soils while in storage;
- Erosion and de-oxygenation of materials while stockpiled;
- Compaction and dust contamination due to vehicle movement while rehabilitating the area;
- Erosion while undertaking the slope stabilization and re-vegetation of disturbed areas;
- Hydrocarbon or chemical spillage from contractor and supply vehicles.

The results of the impact assessment are contained in Table 7-39 to Table 7-41.

Table 7-39: Impact - Power station and associated infrastructure on agriculture

Impact of proposed power station and ash dump infrastructure on agriculture		
SITE 6C		
	No mitigation	Mitigation
Extent	Local	Local
Magnitude	Medium - High	Medium
Duration	Long term	Long term
SIGNIFICANCE	Medium-High (-ve)	Medium (-ve)
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Irreversible	Irreversible

Table 7-40: Impact – powerline infrastructure on agriculture

Impact of proposed Ash dump on agriculture		
Ash 3		
	No mitigation	Mitigation
Extent	Local	Local
Magnitude	High	Medium
Duration	Long term	Long term
SIGNIFICANCE	High (-ve)	Medium (-ve)
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Irreversible	Irreversible

Table 7-41: Impact – powerline infrastructure on agriculture

Impact of proposed Power line on agriculture		
Site 6C		
	No mitigation	Mitigation
Extent	Local	Local

Magnitude	High	Medium
Duration	Long term	Long term
SIGNIFICANCE	Medium (-ve)	Low (-ve)
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Irreversible	Irreversible

7.7.4. Comment on cumulative impacts

In the long term (Life of the operation) and if implemented correctly, the above mitigation measures will reduce the impact on the utilizable soil reserves (erosion, contamination, sterilization) to a significance rating of **LOW** to **MEDIUM**.

In the long term (Life of the SC facility) and if implemented correctly, the above mitigation measures will reduce the impact on the utilizable soil reserves (erosion, contamination, sterilization) to a significance rating of **LOW**.

However, if the soils are not retained/stored and managed, and a workable management plan is not implemented the residual impact will definitely incur additional costs and result in the impacting of secondary areas (Borrow Pits etc.) in order to obtain cover materials etc. These management procedures will likely increase the significance of the impacts to **MEDIUM** in the long term.

7.8. VISUAL IMPACTS

7.8.1. Impact Statement

The establishment of the proposed power station and associated infrastructure may have a visual impact on the residents of the area, recreational users such as tourists and motorists passing through the area.

7.8.2. Discussions

Considering the possibility of the proposed power station and its associated infrastructure (ash dump included), to impact on the visual environment within which it is to be situated a Visual Impact Assessment was undertaken by Visual Resource Management Africa CC.

The Emalahleni Local Municipality has four power stations situated within its area of jurisdiction with two (Kendal and Duhva) Coal Fired Power Stations being located within the vicinity of the greater visual context of the eMalahleni town. The largely gently undulating terrain is mainly utilised for agricultural grazing. As can be seen in Figure 7-10, the views of these two very large structures extend across a large area. Kendal Power station (32 km SW of the town) is the largest coal fired power station in the world with a capacity of 4 032 MW. The chimneys at the Duvha power station (15 km SE from the town) are the highest man-made structures in Africa. These smoke stacks are each 300 metres tall.

PLATE 7: REGIONAL LANDSCAPE CHARACTER

Figure 1: View of N12 to Witbank showing regional landscape character *(Source: http://farm3.static.flickr.com/2321/2143803748_7789f4a3d2_b.jpg)*

Figure 2: View of Witbank Dam and Kendal Power Station

Figure 3: View of Witbank Dam and Duvha Power Station with 300 metres tall chimneys *(Source: www. panoramio.com)*

Figure 7-10: Regional landsacape character (Plate 7)

Coal mining occurs throughout the central and southern portions of the Emalahleni Municipal area, with large sections affected by shallow undermining and/or mineral rights. There are more than 22 collieries in the municipal radius with half of them being within the visual context of the proposed site. The proposed power station and ash dump are located approximately 11 km to the south of eMalahleni within a landscape that is significantly characterised by coal mining activities and associated infrastructure (Figure 7-11).

The Landau Colliery is located approximately 2km to the NE of the power station site and the proposed ash dump is located adjacent the Kleinkoppie mine (See Figure 7-11). Within the vicinity are numerous old and current mine dumps which are of a large enough scale to be clearly visible from a distance. There are power lines which link the mining activities to the grid and traverse the landscape creating visual fragmentation and discord (Figure 7-11). The coal mining has also resulted in environmental degradation of the area which is recognized in the Emalahleni Final Integrated Development Plan Report. 2009-2010. "Coal

mining has had a significant impact on the natural environment, which is also impacting on the built and human environment.
Mining can result in sinkhole formation, subsiding, underground fires, and seepage of water from underground workings. It has also had a significant economic impact on closure, with some of the mining towns closing down and people being retrenched."

Figure 1: Photo point A: Mining sense of place showing waste dumps and transmission lines in the surrounding area.

Figure 2: Photo point B: Mining industry sense of place

Figure 3: Photo point C: View of Witbank highly modified landscape as seen from the R544 travelling south. The proposed power station would be located to the right of the photograph.

PLATE 9: LOCAL MINING AREA LANDSCAPE CHARACTER

Figure 7-11: Local mining area landscape character (Plate 9)

The topography of the greater area around the site is characteristically an undulating landscape without dominating hills or ridges as depicted on digital terrain model map in Plate 11 of the VIA (**VOLUME 4**). Water drainage is to the north with the Witbank/eMalahleni Dam on the Olifants River being a major dam for area. The only conservation area in the Emalahleni Municipality, the eMalahleni Nature Reserve, which was originally established as a recreation resort around the Witbank/eMalahleni Dam, is situated there.[i] As depicted in the section graphs in Plate 11 of the VIA (**VOLUME 4**), the site is located in the 1561 – 1587 elevation band which is slightly elevated within its surrounds but fairly general at the regional context, with raised ground to the south west of the site offering some topographic screening. The receptors of Emalahleni are located on slightly higher ground relative to the site overlooking a wide valley.

Plate 12 of the VIA (**VOLUME 4**) shows the land uses and hence landscape character within the six kilometer distance from the site as depicted by the Google Earth satellite imagery. The image clearly depicts the fragmented nature of the landscape created by the mines, roads and power lines. The only relatively natural landscapes are the water areas, of which the dam to the west is the the most significant, as well as smaller vlei area scattered to the north and south. The developed areas of Emalahleni are visible to the north (in yellow). Other residential areas are smaller, related to mine accommodation and are located some distance to the east and west. The areas between the mining activity, the power stations and the residential areas of Emalahleni Municipality are mostly utilised for agricultural purposes. The Emalahleni Final Integrated Development Plan Report 2009-2010 has noted that agricultural land around the settlements in the Emalahleni area is increasingly under threat, due to the need for urban expansion. The constraints posed by undermined land further increases the attractiveness of agricultural land for development. Currently dairy, potatoes, maize, sheep and sweet potatoes are farmed.

The combination of the charcoal coloured landscapes of the dumps, the numerous powerlines as well as the many mining related activities create a fragmented landscape which generates high levels of visual contrast. The air pollution created by all the surrounding coal mines and power stations adds to the greyness of the landscape and also reduces visibility. In the following photograph of Duhva power station the mass of the structure is 'greyed' out with only the basic shape as reference to form.

Figure 7-12: Photograph of Duhva power station

a) Power Station Site

The proposed power station site echoes the degraded nature of the surrounding landscape (Figure 7-12). The power station is located to the west and east of two existing dumps. A single 400 kV power line and two 132 kV lines are located to the south-west which will need to be moved slightly further south. The site is bisected by the Tweefontein Road which is a public highway. It will thus require relocation to the north. From the T-junction with Tweefontein Road, another District Road runs to the west of the site towards the Landau Colliery. On the opposite side of this road is a covered coal conveyor with a small associated structure at its bend, where a telecommunication lattice mast is also located. A small graveyard is also located on the southern section of the site (**VOLUME 4**) which will also need to be relocated.

The site is characterised by mainly flat ground at the end of a gentle spur which drops off slightly to the south, west and north. Vegetation, to the north and west consists of agricultural fields which are utilised for growing maize. This would offer some scenic quality, with the backdrop of the surrounding dumps, which are not visually significant. The other features of the site are the rows of Gum trees (*Eucalyptus grandis*) which line the road. This type of tree line is fairly common within the greater landscape and offers good screening opportunities from the surrounding mining activities. The photographs in the VIA were taken in the height of winter so the landscape looks bleak and grey as most of the grass is burnt and there is minimal agricultural activity. In summer and spring the vegetation would have more colour due to the presence of veld grasses and maize farming. However, the attention of the casual observer is dominated by the frequent, very large landscape modifications associated with the coal mining industry surrounding the property.

The slight elevation of the site can be seen in the compass point photographs on Plate 15 (**VOLUME 4**) of the VIA which were taken from the site. The southern view depicts the gum and wattle trees on the opposite side of the Tweefontein Road as well as the mine dump. On either side of the road are agricultural lands. The view to the east depicts the drop off in elevation with the 400 kV power line in the middle ground and the Duhva power station in the distant background. The view north-east depicts the district road towards the Landau Colliery as well as the coal conveyor, with agricultural lands on either side of the road. The final view, to the north-east depicts the drop-off in elevation, with the mine dump in the mid ground and the town of Emalahleni in the background, also on elevated ground.

Ash Dump Site

The site for the ash dump is located to the south and east of the Benella mine dumps as well as the mine works of the Kleinkoppie mine. (See Plate 16 of the VIA in **VOLUME 4**) These features significantly detract from the landscape character of the area. To the south of the site is a mine access road which is cut into the terrain which links the Kleinkoppie mine works to the mine site in the north-west, which in effect creates two rectangular pieces of ground. The terrain rises gently from south-east to north-west but has no dominant topographic feature. The vegetation consists of veld grasses, which is currently utilised for agriculture. To the south of the site, there is a centre pivot irrigation system.

The photographs of the site on Plate 17 (of the VIA in **VOLUME 4**) of the VIA depict the low levels of scenic quality. Figure 1 (Plate 17), the photograph taken from the road to the south of the site depicts the gentle rise to the north-east and the large cutting of the mine access road. Figure 2 (Plate 17) depicts the industrial landscape of the mine works on the opposite side of the road as well as the drop-off in elevation towards the east. Figure 3 (Plate 17) to the north, depicts the burnt veld grasses of the site vegetation as well as the mine dumps in the mid-ground. Figure 4 (Plate 17) depicts the agricultural landscapes and terrain drop-off to the west.

Transmission Lines Sites

The area where the two power line alternatives are proposed is depicted in Plate 18 of the VIA (**VOLUME 4**). Both of the alternatives head in a northerly direction to link up with the 400kV power lines located approximately 3 km to the north. Alternative 1 heads due north and bends slightly as it passes close by the Landau Colliery residential area to the east. As depicted in Plate 19, three 400kV powerlines are already located in close proximity to this residential area and as such the sense of place is already strongly associated with the transmissions lines. In terms of general landscape character, the northern photograph in Figure 1 (Plate 19) depicts the veld grasses / vacant land over which the power line would pass before joining with the existing 400 kV lines at the photograph location. Figure 2 (Plate 19)depicts the views to the west along the line of the existing three power lines, as does Figure 3 (Plate 19) views to the north. Figure 4 (Plate 19) depicts the views to the south and the Emalahleni residential area located 9 km away.

As the existing three 400 kV powerlines are located between the receptors and the proposed Alternative 1 line, the new landscape modification would not result in a significant change to the existing landscape character as seen from northern receptors. Plate 20 of the VIA (**VOLUME 4**) depicts the photographs in the vicinity of where the Alternative 2 will link with the existing three 400 kV power lines. Figure 1 (**Plate 20**), the view to the south-east, depicts how the landscape is strongly associated with the presence of transmission lines. Figure 2 (**Plate 20**), towards the north, depicts the area where Alternative 2 will link into the existing 400 kV lines. The clump of alien wattle trees in the foreground will break up views of the new line which would be located in the mid-ground.

The landscape character of the area is moderate to low due to the existing electrical power lines, mine dumps and run down industrial and alien infested type landscapes that characterize the location. The proposed power station is located within a highly modified coal mining landscape with the Duvha Power Station located approximately 10 km from the site and 15 km from eMalahleni/ Witbank. The landscape is characterised by high levels of contrast and reflects a Class IV type landscape which is suitable for large / high contrast generating landscape modifications.

7.8.3. Description and Significance of Potential Impact

The overall visual impact is a function of sensitivity of the landscape and severity of the impact. Landscape sensitivity is an indication of the degree to which the landscape can accommodate change from a particular development. The severity of the impact refers to the magnitude of the change on the landscape as a result of the development.

The heights of the most visible elements of the proposed project are expected to be as follows:

- Power Station 150m stack;
- Power Plant: 95m power plant sections;
- Power Plant 42m power plant sections;
- Ash Dump: approximate height at highest point 30m;
- Power Line Alt1 (38m);
- Power Line Alt2 (38m)

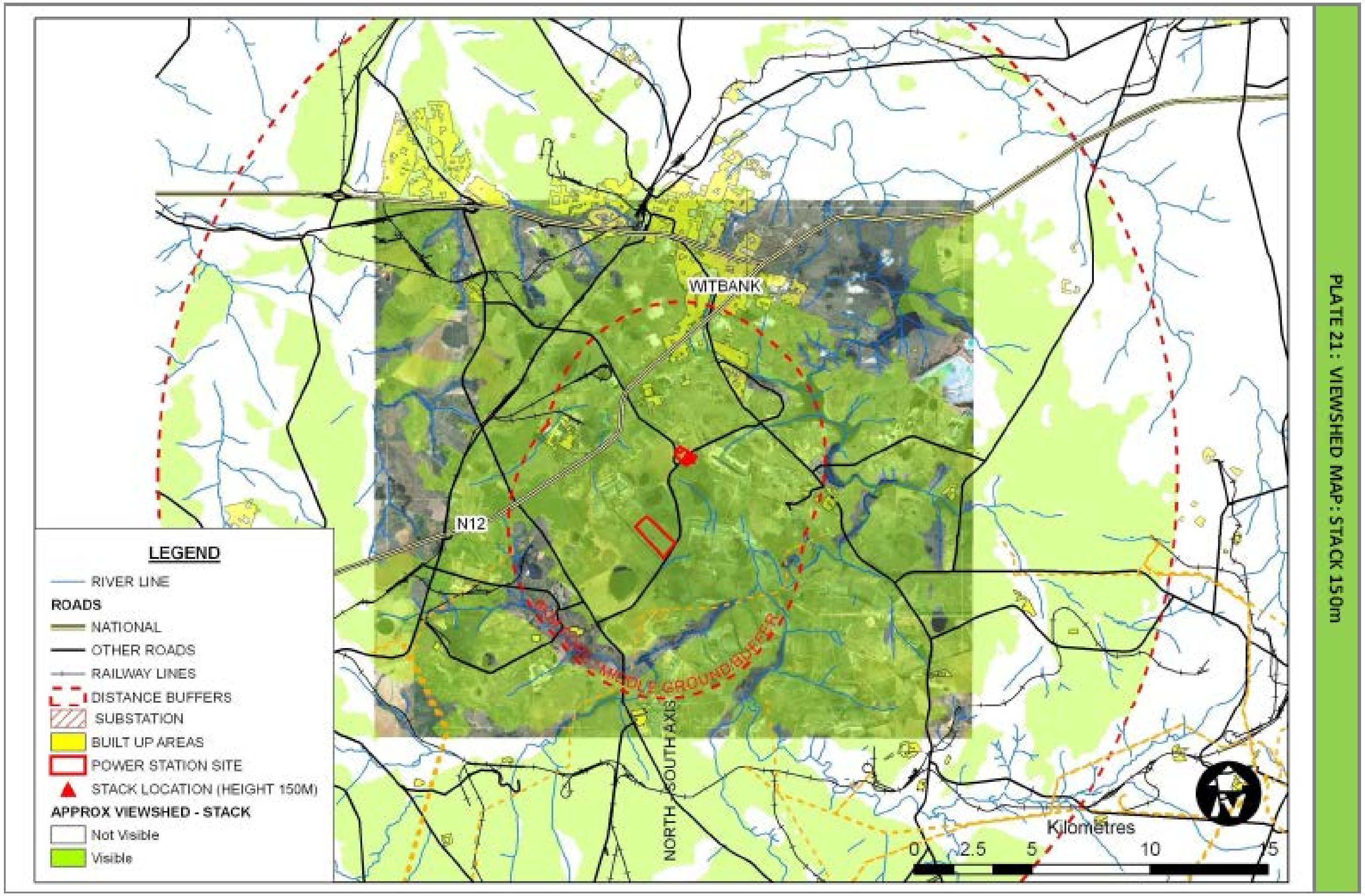


Figure 7-13: Viweshed of Stacks (Plate 21)

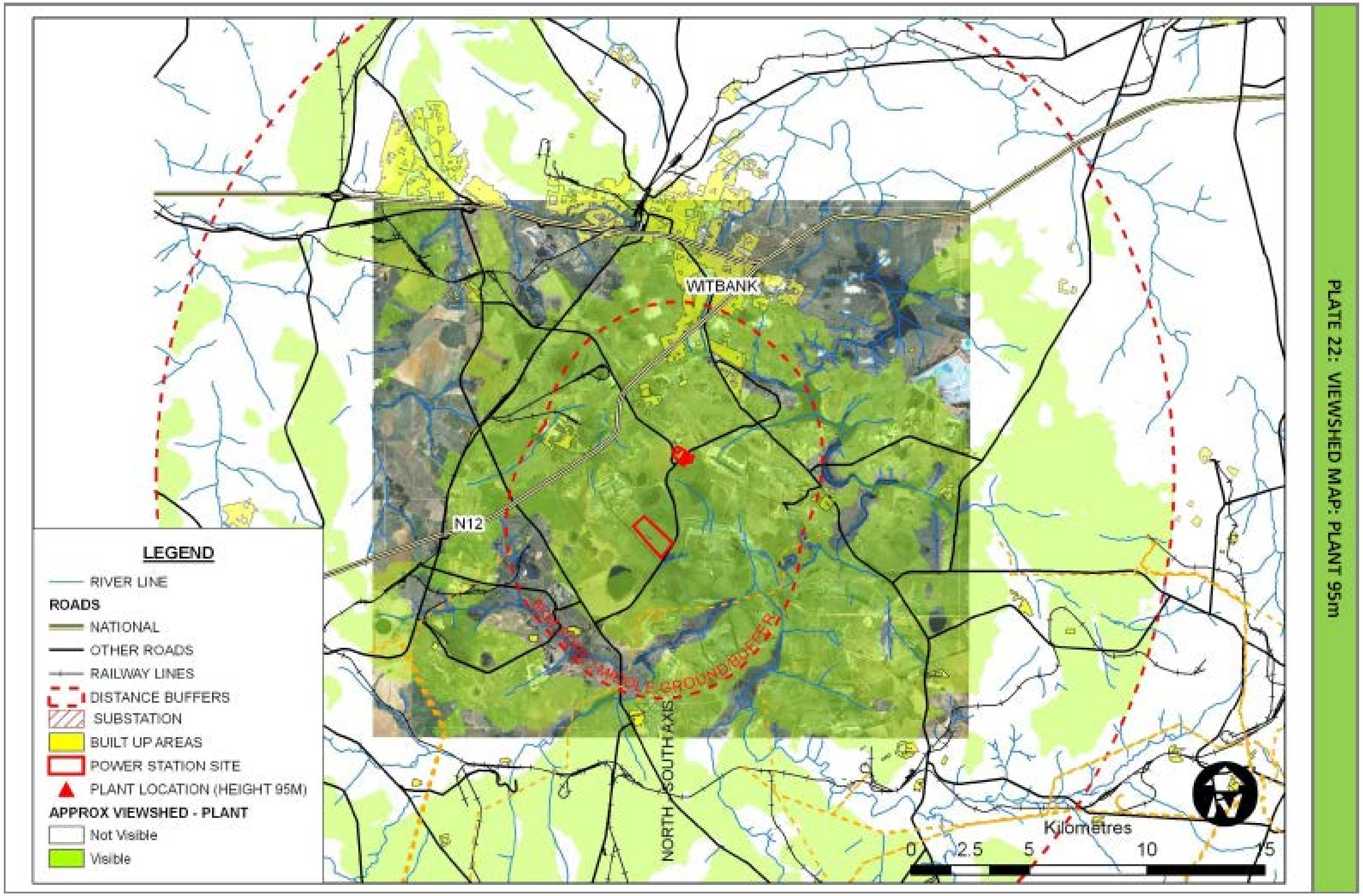


Figure 7-14: Viewshed of power plant 95m (Plate 22)

Figure 7-15: Viewshed of power plant 42m (Plate 23)

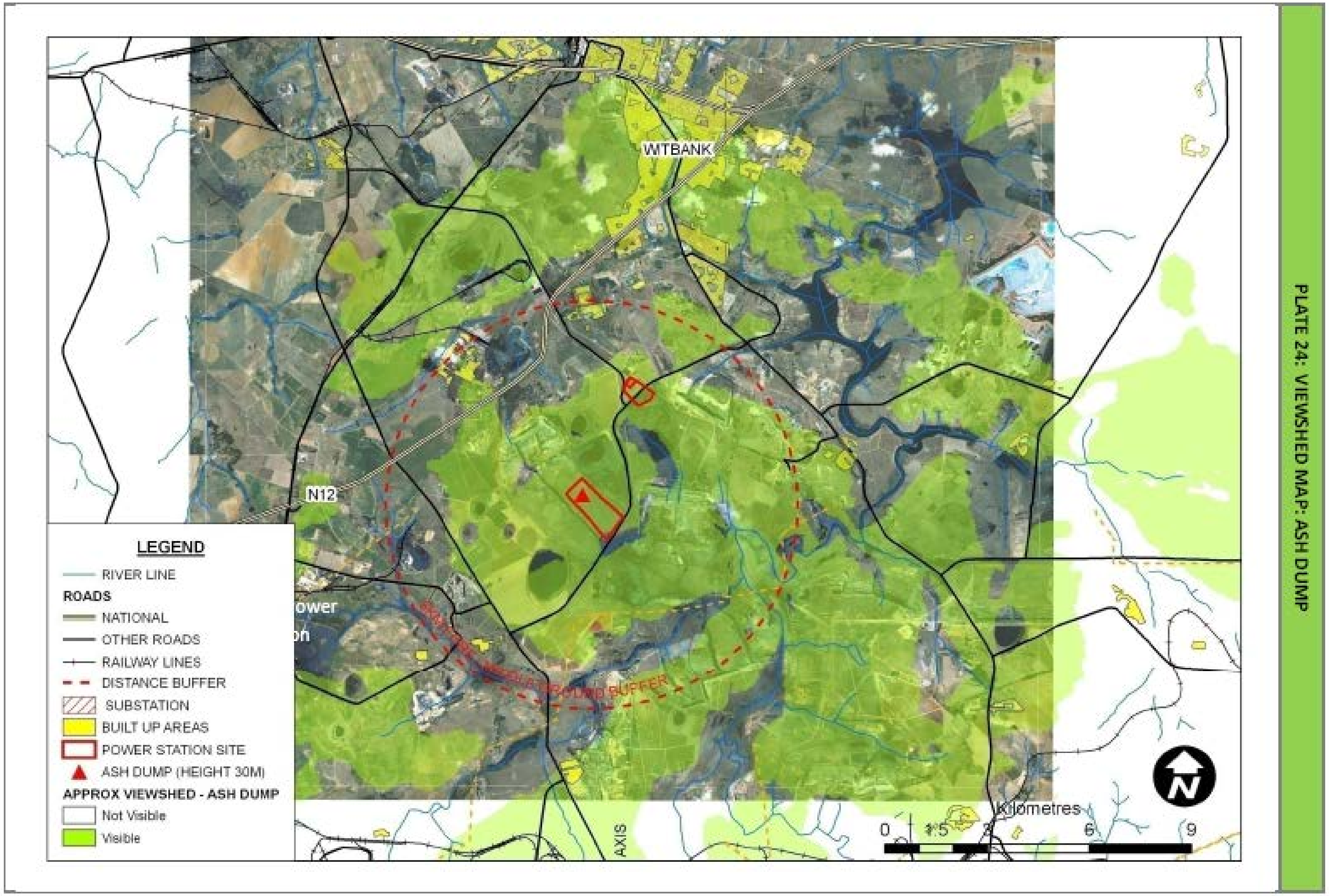


Figure 7-16: Viewshed of Ash dump (Plate 24)

a) Power Station

Initial stages of the construction would have a **Local** extent, with the expansion to Regional as the structure increases in height. With the deconstruction of the plant structures at the end of the life of mine, the extent would rapidly be reduced to local. There is little variation with regard to extent mitigation due to the very large size and scale of the project. The magnitude would be **Low** for all stages of the project due to the significantly modified and degraded state of the regional landscape. The landscape reflects many mining activities and associated infrastructure as well as the common visual influence of two other power stations. As a consequence, the significance of the impact is **Low**. Sufficient time was spent on site (two visits) as well as a detailed 3D modelling and photo montage exercise has resulted in **High** levels of confidence.

The proposed cream and red colours proposed for the plant are alien in this landscape. In this regard it is recommended that the existing colour scheme be modified and the red colour replaced with a grey-green colour (see Plate 37) as this would reduce the visual intrusion but still allow the colour combinations to make the structure an interesting feature.

For all project phases, lights at night need to be kept to an efficient minimum as they can significantly increase the visual influence of the proposed landscape modification. As much as possible, down lighting should be used. Further recommendations for lighting control are attached in the Visual impact Assessment Report in **VOLUME 4**.

Even thought the landscape is degraded, it is recommended that every effort be made to reduce the visual intrusion. The receptors most exposed to the landscape modifications will be those making use the two adjacent district roads. The close and clear views of the power station / sub-station would be result in high levels of visual exposure which could be reduced by means of screening trees and a two meter berm. It is recommended that the existing line of gum trees (or suitable other similar tree as defined by the vegetation specialist) is continued and planted between the Tweefontein road and the power station (see Mitigation Map 1 on Plate 36) so as to screen the mass of the plant workings and substation from the receptors. If possible (and if there is surplus top soil) a low two meter berm would also help to reduce visual exposure to the low level workings of the plant.

Mitigations

- Strict management of lighting needs to be implemented to ensure that light spillage is contained to an effective and safe minimum.

Road & 400 kV Power line deviation

All stages of the project would have a **Local** extent and a **Low** magnitude as the power line is a realignment and as such the visible change will be absorbed into the existing context. The power line will be permanent and as such the duration will be **Long term**. The significance would be **Low** but the impact will take place. The confidence of the decision making is **High**.

Although the impacts of the two options are the same, Alternative 2 is the preferred option as it has less exposure to receptors and is more aligned with existing road infrastructure, hence there would be less potential fragmentation of landscapes / agricultural areas

Mitigations

- NA

Ash Dump

Without mitigation, the visual impact of the ash dump would be higher due to windblown dust which can be seen from a distance. As such the significance without dust contoll mitigations is **Moderate** but **Low** should the mitigations measures be effectively implemented. The dump would be difficult to reverse which increases the importance of effective mitigation.

- Dust reducing measures must be undertaken to reduce the viewshed during construction. Rehabilitation using soil from the site to be carried out continuously.
- An initial 5m 'berm' needs to be constructed on the outside of the dump to screen off the initial construction activities and associated impacts.
- Concurrent rehabilitation needs to take place with the top soil covering and subsequent rehabilitation of the 'berm' face taking place as soon as it has been raised.
- The benching process of construction needs to be followed, each time by raising a small 'berm' of suitable 1 in 7 slope on the outside of the dump to screen off the construction activities from sensitive receptors. Concurrent rehabilitation needs to take place with the covering with top soil and subsequent rehabilitation of the 'berm' face taking place as soon as it has been raised.

- Rehabilitation measures for indigenous / endemic vegetation need to be implemented while construction of the dump is in progress for each bench.
- Dust control measures need to be implemented and monitored

Impact Assessment Results

The results of the impact assessment are contained in Table 7-42.

Table 7-42: Impact – Power station on visual aesthetics

Impact of a power station on visual aesthetics		
SITE 6C and powerline		
	No mitigation	Mitigation
Extent	Regional	Regional
Magnitude	Low	Low
Duration	Long	Long
SIGNIFICANCE	Low (-)	Low (-)
Probability	Probable	Probable
Confidence	Certian	Certain
Reversibility	Reversible	Reversible

Table 7-43: Impact _ Ash dump on visual aesthetics

Impact of an ash dump on visual aesthetics		
Ash 3		
	No mitigation	Mitigation
Extent	Regional	Local
Magnitude	Medium	Low
Duration	Long	Long
SIGNIFICANCE	Medium (-)	Low (-)
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Irreversible	Irreversible

7.8.4. Comment on Cumulative Impacts

The addition of another coal fired power station into the Witbank area may also result in various cumulative impacts. These are as follows:

Power Station

Even though the project is very large, the modification could be reversed within a ten year period and due to the degraded nature of the surrounding regional landscape, the cumulative impacts would be **Low**.

Road and 400 Kv Power Line

The power line can be reversed and due to the existing degraded surrounding landscape, the cumulative impacts would be **Low** for all phases of the project.

Ash Dump

Due to the degraded nature of the surrounding landscape the cumulative impacts from the lack of mitigation would be **Moderate** without mitigation and **Low** with mitigation. It is vital that concurrent rehabilitation needs to take place with the top soil covering and subsequent rehabilitation of the 'berm' face taking place as soon as it has been raised.

7.9. NOISE IMPACTS

7.9.1. Impact Statement

The establishment of a coal-fired power station and its associated infrastructure may elevate the ambient noise levels in the vicinity of the power station site and the surrounding areas to unacceptable levels, as defined in the SANS 10103 standards. Furthermore, the cumulative impact of the additional power station in combination with the existing industrial infrastructure could also lead to unacceptable noise levels.

7.9.2. Discussion

In order to predict the likely impact that the proposed power station would have on noise levels in the area, and to determine the likely compliance with the relevant South African noise standards, a detailed noise impact assessment study was undertaken by Mr Derek Cosijn and Dr Erica Cosijn of Jongens Keet Associates. The detailed Noise Impact Assessment is attached in Volume 2.

The general procedure used to determine the noise impact was guided by the requirements of the Code of Practice SANS 10328 *Methods for Environmental Noise Impact Assessments.* The level of investigation was the equivalent of an ESIA. A comprehensive assessment of all noise impact descriptors (standards) has been undertaken. The noise impact criteria used specifically take into account those as specified in the South African National Standard SANS 10103 *The Measurement and Rating of Environmental Noise with Respect to Annoyance and Speech Communication* as well as those in the National Noise Control Regulations. The investigation comprised the following:

- Determination of the existing situation (prior to the development of the power station).This was done by measuring baseline noise levels in the area and by calculation of the noise profiles of existing sources of noise in the area, namely noise from existing mines, road traffic noise (refer to Figure 7-17) and railway traffic noise. Noise sensitive receptors were identified in the study area (refer to Figure 7-18).
- Determination of the situation during the pre-construction and construction phases. This was done by means of calculation of noise profiles of typical construction sites. The worst case scenario was modelled, namely wind in excess of 6m/s during the day.
- Determination of the situation during the operational phase. Baseline noise data of various plant and equipment that will be installed/used at the planned power station were determined from measurements at other similar operational sites. The baseline noise profiles of the noisiest plant and equipment were then used to calculate the typical noise conditions generated by the operations at the power station. The South African National Standard SANS 10357 -The Calculation of Sound Propagation by the Concawe Method was used to model the situation. For these calculations, the overall study area was subdivided into a number of smaller study areas (discrete noise zones) which relate to the proposed power station project analysis areas. The smaller areas are those focusing around:
    - The power station.
    - The Klippan coal supply dump to the south-west of the power station.
    - The ash dump to the south-west of the coal supply dump.
    - The coal wash plant situated at the coal supply dump.

Where appropriate, the cumulative effects of the noise generated by combinations of these areas have been taken into consideration. The worst case scenario was modelled, namely inversion conditions.

- Assessment of the change in noise climate and impact. The noise levels induced by the power station and its infrastructure were compared to the baseline noise climate data. Based on the existing level and on the change in noise levels the magnitude of the impact was ascertained. The noise impact criteria given in SANS 10103 indicate the ideal situation, where noise sensitive receptors are not already degraded by the existing (residual) noise climate. However, it is likely that the residual noise level at some of the noise sensitive receptors already exceeds the recommended maximum (e.g. next to major roads and railway lines). In order to assess the actual noise impact at any particular site, therefore, the residual noise climate has to be taken into account when determining impact. Where the noise level for a particular site is presently lower than the maximum ambient allowed (as indicated in SANS 10103) the recommended maximum shall not be exceeded by the introduction of the intruding noise. Where the noise level for the site is presently at or exceeds the maximum level allowed, the existing level shall not be increased by more than that indicated as acceptable in SANS 10103[25] .

- Based on the findings, appropriate noise mitigation measures (site scale) have been investigated and recommendations made. These are conceptual and not detailed to final design level.

[25] Details of Noise Impact Standards can be referenced in Volume 2:Noise Impact Assessment, Table A3, Appendix A

Figure 7-17: Existing road network

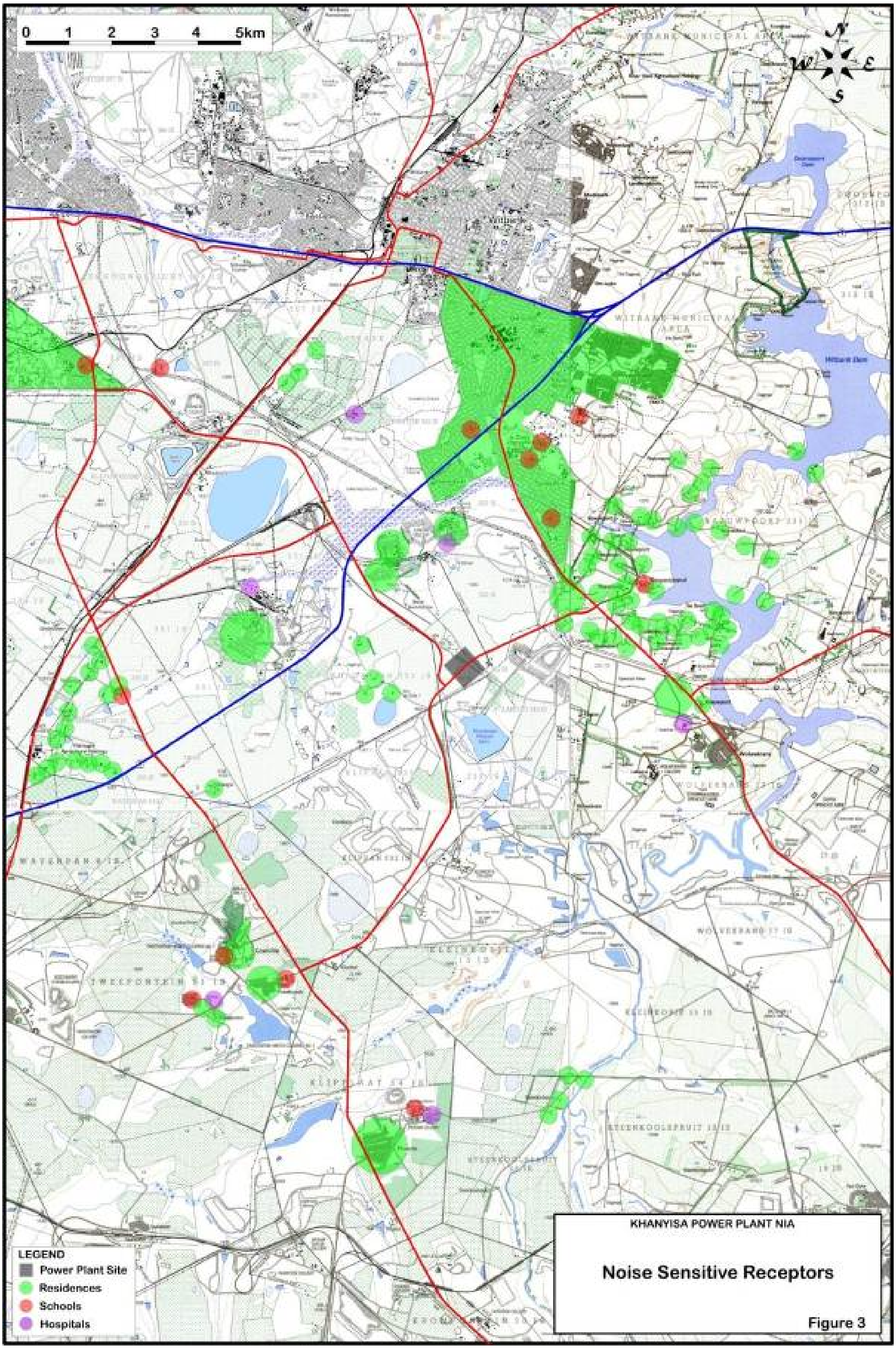


Figure 7-18: Identified noise receptors

7.9.3. Description and Significance of Potential Impact

The baseline noise survey comprised the identification of noise sensitive receptors, noise sources, a field measurement survey and calculation of the noise profiles of the existing Anglo Coal Collieries and modelling of the road traffic noise.

The main sources of noise in the area were found to emanate from:

- Traffic on the main roads
- Several mines/collieries.
- Rail traffic through the area (main lines and industrial spur lines).
- General farming activities (not major source of noise).
- Traffic on the farm (gravel) roads. This is an intermittent source of noise.

The main noise sensitive receptors in the area include:

- Various suburban and rural residences.
- Schools in Emalahleni and farm schools in the rural areas.
- Several hospitals

Measurements and auditory observations were taken at seven main sites in order to establish an overview of the ambient noise conditions of the study area. For a detailed description of the main measurement sites and for more technical details of the measurement survey refer to **VOLUME 3** for the Noise impact Assessment Report. Refer also to Figure 7-19.

Due to the complexity of the mining and industrial land uses in the area, the noise footprints of the major noise sources have been calculated and modelled. These are:

- The surface infrastructure at the Landau, Greenside and Kleinkopje Collieries (refer to Figure 7-20)
- Road traffic noise (refer to Figure 7-21).

As the rail traffic on the three main lines through the study area is relatively low volume, the ambient noise footprint of the train traffic was not modelled. With the pass-by of each train there will be a fluctuation in sound pressure level ranging from the normal background noise for the area (residual noise level) to a maximum as the train passes and then reducing again to the residual level as the train moves away from the receiver point.

The approximate maximum noise levels that will be experienced with the pass-by of a train at various offsets from the railway line and for various typical cross-section types are given in the Noise Impact Assessment in VOLUME 2.

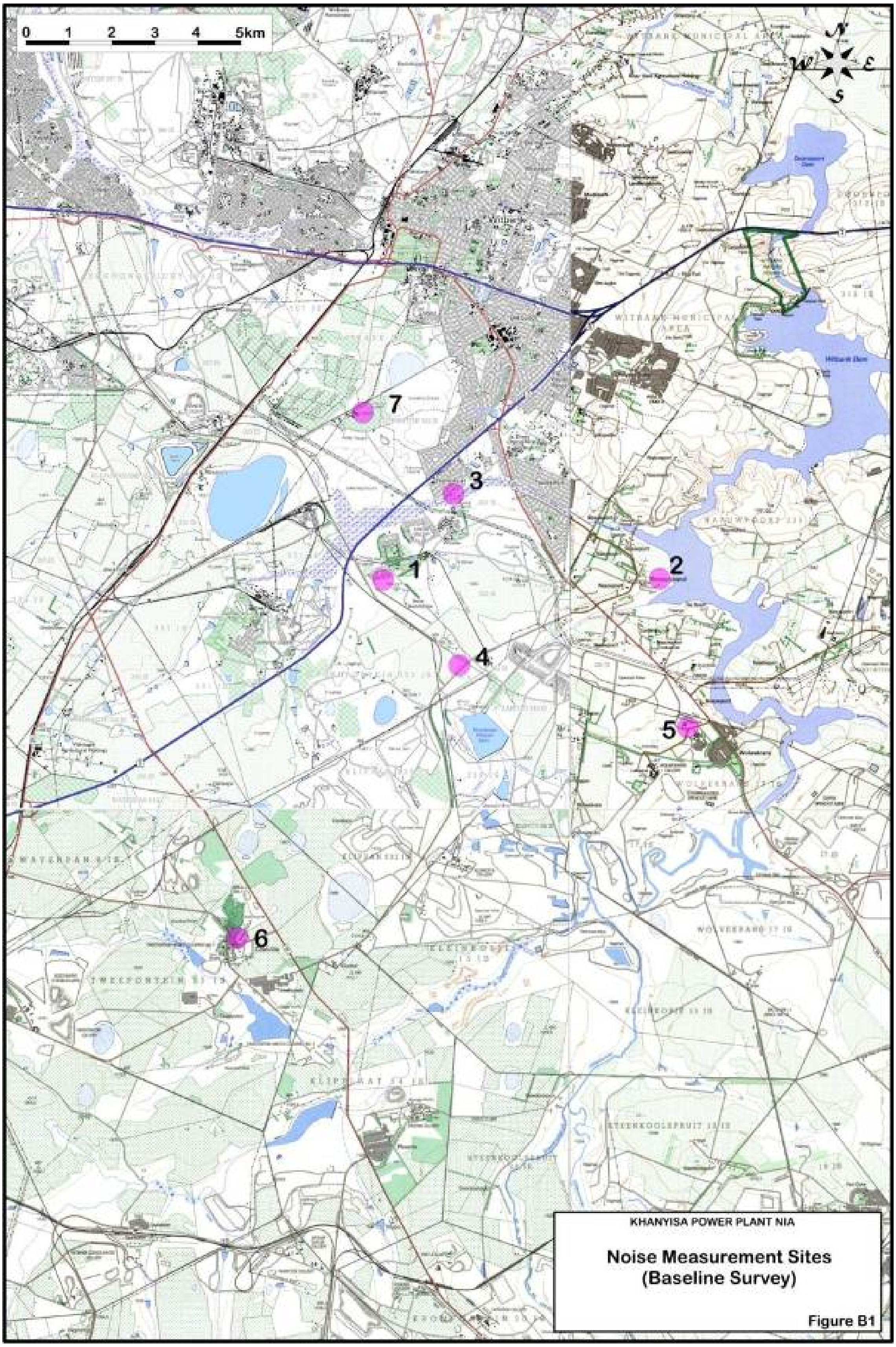


Figure 7-19: Noise measurement sites

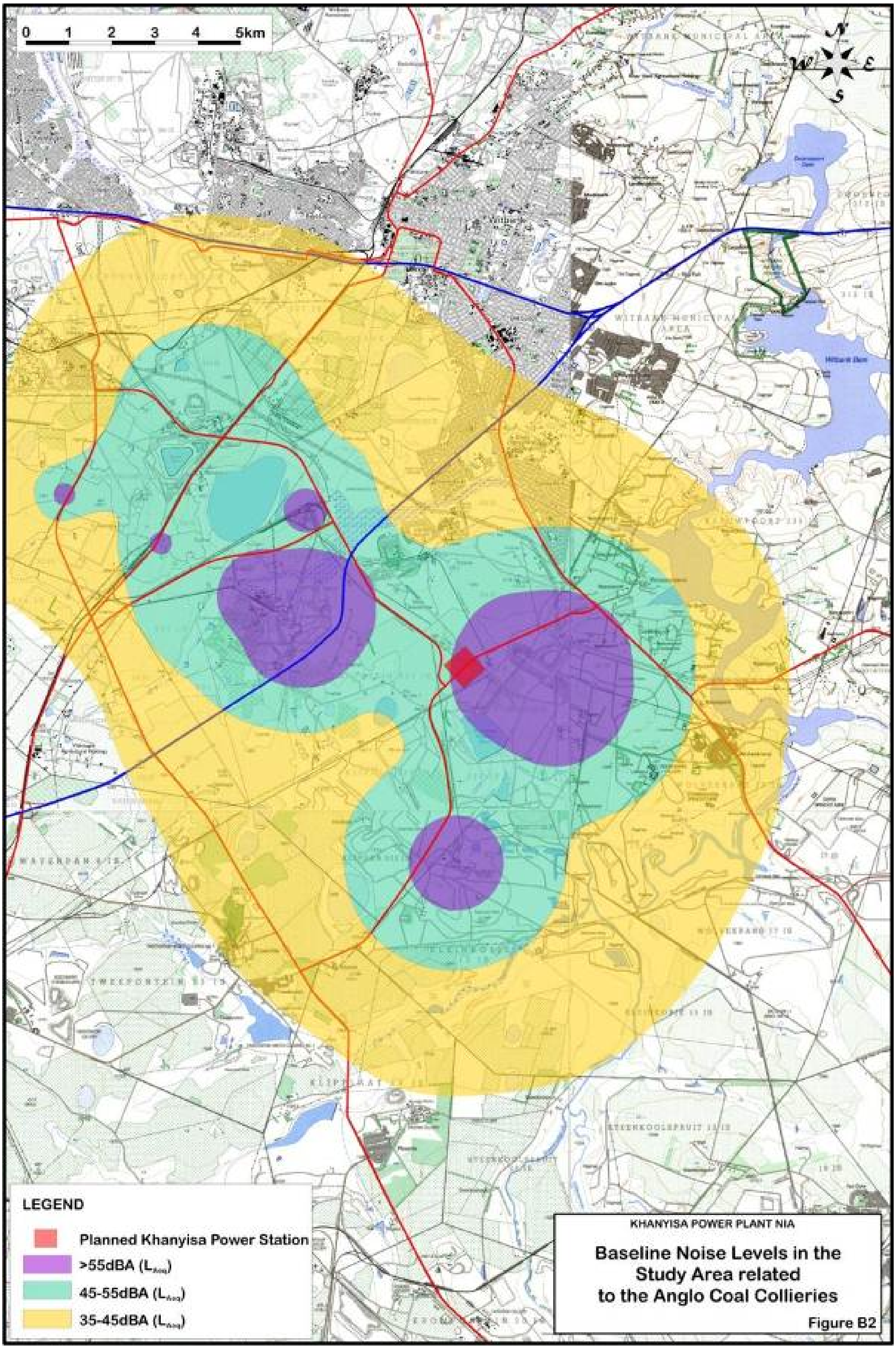


Figure 7-20: Baseline noise level from Anglo American Collieries

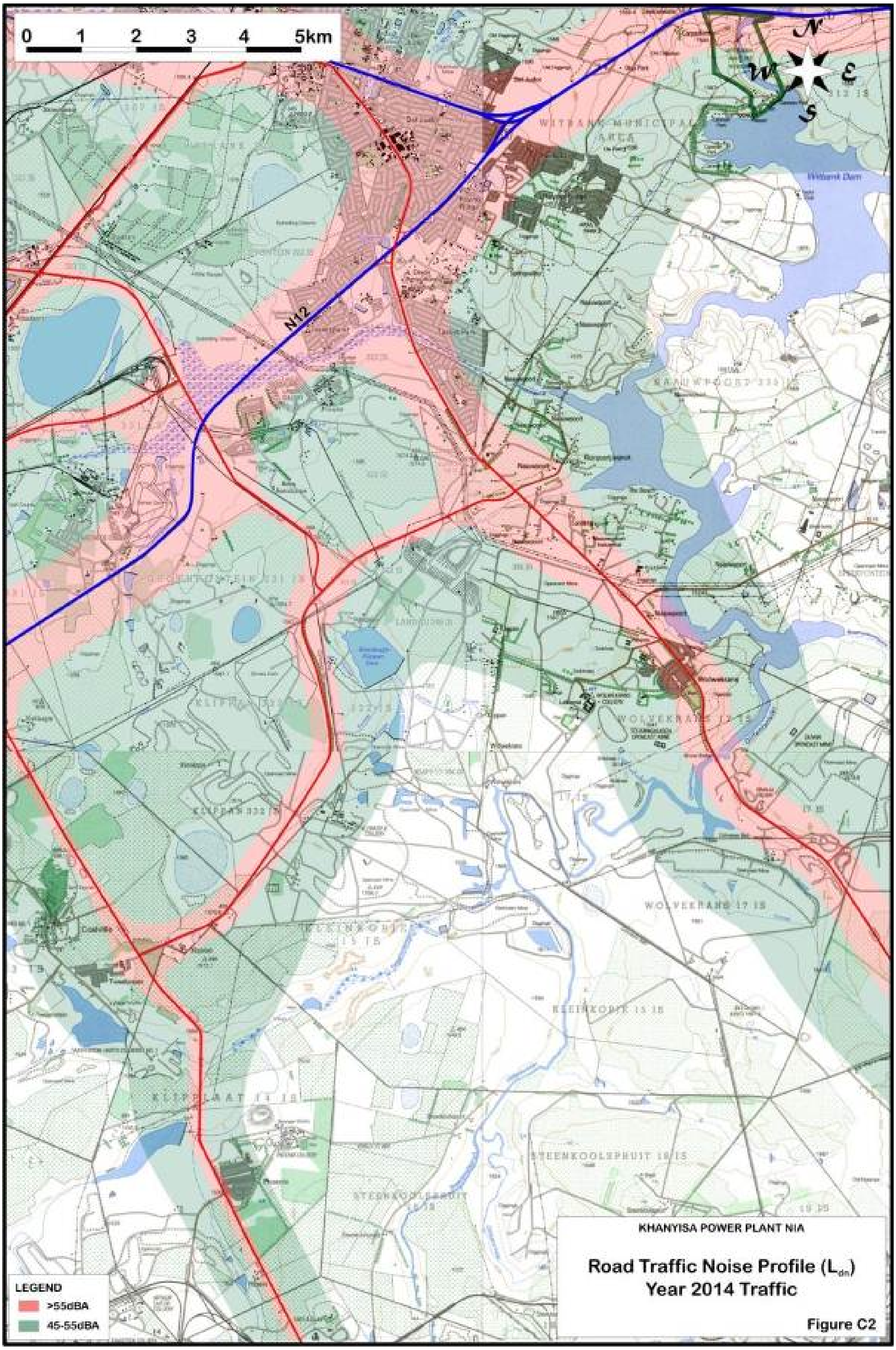


Figure 7-21: Road traffic noise impact

In overview, it was found that residual noise levels across the study area vary significantly:

- Noise levels in many parts of the study area were found to be high; specifically the areas close to the main roads and colliery operations. In these areas, the existing residual noise climate is typical of an urban environment as defined in SANS 10103:2008, that is, areas where ambient noise levels generally do not exceed 55dBA during the day and generally do not exceed 45dBA during the night-time. In areas adjacent to the colliery operations, short-term noise levels in excess of 70dBA were measured.
- In areas remote from these sources of noise, rural conditions prevailed. In these areas, the existing residual noise climate is typical of a rural environment as defined in SANS 10103:2008, that is, areas where ambient noise levels generally do not exceed 45dBA during the day and generally do not exceed 35dBA during the night-time.
- These areas are interspersed with developments where the existing residual noise climate is typical of a suburban environment as defined in SANS 10103:2008, that is, areas where ambient noise levels generally do not exceed 50dBA during the day and generally do not exceed 40dBA during the night-time.

On the basis of these findings it was considered appropriate to apply the following noise standards to the study area:

- Urban residential: the noise impact on the southern sector of Emalahleni/Witbank (Tasbet Park) and the Village of Cluver should be determined on the basis of urban residential district standards (SANS 10103), namely the daytime period ambient noise level should not exceed 55dBA and that for the night-time period should not exceed 45dBA.
- Suburban residential: the noise impact on the residence/area near the Witbank Dam should be determined on the basis of suburban residential district standards (SANS 10103), namely the daytime period ambient noise level should not exceed 50dBA and that for the night-time period should not exceed 40dBA.
- Rural residential: the noise impact on the residences on farms in the area should be determined on the basis of rural residential district standards (SANS 10103), namely the daytime period ambient noise level should not exceed 45dBA and that for the night-time period should not exceed 35dBA. Measured levels indicate that parts of the (rural) study area are already severely degraded close to the main sources of noise.

- Educational: Noise levels at the schools should not exceed 50dBA (outdoor condition) with the proviso that indoor classroom conditions do not exceed 40dBA.
- Nature reserves and environmentally protected areas: acceptable noise levels these areas should be based on the naturally occurring sounds of that locality. Noise criteria used for assessing and controlling noise in urban and suburban residential districts are not applicable to Natural Quiet Spaces. All manmade sounds (instantaneous, as well as average) must be reduced to a minimum.

The potential noise impacts for the pre-construction, construction and operational phases were determined.

Assessment of the Operational Phase

For purposes of noise modelling for the noise impact assessment of the operational phase of the power station project, four noise analysis zones have been identified, namely:

- The power plant.
- The Klippan coal supply dump.
- The ash dump.
- The coal washing facility at the Klippan coal supply dump.

Refer to Figure 7-22.

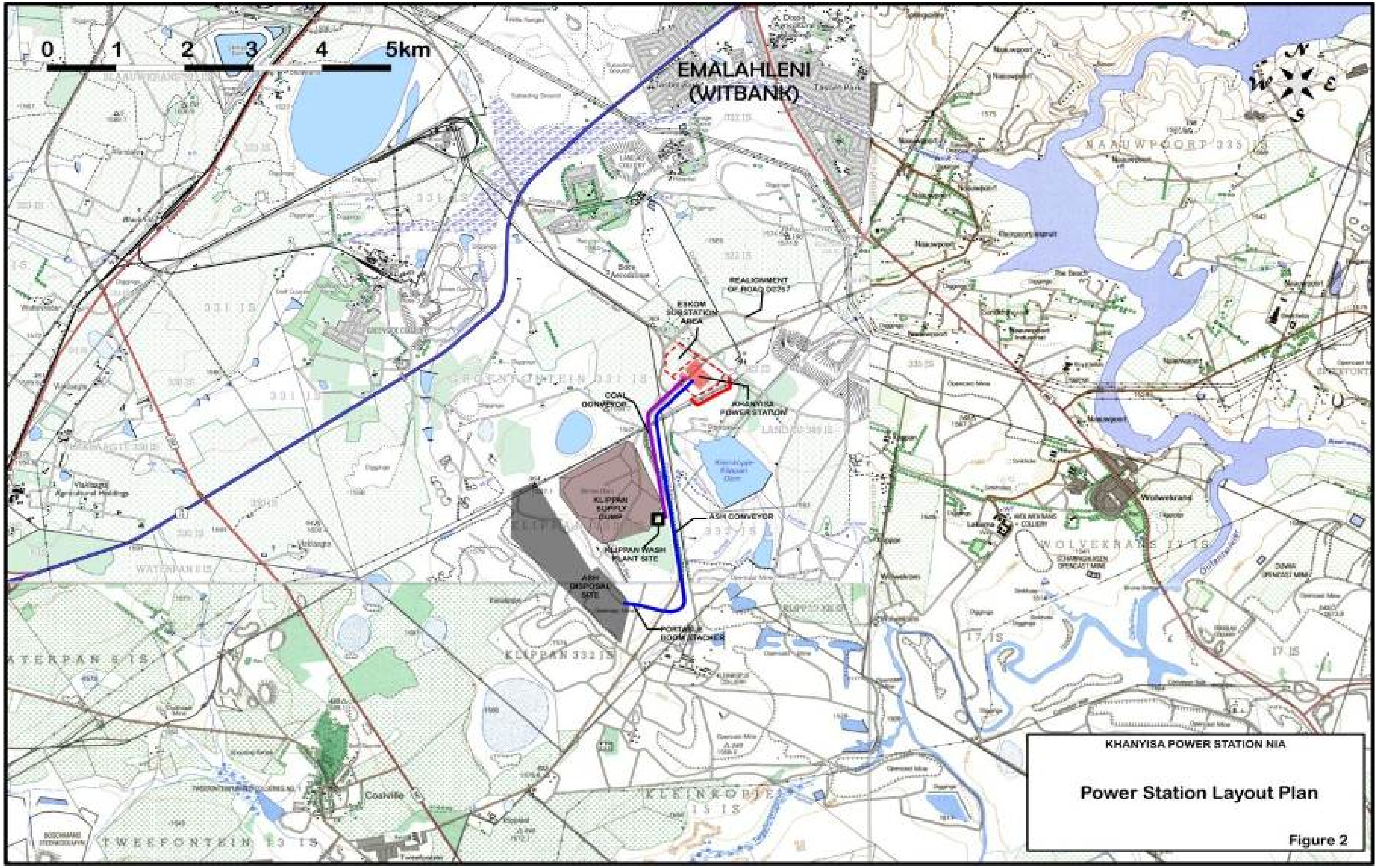


Figure 7-22: Operational phase noise footprints

The overall 35dBA noise footprint of operations at the power station covers a radius of approximately 8500 metres around the site and is shown in Figure 7-23. This 35dBA ambient noise contour (envelope) demarcates the outer limit of influence according to SANS 10103 for rural residential living. The 40dBA footprint shown in Figure 7-24 is the envelope that demarcates the outer limit for suburban residential living. The purpose of the figures are to indicate the entire area that may be influenced at some stage, over the entire life of the power station, by all the possible noise generating operations at the power station and ancillary works.

In accordance with the precautionary principle, Figure 7-25 shows an example of the noise contours from a worst case scenario for the NSRs to the south-west of the power station when the cumulative effects of the power station complex when the south-eastern areas of the ash dump and the coal supply dump are worked simultaneously. These figures represent the worst meteorological conditions (winds in excess of 6m/s, inversion layers, etc.) as well as minor allowance made for barrier effects and vegetation.

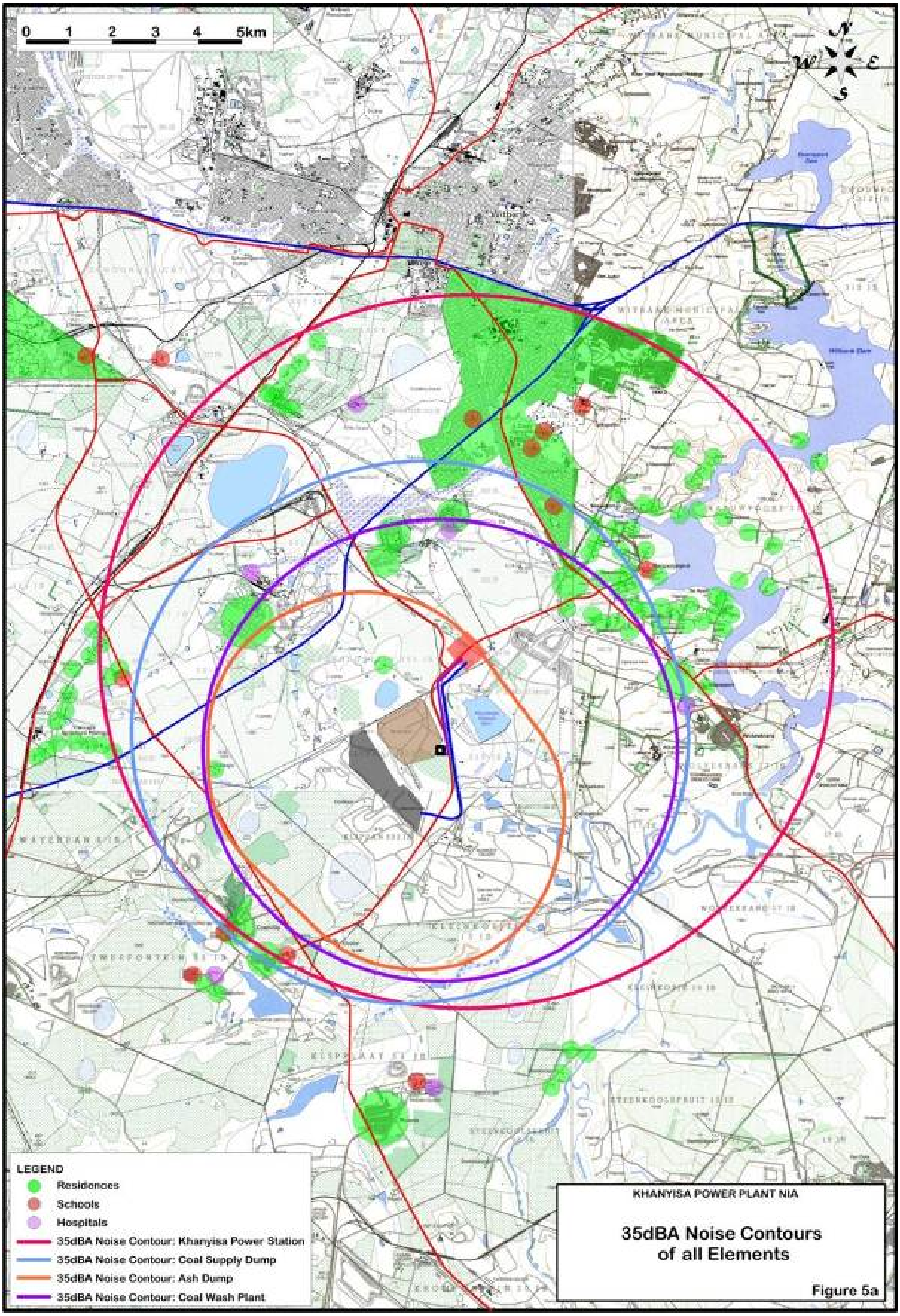


Figure 7-23: Extent of 35dBA noise impact

Figure 7-24: Extent of 40dBA noise impact

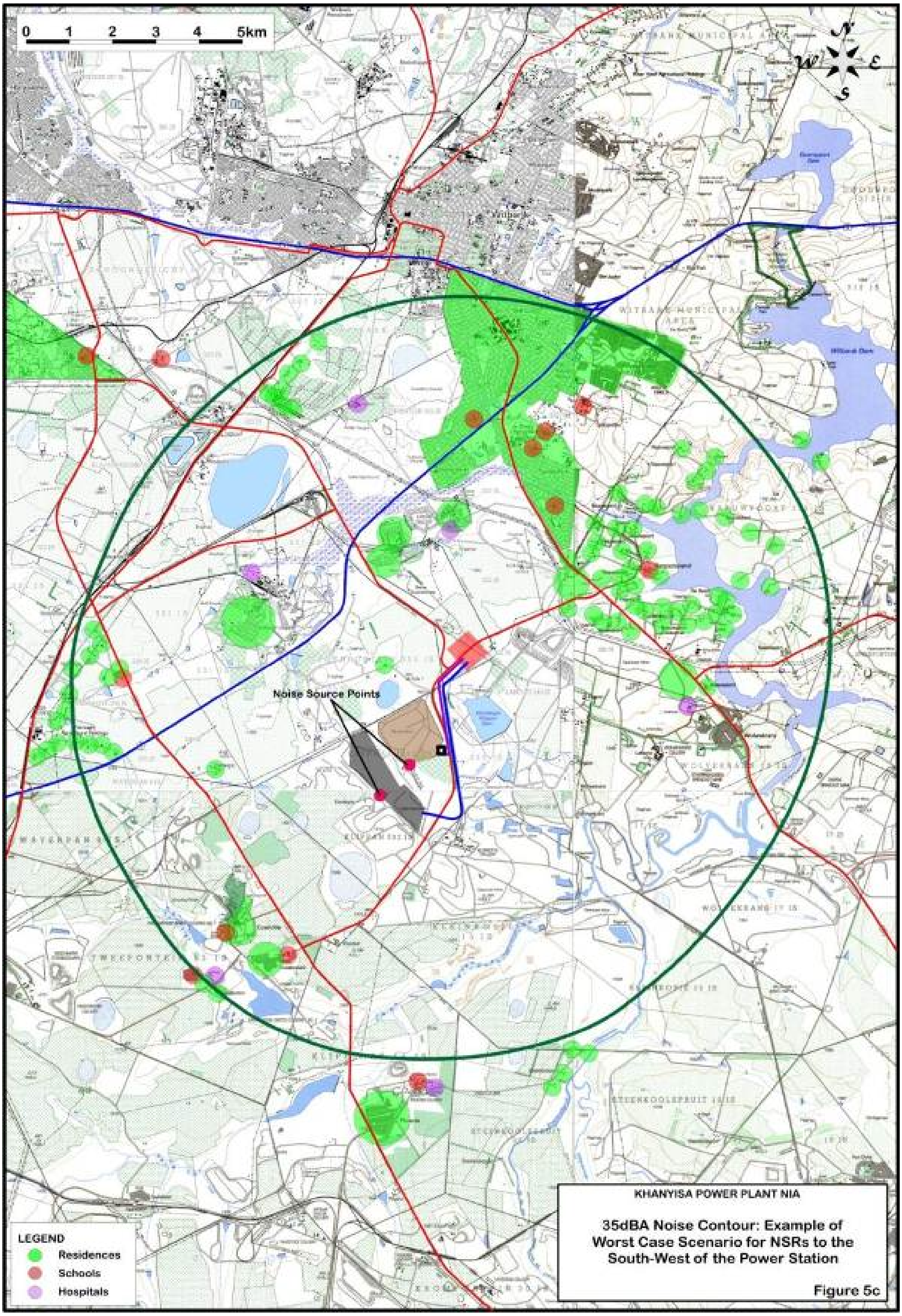


Figure 7-25: Worst case scenario 35dBA noise impact

Conclusions

The following conclusions may be drawn from the foregoing analysis:

- The proposed power plant site is located in an area where active mining takes place. It lies in the industrial/mining hinterland between the urban areas of Emalahleni and rural (farming) areas.
- Residual noise levels across the study area vary significantly.
- The ambient noise levels alongside the main roads exceed the acceptable maximum ambient noise level standards as recommended in SANS 10103 with respect to rural, suburban and urban residential living and for other noise sensitive land uses. The noise climates in these areas can be defined as being severely degraded for these land uses.
- Other than the road traffic noise, the main noise sources in the area are the colliery/mining operations and railway traffic. The noise generated by the Greenside, Landau and Kleinkopje Collieries dominates the noise climate in certain areas[26].
- The construction of the power plant will introduce an extremely loud noise source into the area. From a qualitative aspect, the development of the power plant will bring about a major change in the noise character of sections of the study area and especially in the near field around the power plant (approximately 2000 metres).
- The impact of the power plant itself will, to a large extent, be reduced by the fact that the noise climate has already been degraded by the operations at the Landau, Greenside and Kleinkopje Collieries, and traffic noise. The cumulative effects between the existing sources of noise and the noise generated by the power station operations will be minor, except in the near field around the power plant.
- There are numerous noise sensitive receptors in the study area that potentially might be impacted by the power plant.
- There are mitigation measures that could be introduced to reduce or prevent some of the impacts.

Overall, taking the residual noise climate into consideration, the noise generated by the power station and ancillary works will have a relatively minor impact on the noise sensitive receptors in the study area.

The detailed noise assessment is appended in **Volume 3**.

[26] Refer to Section B5.4 in Appendix B of the Noise Impact Assessment (Volume2) for details.

Table 7-44: Impact: Impact on noise climate (direct dry cooling)

Impact of the proposed power station and associated infrastructure on the noise climate (direct dry cooling)		
SITE 6C		
	No mitigation	Mitigation
Extent	Local	Local
Magnitude	Medium	Low
Duration	Long term	Long term
SIGNIFICANCE	Medium (-)	Low (-)
Probability	Definite	Definite
Confidence	Certain	Certain
Reversibility	Reversible	Reversible

Table 7-45: Impact – Noise climate (ancillary infrastructure)

Impact of ancillary infrastructure on the noise climate		
Ash 3		
	No mitigation	Mitigation
Extent	Local	Local
Magnitude	Low	Low
Duration	Permanent	Permanent
SIGNIFICANCE	Low (-)	Low (-)
Probability	Definite	Definite
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

Mitigation measures

Potential noise mitigation measures for the pre-construction, construction and the operational phases of the project were assessed. The following noise mitigation measures, which will need to be considered where appropriate, are indicators of what needs to be done to reduce or control the noise generated during the operation phase at the power station:

- The design of all major plant for the power station is to incorporate all the necessary acoustic design aspects required in order that the overall generated noise level from the new installation does not exceed a maximum equivalent continuous day/night rating level (L_{Rdn}), namely a noise level of 70dBA (just inside the property projection plane, namely the property boundary of the power station) as specified for industrial districts in SANS 10103. Notwithstanding this provision, the design is also to take into account the maximum allowable equivalent continuous day and night rating levels of the potentially impacted sites outside the power station property. Where the noise level at such an external site is presently lower than the maximum allowed, the maximum shall not be exceeded. Where the noise level at the external site is presently at or exceeds the maximum, the existing level shall not be increased by more than indicated as acceptable in SANS 10103.

- The latest technology incorporating maximum noise mitigation measures for components of the complex should be designed into the system. When ordering plant and machinery, manufacturers should be requested to provide details of the sound power level (SPL).
- Where possible, those with the lowest SPL (most quiet) should be selected.
- The design process is to consider, inter alia, the following aspects:
  - The position and orientation of buildings on the site.
  - The design of the buildings to minimise the transmission of noise from the inside to the outdoors.
  - The insulation of particularly noisy plant and equipment.
  - The cooling fans of the condenser units are the noisiest element at the power station. These need to be carefully designed to reduce the sound power levels as much as possible. The positioning of these fans and shielding (housing design) needs to be carefully considered.
  - All plant, equipment and vehicles are to be kept in good repair.
  - Where possible, very noisy activities should not take place at night (between the hours of 20h00 to 06h00).

It should be noted that any mitigation measures taken at the development sites will limit the impacts in the specific areas designed for, but will not necessarily contribute to improving the degraded noise climates in adjacent areas where there is already a problem.

7.9.4. Comment on Cumulative Impacts

The cumulative effects of noise sources in close proximity to each other are calculated on a logarithmic scale. The greater the difference in the noise levels, the less the cumulative effects will be. If the difference in the levels of two noise sources is approximately 10dBA, the louder of the two sources (the prevailing noise) will only be increased by 0.4dBA. If the two noise sources are approximately at the same level, the cumulative increase will be only 3dBA (not perceptible by most humans).

Inspection of the noise profiles of the traffic, the existing mining operations in the area and those of the planned power station and its ancillary works, indicate that the cumulative effects of the power station project are unlikely to increase the residual noise climate by more than 3dBA, except within a short range (within 2 000 metres) of the power station itself.

7.10. IMPACT ON HERITAGE RESOURCES

7.10.1. Impact Statement

The establishment of the proposed power station may result in the destruction or damage of archaeological or cultural (heritage) material located on the chosen sites.

7.10.2. Discussion

A phase 1 archaeological survey was undertaken by JP Cilliers of Kudzala of Kudzala Antiquity), in accordance with the requirements of the National Heritage Resources Act (No. 25 of 1999) in order to identify and evaluate possible archaeological, cultural and historic sites within the proposed development areas, and to recommend appropriate mitigation measures. The methodology included a literature review, review of existing databases, a field survey and a documentation of sites, objects and structures according to the general minimum standards accepted by the archaeological profession. The full report is contained in **VOLUME 2**.

Heritage resources manifest in a wide variety of forms, ranging from stone tools found as surface scatters, to sites containing structures such as buildings, cemeteries and places to which cultural significance is attached. Heritage resources identified included a total of six sites, (see Figure 7-26: for locations of heritage resources identified):

Yellow border: Proposed impacted area

Red border: Surveyed area

Figure 7-26: Identified heritage resources sites

The methodological approach for this study meets the requirements of relevant heritage legislation. The investigation of the identified area where the proposed activity is to take place consisted of foot (physical) survey, a desktop archival study as well as a study of the results of previous archaeological work in the area. A detailed archival study was conducted in an effort to establish the age of the property and whether structures, graves or features of historical value exist on the property.

Six sites were documented which have characteristics of previous human settlement or activity. None of these are however considered to be of archaeological (historical) value excepting site WK1 which is a historical graveyard containing 147 marked and unmarked graves which are historically ansd socially significant. All the documented sites are located on small portions of the farms Klippan 332 JS and Groenfontein 331 JS.

Site WK 1 is a formal graveyard with approximately 147 marked and unmarked graves. This site is considered to be of **high** significance. Sites WK 2 – WK 6 are regarded as being of **low** significance primarily because they are not regarded as being of archaeological or historic significance, they were observed however, and assessed.

7.10.3. Description of Significance rating of potential impacts

a) Site WK 1.

Location: See Figure 7-26

Description

This is the location of a formal graveyard which contains approximately 147 graves (Photo 3, Figure 7-27). Most of the graves are marked (have tombstones with inscriptions) but there are also unmarked graves present. The oldest marked grave is that of a 14 year old “Msiza’ who was buried here in 1948 (Phot 5, Figure 7-27). Most of the graves are of people who were buried here in the 1960’s. The most represented families in the graveyard include, amongst others, Tsoba, Shoba and Mahlangu (See photos in Figure 7-27).

Photo 1

Photo 2

Photo 3

Photo 4

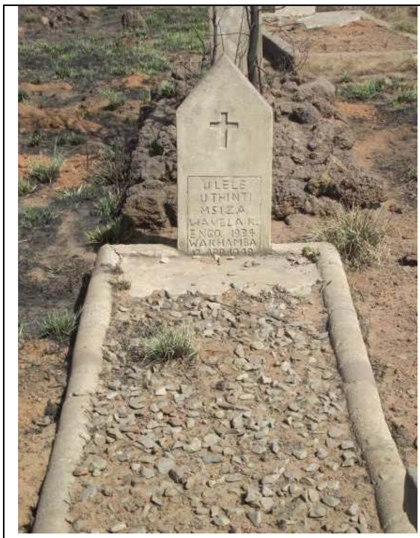


Photo 5

Figure 7-27: Photographs of individual gravesites

It is envisaged that the site will probably be impacted upon by development activity.

Mitigation

It is recommended that the site not be disturbed by any future development activities. It is also recommended that the graves be fenced off and relatives be allowed access to the graves. If this is not possible, a process of social consultation should be followed with the families or relatives of the deceased to discuss further options. This is in accordance to section 36 of the National Heritage Resources Act (25 of 1999) and the National Environmental Management Act (Act 107 of 1998).

Site WK 2

Location: See Figure 7-26

Description

This is a site where scattered remains and the foundation remains on the soil surface indicate the probable presence of a dwelling (Figure 7-28). It is located some 300 metres south of the graveyard (Site WK 1) and is possibly linked to the graveyard. The dwelling is estimated to have occupied an area of approximately 10x15m. Objects found on the surface include the remains of an old iron folding chair, shoes and other iron objects such as tins, drums etc.

Figure 7-28: Photograph with arrows inicating probable location of a dwelling of some sort

It is envisaged that the site will probably be impacted upon by development activity.

Mitigation

None recommended.

Site WK 3

Location: See Figure 7-26

Description

The location of another ruined dwelling. Very small surface scatter of iron material.

Impact of the proposed development/ activity

It is envisaged that the site will probably be impacted upon by development activity.

Mitigation

None recommended.

Site WK 4.

Location: See Figure 7-26

Description

This is the location of a number of old concrete structures. Many of which may have served as floors of previous buildings. There are also stretches of tarmac road and other remains which suggest that this used to serve as a recreational area.

Impact of the proposed development/ activity
It is envisaged that the site will probably not be impacted upon by development activity as the site is not located within the envisaged impact area.

Mitigation
None recommended.

Site WK 5

Location: See Figure 7-26
Description
Small retaining wall, associated with Site WK 4.

Impact of the proposed development/ activity
It is envisaged that the site will probably not be impacted upon by development activity as the site is not located within the envisaged impact area.

Mitigation
None recommended.

Site WK 6

Location: See Figure 7-26
Description
This is the location of a building. It was probably erected in the late 20th century.

Impact of the proposed development/ activity
It is envisaged that the site will probably not be impacted upon by development activity as it is not located within the envisaged impact area.

Mitigation

None recommended.

The results of the impact assessment are contained in Table 7-46 - Table 7-47.

Table 7-46: Impact – Heritage reqources (WK1)

Impact of the proposed power station and associated infrastructure on heritage resources Site WK1		
SITE 6C (WK1)		
	No mitigation	Mitigation
Extent	Site	Site
Magnitude	High	Low
Duration	Permanent	Permanent
SIGNIFICANCE	High (-)	Low (-)
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Irreversible	Irreversible

Table 7-47: Impact – Heritage resources (WK2-6)

Impact of two proposed power station and associated infrastructure on heritage resources sites WK2 - 6		
SITES Site 6C (WK2 – 6)		
	No mitigation	Mitigation
Extent	Site	Site
Magnitude	Low	Low
Duration	Permanent	Permanent
SIGNIFICANCE	Low (-)	Low (-)
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Irreversible	Irreversible

7.10.4. Comment on cumulative impacts

Provided that the identified graveyard is securely protected no cumulative impacts are anticipated as a result of the long-terfm protection which will be afforded to the site.

7.11. IMPACT ON TRAFFIC

7.11.1. Impact Statement

The operation of the proposed power station may result in a large increase in vehicular traffic on the roads in the area. Additional to this the operation of the Ash Dump will also increase vehicular movement and traffic between both the power station and ash dump site. An increase in traffic may result in increased maintenance requirements or road upgrades being required and temporary inconveniences may be experienced during the proposed Tweefontein road realignment.

7.11.2. Discussion

A Traffic Impact Assessment was undertaken by ENDECON UBUNTU (Pty) Ltd in order to identify and evaluate possible impacts on existing roads and propose measures to mitigate any potential impacts.

The purpose of this study was to discuss existing traffic flow phenomena (without development) and highlight possible predicaments that might be encountered after development completion.

The existing intersection operational conditions are determined with the ***aaSIDRA*** and ***TRAFFIX*** for Windows Ver. 8.0 software packages.

The traffic impact was assessed by reviewing the nature and extent of the proposed development (e.g. workforce, transport of construction materials, road deviation etc) and the associated traffic and transport. Literature was reviewed and traffic counts were conducted at strategic points. Traffic was then modelled and the baseline traffic and the traffic peaks for various scenarios were investigated. The full Traffic Impact Assessment is contained in **VOLUME3** of this EIR.

7.11.3. Description and significance of potential impact

It is currently anticipated that discarded coal will be transported by conveyor from the Klippan dump (mainly due to its close proximity) to the new IPP site. The importation of coal to the IPP will therefore have no direct impact on road traffic. The possible scenario in case of an emergency with a mall functioning conveyor is however taken into account and analysed as a possible scenario.

It is anticipated that 3265 kilo tonnes per annum (Mott MacDonald) of coal will be transported towards the IPP (372 tonnes per hour). The latter equates to approximately 19 twenty tonne trucks per hour (both directions).

Apart from the above, limestone will need to be imported to the power plant in order to reduce the sulphur content of the coal discard. The worst case volume (450 MW power plant for unwashed coal) is that approximately 51 tons of limestone needs to be imported per hour.

The above equates to approximately 3, 20-tonne trucks per hour to and from the power plant.

The anticipated trip generation for the operational phase, which includes FTE (Full Time Employees) as well as construction phase (based on the information received) is depicted in Table 7-48 below.

Table 7-48: Peak hour trip generation (opperational phase)

Activity	Unit	Area/units	Rate	Total Trips (in & out)	Directional Split (peak hour)	
FTE Workers (Managers)	No	20	1	24	20	4
FTE Workers (workers)	No	120	10/mini bus	24	12	12
Lime imports (51t/h)				6	3	3
Total				54	36	18

Having conceptualised the discussions and the results of the analysis as contained in the previous sections, it was found that the following two intersections needs to be upgraded in order to accommodate the existing (in the case of the Watermeyer Street intersection) traffic volumes and the anticipated future traffic volumes:

- Watermeyer Street / Road D 2257 intersection;
- Road D 2257 / Road D 2769 (IPP Access intersection).

Intersection upgrading is discussed below as bulleted above WATERMEYER STREET / ROAD D 2257 INTERSECTION.

This intersection currently is a four way stop controlled intersection with dual lanes in the east-west bound directions (refer Figure 7-29 below) through the intersection which terminate to single lanes, single carriageway at both sides of the intersection. This intersection is currently (without the addition of any development trips) operating at an unacceptable level of service during both the morning as well as afternoon peak traffic periods with heavy delays currently being experienced by road users.

It is consequently advised that:

- This intersection be investigated for the possibility of signalisation (the intersection is located at a gradient which may or may not be too steep for signalisation);
- The double lane in the westbound direction terminates to a single lane at a distance of approximately 280m from the intersection only to become double lanes once again approximately 420m from this point. It is consequently advised that the existing dual carriageway road to the west of Watermeyer / Road D 2257 intersection be extended up to the latter intersection in both the east and westbound directions;
- The desirability to relocate the existing Watermeyer / Road D 2257 intersection approximately 1km towards the west (better gradients for signalisation and dual carriage way road) be further investigated and considered by the authorities from a capacity as well as safety point of view. ROAD D 2257 / ROAD D 2769 (IPP Access intersection).

The IPP Access intersection was analysed as a normal two way stop controlled intersection. Although the latter type of intersection control is expected to operate initially at acceptable levels of service, the level of service is expecting normal background traffic growth on Road D 2257. It is consequently advised that the access intersection be a four way stop controlled intersection for a period of approximately 5 years where after the signalisation or upgrading to a possible roundabout can be evaluated.

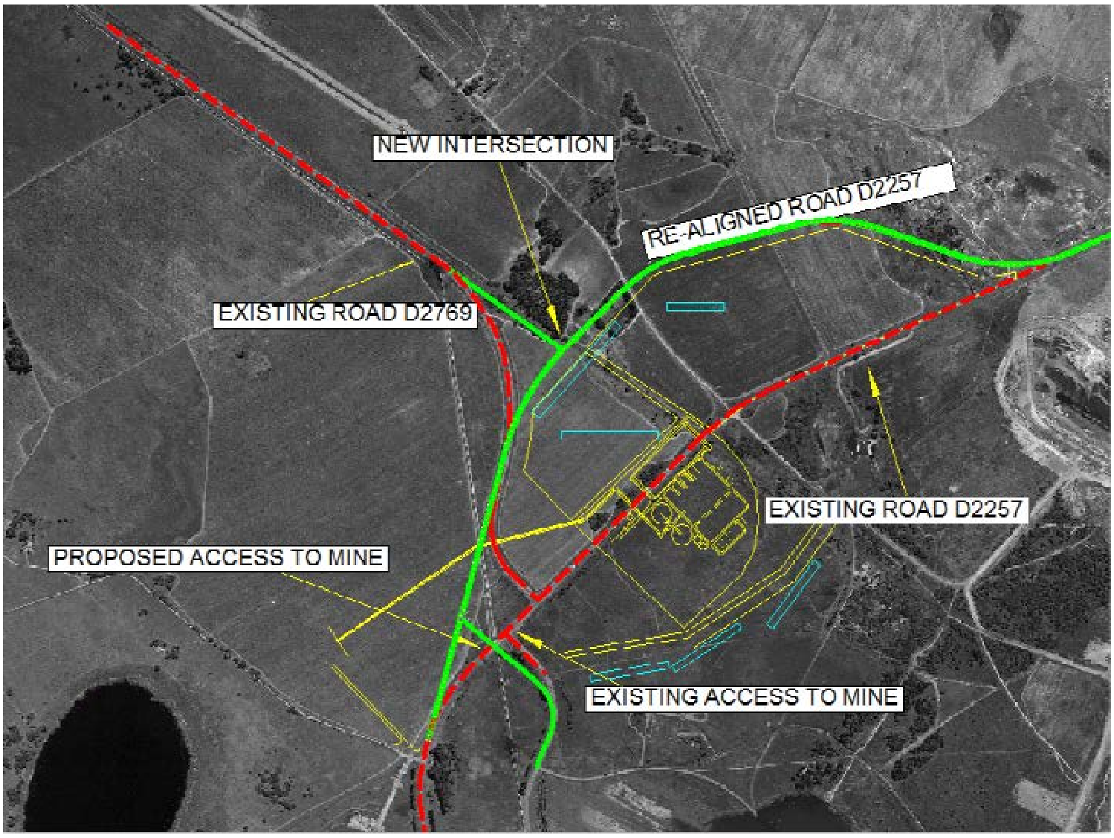


Figure 7-29: Proposed road re-alignment

It is advised that a public transport facility be provided on the outside of the IPP plant security access gate with a well designed drop of and pick up zone. Passengers must be off-loaded to an elevated pedestrian walk-way from where workers can walk in a safe manor towards the security check-in turnstiles at the access gate. The facility must be so designed as to avoid pedestrian –vehicle conflict.

Considering the above, a safe turn-lane must therefore be provided for mini bus taxis as well busses to turn without the need to pass through the access security gates.

Further to all of the above, it is advised that the transport facility be designed to accommodate at least 20 midi bus taxis and two busses at any given point in time with space available for possible future expansion should the IPP wish to expand its operations in future.

Having studied all of the content as included in this report, is concluded that:

- The intersection of Watermeyer Street / Road D2257 is currently operating at an unacceptable level of service during both the am and pm peak periods.

- This intersection should preferably be upgraded as soon as possible by the relevant roads authorities;
- The IPP is expected to generate approximately 54 peak hour trips during the normal operational phase;
- The trip distribution is expected to be in accordance with Figure 7-30, Section 5 of the Traffic Impact Asessment report (**VOLLUME 3**);
- Only the intersection of Watermeyer Street / Road D 2257 is expected to be under pressure after development completion (normal operational phase with existing background traffic volumes scenario);
- The IPP access intersection with Road D 2257 is expected to be operating at an un acceptable level of service during the construction phase of the IPP. Interim traffic control measures will have to be in place (like points men, flag men) during the entire duration of the construction period;
- The intersection of Road D 2257 / D 2769 (IPP Access intersection) is expected to become under pressure within 5 years (prior to 2016) and should this intersection therefore be upgraded in order to be able to accommodate the development traffic with traffic background growth;
- Given an access boom service ratio of approximately 350 vehicles per hour per direction, it was calculated that two access control booms (one for private vehicles and one for the rest) at the access security gate will have sufficient capacity to accommodate the am and pm peak demand. The following was deduced from the analysis:
    - There is a probability of 83% of an empty system;
    - There is a probability of 13% that at least one vehicle will be waiting at the boom when the second vehicle arrives;
    - There is a probability of 2% that two vehicles will be waiting at the boom when the third vehicle arrives; o A Stacking distance of at least 30m must be available between the boom and the Road D 2257 / D 2769 intersection (based on the boom capacity – queuing at the intersection also needs to be considered);
    - The average time spent in the system is calculated as 12.41s (delay) which construes a level of service B operational condition.

o

Mitigation

Based on the conclusions made above, the following are recommended:

- That the development be supported from a traffic engineering point of view;
- With respect to the existing Watermeyer Street / Road D 2257 intersection, it is advised that:
    - o this intersection be investigated for the possibility of signalisation (the intersection is located at a gradient which may or may not be too steep for signalisation);
    - o The double lane in the westbound direction terminates to a single lane at a distance of approximately 280m from the intersection only to become double lanes once again approximately 420m from this point. It is consequently advised that the existing dual carriageway road to the west of Watermeyer / Road D 2257 intersection be extended up to the latter intersection in both the east and westbound directions;
    - o The desirability to relocate the existing Watermeyer / Road D 2257 intersection approximately 1km towards the west (better gradients for signalisation and dual carriage way road) be further investigated and considered by the authorities from a capacity as well as safety point of view.
- The IPP access intersection be upgraded to a four way stop controlled intersection for a period of approximately 5 years where after the signalisation or upgrading to a possible roundabout be investigated at that point in time. It is further proposed that the IPP access intersection be designed in accordance with Figure 7-30 as depicted in section 8 of this Traffic Impact Report (**VOLUME 3**);
- That stacking distance of at least 50m be available between the proposed new Road D 2257 / Road D 2769 intersection;
- That it be realised that the proposed security operational procedure to be implemented will to a large extend influence the traffic flow and queuing at the access booms. It is consequently advised that the security and access control system be strategised in consultation with a traffic engineer;
- That a public transport facility be provided on the outside of the IPP plant security access gate with a well designed drop off and pick up zone. Passengers must be offloaded to an elevated pedestrian walk-way from where workers can walk in a safe manor towards the security check-in turnstiles at the access gate. The facility must be so designed as to avoid pedestrian – vehicle conflict.

- That the above mentioned transport facility be designed to accommodate at least 20 midi bus taxis and two busses at any given point in time with space available for possible future expansion;
- That Road D 2257 be re-aligned in concurrence with Figure 7-29 as depicted in section 11 of this report.

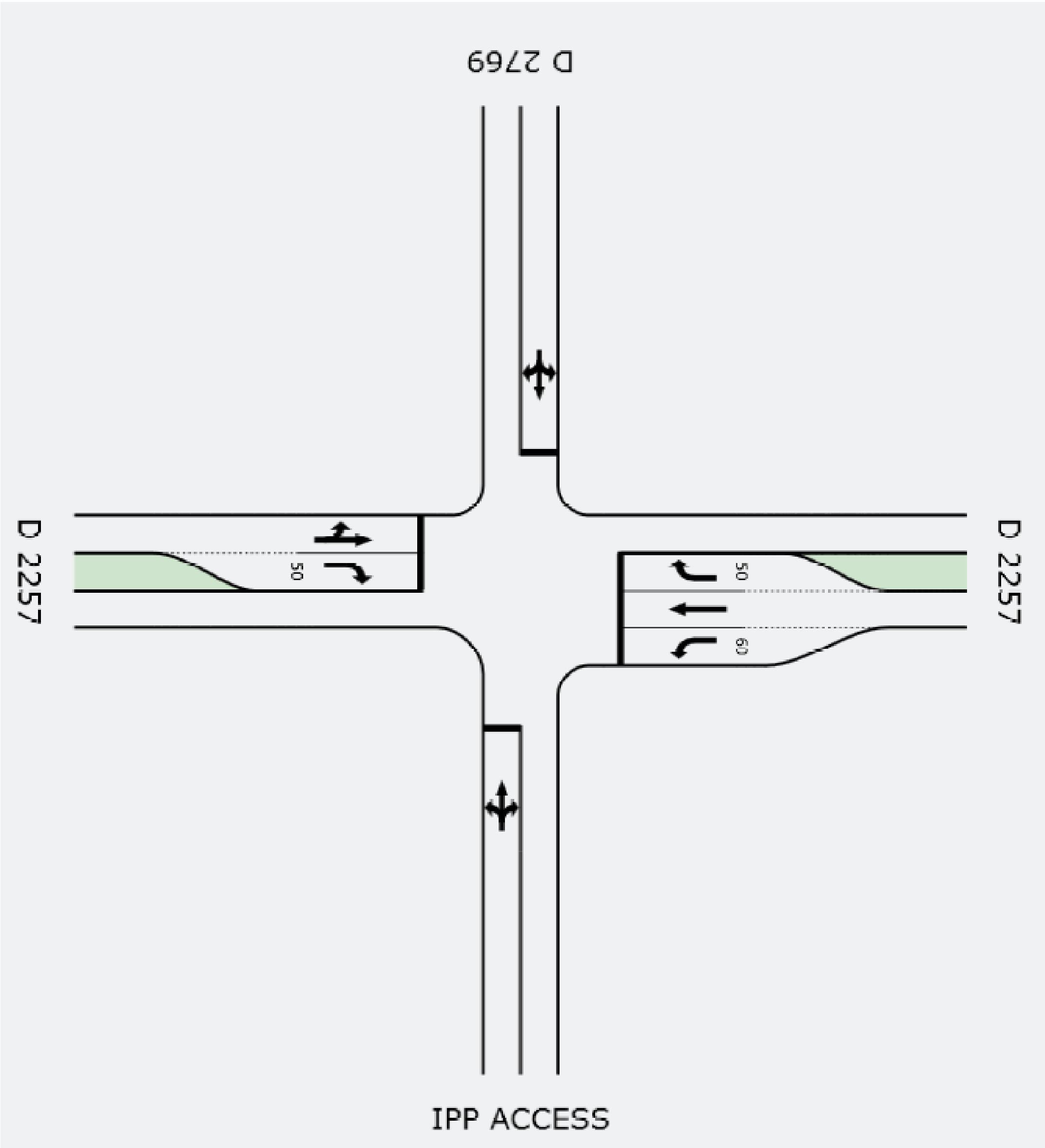


Figure 7-30: Access intersection geometry

The results of the impact assessment are contained in Table 7-49 - Table 7-50.

Table 7-49: Impact –Traffic (Site 6C)

Impact of the proposed power station and associated infrastructure on traffic		
SITE 6C		
	No mitigation	Mitigation
Extent	Local	Local
Magnitude	Medium	Low
Duration	Long term	Long term
SIGNIFICANCE	Medium (-)	Low (-)
Probability	Definite	Definite
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

Table 7-50: Impact – Traffic (Ash site)

Impact of two proposed ash disposal site and associated infrastructure on traffic		
Ash 3		
	No mitigation	Mitigation
Extent	Local	Local
Magnitude	Medium	Low
Duration	Long term	Long term
SIGNIFICANCE	Medium (-)	Low (-)
Probability	Definite	Definite
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

7.11.4. Comment on cumulative impacts

Other developments such as housing developments would increase traffic using DR1675. This may result in a decrease in levels of service of various junctions along the road. However, these are likely to be easily mitigated with traffic signals, as well as making a public transport system (e.g. buses and taxi's) viable. If this is not done, the additional traffic could take up the spare capacity of the junction control such as traffic signals, leading to delays which could result in the requirement for additional lanes at junctions in order to provide additional capacity.

7.12. IMPACT ON SOCIAL ENVIRONMENT

7.12.1. Impact Statement

The proposed power station will have intended and unintended social consequences, both positive and negative, and this may result in impacts on the net welfare of local communities and on economic development in the area. As such a Social Impact Assessment was undertaken by Ptersa Environmental Management Consultants to identify and assess the potential impacts on the people living in the area. The full Social Impact Assessment is included as **VOLUME 3** of this ESIAR.

7.12.2. Discussion

A social impact can be regarded as something that is experienced or felt by people and can be positive or negative in nature. Social impacts can be experienced in a physical or perceptual sense. Therefore, two types of social impacts can be distinguished:

- **Objective** social impacts – i.e. impacts that can be quantified and verified by independent observers in the local context, such as changes in employment patterns, in standard of living or in health and safety.
- **Subjective** social impacts – i.e. impacts that occur "in the heads" or emotions of people, such as negative public attitudes, psychological stress or reduced quality of life.

The methodology employed during the Social Impact Assessment included a literature review, public participation including personal and group interviews and reviewed information from public meetings. The study identified a number of stakeholder groups which may be affected through the proposed development. The following diagram represents the different groups of stakeholders most likely to be affected. In the paragraphs below a brief description of each of these groups will follow.

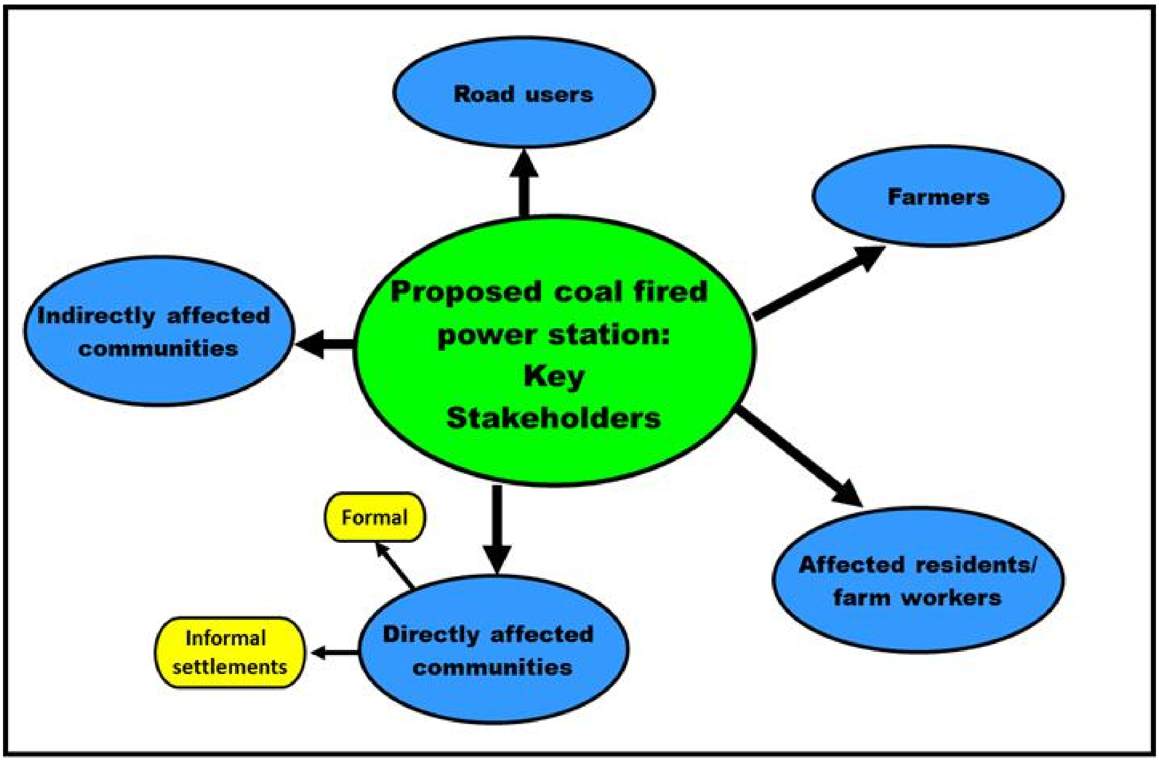


Figure 7-31: Stakeholder groups

a) Farmers

All the land in question belongs to Anglo American; however, some of the farmers have lived in the area for generations, and continue their farming practices on the same land, which they now lease from Anglo American. High quality agriculture land is scarce, and although there are a number of industries in the area, the land is still productive enough to farm commercially, albeit on a smaller scale than before.

Affected residents/farm workers

This group of stakeholders refers to the two (2) families who reside near the proposed site and need to be relocated (Figure 7-32). According to these residents, some of them used to work on the surrounding farms, but when the farms were sold, the mines gave them land. These families do not farm actively, but some subsistence farming activities take place. There are no services such as water, electricity and sewage; they rely on borehole water, candles/firewood/paraffin and pit latrines. Given the high levels of vulnerability in this group, their interests should be protected and they should be assisted to participate in a meaningful manner, as it is unlikely that they will be able to do so unassisted.

Figure 7-32: Residents close to the site

Directly affected communities

The directly affected communities can be divided into formal communities and informal settlements. Duvha Park, Duvha Park Extension, Tasbet Park and Dixon Holdings are the nearest **formal** communities. Many of the residents are familiar with the operation of power stations or mines, given that these industries are the biggest employer in the area, and expressed the opinion that even when all management processes are in place there are still negative effects. The fact that the proposed power station will be independently run did install a little more confidence in the communities.

There are a number of **informal settlements** surrounding the formal communities. The one that will potentially be most affected by the proposed project is a relatively new settlement opposite the El Paso shopping complex. The residents in the informal settlement are optimistic about the employment opportunities presented by the proposed project, but this can also be said of the residents of the formal areas. From a social perspective, this community is also vulnerable to an impact on the social structures as a result of an influx of people in the area, as this is most likely the area where many jobseekers may end up if they are unsuccessful.

Indirectly affected communities

The residents of the broader Emalahleni area will be impacted on in an indirect manner. This relates to cumulative impacts on air quality as well as nuisances like traffic and road closures. The presence of a construction force may add to some of the general impacts to a lesser extent.

Road users

The Tweefontein road will have to be realigned (repositioned) and this will have an impact on all road users – from people travelling to work to industries transporting materials such as coal. The road users will therefore experience temporary nuisance impacts.

7.12.3. Description and Significance of Potential Impact

The fear and uncertainty of the unknowns associated with the project is identified as one of the most severe social impacts. It must be re-iterated that the management of social impacts is more important than the predicting and listing of impacts because if managed properly, the changes may not create impacts. Many of the social impacts that will be experienced as a result of the proposed project are generic, and will take place regardless of which final designs and specifications are chosen. Some social impacts are specific to certain stakeholder groups.

An attempt has been made to simplify the impact assessment and to focus on aspects that can aid the decision-making process. For the purpose of this assessment, social change processes that can potentially cause social impacts have been identified. In order to adequately contextualise the potential social impacts, it is important to understand what a social change process is. A social change process is a discreet, observable and describable process that changes the characteristics of a society, taking place regardless of the societal context (that is, independent of specific groups, religions etc.) and can be measured objectively. The way in which social change processes is perceived, given meaning or valued, depends on the social context in which various societal groups act. Some groups in society are able to adapt quickly and exploit the opportunities of a new situation. Others (e.g. vulnerable groups) are less able to adapt and will bear most of the negative consequences of change.

These social change processes may, in certain circumstances and depending on the context, lead to the experience of social impacts. Social impacts are therefore completely context-dependent (Vanclay, 2003).

A stakeholder analysis was conducted, and the potential impacts on each stakeholder group were investigated. The following table represents the social change processes that have been identified and the possible social impacts that may result because of these processes. It also identifies the stakeholder group that is most likely to be affected by the process.

Table 7-51: Social change process leading to Impacts

Social Change Process	Possible Social Impact	Affected stakeholder group
In-migration	Increased pressure on local services & infrastructure Increased incidence of STD's, HIV & AIDS Social nuisance e.g. prostitution, damage to property, discrepancy in income of workers	Directly affected communities Indirectly affected communities Farmers
Resettlement	Economic impact Uncertainty about future Loss of social structures	Affected residents/farm workers
Change in land use	Decreased access to sources of livelihood resulting in poverty and/or drop in standard of living Loss of productive land leading to loss of profit leading to job losses Environmental nuisance e.g. noise, dust Cumulative impacts on health, Property prices & Traffic	Farmers Affected residents/farm workers Directly affected communities Indirectly affected communities Road users
Deviant social behaviour	Increase in crime and disorder Breakdown of traditional values	Directly affected communities Farmers
Economic activities	Opportunity for local low skill employment Direct employment opportunities	Directly affected communities

Social Change Process	Possible Social Impact	Affected stakeholder group
In-migration	Increased pressure on local services & infrastructure Increased incidence of STD's, HIV & AIDS Social nuisance e.g. prostitution, damage to property, discrepancy in income of workers	Directly affected communities Indirectly affected communities Farmers
	Indirect employment opportunities	Indirectly affected communities

a) Social change 1: In-migration

In-migration is a demographic process that relates to the movement and composition of people in the study area. The most significant impact relating to In-migration will occur during the construction phase of the proposed project due to the high demand for labour during this period. Therefore, this impact is discussed in more detail in Chpter 8.

It is estimated that the operation phase of the power station will employ approximately 120 people and the contracting strategy will be developed closer to the start of construction, and will be influenced by project time lines, costs, resource availability at the estimated time of construction. During the operational phase there will probably not be significant in-migration into the area, but the residual impact may remain. During the decommissioning phase of the project there may be a migration out of the area, but it is impossible to predict the possible social impacts associated with decommissioning at this stage, given the magnitude of social change that will occur between now and when this phase start. A new SIA should be conducted for the decommissioning of the plant at the time.

Social change 2: Resettlement

Resettlement refers to a co-opted or coerced process by which local people surrender land for a project and are relocated elsewhere as part of the relocation package. At this stage it seems as if two communities will need to be relocated for the purpose of the deviation and construction of the road. Again, this impact is applicable during the construction phase and is discussed in Chapter 8.

Social change 3: Change in land use

Change in land use is a geographic process that affects the land use patterns of society. The changes in land use that are relevant to this project are the change from agricultural/mining land to a power station. The potential environmental impacts may cause a number of second- or higher-order social impacts. Figure 7-33 shows the current land uses.

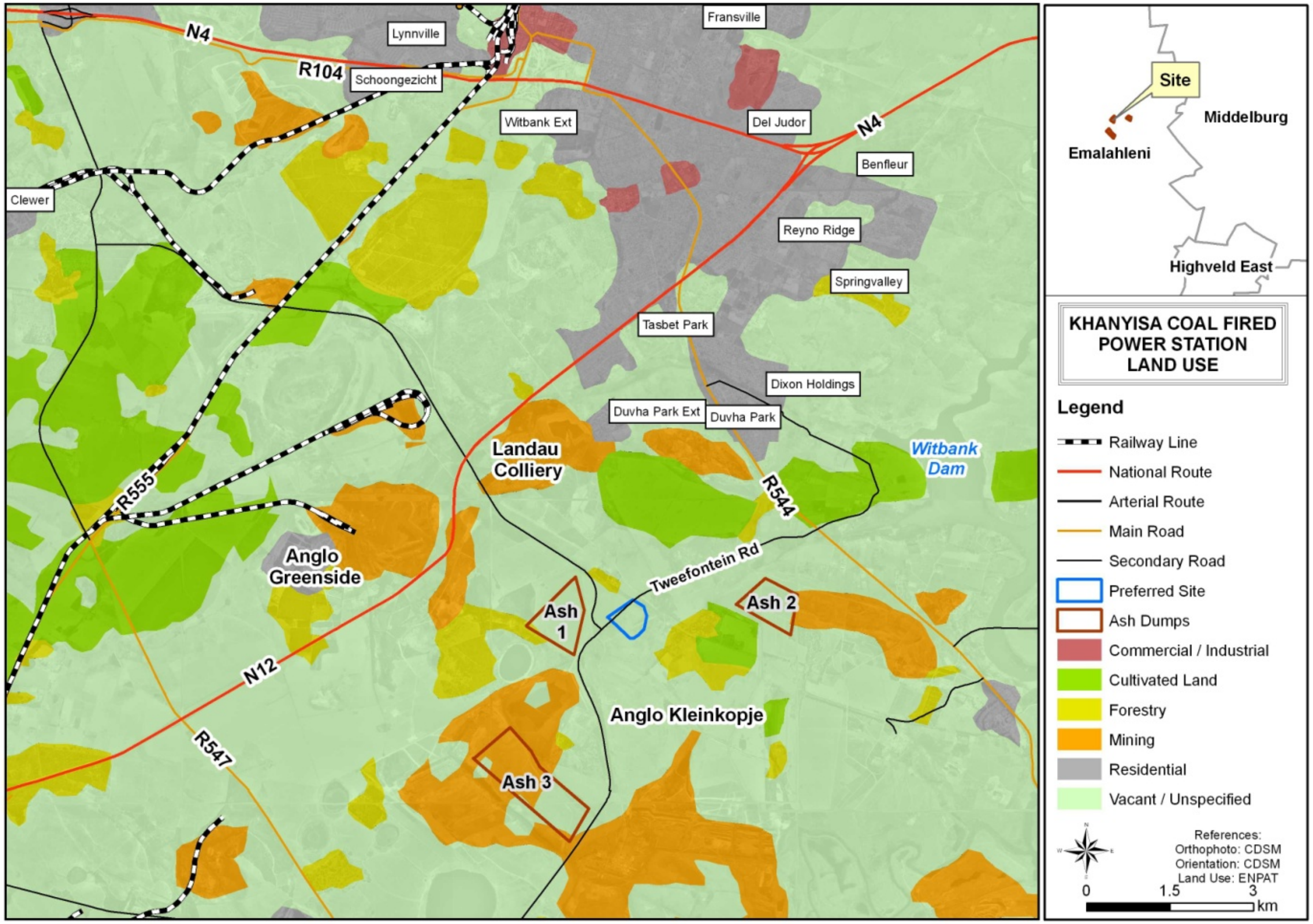


Figure 7-33: Current land uses

Although the investigations predict that the dust impact will be more significant during the construction phase, dust will remain an impact during the operational phase as well. However, due to the extensive mining operations within the project area this impact is already a problem and one of the biggest frustrations mentioned during the consultation process. Residents report that their houses, gardens and swimming pools are affected. There is a concern that the existing fugitive dust and ash impacts will increase as a result of the proposed project.

The roads in the area are already very busy. During the construction phase and while the road deviation is taking place there may be nuisances such as traffic congestion. During the operation phase the impact will be smaller than during the construction phase, but it will remain since there will be an increase in the amount of trucks transporting coal. This impact is identified from a social nuisance perspective, and other traffic impacts are dealt with in the traffic impact assessment.

Mitigations

Environmental nuisances that occur during construction will be temporary. Given the fact that there are existing impacts from industries in the area, many of the nuisances will be cumulative. Impacts related to dust already take place and the operation of the plant will add to these impacts. The nuisance effects of dust can be subjective and are difficult to measure in any quantitative or objective way. They are also very dependent on the sensitivity of the receiving environment. As a result, the effects cannot be controlled or managed easily through the use of air quality guidelines, which is the approach taken with most other air contaminants.

Best practice industry guidelines should be followed to address the dust problem, but it must be acknowledged that this is a cumulative impact and should therefore be addressed by all the industries in the area that contribute to the problem, therefore the IPP alone will not be able to address this impact in isolation. The IPP can approach other industries and work together to compile a dust suppression strategy for the area. The IPP must have a complaints procedure in place to deal with specific complaints. Where possible dust suppression mitigations proposed within the EMP must be adopted.

Table 7-52: Impact – Loss of productive land

Impact of the proposed power station and associated infrastructure – Loss of productive land		
SITE 6C & Ash 3		
	No mitigation	Mitigation
Extent	Local	Local
Magnitude	Medium	Low
Duration	Permanent	Long
SIGNIFICANCE	Medium (-)	Low (-)
Probability	Definite	Definite
Confidence	Certain	Certain
Reversibility	Irreversible	Reversible

Table 7-53: Impact – Property prices

Impact of the proposed power station and associated infrastructure – Property prices		
SITE 6C & Ash 3		
	No mitigation	Mitigation
Extent	Local	Local
Magnitude	Medium	Medium
Duration	Medium	Medium
SIGNIFICANCE	Medium (-)	Low (-)
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Irreversible	Irreversible

Table 7-54: Impact - Traffic

Impact of the proposed power station and associated infrastructure – Traffic		
SITE 6C & Ash 3		
	No mitigation	Mitigation
Extent	Local	Local
Magnitude	High	Medium
Duration	Long	Long
SIGNIFICANCE	Medium (-)	Low (-)
Probability	Definite	Definite
Confidence	Certain	Sure
Reversibility	Reversible	Reversible

7.12.4. Comment on cumulative impacts

The proposed power station will be situated in an industrial area where there are already mines, power stations and other industries. Many of the impacts associated with a change in land use are already experienced in the area, and the new plant will add to the existing impacts. This is true about health, dust and other nuisance impacts. There are already heavy vehicles travelling on a daily basis, and the construction activities will add to these impacts creating a bigger nuisance for local residents.

a) Social Change 4: Economic activities

As already highlighted in social change process 1 (In-migration), the operational phase of the proposed power station is expected to provide permanent employment for 120 people. There are high levels of unemployment in the area and a large number of the population are semi- or illiterate and have limited skills. Issues surrounding employment can have positive or negative social impacts in the study area. Construction will be done by specialist contractors that will bring in a number of their own staff given the specialist nature of the work. Opportunities for local labour will therefore be limited to work that does not require specialised skills. It must be acknowledged that there is some skilled labour available in the area due to similar projects that have been implemented in the past. The work opportunities during the construction period will be short term. Another issue to consider is that the recruitment protocol that will be followed is not know at this stage, since the IPP have not been appointed yet.

Potential impacts

The first potential impact is the potential 'skills drain' by the loss of workers within other industries to the power station construction team. This risk increases with semi-skilled and skilled workers. It is beneficial to the contractor to employ local people, because it reduces the risk of having to provide housing for the labour contingent.

In areas with high unemployment rates there are enough unemployed people that need to benefit from employment, and the focus of recruiting should be on these individuals.

The construction process will create a number of opportunities for low skilled people. The focus should be on local people who are not employed elsewhere. There is a risk that women will not be given equal opportunities to men because of the perception that they cannot do manual labour. This will have a negative impact on the number of opportunities for women unless managed properly.

If local people, including women, are employed, this will have a very positive short-term impact, and if there is sufficient transfer of skills the positive impact can be extended.

Another positive impact is the indirect employment opportunities that will be created. These opportunities will be experienced in the industries that provide services to the construction team such as transport, hospitality and equipment rental etc. These opportunities can also be extended to local entrepreneurs such as women's groups that provide a laundry service or sell meals.

Mitigation

Local unemployed people must be given preference in the recruitment process. Contractors must refrain from employing people who are currently employed in permanent positions. There must be employment desks in the towns or settlement areas. No recruitment may take place in the construction camps. A standard recruitment policy must be implemented across the project area, especially if more than one contracting firm is used. The local recruitment process must be agreed with local leadership. This process must then be advertised in an accessible way – radio advertisements, community meetings and press releases in local languages. No false expectations must be created and it must be underlined that the employment opportunities are specifically for the unemployed. A percentage of the workforce must be female.

Indirect employment/entrepreneurship opportunities must be enhanced. The IPP and the contractor must support local entrepreneurs as far as possible. It must be acknowledged that there will be local entrepreneurs trying to sell their goods to the construction force. Unless managed carefully this may lead to squatter camps near the construction camps. The contractor should provide a designated area where such services can be provided – the area should ideally form part of the construction camp and be cleared and fenced. No open fires must be allowed. Food should rather be prepared off-site and transported in, or people can be encouraged to sell food parcels. The vendors must also travel in and out of the area and should not be allowed in the construction area outside the designated area. The social monitor must assist in managing this process.

Table 7-55: Impact – Economic Activities (+)

Impact of the proposed power station and associated infrastructure – Economic Activities		
SITE 6C & Ash 3		
	No mitigation	Mitigation
Extent	Local	Local
Magnitude	High	Medium
Duration	Short	Medium
SIGNIFICANCE	Medium (+)	High (+)
Probability	Probable	Probable
Confidence	Certain	Sure
Reversibility	Reversible	Reversible

Cumulative impacts on local entrepreneurs will be positive and assist in developing their businesses further.

7.13. ADMINISTRATIVE WASTE IMPACTS

7.13.1. Fabric Filter Bags

Description of Impact

Fabric filter bags are used in coal fired power stations to capture fly ash from the flue gas stream which constitutes approximately 90% of the ash produced by a boiler. According to the Mott MacDonald Technical Report it is not yet known whether fabric filter bags will be used or if electrostatic precipitators. However, in addressing all possible waste stream impacts, it is prudent to address fabric filter bags in the event that this option is chosen.

Mitigation

The scheduled replacement of filter bags at a coal fired power station forms an integral part of the power stations maintenance programme. In addition the replacement of damaged or old fabric filters as required reduces the power stations impact on the environment through reducing atmospheric emissions. With this in mind it is not appropriate to recommend the reduction in the use/replacement of fabric filters but rather to emphasise the need to handle and dispose of them in a responsible manner.

Since ash must be considered as hazardous (unless proven otherwise and de-listed by DWAF), the fabric filters used to capture this ash from the flue gas stream must also be considered hazardous. When filter bags are removed from the plant, they should be placed in a well-marked hazardous waste receptacle. Final disposal must be at a H:H or H:h disposal facility.

Table 7-56: Impacts of fabric filter bag disposal

Impact of fabric bag disposal		
SITE 6C and Ash 3		
	No mitigation	Mitigation
Extent	Regional	Regional
Magnitude	Low	Very Low
Duration	Long term	Long term
SIGNIFICANCE	Medium(-)	Low (-)
Probability	Probable	Probable
Confidence	Certain	Certain
Reversibility	Reversible	Irreversible

7.13.2. Fluorescent Tubes and CFL Disposal

Description of Impact

Fluorescent tubes and other lamps, commonly used in installations such as power stations, contain mercury which is both a corrosive and highly toxic HCS. Although these lamps are beneficial in that their energy requirements are lower and they last much longer than incandescent lamps, disposal of such lamps poses significant health and environmental risk. Common disposal methodologies used in SA include drum crushers of various designs before off-site final disposal. This kind of treatment however does not capture the mercury content.

Although not promulgated as legislation, a policy for safer handling of such lamps has been published by DWAF in the second edition of the *Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste.*

Mitigation

Fluorescent tubes and similar lamps should be handled with care by waste management staff. A designated collection point should be provided. Once suitable volumes have been accumulated, an appropriately trained employee should crush the lamps in a sealed drum (normally a 210lt drum is used) containing a 50% Sodium Sulphide – 50% Sulphur solution in a 1:10 (vol/vol) ratio which will fix the mercury.

An appropriate procedure should be written to govern and guide this process which includes training requirements for employees, record keeping, final disposal certification etc. A specialist contractor should be employed by KPS to remove the crushed lamps from the site for final disposal at a recognised H:H waste disposal site.

Table 7-57: Impact of lamp disposal

Impact of lamp disposal		
SITE 6C and Ash 3		
	No mitigation	Mitigation
Extent	Regional	Regional
Magnitude	High	Medium
Duration	Long term	Long term
SIGNIFICANCE	High(-)	Medium (-)
Probability	Definite	Definite
Confidence	Certain	Certain
Reversibility	Irreversible	Irreversible

7.13.3. Asbestos Disposal

Description of impact

Asbestos is a mineral fibre that occurs naturally and has been mined historically in Southern Africa for many years. It has great heat resistant properties and has therefore been used in many applications. The association of human exposure to asbestos fibres (normally through inhalation) and various types of cancer have however resulted in significant improvements in legislative control. Most asbestos exposure today is through maintenance or demolition of infrastructure (e.g. moth-balled power stations) containing asbestos.

Since the KPS is in a planning phase, it is not expected that any asbestos will be used in the design and construction. The Mot MacDonald Technical report support this supposition however some articles are still produced containing non-friable asbestos and since a possibility exists that they may be used at the power station, the environmental risk is addressed.

Mitigation

It is only envisaged that Class D asbestos containing waste (ACW) may be produced at KPS. This class includes non-friable ACW that is essentially in the same condition as when manufactured and is unlikely to release respirable fibres after being declared a waste product. These waste items, which include parts such as clutch plates, gaskets, brake pads etc, should be handled as ACW even though non-friability reduces the risk significantly.

Table 7-58: Impact of asbestos disposal

Impact of asbestos disposal		
SITE 6C and Ash 3		
	No mitigation	Mitigation
Extent	Regional	Regional
Magnitude	High	Low
Duration	Long term	Long term
SIGNIFICANCE	High(-)	Medium (-)
Probability	Definite	Definite
Confidence	Certain	Certain
Reversibility	Irreversible	Irreversible

7.13.4. Oil Contaminated Waste Disposal

Description of impact

A large percentage of hazardous waste disposed of from coal fire power stations and other industrial application in South Africa is oil contaminated waste. This type of waste includes rags used for cleaning up oil spills or during maintenance operations as well as oil filters and any other waste that may have come into contact with oil at some stage.

Mitigation

One of the imperatives when it comes to the separation and disposal of oil contaminated waste is to ensure that no other waste is disposed in the waste receptacle along with this waste.

This is because any other waste, possibly general waste, will also become oil contaminated and therefore cannot be separated out at a later stage. This practice then increases the volume of hazardous waste generated by KPS and the associated cost of final disposal increases accordingly. Dedicated hazardous waste receptacles (e.g. skips which are labelled and/or colour coded) should be implemented and strict adherence to correct disposal practices by employees and contractors. Such waste receptacles should also be leak proof and be stored either inside bunded areas or on protected, impervious surfaces.

Table 7-59: Impact of oil contaminated waste disposal

Impact of oils and contaminated waste diposal		
SITE 6C and Ash 3		
	No mitigation	Mitigation
Extent	Loal	Local
Magnitude	Medium	Low
Duration	Medium term	Medium term
SIGNIFICANCE	Medium (-)	Low (-)
Probability	Probable	Probable
Confidence	Certain	Certain
Reversibility	Reversible	Reversible

7.13.5. Waste Hazardous Chemical Substances Disposal

Description of Impact

According to the technical report produced by Mott MacDonald (reproduced in Table 7-60 below), a wide variety HCS will be used by the IPP in the running of KPS. HCS pose significant environmental risks when stored in larger volumes and therefore require greater controls.

Table 7-60: Site chemical usage

CHEMICAL	NATURE/COMPOSITION	FUNCTION ON PLANT	ESTIMATED ANNUAL USAGE	METHOD OF STORAGE
Sodium Hypochlorite	NaOCl, / 10 to 15% Aqueous Solution	Water treatment to prevent the build up of organic growth in water tanks and pipework	Small	Semi bulk container
Caustic Soda Liquor	NaOH, 5-50% Liquid Sodium Hydroxide	Ion Exchange, Resin Regeneration, Water Treatment Plant	85 Tonnes pa	Semi bulk container
Sulphuric Acid >50%	H_2SO_4, 96% Liquid	Ion exchange, Resin Regeneration, Water Treatment Plant	50 Tonnes pa	Semi bulk container
Hydrochloric Acid (@ 33% w/w)	HCL in water (H_2O)	Ion exchange, Resin Regeneration, Water Treatment Plant	85 Tonnes pa	Semi bulk container
Hydrazine	N_2H_4 Reduced to 4.9% Aqueous Solution	Oxygen scavenger for boiler feed water treatment	15 Tonnes of 35% annually	Specialist storage and handling kit required
Carbohydrazide[1]	98.0% min CH_6N_4O	Oxygen scavenger for boiler feed water treatment	10 Tonnes pa	Large drums
Hydrazine Hydrate 7.5%w/w / Ammonia Mix[2]	$N_2H_4.NH_3$	Boiler feedwater treatment	12 tonnes	Specialist storage and handling kit required
Ammonium Hydroxide	NH_4OH	Boiler feedwater corrosion control	15 tonnes	Semi bulk container
Hydrogen	H_2, Gas	Alternator	56,000 m³	Cylinders
Gas Oil	Complex mixture of paraffinic, olefinic and aromatic hydrocarbons C_7 to C_{35}, Liquid	Coal Plant Vehicles, Mobile Plant and emergency and black start (if any) Generators	200,000 litres	Bulk tanks
Propane	C_3H_8 - Liquid and Gas	Furnace Start-Up Ignition	8,000 litres	Propane gas tanks
Carbon Dioxide	CO_2, Liquid & Gas	Alternator	12 tonnes	Cylinders
Lubricating oils (Various)	Liquid	Steam Turbine (also used for smaller plant & in workshop)	44,000 litres	Large drums
Mobilcut 132 (ex Aquarious)	Mineral Oils and Additives, Liquid	Antifoaming agent	1,500 litres	Large drums
Teresso 68 CW Oil	Mineral Oils and Additives	Various	2,500 litres	Large drums
Limestone	As received from suppliers	Removal of oxides of sulphur from the flue gases	Dependent upon the sulphur content of the coal. A supply of typical coals would require the use of approximately 170,000 tonnes with an upper estimate of 375,000 tonnes p.a. for high sulphur coals	Silos

[1 & 2] An alternative to Hydrazine.

In addition the containers used to store HCS in smaller volumes (e.g. 5lt glass bottles used for the storage of acid in the laboratory) also pose a risk once empty since some impacts can still take place if not correctly handled. It is expected that the list provided in Table 7-60 above could still change (be added to) once final station design is concluded as well as ancillary services (e.g. lab testing).

Mitigation

It is not expected that KPS, as with other coal fired power stations in SA, will be a large generator of HCS. Used oil is the only waste stream that is generated in sufficient volume to justify recycling. Apart from ensuring that old oils and lubricants are recycled as far as possible (subject to the requirements described in NEMWA (Section 17(1)), no additional measures need to be taken to satisfy these recycling obligations. Disposing of chemical substances into the station drains without regard for the impact on the designed water management methodologies ability to remove such HCS should be avoided at all costs.

The prescribed material safety data (MSDS) sheets need to be maintained for HCS's, defined as a substance in respect of which an exposure limit has been set, or if no such limit exists, for substances that nevertheless present risks to human health. The IPP should ensure that data related to ecological/ecotoxicological impacts are included in the prescribed format for such MSDS's. Once the required information has been obtained, it follows that the ecological and toxicological information must be interpreted with a view to avoiding the acquisition of harmful substances in instances where less harmful alternatives exist.

Table 7-61: Impact of HCS disposal

Impact of HVS disposal		
SITE 6C and Ash 3		
	No mitigation	Mitigation
Extent	Regional	Local
Magnitude	High	Low
Duration	Medium term	Medium term
SIGNIFICANCE	High(-)	Medium (-)
Probability	Probable	Unlikely
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

7.13.6. Used Oil and Lubricants Disposal

Description of Impact

Used oils constitute a fairly common hazardous waste stream at power stations however the volumes produced are not normally very high. This waste stream does include PCB containing oils used in transformer units. This waste oil poses a significant effect on the environment if not handled and disposed of correctly. Waste oil may be generated when new oil is contaminated by some means (e.g. water contamination) or if a storage container ruptures. The spilled oil, once collected during the spill cleaned up, cannot be reused until it has been properly recycled.

Mitigation

It is important to note that the IPP must treat waste oil with the same care as new oil. This means that correct storage containers (e.g. 210lt drums, bulk tanks etc.) as well as the correct storage site infrastructure is imperative. A bunded area with impervious surface must be provided. The bunded area must be tested and the volume limit of oil stored (110% of the total volume of waste oil stored) must be strictly adhered to. Stop cocks/valves used for cleaning purposes or for the removal of rain water (if the bunded area is not roofed) should be locked on “off” at all times. An operational procedure should be developed by the IPP for the maintenance and cleaning of such bunded areas. Installation of a roof over such bunded areas requires additional capital during the construction phase but reduces the cost of oil/water separation the operational phase of the KPS.

A specialist oil recycling contractor should be used for the removal, recycling and/or final disposal of all waste oil products from the KPS. It is imperative that the IPP ensures final disposal certificates/way-bills are provided by the contractor as well as their waste management licence. Periodic inspections/audits of such contractors by KPS staff (or an external specialist on behalf of KPS) regarding responsible management of waste oils once removed from the KPS site are conducted. Reports of such inspections/audits should be kept on record.

Table 7-62: Impact of used oil and lubricant disposal

Impact of used oil and lubricant disposal		
SITE 6C and Ash 3		
	No mitigation	Mitigation
Extent	Regional	Local
Magnitude	Medium	Low
Duration	Medium term	Short term
SIGNIFICANCE	Medium (-)	Low (-)
Probability	Probable	Unlikely
Confidence	Certain	Certain
Reversibility	Reversible	Reversible

7.13.7. Waste Batteries Disposal

Description of Impact

Waste batteries normally constitute a low volume “slow moving” waste stream. Various types of batteries may be used on site and the management of issuing and recycling normally rests with the stores department. This process, if properly managed, can provide very effective control over recycling of batteries and ensuring that such items do not enter the general waste stream.

Mitigation

Batteries such as used car/truck batteries should be placed in a bunded area with an impervious floor. Used inspection torch batteries should be exchanged by employees at Stores when requesting new batteries. These batteries should be retained by KPS stores (in acid resistant containers) until such time as sufficient volumes are available for recycling. Record keeping of the volume of batteries used and recycled should be maintained. The IPP should never allow batteries to enter the general waste stream.

Table 7-63: Impact of waste battery disposal

Impact of battery waste		
SITE 6C and Ash 3		
	No mitigation	Mitigation
Extent	Regional	Regional
Magnitude	Low	Very Low
Duration	Long term	Long term
SIGNIFICANCE	Medium (-)	Low (-)
Probability	Definite	Unlikely
Confidence	Certain	Certain
Reversibility	Irreversible	Irreversible

7.13.8. Sewage Disposal

Description of Impact

The poor management of sewage waste in South Africa has reached critical proportions with many local authority sewage works being poorly maintained and design capacity criteria exceeded. This results in biological contamination and super nitrification of surface and ground water resources which is impacting on environmental, economic and domestic aspects of South African life.

Although the planned KPS would require a sewage treatment plant significantly smaller in capacity than those used by municipalities, poor design and management can result in considerable detrimental impacts on the receiving environment.

Mitigation

From the Mott MacDonald Technical report it is understood that due to the increased reliability of industrial scale electronic systems developed for the semi-conductor industry, sewage management systems such as Membrane Deionisation (MDI) or Electronic Deionisation (EDI) Systems are preferred. This system has been discussed in detail in section 4.2.2 of this report. However, it is imperative that the IPP address sewage management in such a way that the design capacity of the plant, the management of effluent quality and disposal of screenings and sludge meets all national legislation as well as local by-laws.

The permissible utilization and disposal of sewage sludge has been researched and documented by several organs of state and published by the Water Research Commission. A new series of Guidelines for the Utilisation and Disposal of Waste Water Sludge is currently under development. The following reports have been finalised and may be downloaded from the Water Research Commission's website at www.wrc.org.za:

Volume 1: Selection of management options;

Volume 2: Requirements for the agricultural use of sludge; and

Volume 3: Requirements for the on-site and off-site disposal of sludge.

The following two guidelines are still under development:

Volume 4: Requirements for the beneficial use of sludge; and

Volume 5: Requirements for thermal sludge management practices and for commercial products containing sludge.

Volume 1 describes the required sludge characterisation method for determining whether the sewage sludge is suitable for use as soil nutrients, or whether it should be landfilled, and if so, in which manner.

If using the sewage sludge as fertilizers, it is also important not to overlook the fact that the Department of Agriculture must be contacted to determine whether registration requirements for fertilizers apply. The Department of Agriculture requires registration of Type D fertilizer, particulars of which can be obtained from their technical specialists.

Sewage screenings (collected at the inlet to the sewage works) must be handled as hazardous waste. The IPP may opt for the services of a hazardous waste contractor for the removal and disposal of such waste. If so the requirements for cradle to grave management still apply. If the screenings are destroyed by incineration, a registration certificate is required for waste incineration, issued by the Chief Air Pollution Control Officer in terms of section 9 of the Atmospheric Pollution Prevention Act of 1965.

Table 7-64: Impact of sewage disposal

Impact of sewage disposal		
SITE 6C and Ash 3		
	No mitigation	Mitigation
Extent	Regional	Local
Magnitude	Medium	Very Low
Duration	Medium term	Short term
SIGNIFICANCE	Medium (-)	Very Low (-)
Probability	Probable	Unlikely
Confidence	Certain	Certain
Reversibility	Reversible	Reversible

8. ASSESSMENT OF CONSTRUCTION PHASE IMPACTS ON THE BIOPHYSICAL AND SOCIO-ECONOMIC ENVIRONMENT

8.1. INTRODUCTION

This chapter describes the potential construction phase impacts on the biophysical and socio-economic environments, which may occur due to the proposed activities described in Chapter 3. These impacts relate to the short-term impacts that occur during the construction phase. The proposed power station (and associated infrastructure) will be constructed over a period of nine (9) months for the first unit, with the remaining two units over a period of approximately a further eighteen (18) months. The potential impacts identified include the following:

- Disturbance of flora and fauna;
- Soil (and land use capability) impact
- Storage of hazardous substances on site;
- Impact of waste generation;
- Increase in traffic volumes;
- Increased risk of fire;
- Socio-economic impacts (negative);
- Noise impact;
- Visual impact;
- Air quality impact; and
- Employment (positive and negative)

Each of these impacts is assessed in detail, and the significance of the impact is determined in the following section. The methodology used to assess the potential impacts is detailed in Chapter 6 of this report. The terms "No Mitigation" and "Mitigation" reflected in the assessment tables in this chapter refer to the impact with no mitigation and with potential mitigation[27], respectively.

Cumulative impacts are also discussed where applicable. This refers to the synergistic impact of other potential developments such which may occur in the area.

The significance of construction phase impacts is likely to be limited by their relatively short duration, since the construction phase may last approximately 9-27 months. Many of the construction phase impacts could be mitigated through the implementation of an appropriate Framework EMP. The EMP has been compiled as part of the ESIA process, and is submitted as part of the EIR, to provide mitigation and ascribe responsibilities. A draft EMP is contained in **ANNEXURE J** of this report, which broadly outlines the type and range of mitigation measures that could be implemented during the pre-construction, construction, operational and decommissioning phases of the project.

8.2. Disturbance of Fauna and Flora

8.2.1. Impact Statement

The establishment of the power station and its associated infrastructure could result in the damaging, destruction or displacement of important indigenous fauna and flora. Key mitigation measures would involve avoidance of the Untransformed Grassland and Wetland areas.

Key potential impacts associated with the development of a power plant are as follows (**significance before mitigation is given in parentheses**):

Impacts on Flora:

- Loss of threatened vegetation type (Medium)
- Loss of conservation-important plant species (Medium)
- Increased invasion by alien plants (Medium)
- Illegal harvesting of vegetation resources (Medium)

Impacts on Fauna:

- Decrease in habitat quality through dust production (Medium)
- Loss of habitat for conservation-important species (Medium)
- Loss of fauna through illegal harvesting (poaching) (Medium)
- Disruption of animal movement (Low)

[27] Note that this does not imply that mitigation should or would be undertaken, but merely indicates the extent to which mitigation could change the significance of the impact where it is to be implemented.

- Disruption of breeding cycles of conservation-important species (Medium)
- Loss of invertebrates through destruction of natural habitat (Medium)
- Decrease in invertebrate habitat quality through dust production (Medium)
- Loss of invertebrates through provision of artificial lighting (Medium)
- Loss of invertebrates through noise and vibrations (Medium)

Impacts on Invertebrates

- Decrease in quality of wetland habitat through contaminated run-off (Medium)
- Reduction of habitat size and connectivity (Medium)

8.2.2. Discussion

A specialist terrestrial ecological investigation was undertaken to determine the ecological sensitivity of the flora and fauna (including avifauna) in the area, to identify any protected and endangered species on the sites, and to recommend mitigation measures to prevent and or reduce the potential impact on sensitive vegetation or animals. The methodology for this investigation included a literature survey of relevant published sources of information, a field survey and an assessment of both the ash pit and preferred power station site. The full report is included in **VOLUME 3**. A summary of the findings of the investigation is included under the operational impacts (please see Chapter 10).

As it is impossible to rehabilitate temperate grassland to its original floristic diversity, since this is a product of evolution over millennia (Prof. A.E. van Wyk, pers.comm.), there is no reasonable mitigation for the destruction of untransformed grassland within the study area. It is recommended that the impact footprint be confined to transformed areas and that the untransformed grassland is fenced off to prevent heavy vehicle access and subsequent habitat destruction.

Table 8-1: Impact – Loss of threatened vegetation types

a) Impact of the proposed power station and associated infrastructure – Loss of Threatened Vegetation Type		
SITE 6C & Ash Pit		
	No mitigation	Mitigation
Extent	Local	N/A
Magnitude	High	N/A
Duration	Long-term	N/A
SIGNIFICANCE	Medium (-)	N/A
Probability	Definite	N/A
Confidence	Certain	N/A
Reversibility	Irreversible	N/A

Since much of the area which is considered to be of conservation value also has a degree of undermining, which makes it unsuitable for construction purposes, these areas would be excluded from development. The proposed layout has been superimposed on the sensitivity map (please see

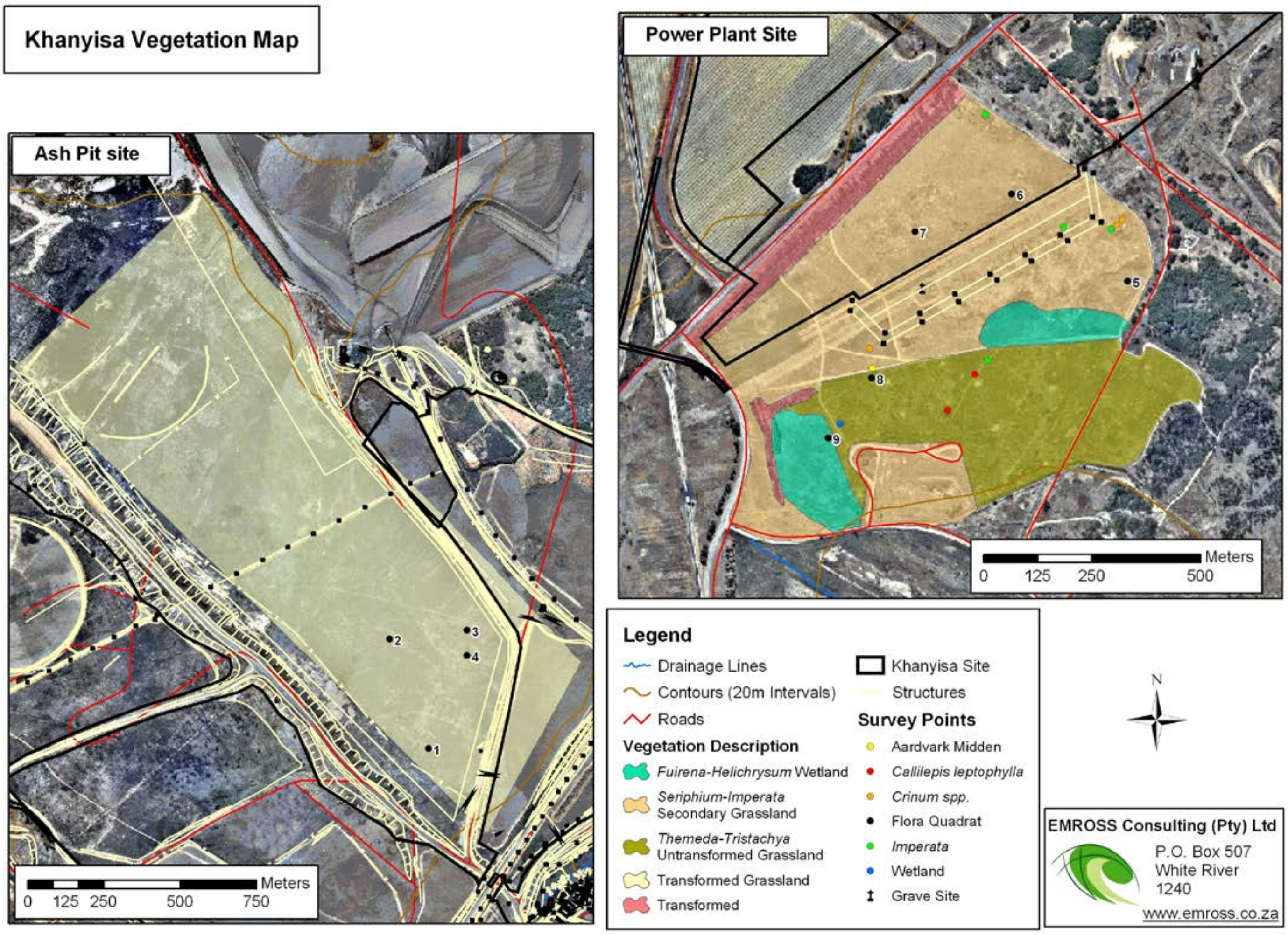


Figure 8-1 below) to indicate the anticipated footprint in relation to the conservation sensitive areas.

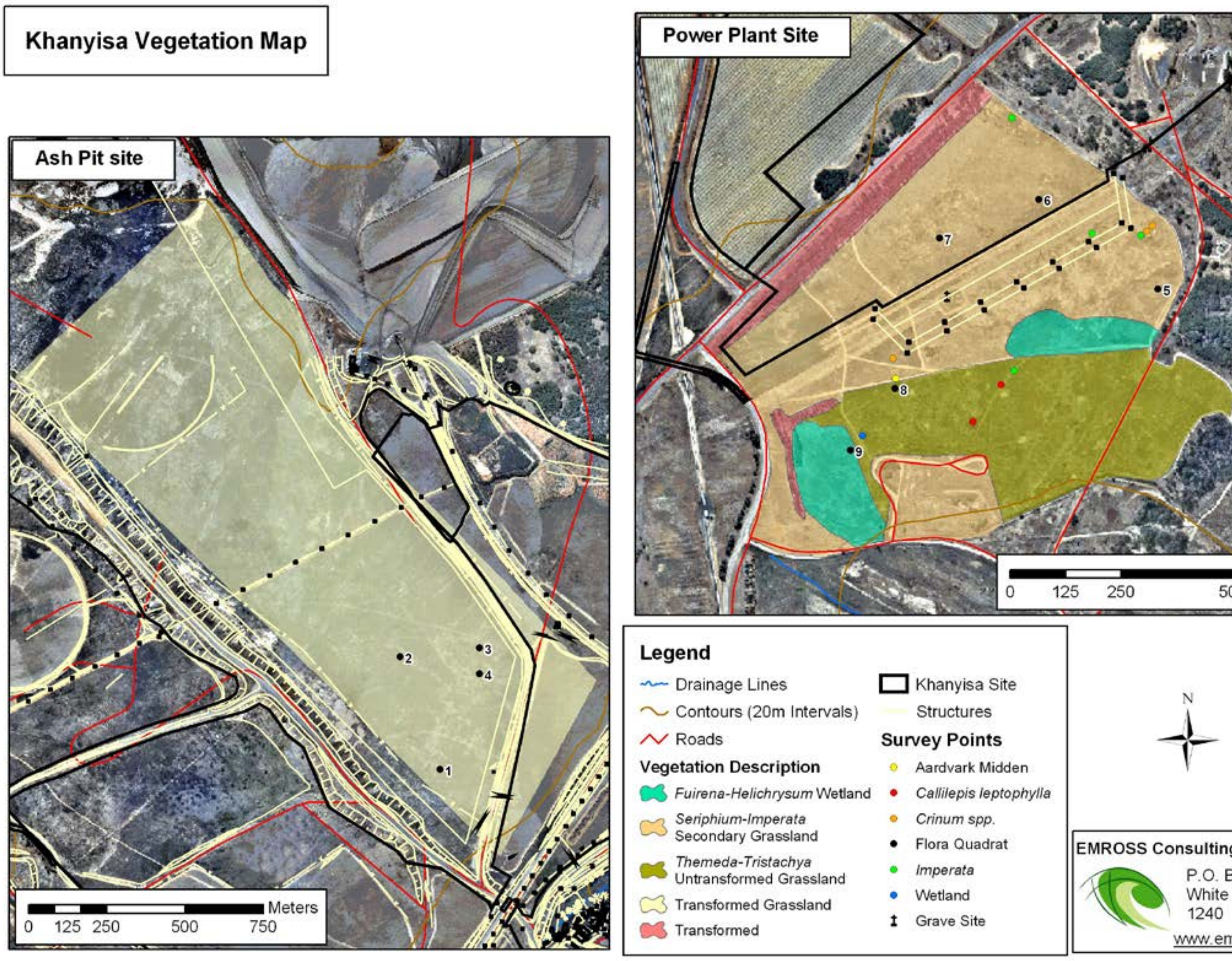
The impacts can be broadly grouped into:

- Impacts on flora
- Impacts on fauna
- Impacts on invertebrates
- Other

Mitigation

Impacts on Flora

- Avoid any construction activity in the area of untransformed grassland and wetland as indicated in



- Figure 8-1
- Fence off the untransformed grassland and wetland areas to especially prevent heavy vehicle access and subsequent habitat destruction. All access to these areas should be prohibited. The Environmental Compliance Officer should check that this area is not being accessed by anyone during construction. Restricted access to this area will be incorporated into the power plant EMP.
- The *Crinum* (most probably *C.macowanii)* plants that are growing in secondary grassland in the vicinity of the proposed power plant site should be carefully removed under the supervision of a botanist with horticultural experience and transplanted in adjacent untransformed grassland.
- The amount of secondary grassland to be destroyed during construction should be kept to an absolute minimum.

- Manage invasions of alien plants, particularly in the areas adjacent to untransformed grassland and at the topsoil stockpiles, which are important for successful rehabilitation of transformed habitat and need to be kept clear of invasive alien plants.
- The presence of additional people in the project area, particularly during construction and operational phases, could increase the risk of plants being illegally harvested, particularly for traditional medicine; and poaching of small animals. Mitigation measures should therefore be preventative as far as possible. All staff should be accommodated off-site to prevent after-hours access to areas outside of the impact footprint, particularly the conservation important areas.
- All staff should be educated with regards to the importance of the biodiversity within the project area during induction and informed of the penalties for transgressing into areas outside of the impact footprint.
- The impact footprint (power plant and adjacent infrastructure) should be securely fenced, making access to sensitive areas more difficult.
- The Environmental Compliance Officer should visit untransformed grassland adjacent to the impact footprint and check for evidence of any illegal harvesting. Transgressors should be prosecuted under the Mpumalanga Nature Conservation Act (No.10 of 1998).
- Dust-producing areas such as haul roads and construction sites should be periodically lightly sprayed with water using water bowsers. This is particularly important during the dry season, or even in the wet season in weeks when no rain has fallen. It is important that these areas are not over-sprayed causing water run-off and subsequent sediment loss into adjacent waterways.
- Location of the transmission lines should be along existing linear features where possible, rather than crossing expanses of open land where large bird movement could be impacted.
- Secondary grassland at the proposed ash pit site should be rehabilitated in increments as these areas are filled to capacity with ash. In order for this to be successfully implemented, a rehabilitation program should be implemented from the construction phase as follows:
    - topsoil (circa 300mm depth) should be stripped and stockpiled separately from the subsoil in windrows so as to preserve as high a proportion as possible of the plant seed bank.

  - o seeding of the reconstructed landscape must be carried out using a mix of locally occurring plant species that are confirmed to occur adjacent to the areas of impact.
- Since both the power station and ash dump sites (especially the latter) have previously been disturbed, it would not be appropriate to use current conditions on these sites as targets for rehabilitation. Especially for the proposed ash dump site which is in relatively early stages of rehabilitation after topsoil covering of a waste rock spoil site, appropriate targets should be set using data from a control site in untransformed grassland, which should be regarded as the minimum rehabilitation target for the site.

Impacts on Invertebrates

- Detailed surveys for Red Data and protected invertebrate species on the proposed development sites are not recommended, as it is very unlikely that such species would be found.
- Detailed rehabilitation plans, using selected invertebrate groups such as ants and leafhoppers for effective monitoring of progress, should be prepared prior to construction; it is recommended that appropriate rehabilitation targets in terms of species richness and community composition bet set using data from control sites in nearby undisturbed areas within the Eastern Highveld Grassland vegetation type. Choice of indicator taxa for use in monitoring should be based on data from baseline surveys of the control sites and statistically valid and repeatable sampling must be used to provide sound baselines and targets.
- Externally visible lighting should be kept to an absolute minimum, and wherever possible long-wavelength light sources (i.e. yellow/orange) should be used:
  - o Internal lighting should as far as possible be shielded by blinds or curtains to prevent spillage of light into the surrounding natural environments.
  - o If external lighting of structures is essential (e.g. for security reasons), light sources should be directed inward so as to light up the structure and result in this becoming a large diffuse light source, rather than having bright point sources directed outward into the natural environment.
  - o Long-wavelength light sources should be used (at least 550 nm, preferably longer than 575 nm), preferably low-pressure sodium vapour, or yellow LEDs, as these result in very low disturbance of insect populations. Less preferable, but still better than mercury vapour or halogen lamps, would be high pressure

sodium vapour or warm white LEDs. LED options, while initially more costly, may prove more economical and environmentally friendly in the long term, as a 20-year life span at 12 hours usage per day is achievable, with efficiency comparable to fluorescent lighting. Another alternative is to use ultraviolet (UV) filters which can reduce insect attraction to high pressure mercury vapour lamps to below that of high pressure sodium vapour lamps. Fluorescent lights, including compact versions, should not be used outdoors, as a significant amount of UV light is emitted by these, and this is highly attractive to insects.

Other: Wetlands and Loss of Habitat connectivity

- Care must be taken to prevent uncontrolled flow of water from the construction areas and waste stockpiles, and such measures must take into account the possibility of extreme rainfall events.
- Re-vegetation must be carried out as rapidly and completely as possible in order to limit the severity of erosion and the length of time before the surface is fully stabilised.

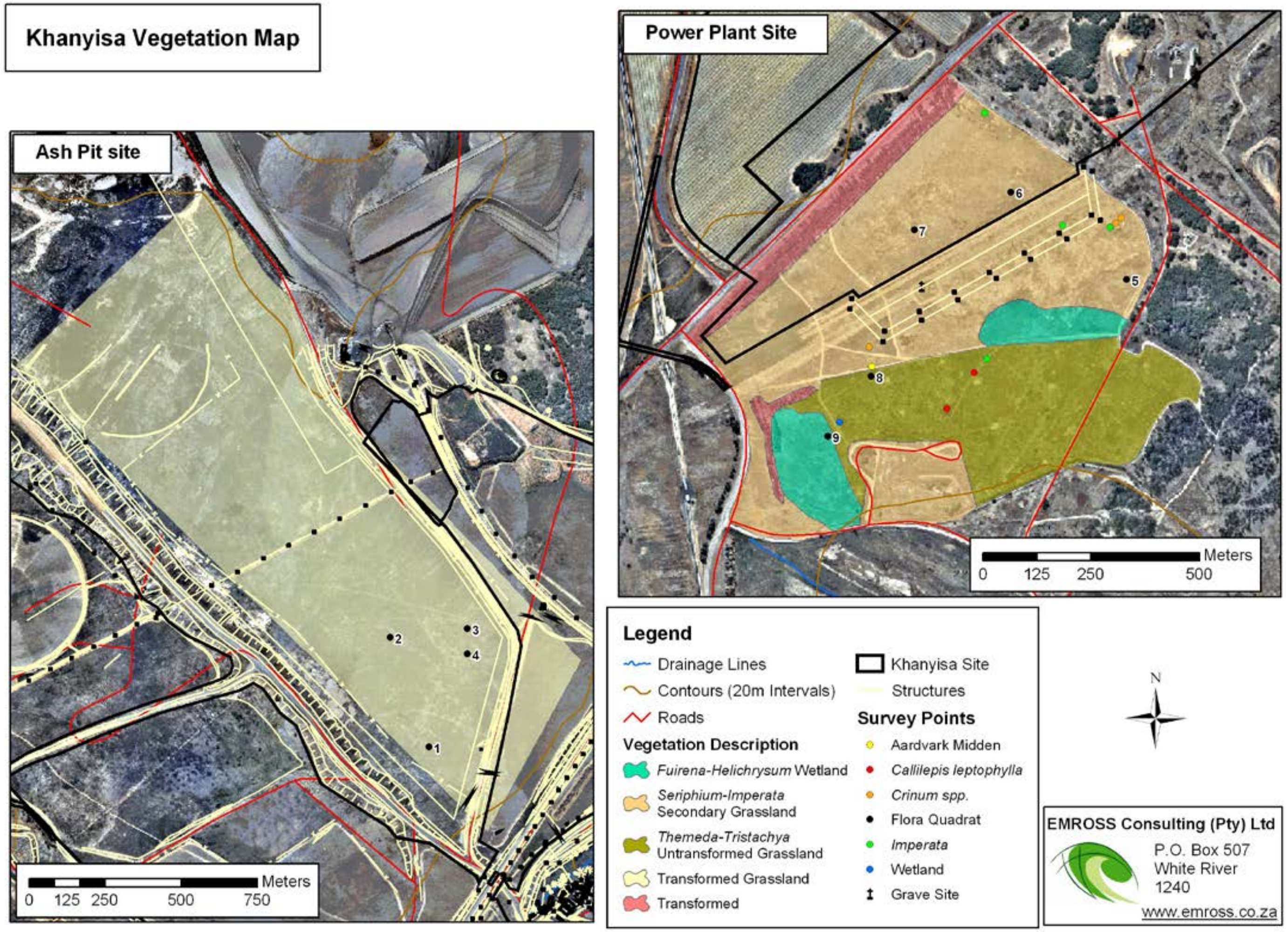


Figure 8-1: Sensitivity map of the study area with propsed powerplant footprint indicated

Impact assessment results

The results of the impact assessment contained in the tables below are based on the assumption that the conservation important areas (Untransformed Grassland and Wetland areas) are effectively excluded from all construction activities (exclusion zone) and thus will not be impacted on. It is recognised that no reasonable mitigation for the destruction of untransformed grassland within the study area can be offered and as such it is therefore excluded from the assessment results below.

The tables below have been integrated (highest significance) for the larger impact group from the specialist study (individual impact tables of each impact can be found in the specialist report in **VOLUME 3**).

Table 8-2: Impact - Flora

b) Impact of the proposed power station and associated infrastructure - Flora		
SITE 6C & Ash Pit		
	No mitigation	Mitigation
Extent	Local	Local
Magnitude	High	Medium
Duration	Medium	Medium
SIGNIFICANCE	Medium (-)	Low (-)
Probability	Probable	Probable
Confidence	Certain	Sure
Reversibility	Irreversible	Reversible

Table 8-3: Impcat Fauna

c) Impact of the proposed power station and associated infrastructure - Fauna		
SITE 6C & Ash Pit		
	No mitigation	Mitigation
Extent	Local	Local
Magnitude	Medium	Medium
Duration	Long	Long
SIGNIFICANCE	Medium (-)	Low (-)
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Irreversible	Reversible

Table 8-4: Impact - Invertebrates

d) Impact of the proposed power station and associated infrastructure – Invertebrates		
SITE 6C & Ash Pit		
	No mitigation	Mitigation
Extent	Local	Local
Magnitude	High	Medium
Duration	Long	Long
SIGNIFICANCE	Medium (-)	Low (-)
Probability	Definite	Probable
Confidence	Certain	Sure
Reversibility	Irreversible	Reversible

Table 8-5: Impacts – Wetlands and habitat connectivity

e) Impact of the proposed power station and associated infrastructure – Other (wetlands and habitat connectivity)		
SITE 6C & Ash Pit		
	No mitigation	Mitigation
Extent	Regional	Regional
Magnitude	High	Medium
Duration	Long	Long
SIGNIFICANCE	Medium (-)	Medium (-)
Probability	Probable	Probable
Confidence	Likely	Likely
Reversibility	Irreversible	Reversible

8.2.3. Comment on cumulative impacts

The area of untransformed grassland in the vicinity of the power plant site is moderately representative of Eastern Highveld Grassland, a threatened vegetation type that has been classified as Vulnerable. Destruction of this fragment of vegetation would increase the cumulative impact of fragmentation of this vegetation type. Untransformed Eastern Highveld Grassland is listed as a Vulnerable ecosystem under Notice 1477 of Government Gazette No. 32689 (6 November 2009)[28]. This means that the ecosystem has a high risk of undergoing significant degradation of ecological structure, function or composition as a result of human intervention, and has been listed in order to **prevent further degradation** and loss of function, structure and composition. Destruction of this fragment within the study area would represent further degradation; and must therefore be avoided.

[28] SANBI & DEAT, 2009

8.3. Soil & Land Use Capability Impact

8.3.1. Impact statement

This refers to the potential loss of the soil resource due the change in land use, erosion, compaction, removal, and / or contamination. Although the proposed sites are earmarked for future mining activities they are leased to farmes, and hence, will impact on moderate intensity grazing and commercial cropping. These activities are perceived to be of economic benefit to the local economy and land owners. A soil and land use study was conducted by Earth Science Solutions (Mr Iain Jones) and the complete report is included in **VOLUME 2**.

8.3.2. Discussion

The variation in soil structure, texture and clay content of the soils combined with the presence of the prominent ferricrete layer at the base of many of the soil profiles ("C" Horizon) associated with the power plant site and power-line route, all make for a complex of natural conditions that are going to be extremely difficult to replicate at closure.

The ferricrete layer mapped is of importance to both the sensitivities and vulnerabilities of the materials described, with this layer forming a moderately impermeable barrier between the soils and the groundwater environment, restricting the vertical infiltration of surface and soil water through the vadose zone. The possible resultant loss of sub surface water when the ferricrete is removed will need to be assessed and understood as a function of the ecological balance and wetland "reserve".

The majority of the power plant site and powerline route development and associated infrastructure that is planned will impact on soils with a prominent ferricrete "C" horizon and/or areas with wet horizons at their base. The depth to the wet horizon (mottled) is generally greater than 800mm which renders these soils non wetland status in terms of the delineation classification for wetland soils, but should be noted in terms of the founding conditions and engineering requirements (Refer to 2010 Study undertaken by Aurecon – Report No. AUR 10-08). These soils should be considered as sensitive to moderately sensitive for the most part, with the potential to be difficult to work in the wet state.

In contrast, the Ash Dump site (proposed alternative 3) comprises rehabilitated materials on the discard dump, with sandy loams and silty clay loams, apedel to weak crumby structure and generally good rooting depths. These soils have been recently worked (geological time) and as such are prone to erosion and compaction, and will be lost permanently if not well protected. The use of this surface area as a disposal site for the ash by-product from the proposed power station will sterilize these soils if they are not removed.

If the soils are not required as a lining to the Ash Dump (ash to be deposited directly onto the discard) then the soils should be removed and stockpiled for future use as capping to the Ash Dump/Storage Facility.

In terms of the “Minimum Requirements”, **usable or utilizable soil** is defined here as all soil above an agreed subterranean cut-off depth defined by the project soil scientist, and will vary for different forms of soil encountered in a project area and the type of project being considered. It does not differentiate between topsoil (orthic horizon) and other subsoil horizons necessarily.

The construction methods and final “End Land Use” are important in deciding if the utilizable soils need to be stripped and retained, and ultimately how much of the materials will be needed for the rehabilitation (stripping volumes). Failure to remove and store the utilizable materials will result in the permanent loss of the growth medium. Making provision for retention of utilizable material for the decommissioning and/or during rehabilitation will not only save significant costs at closure, but will ensure that additional impacts to the environment do not occur.

The depths of utilizable materials vary between 100mm and greater than 1,500mm. However, due to the shallow soil depths on the more rocky areas/slopes, albeit that these are a small percentage of the overall area, it is recommended that sufficient materials are removed from the areas were the soil depths are present and do exist, so that the shallow areas can be adequately rehabilitated at closure.

For the construction area it is recommended that at least 700mm of soil should be stripped, with 750mm wherever possible. The majority of the area confirmed as moderate to sensitive soils with soils that are sufficiently similar that they can be stored as one stockpile. The sensitive soils and wet based materials should not be impacted (i.e. – wetlands).

Mitigation

- Limit the area of impact to as small a footprint as possible, inclusive of waste management facilities, resource stockpiles and the length of servitudes, access and haulage ways and conveyencing systems wherever possible;
- Construct the facility and associated infrastructure over the less sensitive soil groups;
- Consider the length of time that the resource will need to be stored and managed (life of the mining venture and potentially beyond – use of the facility to process additional mining ventures);
- Develop and include soil management as part of the housekeeping operations, and the independent auditing of the management;
- Ensure concurrent rehabilitation of all affected sites that are not required for the operation – rehabilitation of temporary structures and footprint areas used during the feasibility investigation (geotechnical pits, trenching and exploration drill pads and roads etc.);
- Soil stripping should occur during the less windy months when the soils are less susceptible to erosion;
- Separate the utilizable soils and ferricrete base materials from each other and from the soft overburden;
- All berms and soil must be effectively clad , ferricrete stockpiles/heaps with vegetation or large rock fragments, and the minimise the height of storage facilities to 15m and soil berms to 1,5m wherever possible;
- Restrict vehicle movement over unprotected or sensitive areas, this will reduce compaction;
- Implement soil amelioration (cultivation) to enhance the oxygenation and growing capability (germination) of natural regeneration and/or seed within the stockpiled soils (maintain the soils' viability during storage) and areas of concurrent rehabilitation.
- Stripping should only occur where soils are to be disturbed by activities that are described in the design report, and where a clearly defined end rehabilitation use for the stripped soil has been identified.
- It is recommended that all vegetation is stripped and stored as part of the utilizable soil. However, the requirements for moving and preserving fauna and flora according to the biodiversity action plan should be consulted.
- Soils will be handled in dry weather conditions so as to cause as little compaction as possible. Utilizable soil (Topsoil and upper portion of subsoil B2/1) must be removed

and stockpiled separately from the lower "B" horizon, with the ferricrete layer being seperated from the soft/decomposed rock, and wet based soils seperated from the dry soils if they are to be impacted.

- The "Utilizable" soil will be stripped to a depth of 750mm or until hard rock/ferricrete is encountered. These soils will be stockpiled together with any vegetation cover present (only large vegetation to be removed prior to stripping). The total stripped depth should be 750mm, wherever possible.
- Stockpiling areas will be identified in close proximity to the source of the soil to limit handling and to promote reuse of soils in the correct areas. All stockpiles will be founded on stabilized and well-engineered "pads" (compacted and well drained footprint).
- Soils stockpiles will be demarcated, and clearly marked to identify both the soil type and the intended area of rehabilitation.

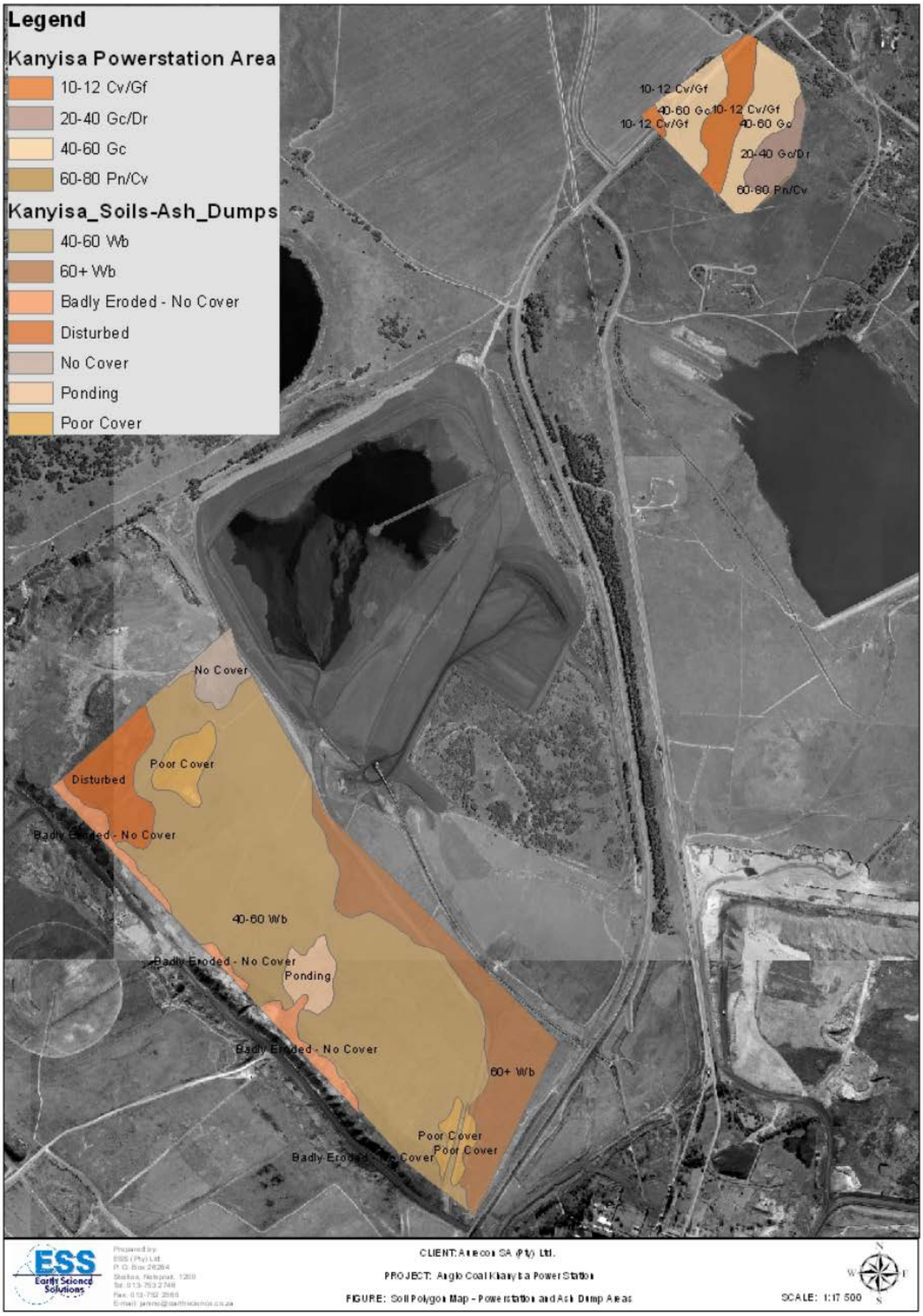


Figure 8-2: Dominant Soil – Power Station and Ash dump

Figure 8-3: Soil types of the two propsed power line route

a) Impact Assessment Results

Table 8-6: Impact – Loss of Agricultural land

Impact of the proposed power station and associated infrastructure on the soil and land use capability		
SITE 6C Power Plant (and associated infrastructure & Ash Disposal Site		
	No mitigation	Mitigation
Extent	Local	Site
Magnitude	Medium-High	Very High
Duration	Long	Long
SIGNIFICANCE	Medium- High (-)	Medium Low (-)
Probability	Definite	Probable
Confidence	Certain	Sure
Reversibility	Irreversible	Reversible

8.3.3. Comment on Cumulative Impacts

The Khanyisa Power Plant project and ash dump areas is located within an existing mine lease area located in close proximity to the town of eMalahleni in Mpumalanga. The preconstruction land capability classes of the project site can be judged as a combination of dry-land agriculture and grazing.

Most of the soils found on the site of the Power Plant area and ash dump site are considered to be of high agricultural potential with moderately deep soils. However, the current mining activities and waste dumps have reduced the soil capability and therefore reduced agricultural potential of crop production and food security. These impacts are cumulative because soil that has been lost to production through mining , buildings and dumps cannot be easily reintroduced into an agricultural production cycle.

On a braoder scale, the reduction of arable agricultural land does present a risk to food security in SouthAfrica because high potential soil is lost from production. This this project has a relatively small regional agricultural impact but the problem is accentuated because a large number of opencast coal mines already operate in theimmediate vicinity of the proposed site. The overall (cumulative) impact on agricultural production and food security is indicated therefore negligible.

8.4. Storage of Hazardous Substances on Site

8.4.1. Impact Statement

During the construction period the use and storage of substances such as shutter oil, curing compounds and diesel on site could have a negative impact on the surrounding environment, if the material is spilled.

8.4.2. Discussion

While the materials mentioned above, would have to be stored and handled responsibly, as prescribed by a suite of legislation, including the Occupational Health and Safety Act (No. 85 of 1993), and the Road Transportation Act (No. 74 of 1977), emergency situations may arise if the hazardous material is spilt or exploded.

Mitigation

Typical mitigation measures include:

- Storage of the material in a bunded area, with a volume of 150 % of the storage container;
- Refuelling of vehicles in designated areas that have a protective surface covering; and
- The utilisation of drip trays for stationary plant.

a) Impact Assessment Results

Table 8-7: Impact – Storage of hazardous substances

Impact of the proposed power station and associated infrastructure		
SITE 6C & ASH 3		
	No mitigation	Mitigation
Extent	Site	Site
Magnitude	Low	Very Low
Duration	Construction	Construction
SIGNIFICANCE	Low-Medium (-)	Low (-)
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

8.4.3. Comment on Cumulative Impacts

As the risks to society from fires, explosions or toxic releases would extend a short distance from the individual power station and this would not impact on any other facilities in the area. As such no cumulative impacts exist for this potential impact.

8.5. Impact of Waste Generation

8.5.1. Impact Statement

The construction of the proposed power plant and associated infrastructure will result in the generation of waste, both general and hazardous. The effects of litter/waste pollution on the biophysical environment would be small, but could be more significant for the aesthetics of the area if not properly controlled.

8.5.2. Discussion

Most construction related waste is considered inert however some more hazardous substances may be disposed of along with construction waste (e.g. empty silicon tubes, empty/partially empty paint tins, stripping agents etc.). It needs to be ensured that such items are removed from construction waste or better yet, it is separated at source and handled as hazardous waste. A waste study was completed by Ferret Mining, but this assessment focuses predominantly on the operational phase (please see report in **VOLUME 4**).

Mitigation

Very few options are available for the minimisation of construction related waste and applies mostly to planning and construction methodologies. This potential impact could be readily managed by the provision of suitable refuse disposal facilities and the effective implementation of an EMP.

- The removal of construction waste from the construction site will mitigate land pollution (however inert) and proper disposal at a permitted landfill site poses very limited environmental risk.

a) Impact Assessment Results

Table 8-8: Impacts – Waste generation

Impact of the proposed power station and associated infrastructure		
SITE 6C & ASH 3		
	No mitigation	Mitigation
Extent	Regional	Regional
Magnitude	Low	Very Low
Duration	Long	Long
SIGNIFICANCE	Medium (-)	Low (-)
Probability	Unlikely	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Irreversible

8.6. Increase in Traffic Volumes

8.6.1. Impact Statement

The construction of the power plant and all associated infrastructure will lead to an increase in traffic which will impact negatively on the existing road network and users.

8.6.2. Discussion

The Tweefontein Road (D2257) is a public highway which directly crosses Site 6C and will need to be relocated in order for the site to be used. A detailed traffic impact assessment, conducted by Endecon Ubuntu, was undertaken as part of the ESIA to investigate the most suitable diversion option as well as to evaluate the expected traffic impact associated with the proposed power plant in order to ensure safety and mobility along the provincial roads (see full report in **VOLUME 3**).

The alignment proposal as indicated below allows for mobility along the Road D 2257 and meets minimum prescribed geometric criteria for a design speed of 80km/h in terms of horizontal radii, horizontal and vertical curve lengths, sight distances and access spacing. The deviation will be constructed and only upon completion thereof, will the traffic then be diverted to the new alignment and the redundant section decommissioned. It is assumed that the construction of the new alignment will not interfere in current road usage.

Table 8-9: Preffered road deviation alternative

During the construction phase, some 900 - 1 200 people would be employed on site. This would result in an increase in traffic volumes as workers are likely to travel to work by private car, bus and minibus taxis and it is estimated that 292 commuter trips would be generated per day. Further to the above, it is estimated that some 30 heavy trucks would visit the site each day, generating 60 vehicle trips each day.

It is evident from the analysis that the following intersections are expected to be operating at an unacceptable level of service during the construction phase of the project:

- Watermeyer Street / Road D 2257; and
- D 2257 / IPP Access intersection.

Mitigation

- With respect to the existing Watermeyer Street / Road D 2257 intersection, it is advised that:
  - o This intersection be investigated for the possibility of signalisation (the intersection is located at a gradient which may or may not be too steep for signalisation);
  - o The double lane in the westbound direction terminates to a single lane at a distance of approximately 280m from the intersection only to become double lanes once again approximately 420m from this point. It is consequently advised that the existing dual carriageway road to the west of Watermeyer / Road D 2257 intersection be extended up to the latter intersection in both the east and westbound directions;
  - o The desirability to relocate the existing Watermeyer / Road D 2257 intersection approximately 1km towards the west (better gradients for signalisation and dual carriage way road) be further investigated and considered by the authorities from a capacity as well as safety point of view.
- The IPP access intersection should be upgraded to a four way stop controlled intersection for a period of approximately 5 years where after the signalisation or upgrading to a possible roundabout be investigated at that point in time. It is further proposed that the IPP access intersection be designed in accordance with Figure 8-4 below;
- That stacking distance of at least 50m be available between the proposed new Road D 2257 / Road D 2769 intersection;
- Provision is made for a public transport facility outside the plant security access gate with a well-designed drop off and pick up zone. Passengers must be off-loaded to an elevated pedestrian walk-way from where workers can walk in a safe manor towards the security check-in turnstiles at the access gate. The facility must be so designed as to avoid pedestrian – vehicle conflict.
- That the above mentioned transport facility be designed to accommodate at least 20 mini bus taxis and two busses at any given point in time with space available for possible future expansion;

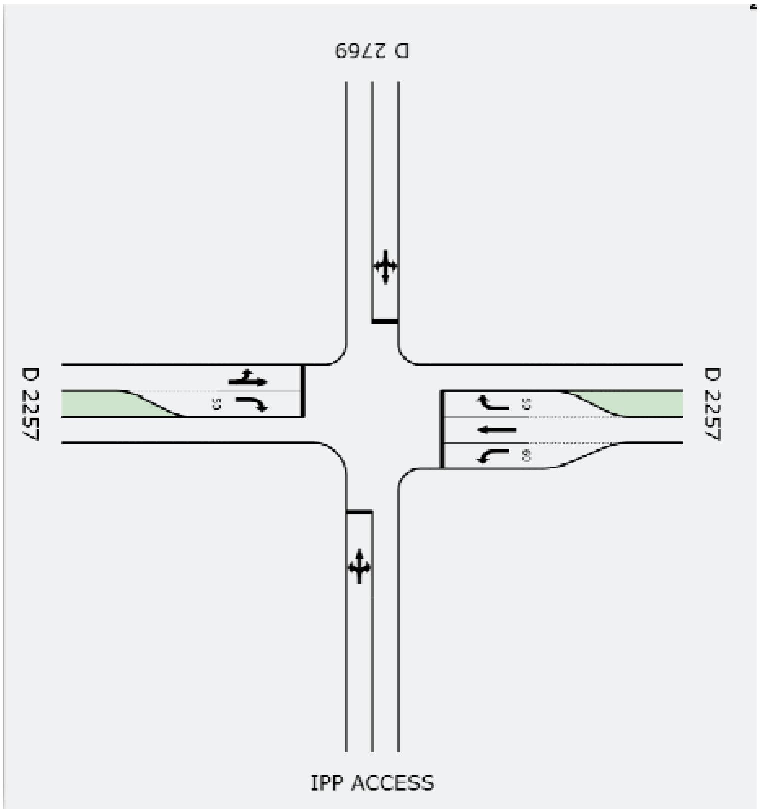


Figure 8-4: Proposed intersection layout

a) Impact Assessment Results

Table 8-10: Impact – Traffic Volumes

Impact of the proposed power station and associated infrastructure on traffic volumes		
SITE 6C & Ash 3		
	No mitigation	Mitigation
Extent	Local	Local
Magnitude	High	Low-Medium
Duration	Short	Short
SIGNIFICANCE	Medium (-)	Low (-)
Probability	Definite	Definite
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

8.6.3. Comment on Cumulative Impacts

The construction phase will result in a decrease in level of service (LOS) of various junctions along the road. However, these are likely to be easily mitigated with traffic signals, as well as making a public transport system (e.g. buses and taxi's) viable. If this is not done, the additional traffic could take up the spare capacity of the junction control such as traffic signals, leading to delays which could result in the requirement for additional lanes at junctions in order to provide additional capacity.

8.7. Increased Risk of Fire

8.7.1. Impact Statement

Construction activities onsite may increase the risk of fire in the area in both the wet summer months and the dry winter months. The outbreak of fire at the construction site could have serious safety, economic and ecological implications.

8.7.2. Discussion

Temperatures in the eMalahleni area can rise to 40ºC in summer. Furthermore, the grassland vegetation is prone to fires being started by lightning strikes in summer.

Mitigation

- Adhere to requirements and guidelines of the National Veld and Forest Fire Act (No. 101 of 1998).
- Have available such equipment, protective clothing and trained personnel required to extinguish such fire as may occur as prescribed in the FPA regulations
- Have in place a properly equipped and trained fire crew to assist in the suppression or containment of wildfires and to maintain fire mitigation measures.
- Ensure that staff are trained and capable of fighting fires.
- Identify areas of high fire risk/hazards.
- Ensure sufficient firebreaks around perimeter of property.
- Maintain firebeaks – area needs to be cleared and checked on a monthly basis.

The risk of fire would be managed through the framework EMP, which would include procedures for dealing with emergency situations such as fires. Impact Assessment Results

Table 8-11: Impact – Risk of fire

Impact of the proposed power station and associated infrastructure		
SITE 6C & Ash 3		
	No mitigation	Mitigation
Extent	Local	Site
Magnitude	Medium	Low
Duration	Long	Short
SIGNIFICANCE	Medium (-)	Low (-)
Probability	Probably	Unlikely
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

8.8. Socio-Economic Impacts (Negative)

8.8.1. Impact Statement

The construction of the proposed power station (and related infrastructure) could have an impact on the socio-economic fabric of the local and regional communities. A social impact assessment was conducted by Ptersa Environmental Management Consultants and the full report is included in **VOLUME 3**.

This could take the form of:

- Increased pressure on local services and infrastructure; increased incidence of STD's, HIV and AIDs; social nuisance; e.g. prostitution, damage to property; and discrepancy in workers' incomes, as a result of in-migration of workers.
- Economic impact, uncertainty about the future; and loss of social status, as a direct result of resettlement.
- Decreased access to sources of livelihood resulting in poverty and/or drop in standard of living; loss of productive land leading to loss of profit leading to job losses; environmental nuisance e.g. noise, dust; cumulative impacts on health; property prices; and traffic impacts as a result of a change in land use.
- Deviant social behaviour.

8.8.2. Discussion

a) In-migration

In-migration is a demographic process that relates to the movement and composition of people in the study area. There will be a temporary in-migration of construction workers. The construction period will last for approximately two to four years, depending on the contractors. It is estimated that at peak construction time (a period of six to eight months) approximately 1200 people will be employed, with approximately 900 people for the remaining construction period. Apart from construction teams there may also be an influx of people looking for economic opportunities.

The **first impact** associated with in-migration is increased pressure on local services and infrastructure. This includes services such as sanitation, electricity, water, waste management and the availability of housing. According to local residents and the 2010/2011 IDP these services are already under pressure, and there is a severe housing backlog. There will also be an increase in the use of local roads and transport systems that may cause road deterioration and congestion. This impact will be magnified by the deviation of the Tweefontein road. The Tweefontein road is used by surrounding mines and coal trucking companies to transport coal and is also used by local residents travelling to Kriel and the mines for work. The local health and education system may not be able to absorb the extra load.

Squatter settlements may develop near the construction fronts or in surrounding suburbs to accommodate job seekers. In-migration can also have an impact in the areas where the aspiring labour force comes from. These labour-sending areas may experience a loss of skilled labour, family units may be destabilised and spending patterns in those areas may change.

The **second impact** associated with in-migration is around sexual behaviour. There may be an increase in the incidence of sexually transmitted diseases, HIV and AIDS. This is usually the result of men being far away from their homes and as a result engages in sexual activity with local women. There can be secondary impacts that will have a long-term impact on the host communities. Local women may provide sexual and housekeeping services to men in exchange for financial security – not to be confused with prostitution, but rather a livelihood strategy.

There is a risk that these women may be left destitute when the construction workers move on to a new project in another area, leaving the local communities with the responsibility to ensure that these individuals survive. There could therefore be an increase in female-headed households in these areas.

In all communities power and authority is distributed unequally – that means everybody cannot be in a position of authority. The distribution of power depends on different aspects, ranging from financial or political status to age or gender. Communities have implicit and explicit social rules that have developed to maintain power relationships. New economic opportunities and increased local employment may result in people achieving a higher status in the community, and therefore be able to challenge existing power relationships. This may cause conflict within communities. If outsiders do not respect or align themselves with existing authority structures, it may also impact on the community cohesion and structure.

Tension between local communities and contractors may develop because of a number of social nuisance factors. Local woman may use prostitution as an income strategy, since the presence of contractors may create a market for these services. This can contribute to the breakdown of traditional value systems and social tension and violence. Another factor to be considered is damage to properties. Contractors may knowingly or unknowingly damage the property of local people. The discrepancy in income between local people and construction workers could also cause social tension. They may choose to spend their money on activities such as alcohol consumption or prostitution that may be offensive to local communities, or just the fact that they are able to enjoy much higher standards of living may create social differentiation and inequity (actual or perceived).

Resettlement

Resettlement refers to a co-opted or coerced process by which local people surrender land for a project and are relocated elsewhere as part of the relocation package. The proposed project will require the relocation of two households. The members of these households are non-landowning tenants; the household heads were formerly employed on the farm before the land was purchased by Anglo American. They have been living there for more than 20 years. The households currently house a total of sixteen people, of which three are employed.

Anglo American has appointed a consultant (Aurecon) to undertake the resettlement process to relocate these households to a suitable alternative location. The resettlement process is currently in the planning stages, which involves the compilation of a Resettlement Action Plan (RAP). The process will be undertaken in accordance with international best-practice principles, such as the World Bank Operation Policy 4.12 and the International Finance Corporation (IFC) Performance Standard 5 on Involuntary resettlement, as well as with Anglo policies incorporated into the company's Socio-Economic Assessment Toolbox (SEAT).

As such, it will involve:

- Involvement of the affected households in all decision-making that will affect them, including the choice of resettlement site;
- Compensation for all assets that will be lost or displaced by relocation, where such compensation will preferably be by means of the replacement of assets rather than monetary remuneration;
- Replacement of affected assets – in particular, replacement housing at the resettlement site – will be to a similar or better quality than those lost;
- Post-resettlement support will be provided in the form of a livelihood restoration programme to ensure that the households are not worse off after resettlement than they were before;
- A monitoring and evaluation programme will be implemented to ensure that the resettlement process does not lead to a deterioration in the households' standard of living; and
- Resettlement will be completed before construction commences.

These measures are intended to avoid or mitigate any negative impacts that may arise from resettlement, as well as to maximise its benefits for the affected households.

Change in land use

Change in land use is a geographic process that affects the land use patterns of society. The changes in land use relevant to this project relate to the change from the current agricultural and mining activities to a power station.

Change in land use may mean that some affected communities no longer have access to natural resources on which they depend for their livelihoods. The result will be loss of income and drop in standard of living.

Some of the farmers may lose access to productive land in the area which may have a financial impact on these farmers. There is limited productive agricultural land available to replace the lost land. Some of the properties may become too small to allow a viable farming business with the remaining resources.

Environmental nuisances such as an increase in dust and noise due to construction activities and an increase in the number of heavy vehicles in the area may cause short-term frustration, and in some sensitive individuals even health impacts such as asthma, sinusitis or allergies.

The roads in the area are already very busy. During the construction phase and while the road deviation is taking place there may be nuisances such as traffic congestion.

Deviant social behaviour

Deviant social behaviour can be described as the types of social behaviour that might be deviant or anti-social, such as excessive alcohol consumption, illegal drug use, various types of risk-taking behaviour and vandalism. There can be a number of causes of deviant social behaviour. The source can be the local communities or the people that migrated into the area. There are high levels of unemployment and poverty rates are high. Opportunistic criminals from outside the area may use the fact that there will be a large influx of people into the area to try and disguise their criminal intent.

The **first potential impact** is that there may be an increase in crime and disorder. An increase in crime is often associated with construction activities. It is more difficult to control access into the area and there are large numbers of strangers present, which allow opportunistic criminals to take advantage of the situation. There is also more money available in the area. This can lead to an increase in alcohol abuse and prostitution, which in turn also create an enabling environment for crime.

The **second potential impact** is an increase in acts of sabotage as a way to express dissatisfaction. This may be triggered by anything from recruitment processes to disciplinary hearings. This may extend to construction camps should the contractor act in a way that the affected parties feel is to their detriment. Sabotage of vehicles, hijackings and sabotage of construction material are all possible ways in which people can express dissatisfaction if the socially acceptable channels do not offer any solutions. It is difficult to change such a culture once it starts, because the devastating impacts of these acts make the powerless feel empowered. Closely related to this impact is the breakdown of traditional values. Behaviour that used to be unacceptable in the past is now accepted as appropriate. Where respect for authority might have been culturally ingrained, the norm might change when newcomers with different ideas enter the area. Younger people who are unemployed may be especially susceptible to people who encourage them to challenge traditional values. This may cause conflict and social instability in the area.

Mitigation

a) In-migration

It would not be practical for a project proponent to manage impacts that occur in a greater societal context. It is very difficult to control an influx of people into an area, especially in a country where there are high levels of unemployment. It is therefore important to anticipate the impacts and plan accordingly.

- Appoint an independent social monitor (who could also function as the community liaison officer) to assist with management of social impacts and dealing with community issues;
- Consult with the directly affected communities and note special concerns;
- Install proper grievance and communication systems; any incidences must be reported in a complaints register that should be inspected by the social and environmental monitor on a weekly basis. The proponent must audit this document on a monthly basis.
- Involve the community in the process as far as possible – encourage co-operative decision-making and management and partnerships with local entrepreneurs;
- The site of the construction camps must be discussed with local government structures and opportunities for co-operative development should be investigated. The government may for example donate the land and services, whilst the proponent donates the physical infrastructure such as buildings. This should then be left behind after the construction process for the use of the local communities.

- Be accessible and sensitive to community needs.
- Roads should be maintained in the present condition during the construction phase when it will carry extra traffic because of the project.
- The contractor should have a person trained in first aid on site to deal with smaller incidents that require medical input.
- If construction camps with local barracks are used these should adhere to strict environmental requirements. Services should be negotiated with landowners and local municipalities and the proponent should audit the agreements that must be put in place to ensure that essential services are not taken away from communities. Local landowners should be allowed to produce a set of rules to which contractors must adhere if camps are on private property. The environmental and social monitors should inspect this.
- The landowner must sign a release form when the construction team leave his property to ensure that there is no unfinished business on his property.
- The social monitor must check in with the affected landowners on a weekly basis whilst there are construction activities on the property.
- A community liaison committee (CLC) representing the affected community and a construction camp management committee (CCMC) representing the inhabitants of the construction camp should be formed. These two committees can meet every two weeks to discuss any problems arising from the presence and behaviour of the construction workers. They can then agree on appropriate measures to address the problems. The social monitor should attend these meetings and be the liaison between the proponent and the affected communities.
- Should the provision of bulk-services to contractors be to the detriment of the affected communities, these services should be brought in from outside the affected area. When investigating existing accommodation the contractor should ensure that the necessary sanitation services are available and have the capacity to meet the additional needs. This assurance should be given to the proponent in writing.
- The proponent cannot control squatter settlements surrounding towns. The contractor must ensure that no squatter settlements are erected near or adjacent to the construction camp. People should be asked to leave before they have the opportunity to settle. The assistance of the local police and community police forum in this matter will be crucial.
- The contractor must put up signs that no recruitment will take place on site, and all jobseekers must be shown away from site.

- The contractor should not allow his staff to utilise services from squatters, unless these services have been approved.
- There must be a formal trading area for informal traders, but they must not be allowed to sleep where they trade or set up camps in close proximity to the construction camp. The contractor must attend community police forum meetings, and the proponent must become a member of the community police forum.
- HIV/AIDS awareness training must form part of the induction of staff. Condoms must be freely available on site. In conjunction with local NGOs or the Department of Health, these awareness training must also be given at local schools and clinics. The training should include discussions about birth control and the potential long-term risks associated with casual sex. Condoms should also be distributed in local places such as schools, clinics, shebeens and other recreational facilities. The workforce must be discouraged from engaging in casual sexual relationships with local people and informed of the consequences. Local people must be discouraged from entering the construction camp. Rules in this regard can be compiled by the community liaison committee (CLC) and the construction camp management committee (CCMC).
- Access to the construction camp should be controlled. Visitors should be signed in and out and no overnight visitors should be allowed. The code of conduct as agreed with the affected communities and landowners should be adhered to. No alcohol should be sold in the camps, and the amount of alcohol allowed in the camp should be limited. Prostitutes should not be allowed to enter the camp. There should be fines for breaking the rules. Frequent inspections of the camps should take place, and if non-conformances are found payment to the contractor must be withheld until it is corrected.
- The contractor must take out insurance for the damage of local property – this should be a condition of the contract. Proof of this insurance must be given to the proponent.

Resettlement

When mitigation is considered, one should look at the ability of the affected community to recreate or improve their current situation. No person should be worse off than before the proposed project was implemented – the minimum requirement would be for the affected residents to be in a similar economic position than they are currently.

- It is recommended that the relocation/resettlement action plan (RAP), which is currently being compiled, be used as the guiding dopcument for the resettlement process because the RAP is being compiled in accordance with international best practice and includes in-depth participation from the affected residents.

- All agreements between the proponent and the affected residents must be put in writing.
- The affected residents should have a say in terms of the area they will be relocated to.
- The new community who will act as a host to accommodate the affected residents must also be consulted.
- It is recommended that a relocation advisory group, which has a fair representation of the affected residents, must be established. An implementation schedule must be compiled to give the affected communities an indication of time frames. It is also recommended that a census of the affected people should be done.
- Another important aspect would be to compile an inventory of the assets in each household. All assets should be considered – physical assets as well as loss of income – either temporary or permanent – resulting from displacement of household members from employment or income-generating resources (for example vendors from customers).
- Community assets should be recorded separately.
- Once all these inventories have been done, it is recommended that an entitlement matrix should be compiled for each of the categories of affected people. This will ensure that everybody is treated in a fair and equal way.
- A grievance procedure should be put into place to indicate how and where the affected residents can express their grievances should they feel the need to do so, or if things are not being done according to the RAP. This would be an important mechanism to ensure the process run as smoothly as possible. Special effort should be made to ensure vulnerable groups like women, children and the elderly have access to the grievance process.
- The grievance process should include:
    - Institutional arrangements;
    - The procedures of recording and processing grievances;
    - The mechanisms for adjudicating grievances and appealing judgments;
    - A schedule, with deadlines, for all steps in the grievance redress process.
- This should be public knowledge and accessible to all community members.
- The community should be able to choose how they would like to receive the compensation.

- Where people would like to construct their own houses, they must be provided with the materials and funds to do so. If they are not able to construct their own houses, or choose not to, they should be provided with houses ready to occupy.
- Compensation should be paid into a trust account managed by an independent attorney, and from there paid directly to the beneficiaries.
- The affected residents must be the owners of the new houses and provided with the necessary paper work to prove their ownership, to ensure security of tenure.
- As soon as an area has been identified and plots been allocated, the planting of trees should start.
- A schedule should be compiled for compensation payments. It should indicate clearly who is responsible for which payments by which dates.
- Should monetary payments be made, it should be considered to stagger the payments to ensure cash flow for the resettlement process.
- Apart from physical assistance, psychological assistance to the affected communities should be given. This will include empowering them to participate in the process and to adapt to their new circumstances, as well as to establish new livelihoods.

Change in land use

- A number of the impacts on livelihoods will be mitigated through the relocation process.
- Since some of the affected farmers rent land from the mines, it will be difficult to mitigate the impacts on livelihoods should they no longer have access to the rented land. The owners of the land can decide what they feel is the most appropriate use for the land. The people who lease the land know that the rental agreements are temporary. From this perspective it is a normal economic transaction and no mitigation is required. The people who rent the land must be given an adequate warning period to ensure that they have sufficient time to look for alternatives and to establish new ventures. Any new land that becomes available for rent must be offered to these farmers first.
- Environmental nuisances that occur during construction will be temporary. Given the fact that there are existing impacts from industries in the area, many of the nuisances will be cumulative.
- Where possible dust suppression must be used (technical measures included in the relevant specialist study).

- Construction vehicles must travel slowly and loads should be covered where possible.
- No construction work should take place on Sundays, public holidays and during the night.
- Construction vehicles must travel outside peak traffic hours.

Deviant social behaviour

- It is a challenge to mitigate the impact of crime, as it is part of a greater societal problem that affects communities throughout South Africa. From a project perspective it is important to make the area as unattractive as possible to criminals. Access to the construction site must be controlled.
- Contractors and employees of the proponent must wear recognisable uniforms and carry identification cards. There must also be a telephone number that directly affected community members can phone to confirm whether people are employees.
- Community policing in association with farmer's associations and local security groups should be implemented.
- Construction camps must be fenced and local security companies must be employed to patrol the areas where there are active construction activities.
- There must be a well-published, culturally appropriate grievance mechanism. This must be agreed with directly affected communities at the start of the construction period in the area. The communities must give input in the process to ensure ownership. Grievances must be dealt with within a certain period. All grievances must be recorded in a register stating the grievance, date that it occurred and action taken. The aggrieved person should sign a form that explains the grievance, the process followed and what the outcomes were.

Impact Assessment Results

Table 8-12: Impact – Pressure on infrastructure

	Impact of the proposed power station and associated infrastructure – Pressure on Infrastructure	
SITE 6C & Ash 3		
	No mitigation	Mitigation
Extent	Regional	Regional
Magnitude	High	Medium
Duration	Short	Short
SIGNIFICANCE	High (-)	Medium (-)
Probability	Definite	Definite
Confidence	Certain	Sure
Reversibility	Reversible	Reversible

Table 8-13: Impact – Increase in STDs / HIV/AIDS

	a) Impact of the proposed power station and associated infrastructure – Increase in STDs/HIV/AIDS	
SITE 6C & Ash 3		
	No mitigation	Mitigation
Extent	Regional	Regional
Magnitude	High	Medium
Duration	Medium	Long
SIGNIFICANCE	Medium (-)	Medium (-)
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

Table 8-14: Impact – Social Nuisance

b) Impact of the proposed power station and associated infrastructure – Social Nuisance		
SITE 6C & Ash 3		
	No mitigation	Mitigation
Extent	Local	Local
Magnitude	High	Medium
Duration	Long	Short
SIGNIFICANCE	High (-)	Medium-Low (-)
Probability	Definite	Probable
Confidence	Certain	Sure
Reversibility	Reversible	Reversible

Table 8-15: Impact - Resettlement

c) Impact of the proposed power station and associated infrastructure – Resettlement		
SITE 6C & Ash 3		
	No mitigation	Mitigation
Extent	Local	Local
Magnitude	High	Medium
Duration	Permanent	Permanent
SIGNIFICANCE	High (-)	Medium (-)
Probability	Definite	Definite
Confidence	Certain	Certain
Reversibility	Irreversible	Irreversible

Table 8-16: Impact: Loss of productive land

d) Impact of the proposed power station and associated infrastructure – Loss of productive land		
SITE 6C & Ash 3		
	No mitigation	Mitigation
Extent	Local	Local
Magnitude	High	Medium
Duration	Permanent	Long
SIGNIFICANCE	High (-)	Medium (-)
Probability	Definite	Definite
Confidence	Certain	Certain
Reversibility	Irreversible	Reversible

Table 8-17: Impact – Property price

e) Impact of the proposed power station and associated infrastructure – Property prices		
SITE 6C & Ash 3		
	No mitigation	Mitigation
Extent	Local	Local
Magnitude	Medium	Medium
Duration	Medium	Medium
SIGNIFICANCE	Medium (-)	Medium (-)
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Irreversible	Irreversible

Table 8-18: Impact - Traffic

f) Impact of the proposed power station and associated infrastructure – Traffic		
SITE 6C & Ash 3		
	No mitigation	Mitigation
Extent	Local	Local
Magnitude	High	Medium
Duration	Long	Long
SIGNIFICANCE	High (-)	Medium (-)
Probability	Definite	Definite
Confidence	Certain	Sure
Reversibility	Reversible	Reversible

Table 8-19: Impact – Crime and Saftey

g) Impact of the proposed power station and associated infrastructure – Crime and safety		
SITE 6C & Ash 3		
	No mitigation	Mitigation
Extent	Regional	Regional
Magnitude	High	Medium
Duration	Short	Short
SIGNIFICANCE	Medium (-)	Medium-low (-)
Probability	Highly Probable	Probable
Confidence	Certain	Sure
Reversibility	Reversible	Reversible

8.8.3. Comment on Cumulative Impacts

Cumulative impacts can be viewed in two ways. The first is to add impacts that may be caused by this project to impacts caused by other projects in the area. The second way in which to understand cumulative impacts is to look at it from the reference point of the receiver as the totality of the impacts experienced. From the first perspective it must be taken into consideration that there are existing construction activities in the project area, so there may already be an influx of construction workers in these areas. Therefore many of the impacts that were described may already be occurring in the area. From the second perspective, the communities that will get the brunt of these impacts must be considered. This will depend where the construction camp will be situated, but it can be assumed that existing informal settlements will increase and therefore that conditions in these settlements may deteriorate. The impact on road users will also increase, especially with the deviation of the road and the additional trucks on the already busy road. Acts of sabotage is already used by some of the local residents as a form of retribution. There is a risk that this may become the accepted way of dealing with grievances in the eyes of the affected communities.

8.9. Employment (Positive and Negative)

8.9.1. Impact Statement

The construction of the proposed power station could have an impact on the economic development of the local, regional and/or national level. It is estimated that at peak construction time (a period of six to eight months) approximately 1200 people will be employed, with approximately 900 people during the remaining construction period.

8.9.2. Discussion

The first potential impact is the loss of workers in other industries to the construction team. This risk increases with semi-skilled workers. It is beneficial to the contractor to employ local people, because it takes the responsibility of supplying housing away from them. Since the contractors only employ people in the short term, they are able to offer better payment. Whilst it will not be fair to deny people a better income, the long-term implications must be explained to them. In areas with high unemployment rates there are enough unemployed people that need to benefit from employment, and the focus of recruiting should be on these individuals.

The construction process will create a number of opportunities for low skilled people. The focus should be on local people who are not employed elsewhere. There is a risk that women will not be given equal opportunities to men because of the perception that they cannot do manual labour. This will have a negative impact on the number of opportunities for women. If local people, including women, are employed, this will have a very positive short-term impact, and if there is sufficient transfer of skills the positive impact can be extended.

Another positive impact is the indirect employment opportunities that will be created. These opportunities will be experienced in the industries that provide services to the construction team such as transport, hospitality and equipment rental etc.

These opportunities can also be extended to local entrepreneurs such as women's groups that provide a laundry service or sell meals.

Mitigation

- Local unemployed people must be given preference in the recruitment process.
- Contractors must refrain from employing people who are currently employed in permanent positions.
- There must be employment desks in the towns or settlement areas. No recruitment may take place in the construction camps.
- A standard recruitment policy must be implemented across the project area, especially if more than one contracting firm is used.
- The local recruitment process must be agreed with local leadership.
- This process must then be advertised in an accessible way – radio advertisements, community meetings and press releases in local languages.
- No false expectations must be created and it must be underlined that the employment opportunities are specifically for the unemployed.
- A percentage of the workforce must be female.
- Indirect employment/entrepreneurship opportunities must be enhanced. The IPP and the contractor must support local entrepreneurs as far as possible.
- It must be acknowledged that there will be local entrepreneurs trying to sell their goods to the construction force. Unless managed carefully this may lead to squatter camps near the construction camps. The contractor should provide a designated area where such services can be provided – the area should ideally form part of the construction camp and be cleared and fenced.
- No open fires must be allowed. Food should rather be prepared off-site and transported in, or people can be encouraged to sell food parcels.
- The vendors must also travel in and out of the area and should not be allowed in the construction area outside the designated area. The social monitor must assist in managing this process.

a) Impact Assessment Results

Table 8-20: Imapct – Loss of workers

a) Impact of the proposed power station and associated infrastructure – Loss of workers to construction team –negative (-)		
SITE 6C & Ash 3		
	No mitigation	Mitigation
Extent	Regional	Regional
Magnitude	Medium	Low
Duration	Short	Short
SIGNIFICANCE	Medium (-)	Low (-)
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

Table 8-21: Imapct – Job oppertunities

b) Impact of the proposed power station and associated infrastructure – job opportunities – Positive (+)		
SITE 6C & Ash 3		
	No mitigation	Mitigation
Extent	Regional	Regional
Magnitude	High	Very High
Duration	Short	Short
SIGNIFICANCE	Medium (+)	High (+)
Probability	Highly Probable	Highly Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

Table 8-22: Impact – Indirect emploment oppertunities

c) Impact of the proposed power station and associated infrastructure – indirect employment opportunities Positive (+)		
SITE 6C		
	No mitigation	Mitigation
Extent	Local	Regional
Magnitude	High	Very High
Duration	Short	Short
SIGNIFICANCE	Medium (+)	High (+)
Probability	Highly Probable	Definite
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

8.9.3. Comment on Cumulative Impacts

Cumulative impacts on local entrepreneurs will be positive and assist in developing their businesses further.

8.10. Noise Impact

8.10.1. Impact Statement

The construction of a coal-fired power station and its associated infrastructure may elevate the ambient noise levels in the vicinity of the power station site and the surrounding areas to unacceptable levels, as defined in the SANS 10103 standards.

8.10.2. Discussion

In order to predict the likely impact that the construction of the proposed power station (associated infrastructure and ash disposal site), would have on noise levels in the area, and to determine the likely compliance with the relevant South African noise standards, a detailed noise impact assessment study was undertaken by Mr Derek Cosijn of Jongeens, Keet and Associates. The assessment was undertaken in accordance with the requirements of the South African National Standards SANS 10328 (SABS 0328) Methods for Environmental Noise Impact Assessments.

A complete description of the methodology applied and the full findings of the study are included in the attached full report (see complete report included in **VOLUME 3**).

The following conditions were observed in the study area and the following aspects were determined from the surveys, calculations of noise indicators and the predictive modelling undertaken for the assessment of the noise impact of the planned new power station project.

General aspects of note were as follow:

- The main sources of noise in the area are from:
  - Traffic on the main roads in the study area
  - Several mines/collieries.
  - Rail traffic through the area (main lines and industrial spur lines).
  - General farming activities (not major source of noise).
  - Traffic on the farm (gravel) roads. This is an intermittent source of noise.
- The main noise sensitive receptors in the area are:
  - Various suburban and rural residences.
  - Schools in Emalahleni and farm schools in the rural areas.
  - Several hospitals

Due to the complexity of the mining and industrial land uses in the area, the noise footprints of the major noise sources have been calculated and modelled. These are:

- The surface infrastructure at the Landau, Greenside and Kleinkopje Collieries.
- Road traffic noise.
- Railway traffic noise.

a) Summary of Baseline Noise Climate

It was found that residual noise levels across the study area varied significantly:

- Noise levels in many parts of the study area were found to be high; specifically the areas close to the main roads and colliery operations. In these areas, the existing residual noise climate is typical of an urban environment as defined in SANS 10103:2008, that is, areas where ambient noise levels generally do not exceed 55dBA during the day and generally do not exceed 45dBA during the night-time. In areas adjacent to the colliery operations, short-term noise levels in excess of 70dBA were measured.

- In areas remote from these sources of noise, rural conditions prevailed. In these areas, the existing residual noise climate is typical of a rural environment as defined in SANS 10103:2008, that is, areas where ambient noise levels generally do not exceed 45dBA during the day and generally do not exceed 35dBA during the night-time.
- These areas are interspersed with developments where the existing residual noise climate is typical of a suburban environment as defined in SANS 10103:2008, that is, areas where ambient noise levels generally do not exceed 50dBA during the day and generally do not exceed 40dBA during the night-time.

Construction Noise

Construction will likely be carried out during the daytime only (07h00 to 18h00 or 20h00). It should however be noted that certain activities may occasionally extend into the late evening period, while others such as de-watering operations may need to take place over a 24-hour period. It is estimated that the development of the project will take place over a period of about 18 months to 24 months.

b) Sources of Noise

The following, where relevant, are likely to be the main construction related sources of noise for the planned surface workings and related infrastructure:

- Construction camp establishment.
- Removal and demolition of existing infrastructure that is no longer needed or needs to be replaced.
- Earthworks to remove topsoil and overburden at open cast pits.
- Activities related to the relocation of services.
- Excavation of heavy plant/building foundations and service trenches. Blasting may be required in places but in general pneumatic breakers will be used where rock is encountered.
- Erection of shuttering for concrete works.
- Fixing of steel reinforcing.
- Placing and vibration of concrete. Poker vibrators will be used.
- Stripping of shuttering after concrete pour.
- Erection of structural steelwork.
- Finishing operations on buildings. Cladding, services installation, etc.

- Installation of plant and equipment.
- General movement of heavy vehicles such as concrete delivery vehicles, mobile cranes, mechanical dumpers and water trucks (dust suppression) around the site.
- De-watering pumps. A 24-hour operation may sometimes be necessary.
- Road construction equipment. Scrapers, dozers, compactors, etc. (Construction of the internal road system, and access roads).
- Construction of the section of Road D2257 which has to be realigned around the northern side of the power station property.
- Construction site fabrication workshops and plant maintenance workshops.
- Concrete batching plant.
- Asphalt batching plant.
- Construction material and equipment delivery vehicles.

The level and character of the construction noise will be highly variable as different activities with different plant/equipment take place at different times, over different periods, in different combinations, in different sequences and on different parts of the construction site. Typical noise levels generated by various types of construction equipment are given in Table 8-23. These noise levels assume that the equipment is maintained in good order. Conservative attenuation conditions (related to intervening ground conditions and screening) have been applied.

Table 8-23: Typical noise levels generated by construction equipment

Plant/Equipment	Typical Operational Noise Level at Given Offset (dBA)							
	5m	10m	25m	50m	100m	250m	500m	1000m
Air compressor	91	85	77	71	65	57	51	46
Compactor	92	86	78	72	66	58	52	46
Concrete mixer	95	89	81	75	69	61	55	49
Concrete vibrator	86	80	72	66	60	52	46	40
Mobile Conveyor belt	77	71	63	57	51	43	37	32
Crusher (aggregate)	90	84	76	70	64	56	50	44
Crane (mobile)	93	87	79	73	67	59	53	47
Dozer	95	89	81	75	69	61	55	49
Loader	95	89	81	75	69	61	55	49
Mechanical shovel	98	92	84	78	72	64	58	52
Pile driver	110	104	97	91	85	77	71	65
Pump	86	80	72	66	60	52	46	40
Pneumatic breaker	98	92	84	78	72	64	58	52
Rock drill	108	102	94	88	82	74	68	62
Roller	84	78	70	64	58	50	44	38
Trucks	87	81	73	67	64	60	57	54

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 for the various components, work *modus operandi* and type of equipment have not been finalised. Using baseline data from typical construction sites, the ambient noise conditions at various offsets from the following main construction activities are predicted:

- Noise from concrete batching plant.
- General concrete construction in the proposed power station area
- Construction of the coal washing plant.

- Refer to Table 8-24 and Figure 8-5.

Table 8-24: Predicted ambient noise levels at given offsets from some spesific construction activities

Equipment	Sound pressure level at given offset(dBA)					
	500m	1000m	1500m	2000m	2500m	3000m
Concrete Batching Plant	53.6	46.0	41.1	37.5	34.7	32.3
Concreting Operations	57.2	49.1	43.9	40.1	37.1	34.6

Noise Impacts

The general nature of the noise impacts from the power station and washing plant construction sites is predicted to be as follows:

- 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.
- Working on a worst case scenario basis, it is estimated that the ambient noise level from general construction activities could negatively affect noise sensitive sites within a distance of 1400 metres of the construction site. Note that this is the offset of the 45dBA noise contour from the construction. Virtually none the noise sensitive receptors outside the power station property will be impacted by and ambient noise climate greater than 45dBA during construction.
- Night-time construction could have a significant impact on noise sensitive sites within a radius of 3000 metres of the construction site.
- There are some short-term noises that may, at times, be heard beyond the indicated positions of the respective 35dBA contours, for example blasting). There are likely to be some significant noise nuisance effects from these intermittent loud noises on some people living in the area.
- It has been estimated that the construction activities at the power station site will on average generate about 1460 vehicle trips (two way trips) daily. The main percentage of the trips will be concentrated in the morning and evening peak periods. In general, the construction traffic will have a relatively minor effect on the noise climate alongside the main external roads in the area. Because of the character of

the traffic (namely heavy vehicles), there is likely to be some noise nuisance factor with the passing of each vehicle at noise sensitive receptors along the access routes.

- There are a number of noise sensitive receptors in the vicinity of the development site that are likely to be affected by construction noise. The nature of the impact will be related to more to noise nuisance (annoyance) than to noise disturbance.

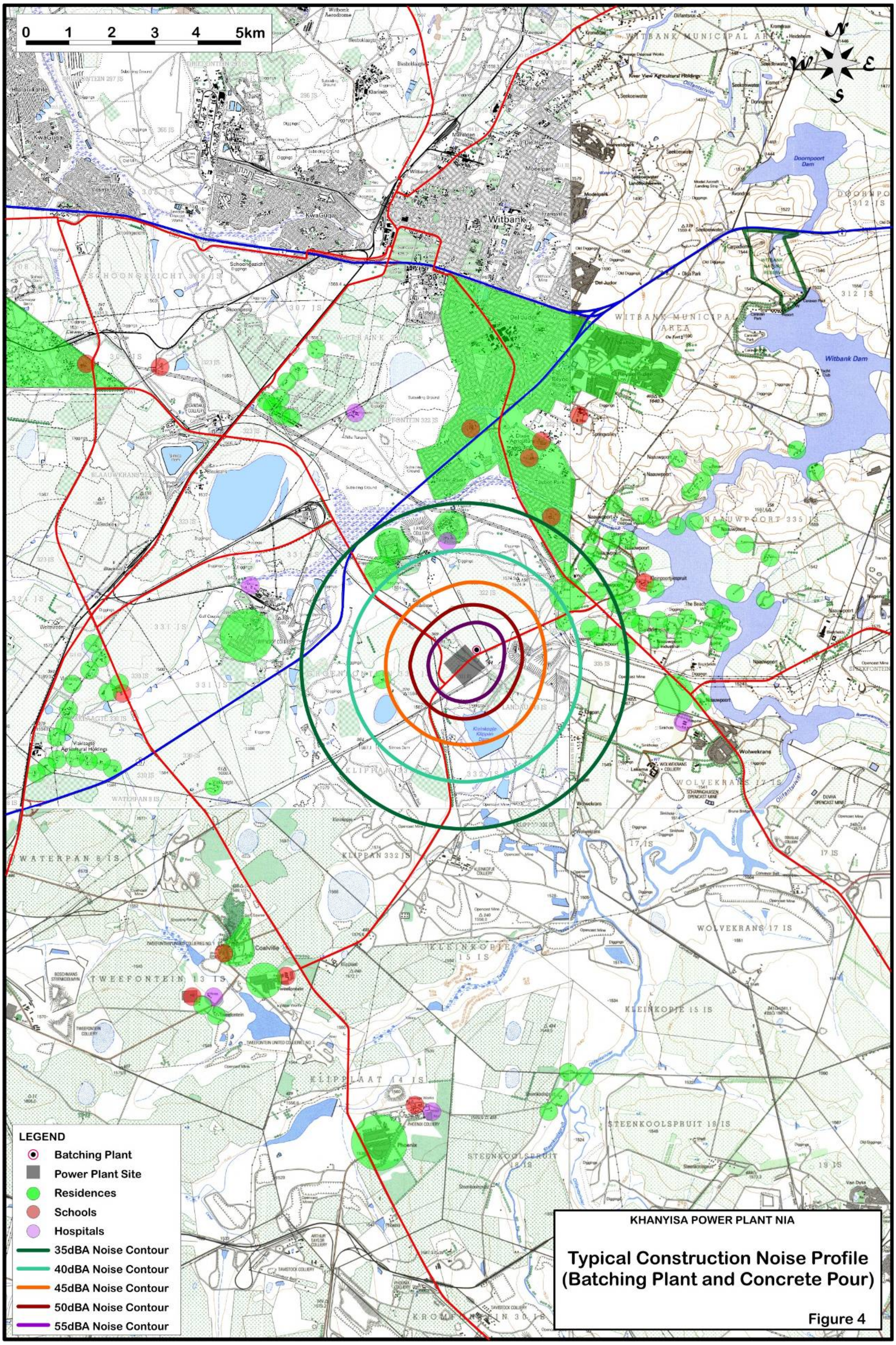


Figure 8-5: Typical construction noise profile

- The general nature of the noise impacts from road construction (internal roads, access roads and realignment of Road D2257) activities is predicted to be as follows:
  - The level and character of the construction noise will be highly variable as different activities with different plant/equipment take place at different times, over different periods, in different combinations, in different sequences and on different parts of the construction site.
  - As no specific construction details or possible locations of major ancillary activity sites are available at this stage, the anticipated noise from various types of construction activities cannot be calculated accurately. In general at this stage, it can be said that the typical noise levels of construction equipment at a distance of 15 metres lie in the range of 75 decibels (dBA) to 100dBA. Refer also to Table 8-23. Based on data from similar "linear" construction sites, a one-hour equivalent noise level of between 75dBA and 78dBA at a point 50 metres from the construction would be typical for the earthmoving phase.
  - There are no noise sensitive receptors in the vicinity of the development site that are likely to be affected by noise from the road construction.

It should be noted that higher ambient noise levels than recommended in SANS 10103 are normally accepted at the noise sensitive receptors as being reasonable during the construction period, provided that the very noisy construction activities (refer to Table 8-23) are limited to the daytime and that the contractor takes reasonable measures to limit noise from the work site. Note that it has been assumed that construction will generally take place from 06h00 to 18h00 with no activities (or at least no noisy construction activities) at night. From the details presently available, it appears that the construction noise impact is not likely to be severe if good noise management procedures are applied on site and various mitigation measures implemented.

Mitigations

- Local residents should be notified of any potentially noisy field survey works or other works during the planning and design phase and these activities should be undertaken at reasonable times of the day. These works should not take place at night or on weekends.
- Construction site yards and other noisy fixed facilities should be located well away from noise sensitive areas adjacent to the development sites.
- All construction vehicles and equipment are to be kept in good repair.

- Where possible, stationary noisy equipment (for example compressors, pumps, pneumatic breakers,) should be encapsulated in acoustic covers, screens or sheds. Proper sound insulation can reduce noise by up to 20dBA. Portable acoustic shields should be used in the case where noisy equipment is not stationary (for example drills, angle grinders, chipping hammers, poker vibrators).
- Construction activities, and particularly the noisy ones, are to be contained to reasonable hours during the day and early evening.
- With regard to unavoidable very noisy construction activities in the vicinity of noise sensitive areas, the power station should liaise with local residents on how best to minimise the impact.
- Machines in intermittent use should be shut down in the intervening periods between work or throttled down to a minimum.
- In general, operations should meet the noise standard requirements of the Occupational Health and Safety Act (Act No 85 of 1993).
- Construction staff working in areas where the 8-hour ambient noise levels exceed 75dBA should wear ear protection equipment.

It should be noted that any mitigation measures taken at the development sites will limit the impacts in the specific areas designed for, but will not necessarily contribute to improving the degraded noise climates in adjacent areas where there is already a problem.

Impact Assessment Results

Table 8-25: Impact – On associated infrastructure

Impact of the proposed power station and associated infrastructure		
SITE 6C & Ash 3		
	No mitigation	Mitigation
Extent	Local	Local
Magnitude	Low	Low
Duration	Short	Short
SIGNIFICANCE	Low (-)	Low (-)
Probability	Definite	Probable
Confidence	Certain	Certain
Reversibility	Reversible	Reversible

8.10.3. Comment on Cumulative Impacts

The cumulative effects of noise sources in close proximity to each other are calculated on a logarithmic scale. The greater the difference in the noise levels, the less the cumulative effects will be. If the difference in the levels of two noise sources is approximately 10dBA, the louder of the two sources (the prevailing noise) will only be increased by 0.4dBA. If the two noise sources are approximately at the same level, the cumulative increase will be only 3dBA (not perceptible by most humans).

8.11. Visual Impact

8.11.1. Impact Statement

The predicted project impacts were found to be **Probable** but of **Low** significance. Initial stages of the construction would have a **Local** extent, with the expansion to Regional as the structure increases in height. A visual impact assessment was conducted by Visual Resource Management Africa and the complete report is part of **VOLUME 4**.

8.11.2. Discussion

The proposed power station site is characterised by mainly flat ground at the end of a gentle spur which drops off slightly to the south, west and north. Vegetation, to the north and west consists of agricultural fields which are utilised for growing maize. This would offer some scenic quality, with the backdrop of the surrounding dumps, which are not visually significant. The other feature of the site is the row of Gum trees (*Eucalyptus grandis*) which lines the road. This type of tree line is fairly common within the greater landscape and offers good screening opportunities from the surrounding mining activities. The attention of the casual observer is dominated by the frequent, very large landscape modifications associated with the coal mining industry surrounding the property.

Figure 8-6: View of N12 to eMalahleni showing regional landscape character [29]

There is little variation with regard to extent mitigation due to the very large size and scale of the project. The magnitude would be **Low** for all stages of the project due to the significantly modified and degraded state of the regional landscape. The landscape reflects many mining activities and associated infrastructure as well as the common visual influence of two other power stations. As a consequence, the significance of the impact is **Low**. Sufficient time was spent on site (two visits) as well as a detailed 3D modelling and photo montage exercise has resulted in **High** levels of confidence.

The site for the proposed ash dump is located to the south and east of the Benella mine dumps as well as the mine works of the Kleinkoppie mine. These features significantly detract from the landscape character of the area. To the south of the site is a mine access road which is cut into the terrain which links the Kleinkoppie mine works to the mine site in the north-west, which in effect creates two rectangular pieces of ground. The terrain rises gently from south-east to north-west but has no dominant topographic feature. The vegetation consists of veld grasses, which is currently utilised for agriculture. To the south of the site, there is a centre pivot irrigation system.

[29] source: http://farm3.static.flickr.com/2321/2143803748_7789f4a3d2_b.jpg

Both of the two power line alternatives head in a northerly direction to link up with the 400kV power lines located approximately 3 km to the north. Alternative 1 heads due north and bends slightly as it passes close by the Landau Colliery residential area to the east. Three 400kV powerlines are already located in close proximity to this residential area and as such the sense of place is already strongly associated with the transmissions lines. In terms of general landscape character, the northern areas is characterised by veld grasses / vacant land over which the power line would pass before joining with the existing 400 kV lines. To the west along the line of the existing three power lines is similar to the views to the north. To the south is the Emalahleni residential area located 9 km away. As the existing three 400 kV powerlines are located between the receptors and the proposed Alternative 1 line, the new landscape modification would not result in a significant change to the existing landscape character as seen from northern receptors.

All stages of the construction of the proposed power lines and road diversion would have a **Local** extent and a **Low** magnitude as the power line is a realignment and as such the visible change will be absorbed into the existing context.
The power line will be permanent and as such the duration will be **Long term**. The significance would be **Low** but the impact will take place. The confidence of the decision making is **High**.

Mitigation

- Lights at night need to be kept to an efficient minimum as they can significantly increase the visual influence of the proposed landscape modification. As much as possible, down lighting should be used.
- Even though the landscape is degraded, it is recommended that every effort be made to reduce the visual intrusion.
- A line of trees needs to be planted between the road and the construction site to provide screening of the construction site and future plant.
- Top soil on the site needs to be removed from the construction site and formed into low berms along the Tweefontein Road to assist with localised screening. Soil would also be used for rehabilitation of areas cleared during construction phase needing re-vegetation.
- The section of the old road that will not be used needs to be broken up and removed and utilised as fill / reused in the construction of the new access road.
- Top soil from the road construction area needs to be stockpiled in a suitably protected area and used to cover the exposed earth areas not surfaced.

- All modified areas not capped need to be covered with top soil and rehabilitated with veldt grasses.
- Erosion measures need to be implemented to ensure that visual scarring does not take place.
- For preparation of the ash dump site, top soil needs to be harvested and stock piled in a suitable location outside of the views of the receptors.
- An initial 5m ‘berm’ needs to be constructed on the outside of the dump to screen off the initial construction activities and associated impacts. This needs to be shaped to a 1 in 7 slope and then covered with top soil and the rehabilitation immediately started using indigenous type vegetation.
- Dust control measures need to be implemented and monitored.

a) Impact Assessment Results

Table 8-26: Impact – Visual aesthetics

Impact of a power station and associated infrastructure on visual aesthetics		
SITE 6C & Ash 3		
	No mitigation	Mitigation
Extent	Regional	Regional
Magnitude	Low	Low
Duration	Long	Long
SIGNIFICANCE	Low (-)	Low (-)
Probability	Probable	Probable
Confidence	Certain	Certain
Reversibility	Reversible	Reversible

8.11.3. Comment on Cumulative Impacts

The landscape character of the area is moderate to low due to the existing electrical power lines, mine dumps and run down industrial and alien infested type landscapes that characterize the location. The proposed power station is located within a highly modified coal mining landscape with the Duvha Power Station located approximately 10 km from the site and15 km from eMalahleni/ Witbank. The landscape is characterised by high levels of contrast and reflects a Class IV type landscape which is suitable for large / high contrast generating landscape modifications. Due to the degraded nature of the surrounding regional landscape, the cumulative impacts would be **Low**.

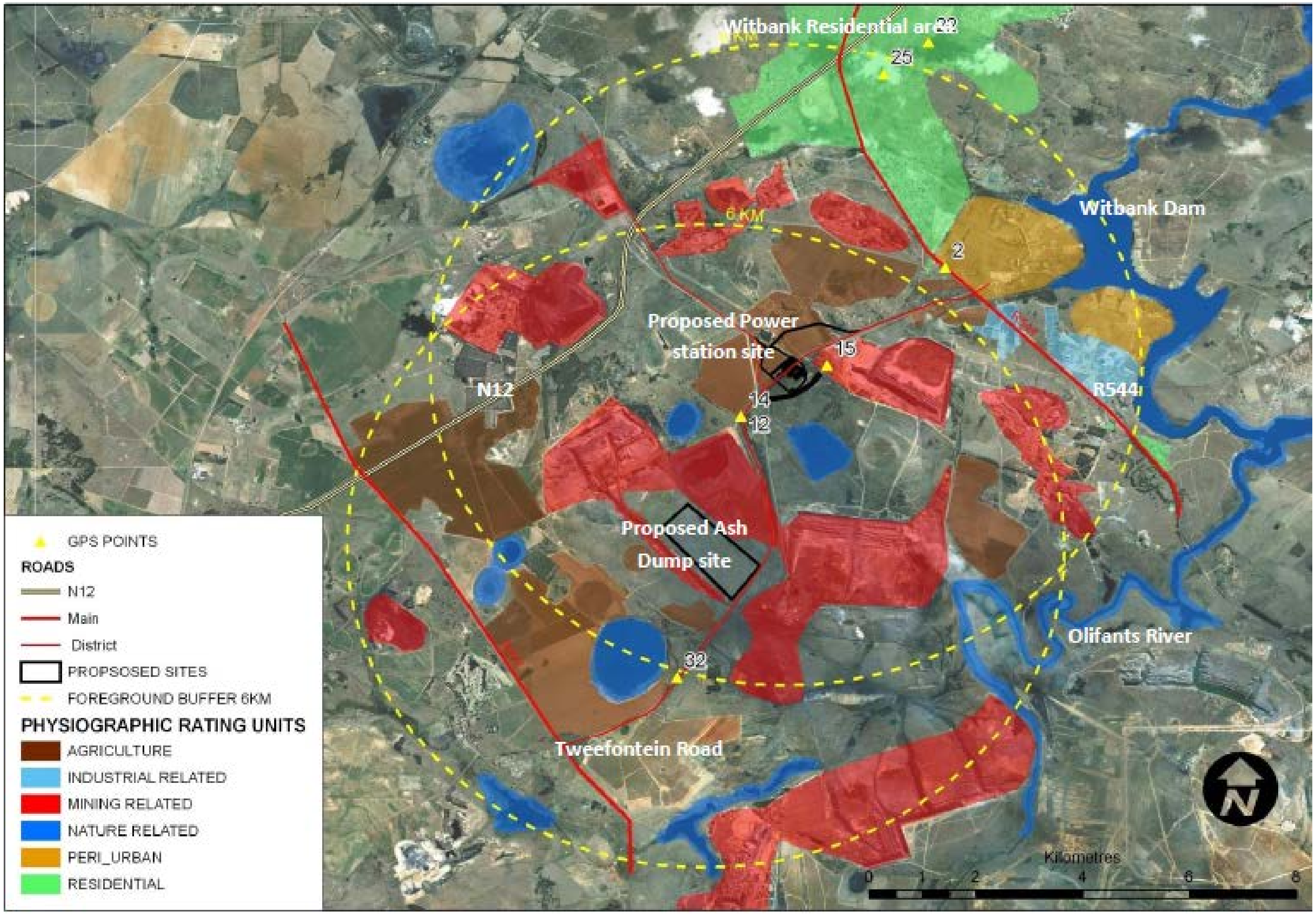


Figure 8-7: Physiographic rating units map

8.12. Air Quality Impact

8.12.1. Impact Statement

The construction activities would result in the large scale earth moving activities, which are likely to result in an increase in the amount of dust that is blown off the site. This could have a negative impact on sensitive receptors, including residential and recreational areas

8.12.2. Discussion

As part of the detailed Air Quality assessment undertaken by Airshed Planning Professionals, dispersion modelling provided expected ambient air concentration levels and associated dispersion patterns for PM_{10}, at an operational level for the proposed power plant and associated mines. It is recognised that the construction phase would result in dust emissions. However, based on the expected duration of the construction phase (i.e. 27 months[30]), the potential dust impacts are considered to be relatively minimal and thus were not modelled as part of the air quality analysis.

In order to understand the potential dust impacts associated with the proposed project, regional climate and local air dispersion potential of a site is essential. Meteorological characteristics of a site govern the dispersion, transformation and eventual removal of pollutants from the atmosphere. The extent to which pollution will accumulate or disperse in the atmosphere is dependent on the degree of thermal and mechanical turbulence within the earth's boundary layer. Dispersion comprises vertical and horizontal components of motion that are primarily influenced by wind velocity. The closest accredited meteorological station to the Khanyisa project which records hourly average wind speed, wind direction and temperature data is the Eskom station at Kendal, approximately 25 km to the west of the Khanyisa site and the South African Weather Service Site at Witbank (eMalahleni) approximately 15 km to the northwest. Given the proximity and the nature of the terrain, the data from both stations is considered to be suitably representative of the conditions at Khanyisa. However the data availability at the Kendal Site was better, with fewer periods of missing data, therefore this data was used for the analysis. Please refer to Figure 8-8 below indicating the seasonal wind roses for the Kendal Site from 2004 – 2008.

[30] The construction will be phased, with Phase 1 lasting approximately 9 months and Phase 2 lasting approximately 18 months.

The spatial variability in the wind field is clearly evident in Figure 8-8 below, with dominant winds from the east and the west-north-westerly sectors experienced during all seasons. Easterly winds are particularly dominant in the Khanyisa area during the summer and autumn, with west north-westerly winds characterising the Khanyisa region during winter and spring. It is evident that during winter and spring, northerly winds are common, whereas east north-easterly winds are experienced during the summer and autumn. Based on the Air Quality Analysis, six sensitive receptors were identified in the eMalahleni area, comprising mainly of residential and recreational landuse.

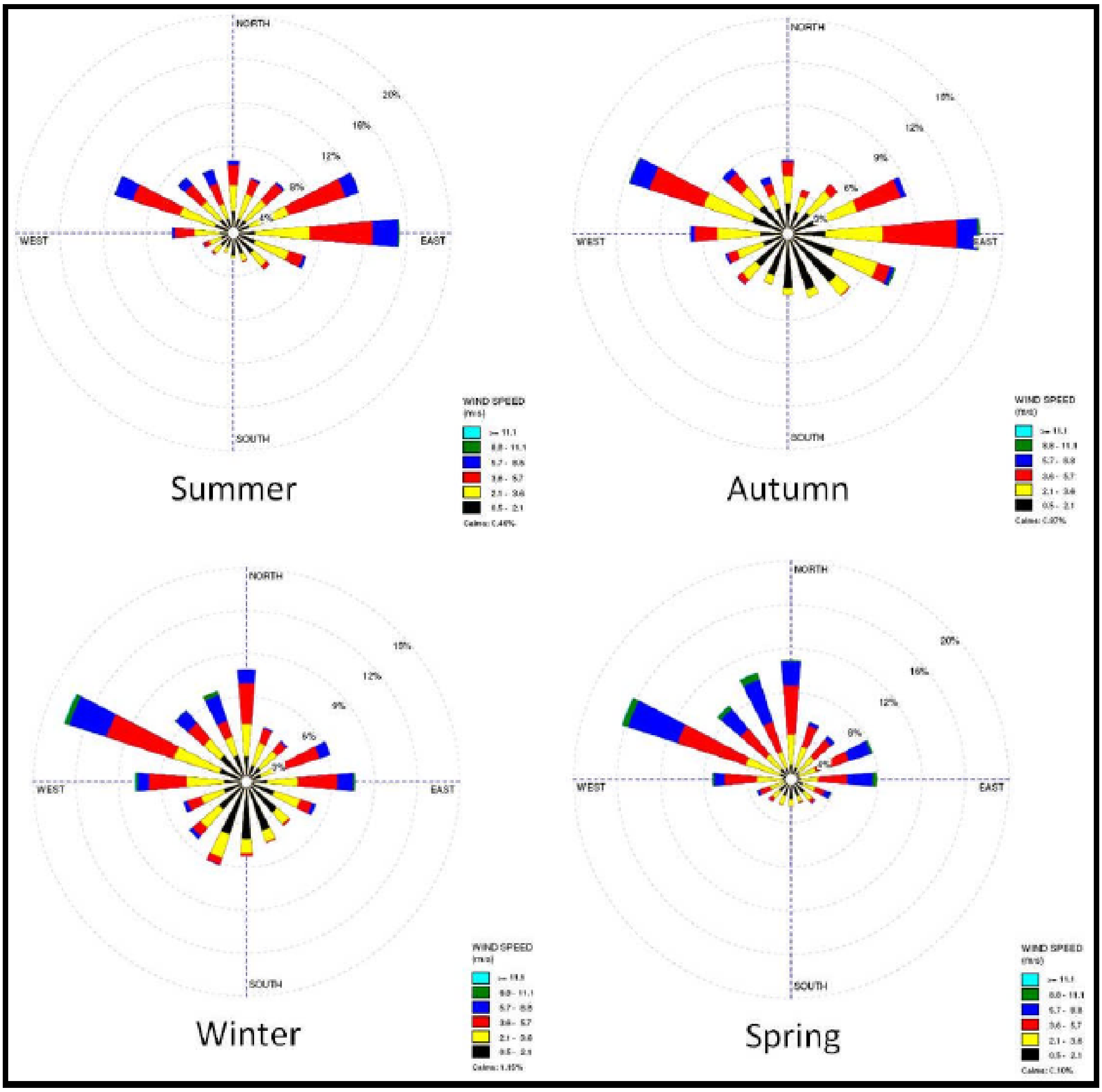


Figure 8-8: Seasonal Wind Roses from 2004 – 2008 at Kendal

Based on the dominant wind direction experienced at a seasonal level, dust plumes during construction are likely to affect areas to the south east and south west to south of the site during all seasons. Based on the wind roses for winter and spring, dust is likely to disperse in a northerly direction, towards the sensitive receptors. Due to the proximity of the sensitive receptors, it is unlikely that dust will impact the eMalahleni area.
As indicated in the Ambient Air Quality Impact Assessment (refer to Chapter 7), particulate matter (including PM_{10}) concentrations currently exceed the NAAQ standards, due to high background values. Furthermore, exceedances are expected to be limited to the property boundaries, with the sensitive receptors experiencing limited increases in PM_{10} concentrations.

Recognising that construction phase impacts are temporary in nature and based on the proximity of the six sensitive receptors (10 km north of the site), potential dust impacts during the construction phase are considered to be of a low magnitude, site specific and construction duration and therefore of **very low (-ve)** significance, without mitigation.

Mitigation

Implementation of dust control measures, including but not limited to:

- Watering down of exposed areas.
- Limiting the extent of area cleared at any one time for construction purposes.
- Phased rehabilitation of areas throughout the construction period, upon completion of construction within those specific areas.
- Earth moving activities shall be limited to the summer and autumn months, where possible.
- Application of Dust Tech during extended periods of no construction (i.e. holiday periods and temporary site closure).

All of the above construction phase impacts would be managed through the implementation of the construction EMP. The purpose of the construction EMP would be to protect sensitive onsite and offsite features through controlling construction activities that could have a detrimental effect on the environment. The framework EMP is contained in **ANNEXURE J** of this report. A construction specific EMP would be developed if the project is approved, and would be designed to incorporate the specific conditions required in terms of DEA's Environmental Decision, and would be based on the framework EMP. Despite the implementation of the suggested mitigation, the significance of the impact is likely to remain of **very low (-ve)** significance.

The results of the impact assessment are contained in Table 8-27 below.

a) Impact assessment results

Table 8-27: Impact – Associated infrastructure

Impact of the proposed power station and associated infrastructure		
SITE 6C		
	No mitigation	Mitigation
Extent	Site	Site
Magnitude	Low	Low
Duration	Construction	Construction
SIGNIFICANCE	Low (-)	Very Low(-)
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

8.12.3. Comment on cumulative impacts

The construction phase of the proposed project would last for approximately 27 months. Earth moving activities are likely to result in an increased concentration of PM_{10} in the immediate vicinity. Whilst construction of the proposed power plant and associated infrastructure would result in dust emissions, cumulative values of PM_{10} in the area will continue to exceed South African standards, due to existing elevated baseline concentrations in the area. Construction activities are defined are short term impacts, and thus the potential cumulative impacts of the proposed project would likely result in a minimal increase in dust concentration levels in the region

9. ASSESSMENT DECOMMISSIONING PHASE IMPACTS ON THE BIOPHYSICAL AND SOCIO-ECONOMIC ENVIRONMENTS

9.1. INTRODUCTION

This Chapter describes the potential decommissioning phase impacts on the biophysical and social environments, which may occur due to the proposed activities described in Chapter 3.

Each of these impacts is assessed in detail, and the significance of the impact is determined in the following sections. The methodology used to assess the potential impacts is detailed in Chapter 6 of this report. The terms "No Mit" and "Mit" reflected in the assessment tables in this chapter refer to the impact with no mitigation and with potential mitigation[31], respectively.

9.2. DECOMMISSIONING PHASE IMPACTS ON THE BIOPHYSICAL AND SOCIAL ENVIRONMENTS

These impacts relate to the short-term impacts that occur during the decommissioning phase of the project, which is only likely to occur once the project has operated for at least 50 years the design life of the project). The proposed power station would be decommissioned over a period of some 3 years, with removal of machinery, dismantling of buildings, including the power station precinct, removing conveyor belts and transmission lines, and capping, closure and rehabilitation of the ash dump. Foundations and infrastructure such as roads and underground pipelines would however remain in place.

[31] Note that this does not imply that mitigation should or would be undertaken, but merely indicates the extent to which mitigation could change the significance of the impact where it is to be implemented.

The following potential impacts have been identified as relevant to the decommissioning of this project:

- Terrestrial fauna and flora;
- Ambient air quality;
- Climate change;
- Groundwater resources;
- Visual aesthetics;
- Noise;
- Traffic;
- Soils and Land Capability;
- Societal risk
- Local economy

Composite Assessment

As noted above these potential decommissioning impacts would take place after the 50 year lifespan of the proposed power station. As such the socio-economic and biophysical environments within which they occur are likely to have undergone changes. As such the magnitudes of these impacts are not easily identified. It should be noted that the baseline against which these potential impacts are assessed against is the future baseline, not the current baseline, i.e. the existence of the proposed power station and potentially other industries in the area.

In general, the decommissioning and closure phase would include the following activities:

- The removal of all infrastructure;
- The demolishing of all concrete slabs and ripping of any hard surfaces;
- The backfilling of any open voids and deep foundations and the reconstruction of the required barrier layer (compaction) wherever feasible and possible;
- Topdressing of the disturbed and backfilled areas with the stored "utilizable" soil ready for re-vegetation;
- Fertilization and stabilization of the backfilled materials and final cover materials (soil and vegetation) and
- The landscaping of the replaced soils to be free draining.

These impacts are assessed in a composite assessment and the overall significance of the impacts is determined below. The methodology used to assess the potential impacts is detailed in Chapter 6 of this report.

The terms “No Mit” and “Mit” reflected in the assessment tables in this chapter refer to the impact with no mitigation and with potential mitigation[32], respectively.

9.3. Composite Assessment

9.3.1. Terrestrial fauna and flora

The proposed power station would have resulted in a loss of habitat and fauna within the Eastern Highveld Grassland vegetation type. According to Prof. A.E van Wyk (pers.comm, 2011), it is very difficult to rehabilitate temperate grassland to its original floristic diversity since this is a product of evolution over millennia. However, the decommissioning of the power station and rehabilitation of the disturbed sites (e.g. ash dump, waste site) with indigenous plants is likely to result in a positive impact on this unique and vulnerable vegetation type as natural vegetation is encouraged to re-establish itself. From an ecological perspective, re-colonisation of the area would naturally occur over time and fauna driven away by the operation of the power station (i.e. due to the noise and presence of humans) may return to site, although some fauna, habituated to the normal power station operations may be driven away temporarily during the decommissioning phase.

9.3.2. Ambient air quality

Decommissioning of the power station could result in large quantities of dust in the short term, and associated negative impacts on air quality. Dust control measures would limit the impact of this impact. The decommissioning of the power stations would result in an improvement in air quality through the discontinuance of coal burning operations.

9.3.3. Climate change

[32] Note that this does not imply that mitigation should or would be undertaken, but merely indicates the extent to which mitigation could change the significance of the impact where it is to be implemented.

The decommissioning of the power station would discontinue the carbon and GHG emissions. As such the impact on climate change would discontinue, although the impact on climate change would be irreversible.

9.3.4. Groundwater resources

Decommissioning of the power station would involve the capping of the waste site and ash dump. Clean and dirty water dams would most likely be filled and rehabilitated. As such the sources of risk to groundwater would be discontinued. While some risk would remain in the short term, for instance until leachate is no longer generated within the waste site, the majority of the potential impacts on groundwater would be eliminated and the situation would revert to the pre-construction phase. During the decommissioning phase however, increased risks to groundwater exist from spillages when removing chemicals kept on site.

9.3.5. Visual

During decommissioning it is likely that the power station would take on a ‘messy’ appearance. However, screening measures implemented for the operational phase of the power station would limit the extent of the impact. Where linear infrastructure such as conveyors and transmission lines are removed natural vegetation would colonise and rehabilitate these corridors over time. The removal of the power station buildings (e.g. stack, boilers, towers, etc) would have a large positive impact on the surrounding areas (land owners and tourists) as well as to passing motorists.

9.3.6. Noise

During decommissioning a large amount of noise is likely to be generated by for instance dismantling of buildings. However, this would be temporary and while it may be louder than power station operations it is likely to impact on the surrounding area less as the nuisance factor of 24 hour noise would discontinue. After decommissioning, noise levels would return to pre-construction levels.

9.3.7. Traffic

Traffic during the decommissioning phase is likely to be less than during the operational phase as shift work would no longer be required. Delivery of supplies would discontinue and although this would most likely be replaced by trucks removing recoverable materials and rubble, the vehicles would probably be travelling with a lower frequency.

9.3.8. Soils and land capability

There will be a net improvement (positive) impact on the soil and land capability environments as the area of disturbance is reduced, and the soils are returned to a state that can support low intensity grazing or sustainable agriculture (as close as possible to the original state).

However, with interventions and well planned management, there will be a positive impact and a lowering of the overall significance rating to **LOW** as the soils are replaced and fertilization of the soils is implemented after removal of the infrastructure. Ongoing rehabilitation during the operational (temporary infrastructure used during exploration and construction phase) and decommissioning phases will bring about a net long-term positive impact on the soils, albeit that the land capability will likely be reduced to wilderness status.

The positive impacts of rehabilitation on the area are the reduction in the footprint of disturbance, the amelioration of the affected soils and oxygenation of the growing medium, the stabilizing of slopes and the re-vegetation of disturbed areas. At closure (obtaining of certificate of closure from authorities) the residual impact should, if all rehabilitation and management efforts have been complied with, result in a positive impact, with the area being returned to a land capability of low intensity grazing or wilderness status, and the use of the land being returned to that of wildlife management.

9.3.9. Societal risk

During decommissioning all hazardous chemicals used and stored on site would be removed. The delivery of these hazardous chemicals would be discontinued and hence the risk to society associated with these chemicals would no longer exist.

9.3.10. Local economy

With the decommissioning of the power stations a large number of employees would be left without employment (120 -140 people). Furthermore, the municipality would no longer receive rates and taxes from the power stations and the national GDP may drop. As such there is likely to be a negative impact on the local economy, and to a smaller scale the regional and national economy. The skilled and semi-skilled workers are likely to be able to find employment elsewhere; however the unskilled workers may have difficulty.

10. CONCLUSIONS AND RECOMMENDATIONS

The purpose of this Chapter is to provide a summary of the significance of the potential impacts identified, provide recommendations and the way forward.

10.1. CONCLUSIONS

The project comprises the construction, commissioning and operation of a discard coal-fired power station using fluidised bed technologies, and its associated infrastructure. The power station would need to deliver a nominal electricity generation capacity of approximately 450 MW. Apart from the power station buildings themselves, the ancillary infrastructure may include the following:

- Coal silo and sorbent stock yards;
- Coal and ash conveyors;
- A High Voltage (HV) yard within the power station precinct and transmission lines;
- Water and wastewater treatment facilities;
- Ash and spent sorbent disposal systems and dump site;
- Gypsum (sorbent) storage facility;
- Access roads (temporary and permanent, and external and internal roads);
- Maintenance, medical, administration, services, control buildings;
- Water supply pipeline for construction and operation phase;
- Dams for storage of “clean” and “dirty” water;
- Power supply for the construction phase;
- Communication mast/telecommunication facilities;
- General and hazardous storage and handling facilities (temporary and permanent);
- Batching plant (including concrete and asphalt); and
- Construction accommodation.

We submit that this Draft EIR provides a comprehensive assessment of the environmental issues associated with each of the feasible alternatives outlined in the FSR and the associated Plan of Study for ESIA. These impacts and alternatives were derived in response to inputs from consultation with I&APs, national, provincial and local authorities, the applicant and the ESIA project team. Table 10-2 and Table 10-3 provide a summary of the significance of the environmental impacts associated with this proposed project. The following key is applicable to Table 10-1.

Table 10-1: Key for summary indicating the colour coding for the significance of various impacts

H+	High Negative Significance	N	Neutral Significance
M-H	Medium to High Significance	H+	High Positive Significance
M	Medium Significance	M-H+	Medium to High Positive Significance
L-M	Low to Medium Significance	M+	Medium Positive Significance
L	Low Significance	L-M+	Low to Medium Positive Significance
VL-L	Very Low to Low Significance	L+	Low Positive Significance
VL	Very Low Significance		

10.1.1. Level of Confidence in Assessment

With reference to the information available at this feasibility stage of the project planning cycle, the confidence in the environmental assessment undertaken is regarded as acceptable for decision making.

It is acknowledged that the project details will evolve during the detailed design and construction phases. However, these are unlikely to change the overall environmental acceptability of the proposed project. Furthermore, any significant deviation from what was assessed in this ESIA should be subject to further assessment and may require an amendment to the Environmental Authorisation, after due process has been met.

Furthermore, with respect to the layout of the power station, most specialist studies have considered a worst case scenario, and investigated the destruction of the entire site. Consequently, the refinement of any of the layout components can be undertaken easily, since the relevant information is available to the eventual owner/operator (IPP) in the specialist reports attached as Annexures hereto (See **VOLEUMES 2-4**).

10.1.2. Operational Phase Impacts on the Biophysical and Social Environment

Table 10-2 and Table 10-3 show the impacts of the operation of the proposed power station and its associated infrastructure, and the operation of the proposed power station and associated infrastructure, on the biophysical and social environment.

The most significant negative impacts (i.e. those that were rated high) for the proposed power station, without any mitigation measures in place are the following:

- Impact of powerlines on avifauna
- Impact of artificial lighting on invertebrate fauna
- Impact on stormwater management;
- Impact on heritage resources ;

It should be noted that the significance of many of the impacts changes if mitigation measures are implemented and the actual significance of the various impacts would therefore depend on what mitigation is committed to by the IPP or required by the DEA. Should the mitigation measures described in the report be implemented, none of the impacts would result in a highly significant impact.

Table 10-2: Summary of significance of the potential impacts associated with the propsed development (Construction Phase)

IMPACT			Site 6C No Mit	Site 6C With Mit	Ash Option 3 No Mit	Ash Option 3 With Mit
CONSTRUCTION PHASE IMPACTS						
	Biophysical impacts					
1	Disturbance of flora and fauna	Impacts on flora	M	L	M	L
1.1		Impacts on fauna	M	M	M	M
1.2		Impacts on invertebrates	M	L	M	L
1.3		Other (wetlands and habitat connectivity)	M	M	M	M
2	Soil (and land use capability) impact	Impact: Loss of agricultural land	M-H	M-L	M-H	M-L
3	Storage of hazardous substances on site	Impact: Storage of hazardous substances	L-M	L	L-M	L
4	Impact of waste generation	Impact: Waste generation	M	L	M	L
5	Increase in traffic volumes	Impact: Traffic volumes	M	L	M	L
6	Increased risk of fire	Impact: Risk of fire	M	L	M	L
7	Noise impact	Impact: Noise	L	L	L	L
8	Visual impact	Impact: Visual	L	L	L	L
9	Air quality impact	Impact: Air quality	VL	VL	VL	VL
	Socio-economic impacts					
10	Socio-economic impacts (negative)	Impact: Pressure on Infrastructure	H	M	H	L
10.1		Impact: Increase in STDs/HIV/AIDs	M	M	M	M
10.2		Impact: Social Nuisance	H	M-L	H	M-L
10.3		Impact: Resettlement	H	M	H	M
10.4		Impact: Loss of productive land	H	M	H	M
10.6		Impact: Property prices	M	M	M	M
10.7		Impact: Traffic	H	M	H	M
10.8		Impact: Crime and safety	M	M-L	M	M-L
11	Employment (positive and negative)	Impact: Loss of workers to construction team –negative (-)	M	L	M	L
11.1		Impact: job opportunities – Positive (+)	M+	H+	M+	H+
11.2		Impact: indirect employment opportunities Positive (+)	M+	H+	M+	H+

Table 10-3: Summary of significance of the potential impacts associated with the propsed development (Opperational & Decomisisoning Phases)

IMPACT			Site 6C		Ash Option 3	
			No Mit	With Mit	No Mit	With Mit
OPERATION PHASE IMPACTS						
	Biophysical impacts					
13	Impact on terrestrial fauna and flora	Impact: Loss of threatended vegetation	M	L	M	L
		Impact: Loss of conservation important plant species	M	L	M	L
		Impact: Increased invasion by alien plants	L	L	M	L
14		Impact: Decrease in habitat quality through dust production	M	L	M	L
		Impact: Disruption of animal movement	M	L	M	L
		Impact: of new powerline on avifauna	H	M	N/A	N/A
		Impact : Artificial lighting on Invertebrate	H	M	M	L
	Impact on ambient air quality	Impact: SO2 emmissions	L	L	L	L
		Impact: NO2 emmissions	L	L	L	L
		Impact: PM10 emmissions	L	L	L	L
		Impact: CO	L	L	L	L
15	Impact on climate change	Impact: Climate change	M	N - V L	N/A	N/A
16	Soil (and land use capability) impact	Impact on agriculture	M	L	H	M
17	Impact on groundwater resources	Impact: Ash Dump on groundwater resources			H	L
		Impact: Stormwater management	H	L	H	L
	Operational waste streams	Impact: operational waste streams	M	L	N/A	N/A
	Socio-economic impacts					
18	Visual impacts	Impact of a power station powerline on visual aesthetics	L	L	L	L
18.2		Impact of an ash dump on visual aesthetics	N/A	N/A	M	L
	Noise impacts	Impact: on the noise climate (direct dry cooling)	M	M	N/A	N/A
		Impact: on the noise climate (indirect dry cooling)	L	L	N/A	N/A
		Impact of ancillary infrastructure on the noise climate	L	L	L	L
	Impact on heritage resources	Impact: Site WK1 (formal grave site)	H	L	N/A	N/A
23		Impact: sites WK2 - 6	L	L	N/A	N/A
24	Impact on traffic	Impact on traffic	M	L	M	L
25	Impact on social environment	Impact on productive land	M	L	M	L
		Impact on property prices	M	L	M	L
		Impact on traffic	M	L	M	L
		Impact on economic activities	M+	H+	M+	H+
DECOMMISSIONING PHASE IMPACTS						
26	All decommissioning impacts (composite assessment)		L-M+	L-M+	L-M+	L-M+

10.1.3. Construction Phase Impacts

The impacts for the construction phase of the power station deemed to have a highly significant impact on the environment all relate to social dynamics. However, considering their relatively short duration, localised extent and the suite of mitigation interventions proposed in the draft framework EMP (see **ANNEXURE J**) the significance of these impacts can be reduced to medium negative. The proposed mitigation interventions need to be implemented in order to avoid and minimise impacts on the biophysical and especially the human environment during the construction phase.

10.1.4. Framework EMP

A draft framework EMP has been developed to guide the construction and operational phases of the proposed project, and is contained in **ANNEXURE J** of this report. The implementation of the framework EMP would minimise possible negative impacts during construction and operation and assigns responsibility for environmental controls. The more detailed project specifications, for inclusion in the various construction contracts would be based on the framework EMP and would only be developed should the project be approved. The detailed project specification would also take cognisance of any Conditions of Approval as specified by DEA.

An important function of the report's conclusion is to identify the project elements that justify the proposed project. In this regard, the following project elements are noteworthy:

- The Khanyisa power station will relieve the electricity strain currently being experienced in South Africa by providing 450MW of electricity into the national grid;
- The project will be utilising reclaimed mine water from the EWRP for all required purposes (potable and process water requirements) and will therefore not place any burden on the regions municipal and groundwater resources;
- The project will utilise existing discard coal for the fuel source and therefore no new mining operations are required for the power station;
- The power station will meet the World Bank and IFC emission standards which are more stringent that the South African standards;

- The project will utilise Air Cooled Condensers to further reduce the projects impact on water requirements (saving of approximately 4570 Tonnes of water per hour);
- The project will provide positive economic benefits for the region by providing job opportunities for approximately 1200 skilled and semi-skilled people for the 36 month construction period and the broad based economic stimulation associated with the contractors and suppliers. and
- The proposed sites falls within transformed land which is situated within existing mining operations and will not present any material impacts on biophysical sensitivities.

10.2. RECOMMENDATIONS

With reference to the assessment described in the Chapters 7-9 of this report, it can be noted that the significance levels of the identified impacts could generally be reduced by implementing the identified mitigatory measures. The following section describes the various project alternatives in terms of their biophysical and socio-economic impacts.

10.2.1. Site

Power Station (Power Island)

The initial site selection process evaluated each site against a range of project dependent criteria such as size of the site, potential boundaries, buffer zones, distance from fuel source, electricity evacuation etc. It was concluded that all 6 initial sites are comprised to varying degrees by undermining activities except for site 6C. Undermined sites present a particular problem as it can be very difficult to price in the costs of foundations and the potential for ground settlement during the operational life of the plant.

All other site alternatives were therefore disqualified due to the foundation risk and site 6C is the only site option that is large enough for the power station and associated infrastructure which is not undermined.

Site 6C is crossed by a single 400 kV overhead power line mounted on lattice transmission towers and two 132 kV pole mounted overhead transmissions lines all owned and operated by Eskom. It is also crossed by a public highway (Tweefontein Road) and has a small graveyard in the South corner.

The Tweefontein Road and the overhead transmission lines will need to be relocated prior to the contractor's arrival on site and the requisite processes and applications for these translocations have been initiated with their respective authorities.

Ash disposal site

Three site alternatives were identified for the ash waste disposal site, identified as Ash 1, 2 and 3 respectively. During the initial feasibility investigations AATC proposed the use of rehabilitated open cast mine workings (Ash 3) because this option has the advantage of being both proximal and a brownfield land area, and hence more suitable from an environmental sensitivity perspective.

There are no significant environmental differences between the sites in that none of the sites are proximal to any biophysical sensitivity such as surface water bodies, sensitive ecological and/or historical areas, steep slopes, highly permeable soils or important aquifers and fault zones.

However, the investigation concluded that Ash 1 is not recommended due to undermining and Ash 2 is not recommended because it is currently an operating open cast mine with an uncertain life of mine, and adding to this, the site abuts a farming community that strongly objects to the prospect of placing the ash dump on their boundary.

Option 3 (former opencast mine area) is a brownfields site with no under mining activities and therefore geotechnically stable. It is recommended that Option 3 be approved.

10.2.2. Site Layouts

The indicative layouts show that it is possible to locate all the main and ancillary buildings on site 6C. However, due to the restricted space on site 6C it is certain that the entire footprint will be developed and therefore if the final layout differs from the proposed layout it is unlikely to change or affect the overall environmental acceptability of the site. Any additional refinements of the power station layout could take place once further technical information is available.

a) Access Road Alternatives

With regard to the relocation of the Tweefontein road (D 2257), Option 1 is the preferred route alignment and is supported by the provincial roads authority. The alignment of Option 1 allows for mobility and meets minimum prescribed geometric criteria, sight distances and access spacing.

Option 1 is the preferred route alignment.

Power Line Route Alternatives

The specialist studies and environmental impact assessment indicated that there are little differences in the sensitivity of the proposed transmission line routes since both routes cross similar habitats. From a visual impact Option 2 is the preferred option as it has less exposure to receptors and is more aligned with the exiting road infrastructure and therefore there would be less potential fragmentation of landscapes / agricultural areas.

Option 2 is the preferred power line alignment.

10.2.3. Cooling Technology Alternatives

An indirect dry-cooling system works similarly to the wet-cooled system, with the primary difference being that the heat is dissipated in the cooling towers via water-to-air heat exchangers, rather than evaporation of the cooling water. Dry cooling uses approximately < 0.2 l of water per kWh sent out. A significant advantage of dry-cooling technology is the conservation of water, which is critical in a semi-arid country like South Africa.

As South Africa is a water scarce country and wet cooling uses far greater volumes of water than dry cooling, it is recommended that the power station make use of direct dry cooling technology

10.2.4. Combustion Technology Alternatives

CFB technology has the advantage of being able to burn colas with a wide range of properties and can cope with high ash and high sulphur coals as proposed for the power plant. The removal of sulphur from the coal during the combustion process is achieved in CFB boilers by the addition of limestone which acts as a sorbent.

It is proposed that CFB technology be implemented to ensure the power stations meet the air quality standards.

10.2.5. Ash Disposal Methods

Above ground ashing would result in a large footprint (some 186 ha) being disturbed over the lifespan of the project and beyond. The impacts with respect to particulate matter and groundwater contamination are however manageable, and it is therefore considered an acceptable means of ash disposal.

For comparative purposes, in-pit ashing and underground pumped ashing were discussed. The in-pit ashing option will require the ash to be conveyed off-site and may result in groundwater contamination, which is possibly less manageable than the potential contamination from an above-ground ash dump. The impact of pumping an ash-cement mixture to fill the underground workings is currently unknown and would require further investigation should the IPP wish to pursue this option.

It is recommended that ash be disposed of in a dry ash mound above ground.

10.2.6. Ash Transportation Alternatives

Ash can be transported by one of three methods, wet slurry by pipeline, dry on a conveyor and dry in trucks.

The preferred ash disposal site is not capable of supporting a lagoon for dewatering ash transported by slurry therefore it is recommended that ash be dumped in a dry (typically 15% moisture) state. Transporting ash by conveyor will require careful design to minimise dust issues. The typical solution is to use pipe conveyors which provide a closed transport solution.

The environmental impact of road transport of ash to the disposal site either through the mine or via a new entrance from the Tweefontein road will be high and this option has been discounted as the primary disposal route, although it could be a practical back up option.

The closed pipe conveyor is therefore recommended as the preferred ash transportation option.

10.3. OPINION WITH RESPECT TO ENVIRONMENTAL AUTHORISATION

Regulation 31(2)(n) of the ESIA Regulations requires that the EAP include an opinion as to whether the activity should be authorised or not.

The impacts associated with the proposed power station would result in local impacts (both biophysical and some social) that would negatively affect the area. The significance of these impacts; **without mitigation;** range from being of **high to low** significance. However, with the implementation of the suite of recommended mitigation measures (refer to Chapters 7-9) the significance of most of the negative impacts would be minimized and would be **medium or low significance**.

Associated with the proposed project are a number of positive impacts, with the impact on the social and economic environments being the most significant, locally and regionally, being of **medium or higher** significance. Unemployed individuals in the area would benefit from the provision of employment opportunities. The economy of the Mpumalanga Province and the eMalahleni area would benefit significantly from the injection of capital and the creation of employment opportunities, and lesser effects would be felt in the South African economy.

If authorised, unless financially or technically unfeasible, the implementation of all mitigation measures listed in Chapters 7-9 should be included as a condition of approval. On this basis it is the opinion of the EAP that this application shoud be approved

10.4. THE WAY FORWARD

The Fianl EIR has been made available to all registered I&Aps at a suite of public venues.. The opportunities for final public involvement were as follows:

- Commenting on the Final EIR, which was lodged in the following locations and on the Aurecon (http://www.aurecongroup.com/)(follow the public participation links) website from 17 February 2012 to 9 March 2012. The I&Aps were requested to submit written comment on the Final EIR to the the competent authority; i.e. DEA;

Fax: 012 320 7539 Tel: 012 395 1780 - attention Vincentia Phukubye, Email vphukubye@environment.gov.za or Private Bag x447, Pretoria, 0001.

Furthermore, I&AP's were also requested to copy all correspondence to: Aurecon (Pty) Ltd, Fax: 013 753 2116, Email: Leandri.Joubert@aurecongroup.com or PO Box 3135, Nelspruit, 1200, For Attention Leandri Joubert.

  - eMalahleni Public Library;
  - Kleinkopje Colliery Environmental Office (Janel Hayes);
  - Kleinkopje Community Development Office (Delani Ngcobo);
  - Greenside Colliery Environmental Office (Erika Prinsloo);
  - Landau Colliery Environmental Office (Sipho Mabuza & Francis Nkosi); and

- All registered I&APs were notified of the availability of the Final EIR by means of a letter which includes a copy of the updated Issues Trail. Draft EIR Summary Document.
- Public notices were placed in the regional newspapers, The Star and Beeld as well as in the local newspapers, the Witbank News and the Middelburg Observer on 17 February 2012 in order to notify I&APs of the availability of the Final EIR.

The next stage of this ESIA process involves sudmission of this Final EIR to DEA who must, within 60 days, do one of the following:

- Accept the report;
- Notify the applicant that the report has been referred for specialist review;
- Request amendments to the report; or
- Reject the report if it does not materially comply with regulations.

If the report is accepted, DEA must within 45 days:

- Grant authorisation in respect of all or part of the activity applied for; or
- Refuse authorisation in respect of all or part of the activity.

Once DEA have made their decision on the proposed project, all registered I&APs on the project database will be notified of the outcome of the decision within ten calendar days of the environmental authorisation having been issued. Should anyone (a member of public, registered I&AP wish to appeal DEA's decision, a Notice of Intention to Appeal in terms of Section 62 of NEMA must be lodged with the Minister of Water and Environmental Affairs within 10 calendar days of the I&AP being notified.

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