Appendix N: Air

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

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Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010

PROJECT TITLE

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED CONTINUOUS ASH DISPOSAL FACILITY FOR THE MATIMBAPOWER STATION IN LEPHALALE, LIMPOPO PROVINCE

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4.2 The specialist appointed in terms of the Regulations_

I, Stuart Thompson, declare that --

General declaration:

I act as the independent specialist in this application
I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
I declare that there are no circumstances that may compromise my objectivity in performing such work;
I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
I will comply with the Act, regulations and all other applicable legislation;
I have no, and will not engage in, conflicting interests in the undertaking of the activity;
I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
all the particulars furnished by me in this form are true and correct; and
I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Royal HaskoningDHV

Name of company (if applicable):

7 April 2014

Date:

Matimba Power Station – Proposed Ash Disposal Facility

March 2014

A Report for: Eskom Holdings SoC Limited

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Enhancing Society Together

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1 INTRODUCTION

1.1 Background

Matimba Power Station, located near the town of Lephalale in the Limpopo Province, is a 3990 MW installed capacity base load coal-fired power station, consisting of six units. Matimba is a direct dry cooling power station, and as such, is designed to be very water efficient due to the dry nature of the surroundings. The power station obtains its coal from the adjacent Exxaro Grootegeluk Coal Mine which provides approximately 3800 tons of coal per hour.

Ash is generated as a by-product from the combustion of coal with Matimba producing approximately 6 million tons of ash annually. This ash is currently being disposed by means of 'dry ashing' approximately 3 km (three kilometres) south of the power station. The ash is transported to the disposal facility by a conveyor belt. At present the Ash dam is nearing capacity, with Eskom looking for a site for the possible expansion of the Ash dam

1.2 Scope of Work

The aim of this study is to identify potential air quality impacts as a result of the proposed ash disposal facility. The proposed ash disposal facility will ensure that the power station is able to accommodate the ashing requirements for the remaining life (approximately 44 years) of the power station. The plan for the impact assessment will be as follows:

- During the impact assessment phase, information gaps in the data provided will be identified.
- Determine the atmospheric dispersion potential for the area being assessed.
- Meteorological data will be sourced from the South African Weather Service, providing hourly average data for the area;
- Identify other sources in the area impacting on ambient air quality; and
- In order to assess the possible cumulative air quality impacts, monitored ambient and meteorological data will be sourced for the area under investigation. If there is no ambient monitored data available, a qualitative assessment will be undertaken which will evaluate the possible impacts of other polluting sources in the area.
- Specific notice needs to be taken regarding the Waterberg-Bojanala Priority Area, as the project will fall within this Air Quality Priority Area

The impact of the proposed operations would be based on a screening health risk assessment approach. The proposal therefore does not include a comprehensive health risk assessment, however all pollutants identified will be compared to National and International Standards to ensure a clean and healthy environment

FIGURE 1: LOCALITY MAP SHOWING LOCATION OF THE EXISTING ASH DISPOSAL FACILITY IN RELATION TO GROOTEGELUK COAL MINE AND MATIMBA POWER STATION

1.3 Project Description

Two site alternatives were selected to be assessed during the Environmental Impact Assessment (EIA) phase of the study (Figure 2).

- Alternative 1: located adjacent to the existing ash disposal facility, south of the Power Station.
- Alternative 2: located north of the Matimba Power Station located on portions of the farms Vooruit 449 LQ, Droogeheuvel 447LQ, Ganzepan 446 LQ and Appelvlakte 448 LQ, with the inclusion of the proposed conveyor system

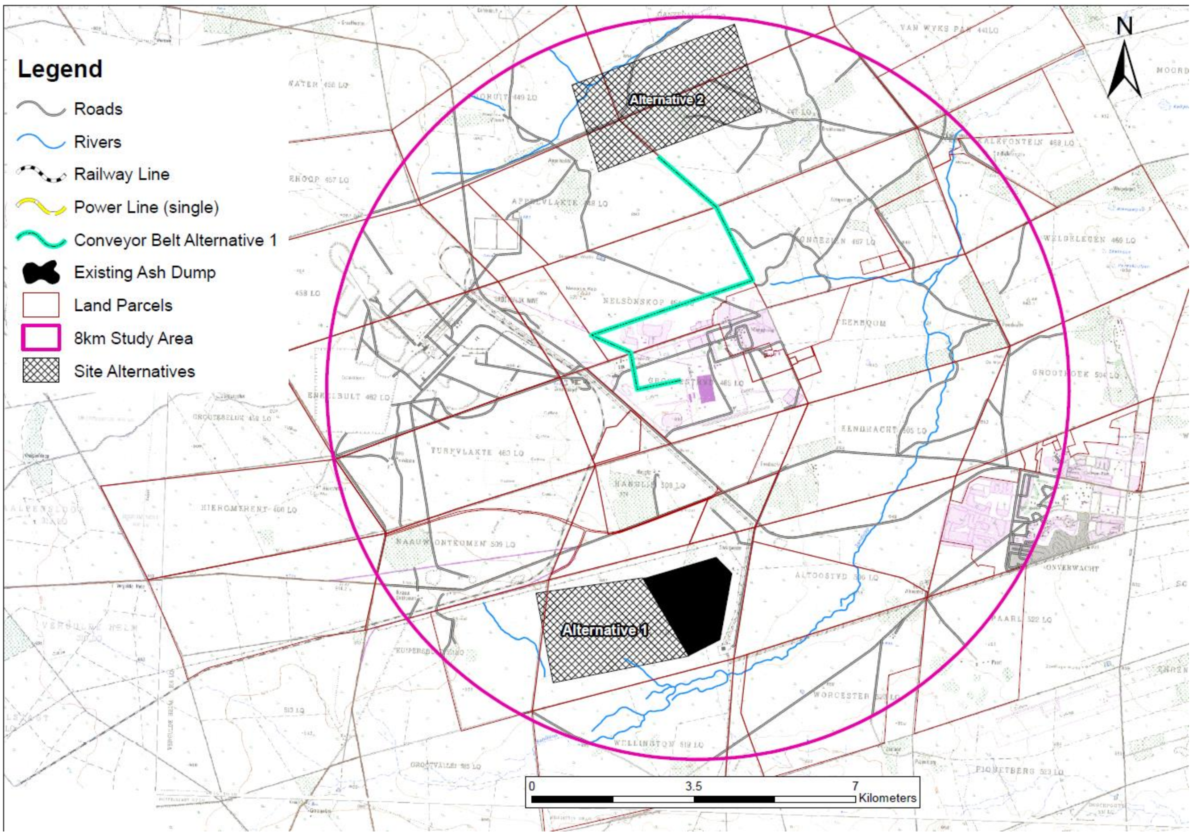


FIGURE 2: MAP SHOWING SELECTED SITE ALTERNATIVES

2 APPLICABLE LEGISLATION

The information presented in the section which follows, details relevant legislation within South Africa, as well as a list of international laws and conventions to which South Africa is a signatory.

2.1 South African Legislative and Standards Frameworks

- **National Environmental Management: Air Quality Act 39 of 2004**

The National Environmental Management: Air Quality Act (No 39 of 2004, “NEM:AQA”) represents a move to an air pollution control strategy that is based on receiving air quality management. It focuses on the adverse impacts of air pollution on the ambient environment and sets standards as the benchmark for air quality management performance. At the same time it sets emission standards to minimize the amount of pollution that enters the environment. The Act regulates the control of noxious and offensive gases emitted by industrial processes, the control of smoke and wind borne dust pollution, and emissions from diesel vehicles.

The promulgation of the National Environmental Management: Air Quality Act (NEM:AQA) resulted in a shift from National air pollution, control based on source based controls to decentralised air quality management through an effects-based approach. An effects based approach requires the meeting of ambient air quality standards. These ambient standards are to be set by the Local and District Municipalities which govern air quality management in the area. The Municipality of concern here is the Waterberg District Municipality. If these standards have not been set yet the National Ambient Air Quality Standards will need to be adhered to. Such standards provide the objectives for air quality management.

Multiple levels of standards provide the basis for both ‘continued improvements’ in air quality and for long term planning in air quality management. Although maximum levels of ambient concentrations should be set at a national level, more stringent ambient standards may be implemented by provincial and local authorities.

The control and management of all sources of air pollution relative to their contributions to ambient concentrations is required to ensure that improvements in air quality are secured in the timeliest, even handed and cost-effective way. The need to regulate diverse source types reinforces the need for varied management approaches ranging from command and control methods to voluntary measures.

The objectives of the Air Quality Act as stated in Chapter 1 are as follows:

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

The National Framework is one of the significant functions detailed in Chapter 2 of the NEM: Air Quality Act. The Framework serves as a blueprint for air quality management and aims to achieve the air quality objectives as described in the preamble of the AQA.

Chapter 3 of the NEM: Air Quality Act covers institutional and planning matters, and is summarised as follows:

- The Minister may establish a National Air Quality Advisory Committee as a subcommittee of the National Environmental Advisory Forum established in terms of the National Environmental Management Act (NEMA);
- Air Quality Officers must be appointed at each level of Government (National, Provincial, Municipal);
- Each National Department or Province preparing an Environmental Implementation Plan or Environmental Management Plan in terms of NEMA must include an Air Quality Management Plan (AQMP). Each Municipality preparing an Integrated Development Plan must include an AQMP;
- The contents of the AQMPs are prescribed in detail; and
- Each organ of state is required to report on the implementation of its AQMP in the annual report submitted in terms of NEMA.

In Chapter 4 of the NEM: Air Quality Act, air quality management measures are outlined in terms of:

- The declaration of Priority Areas, where ambient air quality standards are being, or may be, exceeded;
- The listing of activities that result in atmospheric emissions and which have or may have a significant detrimental effect on the environment;
- The declaration of Controlled Emitters;
- The declaration of Controlled Fuels;
- Other measures to address substances contributing to air pollution, that may include the implementation of a Pollution Prevention Plan or an Atmospheric Impact Report; and
- The requirements for addressing dust, noise and offensive odours.

Licensing of Listed Activities through an Atmospheric Emission Licence is addressed in Chapter 5 of the Air Quality Act. On 31 March 2010, the Minister of Water and Environmental Affairs published the Listed Activities and Minimum Emission Standards. International air quality management is outlined in Chapter 6 and offences and penalties in Chapter 7.

- **National Ambient Air Quality Standards**

The Air Quality Act makes provision for the setting and formulation of National ambient air quality standards for substances or mixtures of substances which present a threat to health, well-being or the environment. On 24 December 2009, the Minister of Water and Environmental Affairs established National ambient air quality standards (Table 1). These standards prescribe the allowable ambient concentrations of pollutants which are not to be exceeded during a specified time period in a defined area. If the air quality standards are exceeded, the ambient air quality is poor and the potential for health effects is greatest.

TABLE 1: NATIONAL STANDARDS (µG/M³) FOR PARTICULATE MATTER, WITH ALLOWABLE FREQUENCIES OF EXCEEDANCE FOR IMMEDIATE COMPLIANCE.

Pollutant	Averaging Period	Concentration	Frequency of Exceedance
Particulate Matter PM10	24-hr average	120 75 (from 2015)	4
	Annual average	50 40 (from 2015)	0

The main pollutant of concern which may pose a health risk to surrounding sensitive receptors and possible communities during the current investigation is particulate matter. Particulate matter is a collective name for fine solid or liquid particles added to the atmosphere by processes at the earth's surface. Particulate matter includes dust, smoke, soot, pollen and soil particles (Kemp, 1998). An overview is provided of the available local regulations and standards, and then for comparison, international guidelines and standards prescribed for inhalable particulate and nuisance dust exposure, these include the World Bank (WB), European Union (EU), United Kingdom (UK), World Health Organisation (WHO), and the United States Environmental Protection Agency (USEPA).

- **Inhalable Particulates**

Particulate matter (PM) has been linked to a range of serious respiratory and cardiovascular health problems. The key effects associated with exposure to ambient particulate matter include: premature mortality, aggravation of respiratory and cardiovascular disease, aggravated asthma, acute respiratory symptoms, chronic bronchitis, decreased lung function, and increased risk of myocardial infarction (USEPA, 1996).

PM represents a broad class of chemically and physically diverse substances. Particles can be described by size, formation mechanism, origin, chemical composition, atmospheric behaviour and method of measurement. The concentration of particles in the air varies across space and time, and is related to the source of the particles and the transformations that occur in the atmosphere (USEPA, 1996).

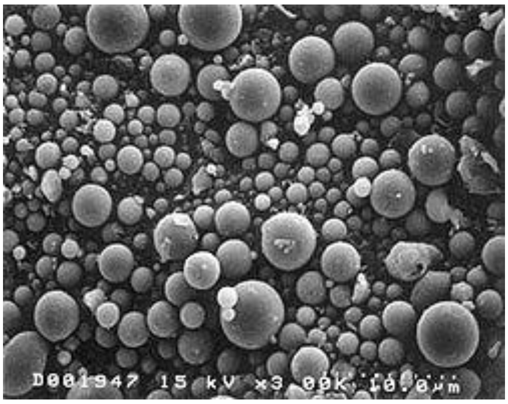


FIGURE 3: ASH PARTICLE MAGNIFIED 2000X

PM can be principally characterised as discrete particles spanning several orders of magnitude in size, with inhalable particles falling into the following general size fractions (USEPA, 1996):

- PM10 (generally defined as all particles equal to and less than 10 microns in aerodynamic diameter; particles larger than this are not generally deposited in the lung);
- PM2.5, also known as fine fraction particles (generally defined as those particles with an aerodynamic diameter of 2.5 microns or less)
- PM10-2.5, also known as coarse fraction particles (generally defined as those particles with an aerodynamic diameter greater than 2.5 microns, but equal to or less than a nominal 10 microns); and
- Ultra fine particles generally defined as those less than 0.1 microns.

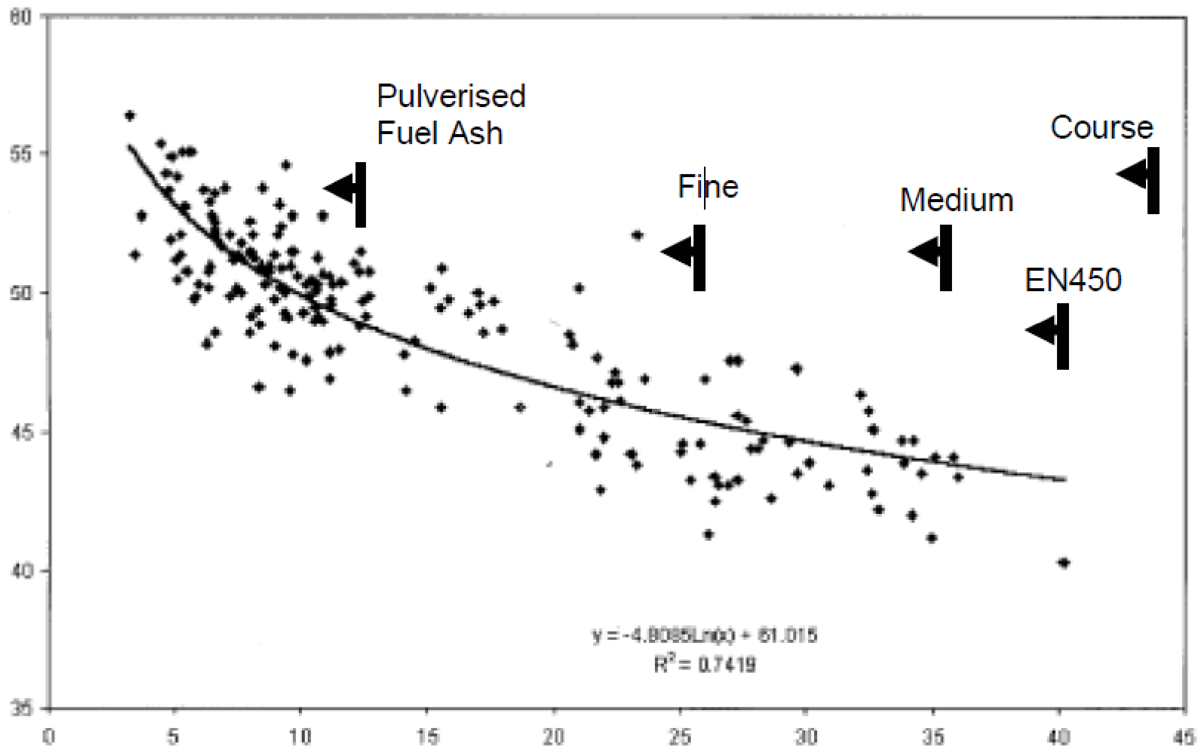


FIGURE 4: GENERAL PARTICLE SIZE DISTRIBUTION OF ASH (SEAR, 2001)

Fine and coarse particles are distinct in terms of the emission sources, formation processes, chemical composition, atmospheric residence times, transport distances and other parameters. Fine particles are directly emitted from combustion sources and are also formed secondarily from gaseous precursors such as sulphur dioxide, nitrogen oxides, or organic compounds. Fine particles are generally composed of sulphate, nitrate, chloride and ammonium compounds, organic and elemental carbon, and metals. Combustion of coal, oil, diesel, gasoline, and wood, as well as high temperature process sources such as smelters and steel mills, produce emissions that contribute to fine particle formation. Fine particles can remain in the atmosphere for days to weeks and travel through the atmosphere hundreds to thousands of kilometres, while most coarse particles typically deposit to the earth within minutes to hours and within tens of kilometres from the emission source. Some scientists have postulated that ultra fine particles, by virtue of their small size and large surface area to mass ratio may be especially toxic.

Coarse particles are typically mechanically generated by crushing or grinding and are often dominated by re-suspended dusts and crustal material from paved or unpaved roads or from construction, farming, and mining activities (USEPA, 1996).

TABLE 2 3 outlines the local and international (to allow for comparisons) health risk criteria used for the assessment of inhalable particulate matter (PM10). Guidelines and standards are provided for a 24-hour exposure and annual average exposure period, respectively.

TABLE 2: AVAILABLE LOCAL AND INTERNATIONAL STANDARDS USED FOR THE EVALUATION OF INHALABLE PARTICULATE MATTER (PM10).

Origin	24-Hour Exposure (µg/m³)	Annual Average Exposure (µg/m³)	Number of Exceedances Allowed per year
RSA(1)	120(1)	50(1)	4 daily exceedances
RSA(2)	75(2)	40(2)	0 daily exceedances
Australia	50		5 daily exceedances
World Bank(3)	500	100	NA
EU(4)	50	20	7 daily exceedances
US-EPA(5)	150	50(6)	1 daily exceedance
UK(7)	50	40	35 daily exceedances
WHO(8) (9) (10)	50	20	NA

Notes: (1) Standard laid out in the National Environment Management: Air Quality Act. No. 39 of 2004:

(2) Compliance by 1 January 2015

(3) World Bank Air Quality Standards summary obtainable at URL http://www.worldbank.org/html/fpd/em/power/standards/airqstd.stm#paq.

(4) European Union Air Quality Standards summary obtainable at URL http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexplus!prod!DocNumber&lg=en&type_doc=Directive&an_doc=1999&nu_doc=30.

(5) United States Environmental Protection Agencies National Air quality Standards obtainable at URL http://www.epa.gov/air/criteria.html

(6) To attain this standard, the 3-year average of the weighted annual mean PM_{10} concentration at each monitor within an area must not exceed 50 µg/m^3.

(7) United Kingdom Air Quality Standards and objectives obtainable at URL http://www.airquality.co.uk/archive/standards.php

(8) WHO = World Health Organisation

(9) Guidance on the concentrations at which increasing, and specified mortality responses due to PM are expected based on current scientific insights (WHO, 2005).

(10) Air quality guideline

- **Nuisance Dust**

Nuisance dust is known to result in the soiling of materials and has the potential to reduce visibility. Atmospheric particulates change the spectral transmission, thus diminishing visibility by scattering light. The scattering efficiency of such particulates is dependent upon the mass concentration and size distribution of the particulates. Various costs are associated with the loss of visibility, including: the need for artificial illumination and heating; delays, disruption and accidents involving traffic; vegetation growth reduction associated with reduced photosynthesis; and commercial losses associated with aesthetics. The soiling of buildings and materials due to dust frequently gives rise to damages and costs related to the increased need for washing, cleaning and repainting. Dust fall may also impact negatively on sensitive industries, e.g. bakeries or textile industries. Certain elements in dust may damage materials. For instance it was found that sulphur and chlorine if present in dust may cause damage to copper materials (Maeda *et al.*, 2001).

The physical smothering of the leaf surface of plants by dust particles causes reduced light transmission, affecting photosynthetic processes resulting in growth reduction (Thompson et al., 1984; Pyatt and Haywood, 1989; Farmer, 1993).

Increases in the temperature of particle-covered leaves result in a positive impact on respiration and a negative impact on photosynthesis and productivity (Eller, 1977). The physical obstruction of the stomata has been observed to reduce stomatal resistance, resulting in the potential for higher uptake of pollutant gases, and it may also affect the exchange of water vapour (CEPA/FPAC Working Group, 1999). Particle accumulation on leaf surfaces may cause plants to become more susceptible to other stresses such as disease (CEPA/FPAC Working Group, 1999). A review of the effects of cement dust on trees showed that the dust caused physical damage to the leaves, reduced fruit setting and generally reduced growth (Farmer, 1993). Several studies in Europe and the United States have indicated that a decline in species diversity may be linked to declining air quality around urban and industrial areas (Gunnarsson, 1988; Hallingbäck, 1992; Váňa, 1992; Van Zanten, 1992; Finizio *et al.*, 1998; Jones & Paine, 2006; Motiejūnaitė, in press; Otnyukova, in press). In South Africa, two studies are currently underway: the first is to determine the potential impacts of Sulphur and Nitrogen from power stations on the forestry industry in the lowveld of Mpumalanga, with the second being a study between the Kruger Park and Foskor to determine impacts associated with phosphate contamination at the Phalaborwa Mine. Neither of these studies have to date yielded publishable results.

Particulate matter is a recognized health hazard for man and domestic animals (Newman *et al.*, 1979). Air pollutants have had a worldwide effect on both wild birds and wild mammals, often causing marked decreases in local animal populations (Newman *et al.*, 1979). The major effects of industrial emissions on wildlife include direct mortality, debilitating industrial-related injury and disease, physiological stress, anaemia, and bioaccumulation. Some air pollutants have caused a change in the distribution of certain wildlife species. As with all air quality studies very little work has been undertaken to determine the impacts on species other than humans.

On the 7th of December 2012 the minister of Water and Environmental affairs published the new National Dust Control Regulations. This document now enforces the monitoring of dust fallout from activities that are suspected of contributing significantly to dust fallout in the affected region. The regulation provides a set standard for dust fallout to comply to, enforces that a baseline should be established to projects that would give rise to increased dust fallout, specifications for dust fallout monitoring and the format of reports if the activity should exceed the threshold. Due to the proximity close proximity to residential areas, the facility will be required to comply with the Residential Area Standard

TABLE 3: ACCEPTABLE DUST FALLOUT RATES MEASURED AT AND BEYOND THE BOUNDARY OF THE PREMISES WHERE DUST ORIGINATES.

Restriction Areas	Dust Fallout rate (mg/m^2/30-days average)	Permitted frequency of exceeding dust fall-out rate
Residential area	D < 600	Two within a year, not sequential months.
Non-residential area	600 < D > 1200	Two within a year, not

	sequential months.

*Note – the measurement of dust fallout is in accordance with the methodology prescribed in **ASTM 1739-98:2004**

If an activity exceeds the standard the Operators or Owners must submit a dust monitoring report to the air quality officer (local authority), (Section 4, GN1007 of 2012). The Operators or Owners must develop a dust management plan, within three months after the submission of a dust monitoring report (Section 5, GN1007 of 2012). If the dust fallout is continued to be exceeded, the authority may request that continuous PM10 monitoring be conducted at the site

- **Waterberg-Bojanala National Priority Area**

The identified area known as the Waterberg-Bojanala National Priority Area includes the following municipalities:

- Waterberg District Municipality;
- Thabazimbi Local Municipality;
- Modimolle Local Municipality;
- Mogalakwena Local Municipality;
- Bela Bela Local Municipality;
- Mookgopong Local Municipality; and
- Lephalale Local Municipality.

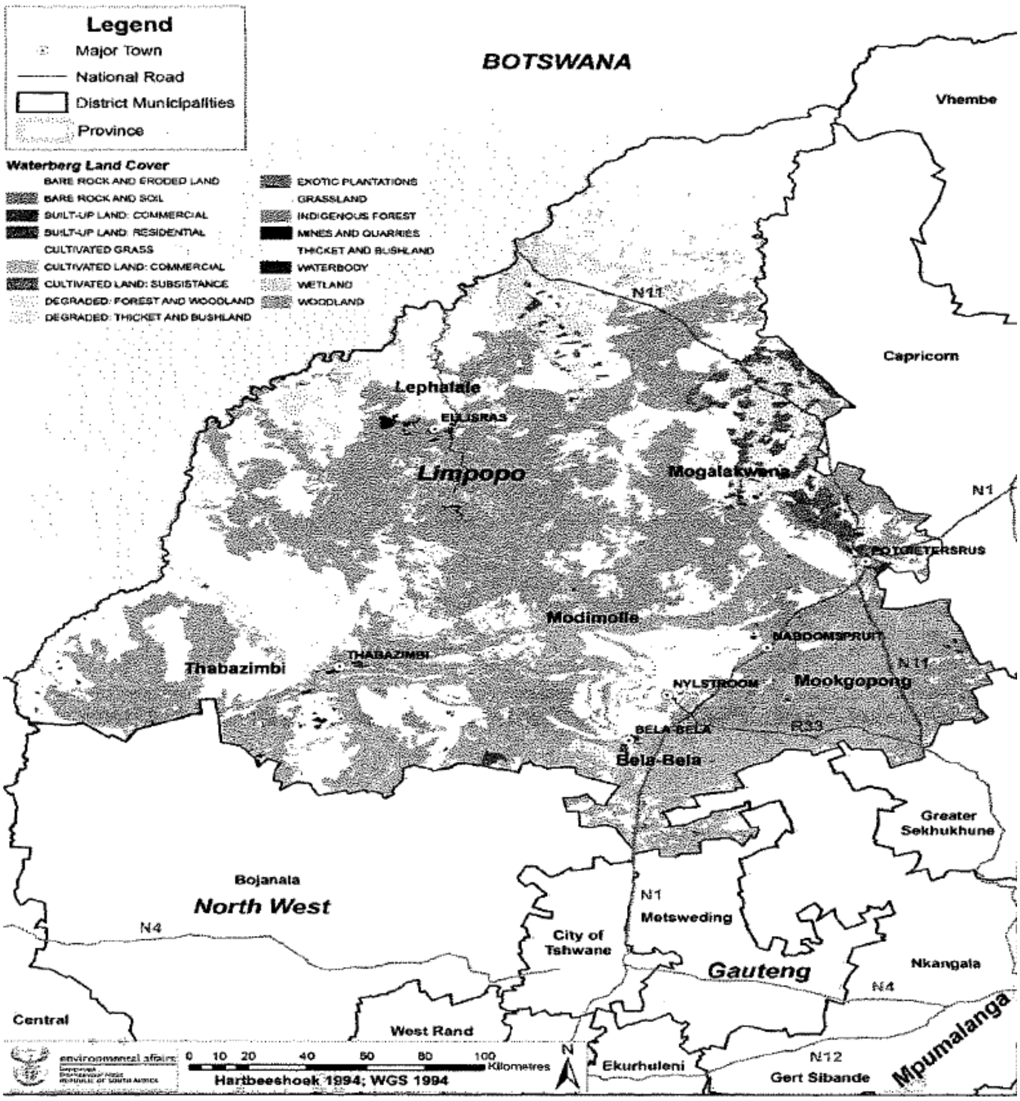


FIGURE 5: WATERBERG-BOJANALA NATIONAL PRIORITY AREA (SOURCE: GG33600)

The Waterberg-Bojanala National Priority has been declared by the Minister due to the belief that the ambient air quality standards may in future exceed the national air quality standards in the area. With this declaration, an air quality management plan must be devised, and based on the findings measures to control emitters, or reduce standards can be enforced.

3 BASELINE ENVIRONMENT

3.1 Description of Environment

- **Regional and Local Climate and Atmospheric Dispersion Potential**

The nature of the local climate will determine what will happen to particulates when released into the atmosphere (Tyson & Preston-Whyte, 2000). Concentration levels fluctuate daily and hourly, in response to changes in atmospheric stability and variations in mixing depth. Similarly, atmospheric circulation patterns will have an effect on the rate of transport and dispersion.

The release of atmospheric pollutants into a large volume of air results in the dilution of those pollutants. This is best achieved during conditions of free convection and when the mixing layer is deep (unstable atmospheric conditions). These conditions occur most frequently in summer during the daytime. This dilution effect can however be inhibited under stable atmospheric conditions in the boundary layer (shallow mixing layer). Most surface pollution is thus trapped under a surface inversion (Tyson & Preston-Whyte, 2000).

Inversion occurs under conditions of stability when a layer of warm air lies directly above a layer of cool air. This layer prevents a pollutant from diffusing freely upward, resulting in an increased pollutant concentration at or close to the earth's surface. Surface inversions develop under conditions of clear, calm and dry conditions and often occur at night and during winter (Tyson & Preston-Whyte, 2000). Radiative loss during the night results in the development of a cold layer of air close to the earth's surface. These surface inversions are however, usually destroyed as soon as the sun rises and warm the earth's surface. With the absence of surface inversions, the pollutants are able to diffuse freely upward; this upward motion may however be prevented by the presence of an elevated inversion (Tyson & Preston-Whyte, 2000).

Elevated inversions occur commonly in high pressure areas. Sinking air warms adiabatically to temperatures in excess of those in the mixed boundary layer. The interface between the upper, gently subsiding air is marked by an absolutely stable layer or an elevated subsidence inversion. This type of elevated inversion is most common over Southern Africa (Tyson & Preston-Whyte, 2000).

All Meteorological Data has been provided by the South African Weather Service for Lephalale Monitoring Station (06743418) approximately 10km east of the Matimba Power Staion.

- **Temperature**

Temperature affects the formation, action, and interactions of pollutants in various ways (Kupchella & Hyland, 1993). Chemical reaction rates tend to increase with temperature and the warmer the air, the more water it can hold and hence the higher the humidity.

The long-term average monthly temperature for Lephalale is depicted in Figure 6. Daily summer temperatures range between 23 °C and 32 °C with inter temperatures ranging between 7 °C and 20 °C.

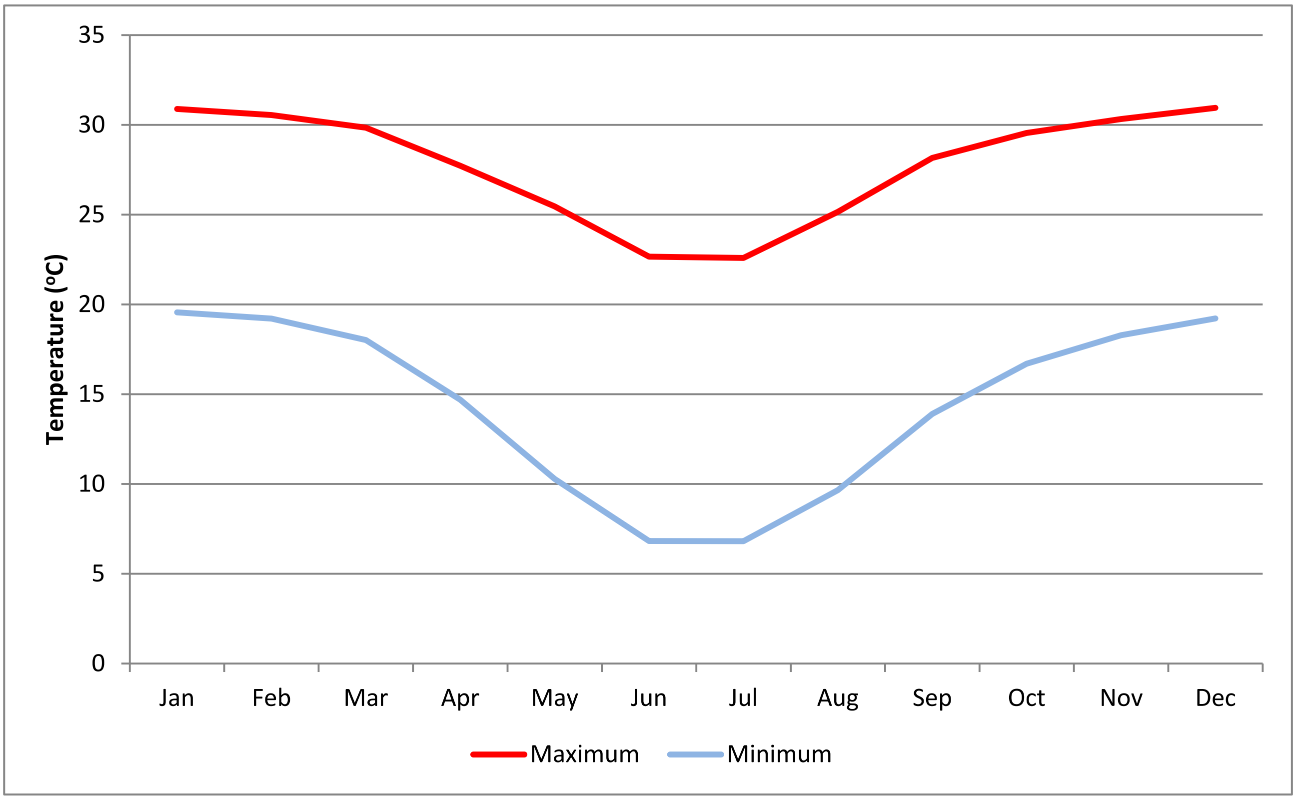
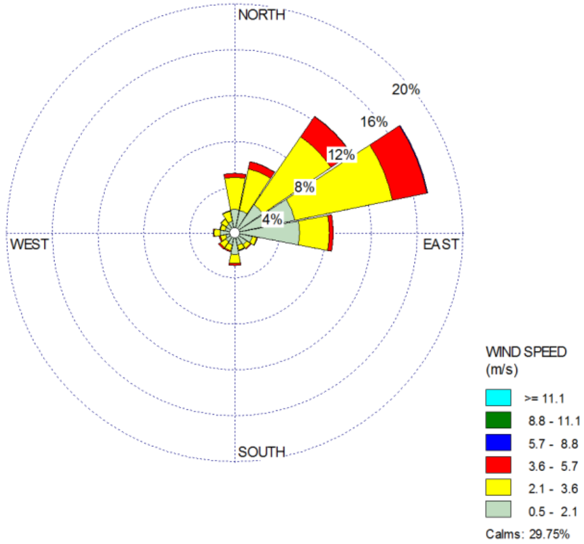


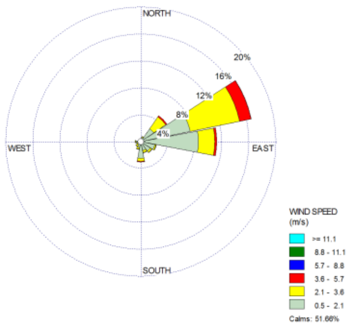
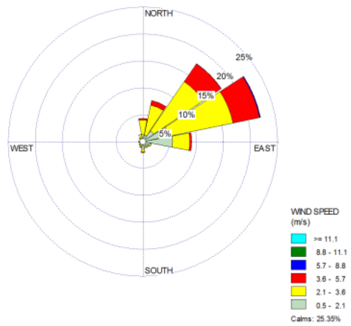
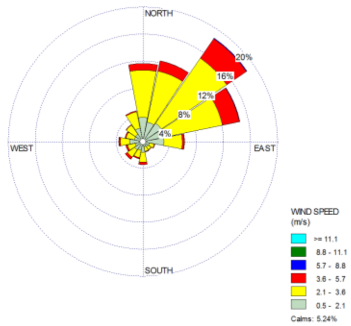
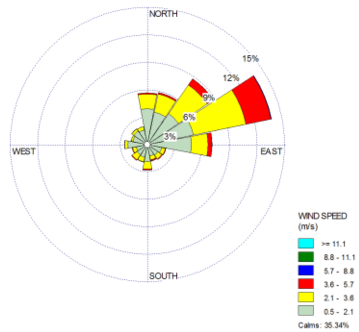
FIGURE 6: AVERAGE MONTHLY MINIMUM AND MAXIMUM TEMPERATURES FOR LEPHALALE FOR THE PERIOD 1979 TO 2000.

- **Winds**

Looking at Figure 7 and Figure 8 respectively, it can be seen that the Lephalale area is not an area of high wind speeds, as per the met data from 2007 to 2011. On average, at the current ashing facility, 29.7% of the time, calm conditions existed over the area. The highest frequency of wind speeds lie between 0.5 to 2.1 m/s which occurred for 45.2% of the time. The second highest wind class (2.1 – 3.6 m/s) occurs 17.5% of the time. Figure 7 shows the prevailing winds blowing from a north easterly direction. This is also noted across the seasons and during the course of a day.



Period

00:00-06:00	06:00-12:00	12:00-18:00	18:00-24:00
			

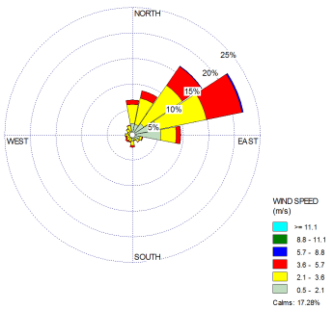
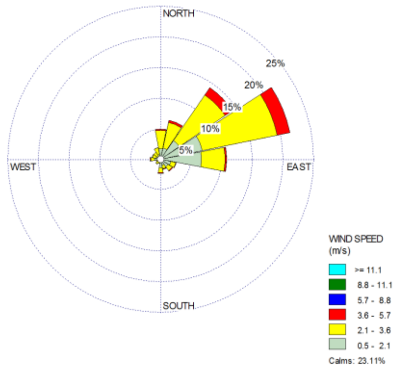
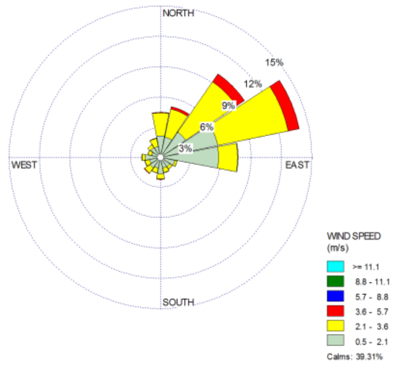
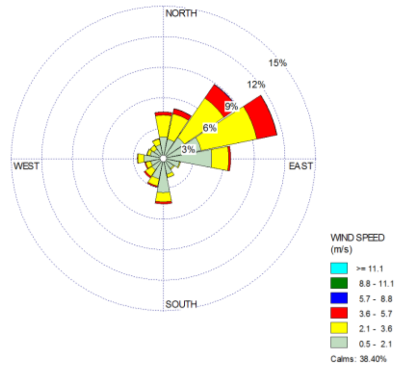
Spring	Summer	Autumn	Winter
			

FIGURE 7: PERIOD WIND ROSES FOR LEPHALALE FOR THE PERIOD 2007 TO 2011

Note: Wind roses comprise 16 spokes which represent the directions from which winds blew during the period. The colours reflect the different categories of wind speeds. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories. The resultant vector represents the mean wind direction.

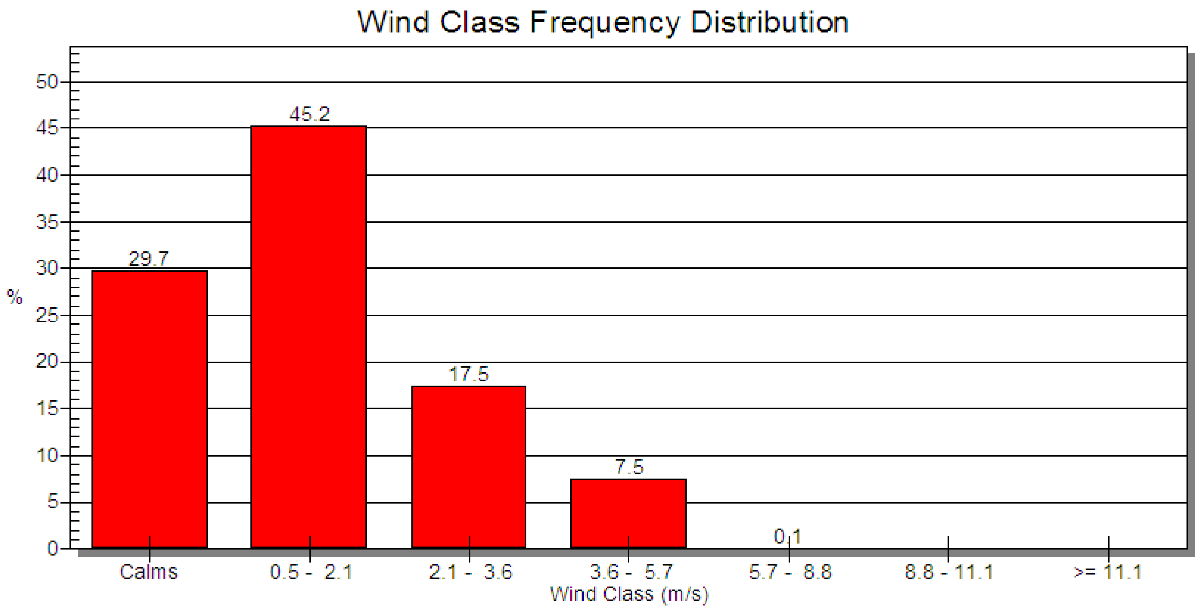


FIGURE 8: WIND CLASS FREQUENCY DISTRIBUTION FOR LEPHALALE FOR THE PERIOD 2007 TO 2011

- **Atmospheric Stability**

Atmospheric stability is commonly categorised into six stability classes. These are briefly described in Table 4. The atmospheric boundary layer is usually unstable during the day due to turbulence caused by the sun's heating effect on the earth's surface. The depth of this mixing layer depends mainly on the amount of solar radiation, increasing in size gradually from sunrise to reach a maximum at about 5-6 hours after sunrise. The degree of thermal turbulence is increased on clear warm days with light winds. During the night-time a stable layer, with limited vertical mixing, exists. During windy and/or cloudy conditions, the atmosphere is normally neutral. Figure 9 indicates that very stable conditions occur 22.6% of the time, which is conducive to the formation of inversion layers and a concentration of pollutants within the valleys surrounding the site.

TABLE 4: ATMOSPHERIC STABILITY CLASSES

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

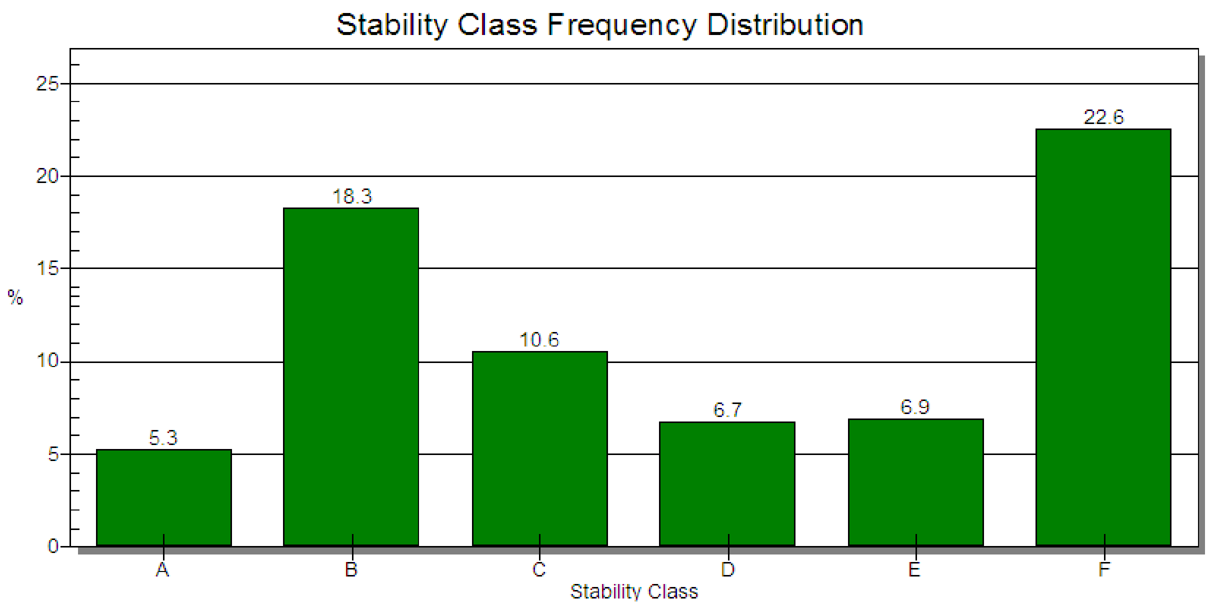


FIGURE 9: SHOWING CLASS STABILITY FREQUENCY DISTRIBUTION

- **Precipitation**

Precipitation cleanses the air by washing out particles suspended in the atmosphere (Kupchella & Hyland, 1993). It is calculated that precipitation accounts for about 80-90% of the mass of particles removed from the atmosphere (CEPA/FPAC Working Group, 1999).

Based on the climate record and the rainfall patterns for Lephalale, this shows it lies in a marked summer rainfall region (Figure 7).

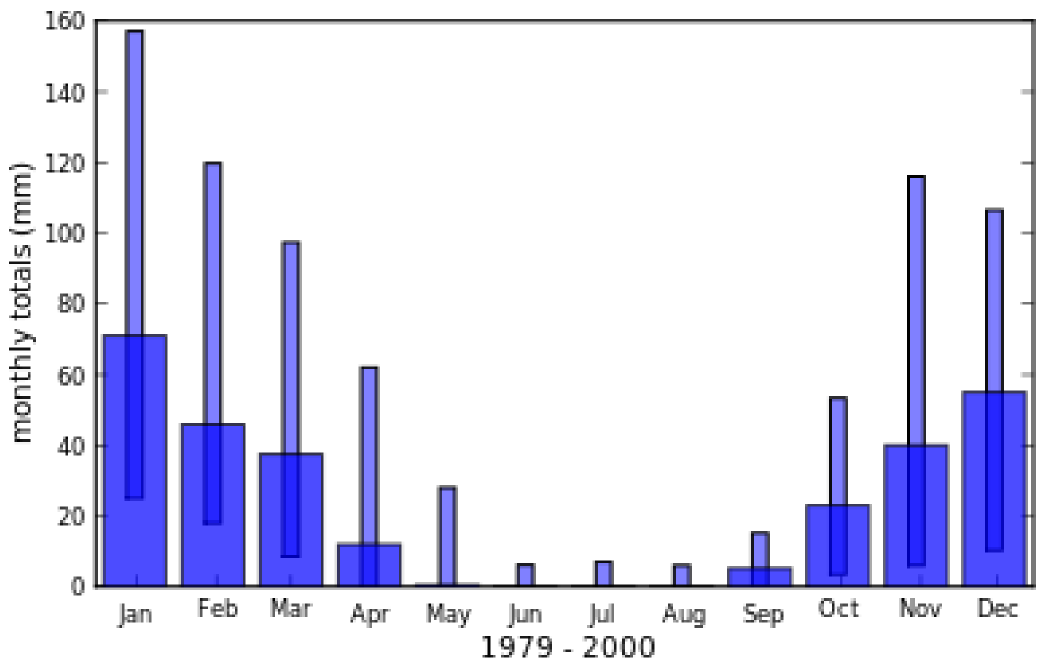


FIGURE 10: OBSERVED LONG TERM MONTHLY RAINFALL TOTALS CLIMATOLOGY (WIDE BARS) WITH 10TH TO 90TH PERCENTILE INTER-ANNUAL RANGE (NARROW BARS) (SOURCE: CSAG UCT)

3.2 Other Polluting Sources in the Area

Based on an aerial photo and site description of the area, the following sources of potential air pollution have been identified:

- Power Stations (Matimba & Medupi {under construction})
- Veld fires;
- Domestic fuel burning;
- Vehicle entrainment;
- Agriculture;
- Mining Operations (Grootegeluk Coal Mine); and
- The existing ash disposal facility.

A qualitative discussion on each of these source types is provided in the subsections which follow. Whilst it is noted that a number of monitoring stations are in the area, no data was available at the time of this report. These subsections aim to highlight the possible extent of cumulative impacts which may result due to the proposed operations.

- **Power Stations**

The burning of coal for power generation can result in emissions being generated. At Matimba power station, various mitigation measures have been put in place at the power station to reduce the emissions before entering the atmosphere. These include bag filters or electrostatic precipitators (ESPs) for the removal of particulate matter and ash, scrubbers for sulphur dioxide and over air burners for oxides of nitrogen. These mitigation measures are highly efficient with a design efficiency of up to 99% of all emissions being captured or removed. Medupi Power Station currently under construction will be the largest dry cooled power plant constructed, whilst similar mitigation measures will be installed at Medupi, as at Matimba, emissions from these stations may have an influence on the surrounding air quality.

- **Veld Fires**

A veld fire is a large-scale natural combustion process that consumes various ages, sizes, and types of flora growing outdoors in a geographical area. Consequently, veld fires are potential sources of large amounts of air pollutants that should be considered when attempting to relate emissions to air quality. The size and intensity, even the occurrence, of a veld fire depends directly on such variables as meteorological conditions, the species of vegetation involved and their moisture content, and the weight of consumable fuel per hectare (available fuel loading).

Once a fire begins, the dry combustible material is consumed first. If the energy released is large and of sufficient duration, the drying of green, live material occurs, with subsequent burning of this material as well. Under suitable environmental and fuel conditions, this process may initiate a chain reaction that results in a widespread conflagration. It has been hypothesized, but not proven, that the nature and amount of air pollutant emissions are directly related to the intensity and direction (relative to the wind) of the veld fire, and are indirectly related to the rate at which the fire spreads (Figure 11).

The factors that affect the rate of spread are:

- weather (wind velocity, ambient temperature, relative humidity);
- fuels (fuel type, fuel bed array, moisture content, fuel size); and
- topography (slope and profile).

However, logistical problems (such as size of the burning area) and difficulties in safely situating personnel and equipment close to the fire have prevented the collection of any reliable emissions data on actual veld fires, so that it is not possible to verify or disprove the hypothesis.

The major pollutants from veld burning are particulate matter, carbon monoxide, and volatile organics. Nitrogen oxides are emitted at rates from 1 to 4 g/kg burned, depending on combustion temperatures. Emissions of sulphur oxides are negligible (USEPA, 1996). A study of biomass burning in the African savanna estimated that the annual flux of particulate carbon into the atmosphere is estimated to be of the order of 8 Tg C, which rivals particulate carbon emissions from anthropogenic activities in temperate regions (Cachier *et al*, 1995).

FIGURE 11: AN EXAMPLE OF BURNT AGRICULTURAL LAND AND BURNING FIELDS NEAR LEPHALALE

- **Domestic Fuel Burning**

It is anticipated that the lower income households in the Marapong Township and other villages, identified as sensitive receptors, in the area surrounding the site are likely to use coal and wood for space heating and/ or cooking purposes. The problems facing Eskom around the impact of particulates generated indoors as a result of the use of coal and wood are not unique. Similar problems are reported around the world in poor communities which either lack access to electricity or lack the means to fully utilise the available supply of electricity (Van Horen *et al*. 1992).

Globally, almost 3 billion people rely on biomass (wood, charcoal, crop residues and dung) and coal as their primary source of domestic energy. Exposure to indoor air particulates (IAP) from the combustion of solid fuels is an important cause of morbidity and mortality in developing countries.

Biomass and coal smoke contain a large number of pollutants and known health hazards, including particulate matter, carbon monoxide, nitrogen dioxide, sulphur oxides (mainly from coal), formaldehyde, and polycyclic organic matter, including carcinogens such as benzo[*a*]pyrene (Ezzati and Kammen, 2002).

Monitoring of exposures in biomass-burning households has shown concentrations are many times higher than those in industrialized countries. The latest Air Quality Objectives, for instance, required the monthly average concentration of PM_{10} (particulate matter < 10 µm in diameter) to be < 200 µg/m^3 (annual average < 100 µg/m^3). In contrast, a typical 24-hr average concentration of PM_{10} in homes using biofuels may range from 200 to 5000 µg/m^3 or more throughout the year, depending on the type of fuel, stove, and housing. Concentration levels, of course, depend on where and when monitoring takes place, because significant temporal and spatial variations may occur within a house. Field measurements, for example, recorded peak concentrations of ≥ 50000 µg/m^3 in the immediate vicinity of the fire, with concentrations falling significantly with increasing distance from the fire. Overall, it has been estimated that approximately 80% of total global exposure to airborne particulate matter occurs indoors in developing nations. Levels of CO and other pollutants also often exceed international guidelines (Ezzati and Kammen, 2002).

- **Vehicle entrained dust**

The force of wheels of vehicles travelling on unpaved roadways causes the pulverisation of the surface material. Particles are lifted and dropped from the rotating wheels and the road surface is exposed to strong air currents in turbulent shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed. The quantity of dust emissions from unpaved roads varies linearly with the volume of traffic as well as the speed of the vehicles.

These types of roads could also be used and new ones may be created to ensure access to the new ash disposal facility where access cannot be obtained from the main roads in the area. The movement of construction vehicles and the possible transportation of conveyer belt sections and other infrastructure parts will result in unusually heavy loads being placed on the roads, which are likely to result in additional damage to the road surface (USEPA, 1996).

- **Agriculture**

Agricultural activity can be considered a significant contributor to particulate emissions, although tilling, harvesting and other activities associated with field preparation are seasonally based. The main crop grown in the area is maize with game and cattle farming being smaller in extent.

Little information is available with respect to the emissions generated due to the growing of crops. The activities responsible for the release of particulates matter would however include:

- Particulate emissions generated due to wind erosion from exposed areas;
- Particulate emissions generated due to the mechanical action of equipment used for tilling and harvesting operations;
- Vehicle entrained dust on paved and unpaved road surfaces.

- **Mining Operations**

Exxaro's Grootegeluk opencast coal mining operations are located in the area. The mine produces coal for the use in the nearby Matimba power station. All aspects from blasting, to material handling and transport of coal can result in particulate emissions to the atmosphere from mine operations. Mines need to ensure their own environmental obligations are met, by compliance to criteria outlined in their Environmental Mangement Plans (EMPs) and air quality permits.

FIGURE 12: GOOGLE EARTH IMAGE OF THE GROOTEGELUK COAL MINE NEAR MATIMBA POWER STATION

- **Existing Ash Disposal Facility**

Figure 13 below shows the advancing face of the existing ash facility. Particulate matter and nuisance dust is expected from the working face, and transfer and tipping points during normal operations. Water sprays are in place for mitigation to reduce the air quality impacts associated with the facility.

FIGURE 13: ADVANCING FACE OF EXISTING ASH DISPOSAL FACILITY

3.3 Sensitive Receptors

The residential, educational and recreational land uses are considered to be sensitive receptors. For this study, the position of houses/dwellings on the farms was taken off 1:50 000 topographical cadastral maps and verified as far as possible using Google Earth and site visit. Even though the latest editions were used, the relevant maps are out of date and there may be new dwellings and/or some of the existing shown buildings may be derelict.

There are a number of small human settlements in the areas as well as farmers and labourers working on surrounding farms, which would need to be accounted for and based on the distances from the proposed sites, may be impacted on. These include:

Marapong Township	1km	North East
Lephalale Town	13km East	
Ubuntu Occupational Health Services	9.17km	East South East
Several guest houses (Mosate Lodge)	6.7km	South East
Doctors practices (Marapong Private Hospital)	1.38km	North East
Local airstrip	10km	South East

4 ASSESSMENT OF ENVIRONMENT LIKELY TO BE AFFECTED

This phase of the investigation assesses the potential impacts that the construction, operational and decommissioning phases of the proposed project could have on the surrounding areas.

This section of the report outlines the potential impacts associated with the expansion/continuation of the existing ash disposal facility (site alternative 1) and the establishment of a new ash disposal facility (site alternative 2). To clearly detail the potential impacts in ambient ground level concentrations, only operational emissions are included in the final model runs. The construction and decommissioning phases of the operation can only qualitatively be addressed due to the variability and unpredictable nature of the construction operations on site.

4.1 Potential Impacts

- **Construction Phase**

During the construction phase it is expected that, the main sources of impact will be associated with the construction of infrastructure such as conveyor lines, ash dam, roads, ash water return dams, storm water channels etc. These predicted impacts cannot be directly quantified, primarily due to the lack of detailed information related to scheduling and positioning of construction related activities. Instead a qualitative description of the impacts has been provided and this involves the identification of possible sources of emissions and the provision of details related to their impacts.

Construction is commonly of a temporary nature with a definite beginning and end. Construction usually consists of a series of different operations, each with its own duration and potential for dust generation. Dust emission will vary from day to day depending on the phase of construction, the level of activity, and the prevailing meteorological conditions (USEPA, 1996).

The following possible sources of fugitive dust have been identified as activities which could potentially generate dust during construction operations at the site:

- Construction of the conveyor belt (site alternative 2)
- Grading of unpaved roads
- Ash disposal site preparation

4.1..1 Creation and Grading of Conveyor Belt and Access Roads

Access roads are typically constructed by the removal of overlying topsoil, whereby the exposed surface is graded to provide a smooth compacted surface for vehicles to drive on. Material removed is often stored in temporary piles close to the road edge, which allows for easy access once the road is no longer in use, whereby the material stored in these piles can be re-covered for rehabilitation purposes. Often however, these unused haul roads are left as is in the event that sections of them could be reused at a later stage.

As with the clearing and grading for access roads, the conveyor corridor requires clearing and grading for construction to be undertaken. This clearing is usually undertaken along the entire route leaving exposed soils vulnerable to wind erosion, as well as acting as a temporary roadway for vehicles.

A large amount of dust emissions are generated by vehicle traffic over these temporary unpaved roads (USEPA, 1996). Substantial secondary emissions may be emitted from material moved out from the construction/clearing area during grading and deposited adjacent to roads (USEPA, 1996). Passing traffic can thus re-suspend the deposited material. To avoid these impacts material storage piles deposited adjacent to the road edge should be vegetated, with watering of the pile prior to the establishment of sufficient vegetation cover. Piles deposited on the verges during continued grading along these routes should also be treated using wet or chemical suppressants depending on the nature and extent of their impacts.

A positive correlation exists between the amount of dust generated (during vehicle entrainment) and the silt content of the soil as well as the speed and size of construction vehicles. Additionally, the higher the moisture content of the soil the lower the amount of dust generated.

Periodic dust suppression, e.g. through watering or environmentally acceptable/friendly binding chemicals, of these road sections will aid in the reduction of dust generated from these sources. Cognisance should be taken to increase the watering rate during high wind days and during the summer months when the rate of evaporation increases, if water is used for dust suppression.

4.1..2 Overview of potential Impacts

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

- ambient air quality;
- local residents and neighbouring communities;
- employees;
- the aesthetic environment; and
- possibly fauna and flora

The impact on air quality and air pollution of fugitive dust is dependent on the quantity and drift potential of the dust particles (USEPA, 1996). Large particles settle out near the source causing a local nuisance problem. Fine particles can be dispersed over much greater distances. Fugitive dust may have significant adverse impacts such as reduced visibility, soiling of buildings and materials, reduced growth and production in vegetation and may affect sensitive areas and aesthetics. Fugitive dust can also adversely affect human health. It is important to note that impacts will be of a temporary nature, only occurring during the construction period.

Sensitive receptors were identified in Section 3.3. Given the short duration (several months) and low level of activity expected during construction, but bearing in mind that no quantitative emission figures exist, no long term adverse impacts are anticipated on these receptors.

- **Operational Phase**

4.1..1 Model Overview

Dispersion modelling has been undertaken using the US-EPA approved Aermod Dispersion Model. This model is based on the Gaussian plume equation and is capable of providing ground level concentration estimates of various averaging times, for any number of meteorological and emission source configurations (point, area and volume sources for gaseous or particulate emissions).

The AERMOD View model can be used extensively to assess pollution concentrations and deposition from a wide variety of sources. AERMOD View is a true, native Microsoft Windows application and runs in Windows 2000/XP/7 and NT4 (Service Pack 6).

The AERMOD (dispersion model used during the current investigation), is a steady state Gaussian plume model which can be used to assess pollutant concentrations and /or deposition fluxes from a wide variety of sources associated with an industrial source complex. Some of the modelling capabilities are summarised as follows:

- AERMOD may be used to model primary pollutants and continuous releases of toxic hazardous waste pollutants;

- AERMOD model can handle multiple sources, including point, volume, area and open pit source types. Line sources may also be modelled as a string of volume sources or as elongated area sources;
- Source emission rates can be treated as constant or may be varied by month, season, hour of day, or other periods of variation, for a single source or for a group of sources;
- The model can account for the effects of aerodynamic downwash due to nearby buildings on point source emissions;
- The model contains algorithms for modelling the effects of settling and removal (through dry deposition) of large particulates and for modelling the effects of precipitation scavenging from gases or particulates;
- Receptor locations can be specified as gridded and/or discrete receptors in a Cartesian or polar coordinate system;
- AERMOD incorporates the COMPLEX1 screen model dispersion algorithms for receptors in complex terrain;
- The model uses real-time meteorological data to account for the atmospheric conditions that affect the distribution of air pollution impact on the modelling area; and
- Output results are provided for concentration, total deposition, dry deposition, and/or wet deposition flux.

Input data to the AERMOD model includes: source and receptor data, meteorological parameters, and terrain data. The meteorological data includes: wind velocity and direction, ambient temperature, mixing height and stability class.

The uncertainty of the AERMOD model predictions is considered to be equal to 2, thus it is possible for the results to be over predicting by double or under predicting by half, it is therefore recommended that dust fallout monitoring be carried out at the proposed site during operation to confirm the modelled results, to ensure legal standards are maintained

4.1..2 Model Requirements

Input data requirements for AERMOD include meteorological and geophysical (terrain) data, model grid specifications as well as emissions source data. Local meteorological data has been obtained from the South African Weather services for the period Jan 2007 – Dec 2011 and includes hourly observations of wind speed, wind direction, temperature, relative humidity and pressure As recommended in Government Notice 35981: Draft Regulations Regarding Air Dispersion Modelling, all suggested requirements, such as a minimum of three years worth of Met Data, use of AERMOD as a Level 2 acceptable model and physical characteristics have been included..

4.1..3 Emissions Inventory

The emissions inventory has been developed to determine the emissions generated from each source. This has been undertaken using the US-EPA AP42 emission factors. These emission factors are calculated based on standard operating conditions for various industries, and activities, and are used as an accepted alternative if no site specific or monitored data are available. The inventory is based on the existing operations at the ash disposal facility, was provided by the client, with the layout for each site provided in Figure 14 and Figure 15, with the technical information provided in Table 5 and Table 6

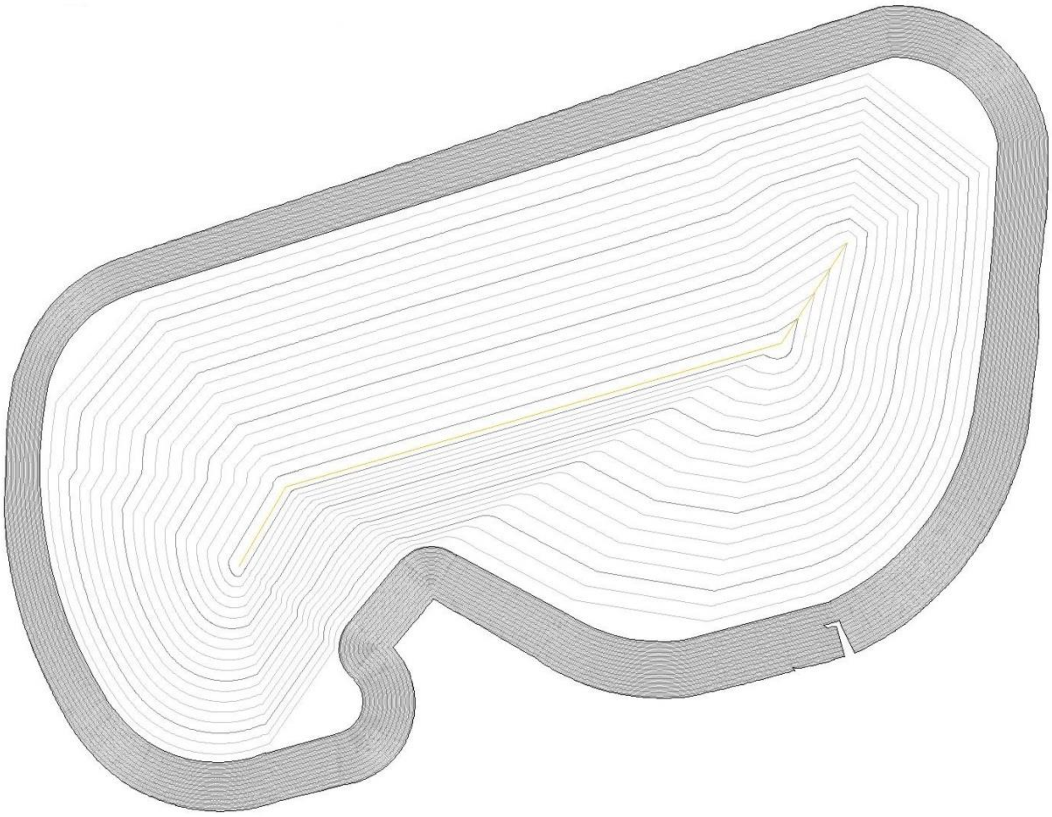


FIGURE 14: DESIGN DETAIL FOR SITE ALTERNATIVE 1

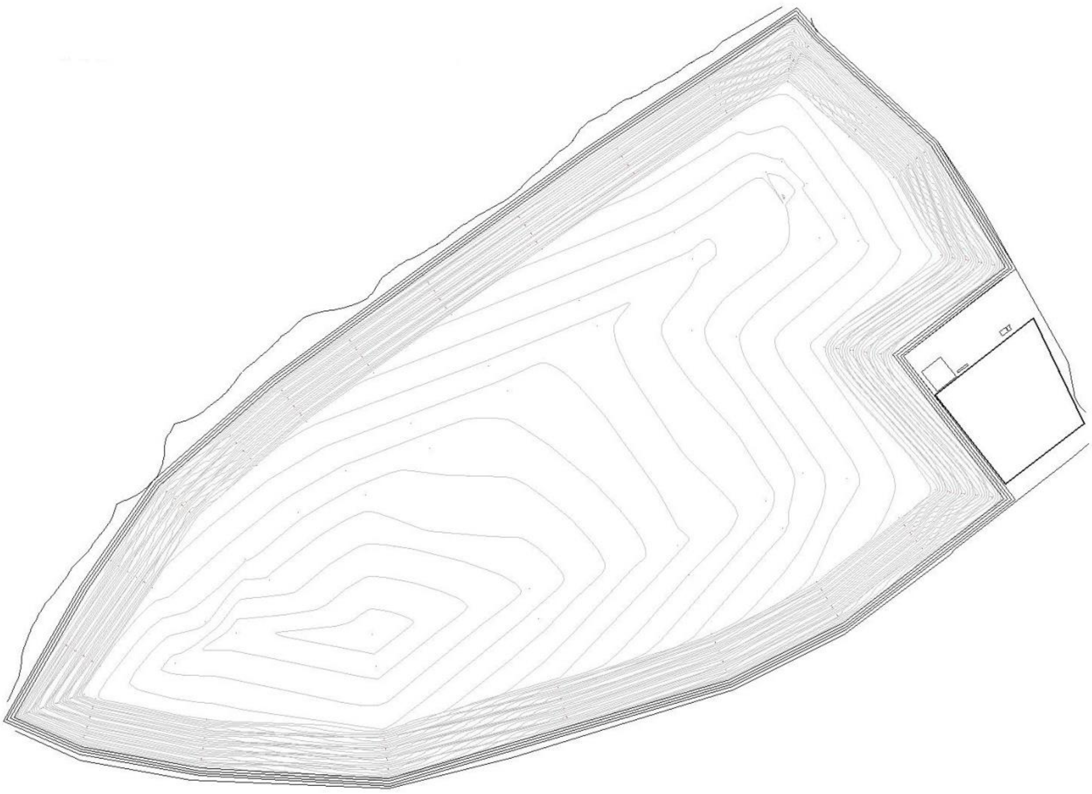


FIGURE 15: DESIGN DETAIL FOR SITE ALTERNATIVE 2

TABLE 5: CO-ORDINATES OF CORNER POINTS FOR ASH DAMS

Site Alternative 1

Coordinate System: WGS 84 Lo 27		
	X	Y
Top Left	59027.940	-2621817.953
Top Right	63827.940	-2621817.953
Bottom Left	59027.940	-2625657.953
Bottom Right	63827.940	-2625657.953
Site Alternative 2 Coordinate System: WGS 84 Lo 27		
Top Left	59120.056	-2610445.135
Top Right	63920.056	-2610445.135
Bottom Left	59120.056	-2614285.135
Bottom Right	63920.056	-2614285.135

TABLE 6: ANALYTICAL ANALYSIS OF COAL (ESKOM CENTRAL COAL LABORATORY, 2012)

Analytical Analysis of Coal	Percentage Value
Analytical Moisture	2.7
Ash	24.8
Volatile Matter	25.6
Fixed Carbon (by Difference)	36.9
Carbon	47.04
Hydrogen	2.73
Nitrogen	0.94
Total Sulphur	0.78
Carbonate	2.37
Oxygen (by Difference)	8.64
Gross Calorific Value (MJ/kg)	20.26

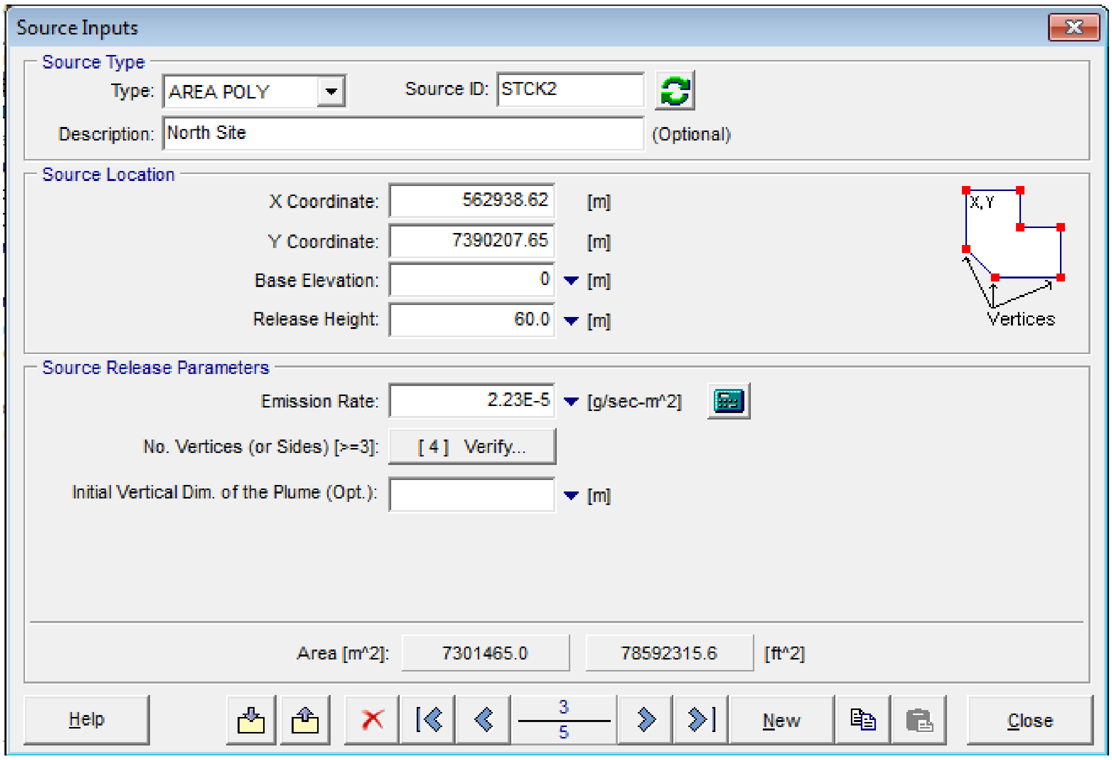


FIGURE 16: SCREEN SHOT OF INPUT PARAMETERS FOR AERMOD

Wind Erosion

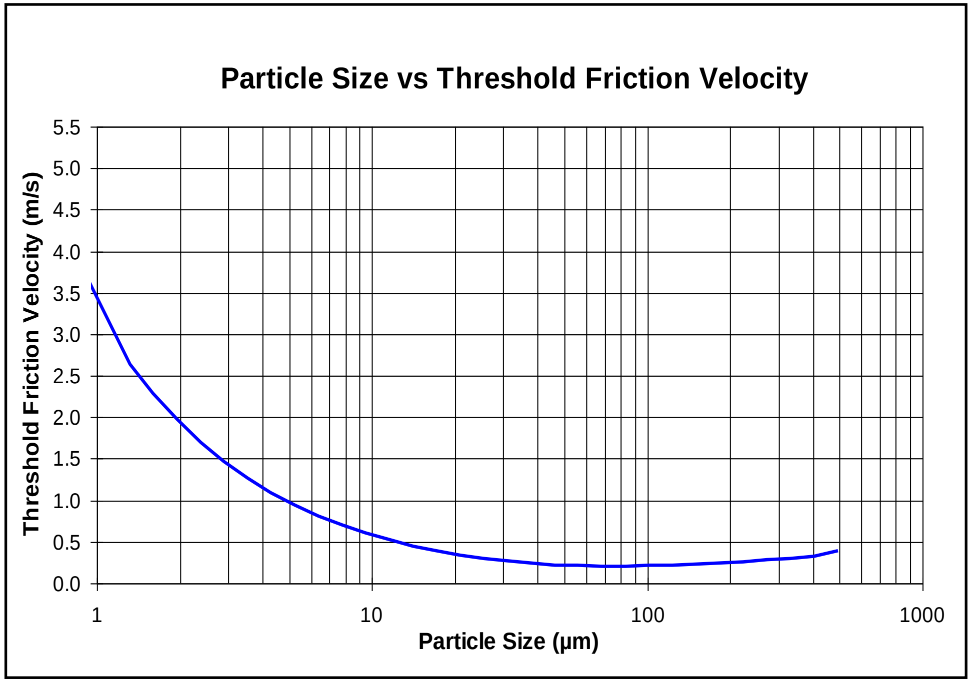


FIGURE 17: PARTICLE SIZE CURVE FOR WIND EROSION CALCULATIONS

TABLE 7: HOURLY WIND EROSION CALCULATION FORMULA AND EXAMPLE

Ei = Gi10^ (0.134C-6)

Gi = 0.261 Pa/gUstar^3(1+Ri)+(1-Ri^2)

Ri = UtStari/Ustar

E	=	Emission rate (size category i)
C	=	Clay Content (%)
Pa	=	air density
g	=	gravitational acceleration
Ustar	=	Friction velocity

UtStari = Friction velocity (size category i)

Ustar = 0.053 U10^+

U10 = wind speed at anemometer height of 10 m

											PM10	TSP	PM10	TSP	PM10	TSP
Year	**Month**	**Day**	**Julian Day**	**Hour**		**Wind Speed (m/s)**	**Ustar**	**Clay %**	**Pa**	**g**	**Ri**	**Ri**	**Gi**	**Gi**	**Ei**	**Ei**
2007	1	1	1	1	100	1.84	0.10	2	0.2	9.81	5.43	2.77	1.20E+01	1.71E+01	2.23E-05	3.17E-05
2007	1	1	1	2	200	1.73	0.09	2	0.2	9.81	5.78	2.94	1.36E+01	1.91E+01	2.52E-05	3.54E-05
2007	1	1	1	3	300	1.65	0.09	2	0.2	9.81	6.06	3.09	1.50E+01	2.09E+01	2.79E-05	3.87E-05
2007	1	1	1	4	400	1.9	0.10	2	0.2	9.81	5.26	2.68	1.13E+01	1.61E+01	2.09E-05	2.99E-05

Materials Handling

The following predictive equation is used to estimate emissions from each conveyor transfer point for Total Suspended Particulates (TSP)

$$E_{TSP} = 0.0016 \frac{(U / 2.2)^{1.3}}{(M / 2)^{1.4}} \tag{3}$$

where,

E

E_{TSP}	=	Total Suspended Particulate emission factor (kg dust / t transferred)
U	=	mean wind speed (m/s)
M	=	material moisture content (%)

						CTP – Mitigated with Water spray and cover
					tonnes/hour	547.94
					Moisture (%)	10.00
YEAR	**MONTH**	**DAY**	**HOUR**	**W/S (m/s)**		**g/s**
94	1	1	1	4.1		0.01915
94	1	1	2	2.3		0.00903
94	1	1	3	2.1		0.00802
94	1	1	4	2.2		0.00853

4.1..4 Impact assessment

Dispersion modelling simulations were undertaken to determine the potential air quality impacts associated with the expansion of the existing ash disposal facility on site alternative 1 or the establishment of a new facility on site alternative 2. These impacts are reflected as isopleths plots below.

The isopleth plots reflect the gridded contours with zones of impact at various distances from the contributing sources. The patterns generated by the contours are representative of the maximum predicted ground level concentrations for the averaging period being represented. These predicted concentrations are for unmitigated conditions (i.e. worst case scenario) and therefore with proper dust management, it is expected that these results will decrease.

A maximum daily average PM_{10} concentration of **203µg/m^3** is predicted for Site Alternative 1 which exceeds the current National daily average standard of 120 µg/m^3 (Figure 18). However, this is still within the site boundary, and therefore with mitigation is unlikely to have an impact on the surrounding receptors. An annual average concentration of **58µg/m^3** is predicted, which exceeds the current National annual average standard of 50µg/m^3

A maximum predicted daily average PM_{10} concentration of **161µg/m^3** for Site Alternative 2, (including the conveyor) exceeds the current National daily average standard of 120µg/m^3 (Figure 19). Due to the location of this site, and it being a new location for the ash disposal facility, there is the potential for the particulate matter to impact on the nearby Grootegeluk Coal Mine. The annual averaging concentration for this site is **71µg/m^3,** which is above the current National annual average standard of 50µg/m^3

Individually, the conveyor system will produce **7.23µg/m^3** and **1.47µg/m^3** of particulate matter for daily, and annual averaging periods respectively. This will result in a very small (2.3%) addition to the overall particulate loading of the receiving environment.

Cumulative impacts on the Matimba Power Station and Grootegeluk Coal Mine have also been assessed, using information provided by Eskom, and US-EPA emission factors, with a maximum daily average of **305 µg/m^3** predicted for Site Alternative 1 and **315 µg/m^3** predicted for Site Alternative 2. An annual average of **97 µg/m^3,** and **104 µg/m^3** was predicted for Site Alternative 1 and Site Alternative 2, respectively.

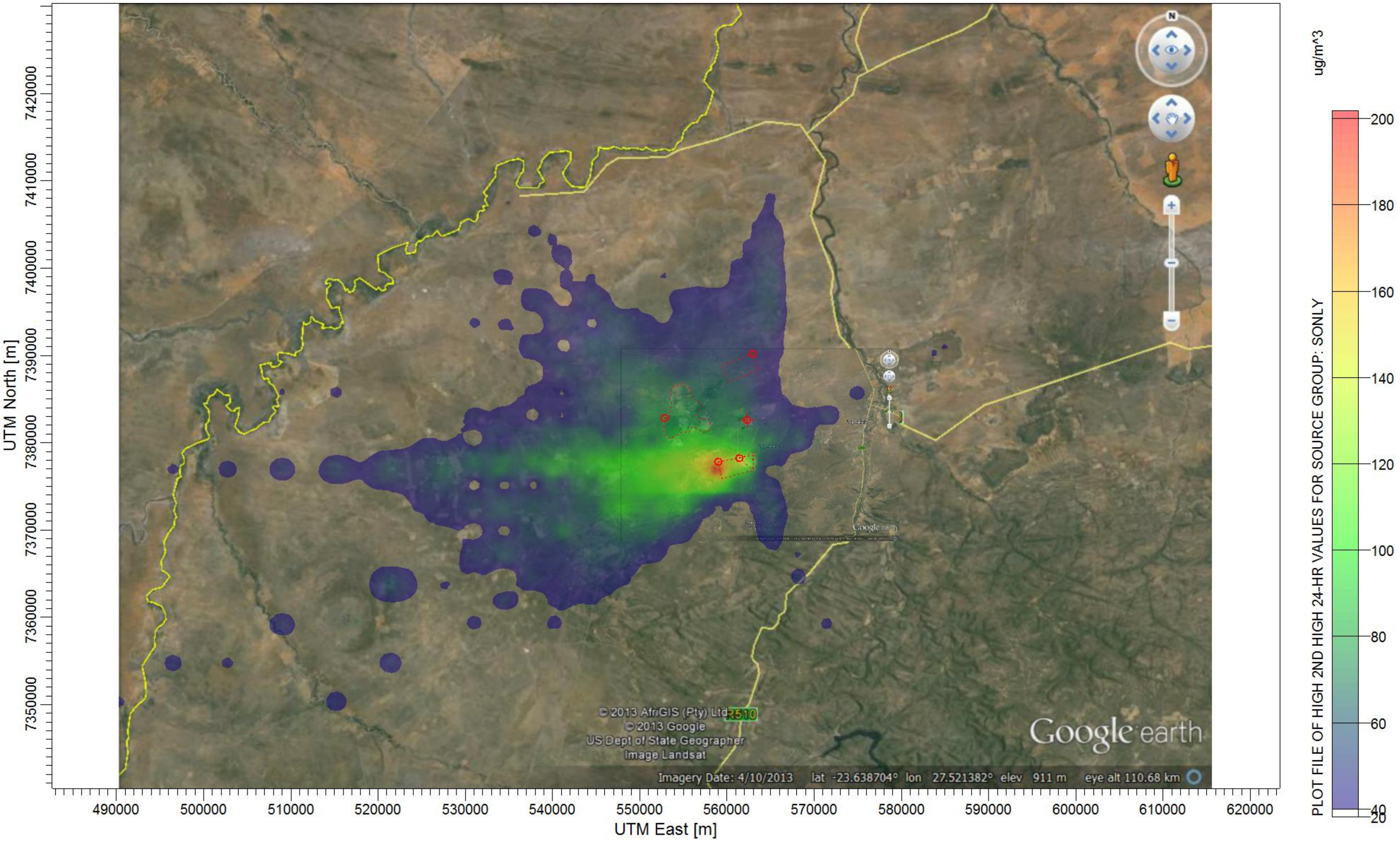


FIGURE 18: DAILY AVERAGE PM10 CONCENTRATIONS AT SITE ALTERNATIVE 1

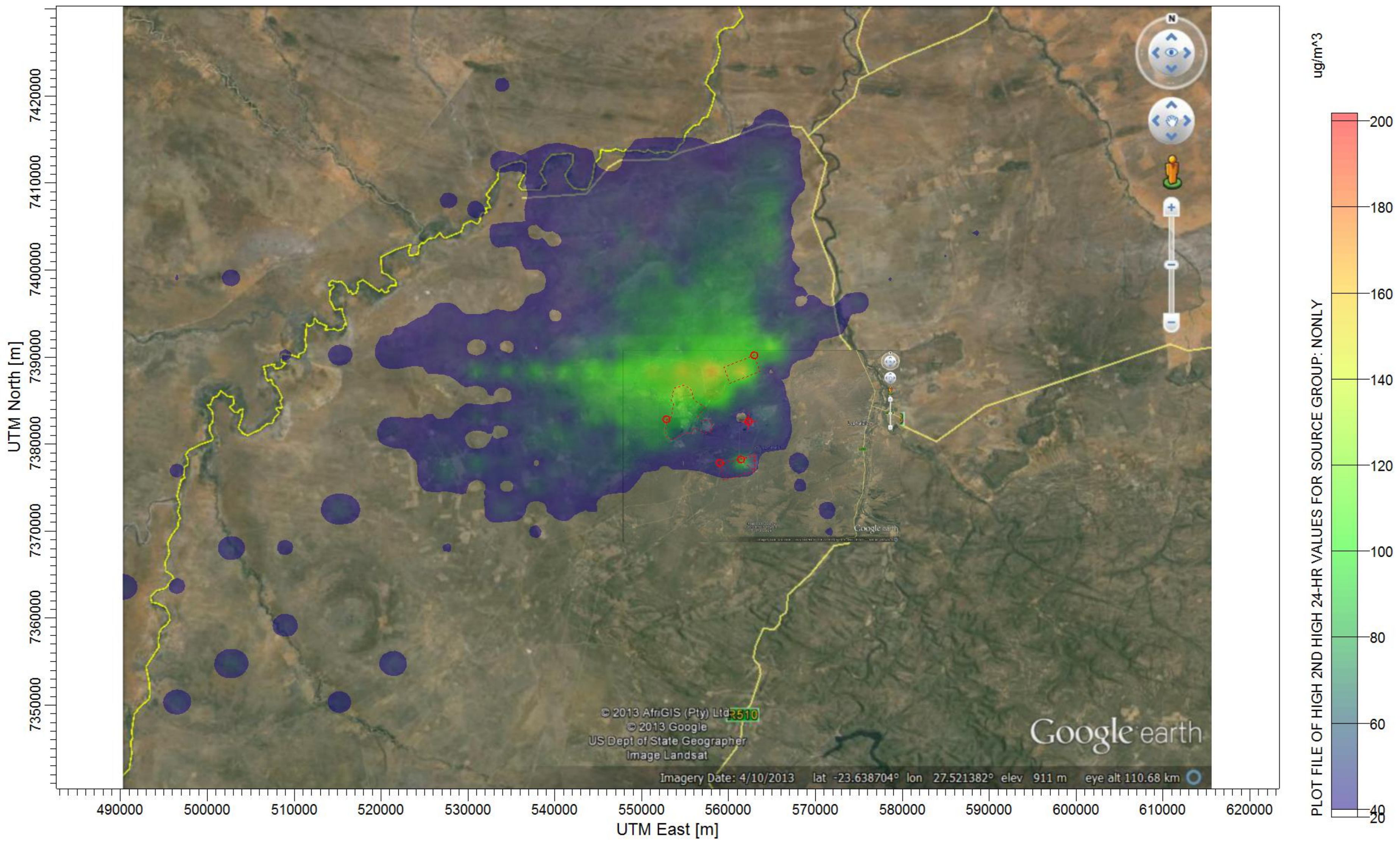


FIGURE 19: DAILY AVERAGE PM10 CONCENTRATIONS AT SITE ALTERNATIVE 2 INCLUDING CONVEYORS

- **Decommissioning Phase**

The decommissioning phase is associated with activities related to the demolition of infrastructure and the rehabilitation of disturbed areas. The total rehabilitation will ensure that the total area will be free draining covered with topsoil and grassed. The following activities are associated with the decommissioning phase (US-EPA, 1996):

- Existing buildings and structures demolished, rubble removed and the area levelled;
- Remaining exposed excavated areas filled and levelled; and
- Land and permanent waste piles re-vegetated.

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

- Smoothing of stockpiles by bulldozer;
- Grading of sites;
- Transport and dumping of overburden for filling;
- Infrastructure demolition;
- Infrastructure rubble piling;
- Transport and dumping of building rubble;
- Transport and dumping of topsoil; and
- Preparation of soil for re-vegetation – ploughing and addition of fertiliser, compost etc.

Exposed soil is often prone to erosion by water. The erodability of soil depends on the amount of rainfall and its intensity, soil type and structure, slope of the terrain and the amount of vegetation cover (Brady, 1974). Re-vegetation of exposed areas for long-term dust and water erosion control is commonly used and is the most cost-effective option. Plant roots bind the soil, and vegetation cover breaks the impact of falling raindrops, thus preventing wind and water erosion. Plants used for re-vegetation should be indigenous to the area, hardy, fast-growing, nitrogen-fixing, provide high plant cover, be adapted to growing on exposed and disturbed soil (pioneer plants) and should easily be propagated by seed or cuttings.

4.2 Proposed Mitigation

- **Construction Phase**

Due to the lack of quantitative dust emissions data for the site, such as vehicle movements and material handing during construction, it is recommended that the precautionary principle be followed and dust control measures be implemented. Recommendations for the control of fugitive dust emissions are given in Table 8. Wet suppression with water is the least expensive of the possible control measures but is temporary in nature.

TABLE 8: RECOMMENDATIONS FOR THE CONTROL OF FUGITIVE DUST EMISSIONS DURING THE CONSTRUCTION PHASE (USEPA, 1996).

Emission Source	Recommended Control Methods
Debris handling and debris piles	Wind speed reduction through wind breaks
	Wet Dust suppression (1)
Truck transport (2)	Wet suppression
	Paving
	Chemical stabilisation (3)

Bulldozers	Wet suppression
Pan scrapers	Wet suppression of travel routes
Cut/fill material handling	Wind speed reduction
	Wet suppression
Cut/fill haulage	Wet suppression
	Paving
	Chemical stabilisation
General construction	Wind speed reduction
	Wet suppression
	Early paving of permanent roads

Note: (1) Dust control plans should contain precautions against watering programs that compound trackout problems.

(2) Loads could be covered to avoid loss of material in transport, especially if material is transported offsite.

(3) Chemical stabilisation is usually cost-effective for relatively long-term or semi-permanent unpaved roads.

Water may be combined with a surfactant such as a wetting agent. Surfactants increase the surface tension of water, reducing the quantity of water required. Chemical stabilisation is of longer duration but is not cost effective for small-scale operations. Dust-A-Side (DAS) represents an example of a chemical product, which is commercially available and widely used by mines and quarries. The DAS product binds with the aggregate used to build on-site roads. It should be noted however, that the treatment with chemical stabilisers can have adverse effects on plant and animal life and can contaminate the treated material (USEPA, 1996).

Dust and mud should be controlled at vehicle exit and entry points to prevent the dispersion of dust and mud beyond the construction site boundary. Facilities for the washing of vehicles could be provided at the entry and exit points. A speed limit of 40 km/hr should be set for all vehicles travelling over exposed areas or near stockpiles. Traffic over exposed areas should be kept to a minimum (USEPA, 1996).

Any temporary storage piles (ash or cleared topsoil) should be maintained for as short a time as possible and should be enclosed by wind breaking enclosures of similar height to the storage pile. Storage piles should be situated away from the site boundary, water courses and nearby receptors and should take into account the predominant wind direction.

During the transfer of material to piles, drop heights should be minimised to control the dispersion of materials being transferred (USEPA, 1996).

Additional preventative techniques include the reduction of the dust source extent and adjusting work processes to reduce the amount of dust generation (USEPA, 1996).

- **Operational Phase**

Based on the predicted concentrations, the following recommendations are outlined:

- Fallout monitoring should be continued to assess the level of nuisance dust associated with the ash disposal facility. Sampling of fallout should also be undertaken within the neighbouring farming and community areas as well as on-site.

Due to dust emissions being generated from increased wind speeds, a water spray system should be operated at the site. It is also recommended that wind breaks be used in close proximity of the ash disposal facility in order to reduce the potential erosive forces of the wind. During the transfer of ash to the disposal facility, drop heights should be minimised to control the dispersion of materials being transferred (USEPA, 1996).

Water may be combined with a surfactant such as a wetting agent to increase the control efficiency for adequate control of dust. Surfactants increase the surface tension of water, reducing the quantity of water required. Chemical stabilisation is of longer duration but is not cost effective for small-scale operations. Dustex represents an example of a product, which is commercially available and widely used by mines and quarries. The Dustex product binds with the aggregate used to build on-site roads. (USEPA, 1996). Nozzles fitted on a spread bar behind trucks for a controlled spray opposed to a wide splash set-up shown in picture below.

FIGURE 20: EXAMPLES OF WATER SPRAY EQUIPMENT

An Ash Dump Operating Manual (January 2011) was developed for the existing Matimba Ashing Facility. The recommendations in the manual and those above are similar, and therefore, if the dust suppression measures recommended in the manual are implemented, all potential dust emissions from the site are likely to be adequately controlled.

- **Decommissioning and Post Closure Phase**

Re-vegetation of exposed areas for long-term dust and water erosion control is commonly used and is the most cost-effective option. Plant roots bind the soil, and vegetation cover breaks the impact of falling raindrops, thus preventing wind and water erosion. Plants used for re-vegetation should be indigenous to the area, hardy, fast-growing, nitrogen-fixing, provide high plant cover, be adapted to growing on exposed and disturbed soil (pioneer plants) and should easily be propagated by seed or cuttings. Additional detail regarding the re-vegetation recommendations are provided in the Ash Dump Operating Manual (January 2011) for the existing Matimba Ashing Facility.

4.3 Significance Rating

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

- ***Nature***: A brief written statement of the environmental aspect being impacted upon by a particular action or activity.

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

TABLE 9: CRITERIA TO BE USED FOR THE RATING OF IMPACTS

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

				very low

Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

TABLE 10: SIGNIFICANCE RATING OF CLASSIFIED IMPACTS

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

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

Site Alternative 1

POTENTIAL IMPACTS	SIGNIFICANCE RATING OF IMPACTS	PROPOSED MITIGATION	SIGNIFICANCE RATING OF IMPACTS AFTER MITIGATION:
Air Quality: Construction The following activities have been identified as possible sources of fugitive dust during construction operations at the site: • Dust from bare areas, including conveyor corridor. • Material handling. • Emissions from construction machinery and equipment. • Trucks transporting material.	Extent: **Site (-1)** Duration: **Medium-term (-2)** Intensity: **Moderate (-2)** Probability: **Highly Probable (-3)** Significance: Medium (-8)	• There should be strict speed limits on site roads to prevent the liberation of dust into the atmosphere. • Dust must be suppressed at the construction site, conveyor areas, temporary dirt roads and during the transportation of material during dry periods by the regular application of water or binding chemicals. Water used for this purpose must be used in quantities that will not result in the generation of run-off. • All site workers during construction will need to wear the appropriate PPE to avoid excessive exposure to dust particles.	Extent: **Site (-1)** Duration: **Medium-term (-2)** Intensity: **Low (-1)** Probability: **Possible(-2)** Significance: Low (-6)
Air Quality: Operation The following activities have been identified as possible sources of fugitive dust during operations at the site: • Dust from working face • Dust from recently worked areas. • Material Handling. • Emissions from machinery and equipment. • Conveyor Transfer Points	Extent: **Regional (-3)** Duration: **Long-term (-3)** Intensity: **High (-3)** Probability: **Definite (-4)** Significance: Very High (-13)	• There should be strict speed limits on site roads to prevent the liberation of dust into the atmosphere. • Dust must be suppressed on the site during the transportation and handling of material during dry periods by the regular application of water, as per Ash Dump Operating Manual. Water used for this purpose must be used in quantities that will not result in the generation of run-off. • All site workers will need to wear the appropriate PPE to avoid excessive exposure to dust particles. • Dust is expected to be generated from each of the conveyor transfer points (and change in direction or drop from one conveyor to another) Dust sprays can be fitted to the transfer points to ensure minimum dust liberation.	Extent: **Local (-2)** Duration: **Medium-term (-2)** Intensity: **Moderate (-2)** Probability: **Possible (-2)** Significance: Medium (-8)

POTENTIAL IMPACTS	SIGNIFICANCE RATING OF IMPACTS	PROPOSED MITIGATION	SIGNIFICANCE RATING OF IMPACTS AFTER MITIGATION:
Air Quality: Decommissioning The following activities have been identified as possible sources of fugitive dust at the site: • Dust from bare areas • Material handling for rehabilitation. • Emissions from construction machinery and equipment.	Extent: **Site (-1)** Duration: **Medium-term (-2)** Intensity: **Moderate (-2)** Probability: **Highly Probable (-3)** Significance: Medium (-8)	• There should be strict speed limits on site roads to prevent the liberation of dust into the atmosphere. • Dust must be suppressed on the site, temporary dirt roads and during the transportation of material during dry periods by the regular application of water. Water used for this purpose must be used in quantities that will not result in the generation of run-off. • All site workers during construction will need to wear the appropriate PPE to avoid excessive exposure to dust particles.	Extent: **Site (-1)** Duration: **Medium-term (-2)** Intensity: **Low (-1)** Probability: **Possible(-2)** Significance: Low (-6)

Site Alternative 2

POTENTIAL IMPACTS	SIGNIFICANCE RATING OF IMPACTS	PROPOSED MITIGATION	SIGNIFICANCE RATING OF IMPACTS AFTER MITIGATION:
Air Quality: Construction The following activities have been identified as possible sources of fugitive dust during construction operations at the site: • Dust from bare areas. • Material handling. • Emissions from construction machinery and equipment. • Trucks transporting material.	Extent: **Site (-1)** Duration: **Medium-term (-2)** Intensity: **Moderate (-2)** Probability: **Highly Probable (-3)** Significance: Medium (-8)	• There should be strict speed limits on site roads to prevent the liberation of dust into the atmosphere. • Dust must be suppressed on the construction site, temporary dirt roads and during the transportation of material during dry periods by the regular application of water. Water used for this purpose must be used in quantities that will not result in the generation of run-off. • All site workers during construction will need to wear the appropriate PPE to avoid excessive exposure to dust particles.	Extent: **Site (-1)** Duration: **Medium-term (-2)** Intensity: **Low (-1)** Probability: **Possible(-2)** Significance: Low (-6)
Air Quality: Operation The following activities have been identified as possible sources of fugitive dust during	Extent: **Regional (-3)** Duration: **Long-term (-3)** Intensity: **High (-3)** Probability: **Definite (-4)**	• There should be strict speed limits on site roads to prevent the liberation of dust into the atmosphere. • Dust must be suppressed on the site during	Extent: **Local (-2)** Duration: **Long-term (-3)** Intensity: **Moderate (-2)** Probability: **Possible (-2)**

POTENTIAL IMPACTS	SIGNIFICANCE RATING OF IMPACTS	PROPOSED MITIGATION	SIGNIFICANCE RATING OF IMPACTS AFTER MITIGATION:
operations at the site: • Dust from working face • Dust from recently worked areas. • Material Handling. • Emissions from machinery and equipment. • Conveyor Transfer Points	Significance: Very High (-13)	the transportation and handling of material during dry periods by the regular application of water, as per Ash Dump Operating Manual. Water used for this purpose must be used in quantities that will not result in the generation of run-off. • All site workers will need to wear the appropriate PPE to avoid excessive exposure to dust particles. • Dust is expected to be generated from each of the conveyor transfer points (and change in direction or drop from one conveyor to another) Dust sprays can be fitted to the transfer points to ensure minimum dust liberation.	Significance: Medium (-9)
Air Quality: Decommissioning The following activities have been identified as possible sources of fugitive dust at the site: • Dust from bare areas • Material handling for rehabilitation. • Emissions from construction machinery and equipment.	Extent: **Site (-1)** Duration: **Medium-term (-2)** Intensity: **Moderate (-2)** Probability: **Highly Probable (-3)** Significance: Medium (-8)	• There should be strict speed limits on site roads to prevent the liberation of dust into the atmosphere. • Dust must be suppressed on the site, temporary dirt roads and during the transportation of material during dry periods by the regular application of water. Water used for this purpose must be used in quantities that will not result in the generation of run-off. • All site workers during construction will need to wear the appropriate PPE to avoid excessive exposure to dust particles.	Extent: **Site (-1)** Duration: **Medium-term (-2)** Intensity: **Low (-1)** Probability: **Possible(-2)** Significance: Low (-6)

5 CONCLUSION

Based on the predicted model results, it is recommended that Site Alternative 1 (expansion of the existing ash disposal facility) be the preferred site alternative for this project. This recommendation also ensures that the existing conveyor route is used, and reduces the potential emissions that would be generated from the construction and operation of a second conveyor corridor. Whilst this site has higher predicted daily particulate matter concentrations, for off-site (environmental) impacts, annually and cumulatively this site produces lower concentrations than Site Alternative 2. Long term exposure is the main concern for dust and particulate matter exposure, and therefore a lower annual concentration is preferred to a lower daily concentration.

With these mitigation measures, it is expected that the site will adequately comply with all air quality legislation.

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Peer Review

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11 June 2015

Royal HaskoningDHV
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Dear Prashika,

Re: Review of the Air Quality Impact Assessment undertaken for the Proposed Ash Disposal Facility at Matimba Power Station

A peer review of the Air Quality Impact Assessment for the Proposed Ash Disposal Facility at Matimba Power Station (Report Number E02.JNB.001222) has been undertaken on behalf of Royal HaskoningDHV. The Air Quality Impact Assessment was completed in June 2014, prior to the publishing of the *Code of Practice for Air Dispersion Modelling in Air Quality Management in South Africa* (11 July 2014). While a draft modelling guideline had been released in 2012, it was not a requirement that the methodologies outlined in the guideline were followed during the development of this Air Quality Impact Assessment. However, it is recommended that where *practical and feasible*, the report is updated to be in-line with the current modelling regulations.

The following key recommendations are made:

- Additional information on the meteorological dataset used in the study needs to be included. This includes information on the location of the meteorological station, the period for which data was obtained and which dataset was used for dispersion modelling purposes. Diurnal and seasonal wind roses should also be included in the meteorological overview;
- Ambient air quality monitoring data should be included to evaluate the existing baseline air quality situation. There are a number of ambient air quality monitoring stations in the Lephalele area from which monitoring data can be obtained;
- The legislative section needs to be updated with the current dust fallout standards;
- The emissions inventory section needs to be amended to include the emission factors and source parameters used in the calculations and the resulting emission rates;

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- Emissions inventory calculations are needed to confirm the calculated emission rates. As such, emission inventory calculations and subsequent modelled results are taken to be correct at the time of review;
- Additional information on the parameters used in the dispersion model should be provided. This includes the meteorological data used, terrain resolution, modelling grid and receptor spacing;
- In terms of the dispersion modelling, predicted impacts need to be assessed off-site i.e beyond the site boundary, to determine compliance with the National ambient air quality standards. The maximum predicted concentrations given in the report do not reflect whether these impacts are on-site or off-site;
- Dust fallout should be included in the dispersion modelling simulations;
- Comparison of the predicted concentrations to the National ambient air quality standards and allowable frequency of exceedence should be done when determining compliance with the National ambient air quality standards;
- Additional information on how cumulative impacts were assessed should be provided;
- All assumptions and limitations of the report should be highlighted;
- A list of references should be included;
- General cosmetic changes are needed for consistency purposes.

Based on the findings of this review, it is the opinion of the independent reviewer that the information presented in this report is consistent with the information required for inclusion in an Air Quality Impact Assessment. However, there are some gaps in the technical information provided in the report with specific reference to the meteorological overview, update of the legislative section (dust fallout standards), emissions inventory calculations, dispersion modelling simulations and predicted impacts. General cosmetic changes are required to the report although it is recognised that these do not influence the scientific validity of the report. It is recommended that these gaps are addressed to ensure that the report is accurate and comprehensive.

Yours sincerely,

NEnslin

Nicola Enslin
Pr.Sci.Nat (400209/09)