Appendix D6

Air Quality Baseline

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AIR QUALITY BASELINE ASSESSMENT FOR THE EXPANSION OF THE EXISTING MANGANESE ORE RAILWAY LINE FROM HOTAZEL IN THE NORTHERN CAPE TO THE PORT OF NGQURA IN THE EASTERN CAPE

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GLOSSARY OF ACRONYMS, TERMS AND UNITS

AEL	Atmospheric Emission License
AELA	Atmospheric Emission Licensing Authority
CO	Carbon monoxide
°C	Degrees Celsius
DEA	Department of Environmental Affairs
Emission	The direct or indirect release of substances from individual or diffuse sources in an installation into the air.
EIA	Environmental Impact Assessment
ERM	Environmental Resources Management
m/s	Meters per second
mtpa	Million tons per annum
NO_2	Nitrous oxide
NO_X	Oxides of nitrogen, NOx = NO + NO_2
PM_{10}	Particulate matter less than 10 microns
$PM_{2.5}$	Particulate matter less than 2.5 microns
SAWS	South African Weather Service
TSP	Total suspended particulates
SO_2	Sulphur dioxide
VOC	Volatile organic compounds
$\mu g/m^3$	Micrograms per cubic meter
US EPA	United States Environmental Protection Agency

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1. INTRODUCTION

Transnet SOC Ltd has appointed Environmental Resources Management (Southern Africa) (ERM) to undertake an Environmental Impact Assessment (EIA) for the expansion of the existing manganese ore railway line from Hotazel in the Northern Cape to the Port of Ngqura in the Eastern Cape (Figure 1). The upgrade involves, amongst other activities, the extension of existing loops and the development of new loops and the development of a compilation yard and common user facility at Mamathwane near Hotazel.

The construction work and the operation of the railway line, the compilation yard and common user facility are associated with potential impacts on air quality. ERM has therefore appointed uMoya-NILU Consulting (Pty) Ltd, a specialist air quality management consultancy, to conduct an air quality baseline assessment for the expansion project. This baseline assessment includes an overview of the railway line expansion project and the potential sources of air pollution, an overview of the pollutants, a discussion of the regulatory requirements with respect to air quality, and a description of the receiving environment with emphasis on air quality.

2. PROJECT DESCRIPTION AND AIR QUALITY

2.1 Project description

The existing manganese railway line from Hotazel is currently used to transport 5.5 mtpa of manganese ore to the export terminal at Port Elizabeth harbour. An upgrade of the line is necessary to meet the requirements of the proposed increase in export of manganese ore to 16 mtpa, through the planned terminal and the Port of Ngqura. The proposed upgrade activities include the:

- Extension of 11 loops at various places on the existing line to accommodate the 200 wagon trains
- Construction of a new loop at Sishen to accommodate the 200 wagon trains,
- Construction of a new loop at Witloop to accommodate 105 wagon trains,
- The doubling of the rail line at 2 sections (From Ripon to Kommadagga and Cookhouse to Golden Valley)
- Reinstating 105 km of double line track on the line between Kimberley to De Aar ;
- Upgrade of 11 3 kV DC single unit substations to double unit substations
- Upgrade of 8 25 kV AC single unit substations to double unit substations;
- Construction of new single unit substations at Witloop and Vlermuislaagte.
- Installing additional feeder lines and return conductors between substations or tie-stations for 336 km of track between Hotazel and Kimberley.
- Installing additional feeder lines and return conductors between substations or tie-stations for 286 km of track between Kimberley and De Aar.
- Installing additional feeder lines and return conductors between substations or tie-stations for 256 km of track between De Aar and Ngqura.
- Development of a compilation yard at Mamathwane; and
- Development of a Common User Facility at Mamathwane with a transfer point and stockpiles.

Figure 1: The manganese railway line from Hotazel to the Port of Ngqura showing rail loop extensions in green

2.2 Sources of air pollution

2.2.1 Construction

Most civil construction activities generate dust and the emission of particulates into the atmosphere is through vehicle dust entrainment, excavation, ground levelling, etc. In most cases the dust is relatively course, but may include fine respireable particles (PM_{10}). Emissions are released close to ground level and have no buoyancy, which limits their dispersion. As a result the coarse particulates generally settle relatively close to the emission source. Finer particulates may be transported further from the point of release, as they are easily carried by wind.

Exhaust emissions from construction vehicles and equipment typically include particulates (including PM_{10}), carbon monoxide (CO), nitrogen oxides (NO_x), sulphur dioxide (SO_2) and volatile organic compounds (VOCs) including benzene.

2.2.2 Operations

Railway line

Dust from open rail cars and emissions from locomotives are potential sources of air pollutants on the railway line. Little or no dust is expected to be blown from the ore wagons as the ore is sprayed during loading to bind the dust. Similarly, the wagons have closed bottoms so dust will not fall from them and deposit on the rail tracks. Analysis conducted on soil collected along the existing railway line did not show higher manganese content along the line than elsewhere (uMoya-NILU, 2008). There are no emissions from the electrically powered locomotives used to haul the manganese ore trains on the main railway line.

Compilation yard

The consolidation and deconsolidation of wagon trains by diesel locomotives in the compilation yard will result in emissions which include particulates, oxides of nitrogen (NO_X), sulphur dioxide (SO_2) and volatile organic compounds (VOCs) including benzene. The movement of vehicles and equipment in the compilation yard may generate dust. Dust may also be generated off open areas in the compilation yard by the wind.

Common user facility

Air pollutants will result in the Common User Facility from exhaust emissions and from haulage vehicles. The movement of vehicles and equipment in the compilation yard may generate dust. Dust may also result from stockpiles, from stacking and reclaiming activities as well as being generated from open areas in the facility by wind.

2.3 Air pollutant overview

Particulate matter

In the ambient environment airborne particulates are ranked according to size. Coarse particles associated with dust fallout or depositions are regarded as nuisance impacts, through accumulation and possible discolouration. Finer dust is categorised into sub-classes depending on its size and the associated human health impacts. The coarsest of the fine dust refers to all dust with a diameter of less than 100 µm, known as total suspended particulates (TSP). The fraction of TSP that is inhalable and associated with health impacts has a diameter equal to or smaller than 10 µm and is known as PM_{10}. When exposed to particulate matter through normal nasal breathing, particles larger than 10 µm would be removed in the passage of the air stream through the nose and upper respiratory airways, and particles between 3 µm and 10 µm would be deposited in the upper airways. Finer particles with a diameter equal to or less than 2.5 µm ($PM_{2.5}$) have yielded stronger associations with health impacts than PM_{10} as these particles can infiltrate deeper into the lung. Sources of $PM_{2.5}$ include combustion processes and the formation of atmospheric aerosols during chemical transformations in the atmosphere. Health effects of PM depend on particle size and chemical composition. While the deposition of particulates on to surfaces may pose a nuisance, they may also be a potential risk to human health and wellbeing. Depending on the chemical nature of the particulate and bioavailability of metals, runoff into drinking water or accumulation on vegetation can occur. The South African ambient air quality standards for PM_{10} and $PM_{2.5}$ and dust fallout limits are shown in Table 1.

Oxides of nitrogen (NO_x)

Nitrogen dioxide (NO_2) and nitric oxide (NO) are formed simultaneously in combustion processes and other high temperature operations such as metallurgical furnaces, blast furnaces, and internal combustion engines. NO_X is a term commonly used to refer to the combination of NO and NO_2. The route of exposure to NO_2 is inhalation and the seriousness of the effects depend more on the concentrations inhaled rather than the length of exposure. The site of deposition for NO_2 is the distal lung (because NO_2 does not readily dissolve in the moist upper respiratory system) where NO_2 reacts with moisture in the fluids of the lower respiratory tract to form nitrous and nitric acids (WHO, 1997). About 80 to 90% of inhaled nitrogen dioxide is absorbed through the lungs (CCINFO, 1998). Nitrogen dioxide (present in the blood as the nitrite ion) oxidises unsaturated membrane lipids and proteins, which results in loss of control of cell permeability. Nitrogen dioxide causes decrements in lung function, particularly increased airway resistance. People with chronic respiratory problems and people who work or exercise outside will be more at risk to NO_2 exposure (EAE, 2006). In the atmosphere, NO_2 reacts with water vapour to produce nitric acid. This acidic pollution can be transported over long distances by wind and deposited as acid rain, causing the acidification of soils, lakes, and streams, accelerated corrosion of buildings and monuments and damages paintwork. NO_2 is also a major source of secondary fine particulate pollution which decreases visibility, and contributes to surface ozone formation through its reaction with VOCs in the presence of sunlight. The South African ambient air quality standards for NO_2 are shown in Table 1.

Sulphur dioxide (SO_2)

The major source of SO_2 is the combustion of sulphur containing fossil fuels such coal, oil and diesel. On inhalation, most SO_2 only penetrates as far as the nose and throat (because it is readily soluble in the moist lining of the upper respiratory system), minimal amounts reach the lungs, unless the person is breathing heavily, breathing only through the mouth, or if the concentration of SO_2 is high (CCINFO, 1998). The acute response to SO_2 is rapid, within 10 minutes for people suffering from asthma (WHO, 2005). Effects such as a reduction in lung function, an increase in airway resistance, wheezing and shortness of breath, are enhanced by exercise, that increases the volume of air inspired, as it allows SO_2 to penetrate further into the respiratory tract (WHO, 1999).SO_2 reacts with cell moisture in the respiratory system to form sulphuric acid. This can lead to impaired cell function and effects such as coughing, broncho-constriction, exacerbation of asthma and reduced lung function. SO_2 has the potential to form sulphurous acid or to slowly form sulphuric acid in the atmosphere via oxidation by the hydroxyl radical. The sulphuric acid may then dissolve in water droplets and fall as precipitation. The South African ambient air quality standards for SO_2 are shown in Table 1.

Benzene

Benzene is a natural component of crude oil, petrol, diesel and other liquid fuels and is emitted when these fuels are combusted. Diesel exhaust emissions therefore contain benzene. After exposure to benzene, several factors determine whether harmful health effects will occur, as well as the type and severity of such health effects. These factors include the amount of benzene to which an individual is exposed and the length of time of the exposure. For example, brief exposure (5–10 minutes) to very high levels of benzene (14000 – 28000 $\mu g/m^3$) can result in death (ATSDR, 2007). Lower levels (980 – 4200 $\mu g/m^3$) can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion, and unconsciousness. In most cases, people will stop feeling these effects when they are no longer exposed and breathe fresh air. Inhalation of benzene for long periods may result in harmful effects on the tissues that form blood cells, especially the bone marrow. These effects can disrupt normal blood production and cause a decrease in important blood components. Excessive exposure to benzene can be harmful to the immune system, increasing the chance of infection. Both the International Agency for Cancer Research and the Environmental Protection Agency(EPA) have determined that benzene is carcinogenic to humans, as long-term exposure to benzene can cause leukaemia, a cancer of the blood-forming organs. The South African ambient air quality standards for benzene are shown in Table 1.

Manganese

Manganese is a naturally occurring substance found in many types of rocks and soil. It does not occur in the environment as a pure metal, but combined with other substances such as oxygen, sulphur, and chlorine. Manganese is a trace element, necessary for good health. Manganese is used principally in steel production to improve hardness, stiffness, and strength in products like carbon steel, stainless steel, high-temperature steel, tool steel, cast iron and superalloys. The toxicity of manganese varies according to the route of exposure. By ingestion, manganese has relatively low toxicity at typical exposure levels and is considered a nutritionally essential trace element. By inhalation, however, manganese has been known to be toxic to workers (WHO, 2000). There is no South African ambient air quality standard for manganese. The IRIS Reference Concentration for Chronic Inhalation Exposure (RfC) of 0.05 $\mu g/m^3$ for manganese reports a Lowest Observed Adverse Effect Level (LOAEL) of 0.05 mg/m^3. This study has an uncertainty factor of 1000 with a confidence rating of 'medium' that had been applied to the study itself, to the data and to the RfC. The WHO ambient annual guideline value for manganese of 0.15$\mu g/m^3$ is derived by dividing the NOAEL by a factor to adjust for continuous exposure and to account for the uncertainty (WHO, 2000).

3. THE REGULATORY REQUIREMENTS

3.1 Atmospheric emission license

Section 21 of the National Environmental management: Air Quality Act (Act 39 of 2004), the AQA, defines Listed Activities as those that the Minister reasonably believes have or may have a significant detrimental effect on the environment. Government Notice 248 (DEA, 2010) defines the Listed Activities and where applicable, minimum emission standards and special conditions. According to Section 37 of the AQA, an application for and Atmospheric Emission License is required for all Listed Activities.

According to Category 5 (Mineral processing, storage and Handling and sub-category 5.1 (Storage and handling of ore or coal) of the list of activities, all installations that are not situated on a mine and hold more than 100 000 tons of ore or coal are classified as a Listed Activity. Transnet will therefore require an AEL for the Common User Facility and this must be supported by an atmospheric impact report (Section 30 of the AQA). The application must be lodged with the relevant AEL Authority.

The principal condition of sub-category 5.1 is that dust fall is measured in eight principal wind directions and the 3-month running average does not exceed the limit values for the adjacent land-use, according to the Draft National Dust Control Regulation (DEA, 2011b) (published on 27 May 2011 for public comment) which formalises the SANS recommendations.

This regulation states that no person may conduct any activity in such a way as to give rise to dust in such quantities and concentrations that:

a) The dust, or dust fall, has a detrimental effect on the environment, including health, social conditions, economic conditions, ecological conditions or cultural heritage, or has contributed to the degradation of ambient air quality beyond the premises where it originates; or
b) The dust remains visible in the ambient air beyond the premises where it originates; or
c) The dust fall at the boundary and beyond the boundary of the premises where it originates exceeds:
    i) 600 mg/m^2/day averaged over 30 days in residential or light commercial areas measured using reference method ASTM D1739; or
    ii) 1200 mg/m^2/day averaged over 30 days in areas other than residential and light commercial areas measured using reference method ASTM D1739.

3.2 Ambient air quality standards

Health-based ambient air quality standards have been established for criteria pollutants and one toxic air pollutant in South Africa. Being health-based, these standards imply that the ambient concentrations less than the standard do not pose a health risk, while concentrations above the standard may pose a risk. The national ambient air quality standard consists of a limit value and a permitted frequency of exceedance. The limit value is the fixed concentration level aimed at reducing the harmful effects of a pollutant. The permitted frequency of exceedance represents the tolerated exceedance of the limit value and accounts for high concentrations as a result of process upsets and meteorological variation. Compliance with the ambient standard, therefore implies that ambient concentrations are below the limit value and the frequency of exceedance does not exceed the permitted tolerance. The criteria pollutants of concern for this assessment are SO_2, NO_2, PM_{10}, $PM_{2.5}$ and benzene from diesel locomotives and ore handling. The national ambient standards are listed in Table 1.

Table 1: National ambient air quality standards (Republic of South Africa, 2009a and 2012)

Pollutant	Averaging period	Limit value µg/m^3	Frequency of exceedance	Compliance date
SO_2	10 min	500	526	In effect
	1-hour	350	88	In effect
	24-hour	125	4	In effect
	Annual	50	0	In effect
NO_2	1-hour	200	88	In effect
	Annual	40	0	In effect
PM_{10}	24 hour	120	4	In effect
	24-hour	75	4	1 Jan 2015
	Annual	50	0	In effect
	Annual	40	0	1 Jan 2015
$PM_{2.5}$	24-hour	65	0	In effect
		40	0	1 Jan 2016–31 Dec 2029
		25	0	1 Jan 2030
	Annual	25	0	In effect
		20	0	1 Jan 2016–31 Dec 2029
		15	0	1 Jan 2030
Benzene	Annual	10	0	In effect
		5	0	1 Jan 2015

4. AIR QUALITY STATUS

4.1 Climate

The climate of any location is determined primarily by its latitude, elevation and distance from the sea. Secondary influences are the general atmospheric circulation, the nature of the earth’s surface, vegetation and the orientation topographical features. The climate will therefore vary considerably along the manganese railway line from Hotazel to the Port of Ngqura. Over the northern parts of the route in the Northern Cape daytime summer temperatures are hot and mild at night, winter daytime temperatures are mils and nights are cold. Rainfall is almost exclusively due to showers and thundershowers in summer. Over the Eastern Cape interior summer temperatures are not as extreme as over the Northern Cape, but winter nights are very cold. Towards the coast temperatures are moderated due to the influence of the warmer Indian Ocean. The average annual rainfall varies across the interior from 317 mm per annul to 418 mm at Postmasburg. The average annual rainfall at Port Elizabeth is 624 mm and rain occurs through the year.

The relative difference in monthly average maximum and minimum temperatures and daily average temperature are shown in Figure 2 from north to south at selected sites along the railway line at Postmasburg, Kimberley, de Aar, Cradock and Port Elizabeth. The average monthly rainfall is also shown.

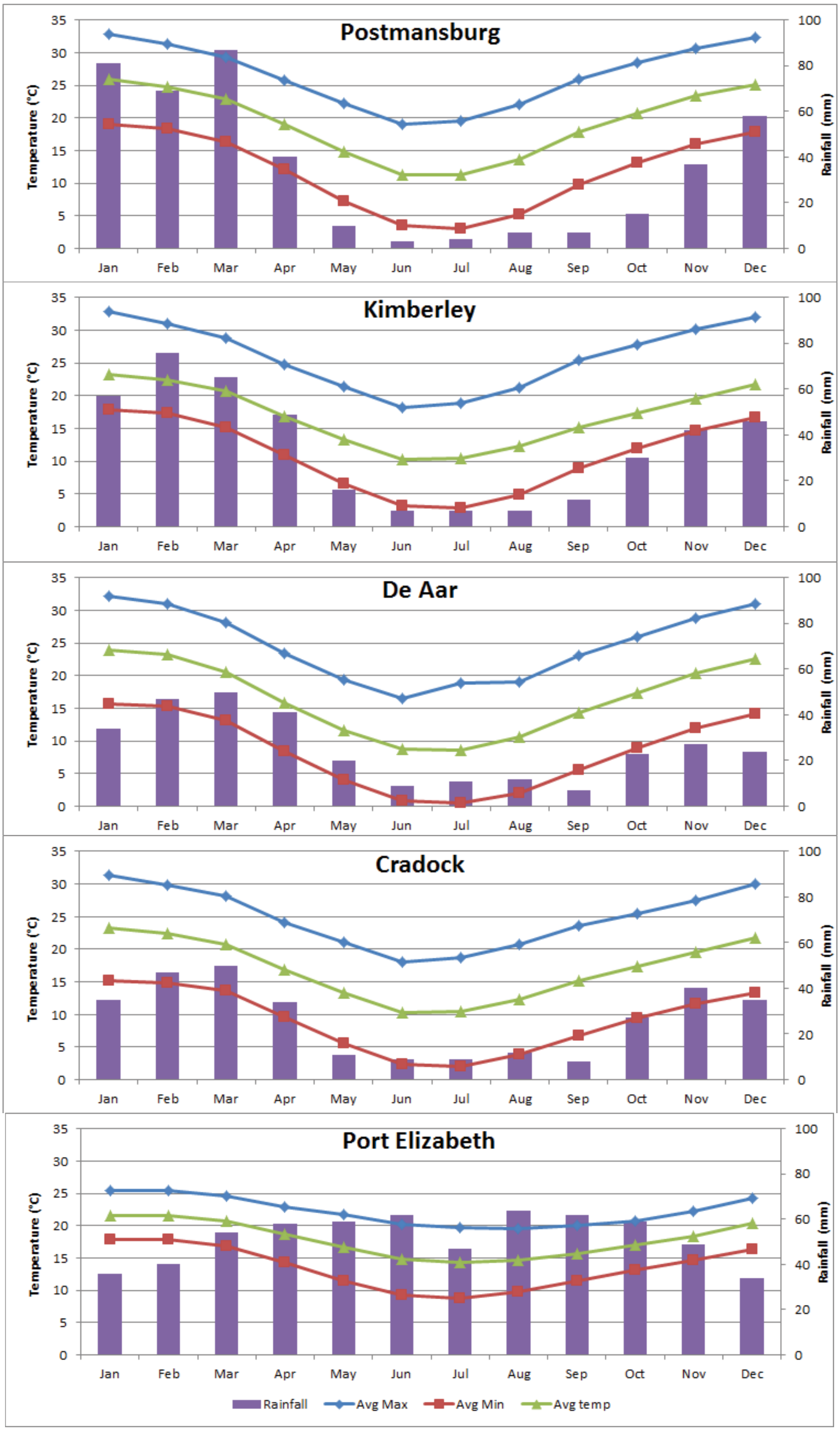

Figure 2: Average monthly maximum and minimum temperature and average daily temperature in °C and average monthly rainfall in mm at selected sites along the railway line route (SAWS, 1998)

Over the northern and central parts of the route in the Northern Cape and the Eastern Cape the winds are generally light to moderate and from the north to northeast. Over the extreme southern parts of the route the wind tends to follow the coastline and the prevailing winds in the Port Elizabeth area are west-southwesterlies and east-northeasterlies. Figure 3 shows the windrose at Port Elizabeth Airport which simultaneously depict the frequency of occurrence of wind from the 16 cardinal wind directions and wind speed classes, for a single site. Wind direction is given as the direction from which the wind blows, i.e., southwesterly winds blow from the southwest. Wind speed is given in meters per second (m/s), and each arc represents a percentage frequency of occurrence (5% in this case).

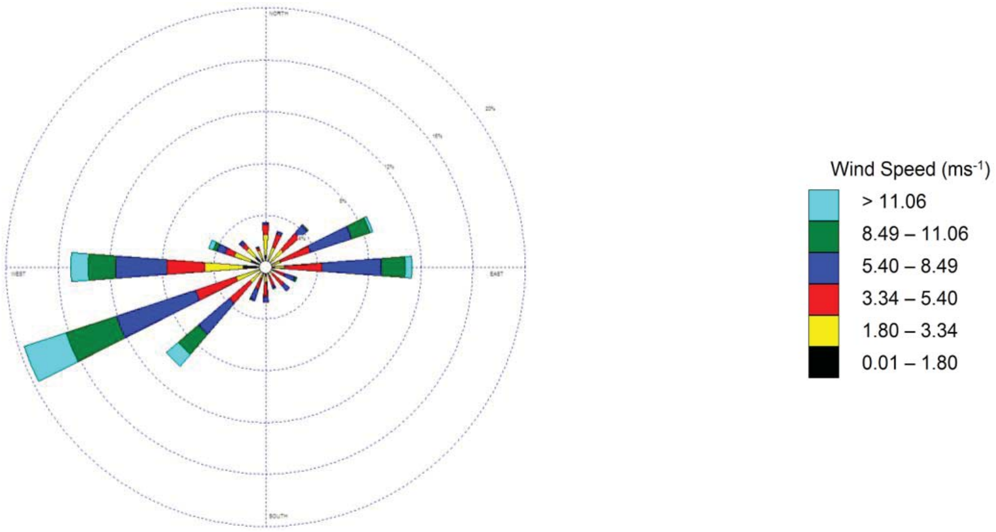

Figure 3: **Annual wind roses for Port Elizabeth Airport for 2009-2011.**

The poorest atmospheric dispersion conditions occur with inversion conditions and calm or light winds. Greater surface cooling in winter is conducive to the formation of surface temperature inversions and a shallow mixing layer, particularly at night. The mixing layer is the layer in which pollutants are able to mix. Pollutants released into the inversion layer are typically trapped between the surface and the top of the inversion. Under light wind conditions, pollutants will tend to accumulate. It is under these conditions for May to July, when the strongest inversions are expected to occur throughout the study area. The inversions are expected to be stronger over the whole of the interior than on the coast due to colder nigh time temperatures.

4.2 Ambient air quality

The manganese railway line runs from the mines at Hotazel to the Port of Ngqura. It passes mostly through sparsely populated rural areas consisting of agricultural lands and natural vegetation. It also passes through a number of urban centres of varying sizes. Industrial activity in all of these is relatively limited consisting of small manufacturing concerns with limited emissions of pollutants to the atmosphere. Emissions from these may include sulphur dioxide (SO_2), oxides of nitrogen (NO_X) and particulate matter including respireable PM_{10} and $PM_{2.5}$. In Hotazel mining, ore processing and handling are sources of particulates.

In un-electrified homes in residential areas along the route wood and other fuels are burnt for cooking and space heating. In winter typically more fuel is burnt than in summer because of the colder temperatures. Pollutants associated with wood burning include CO, NO_X and particulates. Vegetation burning for agricultural purposes and other forms of land management are also sources of gaseous and particulate pollutants.

There are no measurements of ambient air quality on the manganese railway line except at Van Zyl's Rus and Kuruman in the Northern Cape. At the mines and ore handling facilities in the Northern Cape, ambient particulate concentrations are expected to be relatively high. Air quality is expected to be relatively good and this is shown by manganese monitoring at Van Zyl's Rus and Kuruman. Measured concentrations at these residential sites are below the WHO annual ambient air quality guideline (DEA, 2009b).

In the urbanised centres along the freight route, ambient air quality is expected to be generally good and possibly only impacted on by emissions from sources such as small industrial boilers and motor vehicles. In residential areas that the railway line runs close to, where wood and other biomass fuels are used for heating and cooking, air quality may to be poor. In the evenings and early mornings when fires are made, especially in winter air quality in these areas will be most impacted. Elsewhere along the route ambient air quality is expected to be very good.

5. POTENTIAL IMPACTS

The manganese railway line passes mostly through sparsely populated rural areas consisting of agricultural lands and natural vegetation and a number of urban centres of varying sizes on route from Hotazel to the Port of Ngqura. There are no significant sources of air pollution with small manufacturing concerns and the use of wood and other fuels for cooking and heating. There are no measurements of ambient pollutants, but without significant sources air quality is expected to be good.

The civil construction activities associated with the railway line upgrade are likely to generate dust and the emission of particulates into the atmosphere as a result of vehicle entrained dust, excavation, ground levelling, and windblown dust from open areas. Dust from construction activities is generally relatively course, but may include fine respireable particles (PM_{10}). The dust is released close to ground level and has little or no buoyancy, limiting the extent of its dispersion. The coarse particulates generally settle relatively close to the point of release, but finer particulates may be transported further as they are easily carried by wind. Exhaust emissions from construction vehicles and equipment typically include particulates (including PM_{10}), carbon monoxide (CO), nitrogen oxides (NO_x), sulphur dioxide (SO_2) and volatile organic compounds (VOCs) including benzene. They are released close to ground level and their dispersion in inhibited. With construction being relatively short in duration the impacts are likely to be temporary and a nuisance only.

Dust from open rail cars and emissions from locomotives are potential sources of air pollutants along the railway line. However the ore is sprayed with water during loading and dust id bound to the ore so little or no dust is expected to be blown from the ore wagons. Similarly, the wagons have closed bottoms so dust does not fall through and deposit on the rail tracks. There are no emissions from the electrically powered locomotives on the main railway line.

The consolidation and deconsolidation of wagon trains by diesel locomotives in the compilation yard will result in emissions of particulates, oxides of nitrogen (NO_X) and volatile organic compounds (VOCs) including benzene. The activities will endure for the operational lifetime of the facility. These pollutants may pose a health risk in the neighbouring environment if the resultant ambient concentrations of these pollutants exceed the health-based ambient air quality standards. Wind entrained dust from open areas in the compilation yard and may present a nuisance impact.

Manganese ore will be dumped, stored, reclaimed and loaded into train wagons in the Common User Facility. Dust generated from the handling of ore as well wind entrained dust from the stockpiles and open areas may present nuisance impacts in the surrounding environment.

REFERENCES

CCINFO, (1998): The Canadian Centre for Occupational Health and Safety database. http://ccinfoweb.ccohs.ca visited on 21 July 2003.

EAE, (2006): Encyclopaedia of the Atmospheric Environment, 2006, Nitrogen [Online], http://www.ace.mmu.ac.uk/eae/Air_Quality/Older/Nitrogen_Dioxide.html

DEA, (2009a): National Ambient Air Quality Standards, DEA, 32861, Vol. 1210, 24 December 2009.

DEA, (2009b): State of Air Report 2005, A Report on the State of Air in South Africa, ISBN 978-0-621-38724-7.

DEA, (2010): Listed Activities and Associated Minimum Emission Standards indentified in terms of Section 21 of the Air Quality Act, Act No. 39 of 2004, DEA, 33064.

DEA, (2011): Draft National Dust Control Regulations in terms of the National Environmental of the Air Quality Act, Act No. 39 of 2004, Notice 309 of 2011, Government Gazette, 34307.

DEA, (2012): Proposed National Ambient Air Quality Standard for Particulate Matter of Aerodynamic Diameter less than 2.5 micrometers, Notice 515 of 2011, Government Gazette, 34493.

WHO, (1997): Guidance for setting air quality standards. Report on a Working Group. Barcelona, Spain 12-14.

WHO, (1999): Guidelines for Air Quality, World Health Organisation, http://www.who.int/peh/air/Airqualitygd.htm

WHO, (2000): Air Quality Guidelines for Europe, 2nd Edition, World Health Organisation, ISBN 92 890 1358 3.

WHO, (2005): WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulphur dioxide, Global update 2005, Summary of risk assessment, WHO/SDE/PHE/OEH/06.02.