AIR QUALITY IMPACT ASSESSMENT REPORT

FOR THE LISTED ACTIVITIES ASSOCIATED WITH THE MINING RIGHT AND/OR BULK SAMPLING ACTIVITIES INCLUDING TRENCHING IN THE CASE OF ALLUVIAL DIAMOND PROSPECTING

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ASTM	**American Standard for Testing and Materials**
PM	**Particulate matter**
ppb	**Particulates per billion**
ppm	**Particulates per million**
TSP	**Total suspended particulates**
AQMP	**Air Quality Management Plan**
BPDM	**Bojala Platinum District Municipality**
DEA	**Department of Environmental Affairs**
SABS	**South African Bureau of Standards**
USEPA	**United States Environmental Protection Agency**

1. Introduction

Skeiron (Pty) Ltd was appointed by Joan Projects, to conduct an air quality impact assessment for the listed activities associated with the mining right and/or bulk sampling activities including trenching in the case of Alluvial Diamond prospecting. The study will follow the requirements of an environmental impact assessment and include:

- a baseline characterisation
- Potential Receptors
- an air quality impact study during all phases of the development
- final assessment and projected impact on the sensitive receptors
- Impact and mitigation
- Final assessment of the predicted air quality impact
- recommendations

1.1 Site Description

The proposed site will encompass an 88 ha operational area on the farm Palmietfontein 208 JP within the Bojanala Magisterial district in the North-West Province. The proposed site is situated approximately 50 km North-North West of Rustenburg and 16 km North-West of Sun City. The proposed operational area as depicted in Figure 1, is surrounded to the north, east, south and west by Bushveld habitat classified as the Zeerust Thornveld and Savanna biome (Mucina, L, 2006).

	Latitude	Longitude
A	-25.3014	26.95116
B	-25.3014	26.960211
C	-25.3102	26.960207
D	26.95116	-25.310078
E	26.95116	-25.301376

Figure 1: *The proposed Alluvial Diamond Mining Operational area (Mugovhani, 2017)*

1.2 Project description

Diamond reserves were identified around the preferred location, through the specific geology of the area and previous diamond diggings. The reserves can be feasibly mined and the associated mining activities will contribute to providing much needed jobs preferentially to members of the local community and contribute to the GDP and foreign earnings through export. The project will consists out of three phases which might have an impact on the air quality status as well as the surrounding environment. The first phase will consist out of the construction and development of infrastructure and processing plant. The second phase will be the operational phase and consist out of the opencast mining and processing of the diamondiferous ore. The third phase will be the decommissioning phase and consist out of the rehabilitation of mined sites and infrastructure.

2. Baseline Characterisation

The following baseline description will characterize the ambient air quality of the surrounding environment of the proposed project with regards to climate, air quality status and emission inventory of the region using monitoring data of a comprehensive ambient air quality monitoring station operated within the district of the proposed development.

2.1 Climate

The climate of a region is extremely important when it comes to air quality assessments as the level of ambient concentrations of pollutants (gases and aerosols) within the atmosphere are all dependent on regional climatic conditions. This involves diffusion, dispersion and deposition of pollutants and are all directly influenced by weather conditions. These climatic weather conditions includes the local atmospheric stability, which varies on a daily and seasonal basis. During winter in most parts of South Africa, conditions are unfavourable for pollution dispersion and diffusion, while during summer, moist unstable conditions dominate, resulting in conditions that are conducive to rapid pollution dispersion, air mixing and wet deposition by rainfall.

Due to the close proximity of Rustenburg to the proposed site the specific climatic data of South African weather service stations in Rustenburg were subsequently used to describe the climate of the proposed area. Rustenburg is located within a hot and semi-arid region marked with seasonal precipitation and cool, dry winters and warm wet summers. Climatic weather conditions are mainly responsible for determining the ambient concentrations of pollutants (gases and aerosols) regionally through the factors of temperature, precipitation (rain), and wind. The climatic weather conditions directly influencing the concentrations of pollutants (gases and aerosols) in the Rustenburg region through diffusion, dispersion and precipitation will be discussed now as follows: temperature, precipitation and wind.

Temperature

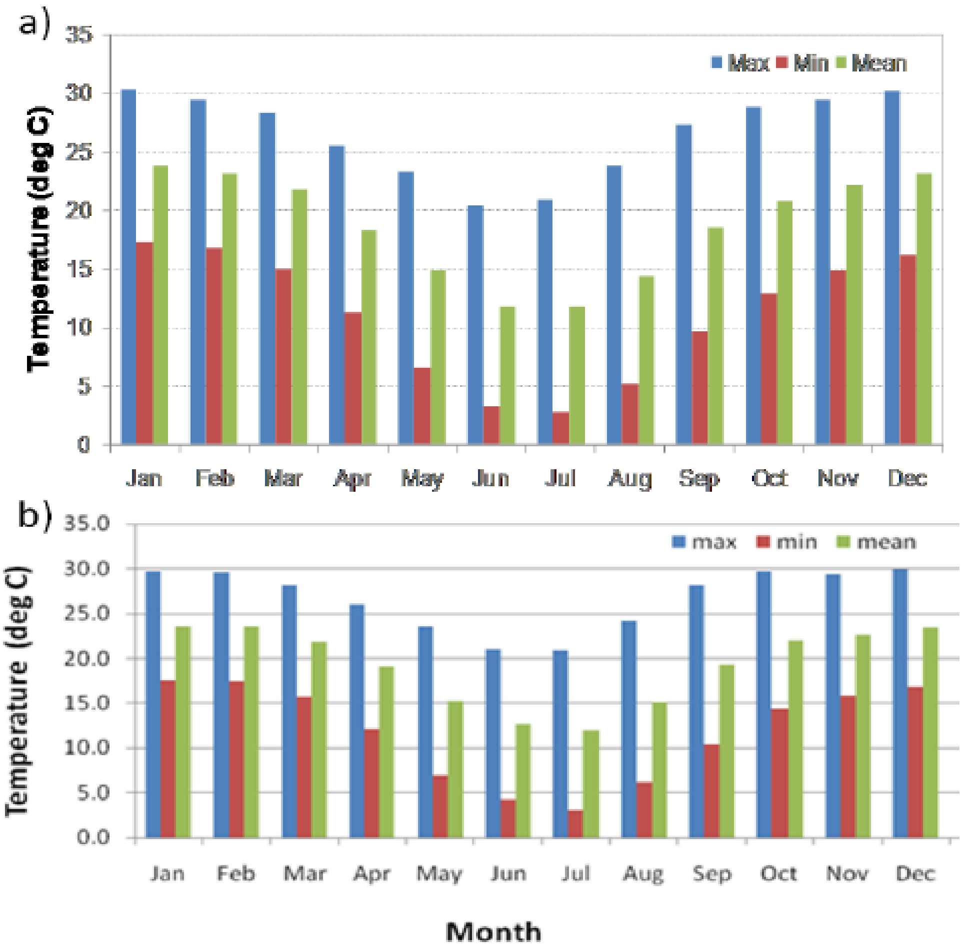

Figure 2: Maximum and minimum temperature for Rustenburg for the period a) 1961-1990 and b) 2000-2010

Temperature play an important role in rapid air mixing and dispersion of pollutants (gases and aerosols) and thus air quality status of a region. Long term average maximum, minimum and mean temperatures for Rustenburg are given in Figure 2. The summer months (October to April) in Rustenburg are hot with average maximum temperatures reaching 30° C and average minimum temperatures not dropping below 12° C (Gondwana, 2011). The winter months (May to September) in Rustenburg are relatively warm during the day with average maximum temperatures of 27° C. The nights do get cold with the average minimum temperatures dropping to just above freezing point (3°C). Average temperatures in Rustenburg for the two periods presented (1961-1990 and 2000-2010) show only very small differences.

Precipitation

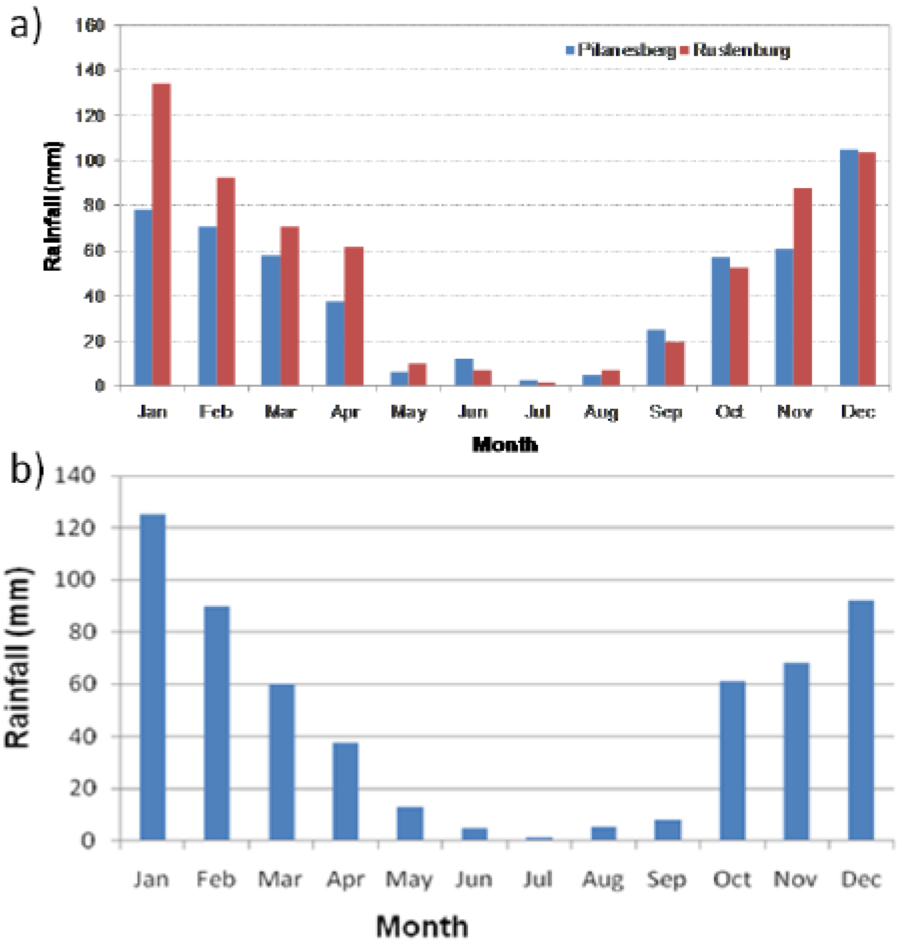

***Figure 3: Monthly rainfall for Rustenburg for the period a) 1961-1987 and b) 2000-2010* (Gondwana, 2011).**

Precipitation or rain plays an important role as it precipitates pollutants (gases and aerosols) from the regional atmosphere thus preventing high concentrations thereof. The mean annual precipitation in Rustenburg is approximately 700 mm. Monthly precipitation is given in Figure 3. The rainfall recorded for the two periods presented (1961-1987 and 2000-2010) show only very small differences (Gondwana, 2011).

Figure 3 indicates that on average the highest precipitation in Rustenburg occurs during the December to February period and the lowest rainfall occurs during the May to September period.

Wind

Wind play an important role in rapid air mixing, dispersion diffusion and transport of pollutants (gases and aerosols) and thus air quality status of a region. Wind roses summarize the occurrence of winds at a location, representing their strength, direction and frequency. Each directional branch on a wind rose represents wind originating from that direction. Each directional branch is divided into segments of different colours which are representative of different wind speeds. The Wind rose for Rustenburg is shown in Figure 4 (Rayten, 2014). The wind rose indicate the prevailing wind direction recorded for the Rustenburg region is south-west for 20% of the time followed by north-east for approximately 8 % of the time. It also indicates that the wind speeds are considered calm at speeds of 1-2 m/s for 20.9 % of the time.

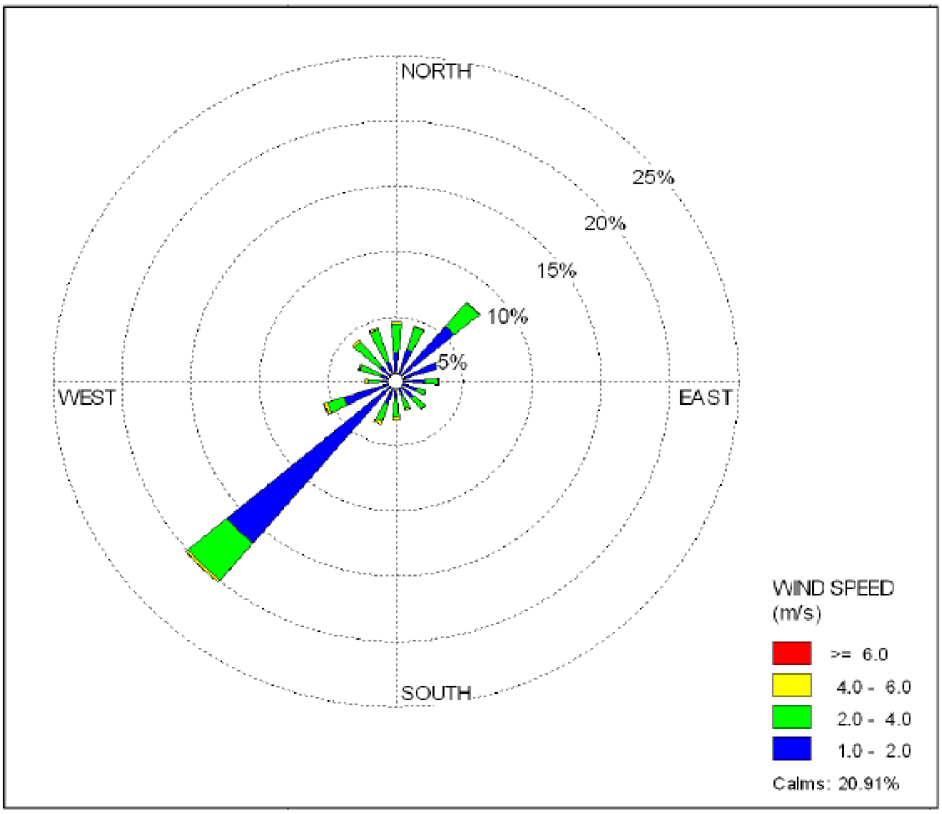

Figure 4: Period wind rose for Rustenburg for the period January 2010-December 2012 (Rayten, 2014)

Wind speed and direction will be the primary contributor to the impacts and location of impact of anthropogenic pollutants generated by the operation.

2.2 Air quality status of region

On 15 June 2012, the Waterberg District Municipality and the Bojanala Platinum District Municipality were declared the third National priority area in South Africa, known as the Waterberg Priority Area, in terms of section 18(1) of the National Environmental Management: Air Quality Act No. 39 of 2004. This implies that the ambient air quality within the Waterberg District Municipality in the Limpopo Province may exceed the ambient air quality standards in the near future. The trans-boundary situation existing between the Waterberg District Municipality and the Bojanala Platinum District Municipality (BPDM) in the North-West Province will potentially cause significant negative impact on the air quality of both areas. The National Framework for Air Quality Management in the Republic of South Africa (2005) rates the Bojanala Platinum District as having poor air quality mainly due to emissions from industries. Industries within BPDM are located in the major towns and along major roads connecting these towns. The Rustenburg and Madibeng Local Municipalities have the highest industrial activity in the District with industries located predominantly in the towns of Rustenburg and Brits (Godwana, 2011). From the provincial emissions inventory conducted during the 2010-2011 period, it is evident that the more industrialized municipalities of Rustenburg and Madibeng together account for over 90 % of the reported emissions. The various metal processing industries by large contribute the most towards air pollution emissions in the district than any other of the listed activities in the Rustenburg and Madibeng local municipalities (Godwana, 2011). O_3 and PM_{10} frequently exceeds regulation standards. The main contributing factor was identified to be regional sources, with high O_3 precursor species concentrations. This problem can only be addressed by reducing the regional sources of O_3 precursors (e.g. CO and NO_2). PM_{10} exceeds the 120 $\mu g/m^3$, the current South African 24-h standard, 6.6 times per year, which emphasises the particulate matter pollution problem in the Western Bush Veld Indigenous Complex (BIC) which includes Rustenburg (Venter A.D. et. al., 2012). The main source of PM_{10} in this region was identified as local household combustion. The increase in energy consumption and need for heating during winter time further exacerbates the problem. The temperature inversions experienced during winter, also concentrate polluted air and keep it close to the ground. The pollution peaks during the end of winter and early spring. The semi-arid climate status of the region means in-frequent wet deposition of pollutants through precipitation during summer which also contributes to the air pollution problems of the region.

2.3 Baseline Emission inventory of region

An emission inventory for the Bojanala Platinum District (BPD) was compiled from the monitoring data of a comprehensive ambient air quality monitoring station operated within the district for more than two years.

Table 1: *Comparison of the measured ambient concentrations of BPD with the regulated ambient air quality standards of South Africa*

Pollutant	Averaging period	Regulated ambient Standard in ppbv(µg/m^3)	Number of tolerable exceedances per year	Sampling period average	Avergage exceedances per year	Percentage data coverage
SO_2	10 min	191 (500)	526	3.8 (9.9)	4	85
	1 year	19 (50)	0		0	
NO_2	1 h	106 (200)	88	8.5 (15.9)	0	59
	1 year	21 (40)	0		0	
O_3	8 h	61 (120)	11	29.1 (58.2)	322.2	87
PM_{10}	24 h	(120)	4	(44)	6.6	87
	1 year	(40)	0		0.9	
CO	1 h	88 (10 000)	0	230 (270)	0	86
	8 h	11	0		0	

The monitoring data in Table 1 shows 4 annual exceedances of the national ambient air quality standards for the ambient gas concentration of SO_2 although 526 exceedances is allowed. For the ambient gas concentration of NO_2 and CO no exceedances were measured during the sampling period. The ambient gas of O_3 indicated 322.2 exceedances per annum where you only allowed 11. The ambient particulate concentration PM_{10} indicates 6.6 exceedances per annum where you are only allowed 11 per year.

Except for the national ambient air quality standards for gases and aerosols the limits for fall-out dust is regulated by the national dust deposition standards. Considering the exceedances of PM_{10} given in Table 1 and the climate as well as surface mining activities described in previous paragraphs we can assume that the deposition of aerosols and mineral dust particles to always be a problem within this region. The national dust control regulations (SANS 1929: 2005) specifies a deposition dust standard of 600 $mg/m^2/d$ for residential areas and 1200 $mg/m^2/d$ for industrial areas. Using the ASTM dust fall monitoring method, dust fallout monitoring at Wesizwe Platinum was initiated in August 2008 at 16 locations surrounding the mines operations. These 16 single-buckets in the monitoring network were located at a variety of sites around the Bojanala Platinum District as indicated in Figure 5. Dust fall-out data was evaluated for the period September 2008 to August 2009 and the results of the network for the period of 1985-2005 are given in Figure 5.

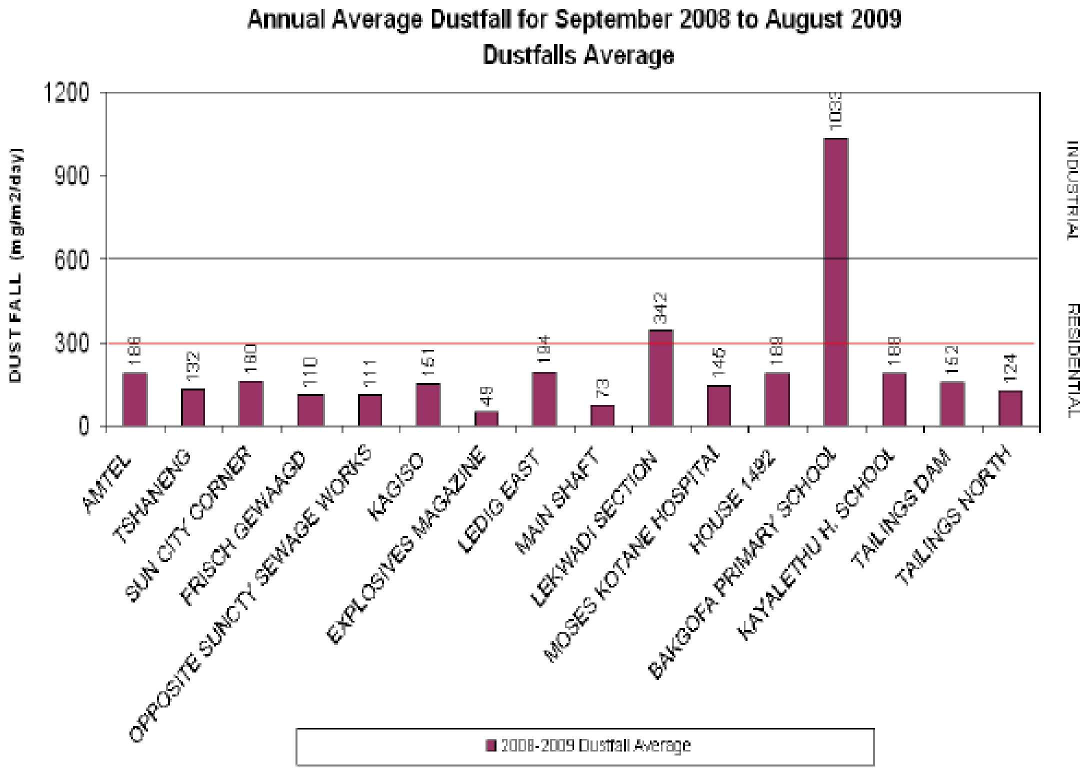

Figure 5: *Annual average dust-fall recorded at Wesizwe during September 2008 to August 2009. (Godwana, 2011)*

Figure 5 indicates no industrial dust fall-out exceedances for this region. This however misleading as the results indicates annual averages while the regulation limit is dust fall-out per day averaged over a month. Generally dust fall-out peaks during the months of July to November when the winds speed starts to increase and acts more frequently on the surfaces still dry before the rainy season starts. The high monthly dust fall-out rates is usually averaged out by low dust fall-out months during the rainy summer months. Despite the data shown in Figure 5, it can be expected that relative high dust fall-out conditions will exists during the months of July to November for this region. The same situation can be expected from the proposed site as the wind speeds is highest during August to November and the surfaces is the driest from May to September (Figure 3). The ambient average temperature drying out surfaces during low precipitation period is also at its highest during September (Figure 2) favouring all the conditions leading to increased dust re-suspension and deposition for this region.

3. Potential Receptors

The project will consists out of three phases which might have impact on the surrounding environment and the potential receptors will be identified as such.

Construction phase:

During the construction phase the following receptors on site and surrounding the proposed site were identified:

- Ambient air quality of the region
- Surrounding residential area residents
- Public roads
- Bushveld habitat

Operational phase

During the operation phase the following receptors on site and surrounding the proposed site were identified:

- Ambient air quality of the region
- Surrounding residential area residents
- Public roads
- Bushveld habitat

Decommissioning phase

During the operation phase the following receptors on site and surrounding the proposed site were identified:

- Ambient air quality of the region

- Surrounding residential area residents
- Public roads
- Bushveld habitat

4. Air Quality Impact Assessment

The air quality impact assessment will assess the impact of the operational activities as described in the Paragraph 4.1 on the identified potential receptors as described in Paragraph 3 by using actual air quality data of the region together with the impact predictions.

4.1 Operation description

Construction phase

This phase will include the clearing of the site of any vegetation present where mining will be carried out as well as additional areas that will be used for listed associated facilities. Topsoil will be ripped, removed and stockpiled on a flat area. The stockpiled soil will be covered with a strong sack or be vegetated to prevent erosion. New mobile offices will be brought in to site. The existing structures on the farm portions neighbouring the site may also be rented to reduce footprint of the mining area. The diamond screening, scrubbing and sorting plant as well as the required equipment will be placed on site. Lockable facilities for hazardous substances and bunded areas for small scale maintenance will be constructed. The diamond processing plant and required mining infrastructure will also be constructed on site. This construction phase will include the following vehicles; a front end loader, bull dozer, and a truck to transport equipment. These vehicles will travel on gravel roads on the site, gravel roads linking the site to public roads and public roads to transport equipment and material on and to site. Gravel roads from the proposed site links with an existing unknown tarred public road 1.90 km to the east of the proposed site which leads to the R556 at Matooster south-east of the site. To the south (3.3 km) and west (6 km) of the site an unknown tarred public road runs pass the site and joins the R556 at Matooster south-east of the site. These public roads will all potentially be used to give access to propose site through gravel roads during construction. During construction a construction camp will also be erected with cooking facilities and portable toilets. There will also be refuelling of vehicles on site as well as the storage of construction material such as sand, stone, gravel, concrete, fuel, oils, paints, solvents, etc. The temporary storage of removed sub- and topsoil destined for the construction of foundations.

Operational phase

During the operational phase, all mining activities and processes will be fully operational. The primary activities will include the opencast mining and processing of the diamondiferous ore material from the mining area. The diamondiferous ore material will be excavated using an excavator and front end loader and the bulk material will be loaded on to a truck. The material will then be transported to and loaded into the processing plant for processing. If necessary, blasting will take place which will comply with the mine health and safety requirements. In the processing plant the material will be screened to remove oversized material (> 5mm), which will be stockpiled on the waste rock dump while the required sized material is moved into the scrubber. The scrubber process precious metals, base metal ores, minerals, aggregates, gravel and sand. The scrubber breaks up alluvial gravels, clay and sand by rotating the fines with water and the result is a soil matrix where the target material (diamonds) is liberated. A density based process is used to further concentrate the diamondiferous material and to reduce the incoming material by 90%. The required diamonds are recovered from this concentrated heavy metals and the remaining material is discarded. Vehicles and equipment usually associated with these activities will be used on the gravel roads onsite. This operational phase will include the following equipment and vehicles; an excavator, front end loader, bull dozer, and a truck to transport material to processing plant.

Decommissioning phase

Concurrent rehabilitation will be carried out throughout the life of the mine. During the life of the mine, areas of the proposed area upon which the ore will be mined to completion will be rehabilitated whilst mining operations are carried out on other parts of the project site. The blasted and excavated pits will be backfilled with waste rock, discard dump soil and the removed topsoil will be re-applied for vegetation. Upon completion of all mining operations, the entire proposed site will be rehabilitated in full. All equipment and camp site/mobile facilities will be removed from site and any concrete slabs/structures will be bulldozed. The old existing shaft will be filled with the bulldozed concrete material and capped. The vehicles and equipment usually associated with these activities will travel on gravel roads on the site, gravel roads linking the site to public roads and public roads to transport equipment and material on and off-site. This decommissioning phase will include the following equipment and vehicles; a front end loader, bull dozer, and a truck to transport equipment off-site.

4.2 Identification Potential sources

The identification of potential sources of emissions for the proposed project is fundamental for the assessment of the potential impacts on the air quality status and surrounding environment. The identification of potential sources of the proposed development project will be based on the impact it might have to the regional atmospheric load. The regional atmospheric load will include the existing sources of the region and their contribution to regulated species of the national air quality standards. The major sources of gaseous and particulate emissions contributing to the regional atmospheric load identified for this region is industrial operations, mining activities, agricultural activities, biomass burning (veld fires), domestic fuel burning (coal), vehicle emissions, vehicle entrainment of dust from paved and unpaved roads and fugitive dust sources such as wind erosion of exposed areas. The contribution of these identified sources to the regional atmospheric load is given in Table 1 (Paragraph 2.3). The identification of the potential sources of each proposed project phase contributing to the atmospheric load as specified in Table 1 and Paragraph 2.3 will be identified now.

Construction phase

During the construction phase the contribution to the regional atmospheric load will mainly include the vehicle and construction camp emissions. These emissions of vehicles will include the gases of carbon dioxide (CO_2), carbon monoxide (CO), hydrocarbons (HCs), SO_2, oxides of nitrogen (NO_x), particulates (PM_{10}) and lead. The emissions of construction camp may include the gases of carbon dioxide (CO_2), carbon monoxide (CO), hydrocarbons (HCs), SO_2, oxides of nitrogen (NO_x) and particulates (PM_{10}) depending on the methods of energy generation. The refuelling of vehicles on site as well as the storage of, fuel, oils and paints will also lead to emissions to the general atmosphere of volatile organic compounds. The storage and use of construction material such as sand, stone, gravel, concrete will emit particulates that will not only have an effect on the regional concentration of PM_{10} but also add to the regional suspended particle load which will increase the dust deposition of the area. The vehicles travelling on the gravel roads on and from proposed site during construction will further contribute to dust deposition of the proposed area and region.

Operational phase

During the operational phase the contribution to the regional atmospheric load will include the vehicle emissions of normal activities associated with all mining activities and processes as well as processing of the diamondiferous ore material and when necessary, when blasting will take place. It will also include the usual gaseous and particulate emissions associated with heat and energy generation of onsite residents. The will include gaseous and particulate emissions of carbon dioxide (CO_2), carbon monoxide (CO), hydrocarbons (HCs), SO_2, oxides of nitrogen (NO_x), particulates (PM_{10}) and lead. The refuelling of vehicles on site as well as the storage of, fuel and oils will also lead to emissions to the general atmosphere of volatile organic compounds. The storage and use of ore and top soil as well as discarded process material will emit particulates that will not only have an effect on the regional concentration of PM_{10} but also add to the regional suspended particle load which will increase the dust deposition of the area. The vehicles travelling on the gravel roads on the proposed site during operation will further contribute to dust deposition of the proposed area and region.

Decommissioning phase

During the decommissioning phase the contribution to the regional atmospheric load will include the vehicle emissions of activities associated with rehabilitation. It will also include the usual gaseous and particulate emissions associated with heat and energy generation of onsite residents. The will include gaseous and particulate emissions of carbon dioxide (CO_2), carbon monoxide (CO), hydrocarbons (HCs), SO_2, oxides of nitrogen (NO_x), particulates (PM_{10}) and lead. The refuelling of vehicles on site as well as the storage of, fuel and oils will also lead to emissions to the general atmosphere of volatile organic compounds. The use of waste rock and top soil as well as discarded process material to backfill mined areas and open pits for rehabilitation will emit particulates that will not only have an effect on the regional concentration of PM_{10} but also add to the regional suspended particle load which will increase the dust deposition of the area. The vehicles travelling on the gravel roads on the proposed site during decommissioning/rehabilitation will further contribute to dust deposition of the proposed area and region.

4.3 Pollutants of concern

Due to the nature of the operation and the amount of emission sources (vehicles, equipment and people) that will be used to construct, operate and decommission the proposed operation will be minimal. This means that potentially most of the gases of carbon dioxide (CO_2), carbon monoxide (CO), hydrocarbons (HCs), SO_2, oxides of nitrogen (NO_x) and lead associated with these sources will have no real impact on the atmospheric load. The only real pollutant of concern during all phases of the proposed project will be the generation of dust and PM_{10}. This will impact on the regional atmospheric load and subsequent air quality of the region as it will increase the dust deposition of the region. The dust loading of the atmosphere and deposition will potentially have a significant impact on the health and well-being of the surrounding environment. The dust associated with the ground moving activities as well as the travelling on gravel roads during the construction phase, operational and decommissioning phase will emit TSP, PM_{10} and $PM_{2.5}$ size particulates. This will also be emitted during the activities of loading, transport, off-loading and compacting of soil as well as the building material. The regional climate as described in Paragraph 2 further favours dust problems and will intensify dust generation activities on site, especially during late winter and early spring.

4.4 Legal requirements

The National Environmental Management: Air Quality Act (AQA) is responsible for managing air quality in South Africa (NEM: AQA, 2004). The Act place the responsibility of air quality management on the local authorities (district and metropolitan municipalities) who is tasked with the management and regulation of ambient air quality, licensing of listed activities, as well as the intervention of strategies to reduce local emissions. Under NEM: AQA listed activities are identified by the Minister and include all activities regarded to have a significant detrimental effect on the environment, including health. Emission limits are established at national level for each of these activities (DEA 2009) and an atmospheric emission licence will be required in order to operate. Apart from for the listed activities NEM: AQA also makes provision for formal ambient air quality standards to enable the reduction of impact on the receiving environment. The South African Bureau of Standards (SABS) developed the National ambient air quality standards (DEA, 2009). The ambient air quality standards indicate safe daily exposure levels for the majority of the population, including the very young and the elderly, through an individual's lifetime. These standards were developed to follow international best practice for PM_{10}, sulphur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), carbon monoxide (CO), lead (Pb) and benzene (C_6H_6). The ambient air quality standards of South Africa are given within Table 2. The Department of Environmental Affairs also issued the National Dust Control regulations on 1 November 2013 in order to control dust in all areas. The National Dust Control regulations is represented in Table 3. The air quality standards and dust control regulations are fundamental to effective air quality management.

Table 2: National ambient air quality standards (DEA, 2009)

Pollutant	**Averaging period**	**Limit value (µg/m^3)**	**Limit value (ppb)**
SO_2	1 year	50	19
NO_2	1 year	40	21
PM_{10}	1 year	40	-
CO	8 hour(a)	10000	8700
Benzene (C_6H_6)	1 year	5	1.6
Lead (Pb)	1 year	0.5	-
Ozone O_3	8 hour(b)	120	61

Table 3: Acceptable dust-fall rates (National Dust Control regulations, 2013)

Restriction Areas	**Dust-fall rate (D) (mg/m^2/day) 30-days average**	**Permitted frequency of exceeding dust-fall 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

4.5 Emissions Inventory of proposed project

Creating a relevant emission inventory is important in order to assess the impacts of the activities during all phases of the operation of the proposed project on the receiving environment. The emissions inventory is source based and includes the contributions of all the emitted pollutants to the total emission and the relevancy of it with regard to the regulated national ambient air quality standards. An emissions inventory was created by using the identified potential sources (Paragraph 4.2) and their relevant emissions to the regulated species of the national ambient air quality standards. The impact the sources will have on the regional atmospheric load and surrounding environment was then predicted using assumptions of literature and real time data of similar sources of the surrounding environment. The emission inventory developed for each of the three phases of this proposed project will now be discussed.

Construction phase

Table 4 represents the identified sources, emissions and relevant impacts during the construction phase to the regional atmospheric load and surrounding environment.

Table 4: *Sources, emissions and impacts during the construction phase*

Source/ activity	Earth moving	Vehicles	Transport	Construction camp	Refuelling	Storage of material	Storage of solvents	mpact on atmospheric load and surrounding environment
SO_2	No	Yes	Yes	Yes	No	No	No	No
NO_2	No	Yes	Yes	Yes	No	No	No	No
O_3	No	No	No	No	No	No	No	No
CO	No	Yes	Yes	Yes	No	No	No	No
C_6H_6	No	Yes	Yes	Yes	Yes	No	Yes	No
Pb	No	Yes	Yes	No	No	No	No	No
PM_{10}	Yes	Yes	Yes	Yes	No	Yes	Yes	No
Dust	Yes	Yes	Yes	No	No	Yes	No	Yes

In Table 4, yes indicates the emission of the specified gas or aerosol species for the listed sources/activity during the construction phase, while a no indicates no emissions. The last column of Table 4 represents the impact these emissions will have on the regional atmospheric load and surrounding environment. A yes will mean a certain impact, while no will mean no impact. The reasons and details of why activities resulting in emissions do or do not impact on the atmospheric load and surrounding environment will be discussed in Paragraph 4.6.

Operational phase

Table 5 represents the identified sources, emissions and relevant impacts during the operational phase to the regional atmospheric load and surrounding environment.

Table 5: ***Sources, emissions and impacts during the operational phase***

Source/ activity	Earth moving	Vehicles	Transport	Residents	Refuelling	Processing plant	Blasting activities	Storage of material	Storage of solvents	Impact on atmospheric load and surrounding environment
SO_2	No	Yes	Yes	Yes	No	No	Yes	No	No	No
NO_2	No	Yes	Yes	Yes	No	No	Yes	No	No	No
O_3	No	No	No	No	No	No	No	No	No	No
CO	No	Yes	Yes	Yes	No	No	Yes	No	No	No
C_6H_6	No	Yes	Yes	Yes	Yes	No	No	No	Yes	No
Pb	No	Yes	Yes	No	No	No	No	No	No	No
PM_{10}	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No
Dust	Yes	Yes	Yes	No	No	Yes	Yes	Yes	No	Yes

In Table 5, yes indicates the emission of the specified gas or aerosol species for the listed sources/activity during the operational phase, while no indicates no emissions. The last column of Table 5 represents the impact these activities/sources emissions will have on the regional atmospheric load and surrounding environment. A yes will mean a certain impact, while a no will mean no impact. The reasons and details of why activities/sources resulting in emissions do or do not impact on the atmospheric load and surrounding environment will be discussed in Paragraph 4.6.

Decommissioning phase

Table 6 represents the identified sources, emissions and relevant impacts during the decommissioning phase to the regional atmospheric load and surrounding environment.

Table 6: ***Sources, emissions and impacts during the decommissioning phase***

Source/ activity	Earth moving	Vehicles	Transport	Residents	Refuelling	Storage of solvents	mpact on atmospheric load and surrounding environment
SO_2	No	Yes	Yes	Yes	No	No	No
NO_2	No	Yes	Yes	Yes	No	No	No
O_3	No	No	No	No	No	No	No
CO	No	Yes	Yes	Yes	No	No	No
C_6H_6	No	Yes	Yes	Yes	Yes	Yes	No
Pb	No	Yes	Yes	No	No	No	No
PM_{10}	Yes	Yes	Yes	Yes	No	Yes	No
Dust	Yes	Yes	Yes	No	No	No	Yes

In Table 6, yes indicates the emission of the specified gas or aerosol species for the listed sources/activity during the decommissioning phase, while no indicates no emissions. The last column of Table 6 represents the impact these activities/sources emissions will have on the regional atmospheric load and surrounding environment. A yes will mean a certain impact, while a no will mean no impact. The reasons and details of why activities/sources resulting in emissions do or do not impact on the atmospheric load and surrounding environment will be discussed in Paragraph 4.6.

4.6 Predicted relevant air quality impacts of the proposed project

Subsequent to the assessments made within Paragraphs 4.1-6 as well as the baseline characterization of the region (Paragraph 2. 1-3) the following assumptions/predictions can be made of the potential impacts of the proposed activities during each of the project phases.

Construction phase

The assessment of emissions within Table 4 indicates that the activities of earth moving, vehicles, transport and storage of material will have an impact on the atmospheric load and surrounding environment. This impact will however be limited to the dust (TSP) generated by ground removal, handling, temporary storage of sand and soil as well as vehicles travelling on unpaved roads. The re-suspension and emission of dust from these activities will add to the atmospheric load (Paragraph 2.2) and potentially impact on surrounding residential and informal settlements and public roads in a region where numerous surface mining activities already contribute to nuisance dust problems. Most of these impacts will however be mitigated which will be described in Paragraph 4.8.

Fugitive dust emissions from the construction phase were estimated using the USEPA emission factor for heavy construction activities (USEPA, 1996). The emission factor for construction operations is given as:

E = 1.2 tons/acre/month of activity

This emission factor is most applicable to construction operations with (i) medium activity levels, (ii) moderate silt contents and (iii) semi-arid climates (USEPA). Construction activities were assumed to take place 7 hours per day, 5 days per week and 4 weeks per month. A control efficiency of 50 % was applied to emissions as mitigation strategy by means of wet suppression. The total area for construction activities of the processing plant, required mining infrastructure and residential area will be 5 ha (50000 m^2).

Table 7: *Estimated emissions during the construction phase*

Source	Unmitigated TSP (g/s)	Mitigated TSP (g/s)
Construction area (5 ha)	23.53	11.76

Table 8: *Predicted maximum dust fall-out during construction phase*

Pollutant	Averaging period	Guideline standard mg/m^2/day	Predicted dust fall-out concentration mg/m^2/day	
			Unmitigated	Mitigated
TSP	Daily average	1200	36.74	18.37

The gases of SO_2, NO_2, CO, C_6H_6 and Pb which although emitted by the activities of vehicle, transport, construction camp, refuelling and storage of solvents is projected not contribute or impact the atmospheric load or surrounding environment. This is assumption is made due to the small scale and number of vehicles used during the construction phase. The relative number of vehicles and the size of the construction site is of such a nature that it will hardly ever put the atmospheric load under pressure or impact negatively in relation to existing concentrations of regulated emissions within the surrounding environment.

Operational phase

The assessment of emissions within Table 5 indicates that the activities of earth moving, blasting, diamondiferous processing, vehicles, transport and storage of material will have an impact on the atmospheric load and surrounding environment. This impact will however be limited dust (TSP) generated by ground removal, handling, blasting, diamondiferous processing, temporary storage of waste rock and discarded process material as well as vehicles travelling on unpaved roads. The re-suspension and emission of dust from these activities will add to the atmospheric load (Paragraph 2.2) and potentially impact on surrounding residential and informal settlements and public roads in a region where numerous surface mining activities already contribute to nuisance dust problems. Most of these impacts will however be mitigated which will be described in Paragraph 4.8.

Fugitive dust emissions from the operational phase were estimated using the USEPA emission factor for heavy construction activities. The emission factor for construction operations is given as:

E = 1.2 tons/acre/month of activity

This emission factor is most applicable to operations with (i) medium activity levels, (ii) moderate silt contents and (iii) semi-arid climates (USEPA, 1996). Operational activities were assumed to take place 7 hours per day, 5 days per week and 4 weeks per month. A control efficiency of 50 % was applied to emissions as mitigation strategy by means of wet suppression. The total area for all operational activities at any specific time will not exceed a 30 ha (300000 m^2).

Table 9: *Estimated emissions during the operational phase*

Source	Unmitigated TSP (g/s)	Mitigated TSP (g/s)
Operational area (30 ha)	141.20	70.6

Table 10: *Predicted maximum dust fall-out during the operational phase*

Pollutant	Averaging period	Guideline standard mg/m²/day	Predicted dust fall-out concentration mg/m²/day	
			Unmitigated	Mitigated
TSP	Daily average	1200	220.45	110.22

The gases of SO_2, NO_2, CO, C_6H_6 and Pb which although emitted by the activities of ground removal, handling, blasting, diamondiferous processing, temporary storage of solvents is projected not to contribute or impact the atmospheric load or surrounding environment. This is assumption is made due to the small scale and number of vehicles and equipment used during the operational phase. The small number of vehicles, equipment and the size of the operational site is of such a nature that it will hardly ever put the atmospheric load under pressure or impact negatively in relation to existing concentrations of regulated emissions within the surrounding environment.

Decommissioning phase

The assessment of emissions within Table 6 indicates that the activities of earth moving, vehicles, transport and storage of material will have an impact on the atmospheric load and surrounding environment. This impact will however be limited dust (TSP) generated by ground removal, material handling, and rehabilitation as well as vehicles travelling on unpaved roads. The re-suspension and emission of dust from these activities will add to the atmospheric load (Paragraph 2.2) and potentially impact on surrounding residential and informal settlements and public roads in a region where numerous surface mining activities already contribute to nuisance dust problems. Most of these impacts will however be mitigated which will be described in Paragraph 4.8. Fugitive dust emissions from the decommissioning phase will not be estimated as the sources and their emissions will be the same or less than the operational phase as rehabilitation will be an ongoing process during the operational life time of the mine.

The gases of SO_2, NO_2, CO, C_6H_6 and Pb which although emitted by the activities of ground handling and rehabilitation is projected not to contribute or impact the atmospheric load or surrounding environment. This is assumption is made due to the small scale and number of vehicles and equipment used during the decommissioning phase. The small number of vehicles, equipment and the size of the operational site is of such a nature that it will hardly ever put the atmospheric load under pressure or impact negatively in relation to existing concentrations of regulated emissions within the surrounding environment.

4.7 Projected impact on surrounding environment and sensitive receptors

TSP and PM_{10} is the only pollutants of concern regarding impacts to the regional atmospheric load and surrounding environment. The particles of PM_{10} which form part of the dust generated are however of an insignificant contribution. This is due to the nature of this mining and subsequent process where generally coarse size dust is mechanically formed and emitted. PM_{10} will not form part of the impact prediction.

The following sensitive receptors in the surrounding environment were identified:

- Public road 1.9 km East of site
- Informal settlement of Maologane 3.63 km North-North-West of site
- Pilansberg Nature reserve 3.15 km East-North-East of site
- Informal settlement of Mahobieskraal 4 km South-South-East of site

As per TSP estimation during all phases of the operation (Table 7-10) the unmitigated dust fall-out on site will not lead to any exceedances of the national dust fall-out regulation limits (Table 3) for either the residential or non-residential limit. The impact predictions is made using estimated TSP data of the operation together with the climatic conditions of the region (paragraph 2.1), the size of particles (generally coarse mechanically formed), the sources of dust as well as the location of sources on site. After a comprehensive literature study into the specific nature of these activities generating dust (soil removal and vehicle entrained dust from gravel roads), the potential impacts related to the dust deposition levels to the surrounding environment and atmospheric load was assessed and determine. The level of control that would be required in order to mitigate it was also determined and will be described in Paragraph 4.8. In general large dust particles (greater than 30 microns-TSP) make up the greatest proportion of dust and largely deposit within 100 metres of the source. Intermediate sized particles (10 to 30 microns) are likely to travel 200 to 500 metres (Goodquarry.com, 2005). Smaller dust particles (less than 10 microns, also known as PM_{10}) will make up such a small proportion of the dust generated it will not be considered for the proposed project (as previously described). For this impact study the travel distances of dust particles as calculated by G.E. Blight under South African conditions were used. Blight determined travel distances using a wind speed of 13.9 $m.s^{-1}$ and calculated distribution distance for the re-suspension of different size dust particles at a height of 1 meter (G.E. Blight, 2007). According to his calculations the travel distance through re-suspension of dust particles will be 38 metres for a 60 micron particle and a distance of 3800 metres for a 6 micron particle (G.E. Blight, 2007). Using this formula for this specific site, a dust particle with a particle size of 30 microns will travel 142 meters and a 15 micron particle will travel 569 meters. This is also more or less in line with real distances of dust particles travelled internationally as described by goodquarrry.com. The predicted impact of the generated dust (TSP) emitted during all the phases of the proposed project can be assessed as follows:

- The closest sensitive receptors is located between 1.9 km and 4 km from the site as indicated in above paragraphs.
- Almost all emitted dust will be 30 microns and larger
- 30 micron dust particles will travel 142 m with a wind speed of 13.9 $m.s^{-1}$
- The wind direction for this region is south-west for 20% of the time (Figure 4)
- The wind speed for this region 1-2 m/s for 20.9 % of the time (Figure 4)
- The only sensitive receptors downwind of the site will be Pilansberg (East-North-East) and the public road (East)
- All sensitive receptors is more than 2 km from site.

It can therefore be presumed that the proposed project will have no impact on any of the nearby receptors including the surrounding bushveld habitat as long as mining does not take place within 500 m of the operational boundary line.

4.8 Impact and mitigation strategies

TSP is the only pollutant of concern regarding impacts to the regional atmosphere and surrounding environment. TSP is not respirable and therefore only have an impact due to the nuisance effect it has on the public. TSP may also have a negative effect on crops of agricultural land which is of no relevance as the site is surrounded by busveld habitat. The composition of dust generated will mostly be of the natural background composition of the region. It should therefore hold no negative impact on the bushveld habitat. The modelled impact of the generated dust was based both on the distance of impact and the predicted mass of deposition. This is done as nuisance dust impacts is daily events and will help to provide relevant information to mitigate potential public complaints. The developer of proposed project must in order to mitigate any potential impact defer mining within 500 m of the operational boundary line. The normal wetting of roads should also always be implemented on daily bases. The distance predictions was made for a re-suspension of dust at a height of 1 meter and any temporary storage of soil or material should therefore only be of a height of 2.5 meter if created at a distance of 500 meters of operational boundary line. The deposition of dust from stockpiles higher than 2.5 meters could impact beyond the 500 meter mark as daily events on high windy days during September and could affect bushveld and should be visually monitored and managed accordingly.

5. Final assessment of the predicted air quality impact

The only major sources of impact for the proposed site will be particulate or dust emissions generated from ground removal activities, blasting operations, processing plants screening activities as well as gravel roads during the construction, operational and decommissioning phase. These sources are expected to have a impact on the regional air quality and surrounding environment of the proposed site (Paragraph 4.5). The sources of dust emission contributions will be intensified by the climatic conditions of the region. The impact of wind-blown dust sources is not anticipated to impact significantly beyond the 500 meter as calculated in Paragraph 4.7.

6. Conclusions and recommendations

The following are the main conclusions from the air quality impact assessment conducted for the proposed mining and trenching activities of alluvial diamond prospecting:

- The proposed mining and trenching activities will have limited impact on the ambient air quality of the Bojanala Platinum District region, during all phases of the proposed project.

- Of all the regulated pollutants that were considered the only pollutant that might have an impact to the proposed region would be that of TSP.
- The greatest impact to the atmosphere and surrounding environment would be due to TSP or deposition dust. Deposition dust is however only relevant from a nuisance point of view and can easily be mitigated to prevent impact.

The following recommendations are made to mitigate the impact to the regional air quality and surrounding environment:

- No temporary storage of soil, waste rock or discarded process material within 500 meters from the operational boundary line.
- No temporary storage of soil, waste rock or discarded process material above a height of 2.5 meters.
- The covering of stockpiled soil or discarded process material with vegetation.
- Good housekeeping to prevent accumulation of wind erodible materials on paved an unpaved road surfaces.
- Regular spraying or irrigation of roads taking traffic volumes
- Consideration of chemical stabilisation of heavily travelled roads.
- Reduce speed to be 40 km/h on site on gravel roads.
- Minimize ground disturbance by avoiding removal of vegetation as far as practically possible.
- Dust generation from materials handling can be reduced by wetting the material handled.
- Dust monitoring would be done at selected sites with potential significant impacts and mitigation of activities pertaining to sources would be managed accordingly.
- All site staff will be responsible for reporting high or abnormally dusty conditions to the Site Manager as soon as is reasonably practicable.
- If an activity is causing high or abnormally dusty conditions (as determined by visual assessment and prescribed licence conditions), the activity will cease until weather conditions change or appropriate dust controls are put in place to ameliorate the dust emissions.

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