APPENDIX 4

AIR QUALITY IMPACT ASSESSMENT REPORT

NOVEMBER 2024

AIR QUALITY IMPACT ASSESSMENT FOR THE PROPOSED WINELANDS AIRPORT EXPANSION

DRAFT

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Submitted to:

PHS Consulting

11 November 2024

DECLARATION OF INDEPENDENCE

4.2 The specialist appointed in terms of the Regulations_

I, __Demos Dracoulides__, 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:

DDA Environmental Engineers

Name of company (if applicable):

Date: 11/11/2024

DETAILS OF SPECILIST

Demos Dracoulides has 25 years of consulting experiences specialising in air quality and noise pollution. He is the Director of DDA Environmental Engineers. He holds an MSc in engineering, Energy Studies.

Over the past years, Demos Dracoulides has been involved in the development of industry-specific emission inventories, establishing the impacts on air quality in a great number and variety of projects, including AEL applications, emissions testing reporting to NAEIS system, etc. These include projects for petrochemical and chemical industries, minerals processing and mining, the ceramic industry, power generation, landfill facilities, incineration operations, wastewater treatment plants, airport facilities, etc.

He has also been active in the noise and vibration fields. He has been involved in the development of industry-specific noise and vibration models, including power stations and transformer stations. He has participated in teams for the design, technical specifications and noise minimisation for projects such as the Gautrain, the Cape Town International Airport Realignment, the Ankerlig and the Gourikwa CCGT Power Stations, as well as the proposed Pebble Bed Modular Reactor Demonstration Power Plant in South Africa.

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List of Acronyms and Abbreviations

AEDT	Aviation Environmental Design Tool
AEM	Aircraft emissions module
APM	Aircraft performance module
APUs	Auxiliary power units
AQA	Air Quality Act
ATM	Air traffic movement
C_6H_6	Benzene
CO	Carbon monoxide
COMEAP	Committee on the Medical Effects of Air Pollutants
CWA	Cape Winelands Airport
DEA	Department of Environmental Affairs
DEADP	Department of Environmental Affairs and Development Planning
DEAT	Department of Environmental Affairs and Tourism
DOT	Department of Transport
ECA	Environment Conservation Act
FAA	Federal Aviation Administration
GSE	Ground support equipment
HCs	Hydrocarbons
ha	Hectare
hr	Hour
ICAO	International Civil Aviation Organization
INM	Integrated Noise Model
LTO	Landing-take off
Mg	Mega grams
Mmbtu	Million btu
NEMA	National Environmental Management Act
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides
O_3	Ozone
PM_{10}	Particulate matters with aerodynamic diameters of 10 micrometres or less
$PM_{2.5}$	Particulate matters with aerodynamic diameters of 2.5 micrometres or less
ppb	Parts per billion
SA	South Africa
SABS	South African Bureau of Standards
SANS	South African National Standards
SAWS	South African Weather Service

SDP	Site development plan
SO_2	Sulphur dioxide
STP	sewage treatment plant
t/y	Tonnes/year
µg	Microgram
USEPA	United States Environmental Protection Agency
VOCs	Volatile organic compounds
WHO	World Health Organisation
WWTW	Wastewater Treatment Works

1 INTRODUCTION

The Cape Winelands Airport (CWA) (formerly Fisantekraal Airfield) is an ex-South African Air Force airfield built around 1943 and was acquired by Cape Winelands Airport Limited in November 2020. The CWA is 150 ha in size and is located approximately 13 km northeast of Durbanville and 25 km northeast of the Cape Town International Airport.

The CWA currently serves as a general flying airfield and is used for flight training. In addition, the airfield offers aircraft maintenance, private charter flights, hangarage for private plane owners, as well as the sale of aviation fuel.

It has been proposed that the existing airfield and adjacent plots of land be developed into a commercial and aviation hub, supporting flight operations domestically, regionally, as well as internationally.

PHS Consulting (Pty) Ltd has been appointed to undertake the Environmental Impact Assessment (EIA) for the proposed project. DDA Environmental Engineers (DDA) was appointed by PHS Consulting to undertake to compile the Atmospheric Impact Report for the proposed development. The objective of the atmospheric impact assessment was to establish an air pollution emissions inventory for all the activities at the CWA, and based on that, to estimate the impact of these emissions on the ambient air quality of the vicinity.

1.1 Terms of Reference

The terms of reference of the Atmospheric Impact Report were:

- Identify and describe the existing air quality of the project area, including climatic patterns and features (i.e. the baseline);
- Identify existing significant sources of air pollution in the area;
- Identify potential receptors;
- Define applicable legislative requirements regarding any permit applications required;
- Identify potential impacts of the proposed project on air quality;
- Assess the impacts of air pollution on the surrounding communities and the environment, using the prescribed impact assessment methodology. Include, where possible, an estimation of worst-case scenarios, such as unfavourable meteorological conditions (e.g. windy days);
- Identify and assess potential cumulative ecological impacts resulting from the proposed development, with the proposed and existing developments in the surrounding area;
- Recommend practicable mitigation measures to avoid and/or minimise/reduce impacts and enhance benefits, and;
- Recommend and draft a monitoring campaign to ensure the correct implementation and adequacy of any recommenced mitigation and management measures, if applicable.

1.2 Study Area

The CWA is located approximately 13 km northeast of Durbanville and 25 km northeast of Cape Town International Airport. The location of the CWA can be seen in Figure 1-1 below and is accessible via R304 and R312.

The communities close to the CWA include Klipheuwel, which is approximately 5 km to the north and Fisantekraal, which is approximately 3 km to the southwest of the CWA. The Durbanville residential suburb is located more than 6 km away, towards the southwest of the project site.

There are two proposed developments in the vicinity of the airport. The first is the Bella Riva Lifestyle & Country Estate, which is situated between the CWA and the railway line to the west. This development will be a mixed residential and lifestyle golf estate. The second is the Greenville Garden City development, which is located south of the CWA and the R312. The Greenville Garden City will be a residential development.

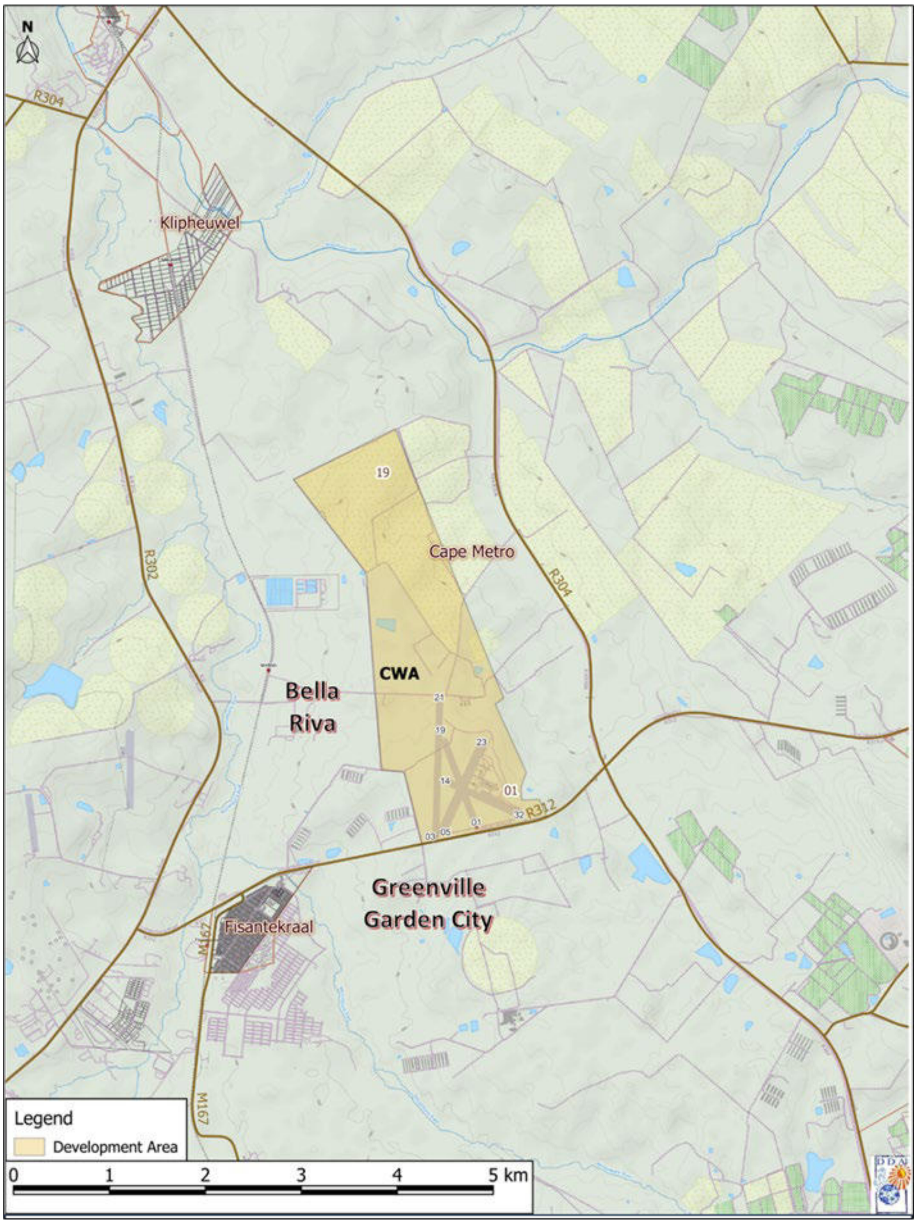


Figure 1-1. Cape Winelands Airport Locality Map

1.3 Project Description

1.3.1 Existing Operations

The CWA currently serves as a general flying airfield and is used for flight training in the Cape Town area. The flight activity at the airport is approximately 100 air traffic movements per day, with variation based on the weather conditions, seasons and days of the week.

The airfield also offers aircraft maintenance, private charter flights, hangarage for private plane owners, as well as the sale of aviation fuel (Avgas 100LL) from a 28,000L tank.

There are four concrete airstrips of 90m width each in varying lengths between 700m and 1500m (see Figure 1-2). The designations of the airstrips, depending on the magnetic bearing of each strip in degrees, are 03/21, 05/23, 14/32 and 01/19.

Figure 1-2. Cape Winelands Airport

1.3.2 Proposed Development

The project entails developing the existing airfield and adjacent plots of land into a commercial and aviation hub, as well as a multimodal transport hub. The development will take place over several phases. The detailed breakdown of this development and its associated infrastructure per phase is as follows:

i. Airside, Terminal and Landside Developments

In Phase 1, the airport will comprise one runway, which will be at an orientation of 01-19 and a length of 3.5km and will be constructed to serve up to Code 4F aircraft, i.e. large aircraft, and instrument operations.

ii. Landside Developments

The Passenger Terminal Building will be developed in Phase 1. Additional developments proposed as part of Phase 1 & Phase 2 include:

- Petrol service station;
- Hotel;
- Access, egress and an internal vehicular road system;
- Drop and go facilities which will allow passengers to drop passengers off close to the passenger terminal building;
- Car rental facilities;
- Vehicular parking (multi-storey parking, at-grade parking);
- Pedestrian walkways;
- Substations;
- Billboards (indoor and outdoor, static and electronic);
- Droneport and vertiports;
- Gardens;
- Public transport facilities (Phase 2);
- Carpark/VTOL (Phase 2).

iii. General Aviation Precinct

The developments proposed as part of Phase 1 & Phase 2 of the General Aviation Precinct include:

- Fixed base operators hangars;
- General aviation hangars;
- Clubhouse area;
- Final approach & take-off infrastructure;
- AVGAS station;
- Substation;
- Remote digital control tower.

iv. Services Precinct

The following developments are proposed as part of Phase 1 & Phase 2 of the Services Precinct:

- The fuel facilities (Phase 1) consist of a bulk fuel depot, a general aviation kerbside refuelling station and a commercial/retail service station. An underground fuel line from the bulk fuel depot to the aprons is also provided for in Phase 2.
- Aircraft rescue and fire fighting (Phase 1);
- Cargo facility (Phase 1);
- The airport maintenance facilities (Phase 1);
- GSE staging areas (Phase 1);
- Aircraft maintenance, repair and overhaul (MRO) facility (Phase 1);
- Catering building (Phase 2);
- Solar PV, biodigester and wind energy (Phase 1 & Phase 2);
- Airport operations centre (Phase 1);
- Air traffic control centre (Phase 1); and
- Additional developments proposed include a potable water reservoir; groundwater treatment infrastructure; a potable water pump station; non-potable water storage; solid waste storage; WWTW; a substation; and a cargo apron (Phase 2).

v. Fuel Facilities:

It has been estimated that the fuel demand (Jet-A1) in the CWA's opening year would be approximately 27 million litres (2029), which would gradually increase over the following years, more than doubling to 57 million litres in 9 years (2038) and increasing to approximately 86 million litres over the next 12 years (2050). An aviation fuel depot with a capacity of 2,000 m^3 is required to always ensure 7 days of buffer stock. It is proposed that the storage capacity be installed as required (K&T, 2024).

The plot size of the fuel depot measures about 70m by 85m. The concept of the depot includes the following:

- All fuel received by road tankers.
- Dedicated road receipt facility with 2 bays (with pump, meter and filters).
- Total required storage capacity (2,000 m^3):
  - Jet-A1: 10x 80 m^3 horizontal tanks, and 3x 350 m^3 vertical storage tanks.
  - Avgas: 2x 30 m^3 and 1x 9 m^3 double-walled (FireGuard or similar) horizontal tanks.
- Six 80 m^3 horizontal tanks are to be installed in 2028, another 4x 80 m^3 by 2032, and then by 2038 construct and commission the three vertical tanks.

All tanks are located within a concrete-bunded area for secondary containment, connected to the oily-water separator.

For general aviation (Avgas users), a curbside refuelling strategy is proposed. Allowed for in-concept design: a 9 m^3 double-walled horizontal tank (FireGuard or similar) located Airside with a dispenser, where small privately-owned planes can taxi to, park and refuel without the need to call on a bowser truck. The bulk receipt of Avgas and filling into the browser would occur at the fuel depot described above.

vi. Diesel Generator Plant

Two backup supplies have been considered for the development, which are a diesel driven generator plant and a renewable battery storage. The battery storage will be powered by solar and by a biodigester. Only in the event of Eskom's supply and battery storage being unavailable, the diesel generator plant will be then be utilised as a backup.

The diesel generators will have a capacity of 8 MW. Bulk dual storage for 80m^3 of diesel has been proposed for the generator plant.

vii. Bio-digester Plant

A bio-digester has been proposed to be established. This bio-digester plant will utilise the available chicken manure in the project area, as well as the treated effluent water. The biogas generated from the bio-digester plant will be accumulated into a (large) bladder system from which electricity will be generated.

The by-product from the bio-digester is a "liquid fertilizer", which can be applied to the land as fertiliser.

It might be possible to add other types of waste-stream sources, such as food-waste into the bio-digester plant in future.

Preliminary design specifications of the bio-digester plant are:

- The bio-fuel source will comprise approximately 50 tons/day of chicken manure.
- The system is designed to provide 1MW of continuous power.
- The bio-fuel generator plant will require between 3 and 5 tons of treated sewage effluent per ton of chickenmanure for the bio-digester plant (approximately 250kl/day). If the sewerage effluent water is not available, ground water (from borehole sources) can also provide the supplementary volumetric requirements.

viii. Sewage Treatment Plant

There are two options for the sewage management and treatment. Option 1 is to send the sewage to the Fisantekraal WWTW by installing a pump station and associated rising main that conveys the flows to the north or to the southwest towards the municipal sewage network in Fisantekraal.

Option 2 is to have an onsite sewage treatment plant (STP). The plant will generate treated sludge/biosolids and treated effluent water. The treated effluent water will be used as a supplementary input liquid in the bio-digester on-site to generate electricity.

ix. Site Development Plan

The proposed site development plans (SDP) for phases 1 and 2 can be seen below:

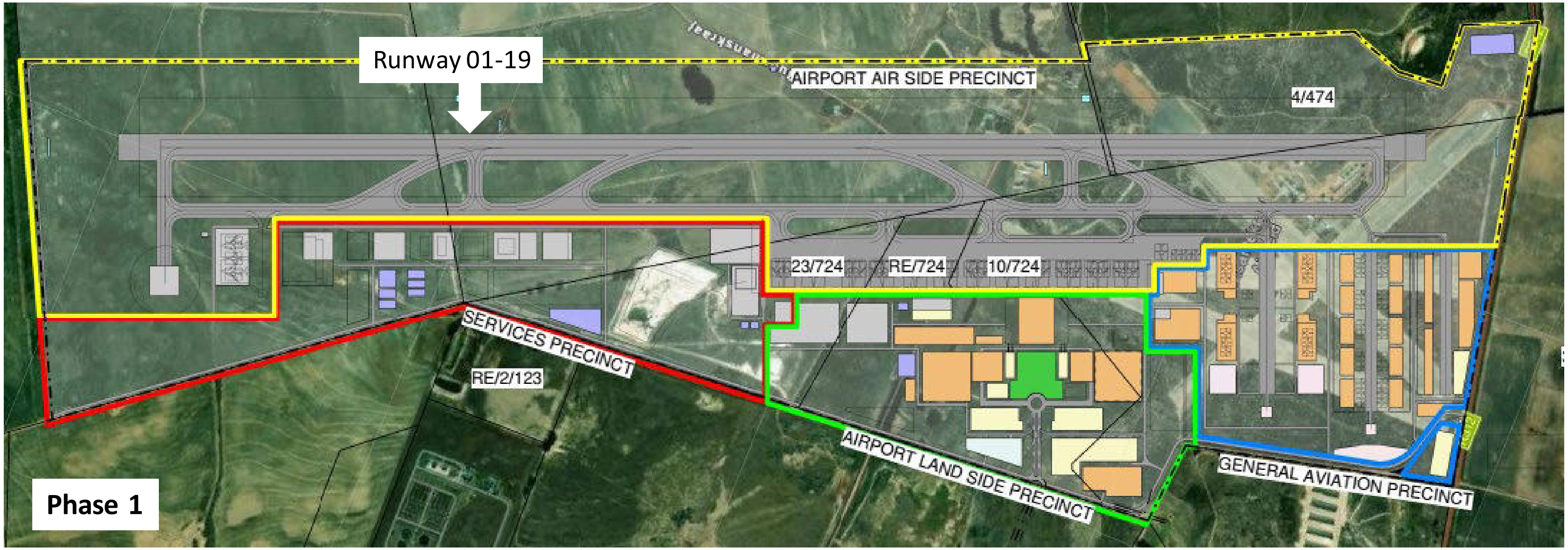


Figure 1-3. Proposed SDP Phase 1 (Capewinelands Aero (Pty) Ltd, 2024)

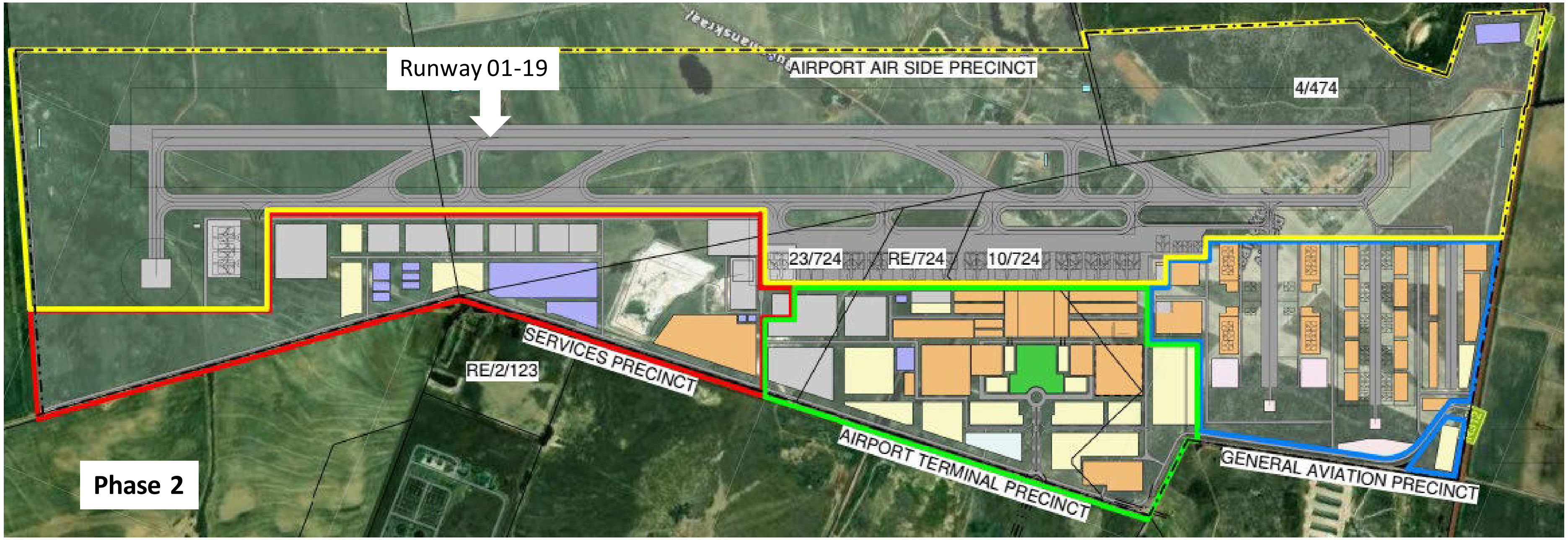


Figure 1-4. Proposed SDP Phase 2 (Capewinelands Aero (Pty) Ltd, 2024)

1.3.3 Project Alternatives

The alternatives considered in this report are:

- Preferred Alternative: entails the construction of a 3,500 m runway at an orientation of 01-19 and the associated infrastructures; and
- No-go Alterative: the status quo is maintained.

1.4 Methodology Overview

The present study comprises the following main components:

- Baseline characterisation;
- Emissions inventory compilation;
- Air pollution dispersion simulation; and
- Impacts assessment.

➢ Baseline Characterisation

An overview of legal requirements, including air quality standards and human health criteria are presented in Section 2, followed by the analysis of the existing air quality and local meteorology in Section 3. The appropriate meteorological and site characteristic data were collected and assessed in terms of their effects on the local air quality. The collected data was prepared accordingly for utilisation in the air pollution dispersion model for airport operations.

➢ Emissions Inventory

A comprehensive emissions inventory is the basis of the air dispersion modelling and impact assessment. The latest Federal Aviation Administration (FAA) Aviation Environmental Design Tool (AEDT) was used for calculating the primary emissions from the airport operations.

AEDT is a software system that is designed to dynamically model aircraft performance in space and time to compute fuel burn, emissions and noise. AEDT replaces the current public-use aviation air quality and noise analysis tools, such as the Integrated Noise Model (INM) and the Emissions and Dispersion Modelling System (EDMS).

The resulting inventory of air pollution emissions from the various activities at the CWA is included in Section 4. A detailed emissions inventory with the primary airport-related air pollutants was created for three operational scenarios for the airport (see Section 1.5). These pollutants were carbon dioxide (CO_2), carbon monoxide (CO), total hydrocarbons (THC), volatile organic compounds (VOC), nitrogen oxides (NO_x), sulphur oxides (SO_x) and suspended particulate matter with a diameter of less than 10 µm (PM_{10}) and less than 2.5 µm ($PM_{2.5}$). The selection of the above-mentioned air pollutants was based on the fact that they constitute the majority of the exhaust gases emitted as a result of the airport operations, as well as being regulated by the South African National Ambient Air Quality Standards.

- Air Dispersion Simulation

The dispersion of the air pollutants' emissions was simulated using the AEDT model. Ambient concentrations were computed for time periods stipulated in the South African National Ambient Air Quality Standards, i.e. maximum 1-hr (99th percentile), 24-hr (99th percentile) and annual ambient concentrations. The modelled maximum ambient concentrations were presented as concentration isopleth plots and are presented in Section 5.

- Impact Assessment

In Section 5.3.3, the simulation data was utilised for the assessment of the impact on the area's air quality and the relative human health risks. The modelled concentrations were compared to the South African National Ambient Air Quality Standards for the assessment of compliance.

The potential human health risks were estimated utilising recommended coefficients, expressing the relative risks for short- and long-term exposure to various air pollutants. These coefficients were used for the estimation of the changes in the incidence of health responses, such as chronic bronchitis and premature mortality and are also presented in Section 5.3.3.

Possible mitigation measures were identified in Section **Error! Reference source not found.** of the report. The generated air pollutant concentrations and impact assessment were also utilised for the determination of the optimum location of an air quality monitoring station, the monitoring characteristics and the development of a monitoring plan.

1.5 Study Operational Scenarios

Three operational scenarios were included in the atmospheric impact assessment study, which are:

Scenario 1: Existing runways at full capacity (No-Go Alternative);

Scenario 2: New runway during its operational year; and

Scenario 3: New runway at full capacity.

Scenario 1 represents the existing runway system at full capacity, which is essentially the No-Go Alternative. Scenarios 2 and 3 assess the future proposed operations. For the assessment of the existing runways (RNW 01/19, 03/21, 05/23 and 14/32), the typical busy day at full utilisation was used, which is expected to generate a total of 301 air traffic movements (ATM).

In order to evaluate the immediate effects of the change to the new runway, the ATMs for the operational year were used, which were estimated to be 29 per day. The maximum capacity of 208 ATMs per busy day for the new runway was used for the assessment of the maximum impact of the new runway.

1.6 Assumptions and Limitations

The main assumptions and limitations of the study are:

- The construction phase emissions were determined and the impact was assessed qualitatively. During the construction phase, the main pollutant of concern is dust. The exhaust emissions from the construction vehicle exhausts were not assessed due to their very limited quantity and their local and temporal nature.
- The air emissions for the criteria air pollutants (i.e. CO, NO_2, SO_2, PM_{10} and $PM_{2.5}$) from the aircraft and the road traffic were quantified and modelled.
- The aircraft emissions of the current scenario were based on the aircraft movement forecasts.
- As a worst-case scenario, for the determination of the NO_2 levels, the Tier 1 approach was adopted, which entails the complete conversion of NO_x to NO_2.
- In addition to the airport-related vehicular traffic on the approach roadways to the airport, the vehicular traffic on the main arterial roads immediately adjacent to the airport was included in the assessment of the three operational scenarios, in order to assess the resulting cumulative concentrations.

- Industrial emission sources in the study area were included in the assessment for the cumulative impact assessment.

It should be noted that the present study is focused on the air quality impacts on the general population in the various areas around the airport and does not assess the allowable air pollution levels within the airport site or the potential health impacts on the airport workers on site.

2 LEGISLATIVE CONTEXT

The South African legislation and guideline documents regarding air quality, emission standards and environmental management on airport-related activities are:

- Constitution of the Republic of South Africa Act, No. 108 of 1996;
- National Environmental Management Act, No. 107 of 1998, as amended (NEMA);
- National Environment Management: Air Quality Act, No. 39 of 2004 (NEM: AQA);
- Environmental Conservation Act, No. 73 of 1989 (ECA);
- White Paper on National Policy on Airports and Airspace Management, of 1998;
- Health Act, No. 63 of 1977; and
- National Policy on Aircraft Noise and Engine Emissions, of 1999.

2.1 The Constitution of the Republic of South Africa and NEMA

According to the South African Constitution, everyone has the right-

(a) to an environment that is not harmful to their health or wellbeing; and

(b) to have the environment protected, for the benefit of present and future generations, through 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.

NEMA requires that an environmental impact assessment be carried out before any activity or development that needs permission by law, or which may significantly impact the environment, is authorised. NEMA places a duty on every potential polluter to take reasonable measures to prevent pollution or degradation from occurring, or else to minimise and rectify such pollution or degradation of the environment. Pollution is defined in the Act as any (significant) change in the environment caused by substances, radioactive or other, waves, noise, odours, dust or heat.

2.2 White Paper on National Policy on Airports and Airspace Management

The National Department of Transport (DOT) has the authority and responsibility to control all airport developments, in terms of their environmental impact and ensure regulatory measures for their minimisation.

The DOT also has the responsibility to encourage all airport developments to be planned with the Integrated Environmental Management principles, as recommended by the Department of Environmental Affairs and Tourism[1] (DEAT). In the White Paper on National Policy on Airports and

[1] This department is now Department of Environmental Affairs (DEA).

Airspace Management (1998), it is also recommended that aviation planning be subject to local, metropolitan and provincial authorisation.

The provincial government is responsible for land use compatibility, zoning and housing regulation that will manage the use of land near airports for purposes compatible with airport operations. The regional and metropolitan authorities should promote airport development according to environmental sustainability regulations.

Airport owners are responsible for planning and implementing actions designed to reduce the effect of air pollution emissions on residents of the surrounding area. Such actions include optimal site location, improvements in airport design, air pollution reduction ground procedures, land acquisition and restrictions on airport use that do not unjustly discriminate against any user, impede the national interest in the safety and management of the air navigation system, or unreasonably interfere with national or foreign commerce.

The Airports Company Act requires that the airport owner manage the airport in a safe and secure manner, according to national and international rules and regulations.

2.3 National Policy on Aircraft Noise and Engine Emissions

The National Policy on Aircraft Noise and Engine Emissions (1999) sets the goals and objectives for national and local planning and control at airports and their surrounding areas. It highlights policy guidelines, such as the establishment of ambient air pollution monitoring, reduction of air pollution emissions and determination of the extent of the impact of airport-related activities' emissions on the environment.

According to the policy, the role-players and their responsibilities for the air quality at airport installations are depicted in Table 2-1.

Table 2-1. Airport Air Quality Role-players and their Responsibilities

Role-player	Responsibility
Department of Environmental Affairs	• Review and update standards and guidelines regarding air quality. • Propose changes, if necessary. • Oversee auditing function to ensure adequate ambient and compliance monitoring (as set out in the Pollution and Waste Management Policy).
Department of Health	• Provide specialist support on air pollution-related matters. • Liaise with the Civil Aviation Agency.
SA Civil Aviation Agency	• Issue license for airport activities. • Ensure compliance with this Policy. • Comply with International Civil Aviation Organization (ICAO) standards and requirements. • Comply with current legislation. • Carry out reviews and updates. • Liaise with airport operators/owners, government departments, local and provincial authorities.
Provincial Government	• Comply with current legislation. • Approve new proposals for the development of airport complexes. • Liaise with the public, airport authorities, government departments, local authorities and industry.

Role-player	Responsibility
Local Authority	• Monitor and regulate matters of air pollution in conjunction with the proposed Integrated Pollution and Waste Management Policy. • Enforce air quality in their area of jurisdiction. • Liaise with the public, airport authorities, government departments, local industry, and provincial government.
Environmental Committee	• Receive and process complaints from the public. • Ensure open lines of communication between all stakeholders and role players.
Airport operators in consultation with Airport Environmental Committee	• Monitor air quality and record data. • Control activities at airport. • Monitor aircraft numbers, types, and movements. • Ensure system of management and reporting. • Comply with current legislation. • Liaise with local, provincial and national authorities.
Source: National Policy on Aircraft Noise and Engine Emissions (DOT, 1999)	

2.4 South African National Ambient Air Quality Standards

The National Environmental Management: Air Quality Act (Act No. 39 of 2004) outlines in Schedule 2 the South African air quality standards. The Act includes margins of tolerance, compliance time frames and permissible frequencies by which the standards may be exceeded.

The South African national ambient air quality standards for criteria pollutants, i.e. SO_2, NO_2, O_3, C_6H_6, CO and PM_{10}, were first published in the Government Gazette No. 32816, of the 24th of December 2009. The national ambient air quality standards for $PM_{2.5}$ was published in the Government Gazette No. 35463, Notice No. 1210, on the 29th June 2012.

The national ambient air quality standards are presented in Table 2-2 below. These standards are based on international best practices and aim to protect human health and indicate safe exposure levels for the majority of the population throughout an individual's lifetime, including the very young and the elderly.

Table 2-2. National Ambient Air Quality Standards

Pollutant	Molecular Formula	Averaging Period	Concentration		Frequency of Exceedance	Compliance Date
			$\mu g/m^3$	ppb [a]		
Sulphur Dioxide	SO_2	10 minute	500	191	526	Immediate
		1 hour	350	134	88	Immediate
		24 hour	125	48	4	Immediate
		1 year	50	19	0	Immediate
Nitrogen Dioxide	NO_2	1 hour	200	106	88	Immediate
		1 year	40	21	0	Immediate
Ozone	O3	8 hour	120	61	11	Immediate
Benzene	C_6H_6	1 year	10	3.2	0	Immediate to 31 Dec 2014

Pollutant	Molecular Formula	Averaging Period	Concentration		Frequency of Exceedance	Compliance Date
			µg/m³	ppb [a]		
			5	1.6	0	From 01 January 2015
Carbon Monoxide	CO	1 hour	30,000	26,000	88	Immediate
		8 hour (calculated on 1 hourly averages)	10,000	8,700	11	Immediate
Particulate Matter	PM10	24 hour	120	-	4	Immediate to 31 Dec 2014
			75	-	4	From 01 January 2015
		1 year	50	-	0	Immediate to 31 Dec 2014
			40	-	0	From 01 January 2015
	PM2.5	24 hour	60	-	4	Immediate to 31 Dec 2015
			40	-	4	01 January 2016 to 31 December 2029
			25	-	4	From 01 January 2030
		1 year	25	-	0	Immediate to 31 Dec 2015
			20	-	0	01 January 2016 to 31 December 2029
			15	-	0	From 01 January 2030

a. ppb: parts per billion

2.5 Dust Fallout Guidelines

On 1st of November 2013, the Government Notice 827 - NATIONAL DUST CONTROL REGULATIONS published in terms of section 53 (o) of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) was promulgated. In these regulations, the standard for acceptable dustfall rate is set out for residential and non-residential areas (see Table 2-3 below).

Table 2-3. Acceptable Dust Fall Rates

Restriction Areas	Dustfall Rate (D) (mg/m²/day) (30-day average)	Comment
Residential area	D < 600	Two within a year, not sequential months.
Non-residential area	600 < D < 1200	Two within a year, not sequential months

The South African Bureau of Standards (SABS) has published dust deposition standards that are based on the cumulative dustfall levels in the South African National Standard (SANS) 1929: 2011. Four bands have been developed against which dust fallout can be evaluated (see Table 2-4). These dustfall levels were taken into consideration for the determination of the levels of nuisance in surrounding communities.

Table 2-4. Bands of Dust Deposition Rates (SANS 1929: 2011)

No.	Band Description Label	Dust Fallout Rate (D) ($mg/m^2/day$) (30-day average)	Comment
1	Residential	D < 600	Permissible for residential and light commercial.
2	Industrial	600 < D < 1200	Permissible for heavy commercial and industrial.
3	Action	1200 < D < 2400	Requires investigation and remediation if two sequential months lie in this band, or more than three occur in a year.
4	Alert	2400 < D	Immediate action and remediation required following the first incidence of the dust fallout rate being exceeded. Incident report to be submitted to the relevant authority.

Target, action and alert thresholds for ambient dust deposition and permissible frequency of exceedances are given in Table 2-5.

Table 2-5 Target, Action and Alert Thresholds for Dust Deposition (SANS 1929: 2011)

Level	Dust Fallout Rate (D) ($mg/m^2/day$) (30 day average)	Averaging Period	Permitted Frequency of Exceeding Dust fall Rate
Target	300	Annual	N/A
Action Residential	600	30 days	Three within any year, no two sequential months.
Action Industrial	1,200	31 days	Three within any year, no two sequential months.
Alert Threshold	2,400	32 days	None. First incidence of dust fall rate being exceeded requires remediation and compulsory report to the authorities.

2.6 Air Quality and Health Effects Quantification

2.6.1 Health Effects of Air Pollution

2.6.1.1 CO

Carbon monoxide (CO) can cause harmful health effects by reducing oxygen delivery to the body's organs (like the heart and brain) and tissues. It can form a strong bond with the haemoglobin molecule, forming carboxyhemoglobin (COHb). COHb impairs the oxygen-carrying capacity of the blood. People with several types of heart disease already have a reduced capacity for pumping oxygenated blood to the heart, which can cause them to experience myocardial ischemia (reduced oxygen to the heart), often accompanied by chest pain (angina), when exercising or under increased stress.

Quantitative relationships have been established between the COHb level in blood and different health effects. At COHb levels in the range of 2-7 % exercise capacity decreases. At levels of COHb above 5% increased heart disease mortality may occur, as well as impaired co-ordination and driving ability (WHO, 1995). With an 8-hour exposure to 11.5 mg/m^3 CO, a person doing sedentary work would reach a COHb level of 1.5% (WHO, 1987), and a person doing heavy work would reach a level of 1.7 %.

The association between CO in air and daily mortality was reported for the city of Toronto (Burnett *et al*., 1998). A 1.5 mg/m^3 increase of CO between different days was associated with an increase of total mortality of 7% (95% confidence). However, the population was exposed to a mixture of PM, CO and other pollutants, such that CO alone may not be the cause of the increased mortality.

2.6.1.2 NO_2

Nitrogen dioxide (NO_2) is known to affect both respiratory and immune systems. According to the World Health Organisation (WHO), when the short-term concentrations of NO_2 exceed 200 µg/m^3 (guideline), it is toxic and causes significant inflammation of the airways.

The type of effects reported in some of the studies of NO_2 exposure were “nuisance effects” and symptoms, such as pulmonary function change or hospitalisations for respiratory diseases. NO_2 often occurs together with other pollutants, such as particulate matter, making it very difficult to draw conclusions about which pollutant had the major causative role.

2.6.1.3 SO_2

Sulphur dioxide (SO_2) can affect the respiratory system and the functions of the lungs, and causes irritation of the eyes. There is scientific evidence that links short-term exposures to SO_2 with adverse respiratory effects like bronchoconstriction and increased asthma symptoms. In addition, studies also show a connection between short-term exposure and increased visits to emergency departments and hospital admissions for respiratory illnesses, especially in susceptible populations including children, the elderly and asthmatics.

USEPA summarized its findings on SO_2 in the evaluation of its health effects in the relevant Integrated Science Assessment study (USEPA, 2008b). It concludes that “there is a causal relationship between respiratory morbidity and short-term exposure to SO_2” and found “clear and convincing evidence in the human clinical, epidemiologic and animal toxicological studies”. It is also stated that in human clinical studies, respiratory effects were observed in asthmatics engaged in moderate to heavy levels of exercise, following 5-10 min exposures to SO_2 at concentrations greater than 200ppb (572 µg/m^3). In the epidemiologic studies, respiratory effects were observed in areas where the maximum ambient 24-hr average SO_2 concentration was below 140ppb (400 µg/m^3). The mean 24-hr average SO_2 levels in the epidemiologic studies ranged from 1 to 30 ppb (2.8 to 86 µg/m^3), and the maximum 24-hr average SO_2 levels ranged from 12 to 75 ppb (34 to 214 µg/m^3).

2.6.1.4 Particulate Matter (PM_{10} and $PM_{2.5}$)

Particulate matters-PM_{10} and $PM_{2.5}$ are known to be small enough to penetrate deep into the lungs. Generally, larger particulate matter (PM) (between 2.5 and 10 µm) deposits in the upper airways, whereas smaller PM (<2.5 µm) lodges in the very small airways deep into the lung. Studies have shown that exposure to PM causes several health effects, which include respiratory and cardiovascular morbidity, e.g. aggravation of asthma, respiratory symptoms and increase in hospital admissions; as well as mortality from cardiovascular and respiratory diseases and lung cancer (WHO, 2013).

It is estimated that PM exposure causes approximately 3% of cardiopulmonary and 5% of lung cancer deaths globally (WHO, 2013). In the European Region, the percentage is 1-3% and 2-5% respectively (Cohen AJ et al, 2004). Moreover, exposure to $PM_{2.5}$ reduces the life expectancy of the population in the European Region by about 8.6 months on average.

2.6.2 Health Effects Quantification

2.6.2.1 Short-term Exposure Health Effect

For the short- and long-term health effects, the coefficients specified by the Committee on the Medical Effects of Air Pollutants (COMEAP) were used. COMEAP is an expert Committee that provides advice to the UK Department of Health's Chief Medical Officer, on all matters concerning the effects of air pollutants on health.

The above-mentioned recommended coefficients for quantifying short-term exposure to PM_{10}, SO_2 and NO_2, utilised in the present study are outlined below (COMEAP, 1998).

Table 2-6. Estimates of Coefficients to Quantify Short-term Exposure to Pollutant

Health Endpoint	PM10 [a]	SO_2 [a]	NO_2 [b]
Deaths (all causes)	0.75%	0.60%	-
Respiratory hospital admissions	0.80%	0.50%	2.50%
Cardiovascular hospital admissions	0.80%	-	-
a Per 10 µg/m^3 1-hr mean of PM_{10} or SO_2			
b Per 50 µg/m^3 1-hr mean of NO_2			

2.6.2.2 Long-term Exposure Health Effect

In various international studies, it has been indicated that there is insufficient evidence to quantify the health effects of long-term exposure to SO_2, NO_2 and O_3 (COMEAP, 2009).

However, the evidence regarding the effects of long-term exposure to particulate matter has increased in recent years. Based on new evidence and quantitative estimates of the impact of the long-term effects of particulate pollution on mortality, COMEAP has published coefficients linking mortality to long-term exposure to $PM_{2.5}$. These are summarised Table 2-7.

Table 2-7. Estimates of Coefficients to Quantify Long-term Exposure to $PM_{2.5}$

Health Endpoint	Coefficient	Note
All-cause mortality	1.06 with 95% confidence interval 1.02-1.11, (i.e. 6% per 10 µg/m3 increase in PM2.5)	For impact assessment of all-cause mortality and assessing policy interventions designed to reduce levels of air pollutants, use the full distribution of probabilities.
	1.01 and1.12 as the 12.5th and 87.5th percentiles of the probability distribution	For sensitivity analysis
	1.00 and 1.15	For reports on the quantification of risks from long-term exposure to particulate air pollution represented by $PM_{2.5}$
Cardiopulmonary mortality	1.09 with 95% confidence interval 1.03-1.16	-
Lung cancer mortality	1.08 with 95% confidence interval 1.01-1.16	-
Note: All coefficients expressed in terms of relative risk per 10 $\mu g/m^3$ increase in $PM_{2.5}$ annual average concentration.		

3 BASELINE ENVIRONMENT CHARACTERISATION

3.1 Existing Air Pollution Quality

The Western Cape Province and the City of Cape Town operate several ambient air quality monitoring stations in the region. The stations closest to the project site include:

- The Wallacedene Station, which is located in Kraaifontein, approximately 10 km south of the CWA;
- The Paarl Station, which is approximately 21 km east of the CWA; and
- The Stellenbosch Station, which is approximately 22 km to the southeast of the CWA.

The locations of these stations can be seen in Figure 3-1.

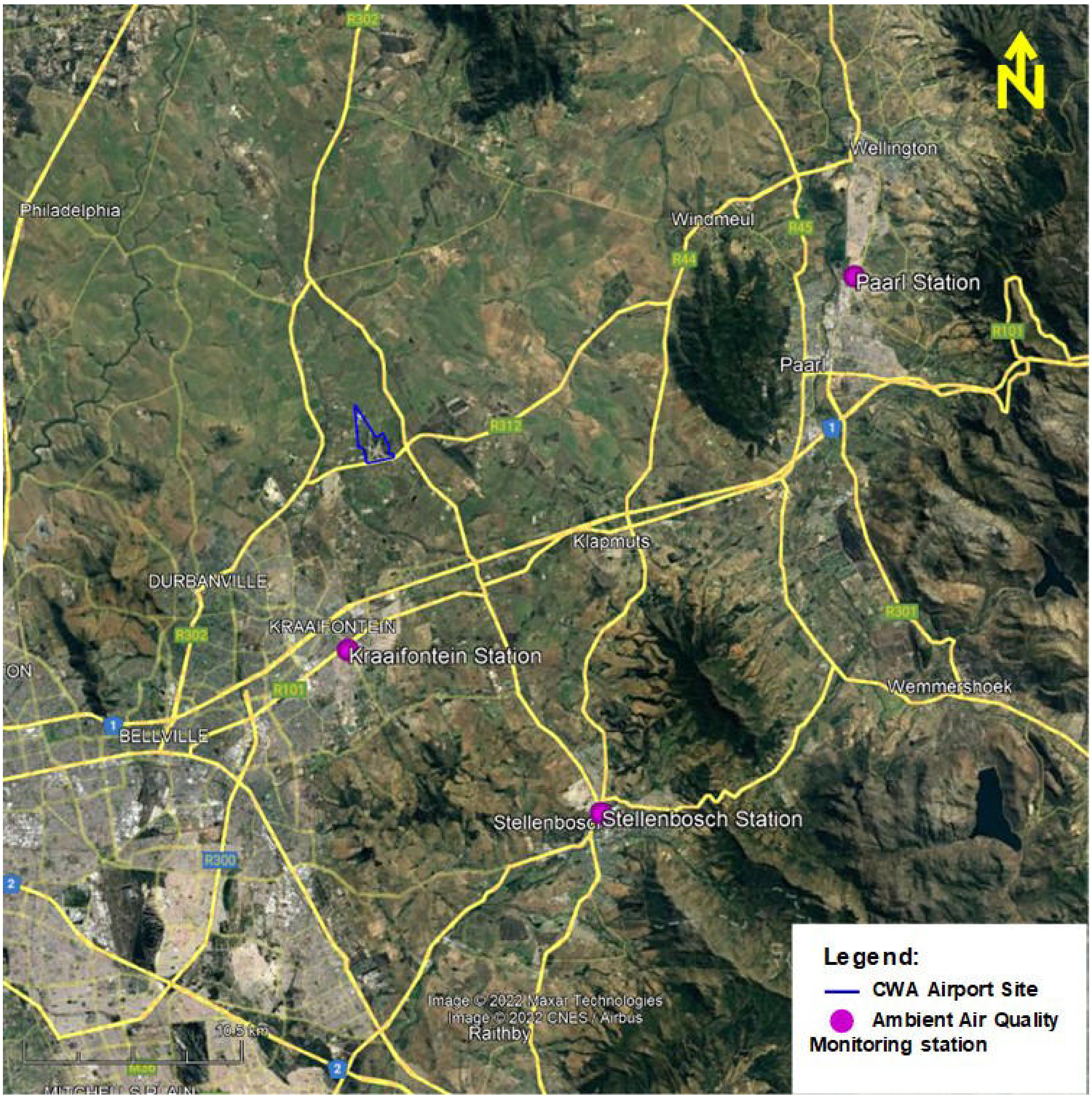


Figure 3-1. Air Quality Monitoring Stations

The available measured ambient concentrations from 2021 to 2023 from these stations were obtained. The measured ambient concentrations can be seen in Table 3-1 to Table 3-3 below.

As is evident, from Table 3-1, the measured average annual concentrations of SO_2, NO_2, O_3, $PM_{2.5}$ and PM_{10} were within their relevant ambient air quality standards, except for PM_{10} in 2022 at the Wallacedene Station. The overall data availability was approximately 33.6%. There is no data for NO_2, O_3 and $PM_{2.5}$ in 2021.

SO_2, NO_2, O_3, $PM_{2.5}$ and PM_{10} were also monitored at the Stellenbosch Station (see Table 3-2). The measured average annual concentrations were all within their relevant national ambient air quality standards. It can be observed from the available data that the measured concentrations of $PM_{2.5}$ and PM_{10} were lower when compared to those from Wallacedene station. The overall data availability was 52.4% for the three years.

The measured average annual concentrations of SO_2, NO_2, O_3 and CO at the Paarl Station can be seen in Table 3-3. $PM_{2.5}$ and PM_{10} were not monitored. The measured concentrations were below their respective standards. The overall data availability was 38.5%.

Table 3-1. Wallacedene Station Ambient Monitoring Data

	Ambient Concentration (µg/m³)				
	SO_2	**NO_2**	**O_3**	**$PM_{2.5}$**	**PM_{10}**
	2021				
Data Percent (%)	33.8	-	-	-	74.6
Annual Average	4.0	-	-	-	39.1
	2022				
Data Percent (%)	48.0	65.8	32.8	10.0	56.1
Annual Average	24.0	6.8	33.2	13	91.7
	2023				
Data Percent (%)	31.6	29.2	32.0	14.7	14.7
Annual Average	10.3	13.3	29.5	11	24.4
Standard	50 [a]	40 [a]	120 [b]	20 [a]	40 [a]

[a] Annual standard.
[b] 8-hour standard.

Table 3-2. Stellenbosch Station Ambient Monitoring Data

	Ambient Concentration (µg/m³)				
	SO_2	**NO_2**	**O_3**	**$PM_{2.5}$**	**PM_{10}**
	2021				
Data Percent (%)	64.8	57.2	40.8	59.7	44.7
Annual Average	37.0	13.2	38.7	7.9	8.2
	2022				
Data Percent (%)	89.4	73.9	82.2	49.4	49.6
Annual Average	15.8	6.3	32.9	4.8	13.1
	2023				

	Ambient Concentration (µg/m³)				
	SO_2	NO_2	O_3	$PM_{2.5}$	PM_{10}
Data Percent (%)	43.1	72.8	58.3	-	-
Annual Average	17.5	5.2	24.6	-	-
Standard	50 [a]	40 [a]	120 [b]	20 [a]	40 [a]

[a] Annual standard.
[b] 8-hour standard.

Table 3-3. Paarl Station Ambient Monitoring Data

	Ambient Concentration (µg/m³)			
	SO_2	NO_2	O_3	CO
	2021			
Data Percent (%)	53.9	55.4	-	7.8
Annual Average	37.7	7.4	-	280.8
	2022			
Data Percent (%)	80.1	80.1	-	-
Annual Average	24.6	10.9	-	-
	2023			
Data Percent (%)	9.1	97.2	78.8	-
Annual Average	38.6	13.2	1.9	-
Standard	50 [a]	40 [a]	120 [b]	30,000 [b]

[a] Annual standard.
[b] 8-hour standard.

3.2 Local Meteorology

Knowledge of the wind speed, wind direction, atmospheric turbulence, ambient temperature, as well as the height of the mixing layer are important inputs for dispersion modelling.

The airborne air pollutants are dispersed in the atmosphere in both the horizontal and vertical directions. The horizontal transport of the air pollutants is attained primarily by the wind field, in which the wind speed determines the rate of dilution, as well as the distance of downwind transport. The vertical transport is governed primarily by the atmospheric turbulence which is induced by boundary layer effects. During the day the atmospheric boundary layer is usually unstable as a result of the sun's heating effect on the earth's surface.

The thickness of the mixing height depends strongly on solar radiation, amongst other parameters. This mixing layer gradually increases in height from sunrise, to reach a maximum at about five to six hours after sunrise. Cloudy conditions, and surface and upper air temperatures also affect the final mixing height and its growth. During these conditions, dispersion plumes can be trapped in this layer and result in high ground-level concentrations. This dispersion process is known as Fumigation and is more pronounced during the winter months due to strong night-time inversions, weak wind conditions and slower-developing mixing layers.

Four-year (2020-2023) hourly meteorological data from the Cape Town International Airport weather station was used for the establishment of the local wind field as wind roses. All three years of hourly data were combined and analysed in one data pool for the establishment of the local wind field as wind roses. The wind roses were generated for all hours, daytime, night-time, as well as for the winter and summer periods and are illustrated in the figures below. These wind roses depict the frequency of the wind speeds for each of the 16 cardinal wind directions. The wind directions in the figures show where the wind blows. The wind classes are indicated by coloured bars, and the frequencies of occurrence for each wind direction are specified by the dashed circles (see Figure 3-2 and Figure 3-3).

Figure 3-2 shows the wind roses and wind speed frequency distributions of all hours, daytime and night-time. As can be seen, the predominant winds are from the southerly direction, for both daytime and night-time. Moderate winds dominate during the daytime, and light to moderate winds prevail at night-time. The average wind speeds are 6.37 m/s and 4.57 m/s for daytime and night-time respectively.

The wind roses and wind speed frequency distributions were also generated for the winter and summer periods and are shown in Figure 3-3. It can be seen that northerly and northerly and westerly winds predominate in winter. In summer, southerly winds are the most frequent. The wind speeds in summer are higher than those during winter. The averaged wind speeds are 6.37 m/s and 4.57 m/s for summer and winter respectively.

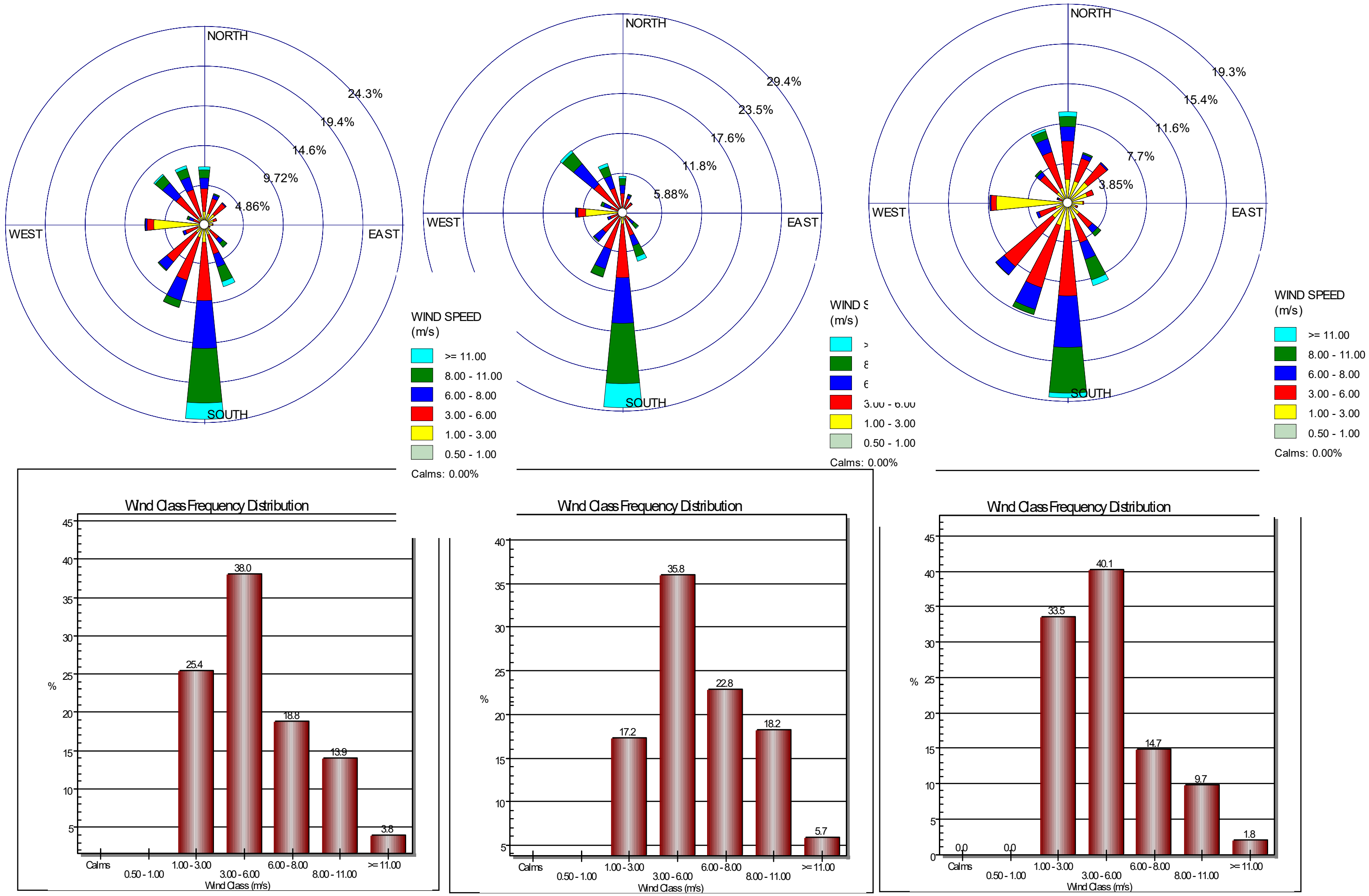


Figure 3-2. Wind Roses and Wind Speed Frequency Distribution for Combined Years 2020-2023: All-hours, Daytime and Night-time

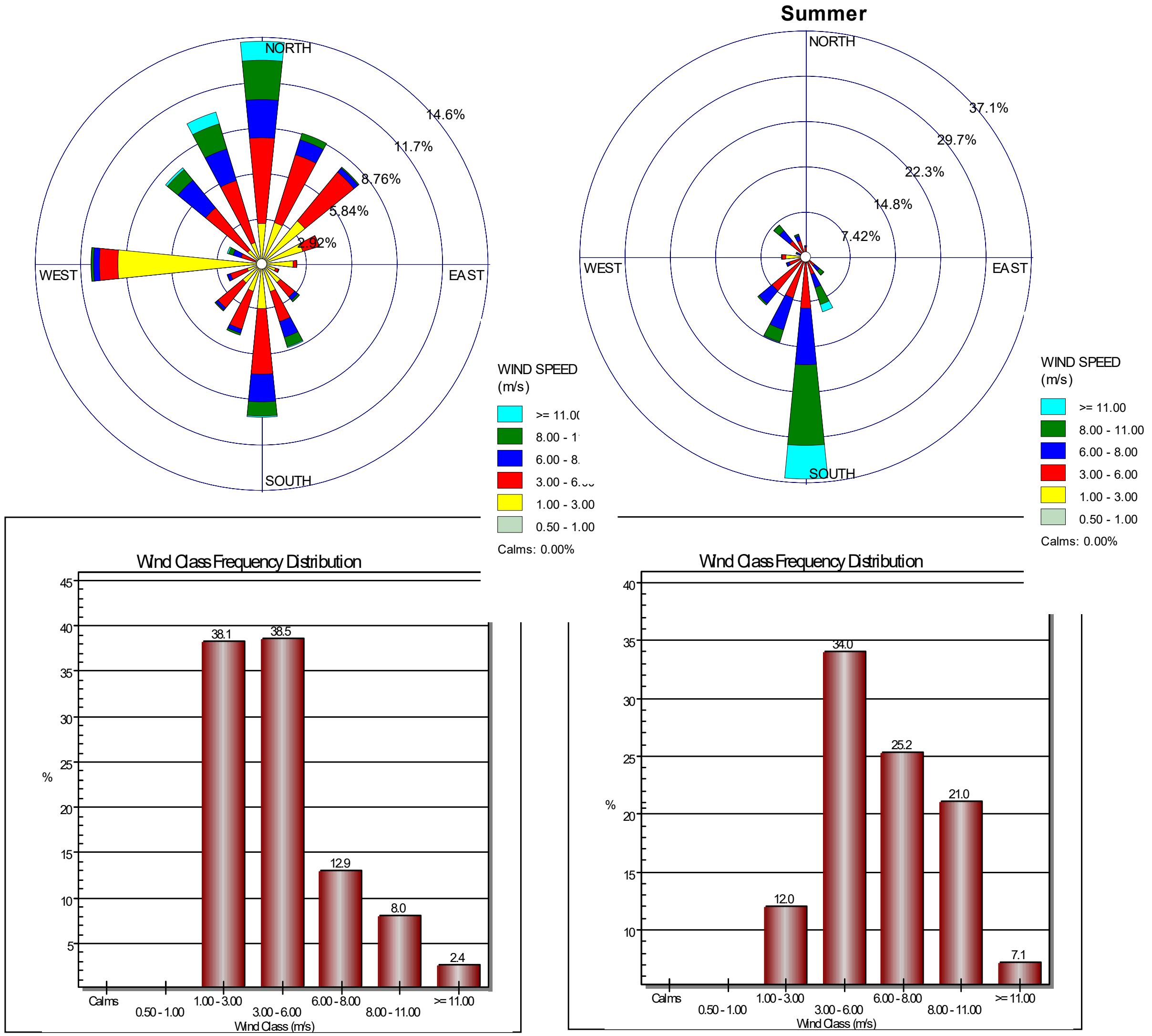


Figure 3-3. Wind Roses and Wind Speed Frequency Distribution for Combined Years 2020-2023: Winter and Summer

4 METHODOLOGY: EMISSIONS INVENTORY

An emissions inventory is the summary of the total air pollutants emitted and involves the identification of the most significant emission sources and the quantification of their emissions into the atmosphere. It forms the basis for air dispersion modelling and is the foundation of the air quality impact assessment study.

The air pollutants selected for inclusion into this emissions inventory were most of the primary pollutants, i.e. sulphur dioxide, nitrogen oxides, carbon monoxide, PM_{10}, as well as organic gases.

The following sections present the methodologies utilised for the compilation of the emissions inventory, in terms of the various emitters at the airport, as well as their emission factors. The activities included in the calculations were aircraft activities, ground support equipment and vehicular traffic.

4.1 Construction Phase

The construction phase of the project is anticipated to last for a period of 2 years. During this phase, the construction of the Runway 01-19 will take place, as well as the associated infrastructure and facilities. The working hours for the construction activities will be from 07h00 to 18h00.

The construction phase of the project will primarily include:

- Establishment of the construction camp and site preparation works;
- Initiation of main civil and electrical works;
- Decommissioning of the existing runways;
- Major civil and electrical works;
- Completion of all major civil works; and
- Commissioning of Runway 01-19.

Dust is a generic term used to describe fine particles that are suspended in the atmosphere. During construction, dust is formed when fine particles become entrained in the atmosphere by the turbulent action of wind or by the mechanical disturbance of fine materials. The potential for dust generation during construction activities is difficult to quantify and will be dependent on the type of activity to be undertaken, soil and substrata types, topographical features, precipitation, wind speed and direction, as well as the shape, size, density and moisture content of the particles.

Dust begins to fall out as soon as it is suspended in the air, depending on the size of the particulates and the wind velocity. Dust fallout is therefore used to describe the deposition of dust in the ambient environment. Although coarse dust is not regarded as a threat to health, as it is not readily inhaled into the lungs, it can create a nuisance by depositing on surfaces.

Dust is mainly generated in the following activities:

- Land clearing;
- Cut and fill operations;
- Loading and unloading of materials;
- Stock piling;
- Wind erosion of the open land and stockpiles;
- Road grading;

- Bulldozing; and
- Trucks movements

The typical large equipment that is generally utilised during such construction activities will be the main contributor to the dust generation. The anticipated list of the equipment to be utilised during the construction phase is shown below.

Table 4-1. Airport Construction Equipment

Item	Description	Quantity
1	Bulldozer	2
2	Grader	1
3	Compactor	1
4	Water Tanker	3
5	Excavator	2
6	Articulated Dump Truck	15
7	Pickup Truck	5
8	Truck	1

In addition to the above-mentioned equipment and vehicles, trucks with a capacity of 15 m^3 will be employed to transport the required fill materials to the site. It is estimated that approximately 58,167 truckloads will be required for approximately 875,000 m^3 of earthworks in total. Most of the earthworks will be contained on-site to balance cut and fill areas.

4.1.1 Dust Emissions

The construction phases will comprise a series of operations, including land clearing, cut and fill operations, materials loading and hauling, stockpiling, grading, bulldozing, compaction, etc. Each of these operations has its own specific duration and potential for dust generation. It is anticipated therefore that the extent of the dust emissions would vary substantially from day to day, depending on the level of activity, the specific operations and the prevailing meteorological conditions.

The dust emissions quantity is directly proportional to the land area on which the construction activities take place, as well as the intensity of the activities. It is expected that for the airport construction operations, most of the emissions will occur during the major earth works.

The magnitude of emissions, which may be generated from construction operations was estimated with the use of the USEPA emission factors for construction activity operations, which are based on field measurements of total suspended particulates (TSP). These emission factors are most applicable to construction operations with (i) medium activity levels, (ii) moderate silt contents, and (iii) semi-arid climates (USEPA 1995). The TSP emission factor considers 42 hours of work per week of construction activity and is given as:

$$E = 2.69 \text{ Mg/hectare/month} \qquad \textbf{Equation 4-1}$$

The PM_{10} fraction in the USEPA method is given as 35% of the total suspended particulate factor. From the above-mentioned equation, the unmitigated daily TSP emission per hectare (ha) is approximately 90 kg and for PM_{10} approximately 31.4 kg.

Since the unmitigated dust generation during construction may cause nuisance, dust suppression measures are recommended to be carried out to minimise the impact. The achievable dust control efficiency with wet suppression for materials handling and unpaved roads is 75%. The unpaved road emissions can be reduced further to approximately 90% with the use of dust suppression chemicals.

To estimate the mitigated dust emissions, an overall control efficiency of 75% was assumed. The estimated total project area is approximately 264 hectares. Assuming that the dust emissions will take place over the construction period of 24 months, the calculated monthly and annual TSP and PM_{10} emissions were calculated and are presented in Table 4-2.

Table 4-2. TSP and PM10 Mitigated Emissions During Construction

Pollutant	Emission Factor	Emission Factor With Mitigation	Emission (kg) [a]	
	(kg/ha/month)	(kg/ha/month)	Monthly	Annually
TSP	2690	672.5	7,398	88,770
PM10	941.5	235.4	2,589	31,070
a. Based on a construction area of 264 ha and a period of 24 months.				

4.2 Operational Phase

The latest AEDT model has been utilised for the establishment of the operational phase emissions inventory. AEDT employs a combination of various USEPA models and approved methodologies for calculating emissions from aircraft engines, auxiliary power units (APUs), ground support equipment (GSE), on-road vehicles and stationary sources. It consists of several external modules, i.e. aircraft performance module (APM), aircraft emissions module (AEM) and utilises the output of the USEPA Motor Vehicle Emission Simulator (MOVES) for the estimation of the emissions from the road network and the parking lots.

The APM and the AEM modules are used for the calculation of the emissions from aircraft-related operations, such as taxiing, take-off and landing. MOVES is a USEPA model, which is used to calculate motor vehicle emissions.

The pollutants quantified were CO_2, CO, THC, VOCs, NO_x, SO_x, PM_{10} and $PM_{2.5}$.

4.2.1 Aircraft Activity

Aircraft activity at the airport includes landside and airside operations. The air pollution assessment has taken into account all the stages of aircraft operations. This includes the following:

- aircraft approach and landing;
- taxiing to the airport terminal gates;
- start-up of the aircraft main engine, at the gates;
- taxiing out of the airport terminal gates to the runway queue;
- aircraft take-off; and

- aircraft climb-out[2].

The combination of these modes constitutes the Landing-Take-off (LTO) cycle. The aircraft activity emissions were based on these modes.

The time an aircraft spends in each of the take-off, climb-out, approach and idle modes of aircraft operation is called Time-in Mode (TIM). The take-off, climb-out, approach and landing roll portion of the idle mode TIMs are aircraft-specific. They are generated in the AEDT model, using flight profile data that are based on the airframe[3], engine, take-off weight, and approach angle to be flown.

Of the four modes (i.e. take-off, climb-out, approach and idle) the taxi and queue components of the idle mode are the most variable. The sum of these two values is airport operations specific. The idle time used for emission calculations includes the sum of the landing roll time, taxi time and the duration spent in the queue. The approach time in the mode for the emissions inventory is the time from the mixing height to the surface.

The take-off mode is the time from the start of the ground roll until the aircraft reaches 1,000 feet above the surface. The climb-out and time-in mode for the emissions inventory is the time from 300 m above the surface to the mixing height.

For this assessment, the aircraft performance module was used, which dynamically models the flight of the aircraft, based on a flight profile using the flight performance modelling in AEDT, which is primarily based on recommendations from three flight performance specifications:

- International Civil Aviation Organization (ICAO) Doc 9911 (Doc 9911)
- EUROCONTROL's User Manual for BADA Family 3 (BADA 3), and
- EUROCONTROL's BADA Family 4

The aircraft landing-take-off cycles used in this study were based on the arriving and departing aircraft. The forecast air traffic movements are shown in Table 4-3 below.

Table 4-3. CWA Forecast Air Traffic Movements

Air Traffic Movements	**Year**				
ONE-WAY (Arrivals or Departures)	**2029**	**2032**	**2038**	**2044**	**2050**
Domestic	3 200	5 050	7 450	9 475	11 150
International	2 375	3 850	4 925	6 000	6 900
Regional International	-	-	-	-	-
Total	**5 575**	**8 900**	**12 375**	**15 475**	**18 050**
Air Traffic Movements	**Year**				
TWO-WAY (Arrivals and Departures)	**2029**	**2032**	**2038**	**2044**	**2050**
Domestic	6 400	10 100	14 900	18 950	22 300
International	4 750	7 700	9 850	12 000	13 800
Regional International	-	-	-	-	-
Total	**11 150**	**17 800**	**24 750**	**30 950**	**36 100**

[2] Climb-out: the portion from engine cutback to the end of flight profile (or the mixing height, whichever is lower).

[3] Airframe: The airframe of an aircraft is its mechanical structure.

The actual source of aircraft emissions is the aircraft engines. The rate at which pollutants are emitted into the atmosphere during various modes of aircraft operation depends on the engine type utilised by each aircraft. AEDT includes a database of aircraft types and engine combinations. For each airframe, there may be several different engine types available for use. Wherever information was available by the airlines as to the main engine type utilised by a certain type of aircraft, this combination was selected. Otherwise, the default airframe-engine was used. The default engine represents an actual engine type, which is the most common or widely used engine for that particular airframe.

In each of the four modes, the engine operates at correspondingly different power settings. These determine the rate of fuel consumption which, in turn, determines the quantity and air pollution components emitted into the atmosphere. The equation below describes the emission quantities from an aircraft in a specific mode.

$$E_{ij} = \Sigma \left((TIM_{jk}) * (FF_{jk}/1000) * (EI_{ijk}) * (NE_j) \right) \qquad \textbf{Equation 4-2}$$

Where:

E_{ij} : total emission of pollutant i, in kilograms, produced by aircraft type j for one LTO cycle

TIM_{jk} : time-in mode for mode k, in minutes, for aircraft type j

FF_{jk} : fuel flow for mode k, in kilograms per minute, for each engine used on the aircraft type j

EI_{ijk} : emission index for pollutant i, in kilograms of pollutant per one thousand kilograms of fuel, in mode *k* for aircraft type j

NE_j : number of engines used on aircraft type j

i : pollutant (CO_2, CO, HC, NO_x, SO_2, PM_{10}, $PM_{2.5}$)

For the estimation of the SO_2 emissions, the sulphur content of 50 ppm was used for the aviation fuel (Jet A-1) in the AEDT model.

The emissions generated by the ground support vehicles, generators and auxiliary power units (APUs), whilst the aircraft is parked at the gate, were also estimated. The aircraft at the gate is met by ground support equipment (GSE) to upload baggage and food carts and to service the aircraft's cabin and lavatory. There are also generators in operation to provide electricity and air. When the aircraft departs from the gate, an aircraft tug is used to push the aircraft from the gate and tow it to the taxiway.

The emissions inventory of the aircraft support equipment was based on the different GSE types and service times necessary for each aircraft type. For example, large commercial aircraft would have longer fuel truck operation times than commuter aircraft.

GSE emission factors contained in the AEDT database were derived from the USEPA NONROAD2008a emission factors. The GSE air pollution emissions were based on the operation time per LTO cycle given in minutes. The calculation of the emissions generated per LTO cycle is the product of the emission factor of the equipment and the operation time, according to Equation 4-3.

The methodology for calculating the emissions from APUs in AEDT was adapted from the U.S. EPA's Procedures for Emission Inventory Preparation, Volume IV, Chapter 5. The APU emissions were calculated similarly, by assigning an operation time per LTO and emission factors in kilograms per hour of operation.

$$E_{tin} = OT_n * EF_{in}$$ **Equation 4-3**

Where:

E_{tin} : total emission of pollutant i, in kilograms, produced by equipment type n for one LTO cycle

OT_n : operational time in minutes per LTO cycle

EF_{in} : emission factor of pollutant i for equipment type n, in kilograms per minute of operation

i : pollutant (CO, HC, NO_x, SO_2, PM_{10}, $PM_{2.5}$)

Emissions of nitrogen oxides are normally estimated in terms of NOx, which consists of NO and NO_2. However, air quality is legislated in terms of NO_2 only. The USEPA recommends a three-tiered approach for the NO_2 assessment in dispersion modelling studies. In Tier 1, it is assumed that all emitted NO is converted to NO_2. In Tier 2, the results from Tier 1 are adjusted by the appropriate NO_2/NO ratio, which is representative of their equilibrium in the specific atmospheric and emission conditions. In the present study, Tier 1 was utilised, as a worst-case scenario.

The aircraft operations emissions are presented in Section 4.2.4 further below.

4.2.2 Vehicles

Two categories of vehicular traffic were considered in this study. The first consisted of all vehicles transporting people and supplies to and from the airport on the airport's road network. The second category comprised all vehicles in the airport's parking lots. Vehicle activities, such as movement on the roadways, in the parking lots, and idling at intersections and parking lots were some of the factors considered for the calculation of the vehicle emissions. Other variables used in these calculations included distance travelled, vehicle speed and total number of vehicles.

The numbers of vehicles on the various roads within and around the airport were obtained from the transport impact study (Innovative Transport Solutions, 2024). The cumulative emissions from the generated traffic due to the proposed development were also taken into consideration. Table 4-4 Shows the development trips in the year 2032.

Based on the existing traffic data, the expected annual growth rate of 3% and the traffic volumes generated due t the airport operations, the cumulative traffic flows were estimated and provided as peak morning and afternoon flows by the traffic engineers. The daytime and night-time hourly flows were thereafter calculated based on the estimated daily flow and the assumption that 90% of this will be distributed during the daytime and 10% during the night-time hours. The traffic flows utilised in the emissions calculations can be seen in Table 4-5.

For the parking lot emissions, based on the traffic study, it is projected that there will be a provision of 1,705 parking bays that are needed for Phase 1. This is estimated from the requirement of 682 bays per million annual passengers. For the CWA at full capacity the 3,500 bays were used.

The vehicles were then grouped in terms of light duty (passenger) vehicles (LDV) and heavy-duty vehicles (HDV) for the emission calculations. The light duty and heavy-duty vehicle percentages were also obtained from the traffic study for all the roads.

Since diesel and petrol cars have very different emission characteristics, i.e. diesel cars emit more NOx and much more PM than petrol cars, the vehicle emissions were estimated in terms of the fuel used. It was assumed that all HDV are diesel fuelled.

Table 4-4. 2032 Background Development Trips

Development	Phase / % Included	Weekday AM Peak Hour			Weekday PM Peak Hour		
		In	Out	Total	In	Out	Total
Glass Factory on Remainder Farm 180, Portion 3 of Farm 180 and Portion 13 of Farm 168	100%	44*	15*	58	15*	44*	58
Industrial development on Erf 1690	100%	214	71	285	71	241	285
Industrial development on Erven 1693 and 1870	100%	91	39	130	33	97	130
Storage Facility on Portion 32 of Farm 168	100%	57	57	115	52	52	105
Groot Phesantekraal Phase 4	Phase 4.1, 4.2 and 4.3	1 633	1 635	3 267	1 915	1 796	3 711
Groot Phesantekraal Phase 5	100%	289	236	525	682	678	1 360
Bella Riva	Phase 1	328	832	1 160	1 016	590	1 606
Greenville Garden City	Remaining Phase 1, 2 and 3	260	641	901	639	361	1 000
Total		**2 916**	**3 526**	**6 441**	**4 423**	**3 859**	**8 255**
* COTO 120, Heavy industry/manufacturing AM and PM Peak split considered							

For the calculation of the emissions, the average vehicle speeds for the internal roads, main roads and secondary streets were assumed to be 30, 60 and 40 km/hr respectively. The emission factors for the road traffic were calculated for all the roadways based on the vehicle speed, vehicle type and fuel used. The vehicle types, vehicle speeds and the relevant emission factors for each road are shown in Table 4-6 for the modelling Scenario 1 and 2.

Table 4-7 further below shows the same data and emission factors used for the roadways in the modelling of Scenarios 2 and 3.

Table 4-5. Traffic Number Utilised in the three Scenarios

Road Section	Scen 1 2029 Daytime Veh/hr	Scen. 2 2029 Daytime Veh/hr	Scen. 3 2050 Daytime Veh/hr	Scen 1 2029 Night-time Veh/hr	Scen. 2 2029 Night-time Veh/hr	Scen. 3 2050 Night-time Veh/hr	2029 Heavy Vehicles %	2050 Heavy Vehicles %
Melish Road (Secondary)	84	700	90	19	156	20	0.04	0.03
Airport Access Road	0	714	1795	0	14	36	0.04	0.03
Lucullus Road North Extension	28	28	141	6	6	31	0.04	0.03
Klipheuwel Road	612	641	840	136	143	187	0.075	0.045
Klipheuwel Road	753	750	2035	167	167	452	0.075	0.045
Klipheuwel Road	2044	2371	4545	454	527	1010	0.075	0.045
Lichtenburg Road	1507	1832	2795	335	407	621	0.075	0.045
Lichtenburg Road	784	1109	1680	174	246	373	0.075	0.045
Lichtenburg Road	857	1181	2099	190	263	466	0.075	0.045
Lichtenburg Road	941	1167	2075	209	259	461	0.075	0.045
Lichtenburg Road	930	1167	2075	207	259	461	0.075	0.045
Lichtenburg Road	414	473	804	92	105	179	0.075	0.045
Koelenhof Road	382	411	561	85	91	125	0.075	0.045
Koelenhof Road	855	1004	1431	190	223	318	0.075	0.045
Lucullus Road South Extension	364	364	955	81	81	212	0.075	0.045
Lucullus Road North Extension	0	0	1312	0	0	292	0.04	0.03
East West Class 3 Melish	95	128	1132	21	28	252	0.04	0.03
East West Class 3 Melish	197	230	1641	44	51	365	0.04	0.03

Table 4-6. Emission Factors for Roadways for Scenarios 1&2

			Emission Factor							
Road Section		**2029**	**CO**	**NMHC**	**VOC**	**TOG**	**NOx**	**SOx**	**PM_{10}**	**$PM_{2.5}$**
		HV								
	km/hr	**%**	**g/veh/km**							
Melish Road (Secondary)	60	0.040	2.0506	0.0785	0.0800	0.0845	0.0807	0.0047	0.0166	0.0079
Airport Access Road	30	0.040	2.0568	0.0712	0.0709	0.0750	0.0716	0.0041	0.0147	0.0070
Lucullus Road North Extension	40	0.040	2.0526	0.0712	0.0725	0.0767	0.0733	0.0042	0.0150	0.0072
Klipheuwel Road	60	0.075	2.0506	0.0785	0.0800	0.0845	0.0807	0.0047	0.0166	0.0079
Klipheuwel Road	60	0.075	2.0506	0.0785	0.0800	0.0845	0.0807	0.0047	0.0166	0.0079
Klipheuwel Road	60	0.075	2.0506	0.0785	0.0800	0.0845	0.0807	0.0047	0.0166	0.0079
Lichtenburg Road	60	0.075	2.0506	0.0785	0.0800	0.0845	0.0807	0.0047	0.0166	0.0079
Lichtenburg Road	60	0.075	2.0506	0.0785	0.0800	0.0845	0.0807	0.0047	0.0166	0.0079
Lichtenburg Road	60	0.075	2.0506	0.0785	0.0800	0.0845	0.0807	0.0047	0.0166	0.0079
Lichtenburg Road	60	0.075	2.0506	0.0785	0.0800	0.0845	0.0807	0.0047	0.0166	0.0079
Lichtenburg Road	60	0.075	2.0506	0.0785	0.0800	0.0845	0.0807	0.0047	0.0166	0.0079
Lichtenburg Road	60	0.075	2.0506	0.0785	0.0800	0.0845	0.0807	0.0047	0.0166	0.0079
Koelenhof Road	60	0.075	2.0506	0.0785	0.0800	0.0845	0.0807	0.0047	0.0166	0.0079
Koelenhof Road	60	0.075	2.0506	0.0785	0.0800	0.0845	0.0807	0.0047	0.0166	0.0079
Lucullus Road South Extension	40	0.075	2.0526	0.0712	0.0725	0.0767	0.0733	0.0042	0.0150	0.0072
Lucullus Road North Extension	40	0.040	2.0526	0.0712	0.0725	0.0767	0.0733	0.0042	0.0150	0.0072
East West Class 3 Melish	40	0.040	2.0526	0.0712	0.0725	0.0767	0.0733	0.0042	0.0150	0.0072
East West Class 3 Melish	40	0.040	2.0526	0.0712	0.0725	0.0767	0.0733	0.0042	0.0150	0.0072

Table 4-7. Emission Factors for Roadways for Scenarios 3

			Emission Factor							
Road Section		**2050**	**CO**	**NMHC**	**VOC**	**TOG**	**NOx**	**SOx**	**PM_{10}**	**$PM_{2.5}$**
		HV								
	km/hr	**%**	**g/veh/km**							
Melish Road (Secondary)	60	0.030	1.8106	0.0923	0.0942	0.0994	0.1143	0.0050	0.0177	0.0088
Airport Access Road	30	0.030	1.8161	0.0837	0.0836	0.0882	0.1014	0.0044	0.0157	0.0078
Lucullus Road North Extension	40	0.030	2.2094	0.0436	0.0443	0.0474	0.0505	0.0032	0.0146	0.0068
Klipheuwel Road	60	0.045	1.8106	0.0923	0.0942	0.0994	0.1143	0.0050	0.0177	0.0088
Klipheuwel Road	60	0.045	1.8106	0.0923	0.0942	0.0994	0.1143	0.0050	0.0177	0.0088
Klipheuwel Road	60	0.045	1.8106	0.0923	0.0942	0.0994	0.1143	0.0050	0.0177	0.0088
Lichtenburg Road	60	0.045	1.8106	0.0923	0.0942	0.0994	0.1143	0.0050	0.0177	0.0088
Lichtenburg Road	60	0.045	1.8106	0.0923	0.0942	0.0994	0.1143	0.0050	0.0177	0.0088
Lichtenburg Road	60	0.045	1.8106	0.0923	0.0942	0.0994	0.1143	0.0050	0.0177	0.0088
Lichtenburg Road	60	0.045	1.8106	0.0923	0.0942	0.0994	0.1143	0.0050	0.0177	0.0088
Lichtenburg Road	60	0.045	1.8106	0.0923	0.0942	0.0994	0.1143	0.0050	0.0177	0.0088
Lichtenburg Road	60	0.045	1.8106	0.0923	0.0942	0.0994	0.1143	0.0050	0.0177	0.0088
Koelenhof Road	60	0.045	1.8106	0.0923	0.0942	0.0994	0.1143	0.0050	0.0177	0.0088
Koelenhof Road	60	0.045	1.8106	0.0923	0.0942	0.0994	0.1143	0.0050	0.0177	0.0088
Lucullus Road South Extension	40	0.045	2.2094	0.0436	0.0443	0.0474	0.0505	0.0032	0.0146	0.0068
Lucullus Road North Extension	40	0.030	2.2094	0.0436	0.0443	0.0474	0.0505	0.0032	0.0146	0.0068
East West Class 3 Melish	40	0.030	2.2094	0.0436	0.0443	0.0474	0.0505	0.0032	0.0146	0.0068
East West Class 3 Melish	40	0.030	2.2094	0.0436	0.0443	0.0474	0.0505	0.0032	0.0146	0.0068

Stationary Sources

The stationary sources at the CWA include the following:

- **Diesel generator plant:**

  The diesel generator plant is one of the two backup supply options. It will only be utilised when the Eskom supply and the battery storage are both not available. The potential emissions from this plant will be of low significance.

- **Bio-digester plant:**

  The Bio-digester plant is designed to provide 1MW of continuous power. The potential emissions from the combustion of biogas were calculated using the US EPA AP42 emission factors for stationary internal combustion sources, section 3.1. Stationary Gas Turbines.

  The emission factors used and the emission calculated based on the capacity of 1MW can be found in Table 4-8 below. As can be seen, the hourly emissions calculated were very low.

Table 4-8. Bio-digester Plant Emissions

Pollutant	Emission Factor (lb/Mmbtu)	Emission Rate (kg/hour)
NOx	0.16	0.0212
CO	0.017	0.0023
PM_{10}	0.023	0.0031
SO_2	0.045	0.0060
VOC	0.013	0.0017

- **Fuel Storage Tanks:**

The total required storage capacity is 2,000 m^3 and consists of the following tanks:

- Jet-A1: 10x 80 m^3 horizontal tanks, and 3x 350 m^3 vertical storage tanks
- Avgas: 2x 30 m^3 and 1x 9 m^3 double-walled (FireGuard or similar) horizontal tanks

For the Jet A1 fuel tanks, six 80 m^3 horizontal tanks are to be installed in 2028, another 4x 80 m^3 by 2032, and then construct and commission the three vertical tanks by 2038.

It has been estimated that the fuel demand (Jet-A1) in the CWA's opening year would be approximately 27 million litres (2029), which would gradually increase over the following years, more than doubling to 57 million litres in 9 years (2038) and increasing to approximately 86 million litres over the next 12 years (2050).

Due to the low vapour pressure of the Jet-A1 fuel, the potential emissions from the storage tanks will be low and are considered insignificant. As such, due to the expected very low emissions from the above-mentioned sources, they were not included in the dispersion modelling calculations.

4.2.3 Air Pollution Sources Operational Profiles

To distribute the emissions from each source group more accurately over time, operational profiles for each month of the year, day of the week and quarter-hour of the day were utilised. The profiles are used to more accurately gauge the emission rates, and thus to more accurately model the resulting concentrations in dispersion.

Each time period in a profile is assigned a value from 0 to 1, representing the fraction of the maximum activity occurrence. Zero means no activity and 1 means that the peak of activity is reached.

For the aircraft, the operational profiles were created from the hourly arrival and departure busy days provided for each scenario.

The detailed operational profiles utilised for the calculation of the emissions inventory and dispersion modelling can be found in APPENDIX A.

4.2.4 Emission Quantities

Based on the methodology outlined in the previous sections, the resulting emissions from all the on-site operational activities were calculated. The composite air pollution emissions for each of the scenarios are shown in the following sections. It should be noted that in the AEDT model, the CO_2 is calculated only for aircraft, and the THC is calculated for aircraft, APUs and the fuel tanks.

This section presents the results of the combined emissions from all the on-site operational activities, including the general traffic on the main roads around the airport for all scenarios.

The composite air pollution emissions for the current runways at full capacity are shown in Table 4-9.

The main contributors to the total of 523 tons of CO are vehicular traffic on the roadways (53%). Aircraft and GSE account for 16% and 24% of the emissions respectively.

Most of the VOCs are emitted by aircraft and vehicular traffic on the main roads around and within the airport site, accounting for 49% and 14% respectively.

Of the emitted 249 tons/year (t/y) of NOx, approximately 88% is attributed to aircraft, 5% to vehicles and 7.5% to GSE and APUs.

Most of the SOx, approximately 97% of the total, is emitted by aircraft. Roadway traffic accounts for 4%.

PM_{10} and $PM_{2.5}$ are emitted mainly by vehicular traffic and aircraft.

Table 4-9. Emissions of Current Runways at Capacity (Scenario 1: No-Go Alternative)

Category	Emissions (tonne/yr)							
	CO_2	CO	THC	VOC	NOx	SOx	PM_{10}	$PM_{2.5}$
Aircraft	37,518	85.1	13.3	15.1	249.4	69.7	3.2	3.2
GSE	-	128.5	-	4.4	13.9	0.4	0.5	0.5
APUs	-	9.8	0.7	0.8	7.1	1.1	1.2	1.2
Parking Facilities	-	3.9	-	0.5	0.3	0.002	0.009	0.005
Roadways (airport)	-	19.4	-	0.9	0.84	0.04	0.16	0.08
Stationary Sources	-	-	0.6	0.7	-	-	-	-
Sub-Total	37,518	246.8	14.6	22.3	271.6	71.2	5.0	4.9
Roadways (general)	-	279.4	-	8.4	8.7	0.3	2.0	0.9
Grand Total	37,518	526	15	31	280	71	7	6

As can be seen from Table 4-11, due to the very few operations during the starting year of the new runway, the emissions are expected to be very low. For this reason,1 the dispersion m1odelling contour results were not included in the report. The resulting cumulative concentrations at the identified discrete receptors are included in the sections below.

Table 5-1 further below shows the emissions due to the new airport operation at full capacity. The aircraft is the main contributor to VOCs, SOx and NOx and vehicular traffic for CO.

Table 4-10. Emissions of New Runway at Operating Year (Scenario 2)

Category	Emissions (tonne/yr)							
	CO_2	CO	THC	VOC	NOx	SOx	PM_{10}	$PM_{2.5}$
Aircraft	5,422	12.3	1.9	2.2	36.0	10.1	0.5	0.5
GSE	-	11	-	0.38	1.20	0.03	0.04	0.07
APUs	-	0.284	0.019	0.022	0.206	0.032	0.033	0.284
Parking Facilities	-	0.19	-	0.02	0.02	0.00	0.00	0.19
Roadways (airport)	-	1.40	-	0.06	0.06	0.00	0.01	0
Stationary Sources	-	-	0.094	0.105	-	-	-	-
Sub-Total	5,422	25.3	2.0	2.8	37.5	10.1	0.6	0.7
Roadways (general)	-	20.2	-	0.6	0.6	0.0	0.1	0.1
Grand Total	5,422	46	2.0	3.4	38	10	0.7	0.8

Table 4-11. Emissions of New Runway at Full Capacity (Scenario 3)

Category	Emissions (tonne/yr)							
	CO_2	CO	THC	VOC	NOx	SOx	PM_{10}	$PM_{2.5}$
Aircraft	37,518	85.1	13.3	15.1	249.4	69.7	3.2	3.2
GSE	-	128.5	0.0	4.4	13.9	0.4	0.5	0.5
APUs	-	9.8	0.7	0.8	7.1	1.1	1.2	1.2
Parking Facilities	-	3.9	-	0.5	0.3	0.002	0.009	0.005
Roadways (airport)	-	19.4	-	0.9	0.84	0.04	0.16	0.08
Stationary Sources	-	-	0.6	0.7	-	-	-	-
Sub-Total	37,518	246.8	14.6	22.3	271.6	71.2	5.0	4.9
Roadways (general)	-	279.4	-	8.4	8.7	0.3	2.0	0.9
Grand Total	37,518	526	15	31	280	71	7	6

5 DISPERSION SIMULATION

The hourly meteorological parameters, the source configuration and emission quantities from all the sources included in the emissions inventory were used as input for the dispersion modelling. The latest AEDT model has been used to estimate the contribution of the sources of pollution to the ambient pollutant concentrations.

5.1 The AEDT Model

The AEDT model is a software system that models aircraft performance in space and time to estimate noise, fuel consumption, emissions and air quality impacts. AEDT is designed to process individual studies, ranging in scope from a single flight at an airport, to scenarios at the regional, national, and global levels.

AEDT is actively used by the U.S. government for regulatory studies, research and domestic aviation system planning, as well as domestic and international aviation environmental policy analysis.

AEDT uses the EPA's atmospheric dispersion modelling system, the American Meteorological Society (AMS)/EPA Regulatory Model (AERMOD), to estimate air quality impacts of airport-related emissions. AEDT submits input and receives output from AERMOD and can create pollutant concentration maps near an airport.

AEDT outputs include reports, graphs and tables that summarize the flight performance, fuel burn, emissions inventories, noise results, contours and emission dispersion results. The AEDT model architecture can be seen in Figure 5-1 below.

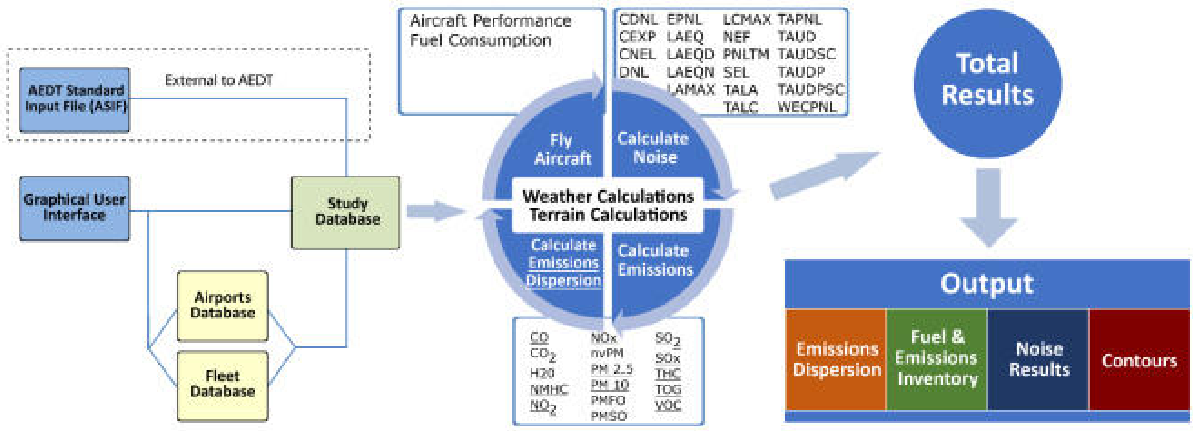


Figure 5-1. AEDT System Architecture

The AERMOD model is a straight-line, steady-state Gaussian plume equation, which is used with some modifications, in order to model point source emissions from stacks, isolated and multiple vents, liquid tanks, waste sites, storage piles, conveyor belts, etc. Emission sources are categorised into four basic types, i.e. point sources, volume sources, area sources and open pit sources.

AERMOD is itself a modelling system with three separate components: AERMIC (AERMOD Dispersion Model), AERMAP (AERMOD Terrain Preprocessor), and AERMET (AERMOD Meteorological Preprocessor). In the present study, only the two components of AERMOD and AERMET were used, since the terrain of the study area is flat.

There are two basic types of input needed to run the AERMOD model. Firstly, the emissions input set-up file and secondly the meteorological data file. The emissions input set-up file contains the selected modelling options, as well as source location and parameter data, receptor locations, meteorological data file specifications and output options. The meteorological data file contains all the hourly meteorological parameters used for the dispersion modelling, such as wind direction, wind speed, temperature, atmospheric stability and mixing height.

5.2 Model Setup and Data Input

At the top level, the global parameters for AEDT were specified, such as location, elevation and area characteristics. All the emission sources to be included in this study were spatially allocated, and several sources such as roads, parking lots, aircraft taxi-ways, etc. were divided into smaller segments, to capture their exact shapes. In this way, a more accurate emission allocation was achieved for the entire CWA. The AEDT system further segments the sources, to capture the spatial allocation of the aircraft approach and departure paths. A total of 1,005 sources were used in the AERMOD dispersion model, to simulate all the emissions from the airport area.

In order to have a more accurate estimation of the resulting hourly air pollution concentrations, the annual emissions from each type of source were apportioned to hourly emissions by using the emission profiles. This apportionment of the annual emissions was based on monthly (January to December), weekly (Monday to Friday) and hourly (1 to 24) profiles. These profiles, which are described in the emissions inventory section, were introduced in AEDT as a percentage of the peak emission occurring in a certain month, weekday or hour of the day. It should be noted that for the aircraft the actual distribution of the busy day for each scenario was used.

With the above-mentioned method, the hourly emissions for all 1,005 sources in AEDT generate enormous input files. This is because hourly emissions need to be generated for each source for as many pollutants examined and as many years considered, according to the meteorological input files, i.e. 2020 to 2023. These emission files were in the order of 2.1GB for each pollutant. The hourly emission files for all the airport sources were generated for each pollutant, and each of these four years and were introduced into AERMOD for the dispersion modelling.

In addition to the emissions, the AERMOD model requires hourly meteorological data as input. Four years (2020-2023) of hourly meteorological data for the study area, obtained by the SAWS, was utilised. All four years of data was combined and analysed in one data pool to determine the resulting worst-case concentrations from all the potential atmospheric condition combinations and their related dispersion characteristics in the area.

The hourly emission files and the meteorological data were introduced into AERMOD for the dispersion modelling, so to predict the spatial and temporal dispersion patterns of the pollutants and obtain the maximum ground-level concentrations.

The dispersion modelling was conducted with a rectangular receptor grid, covering 12 km x 12 km with the airport at the centre. The resulting maximum ground-level concentrations for each receptor were used to generate the concentration isopleths for each pollutant and time scenario. These results are presented in the following sections.

In addition to the original receptor grid utilised for the generation of the concentration isopleths, additional receptors were placed in the immediate vicinity around the airport area at several sensitive receptors, such as residential areas, schools and clinics. The locations of these receptors are shown in Figure 5-2 and are described in Table 5-1.

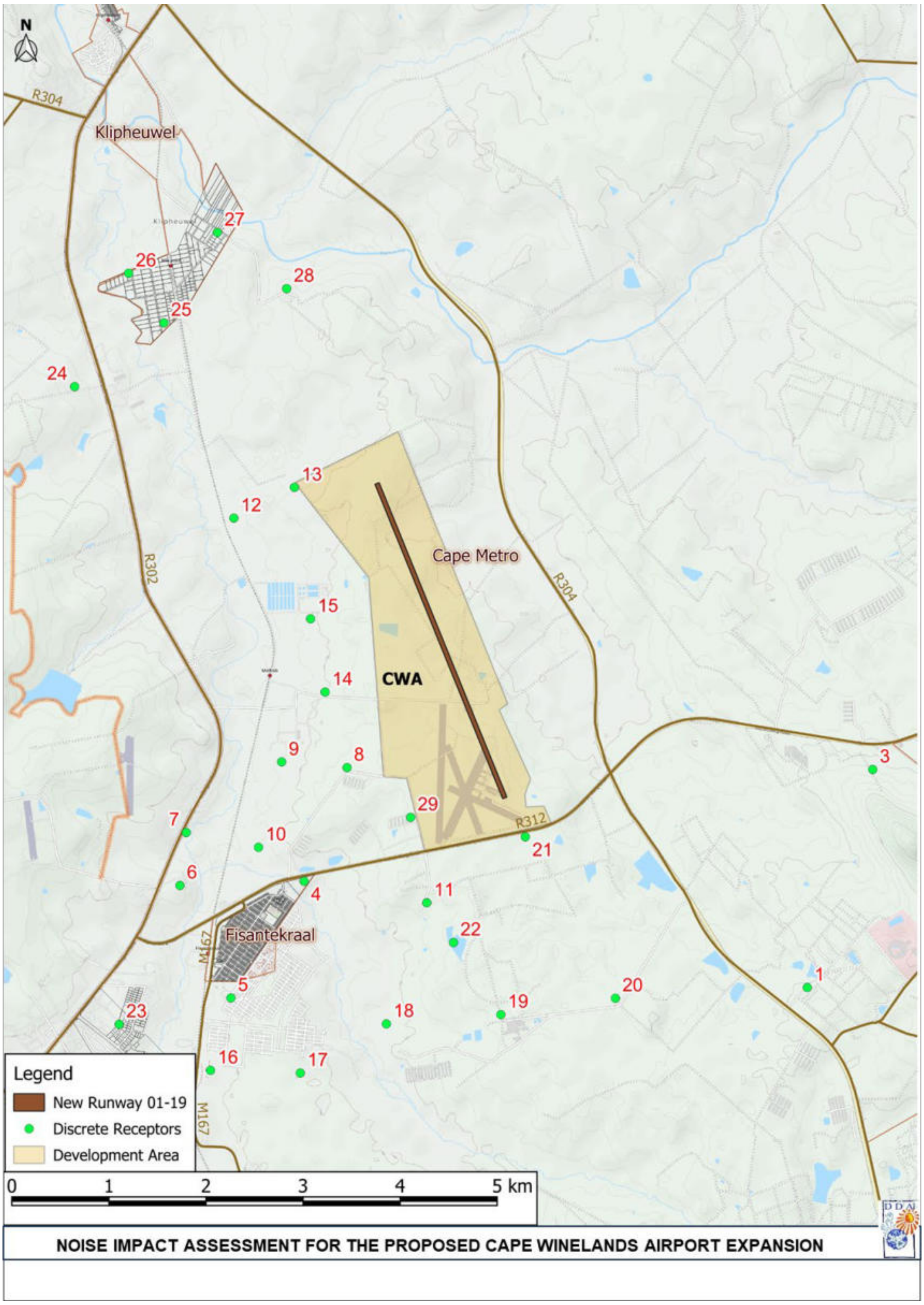


Figure 5-2. Location of Discrete Receptors in the Study Area

Table 5-1. Dispersion Modelling Discrete Receptor Positions

Receptor	**UTM X (m)**	**UTM Y (m)**	**Description**
R01	294286.1	6258993	Farmhouse, ~3.3 km southeast of CWA
R02	295746.5	6260229	Farmhouse, ~4.0 km southeast of CWA
R03	294917.2	6261250	Farmhouse, ~3.5 km east of CWA
R04	289082	6259985	Fisantekraal High School, ~1.3 km west of CWA
R05	288351.5	6258769	Fisantekraal residence, ~2.6 km southwest of CWA
R06	287803.7	6259918	Farmhouse, ~2.6 km west of CWA
R07	287857.1	6260464	Farmhouse, ~2.4 km west of CWA
R08	289501	6261165	Bella Riva Development, ~400 m west of CWA
R09	288826.5	6261211	Bella Riva Development, ~1.1 km west of CWA
R10	288605.1	6260326	Bella Riva Development, ~1.7 km west of CWA
R11	290350.3	6259789	Farmhouse, ~600 m east of CWA
R12	288285.7	6263713	Bella Riva Development, ~1.6 km northwest of CWA
R13	288902.9	6264040	Bella Riva Development, ~1.3 km west of CWA
R14	289259.8	6261938	Bella Riva Development, ~500 m west of CWA
R15	289095.8	6262690	Bella Riva Development, ~600 m west of CWA
R16	288155.4	6258019	Greenville Garden City Development, ~3.2 km south of CWA
R17	289081	6258009	Greenville Garden City Development, ~2.7 km south of CWA
R18	289957.3	6258533	Greenville Garden City Development, ~1.9 km south of CWA
R19	291135	6258652	Greenville Garden City Development, ~1.8 km south of CWA
R20	292312.6	6258842	Greenville Garden City Development, ~2.0 km south of CWA
R21	291352.1	6260487	Greenville Garden City Development south of CWA
R22	290632.9	6259385	Greenville Garden City Development, ~1 km south of CWA
R23	287204.7	6258475	Darwin Industrial Park in Durbanville, ~3.7 km southwest of CWA
R24	286618.7	6265034	Farmhouse, ~3.7 km northwest of CWA
R25	287525	6265710	Klipheuwel Equitots School, ~3.5 km northwest of CWA
R26	287152.9	6266213	Klipheuwel residence, ~4.0 km northwest of CWA
R27	288058.1	6266651	Klipheuwel Primary School, ~4.0 km northwest of CWA
R28	288794	6266075	Farmhouse, east of Klipheuwel, ~3.2 km northwest of CWA
R29	290146	6260657	Chicken Farm, west of CWA

5.3 Dispersion Simulation Results

Using the methodology described in the previous sections, the 1-hr, 24-hr and annual ground-level concentrations were generated for the criteria air pollutants, i.e. pollutants with guidelines. These represent the resulting concentrations from all the sources in the airport area for each of the emission scenarios below:

Scenario 1: Existing runways at full capacity (No-Go Alternative);

Scenario 2: New runway during its operational year; and

Scenario 3: New runway at full capacity.

The modelling results are presented as concentration isopleth plots. These isopleths represent the maximum ground-level concentrations predicted via the dispersion modelling over the four years of hourly meteorological and emissions data.

5.3.1 Scenario 1

5.3.1.1 CO

Figure 5-3 shows the maximum 1-hr concentration isopleths of CO, resulting from the airport operations for the existing runways at full capacity.

These maxima represent the highest estimated concentrations that result from all four years of hourly emissions and meteorological condition combinations, thus representing the worst-case concentrations that may be expected around the airport.

From these maximum 1-hr CO concentrations, it can be seen that there were no exceedances of the 30,000 µg/m^3 CO guideline.

5.3.1.2 NO_2

The maximum 1-hr ground level NO_2 concentrations are depicted in Figure 5-4. The 1-hr guideline value of 200 µg/m^3 was only exceeded within a very small area immediately south of the runways. However, the frequency of exceedance was well below the guideline of 88 times per annum.

The maximum annual NO_2 concentrations were below the guideline of 40 µg/m^3 within the airport site boundaries and well below the guideline in all of the communities around the airport (see Figure 5-5).

5.3.1.3 SO_2

The SO_2 concentrations are shown in Figure 5-6 and Figure 5-7. The maximum 1-hr concentrations did not reach the guideline level of 350 µg/m^3 in any of the areas within or outside the airport site.

The annual maximum concentrations of SO_2 were well within the guideline of 50 µg/m^3 within the site, as well as outside its boundaries.

5.3.1.4 PM_{10}

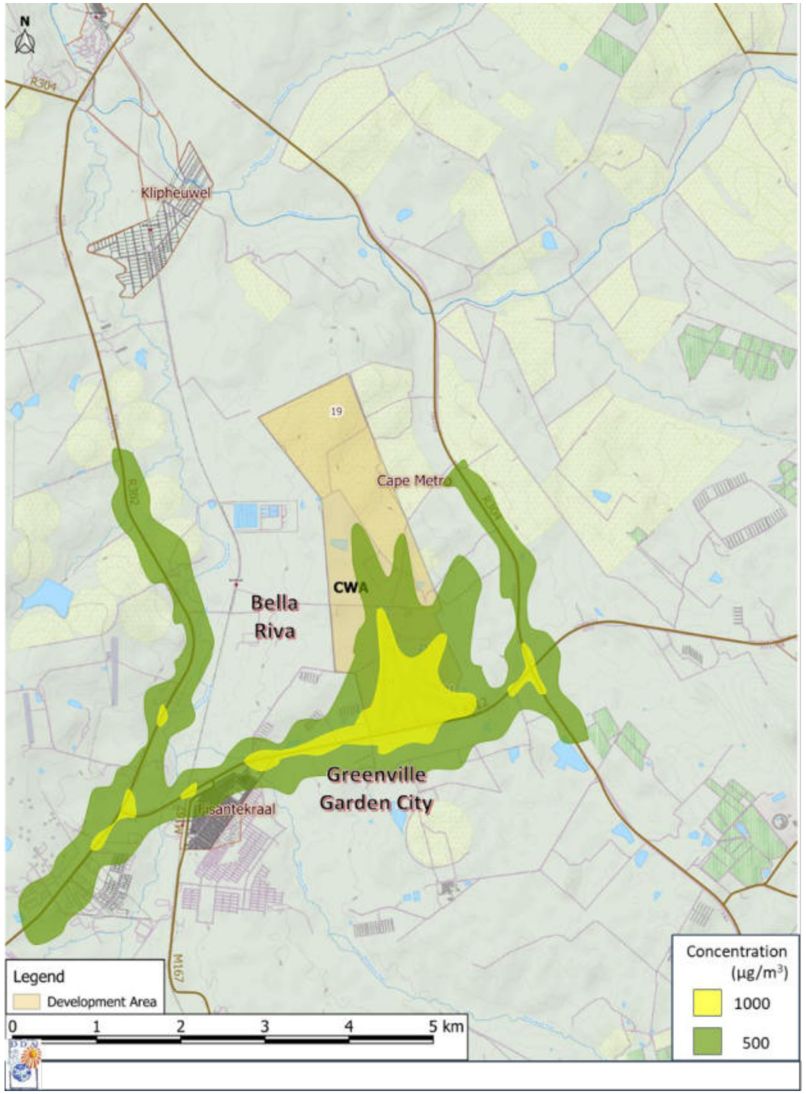
The 1-hr PM_{10} ground-level maximum concentrations are shown in Figure 5-8. It is clear that the maximum concentrations for both averaging periods were well within their respective guidelines.

5.3.1.5 $PM_{2.5}$

The maximum 1-hr $PM_{2.5}$ ground-level concentrations are shown in Figure 5-9 below. Similarly to the PM_{10}, it can be seen that they were well within their 1-hr and annual guideline of 60 µg/m^3.

5.3.1.6 Modelled Concentrations at Sensitive Receptors

As indicated in Section 5.2, additional discrete receptors were placed within the residential areas around the airport. Table 5-1 below shows the modelled concentrations at these receptors for the existing situation, i.e. Scenario 1. From this table, it can be seen that for all of the selected receptor locations, the maximum concentrations of all pollutants and time averages are below their respective guidelines.



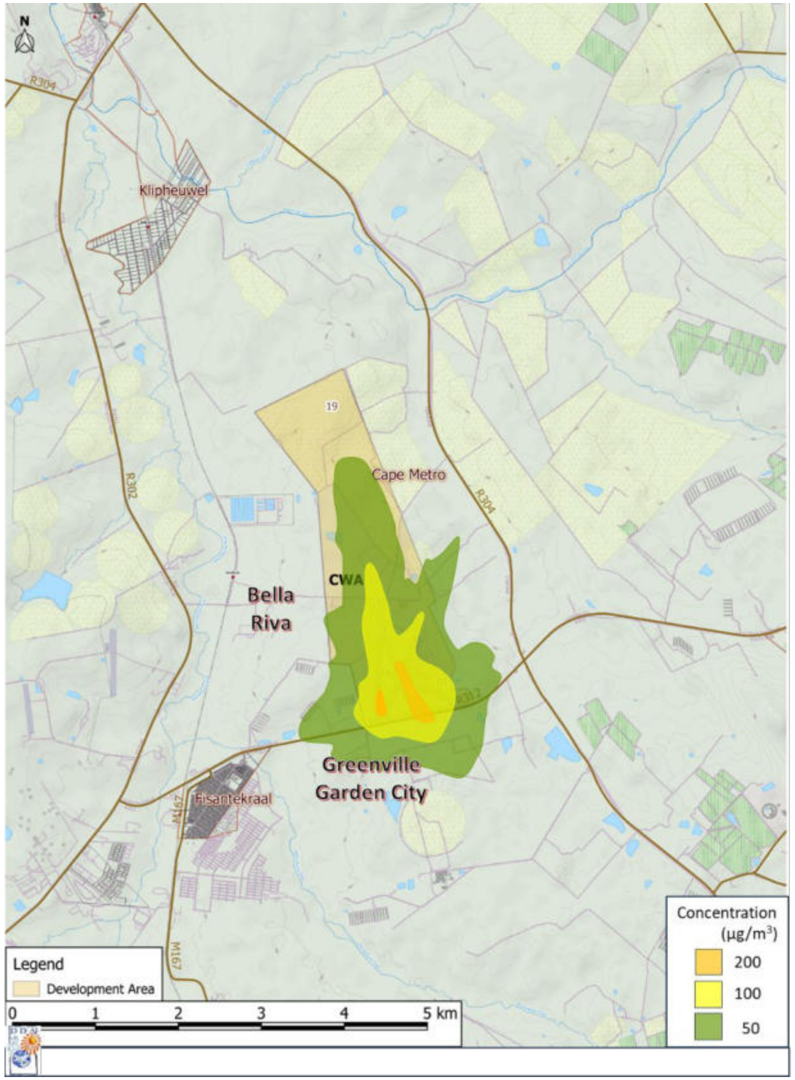


Figure 5-4. Scenario 1: NO_2 1-hr Maximum Concentrations (Guideline value: 200 µg/m³)

Figure 5-3. Scenario 1: CO 1-hr Maximum Concentrations (Guideline 30,000 µg/m^3)

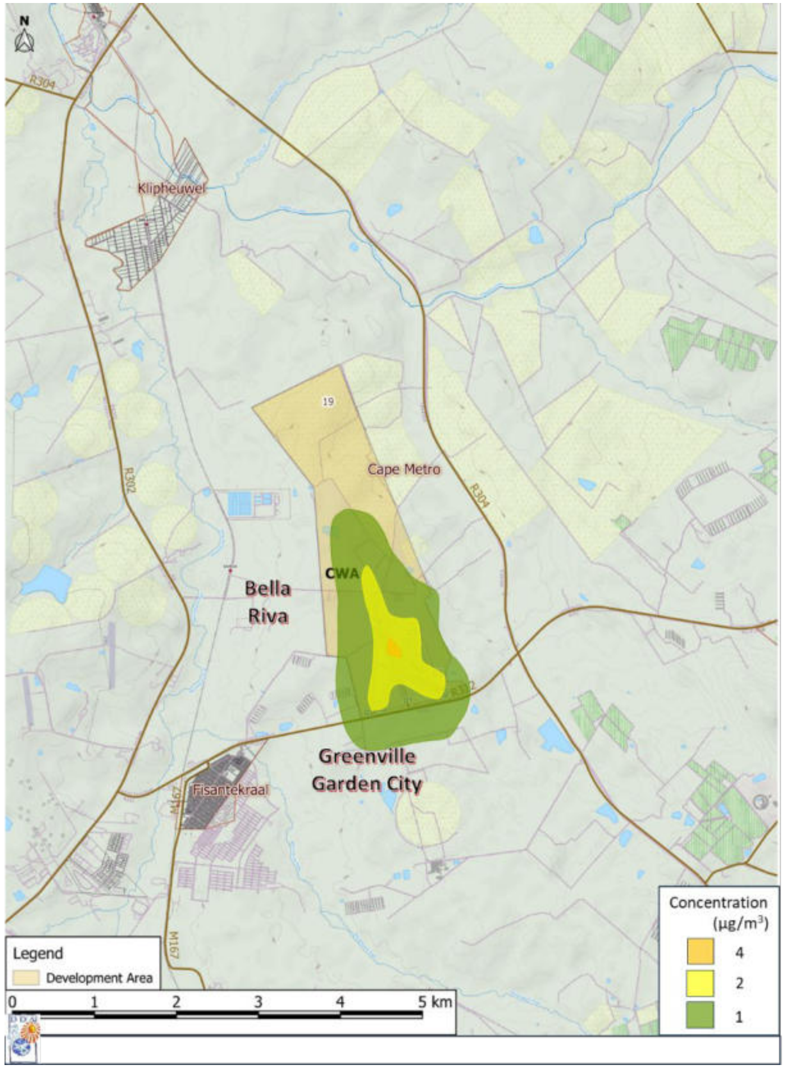


Figure 5-5. Scenario 1: NO_2 Maximum Annual Concentrations (Guideline: 40 µg/m³)

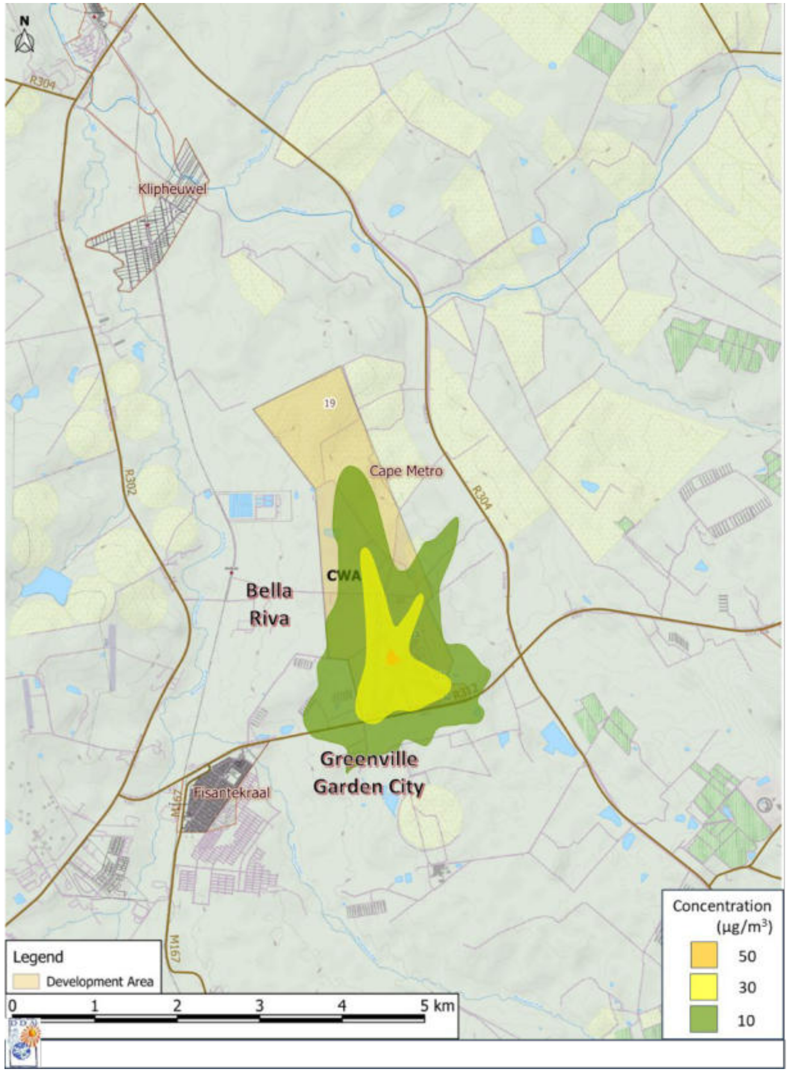


Figure 5-6. Scenario 1: SO_2 1-hr Maximum Concentrations (Guideline value: 350 µg/m³)

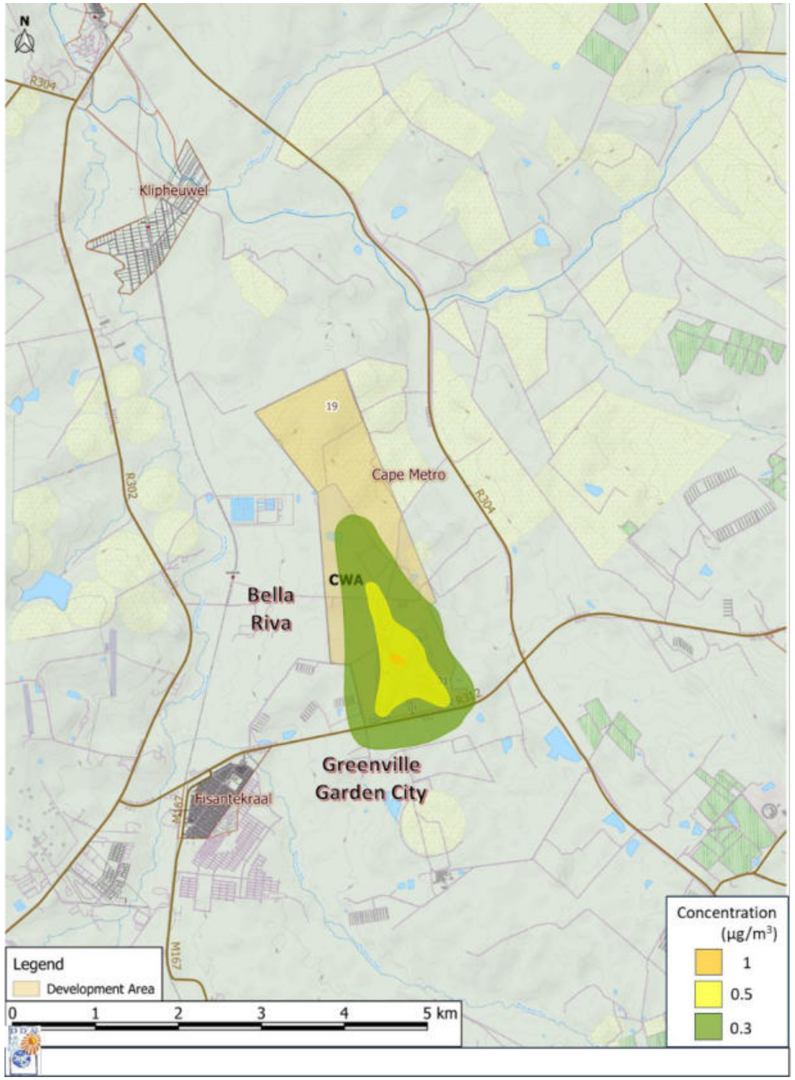


Figure 5-7. Scenario 1: SO_2 Maximum Annual Concentrations (Guideline: 50 µg/m³)

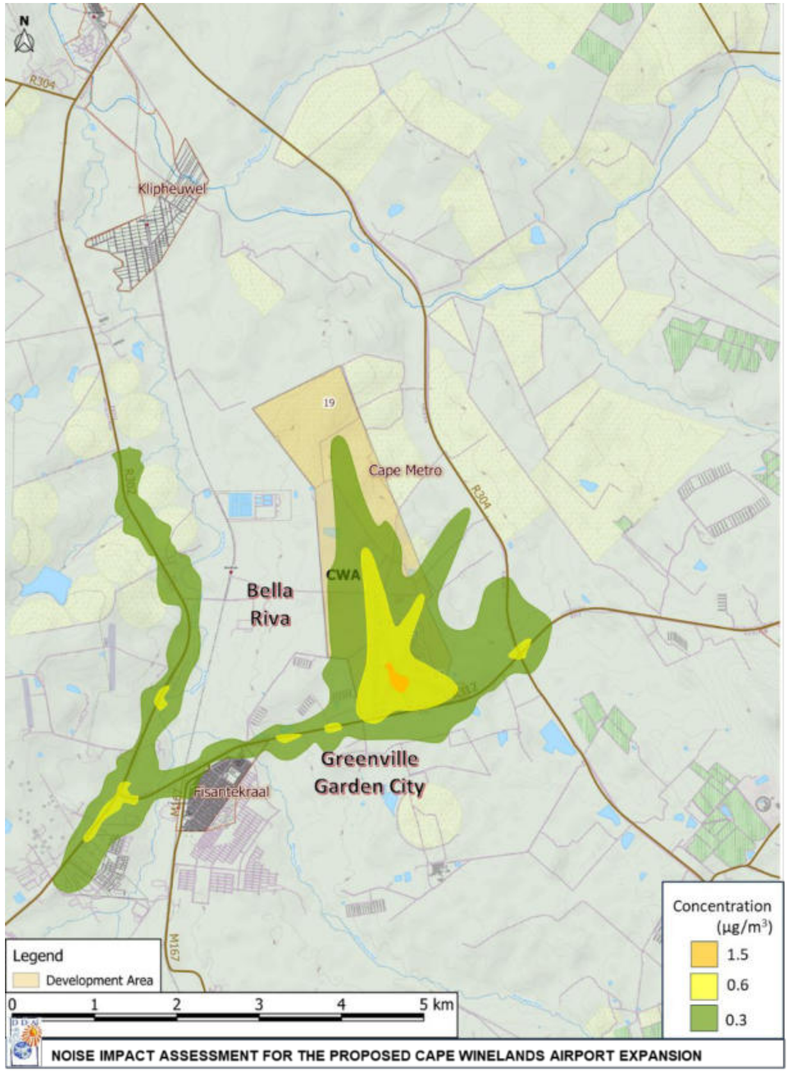


Figure 5-8. Scenario 1: PM_{10} 24-hr Maximum Concentrations (Guideline 120 µg/m³

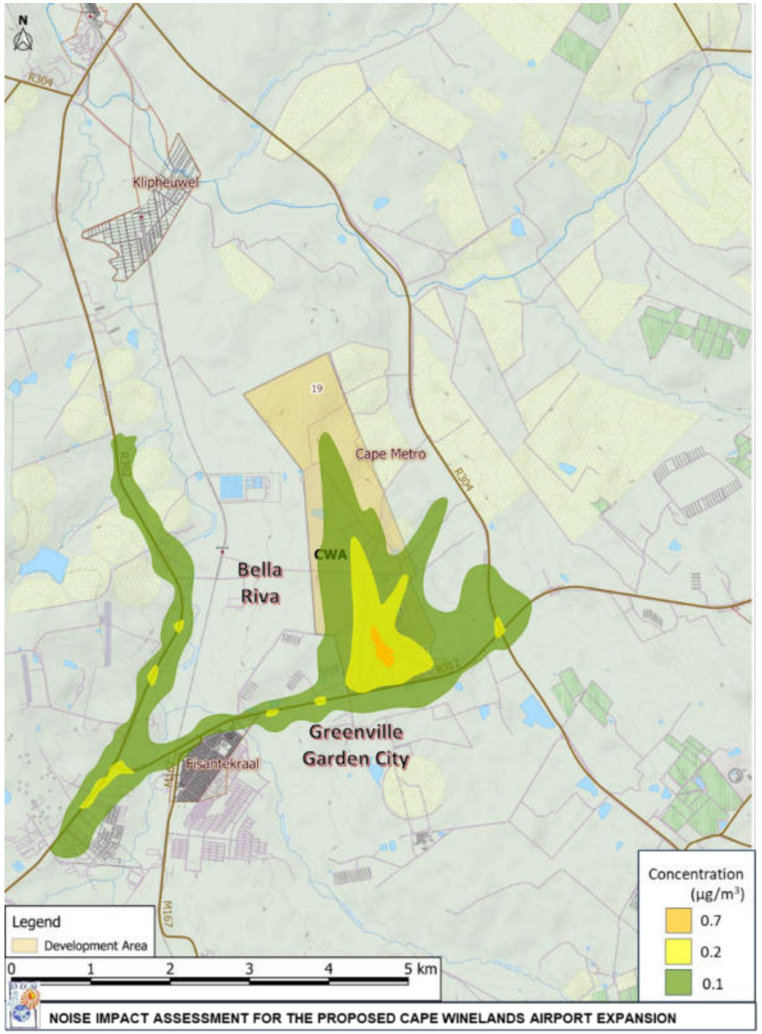


Figure 5-9. Scenario 1: $PM_{2.5}$ 24-hr Maximum Concentrations (Guideline 60 µg/m³)

Table 5-2. Scenario 1: Modelled Maximum Concentrations at Sensitive Receptors (exceedances indicated in red)

Receptor	CO 1-hr (µg/m³)	NO_2 1-hr (µg/m³)	NO_2 Annual (µg/m³)	PM_{10} 24-hr (µg/m³)	PM_{10} Annual (µg/m³)	$PM_{2.5}$ 24-hr (µg/m³)	$PM_{2.5}$ Annual (µg/m³)	SO_2 1-hr (µg/m³)	SO_2 24-hr (µg/m³)	SO_2 Annual (µg/m³)	Benzene Annual (µg/m³)
R01	211.9	26.2	0.3	0.2	0.1	0.0	0.0	9.2	0.1	0.10	0.03
R02	192.6	23.8	0.3	0.2	0.1	0.4	0.0	8.4	1.5	0.11	0.03
R03	219.6	27.1	0.6	0.2	0.1	0.3	0.1	9.5	1.2	0.23	0.07
R04	1074.1	41.5	0.3	0.5	0.0	0.1	0.0	11.6	0.3	0.09	0.02
R05	266.4	20.6	0.2	0.2	0.0	0.1	0.0	5.8	0.2	0.05	0.01
R06	534.3	21.2	0.1	0.6	0.0	0.0	0.0	5.9	0.0	0.03	0.01
R07	791.0	22.2	0.1	0.7	0.0	0.0	0.0	6.2	0.0	0.03	0.01
R08	354.0	38.3	0.3	0.3	0.0	0.0	0.0	15.4	0.1	0.08	0.02
R09	154.1	23.8	0.1	0.1	0.0	0.0	0.0	6.7	0.0	0.04	0.01
R10	437.0	30.7	0.2	0.4	0.0	0.0	0.0	8.6	0.1	0.04	0.01
R11	575.4	53.8	0.8	0.5	0.1	0.2	0.1	15.1	0.9	0.19	0.06
R12	128.5	19.8	0.2	0.1	0.0	0.1	0.0	5.6	0.3	0.05	0.02
R13	164.2	25.3	0.3	0.1	0.0	0.1	0.0	7.1	0.3	0.08	0.02
R14	304.2	47.0	0.3	0.3	0.0	0.1	0.0	13.2	0.3	0.09	0.02
R15	180.8	27.9	0.3	0.2	0.0	0.1	0.0	7.8	0.5	0.09	0.03
R16	147.9	22.8	0.2	0.1	0.0	0.1	0.0	6.4	0.2	0.05	0.01
R17	183.0	28.3	0.3	0.2	0.0	0.1	0.0	7.9	0.3	0.07	0.02
R18	169.9	26.2	0.3	0.1	0.0	0.1	0.0	7.4	0.3	0.07	0.02
R19	282.2	43.6	0.5	0.2	0.1	0.1	0.1	12.2	0.5	0.12	0.04
R20	159.9	24.7	0.4	0.1	0.1	0.1	0.0	6.9	0.5	0.10	0.03
R21	805.5	124.4	1.8	0.7	0.2	0.8	0.2	25.6	3.5	0.45	0.13
R22	310.8	43.2	0.6	0.3	0.1	0.2	0.1	13.5	0.7	0.16	0.05
R23	456.0	22.7	0.2	0.4	0.0	0.0	0.0	6.4	0.1	0.04	0.01
R24	63.2	9.8	0.1	0.2	0.0	0.0	0.0	2.7	0.1	0.02	0.01
R25	73.7	11.4	0.1	0.1	0.0	0.0	0.0	3.2	0.2	0.03	0.01
R26	64.0	9.9	0.1	0.1	0.0	0.0	0.0	2.8	0.1	0.03	0.01
R27	67.7	10.5	0.1	0.1	0.0	0.0	0.0	2.9	0.2	0.04	0.01
R28	137.6	20.4	0.3	0.4	0.1	0.1	0.0	6.6	1.4	0.15	0.05
R29	690.8	106.9	1.6	1.3	0.3	0.7	0.2	31.4	7.5	0.66	0.12
Standard	30000	200	40	75	40	40	20	350	125	50	5

5.3.2 Scenario 3

As mentioned in the sections above, the contour concentration figures were not generated for the new runway for the operational year (Scenario 2), since the emissions were very low and Scenario 3 is considered the worst-case for the new runway.

5.3.2.1 CO

Figure 5-10 shows the 1-hr concentration isopleths of the maximum expected concentrations of CO, for Scenario 3.

As can be seen, the 1-hr CO concentration was well below the guideline of 30,000 µg/m^3. The predicted maximum 1-hr CO concentrations were approximately 3,500 µg/m^3.

5.3.2.2 NO_2

The ground-level 1-hr and annual maximum concentrations of NO_2 are depicted in Figure 5-11 and Figure 5-12 respectively. The 1-hr guideline of 200 µg/m^3 was exceeded in a small area south and north of the runway. However, the exceedance number per year was only 2 and below the allowable exceedances of 88 per year.

The maximum annual NO_2 concentrations were well within the guideline of 40 µg/m^3 (see Figure 5-12).

5.3.2.3 SO_2

The maximum ground-level SO_2 concentrations are shown in Figure 5-13 and Figure 5-14 for the 1-hr and annual averaging periods respectively. From Figure 5-13, it can be seen that the 1-hr guideline of 350 µg/m^3 was not exceeded anywhere on or off-site.

The maximum annual concentrations were also well within the annual guideline of 50 µg/m^3 with the maximum reaching approximately 5 µg/m^3, within the site (see Figure 5-14).

5.3.2.4 PM_{10}

The maximum 1-hr ground-level concentrations are shown in Figure 5-15. It can be seen that these concentrations were well below their respective guidelines on-site, as well as in all the residential areas around the airport.

5.3.2.5 $PM_{2.5}$

The maximum 1-hr $PM_{2.5}$ ground-level concentrations are shown in Figure 5-16. It is evident that the maximum 1-hr concentrations in the surrounding residential areas were well within the 40 µg/m^3 guideline and are expected to be below 1 µg/m^3 due to the airport operations.

5.3.2.6 Modelled Concentrations at Sensitive Receptors

Table 5-3 further below show the modelled concentrations at the additional discrete receptors, placed within the residential areas around the airport. As can be seen from these tables, the maxima for all pollutants and receptor points in the surrounding communities were well below their respective guidelines.

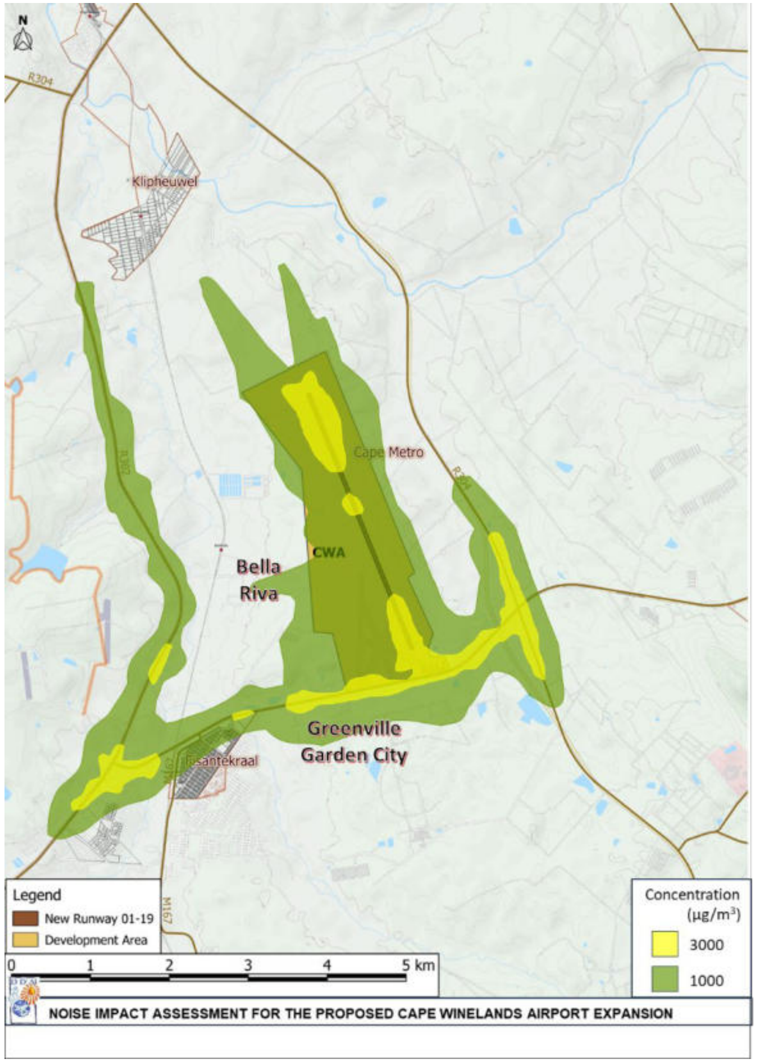


Figure 5-10. Scenario 3: CO 1-hr Maximum Concentrations (Guideline 30,000 µg/m³)

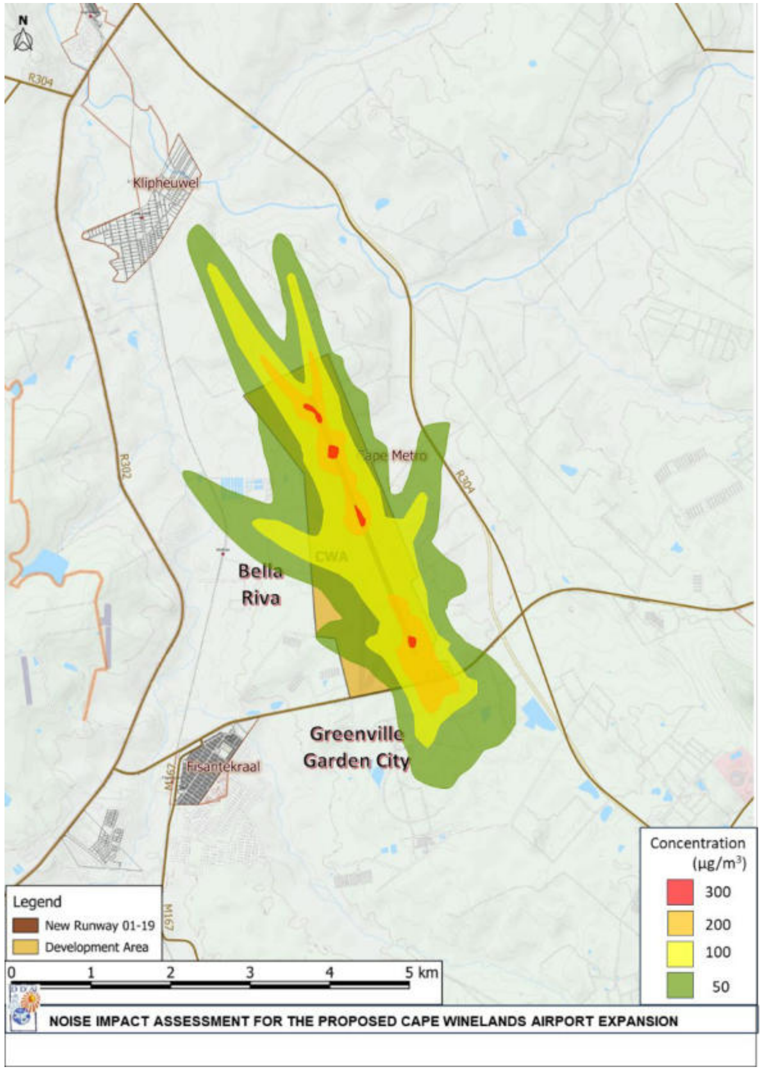


Figure 5-11. Scenario 3: NO_2 1-hr Maximum Concentrations (Guideline 200 µg/m³)

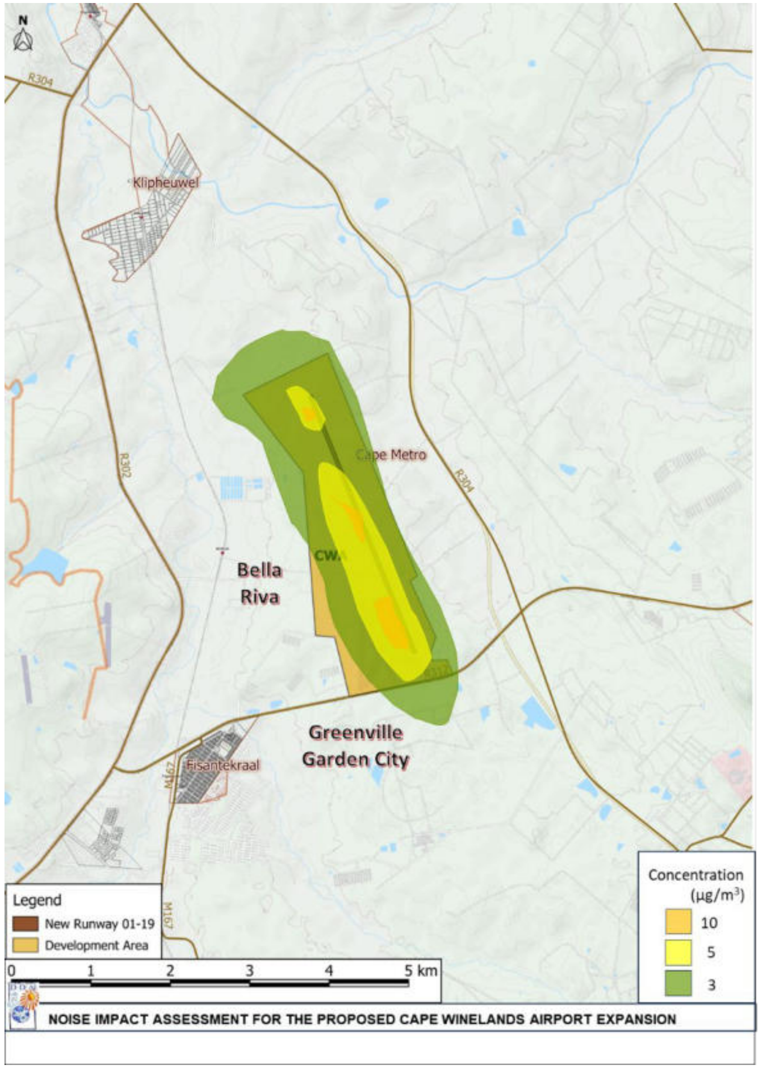


Figure 5-12. Scenario 3: NO_2 Maximum Annual Concentrations (Guideline 40 µg/m^3)

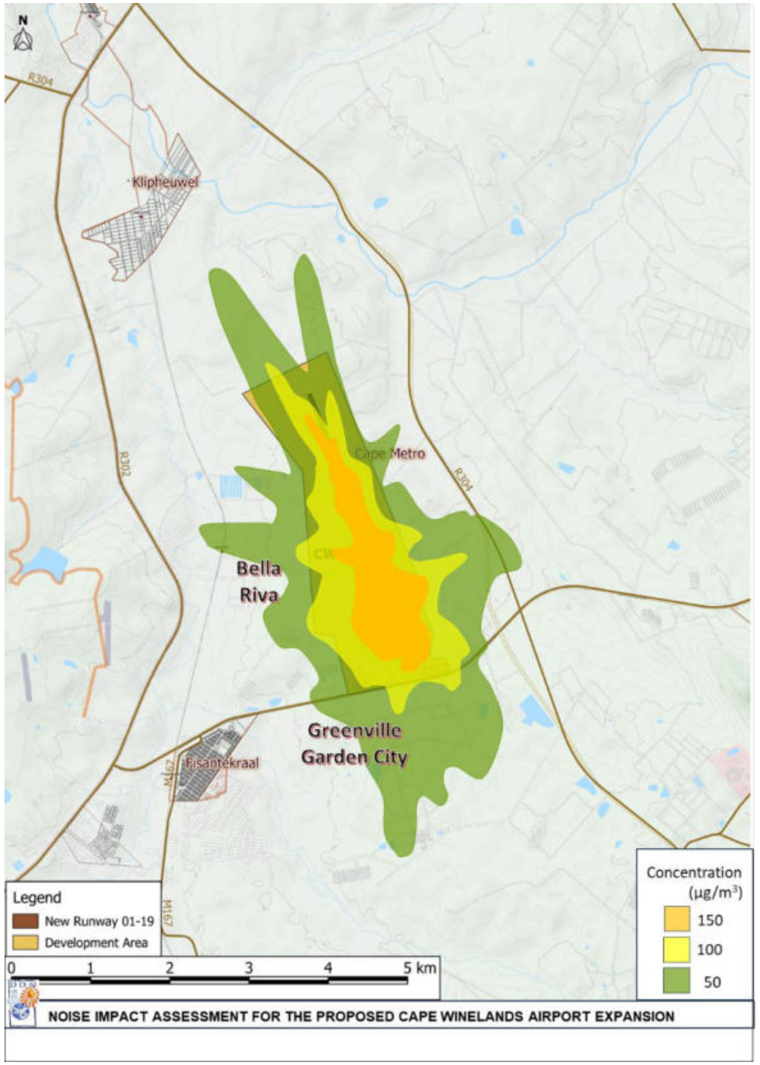


Figure 5-13. Scenario 3: SO_2 1-hr Maximum Concentrations (Guideline 350 µg/m^3)

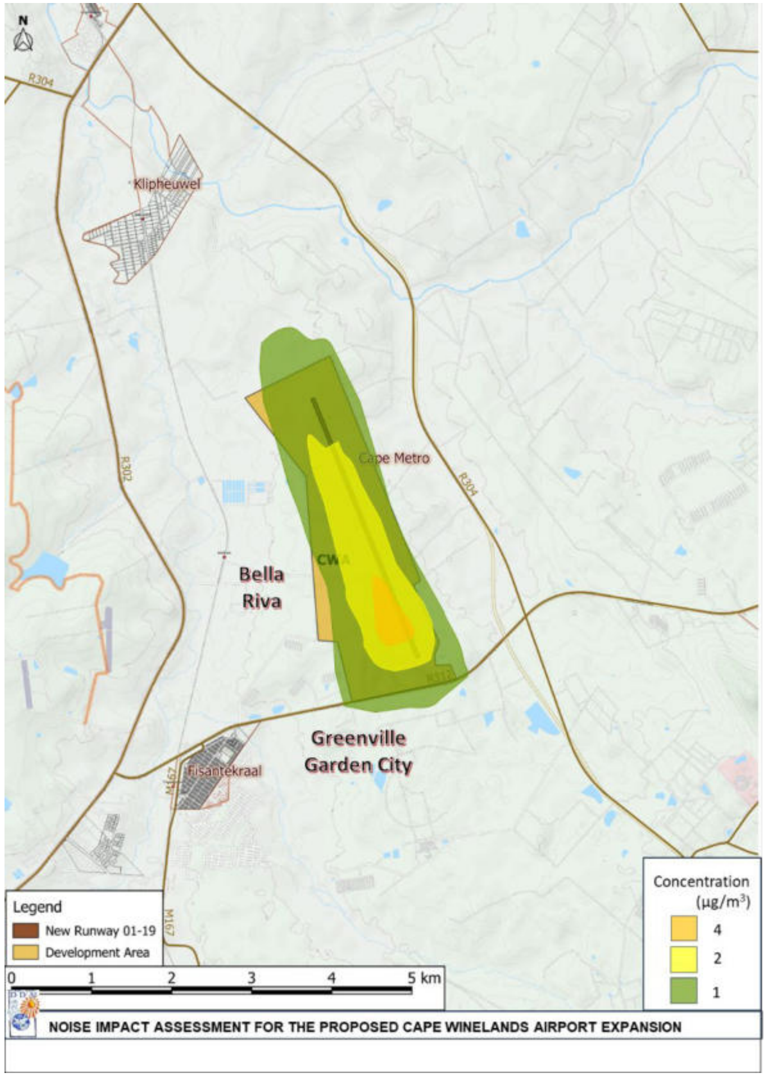


Figure 5-14. Scenario 3: SO_2 Maximum Annual Concentrations (Guideline 50 µg/m³)

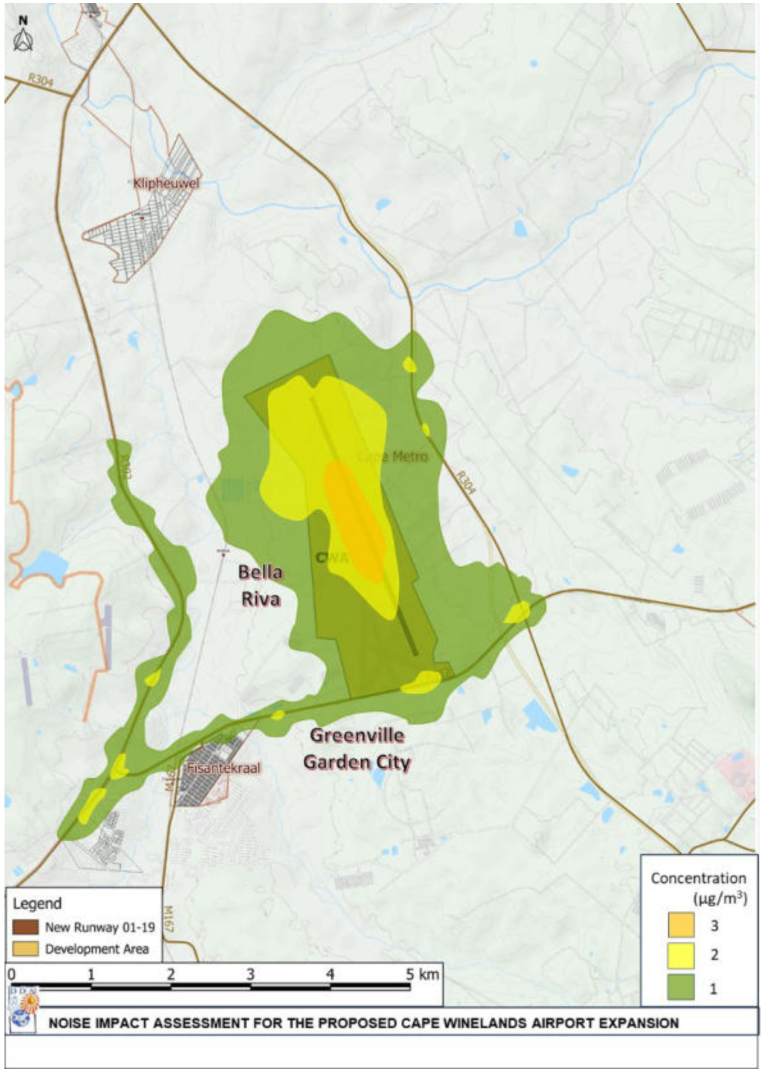


Figure 5-15. Scenario 3: PM_{10} 24-hr Maximum Concentrations (Guideline 75 µg/m³)

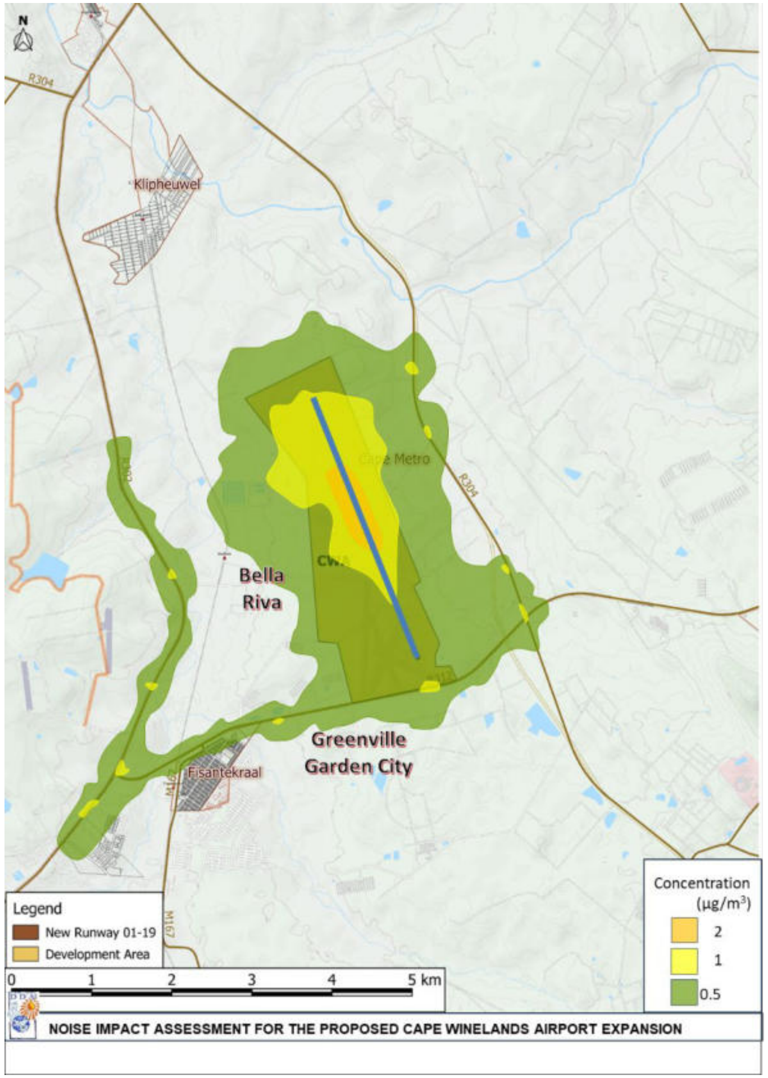


Figure 5-16. Scenario 3: $PM_{2.5}$ 24-hr Maximum Concentrations (Guideline 40 µg/m³)

Table 5-3. Scenario 3: Modelled Maximum Concentrations at Sensitive Receptors (exceedances indicated in red)

Receptor	CO 1-hr (µg/m³)	NO_2 1-hr (µg/m³)	NO_2 Annual (µg/m³)	PM_{10} 24-hr (µg/m³)	PM_{10} Annual (µg/m³)	$PM_{2.5}$ 24-hr (µg/m³)	$PM_{2.5}$ Annual (µg/m³)	SO_2 1-hr (µg/m³)	SO_2 24-hr (µg/m³)	SO_2 Annual (µg/m³)	Benzene Annual (µg/m³)
R01	523.1	14.0	0.4	0.1	0.1	0.0	0.0	25.2	0.5	0.32	0.08
R02	475.6	12.7	0.4	0.8	0.1	0.4	0.0	22.9	4.8	0.36	0.09
R03	542.1	14.5	0.9	0.6	0.1	0.3	0.1	26.2	4.0	0.72	0.19
R04	1936.1	17.8	0.3	1.2	0.1	0.6	0.0	32.0	0.9	0.27	0.07
R05	657.7	8.8	0.2	0.1	0.0	0.1	0.0	15.9	0.8	0.16	0.04
R06	1583.1	9.1	0.1	1.6	0.0	0.8	0.0	16.3	0.1	0.10	0.02
R07	3320.1	9.5	0.1	2.6	0.0	1.3	0.0	17.1	0.1	0.08	0.02
R08	891.5	23.4	0.3	0.1	0.0	0.0	0.0	54.8	0.3	0.24	0.06
R09	380.5	15.3	0.3	0.0	0.0	0.0	0.0	27.5	0.1	0.12	0.03
R10	863.2	13.1	0.3	0.0	0.0	0.0	0.0	23.7	0.2	0.13	0.03
R11	1420.8	23.1	0.8	0.5	0.1	0.2	0.1	54.0	3.0	0.60	0.16
R12	317.2	25.5	0.2	0.1	0.0	0.1	0.0	15.3	0.9	0.16	0.04
R13	972.7	48.9	3.4	1.3	0.1	0.6	0.0	19.6	1.0	0.25	0.06
R14	751.0	56.4	0.3	1.3	0.1	0.7	0.0	58.0	1.0	0.27	0.07
R15	446.3	59.8	0.3	2.0	0.1	1.0	0.0	40.9	1.7	0.27	0.07
R16	365.3	9.8	0.2	0.1	0.0	0.1	0.0	17.6	0.7	0.16	0.04
R17	451.8	12.1	0.3	0.1	0.0	0.1	0.0	21.8	0.9	0.21	0.05
R18	419.4	11.2	0.3	0.2	0.0	0.1	0.0	20.2	1.1	0.22	0.06
R19	696.7	18.7	0.5	0.3	0.1	0.1	0.0	33.6	1.6	0.39	0.10
R20	394.8	10.6	0.4	0.2	0.1	0.1	0.0	19.0	1.5	0.33	0.08
R21	3279.5	213.2	4.1	2.6	0.3	1.3	0.1	121.5	11.5	1.42	0.37
R22	767.5	26.7	0.6	0.4	0.1	0.2	0.0	55.5	2.3	0.50	0.13
R23	990.9	9.7	0.2	0.0	0.0	0.0	0.0	17.5	0.3	0.12	0.03
R24	545.8	4.2	0.1	0.1	0.0	0.0	0.0	7.5	0.4	0.07	0.02
R25	181.9	14.6	0.1	0.1	0.0	0.0	0.0	8.8	0.5	0.11	0.03
R26	158.0	12.7	0.1	0.1	0.0	0.0	0.0	7.6	0.4	0.09	0.02
R27	167.2	13.4	0.1	0.1	0.0	0.0	0.0	10.5	0.5	0.12	0.03
R28	321.4	25.9	0.3	0.4	0.1	0.1	0.0	22.0	1.9	0.29	0.08
R29	1689.8	46.9	1.6	1.9	0.4	0.7	0.1	82.9	12.8	1.48	0.32
Standard	30,000	200	40	75	40	40	20	350	125	50	5

5.3.3 Cumulative Assessment

The CWA project site is located on the outskirts of the Cape Town Metropolitan area and is surrounded by farmlands. The main land uses in the area include agriculture and poultry farming.

There are a few existing emission sources within the study area, which are within a 5 km radius of the project area, and which include the:

- Fisantekraal Wastewater Treatment Works (WWTW), located less than 1 km away from the project site to the northwest;
- County Fair Primary Processing Plant, located approximately 2 km south of the CWA;
- Claytile brick factory, located approximately 4 km from the CWA to the southeast; and
- Clay Industry brick factory, located approximately 5 km southwest of the CWA.

County Fair is an abattoir and rendering facility. DDA conducted an Atmospheric Impact Assessment study for County Fair in 2019. The main emission sources for criteria pollutants at the facility are three coal boilers. The stack emission monitoring results were used for the calculation of emission rates, which were used as input into the dispersion model. Three-year hourly meteorological data from the Cape Town International Airport weather station was used as input to the model.

The Clay Industry brick factory is a clay brick manufacturer utilizing a Transverse Arch Kiln, where coal is used as the fuel. There is one point source, which is the kiln stack at the site. DDA conducted an Atmospheric Impact Assessment study for Clay Industry in 2020. The emission rates used in the dispersion modelling were calculated based on the actual stack emission monitoring results, as well as the coal usage. A Level 1 assessment was conducted for the facility, since there was only a single point source at the site. Level 1 assessment provides an estimate of the worst-case air quality impacts utilising screening air dispersion models.

Claytile is a clay brick factory utilizing a tunnel kiln for firing the bricks. There is one point source at the site. DDA conducted an Atmospheric Impact Assessment study for the facility in 2023, as the facility proposed the installation of a second tunnel kiln.

Fisantekraal WWTW receives sewage from parts of Durbanville, Kraaifontein and Joostenberg Vlakte. The main components of the wastewater treatment process at the WWTW include sedimentation tanks, reactors, clarifiers, sludge thickeners, sludge dewatering components and maturation dams.

The air pollutants from the wastewater treatment and collection systems are emitted through the volatilisation of organic compounds at the liquid surface level. The air pollutants emitted are various volatile organic compounds (VOCs).

For the cumulative impact assessment, the air pollutants that may have a cumulative effect on the air pollution from the airport-related operations were examined. These were the criteria pollutants of CO, NOx, SO_2 and PM (PM_{10} and $PM_{2.5}$), including benzene.

To assess the potential cumulative impacts, individual modelling was carried out for County Fair, Clay Industry, the Fisantekraal WWTW and Claytile. The resulting ambient concentrations were modelled for the receptors identified around the airport. The modelling was performed for CO, NOx, SO_2, PM (PM_{10} and $PM_{2.5}$) and benzene.

The cumulative concentrations that take into account the other emission sources in the extended area, can be found in Table 5-4 for Scenario 1.

It is evident that also for the cumulative concentrations at the selected receptor locations, the maximum concentrations of all pollutants and time averages are below their respective guidelines.

The cumulative cocnetrations for Scenario 3 can be found in Table 5-5. It is evident that there all the resulting concentrations were well below the guidelines for all pollutants at the community and sensitive receptors.

The similar tables for Scenario 2 can be found in 0, and as expected the resulting concentrations are very low to negligible.

Table 5-4. Scenario 1: Cumulative Modelled Maximum Concentrations at Sensitive Receptors (exceedances indicated in red)

Receptor	CO 1-hr (µg/m³)	NO_2 1-hr (µg/m³)	NO_2 Annual (µg/m³)	PM_{10} 24-hr (µg/m³)	PM_{10} Annual (µg/m³)	$PM_{2.5}$ 24-hr (µg/m³)	$PM_{2.5}$ Annual (µg/m³)	SO_2 1-hr (µg/m³)	SO_2 24-hr (µg/m³)	SO_2 Annual (µg/m³)	Benzene Annual (µg/m³)
R01	254.0	28.1	0.4	1.3	0.2	0.4	0.1	13.5	3.8	0.38	0.03
R02	342.4	28.1	0.6	2.0	0.4	1.5	0.3	16.9	5.0	0.84	0.03
R03	288.8	31.5	0.9	3.3	0.5	1.0	0.2	23.4	9.3	1.00	0.07
R04	1084.7	42.8	0.4	1.0	0.1	0.2	0.0	14.1	1.5	0.20	0.04
R05	297.5	23.9	0.3	0.9	0.1	0.2	0.0	8.5	1.7	0.17	0.03
R06	564.0	24.3	0.3	1.2	0.1	0.2	0.0	8.5	1.4	0.17	0.01
R07	818.4	25.2	0.2	1.3	0.1	0.2	0.0	9.0	1.3	0.16	0.06
R08	368.9	40.2	0.4	0.9	0.1	0.2	0.0	19.0	1.6	0.26	0.03
R09	172.0	26.0	0.2	0.7	0.1	0.1	0.0	9.9	1.5	0.19	0.03
R10	456.8	32.9	0.3	0.9	0.1	0.1	0.0	11.3	1.2	0.16	0.02
R11	584.7	55.9	0.9	1.5	0.2	0.4	0.1	22.3	3.6	0.59	0.07
R12	139.4	21.0	0.3	0.5	0.1	0.2	0.0	7.3	1.0	0.16	0.07
R13	175.7	26.6	0.4	0.5	0.1	0.2	0.0	9.1	1.1	0.19	0.15
R14	319.0	48.8	0.4	0.8	0.1	0.2	0.0	16.1	1.6	0.24	0.21
R15	195.4	29.6	0.4	0.6	0.1	0.2	0.0	10.5	1.5	0.22	1.03
R16	174.2	25.6	0.3	0.8	0.1	0.2	0.0	8.7	1.7	0.17	0.02
R17	226.1	32.8	0.4	1.0	0.1	0.3	0.0	11.6	2.3	0.22	0.03
R18	201.5	29.6	0.4	0.9	0.1	0.3	0.0	10.6	2.3	0.24	0.05
R19	319.4	53.9	1.6	6.7	1.6	0.9	0.2	48.9	18.6	4.49	0.04
R20	179.2	27.9	0.6	1.3	0.2	0.4	0.1	16.1	3.4	0.46	0.03
R21	815.3	126.6	2.0	1.7	0.4	1.0	0.2	33.4	6.0	0.99	0.14
R22	324.5	46.6	0.8	1.8	0.3	0.4	0.1	25.6	4.9	0.85	0.05
R23	759.6	55.0	1.2	3.0	0.4	0.7	0.1	29.8	5.2	0.82	0.01
R24	72.2	10.7	0.1	0.4	0.0	0.1	0.0	4.1	0.6	0.10	0.02
R25	83.6	12.3	0.2	0.3	0.1	0.1	0.0	4.6	0.7	0.11	0.03
R26	72.1	10.7	0.2	0.3	0.0	0.1	0.0	3.9	0.6	0.10	0.02
R27	77.4	11.3	0.2	0.3	0.1	0.1	0.0	4.3	0.8	0.12	0.03
R28	137.6	20.4	0.3	0.4	0.1	0.1	0.0	6.6	1.4	0.15	0.05
R29	690.8	106.9	1.6	1.3	0.3	0.7	0.2	31.4	7.5	0.66	0.12
Standard	30,000	200	40	75	40	40	20	350	125	50	5

Table 5-5. Scenario 3: Cumulative Modelled Maximum Concentrations at Sensitive Receptors (exceedances indicated in red)

Receptor	CO 1-hr (µg/m³)	NO_2 1-hr (µg/m³)	NO_2 Annual (µg/m³)	PM_{10} 24-hr (µg/m³)	PM_{10} Annual (µg/m³)	$PM_{2.5}$ 24-hr (µg/m³)	$PM_{2.5}$ Annual (µg/m³)	SO_2 1-hr (µg/m³)	SO_2 24-hr (µg/m³)	SO_2 Annual (µg/m³)	Benzene Annual (µg/m³)
R01	565.3	15.9	0.5	1.2	0.2	0.4	0.1	29.5	4.1	0.60	0.08
R02	625.4	17.0	0.8	2.6	0.4	1.6	0.3	31.5	8.4	1.08	0.09
R03	611.4	19.0	1.2	3.7	0.5	1.0	0.2	40.1	12.1	1.49	0.19
R04	1946.7	19.1	0.4	1.7	0.1	0.7	0.0	34.4	2.1	0.39	0.08
R05	688.8	12.1	0.3	0.8	0.1	0.2	0.0	18.6	2.3	0.28	0.05
R06	1612.8	12.2	0.3	2.2	0.1	0.9	0.0	18.9	1.5	0.24	0.03
R07	3347.6	12.5	0.2	3.2	0.1	1.4	0.0	19.8	1.4	0.22	0.07
R08	906.4	25.4	0.4	0.7	0.1	0.2	0.0	58.5	1.8	0.43	0.07
R09	398.3	17.5	0.4	0.6	0.1	0.1	0.0	30.8	1.6	0.27	0.05
R10	882.9	15.4	0.4	0.5	0.1	0.1	0.0	26.3	1.4	0.25	0.04
R11	1430.0	25.2	0.9	1.5	0.3	0.4	0.1	61.1	5.7	1.01	0.17
R12	328.2	26.7	0.3	0.5	0.1	0.2	0.0	17.1	1.6	0.27	0.10
R13	984.2	50.1	3.5	1.7	0.1	0.7	0.0	21.5	1.8	0.36	0.19
R14	765.9	58.2	0.4	1.9	0.1	0.8	0.0	60.9	2.3	0.43	0.25
R15	460.9	61.5	0.4	2.4	0.1	1.1	0.0	43.6	2.6	0.40	1.08
R16	391.5	12.5	0.3	0.8	0.1	0.2	0.0	19.9	2.2	0.28	0.05
R17	494.9	16.7	0.4	1.0	0.1	0.3	0.0	25.5	2.9	0.36	0.07
R18	451.0	14.6	0.4	1.0	0.1	0.3	0.0	23.4	3.1	0.39	0.08
R19	733.9	29.0	1.6	6.7	1.6	0.9	0.2	70.2	19.7	4.76	0.10
R20	414.1	13.8	0.6	1.4	0.2	0.4	0.1	28.2	4.5	0.69	0.08
R21	3289.3	215.4	4.2	3.6	0.5	1.5	0.2	129.3	14.0	1.96	0.38
R22	781.1	30.2	0.8	1.9	0.4	0.4	0.1	67.6	6.4	1.19	0.13
R23	1294.4	42.0	1.2	2.6	0.4	0.7	0.1	40.9	5.4	0.91	0.03
R24	554.9	5.1	0.1	0.3	0.0	0.1	0.0	8.9	0.9	0.15	0.03
R25	191.8	15.6	0.2	0.3	0.1	0.1	0.0	10.1	1.0	0.19	0.04
R26	166.1	13.5	0.2	0.3	0.0	0.1	0.0	8.8	0.9	0.16	0.03
R27	177.0	14.3	0.2	0.3	0.1	0.1	0.0	11.9	1.1	0.20	0.05
R28	321.4	25.9	0.3	0.4	0.1	0.1	0.0	22.0	1.9	0.29	0.08
R29	1689.8	46.9	1.6	1.9	0.4	0.7	0.1	82.9	12.8	1.48	0.32
Standard	30,000	200	40	75	40	40	20	350	125	50	5

6 IMPACT RATINGS

6.1 Construction Phase

During construction, the main air pollutant of concern is dust. Dust will be generated during the land clearing, site preparations and levelling, bulk earthworks, such as cut and fill operations to the east of the existing runways, material loading and hauling, travelling on unpaved roads and wind erosion from exposed areas.

The dust is expected to settle to the ground near the sources due to gravity in a matter of a few hours and can cause a nuisance to the receptors in close proximity to the sources. The effects of dust include visual soiling of clean surfaces, such as cars, window sills and household washing. The airborne dust can also have an effect on visibility in the immediate vicinity of the source, which may affect potential aircraft operations during the construction phase.

The sensitivity in the immediate vicinity of the site is considered low, since there are no existing residential areas bordering the CWA airport site. The closest community is that of Fisantekraal, which is situated more than 1,000 m away, towards the south-west.

The exhaust emissions from the truck movements and equipment at the site are expected to marginally increase air pollution concentrations, primarily within the site. At the existing communities around the airport site, these increases are expected to be negligible. Therefore, the expected impact of the vehicle and equipment exhaust emissions during construction is considered to be insignificant.

During construction the dust deposition is expected to increase in close proximity to the various construction activities, i.e. within 300 m from the working face. Therefore, the extent of the impact was considered to be contained primarily within the site boundaries and set to local (1). The duration of the main construction activities may take up to 2 years, and as such was set to short-term (1). The total dust deposition beyond a 200m zone from the airport site is expected to be well below the DEA guideline of 600 mg/m^2/day for residential areas, such that the intensity rating was considered to be medium (2). The significance of the unmitigated impact is anticipated to be *VERY LOW*.

Even though, under hot and windy summer conditions the generated dust may blow off site, it is unlikely to create nuisance at Fisantekraal. Dust suppression measures, however, are recommended in order to reduce any possible impacts. For the mitigated impact, it is assumed that the "good practice" dust suppression measures will be adopted, such as:

- Apply wet suppression on the main site roads.
- Implement a speed limit of 30km/hour on unpaved roads on site.
- Give preference to routes away from the western site boundary.
- Reduce the frequency of disturbance of stockpiles.

With the implementation of the above-mentioned mitigation measures, the impact is expected to be *INSIGNIFICANT*. The impact ratings for the construction phase are summarised in Table 6-1.

Dust monitoring along the western, southern and northern boundaries of the site is recommended to be conducted on a monthly basis during construction and to be reported quarterly to the authorities.

Table 6-1. Construction Air Quality Impact Ratings

Ambient Air Quality	**Extent**	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**	**Status**	**Confidence**
Without Mitigation	Local 1	Low 1	Short-term 1	**Very Low** **3**	Probable	**VERY LOW**	**– ve**	High
Ambient Air Quality	**Extent**	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**	**Status**	**Confidence**
With Mitigation	Local 1	Low 1	Short-term 1	**Very Low** **3**	Possible	**INSIGNIFICANT**	**– ve**	Medium

6.2 Operational Phase

The resulting air pollution levels around the Cape Winelands Airport due to the airport operations were simulated with the use of the US FAA's AEDT model, which utilises the USEPA AERMOD model for the for the dispersion calculations. The resulting air pollution contours and air quality impacts were estimated for the following scenarios:

Scenario 1: Existing runway setup under full utilisation (No-Go Alternative);
Scenario 2: Operations on the new runway 01/19 in the operational year;
Scenario 3: Operations on the new runway 01/19 at full capacity.

6.2.1 Scenario 1: Existing Runway System at Full Utilisation (No-Go Alternative)

Based on the modelling results for the existing situation under full capacity (Scenario 1), the ground-level concentrations of all pollutants are expected to exceed their respective guidelines outside the CWA airport site boundaries.

It should be noted that the highest maximum 1-hr NO_2 concentrations at some small areas around the site exceeded the 1-hr guideline value. However, the frequency of exceedances was below 3 per year, which is well below the 88 times per annum permissible by the South African legislation.

Currently, the sensitivity of the area in the immediate vicinity of the site is considered low, due to the fact that the closest community, Fisantekraal, is situated more than 1,000 m away.

However, as indicted in previous sections, in the near future two residential areas are planned to be developed immediately south and towards the west of the airport. Once these communities are established, the sensitivity of the area would be considered moderate, assuming appropriate buffer zones will be established, primarily due to noise impact concerns.

Based on the modelling results for Scenario 1, the existing air pollution intensity due the airport's operations is considered to be low. The extent of the impact is mostly limited to the airport site, with two small areas extending towards the west and south of the site. The overall impact rating for Scenario 1 was found to be of *VERY LOW* significance and is summarised in Table 6-2.

In line with the ICAO emission reduction action plans and best practices with respect to airport-related air quality, the following "best practice" emission mitigation measures could be investigated for implementation for Scenario 1:

- Implementation of measures to decrease the queuing lines.

- Minimisation of the waiting time for parking.
- Examination of permitting aircraft taxiing at higher speeds.
- Limitation of the length of the course of taxiing.
- Utilisation of aircraft-serving equipment with "cleaner" technology.

It should be noted that the identification of the most suitable and cost-effective mitigation measures, together with a realistic time schedule for their application, can only be a result of consultations between the various stakeholders associated with all the airport operations. As such, a mitigation version of the impact ratings was not produced for the operational impact ratings of the No-Go Alternative.

Table 6-2. Air Quality Impact Ratings: Scenario 1 (No-Go Alternative)

Ambient Air Quality	**Extent**	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**	**Status**	**Confidence**
Without Mitigation	Local 1	Low 1	Long-term 3	**Low** **5**	Probable	**LOW**	**– ve**	High

6.2.2 Scenario 2: New Runway 01/19 in Operational Year

With the introduction of the new runway, the air quality impact zones during the operational year will be reduced in size, compared to Scenario 1. In addition, these zones will also follow a more north-westerly and south-easterly direction, in line with the new runway.

All of the air pollutant levels outside the airport site boundaries were found to be very low. The air pollution concentrations due to the airport operations at the Fisantekraal community, but also at the new developments west and south of the airport, are expected to be very low and well within the air quality standards.

The overall air quality impact for Scenario 2 is considered to be of *VEY LOW* significance (see Table 6-3).

Similar to Scenario 1, a mitigation version of the impact ratings was not produced for the operational impact ratings of Scenario 2. However, the most suitable and cost-effective mitigation measures should be investigated, and an acceptable implementation timeframe should be established before the new runway reaches its capacity.

Table 6-3. Air Quality Impact Ratings: Scenario 2 (New Runway 01/19 at Operational Year)

Ambient Air Quality	**Extent**	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**	**Status**	**Confidence**
Without Mitigation	Local 1	Low 1	Long-term 3	**Low** **5**	Possible	**VERY LOW**	**– ve**	High

6.2.3 Scenario 3: New Runway 01/19 at Full Capacity

The air quality impact zones for the new runway at full capacity will extend beyond the airport site boundaries in a north-westerly and south-easterly direction. The air pollutant levels, however, will be within their respective air quality standards, except for the highest maximum 1-hr NO_2 concentrations within small areas north and south of the runway.

Even though the maximum 1-hr NO_2 concentrations exceeded the 1-hr standard, the frequency of exceedances was below 10 per year, which is within the allowed number of exceedances of 88 times, as specified by the South African legislation.

The air pollutant levels at the identified community receptors, including at Fisantekraal and Klipheuwel were found to be well within the standards.

Table 6-4 shows the overall air quality impact for Scenario 3, which is considered to be of *LOW* significance.

For Scenario 3, a number of mitigation measures should be considered for implementation in consultation with the various stakeholders associated with all the airport operations. In addition, in line with the noise impact recommendations, the airport-compatible land-use planning immediately south of the new runway would be recommended. As such, the identified potential mitigation measures are:

- Encourage airport-compatible land-use planning.
- Implement measures to decrease the queuing lines.
- Limit the length of the course of taxiing.
- Shutting down as many engines as possible when idling and taxiing.
- Reduce reverse thrust use during landing.
- Utilise aircraft-serving equipment with “cleaner” technology.
- Investigate the provision of electricity at terminal gates, so as to minimise use of the APUs and GSE as much as possible.

Assuming that some of the above-mentioned mitigation measures will be implemented before the airport capacity is reached, the resulting overall impact with mitigation for Scenario 3 would be expected to be slightly lower than the unmitigated one. However, the overall significance rating would not change.

Table 6-4. Air Quality Impact Ratings: Scenario 3 (New Runway 01/19 at Full Capacity)

Ambient Air Quality	**Extent**	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**	**Status**	**Confidence**
Without Mitigation	Local 1	Low 1	Long-term 3	**Low** **5**	Probable	**LOW**	**– ve**	High

Based on the modelling results presented in Section 5, the highest concentrations occur along the runway, and extending north of these runways. This is due to the strong south-easterly wind during the summer season in the Western Cape. Therefore, the existing location of the monitoring station is suitable for current and future runway operations. The concentrations measured represent the highest concentrations. The pollutants’ concentrations at other locations around the airport and the surrounding communities are deemed to be much lower.

The station is equipped to measure the ambient concentrations of SO_2, NO_2, O_3, CO and PM_{10}

It is further recommended that the monitoring data be reported biannual basis to the City of Cape Town Air Quality Management Unit and the South African Air Quality Information System as operated by SAWS, on an ongoing basis.

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APPENDIX A

Hourly Distribution of the Aircraft Operations

Table A-1 Current Runway System Operations per Hour (Scenario 1)

Hour	Operations			
	Scenario 1			
	Arrival	Circuit	Departure	Total
0	0	0	0	0
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0
5	0	0	0	0
6	0	0	0	0
7	3	0	3	6
8	6	0	6	12
9	12	10	11	33
10	11	16	12	39
11	10	12	11	33
12	7	8	7	22
13	6	6	9	21
14	10	15	8	33
15	8	21	7	36
16	13	6	14	33
17	6	6	6	18
18	6	1	5	12
19	2	0	1	3

Hour	Operations			
	Scenario 1			
	Arrival	Circuit	Departure	Total
20	0	0	0	0
21	0	0	0	0
22	0	0	0	0
23	0	0	0	0
Grand Total (24-hour)	100	101	100	301

Note: Hour values are rounded to the closest integer.

Table A-2 New Runway 01/19 Operations per Hour (Scenario 2 & 3)

Hour	Operations				Operations			
	Scenario 2				Scenario 3			
	Arrival	Circuit	Departure	Total	Arrival	Circuit	Departure	Total
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	5	5
7	0	0	0	0	1	0	1	2
8	0	0	1	1	5	0	8	13
9	3	1	0	4	11	3	4	18
10	2	0	2	4	8	0	10	18

Hour	Operations				Operations			
	Scenario 2				Scenario 3			
	Arrival	Circuit	Departure	Total	Arrival	Circuit	Departure	Total
11	3	0	1	4	13	0	9	22
12	1	0	1	2	6	0	5	11
13	0	2	0	2	4	8	2	14
14	1	1	2	4	11	4	8	23
15	0	2	1	3	4	6	9	19
16	2	0	1	3	16	0	9	25
17	0	0	1	1	3	0	8	11
18	0	0	1	1	4	0	6	10
19	0	0	0	0	3	0	2	5
20	0	0	0	0	4	0	3	7
21	0	0	0	0	1	0	1	2
22	0	0	0	0	2	0	1	3
23	0	0	0	0	0	0	0	0
Grand Total (24-hour)	12	6	11	29	96	21	91	208

Note: Hour values are rounded to the closest integer.

Operational Profiles

Table A-1. Daily Profiles

Day of the Week	Internal Roads	Public Roads	Parking Lots	Fuel Tanks
	(fraction of peak value)			
Monday	0.919	0.625	0.883	1.000
Tuesday	0.867	0.877	0.869	1.000
Wednesday	0.918	0.885	0.897	1.000
Thursday	1.000	0.898	0.942	1.000
Friday	0.980	0.917	1.000	1.000
Saturday	0.648	1.000	0.719	1.000
Sunday	0.831	0.759	0.908	1.000

Table A-2. Monthly Profiles

Month	Internal Roads	Public Roads	Parking Lots	Fuel Tanks
	(fraction of peak value)			
January	1.000	1.000	1.000	1.000
February	1.000	1.000	1.000	1.000
March	1.000	1.000	1.000	1.000
April	1.000	1.000	1.000	1.000
May	1.000	1.000	1.000	1.000
June	1.000	1.000	1.000	1.000
July	1.000	1.000	1.000	1.000
August	1.000	1.000	1.000	1.000
September	1.000	1.000	1.000	1.000
October	1.000	1.000	1.000	1.000
November	1.000	1.000	1.000	1.000
December	1.000	1.000	1.000	1.000

Table A-3. Quarter-Hourly Profiles

Quarter-Hour	Internal Roads	Public Roads	Parking Lots	Fuel Tanks
	(fraction of peak value)			
00:00-00:15	0.059	0.150	0.019	1.000
00:15-00:30	0.059	0.150	0.019	1.000
00:30-00:45	0.059	0.150	0.019	1.000
00:45-01:00	0.059	0.150	0.019	1.000
01:00-01:15	0.010	0.091	0.005	1.000
01:15-01:30	0.010	0.091	0.005	1.000
01:30-01:45	0.010	0.091	0.005	1.000
01:45-02:00	0.010	0.091	0.005	1.000
02:00-02:15	0.013	0.062	0.004	1.000
02:15-02:30	0.013	0.062	0.004	1.000
02:30-02:45	0.013	0.062	0.004	1.000
02:45-03:00	0.013	0.062	0.004	1.000
03:00-03:15	0.039	0.066	0.011	1.000
03:15-03:30	0.039	0.066	0.011	1.000
03:30-03:45	0.039	0.066	0.011	1.000
03:45-04:00	0.039	0.066	0.011	1.000
04:00-04:15	0.445	0.132	0.117	1.000
04:15-04:30	0.445	0.132	0.117	1.000
04:30-04:45	0.445	0.132	0.117	1.000
04:45-05:00	0.445	0.132	0.117	1.000

Quarter-Hour	Internal Roads	Public Roads	Parking Lots	Fuel Tanks
	(fraction of peak value)			
05:00-05:15	0.563	0.369	0.520	1.000
05:15-05:30	0.563	0.369	0.520	1.000
05:30-05:45	0.563	0.369	0.520	1.000
05:45-06:00	0.563	0.369	0.520	1.000
06:00-06:15	0.373	0.832	0.422	1.000
06:15-06:30	0.373	0.832	0.422	1.000
06:30-06:45	0.373	0.832	0.422	1.000
06:45-07:00	0.373	0.832	0.422	1.000
07:00-07:15	0.568	1.000	0.392	1.000
07:15-07:30	0.568	1.000	0.392	1.000
07:30-07:45	0.568	1.000	0.392	1.000
07:45-08:00	0.568	1.000	0.392	1.000
08:00-08:15	0.814	0.932	0.668	1.000
08:15-08:30	0.814	0.932	0.668	1.000
08:30-08:45	0.814	0.932	0.668	1.000
08:45-09:00	0.814	0.932	0.668	1.000
09:00-09:15	0.818	0.874	0.778	1.000
09:15-09:30	0.818	0.874	0.778	1.000
09:30-09:45	0.818	0.874	0.778	1.000
09:45-10:00	0.818	0.874	0.778	1.000
10:00-10:15	0.976	0.858	0.891	1.000

Quarter-Hour	Internal Roads	Public Roads	Parking Lots	Fuel Tanks
	(fraction of peak value)			
10:15-10:30	0.976	0.858	0.891	1.000
10:30-10:45	0.976	0.858	0.891	1.000
10:45-11:00	0.976	0.858	0.891	1.000
11:00-11:15	0.986	0.868	1.000	1.000
11:15-11:30	0.986	0.868	1.000	1.000
11:30-11:45	0.986	0.868	1.000	1.000
11:45-12:00	0.986	0.868	1.000	1.000
12:00-12:15	0.961	0.890	0.919	1.000
12:15-12:30	0.961	0.890	0.919	1.000
12:30-12:45	0.961	0.890	0.919	1.000
12:45-13:00	0.961	0.890	0.919	1.000
13:00-13:15	0.873	0.881	0.868	1.000
13:15-13:30	0.873	0.881	0.868	1.000
13:30-13:45	0.873	0.881	0.868	1.000
13:45-14:00	0.873	0.881	0.868	1.000
14:00-14:15	0.927	0.830	0.859	1.000
14:15-14:30	0.927	0.830	0.859	1.000
14:30-14:45	0.927	0.830	0.859	1.000
14:45-15:00	0.927	0.830	0.859	1.000
15:00-15:15	1.000	0.917	0.869	1.000
15:15-15:30	1.000	0.917	0.869	1.000

Quarter-Hour	Internal Roads	Public Roads	Parking Lots	Fuel Tanks
	(fraction of peak value)			
15:30-15:45	1.000	0.917	0.869	1.000
15:45-16:00	1.000	0.917	0.869	1.000
16:00-16:15	0.947	0.948	0.938	1.000
16:15-16:30	0.947	0.948	0.938	1.000
16:30-16:45	0.947	0.948	0.938	1.000
16:45-17:00	0.947	0.948	0.938	1.000
17:00-17:15	0.873	0.906	0.941	1.000
17:15-17:30	0.873	0.906	0.941	1.000
17:30-17:45	0.873	0.906	0.941	1.000
17:45-18:00	0.873	0.906	0.941	1.000
18:00-18:15	0.752	0.803	0.814	1.000
18:15-18:30	0.752	0.803	0.814	1.000
18:30-18:45	0.752	0.803	0.814	1.000
18:45-19:00	0.752	0.803	0.814	1.000
19:00-19:15	0.771	0.611	0.943	1.000
19:15-19:30	0.771	0.611	0.943	1.000
19:30-19:45	0.771	0.611	0.943	1.000
19:45-20:00	0.771	0.611	0.943	1.000
20:00-20:15	0.600	0.462	0.791	1.000
20:15-20:30	0.600	0.462	0.791	1.000
20:30-20:45	0.600	0.462	0.791	1.000

Quarter-Hour	Internal Roads	Public Roads	Parking Lots	Fuel Tanks
	(fraction of peak value)			
20:45-21:00	0.600	0.462	0.791	1.000
21:00-21:15	0.528	0.374	0.603	1.000
21:15-21:30	0.528	0.374	0.603	1.000
21:30-21:45	0.528	0.374	0.603	1.000
21:45-22:00	0.528	0.374	0.603	1.000
22:00-22:15	0.541	0.311	0.797	1.000
22:15-22:30	0.541	0.311	0.797	1.000
22:30-22:45	0.541	0.311	0.797	1.000
22:45-23:00	0.541	0.311	0.797	1.000
23:00-23:15	0.226	0.209	0.328	1.000
23:15-23:30	0.226	0.209	0.328	1.000
23:30-23:45	0.226	0.209	0.328	1.000
23:45-00:00	0.226	0.209	0.328	1.000

Cumulative Concentrations for Scenario 2

Receptor	CO 1-hr (µg/m³)	NO_2 1-hr (µg/m³)	NO_2 Annual (µg/m³)	PM_{10} 24-hr (µg/m³)	PM_{10} Annual (µg/m³)	$PM_{2.5}$ 24-hr (µg/m³)	$PM_{2.5}$ Annual (µg/m³)	SO_2 1-hr (µg/m³)	SO_2 24-hr (µg/m³)	SO_2 Annual (µg/m³)
R01	187.9	9.5	0.2	1.2	0.1	0.4	0.1	6.4	3.6	0.30
R02	282.4	11.2	0.4	1.9	0.3	1.3	0.2	10.5	3.9	0.75
R03	220.3	12.3	0.5	3.2	0.4	0.8	0.2	16.1	8.4	0.83
R04	195.3	11.0	0.1	0.5	0.1	0.1	0.0	5.1	1.2	0.14
R05	122.8	8.1	0.2	0.6	0.1	0.2	0.0	4.0	1.5	0.13
R06	124.0	8.1	0.2	0.6	0.1	0.2	0.0	4.0	1.4	0.15
R07	126.4	8.1	0.2	0.6	0.1	0.2	0.0	4.2	1.3	0.14
R08	258.4	14.7	0.2	0.6	0.1	0.2	0.0	7.2	1.5	0.21
R09	123.9	7.7	0.1	0.6	0.1	0.1	0.0	4.8	1.5	0.16
R10	156.4	9.4	0.1	0.5	0.1	0.1	0.0	4.6	1.2	0.12
R11	249.2	14.6	0.3	1.1	0.2	0.2	0.0	10.6	2.9	0.45
R12	99.3	5.8	0.1	0.4	0.1	0.1	0.0	3.0	0.8	0.12
R13	124.4	7.1	0.1	0.4	0.1	0.1	0.0	3.6	0.9	0.13
R14	224.1	12.7	0.2	0.5	0.1	0.1	0.0	6.0	1.3	0.18
R15	139.0	8.2	0.2	0.4	0.1	0.1	0.0	4.5	1.1	0.15
R16	128.0	8.1	0.2	0.7	0.1	0.2	0.0	3.7	1.6	0.13
R17	169.0	11.1	0.2	0.9	0.1	0.2	0.0	5.5	2.1	0.17
R18	148.5	9.5	0.2	0.8	0.1	0.2	0.0	4.9	2.1	0.19
R19	231.3	20.4	1.3	6.4	1.5	0.8	0.2	39.5	18.3	4.40
R20	129.3	9.0	0.3	1.2	0.2	0.3	0.0	10.8	3.1	0.39
R21	379.2	21.5	0.6	1.2	0.3	0.4	0.1	13.2	3.4	0.65
R22	227.5	14.6	0.3	1.6	0.3	0.3	0.0	15.2	4.3	0.73
R23	404.8	37.5	1.1	2.6	0.4	0.7	0.1	24.9	5.2	0.79
R24	52.5	3.2	0.1	0.2	0.0	0.1	0.0	2.0	0.5	0.08
R25	60.6	3.6	0.1	0.2	0.0	0.1	0.0	2.1	0.6	0.08
R26	52.1	3.1	0.1	0.2	0.0	0.1	0.0	1.8	0.5	0.08
R27	56.3	3.3	0.1	0.3	0.0	0.1	0.0	2.1	0.7	0.09
R28	98.6	5.6	0.1	0.3	0.0	0.1	0.0	2.4	1.2	0.11
R29	180.8	26.3	0.5	0.8	0.2	0.3	0.1	8.7	5.8	0.37
Standard	30,000	200	40	75	40	40	20	350	125	50

APPENDIX B Impact Assessment Methodology

The significance of all potential impacts that would result from the proposed project is determined in order to assist decision-makers. The significance rating of impacts is considered by decision-makers, as shown below.

- INSIGNIFICANT: the potential impact is negligible and will not have an influence on the decision regarding the proposed activity.
- VERY LOW: the potential impact is very small and should not have any meaningful influence on the decision regarding the proposed activity.
- LOW: the potential impact may not have any meaningful influence on the decision regarding the proposed activity.
- MEDIUM: the potential impact should influence the decision regarding the proposed activity.
- HIGH: the potential impact will affect a decision regarding the proposed activity.
- VERY HIGH: the proposed activity should only be approved under special circumstances.

The **significance** of an impact is defined as a combination of the **consequence** of the impact occurring and the **probability** that the impact will occur. The significance of each identified impact[d] must be rated according to the methodology set out below:

Step 1 – Determine the **consequence** rating for the impact by determining the score for each of the three criteria (A-C) listed below and then **adding** them. The rationale for assigning a specific rating, and comments on the degree to which the impact may cause irreplaceable loss of resources and be irreversible, must be included in the narrative accompanying the impact rating:

Rating	Definition of Rating	Score
A. ***Extent***– *the area over which the impact will be experienced*		
Local	Confined to project or study area or part thereof	1
Regional	The region, which may be defined in various ways, e.g. cadastral, catchment, topographic	2
(Inter) national	Nationally or beyond	3
B. ***Intensity***– *the magnitude of the impact in relation to the sensitivity of the receiving environment, taking into account the degree to which the impact may cause irreplaceable loss of resources*		
Low	Site-specific and wider natural and/or social functions and processes are negligibly altered	1
Medium	Site-specific and wider natural and/or social functions and processes continue albeit in a modified way	2
High	Site-specific and wider natural and/or social functions or processes are severely altered	3
C. ***Duration***– *the timeframe over which the impact will be experienced and its reversibility*		
Short-term	Up to 2 years	1
Medium-term	2 to 15 years	2

[d] This does not apply to minor impacts which can be logically grouped into a single assessment.

Long-term	More than 15 years	3

The combined score of these three criteria corresponds to a **Consequence Rating**, as follows:

Combined Score (A+B+C)	3 – 4	5	6	7	8 – 9
Consequence Rating	Very low	Low	Medium	High	Very high

Step 2 – Assess the **probability** of the impact occurring according to the following definitions:

Probability– the likelihood of the impact occurring	
Improbable	< 40% chance of occurring
Possible	40% - 70% chance of occurring
Probable	> 70% - 90% chance of occurring
Definite	> 90% chance of occurring

Step 3 – Determine the overall **significance** of the impact as a combination of the **consequence** and **probability** ratings, as set out below:

		Probability			
		Improbable	Possible	Probable	Definite
Consequence	Very Low	**INSIGNIFICANT**	**INSIGNIFICANT**	**VERY LOW**	**VERY LOW**
	Low	**VERY LOW**	**VERY LOW**	**LOW**	**LOW**
	Medium	**LOW**	**LOW**	**MEDIUM**	**MEDIUM**
	High	**MEDIUM**	**MEDIUM**	**HIGH**	**HIGH**
	Very High	**HIGH**	**HIGH**	**VERY HIGH**	**VERY HIGH**

Step 4 – Note the **status** of the impact.

Status of impact	
Indication whether the impact is adverse (negative) or beneficial (positive).	+ ve (positive – a 'benefit')
	– ve (negative – a 'cost')

Step 5 – State your level of **confidence** in the assessment of the impact (high, medium or low).

Confidence of assessment	
The degree of confidence in predictions based on available information, and/or specialist knowledge.	Low
	Medium
	High

Step 6 – Identify and describe practical mitigation and optimisation measures that can be implemented effectively to reduce or enhance the significance of the impact. Mitigation and optimisation measures must be described as either:

- Essential: best practice measures which must be implemented and are non-negotiable; and
- Best Practice: recommended to comply with best practice, with adoption dependent on the proponent's risk profile and commitment to adhere to best practice, and which must be shown to have been considered and sound reasons provided by the proponent if not implemented.

Essential mitigation and optimisation measures must be inserted into the completed impact assessment table. The impact should be re-assessed with mitigation, by following Steps 1-5 again to demonstrate how the extent, intensity, duration and/or probability change after implementation of the proposed mitigation measures. *Best practice* measures must also be inserted into the impact assessment table, but not considered in the "with mitigation" impact significance rating.

Step 7 – Summarise all impact significance ratings as follows in your executive summary:

Impact	Consequence	Probability	Significance	Status	Confidence
Impact 1: XXXX	Medium	Improbable	LOW	–ve	High
With Mitigation	Low	Improbable	VERY LOW		High
Impact 2: XXXX	Very Low	Definite	VERY LOW	–ve	Medium
With Mitigation:	Not applicable				