ATMOSPHERIC IMPACT REPORT

In support of the EIA for the proposed Coega 3000 MW Integrated Gas-to-Power Project
Land-based LNG Terminal and Infrastructure Project

uMOYA-NILU

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Report Details

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EXECUTIVE SUMMARY

The Coega Development Corporation (CDC) proposes to develop a power project within the Coega Special Economic Zone (SEZ) and the Port of Ngqura including three gas to power plants and associated infrastructure for gas import and distribution.

In accordance with the requirements of the National Environmental Management Act (NEMA) 2014 EIA regulations, as amended, the proposed project requires a full Scoping and EIA process to be conducted. The CDC has appointed SRK Consulting (South Africa) (Pty) Ltd to facilitate the required environmental authorisation process and to conduct an Environmental Impact Assessment (EIA) in terms of the National Environmental Management Act. SRK has appointed uMoya-NILU Consulting (Pty) Ltd to undertake the supporting air quality specialist study for the EIA.

An air quality assessment for the proposed Land-based LNG Terminal and Infrastructure Project and the on-site liquid fuel storage tanks has been conducted. The requirements of the Atmospheric Impact Report (AIR) have been adhered to and the methodology followed the regulatory requirement for dispersion modelling studies.

LNG is a clean fuel. The predicted ambient concentrations of SO_2, NO_2, PM_{10} and CO resulting from emissions from the Land based LNG Terminal and Infrastructure Project are therefore very low. The significance rating for the air quality impacts is insignificant for all pollutants.

Ambient monitoring and dispersion modelling show that ambient concentrations of SO_2 and NO_2 in the Coega SEZ are generally low, but there are some areas where NO_2 exceedances occur. PM_{10} concentrations are relatively high and exceedances of ambient standards were modelled from baseline emission data. The cumulative effect of the proposed operation will be negligible and will not contribute to exceedances of the ambient standards in the SEZ.

The predicted ambient concentrations resulting from emissions from the CDC project (three 1 000 MW power plants and the infrastructure project) are very low and the intensity is rated as low for NO_2 and irrelevant for the other pollutants. It is highly unlikely that they will contribute to exceedances of the ambient standards. The cumulative effect of the overall CDC project will be very small or negligible.

The cumulative effect of the gas-to-power projects is also predicted to be very small or negligible. The predicted ambient concentrations resulting from the power plant emissions are very low and the intensity is rated as low for NO_2 and irrelevant for the other pollutants. It is highly unlikely that they will contribute to exceedances of the ambient standards.

Based on the findings of this assessment of the Land-based LNG Terminal and Infrastructure Project, it is recommended that the application be approved.

GLOSSARY OF TERMS AND ACRONYMS

AEL	Atmospheric Emission Licence
AIR	Atmospheric Impact Report
DEA	Department of Environmental Affairs
g/s	Grams per second
kPa	Kilo Pascal
MES	Minimum Emission Standards
mg/hr	Milligrams per hour refers to emission rate, i.e. mass per time
mg/Nm^3	Milligrams per normal cubic meter refers to emission concentration, i.e. mass per volume at normal temperature and pressure, defined as air at 20^{o}C (293.15 K) and 1 atm (101.325 kPa)
NAAQS	National Ambient Air Quality Standards
NEM-AQA	National Environment Management: Air Quality Act, 2004 (Act No. 39 of 2004)
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
USEPA	United States Environmental Protection Agency
µm	1 µm = Micro meter 1 µm = 10^{-6} m
WHO	World Health Organization

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1. ENTERPRISE DETAILS

1.1 Project overview

Ultimately the proposed Coega 3000 MW Integrated Gas-to-Power Project will include the following components:

i. A Liquefied Natural Gas (LNG) terminal, consisting of a berth with off-loading arms within the Port of Ngqura, cryogenic pipelines, storage and handling facilities and re-gasification modules. Initially a floating storage and regasification unit in the Port of Ngqura is proposed, followed by land-based storage and regasification as the economics of the project merit the investment in this infrastructure.

ii. Three 1000 MW Gas to Power plants. Two power plants are proposed in Zone 10 (coastal) and one in Zone 13 (inland) of the SEZ. Power generation will be by means of a hybrid of Combined Cycle Gas Turbines (CCGT), Open Cycle Gas Turbines (OCGT), and Reciprocating Engines (RE). Each power plant will use LNG as the primary source of fuel, with diesel and fuel oil as back up fuels. On-site storage of back up fuels will include two 4 000 m^3 tanks for diesel and two 4 000 m^3 tanks for fuel oil.

iii. Gas pipelines for the transmission, distribution, and reticulation of natural gas from the ship off loading berth to the power plants and to a designated off take point for road transport of LNG & Natural Gas (NG).

The proposed layout of the project components is shown in Figure 1.

Environmental Authorisation will be sought for each project. This AIR supports the application for the proposed Land-based LNG Terminal and infrastructure project.

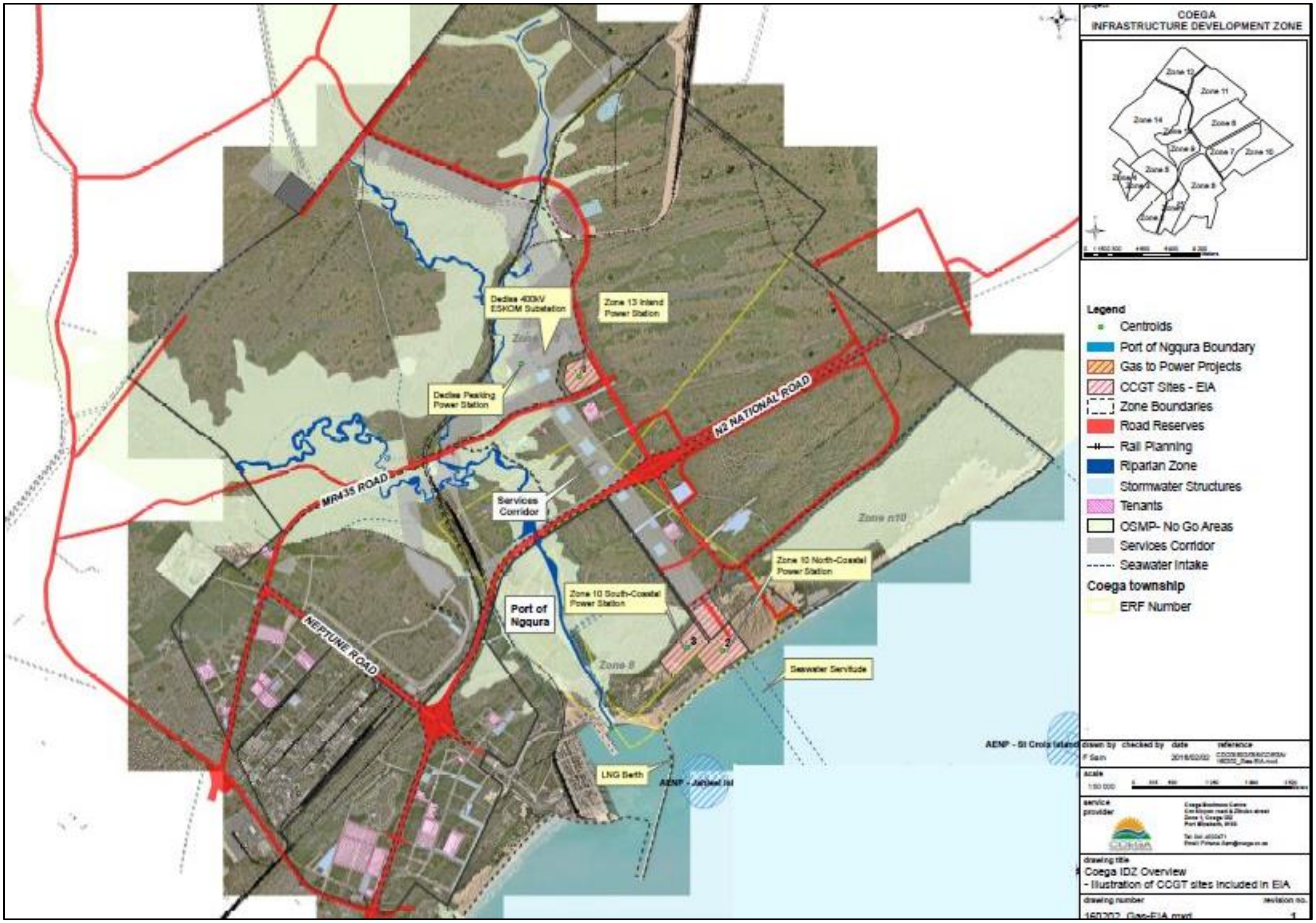


Figure 1: Proposed layout of the Coega 3000 MW Integrated Gas-to-Power Project

1.2 Enterprise Details

The enterprise details for the Coega Development Corporation (CDC) are listed in Table 1.

Table 1: Enterprise details

Entity Name:	Coega Development Corporation
Trading as:	Coega Development Corporation
Type of Enterprise, e.g. Company/Close Corporation/Trust, etc.:	Corporation
Company/Close Corporation/Trust Registration Number (Registration Numbers if Joint Venture):	82003891/07
Registered Address:	Corner Alcyon & Zibuko St, Zone 1, Coega SEZ, Port Elizabeth, 6100
Postal Address:	Pvt Bag X6009, Port Elizabeth
Telephone Number (General):	041 4030421
Fax Number (General):	041 4030401
Company Website:	
Industry Type/Nature of Trade:	Power generation
Land Use Zoning as per Town Planning Scheme:	Industrial
Land Use Rights if outside Town Planning Scheme:	N/A
Responsible Person:	Mr Sadiek Davids
Emissions Control Officer:	To be appointed
Telephone Number:	041403 0400
Cell Phone Number:	084570 2849
Fax Number:	041 4030401
Email Address:	Sadick.davids@coega.co.za
After Hours Contact Details:	As above

1.3 Location and extent of the plant

The site information relating to the proposed Coega 3000 MW Integrated Gas-to-Power Project's Land-based LNG Terminal and Infrastructure Project is listed in Table 2.

Table 2: Site information

Physical Address of the Licensed Premises:	Coega SEZ and Ngqura Port
Description of Site:	Coega SEZ and Ngqura Port
Property Registration Number (Surveyor-General Code):	ERF 355 C07600230000035500000
Coordinates (latitude, longitude) of Approximate Centre of Operations (Decimal Degrees):	Latitude: -33.776803° Longitude: 25.710402°
Coordinates (UTM) of Approximate Centre of Operations:	Easting: 380594 m E Northing: 6261844 m S
Extent (km²):	0.23 km^2
Elevation Above Mean Sea Level (m):	72 m
Province:	Eastern Cape
District/Metropolitan Municipality:	Nelson Mandela Bay Metropolitan Municipality
Local Municipality:	N/A
Designated Priority Area (if applicable):	N/A

1.3 Description of surrounding landuse (within 5 km radius)

The proposed project site is currently a Greenfield location in Zone 10 of the Coega SEZ (Figure 1 and Figure 2). The Coega SEZ is located within the Nelson Mandela Bay Municipality (NMBM). There are no residences within the SEZ, so human exposure to emissions from the proposed power station is limited to the industries and businesses that operate at the Coega SEZ and the adjacent Markman industrial area.

According to the USEPA, sensitive receptors include, but are not limited to, hospitals, schools, day care facilities, elderly housing and convalescent facilities. These are areas where the occupants are more susceptible to the adverse effects of exposure to toxic chemicals, pesticides, and other pollutants. Extra care must be taken when dealing with contaminants and pollutants in close proximity to areas recognised as sensitive receptors.

Industrial areas may be classified as receptors, but not necessarily sensitive receptors. Higher pollutant concentrations are normally expected in industrial areas and this is reflected in the NAAQS (e.g. dust fallout limit value of 1 200 $mg/m^2/day$ for industrial areas versus 600 $mg/m^2/day$ for residential areas).

The closest residential area to the proposed site is Motherwell, which is located adjacent to the south-western border of the SEZ, approximately 2.3 km away. Motherwell is a densely populated township with a total population of approximately 130 000 or 4 000 inhabitants per square kilometre. Motherwell is identified as a sensitive receptor due to the presence of schools, hospitals, crèches, etc. there.

Another residential area, Wells Estate, is located on the southern border of the SEZ, approximately 4.2 km from the proposed site. This is a smaller area with substantially fewer residents. Further south is Bluewater Bay, located approximately 7 km away. All other residential areas are located more than 10 km away from the power plant site.

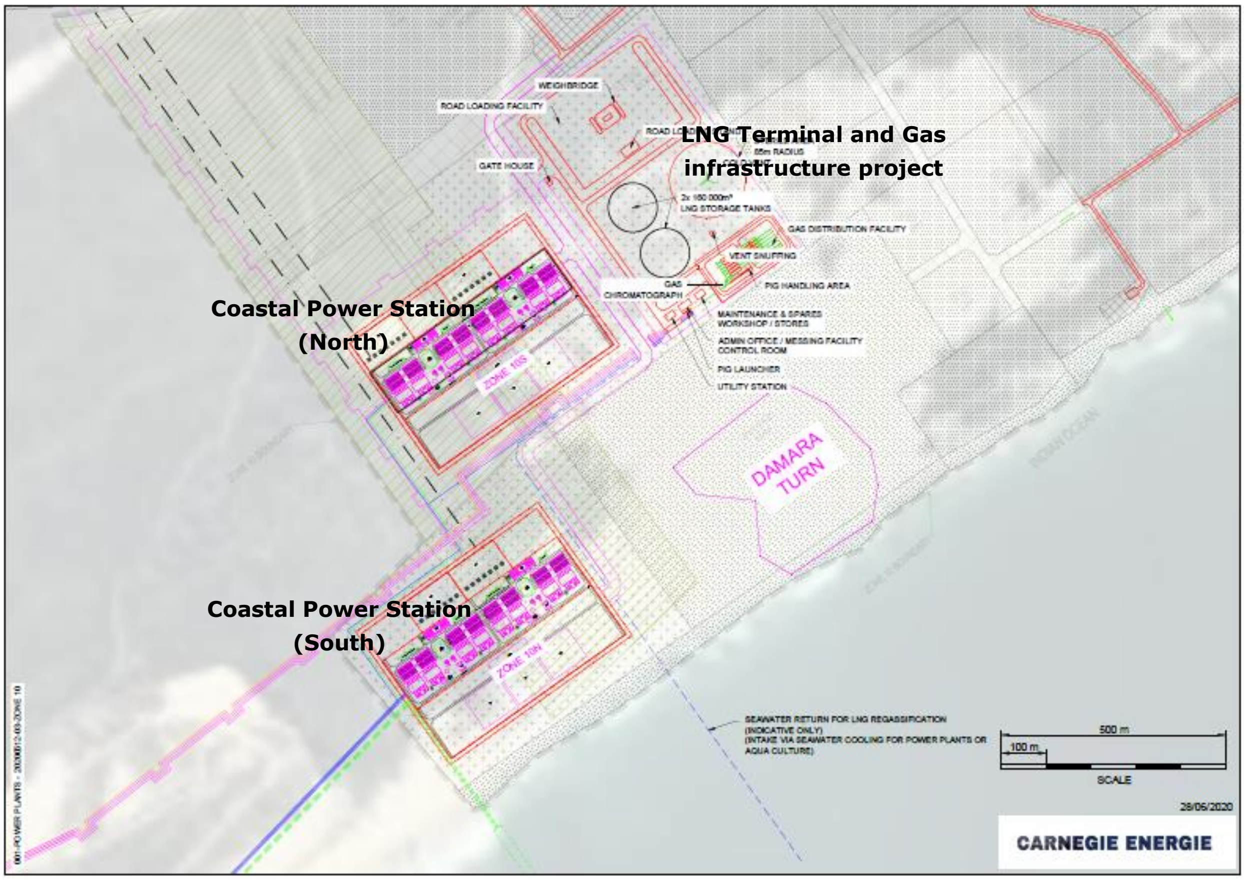


Figure 2: Relative location of the Land-based LNG Terminal and Infrastructure Project, also showing the Zone 10: Coastal Power Station (South), also shown in the Zone 10: Coastal Power Station (North)

1.5 Emission Control Officer

The Power Station Manager will be the Emission Control Officer (ECO). This position does not yet exist.

1.6 Atmospheric Emission Licence (AEL) and Other Authorisations

An Atmospheric Emissions Licence (AEL) nor any other authorisations have been issued for the proposed Land-based LNG Terminal and Infrastructure Project of the Coega 3000 MW Gas-to-Power Project (Table 3).

Table 3: Current authorisations related to air quality

Atmospheric Emission License	Date of Registration Certificate	Listed Activity Subcategory	Category of Listed Activity	Listed Activity Process Description
No record				

1.6 Modelling contractor

The dispersion modelling for this AIR is conducted by:

Company:	uMoya-NILU Consulting (Pty) Ltd	
Modellers:	Dr Mark Zunckel and Atham Raghunandan	
Contact details:	Tel:	031 262 3265
	Cell:	083 690 2728
	email:	mark@umoya-nilu.co.za or atham@umoya-nilu.co.za

1.7 Terms of Reference

The application for Environmental Authorisation for the proposed 3 000 MW Coega Gas-to-Power Project will be split into four separate applications. Therefore, separate AIRs will be compiled for each power plant and for the gas infrastructure (i.e. a total of four AIRs).

The terms of reference for the Atmospheric Impact Reports (AIRs) are to:

- Conduct a baseline assessment.
- Describe the sources of emissions and compile of an emissions inventory for each of the proposed facilities.
- Conduct dispersion modelling for key pollutants identified in the emissions inventory to predict ambient concentrations and present these as isopleths on a base map of the surrounding area.
- Assess impacts on ambient air quality during construction, operation and decommissioning phases of the projects.
- Identify operating conditions (e.g. start-up & maintenance) that may lead to 'abnormal' air emissions.
- Recommend management and mitigation measures (including optimal height of stacks) associated with impacts from the proposed power plants.
- Assess cumulative impacts on ambient air quality, with reference to the additional emissions each power plant will add.

1.8 Assumptions

The following assumptions are relevant to this AIR:

a) No ambient monitoring is done in this assessment, rather available ambient air quality data is used.
b) The Model Plan of Study (uMoya-NILU, 2020) describes the dispersion modelling methodology and has been accepted by the Licensing Authority.
c) The potential air quality impacts of the proposed Land-based LNG Terminal and Infrastructure Project is assessed for the plant only and for the plant with existing air pollution sources in the Coega SEZ.
d) The assessment of potential human health impacts is based on predicted (modelled) ambient concentrations of SO_2, NO_2, CO, PM_{10} and benzene and health-based NAAQS.

2. NATURE OF THE PROCESS

2.1 Listed Activity or Activities

As a measure to reduce emissions from industrial sources and to improve ambient air quality, Listed Activities and associated Minimum Emission Standards (MES) were published in 2010 in Government Notice 248 (DEA, 2010) and revised in 2013 (Government Notice 893, DEA, 2013), in 2019 (Government Notice 867, DEA, 2019) and in 2020 (Government Notice 657, DEA, 2020).

The storage of gas and liquid fuels over a specified storage capacity is a Listed Activity. The definition of the Listed Activity is shown in Table 4. The MES for Sub-categories are listed in Table 5.

Table 4: Details of the Listed Activities carried out at the Land-based LNG Terminal and Infrastructure Project, according to GN 248 (DEA, 2010) and its revisions (DEA, 2013, 2019 and 2020)

Category of Listed Activity	Sub-category of the Listed Activity	Application
Category 2: Petroleum industry, the production of gaseous and liquid fuels as well as petrochemicals from crude oil, coal, gas or biomass	Sub-category 2.4: Storage and Handling of Petroleum Products	All permanent immobile liquid storage facilities at a single site with a combined storage capacity greater than 1000 m^3.

Table 5: Minimum Emission Standards for Listed Activity sub-category 2.4 according to GN 248 (DEA, 2010) and its revisions (DEA, 2013, 2019 and 2020)

<table>
<tr><th colspan="4">2.4: Storage and Handling of Petroleum Products</th></tr>
<tr><th colspan="2">Application</th><th colspan="2">All permanent immobile liquid Storage facilities at a single site with a combined storage capacity of greater than 1 000 m^3</th></tr>
<tr><th colspan="2">True vapour pressure of contents at product storage temperature</th><th colspan="2">Type of tank or vessel</th></tr>
<tr><td colspan="2">Type 1: Up to 14 kPa</td><td colspan="2">Fixed-roof tank vented to atmosphere, or as per Type 2 and 3</td></tr>
<tr><td colspan="2">Type 2: Above 14 kPa and up to 91 kPa with a throughput of less than 50 000 m^3 per annum</td><td colspan="2">Fixed-roof tank with Pressure Vacuum Vents fitted as a minimum, to prevent "breathing" losses, or as per Type 3</td></tr>
<tr><td colspan="2">Type 3: Above 14 kPa and up to 91 kPa with a throughput greater than 50 000 m^3 per annum</td><td colspan="2">a) External floating-roof tank with primary rim seal and secondary rim seal for tank with a diameter greater than 20 m, or
b) fixed-roof tank with internal floating deck / roof fitted with primary seal, or
c) fixed-roof tank with vapour recovery system.</td></tr>
<tr><td colspan="2">Type 4: Above 91 kPa</td><td colspan="2">Pressure vessel</td></tr>
<tr><th colspan="2">Description:</th><th colspan="2">Vapour Recovery Units</th></tr>
<tr><th colspan="2">Application:</th><th colspan="2">All loading/ offloading facilities with a throughput greater than 50 000 m^3</th></tr>
<tr><th colspan="2">Substance or mixture of substances</th><th rowspan="2">Plant status</th><th rowspan="2">mg/Nm^3 under normal conditions of 273 Kelvin and 101.3 kPa</th></tr>
<tr><th>Common Name</th><th>Chemical Symbol</th></tr>
<tr><td rowspan="2">Total volatile organic compounds from vapour recovery/ destruction units using thermal treatment</td><td rowspan="2">N/A</td><td>New</td><td>150</td></tr>
<tr><td>Existing</td><td>150</td></tr>
<tr><td rowspan="2">Total volatile organic compounds from vapour recovery/ destruction units using non-thermal treatment</td><td rowspan="2">N/A</td><td>New</td><td>40 000</td></tr>
<tr><td>Existing</td><td>40 000</td></tr>
</table>

2.2 Controlled emitters

To regulate emissions from small boilers to improve ambient air quality, boilers with a design capacity equal to 10 MW but less than 50 MW net heat input per unit have been declared Controlled Emitters (DEA, 2013). Amongst others, the regulation includes Minimum Emission Standards for SO_2 and PM for gaseous fuel-fired boilers using natural gas or LPG (Table 6).

For this assessment, it is assumed that one heater and two power units will be operated at the Land-based LNG Terminal and Infrastructure Project. It is further assumed that each of the three units has a net heat input of less than 50 MW and they all use natural gas. The regulations for Controlled Emitters may apply to these units.

Table 6: Minimum emission standards for small boilers using low particulate matter gaseous fuel

Substance or mixture of substances		Limit value (dry mg/Nm^3, 273K, 101.3 kPa, 3% O_2)
Common Name	**Chemical Symbol**	
Particulate matter	PM	10
Sulphur dioxide	SO_2	35

2.3 Process Description

2.3.1 *Liquefied natural gas (LNG)*

Natural gas used for energy generation is primarily methane, with low concentrations of other hydrocarbons, water, carbon dioxide, nitrogen, oxygen and some sulphur compounds. Liquefied Natural Gas (LNG) is natural gas which has been cooled below its boiling point (-161°C) in a process known as liquefaction. The process of liquefaction involves extracting most of the impurities in raw natural gas. The remaining natural gas is primarily methane with only small amounts of other hydrocarbons and consequently is widely considered a clean fossil fuel.

2.3.2 *Land-based storage and regasification plant*

It is proposed that cryogenic pipelines will feed LNG to the land-based storage and regasification terminal. Cryogenic pipelines maintain the gas as a liquid at a temperature below its boiling point (-162°C) close to atmospheric pressure. LNG storage tanks are designed to withstand cryogenic temperatures, maintain the liquid at low temperature, and minimise the amount of evaporation. Due to surrounding temperatures, even with effective insulation, part of the LNG reaches its boiling point and begins to evaporate creating a gas called Boil-Off Gas (BOG) which is largely methane. The BOG is captured and re-condensed to be sent to the vaporiser with LNG or compressed and sent to the pipeline.

It is estimated that two LNG Storage tanks or 160,000 m^3 each (i.e. total LNG storage of 340,000 m^3) will be required (Carnegie Energie, 2019). No storage of natural gas is proposed. The storage facility will require a venting system as protection against the risk of overpressure due to "roll-over" in the LNG tank. LNG "rollover" refers to the rapid release of LNG vapours from a storage tank, resulting from stratification. A schematic of the storage and regasification process flow is shown in Figure 3.

2.3.3 *LNG Regasification*

Regasification is the opposite of liquefaction and involves the warming LNG to the point where it becomes a gas. This process occurs naturally at atmospheric temperatures (known as "boil off"), and is expedited by passing LNG through warmer media.

The main component in the regasification process is the vaporiser. LNG vaporisers are heat exchangers used to return the LNG to its regular vapour phase. Due to the proximity of the sea the technically preferred vaporisers are Open Rack Vaporisers (ORV). ORVs take seawater and flow it over the vertical tubes of the vaporisers in order to warm up the LNG. This is the most common type and generally is the preferred choice where warm seawater is available.

2.3.4 *Gas Distribution*

The gas exported from the regasification unit will be transported to a gas distribution. Gas will be regulated at the facility to meet the export gas pressure and flow requirements based on the client's specific purposes. It is envisaged that the distribution facility will cater the power plants and for third party users, including a truck loading facility.

It is anticipated that pipelines of about 6 km long will be required to reach the Zone 13 power plant and existing Dedisa power plant, and approximately 1 km long to the Zone 10 power plant and truck loading facility. The diameters of these pipelines are currently unknown.

2.3.5 *LNG truck loading facility*

The LNG Truck Loading Facility will be provided for third party offtake. This will be complete with recirculation systems for BOG and LNG. The Truck Loading Facility will typically include a weighbridge and loading arms. The estimated offtake of LNG is approximately of 787 tpd, providing offtake by 40 x 20 ton LNG trucks per day.

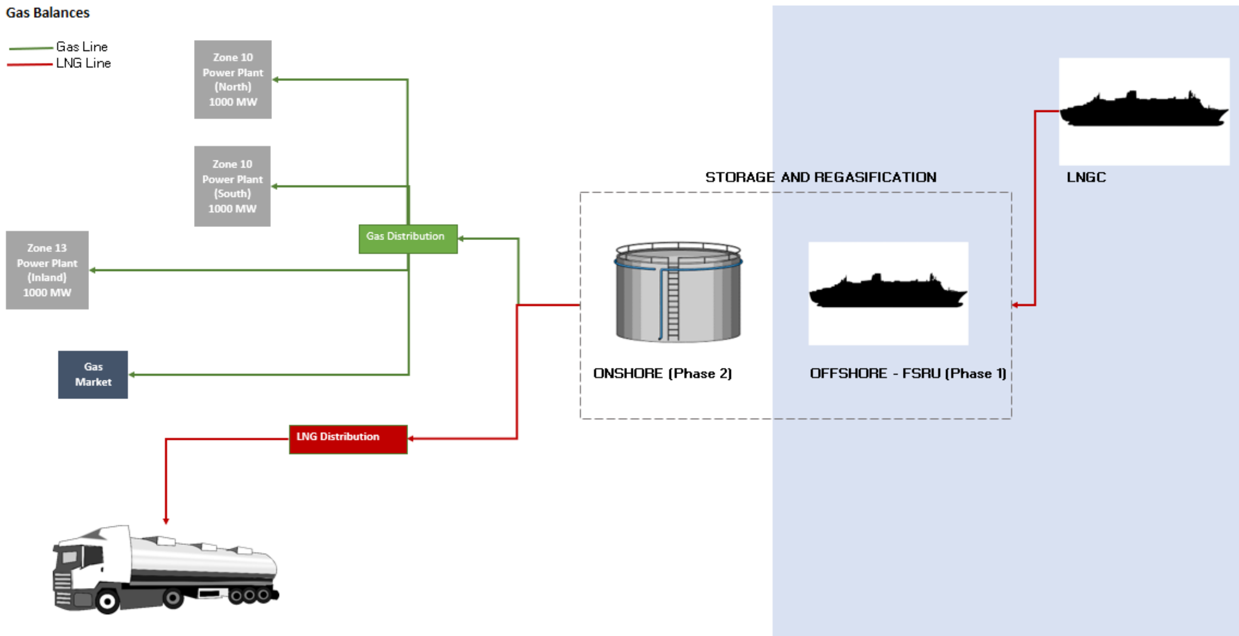


Figure 3: Schematic process diagram for the LNG storage and regasification facility (Carnegie Energie, 2019)

2.3.6 *Air pollutants resulting from the process*

2.2.3.1 Overview

The quantity and nature of emissions to the atmosphere from LNG combustion depends on the quality of the fuel, fuel consumption, the combustion device, and the air pollution control devices.

The combustion of LNG included results in gaseous emissions of sulphur dioxide (SO_2), oxides of nitrogen ($NO + NO_2 = NO_X$), carbon monoxide (CO), and some particulate matter (PM). Carbon dioxide (CO_2) is the main Greenhouse Gases resulting from LNG combustion.

SO_2 is produced from the combustion of sulphur in the LNG. NO_X is produced from thermal fixation of atmospheric nitrogen in the combustion flame and from oxidation of nitrogen bound in the LNG. The quantity of NO_x produced is directly proportional to the temperature of the flame. The non-combustible portion of the fuel remains as solid waste and emitted as particulates.

Back-up fuels stored on-site can generate VOC’s such as benzene, toluene, ethyl benzene and xylene from storage and transportation losses.

2.2.3.2 National Ambient Air Quality Standards

The effects of air pollutants on human health occur in different ways of ways with short-term, or acute effects, and chronic, or long-term, effects. Different groups of people are affected differently, depending on their level of sensitivity, with the elderly and young children being more susceptible. Factors that link the concentration of an air pollutant to an observed health effect are the concentration and the duration of the exposure to that particular air pollutant.

Criteria pollutants occur ubiquitously in urban and industrial environments. Their effects on human health and the environment are well documented by the World Health Organisation (WHO) (e.g. WHO, 1999; 2003; 2005). South Africa has accordingly established NAAQS for SO_2, NO_2, CO, respirable particulate matter (PM_{10}), amongst others (DEA, 2009).

The NAAQS consists of a 'limit' value and a permitted frequency of exceedance. The limit value is the fixed concentration level aimed at reducing the harmful effects of a pollutant. The permitted frequency of exceedance represents the acceptable number of exceedances of the limit value expressed as the 99th percentile. Compliance with the ambient standard implies that the frequency of exceedance of the limit value does not exceed the permitted tolerance. Being a health-based standard, ambient concentrations below the standard imply that air quality poses an acceptable risk to human health, while exposure to ambient concentrations above the standard implies that there is an unacceptable risk to human health. The NAAQS for PM_{10}, NO_X, SO_2, CO and benzene are presented in Table 13.

Table 7: NAAQS for pollutants relevant to the Inland Power Station. Values in brackets are effective from 1 Jan 2030

Pollutant	Averaging period	Limit value ($\mu g/m^3$)	Tolerance
SO_2	1 hour	350	88
	24 hour	125	4
	1 year	50	0
NO_2	1 hour	200	88
	1 year	40	0
CO	1-hour	30 000	88
	8-hour running mean	10 000	11
PM_{10}	24 hour	75	4
	1 year	40	0
$PM_{2.5}$	24 hour	40 (25)	0
	1 year	20 (15)	0
Benzene	Annual	5	0

CO_2 is a Greenhouse Gas, therefore ambient air quality standards do not apply. However, it is a priority pollutant (DEA, 2016). Emissions must be accounted for and reported.

2.2.3.3 Air pollutants and health implications

The sections below provide a literature review of these pollutants from an air quality and human health perspective.

Sulphur dioxide (SO_2)

Dominant sources of SO_2 include fossil fuel combustion from industry and power plants. SO_2 is emitted when coal is burnt for energy. The combustion of fuel oil also results in high SO_2 emissions. Domestic coal or kerosene burning can thus also result in the release of SO_2. Motor vehicles also emit SO_2, in particular diesel vehicles due to the higher sulphur content of diesel fuel. Smelting of mineral ores can also result in the production of SO_2, because metals usually exist as sulphides within the ore.

On inhalation, most SO_2 only penetrates as far as the nose and throat, with minimal amounts reaching the lungs, unless the person is breathing heavily, breathing only through the mouth, or if the concentration of SO_2 is high (CCINFO, 1998). The acute response to SO_2 is rapid, within 10 minutes in people suffering from asthma (WHO, 2005). Effects such as a reduction in lung function, an increase in airway resistance, wheezing and shortness of breath, are enhanced by exercise that increases the volume of air inspired, as it allows SO_2 to penetrate further into the respiratory tract (WHO, 1999). SO_2 reacts with cell moisture in the respiratory system to form sulphuric acid. This can lead to impaired cell function and effects such as coughing, broncho-constriction, exacerbation of asthma and reduced lung function. For example an exposure of 5 to 10 min to 200 to 300 ppb (520 to 780 μg/m^3) may reduce lung function (measured as Forced Expiratory Volume in the first second (FEV_1)) by more than 15% (US-EPA, 2009). There is however, uncertainty about exposure-response effects below concentrations of 200 ppb (520 μg/m^3). For SO_2 exposure short-term peak concentrations are therefore important (US-EPA, 2009). Re-analysis of the effects of SO_2 done post-2005 has found evidence to suggest that the point of departure for setting the 10-minute guideline needs an additional uncertainty factor, which indicates that the guideline may have to be lowered when it is re-evaluated (WHO, 2013).

Nitrogen dioxide (NO_2)

Nitrogen dioxide (NO_2) and nitric oxide (NO) are formed simultaneously in combustion processes and other high temperature operations such as metallurgical furnaces, blast furnaces, plasma furnaces, and kilns. NO_X is a term commonly used to refer to the combination of NO and NO_2. NO_X can also be released from nitric acid plants and other types of industrial processes involving the generation and/or use of nitric acid. NO_X also forms naturally through de-nitrification by anaerobic bacteria in soils and plants. Lightning is also a source of NO_X.

The route of exposure to NO_2 is inhalation and the seriousness of the effects depend more on the concentration than on the length of exposure. The site of deposition for NO_2 is the distal lung where NO_2 reacts with moisture in the fluids of the respiratory tract to form nitrous and nitric acids. About 80 to 90% of inhaled nitrogen dioxide is absorbed through the lungs (CCINFO, 1998). Nitrogen dioxide (present in the blood as the nitrite ion) oxidises unsaturated membrane lipids and proteins, which then results in the loss of control of cell permeability. Nitrogen dioxide causes decrements in lung function, particularly increased airway resistance. Inflammatory reactions were observed at NO_2 concentrations between 200 and 1000 ppb (380 to 1880 µg/m^3) when individuals were exposed under controlled conditions for periods that varied between 15 minutes and six hours (WHO, 2013). However, the results had been inconsistent below 1000 ppb but were much more evident at concentrations higher than 1000 ppb (1880 µg/m^3) (WHO, 2013). Below 1000 ppb healthy individuals did not show inflammatory reactions and for those with respiratory diseases (asthma and chronic obstructive pulmonary disease), inflammation was not induced below 600 ppb, except for one study that reported individuals responded at 260 ppb (500 µg/m^3) (Hesterberg et al., 2009). A review study (on 50 publications) published in 2009 by Hesterberg et al. focussed on short-term exposure to NO_2 and adverse health effects on humans. The authors came to the conclusion that a short-term exposure standard of not more than 200 ppb would protect all individuals, including sensitive individuals. People with chronic respiratory problems and people who work or exercise outside will be more at risk to NO_2 exposure.

Chronic exposure to NO_2 increases susceptibility to respiratory infections (WHO, 1997). However, a review study of 50 publications found no consistent evidence that short-term exposure below 200 ppb increased susceptibility to viral infections (Hesterberg et al., 2009).

The WHO has reviewed hundreds of studies published between 2004 and 2011 on adverse health effects after short-term and long-term exposure to NO_2 (WHO, 2013). The health effects from short-term exposure are more evident than those from long-term (chronic) exposure, because in many studies a high correlation was found between NO_2 and other pollutants (WHO, 2013). However, some epidemiology studies suggested an association between NO_2 and respiratory mortality and an association with respiratory effects in children, including effects on children’s lung function (WHO, 2013).

Particulate Matter

Particulate Matter (PM) is a broad term used to describe the fine particles found in the atmosphere, including soil dust, dirt, soot, smoke, pollen, ash, aerosols and liquid droplets. With PM, it is not just the chemical composition that is important but also the particle size. Particle size has the greatest influence on the behaviour of PM in the atmosphere with smaller particles tending to have longer residence times than larger ones. PM is categorised, according to particle size, into TSP, PM_{10} and $PM_{2.5}$.

Total suspended particulates (TSP) consist of all particles smaller than 100 μm suspended within the air. TSP is useful for understanding nuisance effects of PM, e.g. settling on houses, deposition on and discolouration of buildings, and reduction in visibility.

PM_{10} describes all particulate matter in the atmosphere with a diameter equal to or less than 10 μm. Sometimes referred to simply as coarse particles, they are generally emitted from motor vehicles, factory and utility smokestacks, construction sites, tilled fields, unpaved roads, stone crushing, and burning of wood. Natural sources include sea spray, windblown dust and volcanoes. Coarse particles tend to have relatively short residence times as they settle out rapidly and PM_{10} is generally found relatively close to the source except in strong winds.

$PM_{2.5}$ describes all particulate matter in the atmosphere with a diameter equal to or less than 2.5 μm. They are often called fine particles, and are mostly related to combustion (motor vehicles, smelting, incinerators), rather than mechanical processes as is the case with PM_{10}. $PM_{2.5}$ may be suspended in the atmosphere for long periods and can be transported over large distances. Fine particles can form in the atmosphere in three ways: when particles form from the gas phase, when gas molecules aggregate or cluster together without the aid of an existing surface to form a new particle, or from reactions of gases to form vapours that nucleate to form particles.

Particulate matter may contain both organic and inorganic pollutants. The extent to which particulates are considered harmful depends on their chemical composition and size, e.g. particulates emitted from diesel vehicle exhausts mainly contain unburned fuel oil and hydrocarbons that are known to be carcinogenic. Very fine particulates pose the greatest health risk as they can penetrate deep into the lung, as opposed to larger particles that may be filtered out through the airways' natural mechanisms.

In normal nasal breathing, particles larger than 10 μm are typically removed from the air stream as it passes through the nose and upper respiratory airways, and particles between 3 μm and 10 μm are deposited on the mucociliary escalator in the upper airways. Only particles in the range of 1 μm to 2 μm penetrate deeper where deposition in the alveoli of the lung can occur (WHO, 2003). Coarse particles (PM_{10} to $PM_{2.5}$) can accumulate in the respiratory system and aggravate health problems such as asthma. $PM_{2.5}$, which can penetrate deeply into the lungs, are more likely to contribute to the health effects (e.g. premature mortality and hospital admissions) than coarse particles (WHO, 2003).

The WHO has reviewed many studies since 2005 to update information on health effects on PM (WHO, 2013). Studies have once again confirmed that PM (not only PM_{10} but fine and ultra-fine PM as well), has short and long-term (both immediate and delayed) adverse health effects such as cardiovascular effects, but new associations with diseases such as atherosclerosis (thickening of artery walls), birth defects and respiratory illness in children have also been found (WHO, 2013). In addition, some studies have suggested a possible link between PM and diabetes and effects on the central nervous system (WHO, 2013). The increase in daily mortality (between 0.4% and 1%) from exposure to PM_{10} was also confirmed in several studies since 2005 (WHO, 2013).

Carbon monoxide

CO is an odourless, colourless and toxic gas. People with pre-existing heart and respiratory conditions, blood disorders and anaemia are sensitive to the effects of CO. Health effects of CO are mainly experienced in the neurological system and the cardiovascular system (WHO, 1999). The binding of CO with haemoglobin reduces the oxygen-carrying capacity of the blood and impairs the release of oxygen from haemoglobin to extravascular tissues. These are the main causes of tissue hypoxia produced by CO at low exposure levels. The toxic effects of CO become evident in organs and tissues with high oxygen consumption such as the brain, the heart, exercising skeletal muscle and the developing fetus.

Benzene

Benzene (C_6H_6) is a natural component of crude oil, petrol, diesel and other liquid fuels and is emitted when these fuels are combusted. Diesel exhaust emissions therefore contain benzene. After exposure to benzene, several factors determine whether harmful health effects will occur, as well as the type and severity of such health effects. These factors include the amount of benzene to which an individual is exposed and the length of time of the exposure. For example, brief exposure (5–10 minutes) to very high levels of benzene (14000 – 28000 $\mu g/m^3$) can result in death (ATSDR, 2007). Lower levels (980 – 4200 $\mu g/m^3$) can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion and unconsciousness. In most cases, people will stop feeling these effects when they are no longer exposed and begin to breathe fresh air. Inhalation of benzene for long periods may result in harmful effects in the tissues that form blood cells, especially the bone marrow. These effects can disrupt normal blood production and cause a decrease in important blood components. Excessive exposure to benzene can be harmful to the immune system, increasing the chance for infection. Both the International Agency for Cancer Research and the US-EPA have determined that benzene is carcinogenic to humans as long-term exposure to benzene can cause leukaemia, a cancer of the blood-forming organs.

2.4 Unit Processes

The unit processes for the Land-based LNG Terminal and Infrastructure Project are listed in Table 8.

Table 8: Unit processes at the Land-based LNG Terminal and Infrastructure Project

Name of the Unit Process	Unit Process Function	Batch or Continuous
Gas Engine: Unit 1	Electricity generation	Continuous
Gas Engine: Unit 2	Electricity generation	Continuous
Heater	Oil heating	Continuous
Cold vent	Emergency release	Emergency only
Storage tanks	Storage of LNG	Continuous
Loading gantry	Loading of trucks	Continuous

3. TECHNICAL INFORMATION

3.1 Raw Materials Used

The proposed Land-based LNG Terminal and Infrastructure Project uses LPG to generate electricity. The raw materials consumption rate at the proposed gas to power plant, the production rate and the energy consumption are listed in Table 9 to Table 11. No by-products are produced.

Table 9: Raw material used

Material Type	Maximum consumption rate	Units
To be confirmed	To be confirmed	To be confirmed
To be confirmed	To be confirmed	To be confirmed

Table 10: Production rate

Product	Maximum production rate	Units
n/a		

Table 11: Energy sources used

Energy source	Sulphur content of fuel (%)	Ash content of fuel (%)	Maximum permitted consumption rate	Units
LNG	0.002% v/v H2S	0	1 681 920	Tonnes/annum

3.2 Appliances and Abatement Equipment Control Technology

No emission abatement will be installed for the of emissions from LNG handling and storage.

Table 12: Appliances and abatement equipment and control technology

Appliance Name	Appliance Type/Description	Appliance Function/Purpose
No air pollution control and/or abatement technology are currently proposed		

4. ATMOSPHERIC EMISSIONS

4.1 Point Source Parameters

The location of the stack and stack parameters are provided in Table 13. For the Land based LNG Terminal and Infrastructure these include the Heater Stack, the generators via a combined stack, and the four stacks on a typical LNG carrier.

Table 13: Location of stacks and stack parameters

Point source name	Unit name	Point source coordinates*	Height of release above ground (m)	Height above nearby building (m)	Diameter at stack tip/vent exit (m)	Actual gas exit temperature (K)	Actual gas volumetric flow (m³/hr)	Actual gas exit velocity (m/s)	Type of emission (continuous/ batch)
Heater Stack	Heater 1	Latitude: -33.777°; Longitude: 25.713°	40	>10	3.2	773.15	434 294	15	Continuous
Power Generator Stack	Gen 1 Gen 2	Latitude: -33.778°; Longitude: 25.712°	25	>10	0.7	473.15	13 854	10	Continuous
LNG Carrier Stack 1	Engine 1	Latitude: -33.798°; Longitude: 25.696°	55	>10	1.8	632.15	230 832	25.2	Batch
LNG Carrier Stack 2	Engine 1	Latitude: -33.798°; Longitude: 25.696°	55	>10	1.8	632.15	230 832	25.2	Batch
LNG Carrier Stack 3	Engine 1	Latitude: -33.798°; Longitude: 25.696°	55	>10	1.8	632.15	230 832	25.2	Batch
LNG Carrier Stack 4	Engine 1	Latitude: -33.798°; Longitude: 25.696°	55	>10	1.8	632.15	230 832	25.2	Batch

* Decimal degrees

4.2 Point Source Maximum Emission Rates (Normal Operating Conditions)

Power generation will be by means of a hybrid of gas turbines and gas engines.

This range of possible technology options is assessed by assuming the 'worst case' scenario in terms of emissions. This entails selecting the 'worst case' MES for SO_2, NO_X for the respective technology (see MES in Table 6). The emission concentrations that are applied are listed in Table 14 with the respective emission rates.

Table 14: Stack emission concentrations and emission rates

Source Name	Substance	Emission concentration (mg/Nm^3)	Emission rate (tonnes/annum)	Listed activity category
Heater Stack	Sulphur dioxide (SO_2)	400	537.34	1.4: Gaseous fuels
	Oxides of Nitrogen (NO_X)	400	537.34	1.5 Reciprocating engines (gas)
	Particulate matter (PM)	50	67.17	1.5 Reciprocating engines (gas)
	Carbon monoxide (CO)	440	591.25	Not Applicable (No MES available)
Power Generator Stack	Sulphur dioxide (SO_2)	400	28.01	1.4: Gaseous fuels
	Oxides of Nitrogen (NO_X)	400	28.01	1.5 Reciprocating engines (gas)
	Particulate matter (PM)	50	3.5	1.5 Reciprocating engines (gas)
	Carbon monoxide (CO)	32647	2 286.15	Not Applicable (No MES available)
LNG Carrier Stack 1 Stack 2 Stack 3 Stack 4	Sulphur dioxide (SO_2)	1.01	0.89	Not based on Listed activity category
	Oxides of Nitrogen (NO_X)	6.44	5.62	Not based on Listed activity category
	Particulate matter (PM)	0.19	0.16	Not based on Listed activity category
	Carbon monoxide (CO)	0.54	0.47	Not Applicable (No MES available)

4.3 Point Source Maximum Emission Rates (Start Up, Shut-Down, Upset and Maintenance Conditions)

Emissions from LNG handling and storage during start-up are negligible and are assessed.

4.4 Fugitive Emissions

Storage and loading of LNG or NG from the Land-based LNG Terminal and Infrastructure Project generates negligible emissions as the fuel is kept at extremely low temperatures. Any gas that may escape is returned to the storage unit.

In this assessment, the main sources of fugitive emissions include (i) the LNG resupply vessels during their transit from the eastern breakwater to the berthing area and (ii) the LNG Truck Loading Facility and associated road infrastructure (Table 15). Fugitive emissions are treated as area sources.

Table 15: Emissions (tons/annum) from the LNG Carrier transit zone and LNG Truck Loading Facility and associated road infrastructure

Source name	SO_2	NO_X	PM_{10}	CO
LNG Carrier Transit Zone	4.2	37.9	0.85	2.46
LNG Truck Loading Facility and associated road infrastructure	0.06	0.58	0.11	0.1

4.5 Emergency Incidents

There have been no incidents as this is a new project.

5. IMPACT OF ENTERPRISE ON THE RECEIVING ENVIRONMENT

5.1 Baseline conditions

5.1.1 Introduction

5.1.2 Climate and meteorology

The Port Elizabeth region has a warm temperate climate and the temperature range is not extreme, although high temperatures can occur during summer. Averages of daily minimum, maximum and mean temperatures for the period 1961 – 1990 are presented in Figure 4 with accompanying wind. Very high temperatures may be experienced during berg wind conditions when maximum temperatures my exceed 30°C.

Rain occurs throughout the year, brought about by convective summer rain and winter rain associated with the passage of frontal systems. The area receives an annual average rainfall of 624 mm. Monthly average rainfall data for Port Elizabeth Airport for the period 1961 – 1990 is presented in Figure 4.

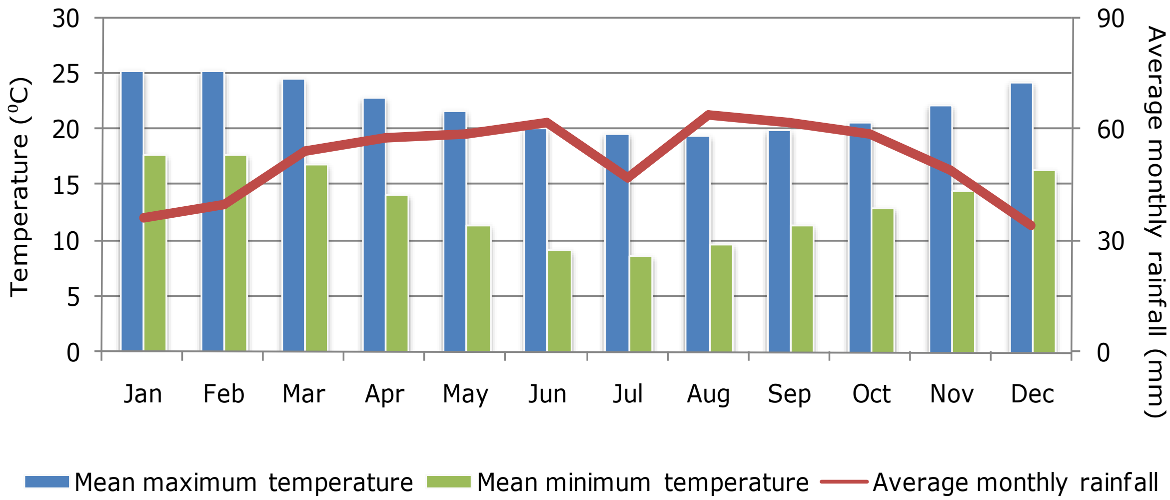
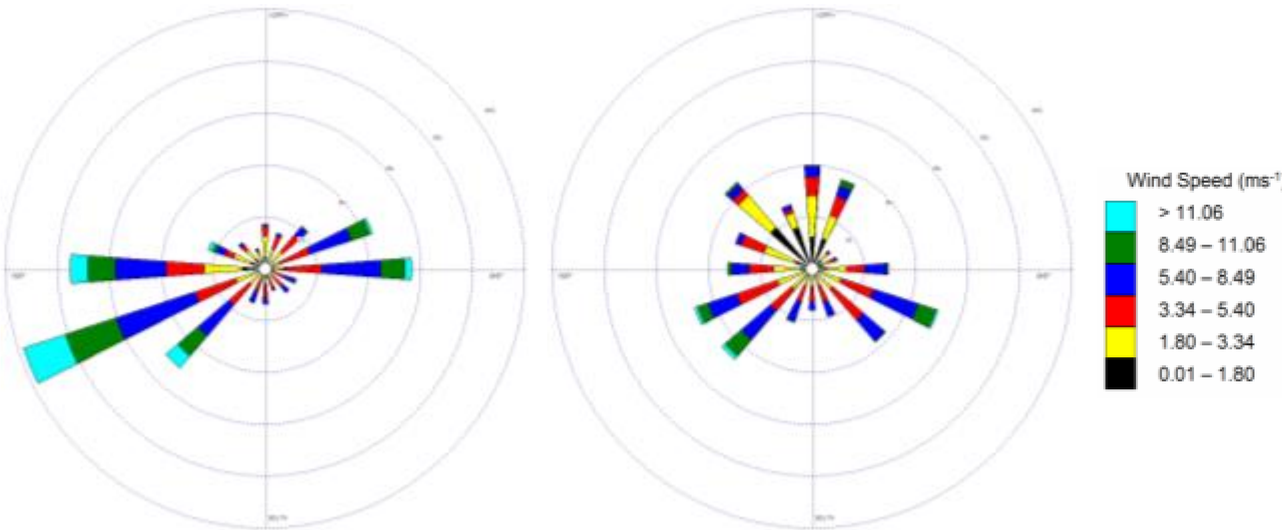


Figure 4:Average of daily minimum, maximum and mean temperatures (°C) and average monthly precipitation (mm) at Port Elizabeth Airport for the period 1961 – 1990

Prevailing wind tends to follow the coastline and the prevailing winds in the Port Elizabeth area are west-southwesterlies and east-northeasterlies. Wind roses are presented for Port Elizabeth Airport, Amsterdamplein, Motherwell and Saltworks in Figure 5. Wind roses simultaneously depict the frequency of occurrence of wind from the 16 cardinal wind directions and wind speed classes, for a single site. Wind direction is given as the direction from which the wind blows, i.e., southwesterly winds blow from the southwest. Wind speed is given in meters per second (m/s), and each arc represents a percentage frequency of occurrence (5% in this case).

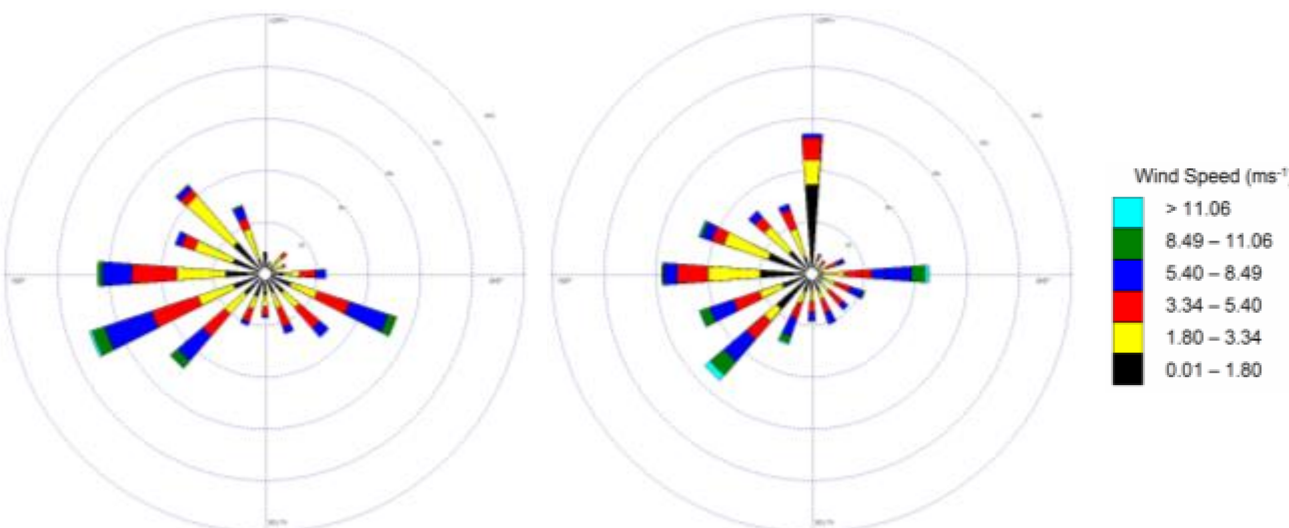
The airport at Port Elizabeth is the most climatologically representative of the sites and is well exposed to the prevailing synoptic-scale winds, showing a high frequency of winds from the sector west to southwest (more than 50% of all winds). These are also the strongest winds. There is some occurrence of wind from the northeast and east at this site. The annual average wind speed here is 5.7 m/s.

The winds at Amsterdamplein, Motherwell and Saltworks also indicate the occurrence of reasonably strong west to southwesterly synoptic scale winds. At Amsterdamplein, winds are fairly, equally spread from the southwest, southeast, northwest, north and north-northeast, with an average wind speed of 4 m/s. At Motherwell, winds are predominantly from the northwest to southwest and east-southeast, with an average wind speed of 3.4 m/s. At Saltworks, winds are mainly from the west-northwest to southwest, north and east, also with an average wind speed of 3.4 m/s.



Port Elizabeth Airport
Total hours: 26116
Avg. wind speed: 5.73 m/s
% Calm Winds: 3.05%

Amsterdamplein
Total hours: 13536
Avg. wind speed: 4.04 m/s
% Calm Winds: 0%



Motherwell
Total hours: 14863
Avg. wind speed: 3.40 m/s
% Calm Winds: 0.09%

Saltworks
Total hours: 16887
Avg. wind speed: 3.42 m/s
% Calm Winds: 0%

Figure 5: Annual wind roses for Port Elizabeth Airport, Amsterdamplein, Motherwell and Saltworks for 2009-2011. Arcs represent 5% frequency intervals.

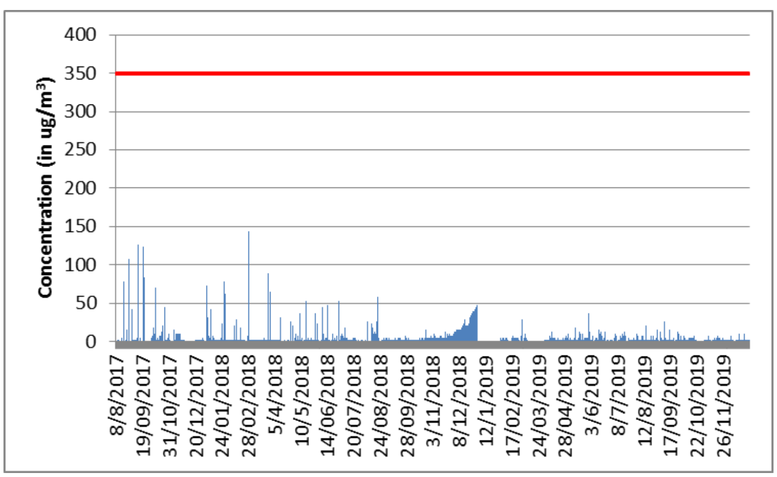
The poorest atmospheric dispersion conditions occur with inversion conditions and calm or light winds. Greater surface cooling in winter is conducive to the formation of surface temperature inversions and a shallow mixing layer, particularly at night. Pollutants that are released into the inversion layer are typically trapped between the surface and the top of the inversion. Under light wind conditions, pollutants will tend to accumulate. It is under these conditions for May to July when the highest ground level concentrations of pollutants may be expected in the area.

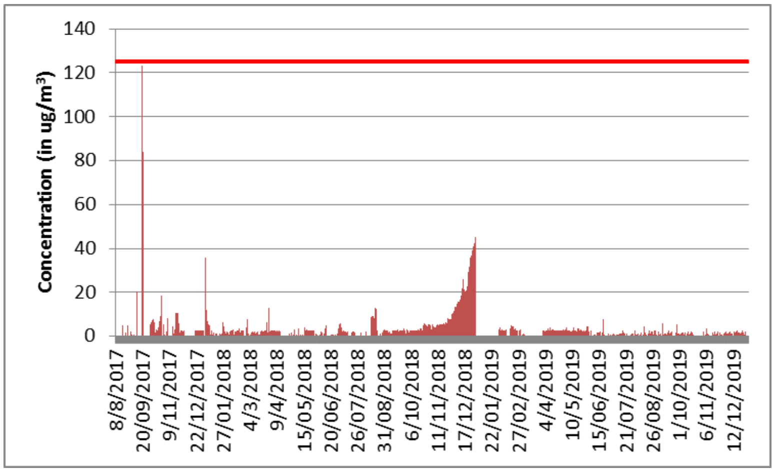
5.1.3 Ambient Air Quality

The status of ambient air quality in the Coega SEZ is described here using data from the Saltworks monitoring site, and dispersion modelling for existing industries. Monitoring data provided accurate measurement at a single point which may not be representative of the entire area of interest. Dispersion modelling provides estimated concentrations over the area.

Ambient monitoring data for 2017 to 2019 at Saltworks is analysed for SO_2, NO_2, and PM_{10}. A relatively coherent dataset was available for the Saltworks site for August 2017 to December 2019. Monitored SO_2 data show ambient levels for the monitoring period, with no exceedances of NAAQS. Monitored NO_2 concentrations are elevated with higher concentrations observed in winter (i.e. June to August). Monitored PM_{10} concentrations are elevated year-round with no exceedances of NAAQS. An estimated background concentration of 10 µg/m^3 is observed, increasing in late winter and early spring. This is consistent with inputs from regional biomass burning. An increasing annual trend can also be observed and is suggestive of additional air quality management needs in the area.

a)





b)

Figure 6: a) 1-hr and b) 24-hr average SO_2 monitored concentrations

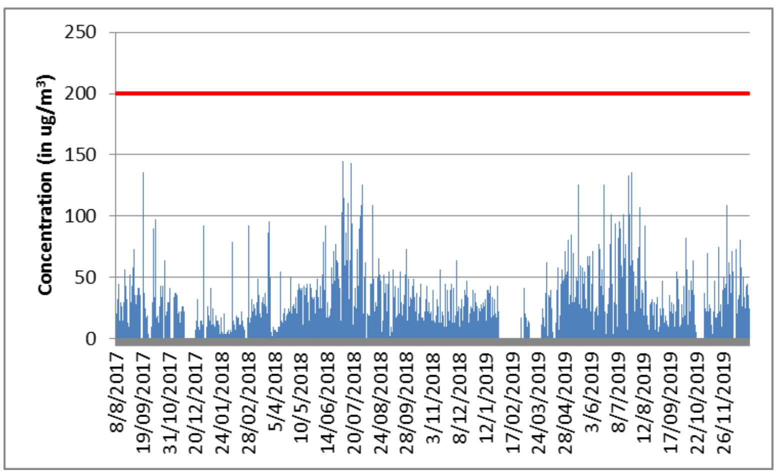


Figure 7: 1-hr average NO_2 monitored concentrations

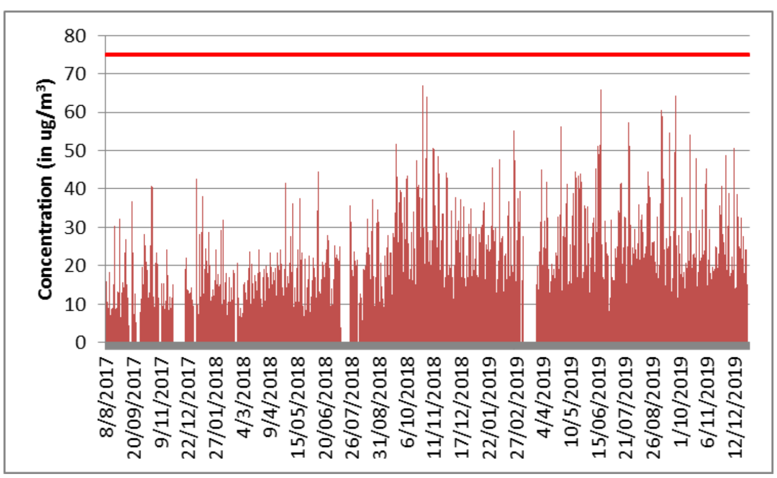


Figure 8: 24-hr average PM_{10} monitored concentrations

Table 16: Annual average monitored concentrations

Year	SO_2	NO_2	PM_{10}
	NAAQS 50 µg/m^3	NAAQS 40 µg/m^3	NAAQS 40 µg/m^3
2017*	3.3	8.5	14.8
2018	4.4	9.1	20.9
2019	1.6	10.7	26.6

* Limited dataset for August – December

Lethabo Air Quality Specialists have characterised emissions from industrial point sources, area sources, roads and shipping including and up to 5 km from the Coega SEZ (Pers. Comm. Chris Albertyn, June 2020). These emissions are used with dispersion modelling to illustrate ambient SO_2, NO_2 and PM_{10} concentrations throughout the Coega SEZ. In other words, dispersion modelling has been used to compliment the ambient monitoring data and to provide a spatially continuous picture of ambient concentrations throughout the SEZ. The relative location of industries relevant to this assessment are shown in Figure 9, in terms of distance and direction from the project.

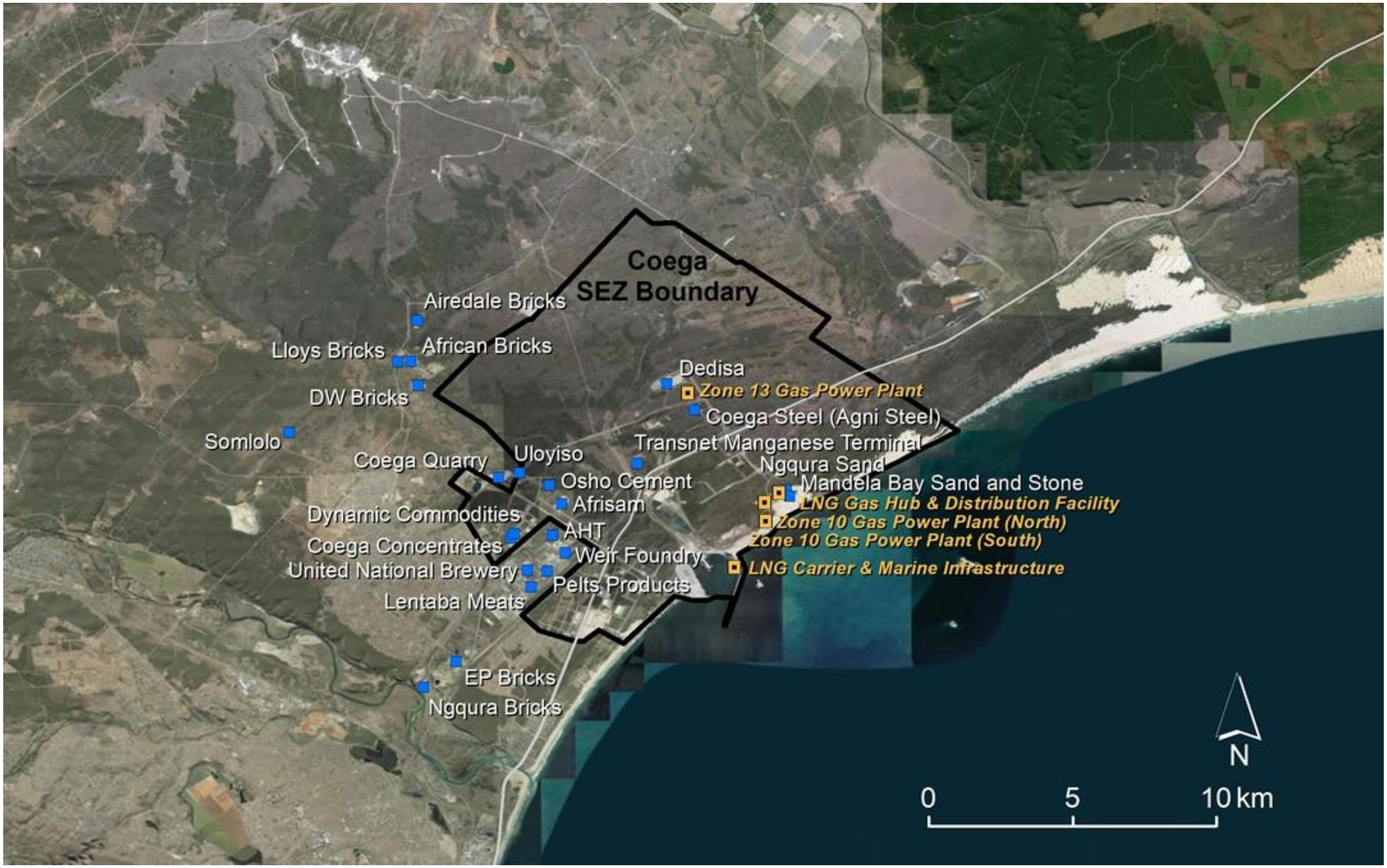


Figure 9: Industrial Sources

For SO_2 the annual, 24-hour and 1-hour modelled concentrations are shown by the isopleth maps in Figure 10. The limit value of the NAAQS is shown by the red isopleth in Figure 10, and the tolerance is shown by the yellow line. Ambient SO_2 concentrations are generally relatively low compared with the NAAQS throughout the SEZ, but exceedances are shown to occur beyond the SEZ boundary to the west because of emissions from local sources. The low modelled SO_2 concentrations in the SEZ agree with monitored concentrations at Saltworks. The maximum predicted annual average baseline concentration is 84.2 µg/m^3 (Table 17).

For NO_2 the annual and 1-hour modelled concentrations are shown by the isopleth maps in Figure 11. The annual average ambient NO_2 concentrations are relatively low throughout the SEZ and comply with the NAAQS. For 1-hour ambient concentrations, the limit value of the NAAQS is shown by the red isopleth in Figure 11, and the tolerance is shown by the yellow line. Ambient 1-hour NO_2 concentrations are generally relatively low compared with the NAAQS throughout the SEZ, but exceedances are shown to occur beyond the SEZ boundary to the west and along the N2 to the east. The maximum predicted 1-hour baseline concentration is 465 µg/m^3 (Table 17). The generally low modelled NO_2 concentrations in the SEZ agree with monitored concentrations at Saltworks.

Annual average and 24-hour PM_{10} concentrations are shown to be high over the central part of the SEZ where the NAAQS is exceeded (Figure 12). There are several sources of PM_{10} in the SEZ with stacks and fugitive emissions resulting in the general area of exceedance. The NAAQS is also exceeded in places to the west of the SEZ because of local sources. While there are no exceedances of the NAAQS in the monitored data at Saltworks, the measured concentrations are relatively high. The highest annual average PM_{10} concentration is 159 µg/m^3 (Table 17)

Table 17: Maximum predicted baseline ambient annual SO_2, NO_2 and PM_{10} concentrations in µg/m^3 and the predicted 99th percentile concentrations for 24-hour and 1-hour, with the South African NAAQS

	SO_2		
Description	**Annual**	**24-hour**	**1-hour**
Baseline	84.2	340	1 322
NAAQS	**50**	**180**	**350**
	NO_2		
Baseline	30.2		465
NAAQS	**40**		**200**
	PM_{10}		
Baseline	159	557	
NAAQS	**40**	**75**	

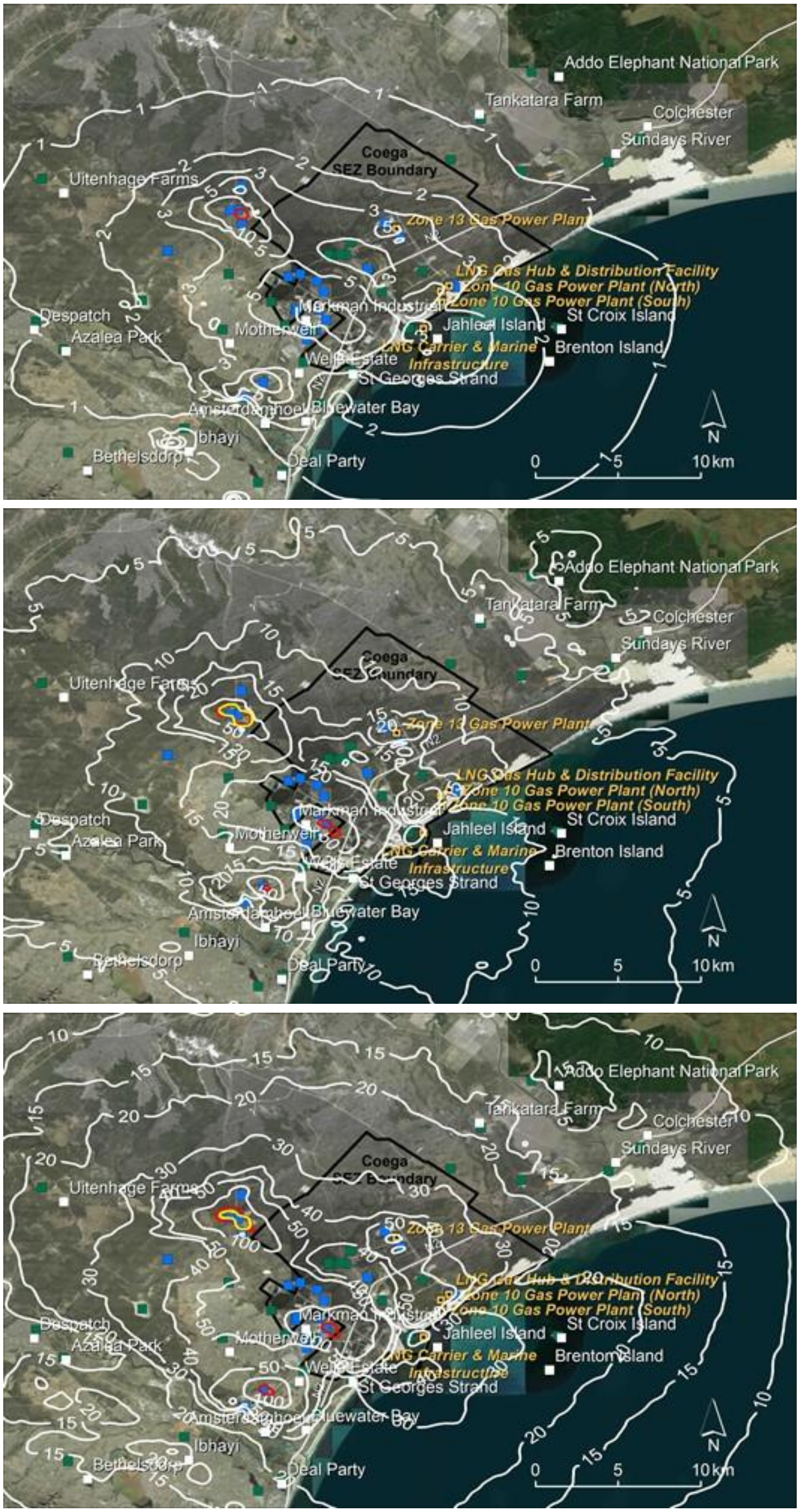


Figure 10: Modelled baseline annual average (top), 99th percentile of 24-hour (middle) and of 1-hour (bottom) SO_2 concentrations in the Coega SEZ in µg/m³

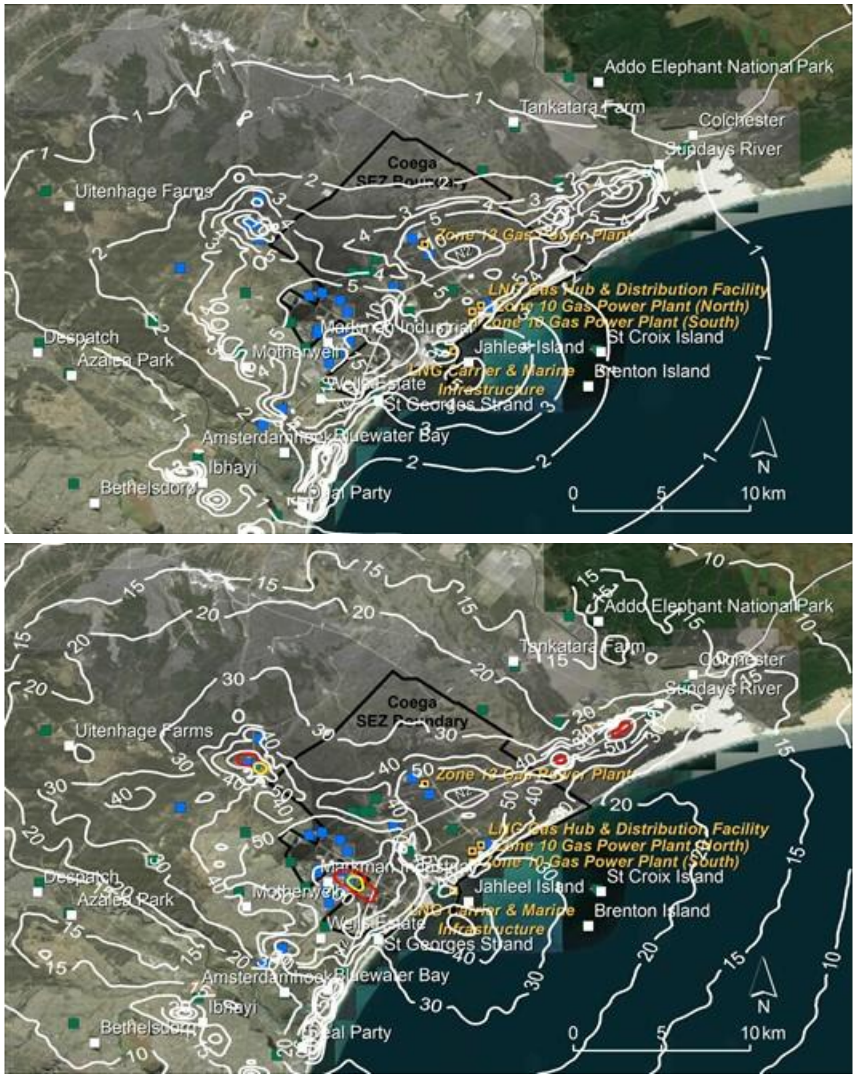


Figure 11: Modelled baseline annual average (top) and 99th percentile of 1-hour (bottom) NO_2 concentrations in the Coega SEZ in μg/m^3

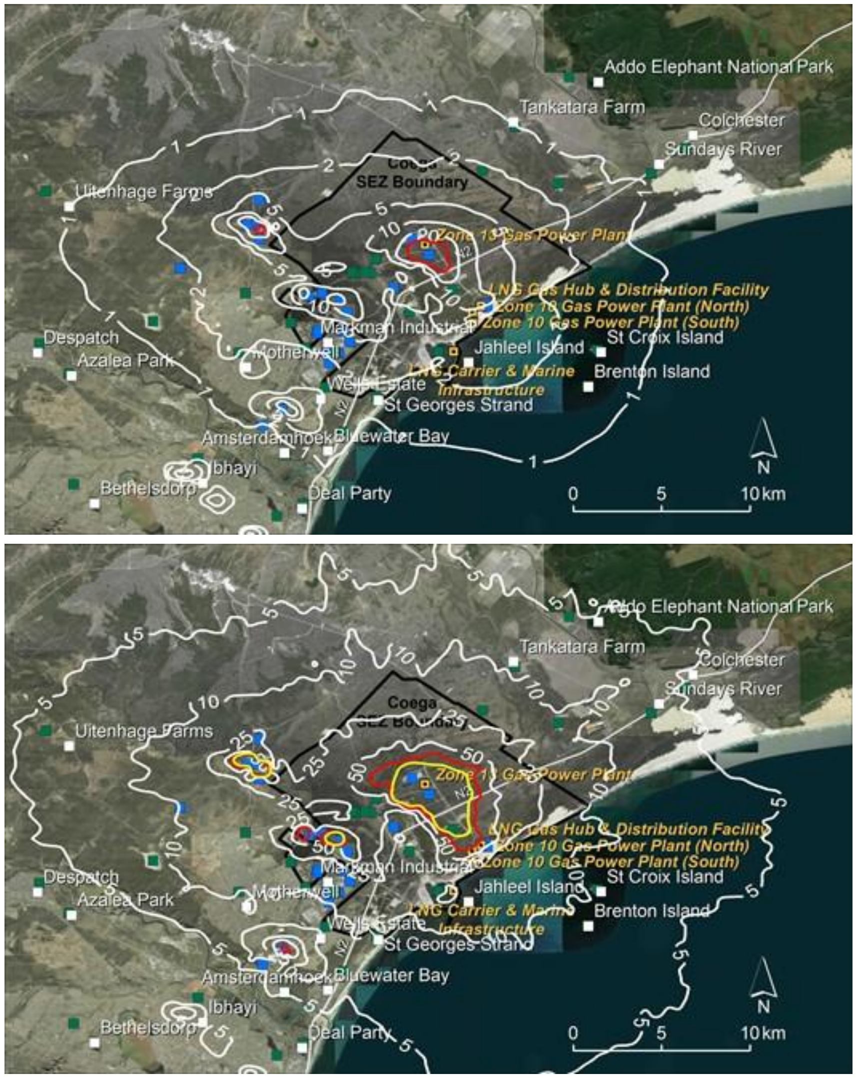


Figure 12: Modelled baseline annual average (top) and 99th percentile of 24-hour (bottom) PM_{10} concentrations in the Coega SEZ in µg/m^3

5.2 Dispersion Modelling

5.2.1 Models used

A Level 3 air quality assessment must be conducted in situations where the purpose of the assessment requires a detailed understanding of the air quality impacts (time and space variation of the concentrations) and when it is important to account for causality effects, calms, non-linear plume trajectories, spatial variations in turbulent mixing, multiple source types and chemical transformations (DEA, 2014). A Level 3 assessment may be used in situations where there is a need to evaluate air quality consequences under a permitting or environmental assessment process for large industrial developments that have considerable social, economic and potential environmental consequences. Under these circumstances, the proposed CDC power project clearly demonstrates the need for a Level 3 assessment.

The CALPUFF suite of models are approved by the US EPA (http://www.src.com/calpuff/calpuff1.htm) and by the DEA for Level 3 assessments (DEA, 2014). It consists of a meteorological pre-processor, CALMET, the dispersion model, CALPUFF, and the post-processor, CALPOST. It is an appropriate air dispersion model for the purpose of this assessment as it is well suited to simulate dispersion from several sources. It also has capability to simulate dispersion in the atmosphere's complex land-sea interface. More information about the model can be found in the User's Guide for the CALPUFF Dispersion Model (US EPA, 1995).

The Air Pollution Model (TAPM) (Hurley, 2000; Hurley et al., 2001; Hurley et al., 2002) is used to model surface and upper air metrological data for the study domain. TAPM uses global gridded synoptic-scale meteorological data with observed surface data to simulate surface and upper air meteorology at given locations in the domain, taking the underlying topography and land cover into account. The global gridded data sets that are used are developed from surface and upper air data that are submitted routinely by all meteorological observing stations to the Global Telecommunication System of the World Meteorological Organisation. TAPM has been used successfully in Australia where it was developed (Hurley, 2000; Hurley et al., 2001; Hurley et al., 2002). It is considered to be an ideal tool for modelling applications where meteorological data does not adequately meet requirements for dispersion modelling. TAPM modelled output data is therefore used to augment the site-specific surface meteorological data for input to CALPUFF.

5.2.2 TAPM and CALPUFF parameterisation

TAPM is set-up in a nested configuration of three domains, centred on the Coega SEZ. The outer domain is 480 km by 480 km with a 24 km grid resolution, the middle domain is 240 km by 240 km with a 12 km grid resolution and the inner domain is 60 km by 60 km with a 3 km grid resolution (Figure 7.1). Three years (2017-2019) of hourly observed meteorological data from the SAWS station at Saltworks are used to 'nudge' the modelled meteorology towards the observations. The nesting configuration ensures that topographical effects on meteorology are captured and that meteorology is well resolved and characterised across the boundaries of the inner domain. Twenty seven vertical levels are modelled in each nest from 10 m to 5 000 m, with a finer resolution in the lowest 1 000 m.

The 3-dimensional TAPM meteorological output on the inner grid includes hourly wind speed and direction, temperature, relative humidity, total solar radiation, net radiation, sensible heat flux, evaporative heat flux, convective velocity scale, precipitation, mixing height, friction velocity and Obukhov length. The spatially and temporally resolved TAPM surface and upper air meteorological data is used as input to the CALPUFF meteorological pre-processor, CALMET.

A CALPUFF modelling domain will cover an area of 1 600 km^2, where the domain extends 40 km (west-east) by 40 km (north-south) (Figure 13). It will consist of a uniformly spaced receptor grid with 0.25 km spacing, giving 25 600 grid cells (160 x 160 grid cells).

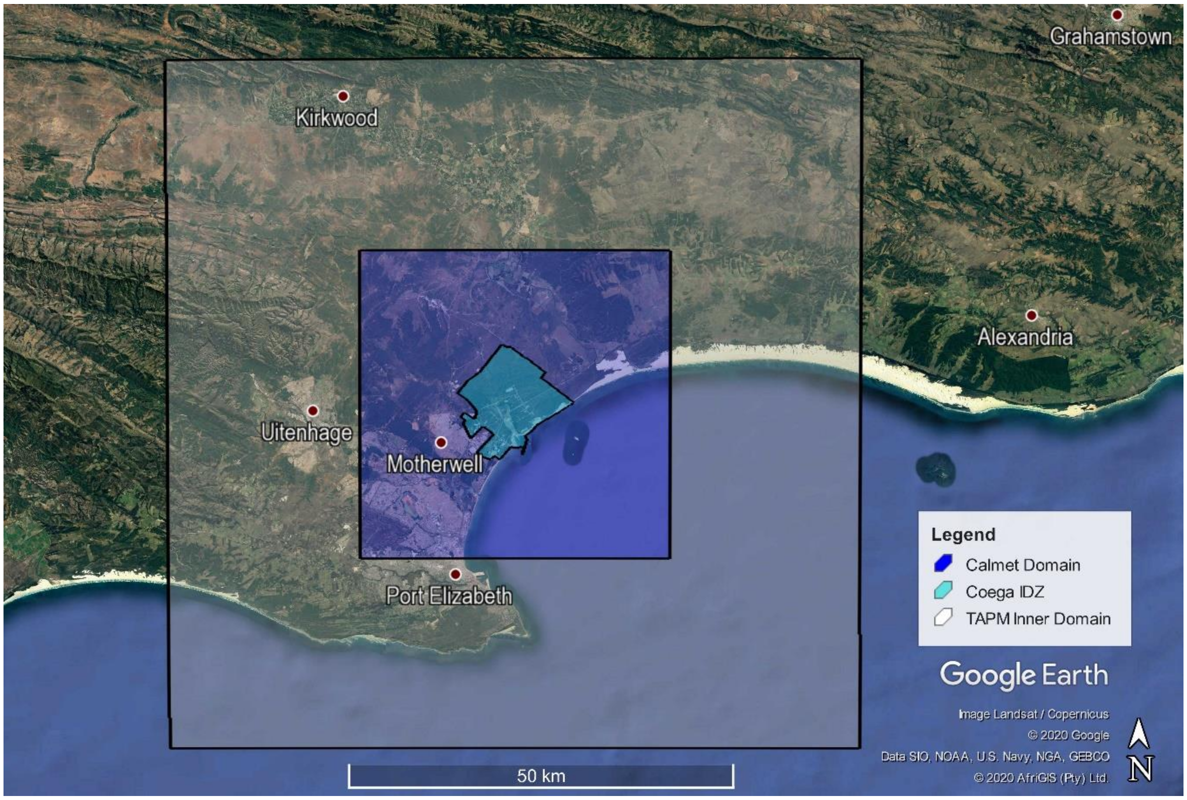


Figure 13: Proposed location of the modelling domains for TAPM and CALPUFF modelling

The topographical and land use for the respective modelling domains is obtained from the dataset accompanying the Commonwealth Scientific and Industrial Research Organisation (CSIRO) The Air Pollution Model (TAPM) modelling package (CSIRO, 2008). This dataset includes global terrain elevation and land use classification data on a longitude/latitude grid at 30-second grid spacing from the US Geological Survey, Earth Resources Observation Systems (EROS) Data Center.

The parameterisation of key variables that will apply in CALMET and CALPUFF are indicated in Table 18 and Table 19 respectively.

Table 18: Parameterisation of key variables for CALMET

Parameter	Model value
12 vertical cell face heights (m)	0, 20, 40, 80, 160, 320, 640, 1000, 1500, 2000, 2500, 3000, 4000
Coriolis parameter (per second)	0.0001
Empirical constants for mixing height equation	Neutral, mechanical: 1.41 Convective: 0.15 Stable: 2400 Overwater, mechanical: 0.12
Minimum potential temperature lapse	0.001

Parameter	Model value
rate (K/m)	
Depth of layer above convective mixing height through which lapse rate is computed (m)	200
Wind field model	Diagnostic wind module
Surface wind extrapolation	Similarity theory
Restrictions on extrapolation of surface data	No extrapolation as modelled upper air data field is applied
Radius of influence of terrain features (km)	5
Radius of influence of surface stations (km)	Not used as continuous surface data field is applied

Table 19: Parameterisation of key variables for CALPUFF

Parameter	Model value
Chemical transformation	Default NO_2 conversion factor is applied
Wind speed profile	Urban
Calm conditions	Wind speed < 0.5 m/s
Plume rise	Transitional plume rise, stack tip downwash, and partial plume penetration is modelled
Dispersion	CALPUFF used in PUFF mode
Dispersion option	Pasquill-Gifford coefficients are used for rural and McElroy-Pooler coefficients are used for urban
Terrain adjustment method	Partial plume path adjustment

5.2.3 Model accuracy

Air quality models attempt to predict ambient concentrations based on "known" or measured parameters, such as wind speed, temperature profiles, solar radiation and emissions. There are however, variations in the parameters that are not measured, the so-called "unknown" parameters as well as unresolved details of atmospheric turbulent flow. Variations in these "unknown" parameters can result in deviations of the predicted concentrations of the same event, even though the "known" parameters are fixed.

There are also "reducible" uncertainties that result from inaccuracies in the model, errors in input values and errors in the measured concentrations. These might include poor quality or unrepresentative meteorological, geophysical and source emission data, errors in the measured concentrations that are used to compare with model predictions and inadequate model physics and formulation used to predict the concentrations. "Reducible" uncertainties can be controlled or minimised. This is done by using accurate input data, preparing the input files correctly, checking and re-checking for errors, correcting for odd model behaviour, ensuring that the errors in the measured data are minimised and applying appropriate model physics.

Models recommended in the DEA dispersion modelling guideline (DEA, 2014) have been evaluated using a range of modelling test kits (http://www.epa.gov./scram001). CALPUFF is one of the models that have been evaluated and it is therefore not mandatory to perform any modelling evaluations. Rather the accuracy of the modelling in this assessment is enhanced by every effort to minimise the "reducible" uncertainties in input data and model parameterisation.

5.2.4 Background Concentrations and other sources

A background concentration refers to the portion of the ambient concentration of a pollutant due to sources, both natural and anthropogenic, other than the source being assessed.

A cumulative assessment of other sources of particulates (PM_{10} and $PM_{2.5}$), NO_2, SO_2 and CO in the Coega EDZ and up to 5 km from the EDZ boundary is conducted using the CDC emission inventory provided by Lethabo Air Quality Specialists (pers. Comm. Chris Albertyn, June 2020). Included are industrial point sources, area sources, roads and shipping.

5.2.5 Sensitive Receptors

According to the US EPA, sensitive receptors include, but are not limited to, hospitals, schools, day care facilities and old age homes. These are areas where the occupants are more susceptible to the adverse effects of exposure to toxic chemicals, pesticides, and other pollutants.

In this assessment, all neighbouring residential and commercial areas are treated as sensitive areas as they as expected to include sensitive areas as identified by the USEPA. The relative location of selected sensitive receptors that are relevant to this assessment are shown in Figure 14, in terms of distance and direction from the project.

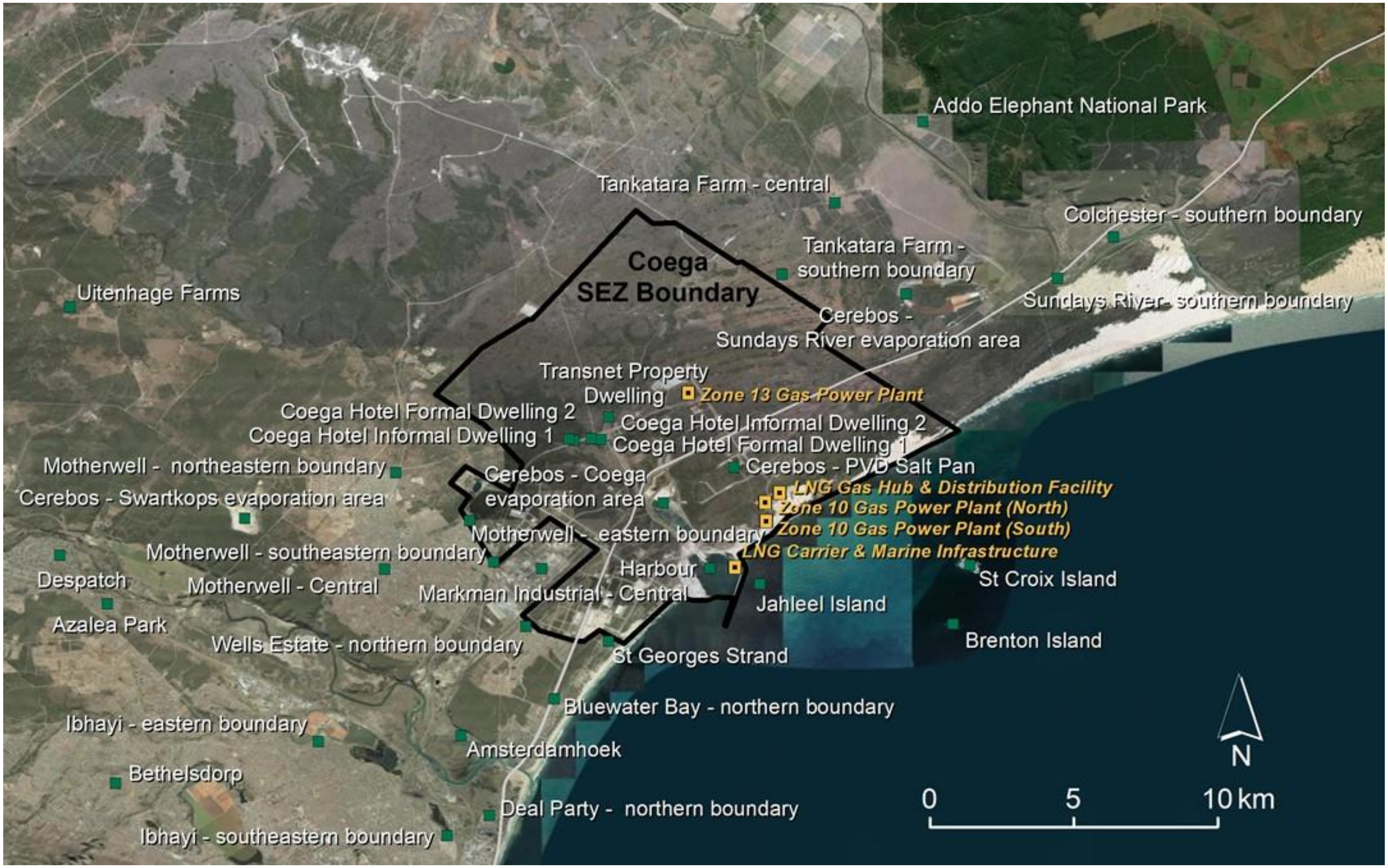


Figure 14: Selected sensitive receptors

5.2.6 *Assessment scenarios*

To assess the potential impacts of the Coega 3 000 MW Integrated Power Project and its components on ambient air quality, it is necessary to assess different emission scenarios. Dispersion modelling is therefore undertaken for the following emission scenarios:

i. Emissions from the Land-based LNG Terminal and Infrastructure Project.
ii. Emissions from the Land-based LNG Terminal and Infrastructure Project with emissions from existing sources and within a 5km radius of the Coega SEZ, i.e. the baseline conditions.
iii. Emissions for the Coega 3 000 MW Integrated Power Project, i.e. the 1 000 MW three power stations and the infrastructure project together.
iv. Emissions for the Coega 3 000 MW Integrated Power Project with emissions from existing sources and within a 5km radius of the Coega SEZ, i.e. the baseline conditions.

In addition, the potential cumulative effects on ambient air quality of other gas-to-power projects in the Coega SEZ are assessed qualitatively. These projects are i) the proposed Karpowership located in the Port of Ngqura and ii) the proposed Engie Gas-Fired Power Plant in Zone 13 of the Coega SEZ.

5.3 Dispersion Modelling Results

The dispersion modelling results are presented in the following sections for SO_2, NO_2, PM_{10} and CO for the four emissions scenarios. First the maximum predicted ambient concentrations are presented in Section 5.3.1. An explanation of the model output is provided in Section 5.3.2, followed by the dispersion modelling results presented as isopleth maps.

5.3.1 Maximum predicted ambient concentrations

The dispersion modelling results are presented in the following sections for SO_2, NO_2, PM_{10}, CO and benzene for the four emissions scenarios. First the maximum predicted ambient concentrations are presented in Section 5.3.1. An explanation of the model output is provided in Section 5.3.2, followed by the dispersion modelling results presented as isopleth maps.

5.3.1 Maximum predicted ambient concentrations and sensitive receptor concentrations

5.3.1.1 SO_2

For SO_2 for the Land-based LNG Terminal and Infrastructure Project (Scenario 1) the maximum predicted annual average, 24-hour and 1-hour concentrations are very low and are well below the respective limit values of the NAAQS (Table 20). The maximum SO_2 concentrations for the baseline (Scenario 2) however exceed the limit values of the NAAQS. The areas where the exceedances occur are shown in Figure 10. It is noteworthy that the addition by the Land-based LNG Terminal and Infrastructure Project to existing ambient SO_2 concentrations is negligible.

For SO_2 for the 3 000 MW Coega Gas Project (Scenario 3) the maximum predicted annual average, 24-hour and 1-hour concentrations are very low and are well below the respective limit values of the NAAQS (Table 20). As noted above, the maximum SO_2 concentrations for the baseline (Scenario 4) however exceed the limit values of the NAAQS, as mentioned above. However, it is noteworthy that the addition by the 3 000 MW Coega Gas Project to existing ambient SO_2 concentrations is very small.

The predicted maximum annual average, 24-hour and 1-hour SO_2 concentrations are well below the NAAQS at all of the 36 selected sensitive receptor points (Table 20).

Table 20: Maximum predicted ambient annual SO_2 concentrations in $\mu g/m^3$ and the predicted 99th percentile concentrations for 24-hour and 1-hour, with the South African NAAQS

		SO_2		
Scenario	**Description**	**Annual**	**24-hour**	**1-hour**
1	Land-based LNG Terminal and Infrastructure Project	0.8	8.4	20.7
2	Land-based LNG Terminal and Infrastructure Project + baseline	84.3	341	1 322
3	3 000 MW Coega Gas-to-Power Project	1.2	15.5	29.2
4	3 000 MW Coega Gas-to-Power Project + baseline	84.9	341	1 322
NAAQS		**50**	**180**	**350**

Table 21: Predicted maximum annual average, 24-hour and 1-hour SO_2 concentrations in µg/m³ at the sensitive receptors for the four scenarios

RECEPTOR	Scenario 1			Scenario 2			Scenario 3			Scenario 4		
	1-hr	24-hr	Annual	1-hr	24-hr	Annual	1-hr	24-hr	Annual	1-hr	24-hr	Annual
Addo Elephant National Park - southern boundary	1.1	0.4	0.1	14.1	5.0	0.7	11.3	4.9	0.5	18.2	7.6	1.1
Amsterdamhoek	0.9	0.6	0.0	27.8	11.8	1.6	3.9	2.6	0.2	28.7	11.9	1.8
Azalea Park	1.2	0.6	0.1	15.0	5.4	1.1	10.5	4.1	0.5	17.3	7.6	1.6
Bethelsdorp	1.2	0.5	0.1	14.6	5.1	0.6	9.5	4.3	0.4	17.4	6.6	1.0
Bluewater Bay - northern boundary	1.0	0.5	0.0	31.4	9.8	2.2	3.4	2.4	0.2	31.8	10.2	2.4
Brenton Island	5.5	2.4	0.2	26.9	9.8	2.1	17.2	7.8	0.7	30.9	11.8	2.6
Cerebos - Coega evaporation area	5.0	1.9	0.2	33.9	12.7	3.5	10.8	5.3	0.5	35.0	13.7	3.8
Cerebos - PVD Salt Pan	8.1	3.0	0.4	54.7	17.7	4.6	10.4	6.0	0.6	55.8	18.3	4.8
Cerebos - Sundays River evaporation area	2.0	0.7	0.1	15.9	5.6	1.1	11.9	4.6	0.5	19.3	6.9	1.5
Cerebos - Swartkops evaporation area	2.3	0.9	0.1	32.0	12.2	2.1	12.8	5.7	0.7	34.5	13.5	2.7
Coega Hotel Formal Dwelling 1	3.8	1.5	0.2	34.7	12.7	3.1	13.3	6.7	0.6	37.7	14.2	3.6
Coega Hotel Formal Dwelling 2	3.7	1.5	0.2	35.2	13.0	3.1	13.0	6.7	0.6	37.5	14.1	3.6
Coega Hotel Informal Dwelling 1	4.0	1.6	0.2	32.0	10.0	2.9	11.9	6.4	0.6	34.5	12.5	3.3
Coega Hotel Informal Dwelling 2	3.9	1.5	0.2	32.6	10.8	2.9	12.9	6.8	0.6	35.4	12.2	3.3
Colchester - southern boundary	1.3	0.5	0.1	12.3	5.0	0.7	10.1	3.5	0.5	15.7	5.8	1.1
Deal Party - northern boundary	0.9	0.4	0.0	20.4	8.3	1.0	3.3	2.1	0.2	21.2	8.4	1.1
Despatch	1.3	0.6	0.1	13.9	5.2	1.1	10.0	4.2	0.5	16.3	7.0	1.5
Harbour	1.1	1.0	0.1	31.3	9.1	2.4	3.9	3.8	0.2	32.7	10.7	2.6

RECEPTOR	Scenario 1			Scenario 2			Scenario 3			Scenario 4		
	1-hr	24-hr	Annual	1-hr	24-hr	Annual	1-hr	24-hr	Annual	1-hr	24-hr	Annual
Ibhayi - eastern boundary	0.9	0.4	0.0	17.4	5.8	0.9	5.7	2.8	0.3	18.9	7.0	1.1
Ibhayi - southeastern boundary	1.0	0.4	0.0	17.6	7.2	0.8	3.7	2.2	0.2	18.8	8.2	0.9
Jahleel Island	1.0	1.0	0.1	32.7	12.6	4.1	3.0	1.7	0.2	33.3	13.2	4.2
Markman Industrial - Central	2.4	1.2	0.1	98.9	43.8	9.5	11.1	4.5	0.5	102.1	44.2	9.9
Motherwell - Central	2.2	0.9	0.1	45.9	15.0	3.6	12.2	4.3	0.6	46.6	16.3	4.1
Motherwell - eastern boundary	3.1	1.4	0.2	81.3	43.3	7.0	12.4	5.5	0.6	81.7	43.3	7.4
Motherwell - northeastern boundary	3.2	1.3	0.2	52.3	19.2	3.7	15.2	6.9	0.8	53.5	21.4	4.3
Motherwell - southeastern boundary	2.3	1.0	0.1	75.8	31.5	6.1	11.8	4.4	0.5	77.0	34.3	6.5
Northern Farms	0.9	0.3	0.0	11.7	4.2	0.6	10.0	4.3	0.4	15.3	6.4	0.9
Sidwell	1.1	0.4	0.0	12.0	5.3	0.4	6.9	3.9	0.3	16.1	6.9	0.7
St Croix Island	4.6	1.7	0.2	25.5	8.8	2.0	10.0	4.4	0.5	27.1	9.4	2.3
St Georges Strand	1.0	0.6	0.1	37.5	16.1	3.3	3.8	2.9	0.2	38.5	16.2	3.4
Sundays River- southern boundary	1.6	0.6	0.1	14.6	5.3	0.9	10.6	4.1	0.5	17.8	7.0	1.3
Tankatara Farm - central	1.5	0.5	0.1	18.1	6.0	1.0	12.5	4.9	0.5	21.0	8.2	1.4
Tankatara Farm - southern boundary	2.3	0.7	0.1	27.5	9.3	1.5	12.9	5.8	0.5	29.8	11.0	1.9
Transnet Property Dwelling	4.0	1.4	0.2	35.8	10.8	3.0	11.5	6.7	0.6	37.8	12.6	3.4
Uitenhage Farms	2.1	0.8	0.1	21.7	7.6	1.3	11.8	5.2	0.5	23.5	9.7	1.7
Wells Estate - northern boundary	1.7	0.7	0.1	48.9	15.3	3.7	7.5	3.5	0.3	49.6	16.1	4.0

5.3.1.2 NO_2

For NO_2 for the Land-based LNG Terminal and Infrastructure Project (Scenario 1) the maximum predicted annual average and 1-hour concentrations are very low and are well below the respective limit values of the NAAQS (Table 22). The maximum 1-hour NO_2 concentrations for the baseline (Scenario 2) however exceed the limit values of the NAAQS. The areas where the exceedances occur are shown in Figure 11. It is noteworthy that the addition by the Land-based LNG Terminal and Infrastructure Project to ambient NO_2 concentrations is very small.

For NO_2 for the 3 000 MW Coega Gas Project (Scenario 3) the maximum predicted annual average and 1-hour concentrations are very low and are well below the respective limit values of the NAAQS (Table 22). As noted above, the maximum 1-hour NO_2 concentrations for the baseline (Scenario 4) however exceed the limit values of the NAAQS, as mentioned above. However, it is noteworthy that the addition by the 3 000 MW Coega Gas Project to ambient NO_2 concentrations is very small.

The predicted maximum annual average and 1-hour NO_2 concentrations are well below the NAAQS at all of the 36 selected sensitive receptor points (Table 22).

Table 22: Maximum predicted ambient annual NO_2 concentrations in µg/m^3 and the predicted 99th percentile concentrations for 1-hour with the South African NAAQS

Scenario	Description	Annual	1-hour
1	Land-based LNG Terminal and Infrastructure Project	1.2	17.2
2	Land-based LNG Terminal and Infrastructure Project + baseline	30.4	466
3	3 000 MW Coega Gas-to-Power Project	1.5	23.4
4	3 000 MW Coega Gas-to-Power Project + baseline	30.8	466
NAAQS		**40**	**200**

Table 23: Predicted maximum annual average and 1-hour NO_2 concentrations in µg/m^3 at the sensitive receptors for the four scenarios

RECEPTOR	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
	1-hour	Annual	1-hour	Annual	1-hour	Annual	1-hour	Annual
Addo Elephant National Park - southern boundary	1.3	0.1	13.8	0.8	9.1	0.4	16.9	1.1
Amsterdamhoek	1.3	0.1	20.4	1.6	3.3	0.2	20.9	1.8
Azalea Park	1.1	0.1	13.7	0.9	8.4	0.4	15.1	1.3

RECEPTOR	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
	1-hour	Annual	1-hour	Annual	1-hour	Annual	1-hour	Annual
Bethelsdorp	1.2	0.1	12.1	0.5	7.7	0.4	14.4	0.8
Bluewater Bay - northern boundary	1.6	0.1	39.1	2.9	3.2	0.2	39.1	3.0
Brenton Island	4.6	0.2	27.9	2.5	13.7	0.6	30.1	2.9
Cerebos - Coega evaporation area	4.0	0.3	38.4	5.4	8.7	0.5	39.4	5.6
Cerebos - PVD Salt Pan	7.2	0.4	64.6	6.2	9.2	0.6	65.2	6.4
Cerebos - Sundays River evaporation area	2.0	0.1	20.4	2.1	9.5	0.4	22.2	2.4
Cerebos - Swartkops evaporation area	2.0	0.1	28.8	2.0	10.3	0.6	30.4	2.5
Coega Hotel Formal Dwelling 1	3.2	0.2	40.5	3.7	10.7	0.6	41.5	4.1
Coega Hotel Formal Dwelling 2	3.2	0.2	40.3	3.7	10.6	0.6	41.6	4.0
Coega Hotel Informal Dwelling 1	3.3	0.2	37.0	3.7	9.7	0.5	38.2	4.0
Coega Hotel Informal Dwelling 2	3.2	0.2	36.7	3.7	10.3	0.5	38.3	4.0
Colchester - southern boundary	1.4	0.1	19.5	1.0	8.1	0.4	21.0	1.4
Deal Party - northern boundary	1.3	0.0	48.0	5.3	2.9	0.1	48.0	5.4
Despatch	1.2	0.1	12.9	0.9	8.0	0.5	14.4	1.3
Harbour	3.0	0.2	31.2	3.3	4.9	0.3	32.5	3.4
Ibhayi - eastern boundary	1.1	0.1	15.5	1.2	4.6	0.2	16.5	1.4
Ibhayi - southeastern boundary	1.2	0.0	20.0	1.2	3.1	0.2	20.6	1.3
Jahleel Island	2.8	0.2	36.3	5.3	3.6	0.3	36.6	5.3
Markman Industrial - Central	2.8	0.2	79.1	9.4	9.0	0.5	79.4	9.7
Motherwell - Central	2.1	0.1	42.6	3.6	9.8	0.5	42.9	3.9
Motherwell - eastern boundary	2.8	0.2	71.8	5.4	10.0	0.6	72.0	5.8
Motherwell - northeastern boundary	2.7	0.2	49.7	4.3	12.2	0.7	50.4	4.8
Motherwell - southeastern boundary	2.5	0.2	69.8	5.3	9.5	0.5	70.3	5.7

RECEPTOR	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
	1-hour	Annual	1-hour	Annual	1-hour	Annual	1-hour	Annual
Northern Farms	1.0	0.1	12.4	0.6	8.0	0.3	15.2	0.9
Sidwell	1.2	0.0	12.2	0.5	5.7	0.2	16.4	0.7
St Croix Island	3.9	0.2	26.9	2.3	8.1	0.5	27.4	2.6
St Georges Strand	2.3	0.1	39.9	3.8	3.8	0.2	40.4	3.9
Sundays River-southern boundary	1.8	0.1	57.9	4.0	8.6	0.4	59.4	4.4
Tankatara Farm - central	1.6	0.1	18.2	1.3	10.1	0.4	20.5	1.6
Tankatara Farm - southern boundary	2.3	0.1	26.3	2.0	10.3	0.4	27.9	2.4
Transnet Property Dwelling	3.4	0.2	38.3	3.5	9.3	0.5	40.0	3.8
Uitenhage Farms	1.9	0.1	26.0	1.4	9.5	0.4	27.1	1.7
Wells Estate - northern boundary	2.2	0.1	61.4	10.1	6.3	0.4	62.0	10.3

5.3.1.3 PM_{10}

For PM_{10} for the Land-based LNG Terminal and Infrastructure Project (Scenario 1) the maximum predicted annual average and 1-hour concentrations are very low and are well below the respective limit values of the NAAQS (Table 24). The maximum 24-hour PM_{10} concentrations for the baseline (Scenario 2) however exceed the limit values of the NAAQS. The areas where the exceedances occur are shown in Figure 12. It is noteworthy that the addition by the Land-based LNG Terminal and Infrastructure Project to existing ambient PM_{10} concentrations is negligible.

For PM_{10} for the 3 000 MW Coega Gas Project (Scenario 3) the maximum predicted annual average and 24-hour concentrations are very low and are well below the respective limit values of the NAAQS (Table 24). As noted above, the maximum 24-hour PM_{10} concentrations for the baseline (Scenario 4) however exceed the limit values of the NAAQS, as mentioned above. However, it is noteworthy that the addition by the 3 000 MW Coega Gas Project to existing ambient PM_{10} concentrations is negligible.

The predicted maximum annual average and 24-hour PM_{10} concentrations are well below the NAAQS at all of the 36 selected sensitive receptor points (Table 24).

Table 24: Maximum predicted ambient annual PM_{10} concentrations in µg/m³ and the predicted 99th percentile concentrations for 24-hour with the South African NAAQS

Scenario	Description	Annual	24-hour
1	Land-based LNG Terminal and Infrastructure Project	0.2	1.1
2	Land-based LNG Terminal and Infrastructure Project + baseline	159	557
3	3 000 MW Coega Gas-to-Power Project	0.3	1.9
4	3 000 MW Coega Gas-to-Power Project + baseline	160	557
NAAQS		**40**	**75**

Table 25: Predicted maximum annual average and 24-hour PM_{10} concentrations in µg/m³ at the sensitive receptors for the four scenarios

RECEPTOR	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
	24-hr	Annual	24-hr	Annual	24-hr	Annual	24-hr	Annual
Addo Elephant National Park - southern boundary	0.1	0.0	5.9	0.6	0.6	0.1	6.0	0.6
Amsterdamhoek	0.1	0.0	4.7	0.7	0.3	0.0	4.7	0.7
Azalea Park	0.1	0.0	4.0	0.5	0.5	0.1	4.2	0.6
Bethelsdorp	0.1	0.0	2.0	0.2	0.5	0.1	2.2	0.3
Bluewater Bay - northern boundary	0.1	0.0	6.3	1.2	0.3	0.0	6.3	1.2
Brenton Island	0.3	0.0	8.8	1.4	1.0	0.1	8.8	1.4
Cerebos - Coega evaporation area	0.2	0.0	16.9	4.3	0.7	0.1	16.9	4.3
Cerebos - PVD Salt Pan	0.4	0.1	116.2	15.0	0.8	0.1	116.2	15.1
Cerebos - Sundays River evaporation area	0.1	0.0	13.7	1.4	0.6	0.1	13.7	1.5
Cerebos - Swartkops evaporation area	0.1	0.0	9.0	1.2	0.7	0.1	9.0	1.3
Coega Hotel Formal Dwelling 1	0.2	0.0	27.2	5.7	0.8	0.1	27.5	5.7
Coega Hotel Formal Dwelling 2	0.2	0.0	27.9	5.5	0.8	0.1	27.9	5.6
Coega Hotel Informal Dwelling 1	0.2	0.0	26.3	6.4	0.8	0.1	26.4	6.4
Coega Hotel Informal Dwelling 2	0.2	0.0	27.7	6.0	0.9	0.1	27.7	6.1
Colchester - southern boundary	0.1	0.0	4.8	0.5	0.4	0.1	4.9	0.6
Deal Party - northern boundary	0.1	0.0	4.5	0.6	0.3	0.0	4.6	0.6

RECEPTOR	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
	24-hr	Annual	24-hr	Annual	24-hr	Annual	24-hr	Annual
Despatch	0.1	0.0	3.6	0.5	0.5	0.1	3.8	0.6
Harbour	0.1	0.0	11.2	2.2	0.5	0.0	11.2	2.2
Ibhayi - eastern boundary	0.1	0.0	3.4	0.7	0.4	0.0	3.6	0.7
Ibhayi - southeastern boundary	0.1	0.0	4.3	0.4	0.3	0.0	4.3	0.5
Jahleel Island	0.1	0.0	13.1	2.6	0.2	0.0	13.1	2.6
Markman Industrial - Central	0.2	0.0	12.1	2.4	0.6	0.1	12.2	2.5
Motherwell - Central	0.1	0.0	10.1	2.0	0.5	0.1	10.1	2.0
Motherwell - eastern boundary	0.2	0.0	20.7	3.0	0.7	0.1	21.2	3.0
Motherwell - northeastern boundary	0.2	0.0	17.6	3.1	0.9	0.1	17.8	3.2
Motherwell - southeastern boundary	0.1	0.0	10.5	2.0	0.6	0.1	10.7	2.0
Northern Farms	0.0	0.0	4.1	0.4	0.5	0.0	4.3	0.5
Sidwell	0.1	0.0	2.9	0.2	0.5	0.0	3.1	0.3
St Croix Island	0.2	0.0	8.2	1.4	0.6	0.1	8.2	1.4
St Georges Strand	0.1	0.0	7.5	1.4	0.4	0.0	7.5	1.4
Sundays River-southern boundary	0.1	0.0	5.8	0.8	0.5	0.1	6.0	0.9
Tankatara Farm - central	0.1	0.0	7.9	1.1	0.6	0.1	8.2	1.1
Tankatara Farm - southern boundary	0.1	0.0	18.6	2.3	0.7	0.1	18.7	2.3
Transnet Property Dwelling	0.2	0.0	39.7	7.5	0.8	0.1	39.7	7.5
Uitenhage Farms	0.1	0.0	5.7	0.8	0.7	0.1	5.9	0.9
Wells Estate - northern boundary	0.1	0.0	9.2	1.9	0.4	0.0	9.2	2.0

5.3.1.4 CO

For CO for the Land-based LNG Terminal and Infrastructure Project (Scenario 1) the maximum predicted 8-hour and 1-hour concentrations are very low and are well below the respective limit values of the NAAQS (Table 26). It is noteworthy that the addition by the Land-based LNG Terminal and Infrastructure Project to existing ambient CO concentrations is negligible.

For CO for the 3 000 MW Coega Gas Project (Scenario 3) the maximum predicted 8-hour and 1-hour concentrations are very low and are well below the respective limit values of the NAAQS (Table 26). It is noteworthy that the addition by the 3 000 MW Coega Gas Project to existing ambient CO concentrations is negligible.

The predicted maximum 8-hour and 1-hour CO concentrations are well below the NAAQS at all of the 36 selected sensitive receptor points (Table 26).

Table 26: Maximum predicted ambient 8-hour and 1-hour CO concentrations in µg/m³ with the South African NAAQS

Scenario	Description	8-hour	1-hour
1	Land-based LNG Terminal and Infrastructure Project	839	1 570
2	Land-based LNG Terminal and Infrastructure Project + baseline	839	1 570
3	3 000 MW Coega Gas-to-Power Project	839	1 570
4	3 000 MW Coega Gas-to-Power Project + baseline	839	1 570
NAAQS		**10 000**	**30 000**

Table 27: Predicted maximum 8-hour and 1-hour CO concentrations in µg/m³ at the sensitive receptors for the four scenarios

RECEPTOR	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr
Addo Elephant National Park - southern boundary	20.8	14.1	30.1	20.1	24.5	15.2	32.0	20.5
Amsterdamhoek	17.2	10.1	32.5	18.4	18.6	10.5	32.9	18.5
Azalea Park	22.6	11.2	31.4	17.4	22.8	11.4	31.7	17.6
Bethelsdorp	10.7	6.2	26.1	14.0	13.8	7.7	27.0	15.0
Bluewater Bay - northern boundary	25.5	15.9	48.1	27.4	25.7	15.9	48.1	27.6
Brenton Island	84.5	52.8	92.1	63.7	84.9	53.2	93.0	64.6
Cerebos - Coega evaporation area	112.1	69.0	116.3	69.0	112.1	69.1	116.4	69.1
Cerebos - PVD Salt Pan	344.7	172.6	345.8	175.1	344.7	172.6	345.8	175.1
Cerebos - Sundays River evaporation area	29.7	19.3	38.3	22.8	31.0	19.3	39.6	23.1
Cerebos - Swartkops evaporation area	51.2	28.4	70.6	42.9	51.5	28.4	71.1	43.8
Coega Hotel Formal Dwelling 1	70.9	46.3	87.3	53.6	71.1	46.3	87.4	53.6

RECEPTOR	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr
Coega Hotel Formal Dwelling 2	70.3	46.7	87.2	52.1	70.9	46.7	87.2	52.1
Coega Hotel Informal Dwelling 1	75.1	44.1	80.0	49.9	75.1	44.1	80.0	49.9
Coega Hotel Informal Dwelling 2	71.7	45.7	79.0	50.4	72.0	46.0	79.0	50.5
Colchester - southern boundary	25.6	14.2	36.9	23.2	26.1	14.8	37.3	23.2
Deal Party - northern boundary	17.2	11.0	57.9	33.6	17.8	11.1	57.9	33.6
Despatch	21.4	11.3	32.0	18.2	21.9	11.5	32.3	18.3
Harbour	19.8	17.0	38.3	24.3	21.8	17.2	38.9	24.9
Ibhayi - eastern boundary	11.6	7.3	23.2	13.6	14.1	8.3	24.0	13.9
Ibhayi - southeastern boundary	15.3	9.2	32.7	19.6	16.0	10.0	33.2	19.9
Jahleel Island	31.7	28.9	48.7	31.7	32.4	29.0	48.9	31.7
Markman Industrial - Central	64.3	36.2	76.1	44.3	64.3	36.2	76.3	44.3
Motherwell - Central	59.6	30.1	69.1	37.2	59.8	30.1	69.3	37.2
Motherwell - eastern boundary	84.8	45.4	90.4	50.8	85.2	45.9	90.7	51.0
Motherwell - northeastern boundary	81.6	50.9	110.6	75.6	81.9	51.0	110.6	75.8
Motherwell - southeastern boundary	62.9	32.3	69.7	37.5	63.3	32.4	69.8	37.6
Northern Farms	19.4	13.0	28.1	19.9	20.8	13.4	29.1	20.0
Sidwell	9.8	6.9	21.3	12.5	13.9	8.4	23.5	13.4
St Croix Island	97.1	57.1	115.0	68.2	97.1	57.6	115.0	68.2
St Georges Strand	26.6	15.8	40.8	24.7	28.1	16.7	41.4	25.4
Sundays River-southern boundary	30.4	17.0	72.2	43.7	31.5	17.1	72.3	43.9
Tankatara Farm - central	33.6	25.9	40.2	30.3	34.9	25.9	41.4	30.8
Tankatara Farm - southern boundary	50.5	28.5	61.2	35.5	51.7	29.0	61.5	35.8

RECEPTOR	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr
Transnet Property Dwelling	79.7	48.2	84.1	51.4	80.1	48.2	84.4	51.4
Uitenhage Farms	35.6	25.5	63.7	40.2	36.0	25.5	64.1	40.6
Wells Estate - northern boundary	33.6	19.1	76.3	40.7	34.7	19.1	76.3	40.8

5.3.1.5 Benzene

There is no benzene emission from the Land-based LNG Terminal and Infrastructure Project. Benzene has therefore not been modelled for Scenario 1. Similarly, there are no benzene emission in the baseline so modelling has not been done for Scenario 2.

For the 3 000 MW Coega Gas Project (Scenario 3) some benzene is emitted from the fuel oil and diesel storage tanks. The maximum predicted annual concentrations are very low and are well below the respective limit values of the NAAQS (Table 28). It is noteworthy that the addition by the 3 000 MW Coega Gas Project to existing ambient benzene concentrations is very small.

The predicted maximum annual average benzene concentration is less than 0.00001 µg/m^3 at all of the 36 selected receptor points.

Table 28: Maximum predicted ambient annual benzene concentrations in µg/m^3 with the South African NAAQS

Scenario	Description	Annual
1	Land-based LNG Terminal and Infrastructure Project	N/A
2	Land-based LNG Terminal and Infrastructure Project + baseline	N/A
3	3 000 MW Coega Gas-to-Power Project	0.0002
4	3 000 MW Coega Gas-to-Power Project + baseline	0.0002
NAAQS		**5**

5.3.2 Isopleth maps

Maps of predicted ambient SO_2, NO_2, PM_{10} and CO concentrations for the four scenarios are presented in the following sections. The predicted concentrations are shown as isopleths, lines of equal concentration, in µg/m^3 for the respective NAAQS averaging periods. The following should be noted:

- Isopleths are depicted as white lines.

- Where the predicted ambient concentrations exceed the Limit Value of the NAAQS, the Limit Value is shown as a red isopleth.
- Where the frequency of exceedances is greater than the permitted tolerance, the tolerance is shown as a yellow line on the maps.
- The tolerance allows 4 exceedances per annum of the 24-hour limit value, so a line showing 12 exceedances is depicted when necessary.
- The tolerance allows 88 exceedances per annum of the 1-hour limit value, so a line showing 264 exceedances is depicted when necessary.

5.3.2.1 Sulphur dioxide (SO_2)

The predicted ambient SO_2 concentrations are shown and compared for the four scenarios in Figure 15 (annual), Figure 16 (24-hour) and Figure 17 (1-hour).

- For Scenario 1, the Land-based LNG Terminal and Infrastructure Project, the predicted ambient SO_2 concentrations are very low and well below the NAAQS for the annual, 24-hour and 1-hour averaging periods.
- For Scenario 2, the Land-based LNG Terminal and Infrastructure Project with the current baseline, the predicted ambient SO_2 concentrations are generally low and well below the NAAQS in the SEZ for the annual, 24-hour and 1-hour averaging periods. However, exceedances are predicted to occur in three small areas to the west of the SEZ. It is noteworthy that these exceedances occur because of the existing sources and are not attributed to the small addition by the Land-based LNG Terminal and Infrastructure Project.
- For Scenario 3, the 3 000 MW Coega Gas-to-Power Project, the predicted ambient SO_2 concentrations are very low and well below the NAAQS for the annual, 24-hour and 1-hour averaging periods.
- For Scenario 4, the 3 000 MW Coega Gas-to-Power Project with the current baseline, the predicted ambient SO_2 concentrations are generally low and well below the NAAQS in the SEZ for the annual, 24-hour and 1-hour averaging periods. However, exceedances are predicted to occur in three small areas to the west of the SEZ. It is noteworthy that these exceedances occur because of the existing sources and are not attributed to the small addition by the 3 000 MW Coega Gas-to-Power Project.

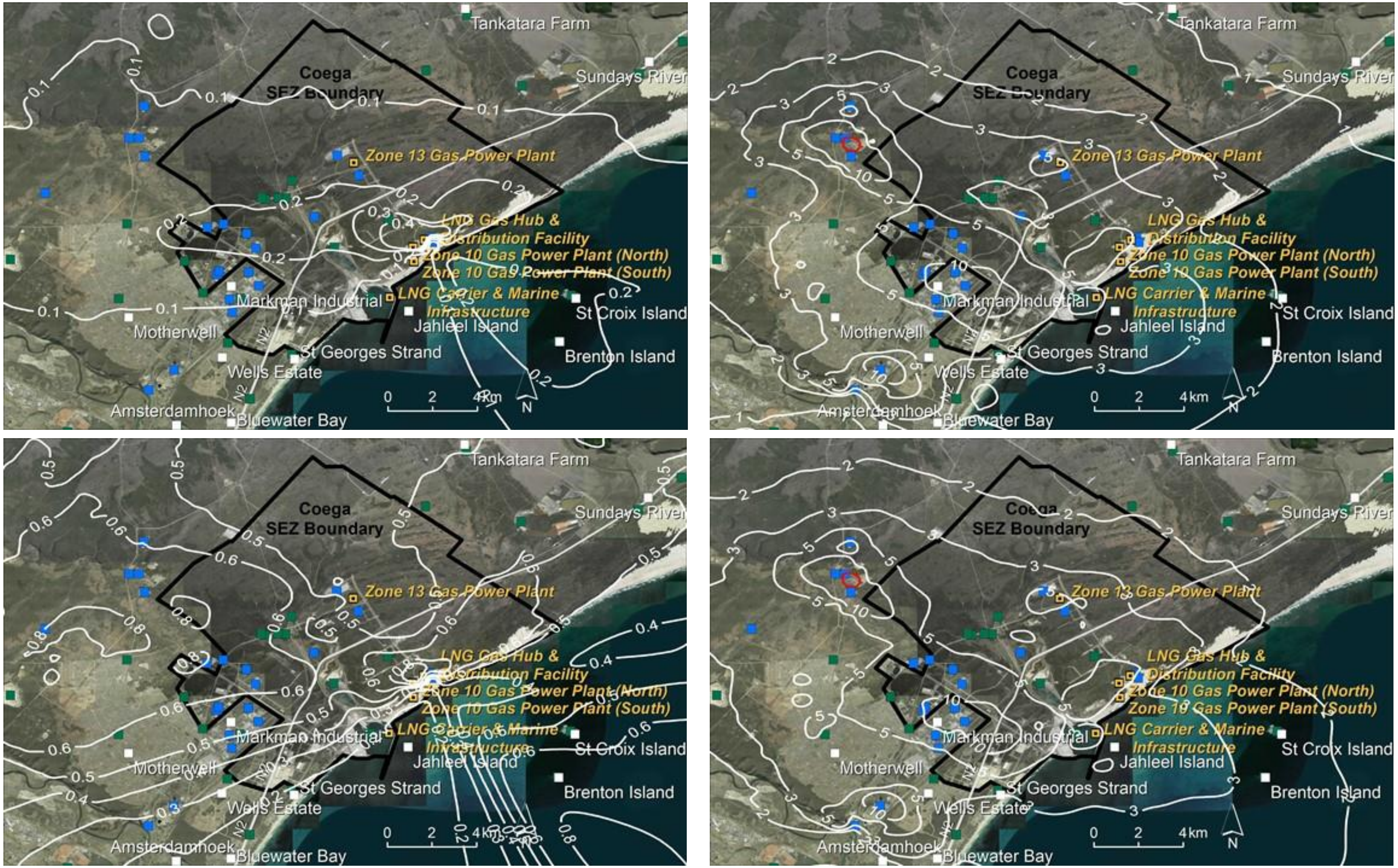


Figure 15: Predicted annual average SO_2 concentrations in µg/m^3 for Scenario 1 the Land-based LNG Terminal and Infrastructure Project (top left), Scenario 2 the Land-based LNG Terminal and Infrastructure Project with baseline (top right), Scenario 3 the 3 000 MW Coega G2P Project (bottom left) and Scenario 4 the 3 000 MW Coega G2P Project and baseline (bottom right)

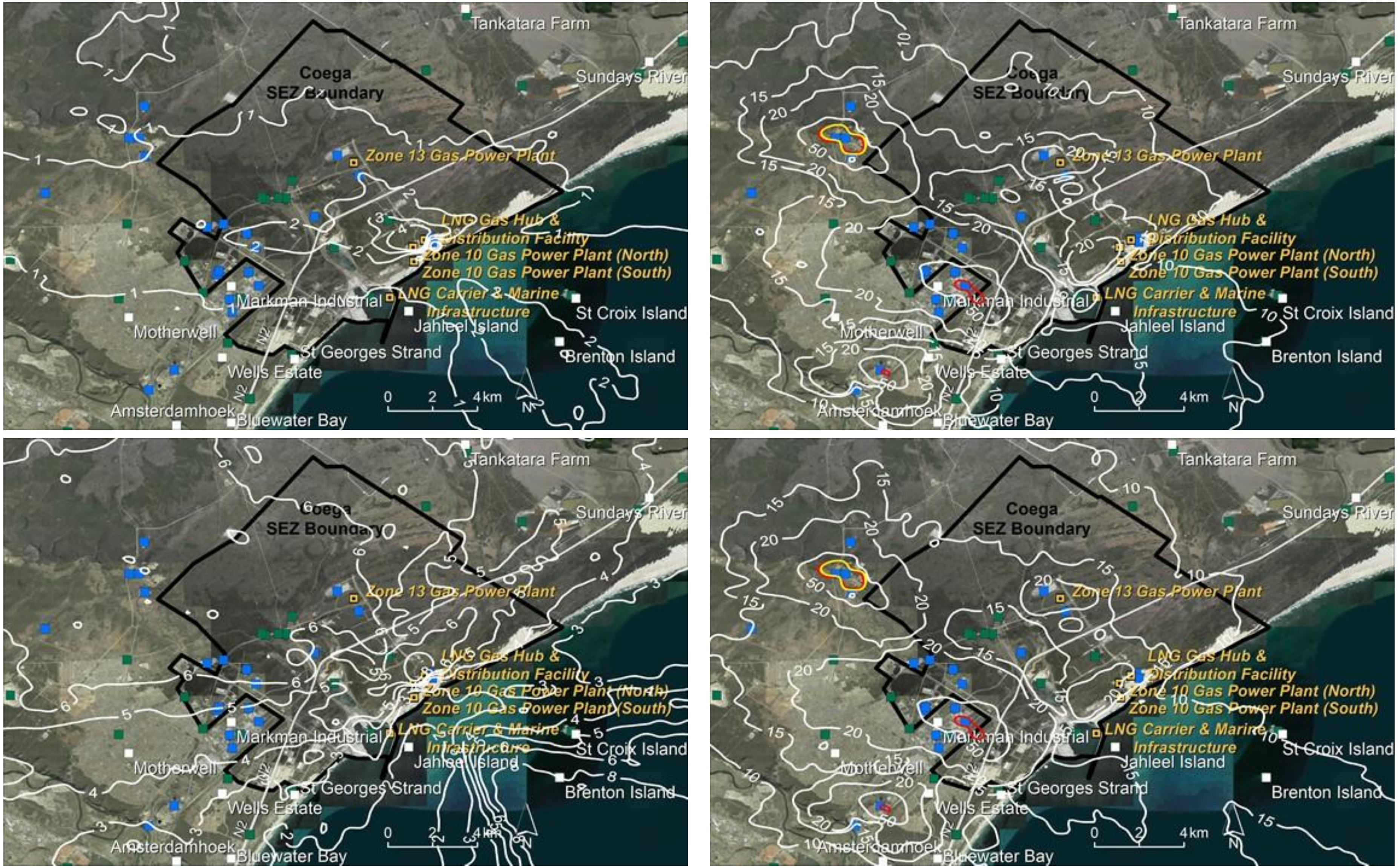


Figure 16: Predicted 99th percentile of the 24-hour SO_2 concentrations in µg/m³ for Scenario 1 the Land-based LNG Terminal and Infrastructure Project (top left), Scenario 2 the Land-based LNG Terminal and Infrastructure Project with baseline (top right), Scenario 3 the 3 000 MW Coega G2P Project (bottom left) and Scenario 4 the 3 000 MW Coega G2P Project and baseline (bottom right)

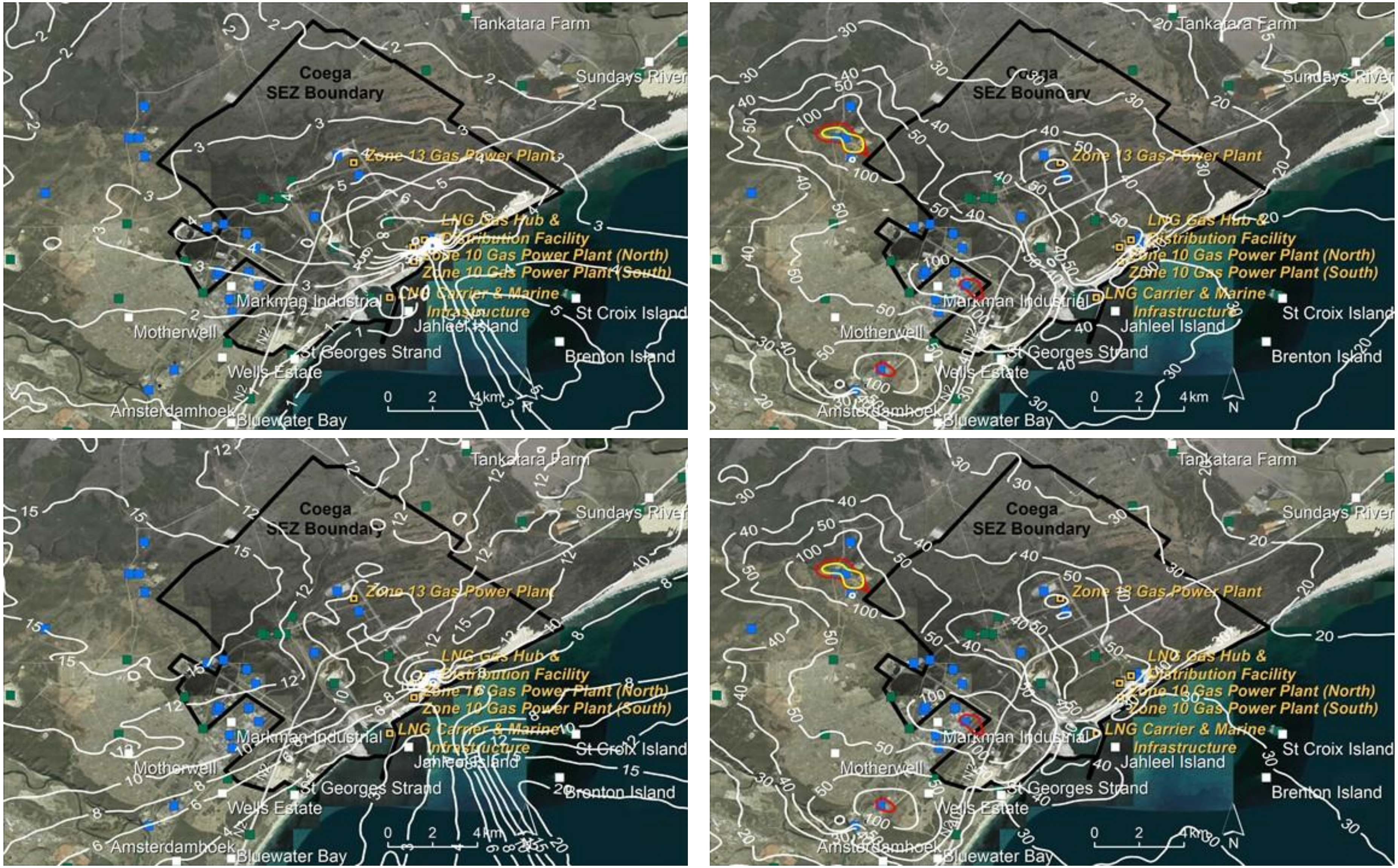


Figure 17: Predicted 99th percentile of the 1-hour SO_2 concentrations in µg/m³ for Scenario 1 the Land-based LNG Terminal and Infrastructure Project (top left), Scenario 2 the Land-based LNG Terminal and Infrastructure Project with baseline (top right), Scenario 3 the 3 000 MW Coega G2P Project (bottom left) and Scenario 4 the 3 000 MW Coega G2P Project and baseline (bottom right)

5.3.2.2 Nitrogen dioxide (NO_2)

The predicted ambient NO_2 concentrations are shown and compared for the four scenarios in Figure 18 (annual) and Figure 19 (1-hour).

- For Scenario 1, the Land-based LNG Terminal and Infrastructure Project, the predicted ambient NO_2 concentrations are very low and well below the NAAQS for the annual and 1-hour averaging periods.
- For Scenario 2, the Land-based LNG Terminal and Infrastructure Project with the current baseline, the predicted annual ambient NO_2 concentrations are generally low and below the NAAQS in the SEZ. Noteworthy is the extension of relatively high concentrations along the N2. For the 1-hour averaging periods exceedances of the NAAQS are predicted to occur in two small areas to the west of the SEZ and along the N2 to the east. It is noteworthy that these exceedances occur because of the existing sources and are not attributed to the small addition by the Land-based LNG Terminal and Infrastructure Project.
- For Scenario 3, the 3 000 MW Coega Gas-to-Power Project, the predicted ambient NO_2 concentrations are very low and well below the NAAQS for the annual and 1-hour averaging periods.
- For Scenario 4, the 3 000 MW Coega Gas-to-Power Project with the current baseline, the predicted ambient NO_2 concentrations are generally low and below the NAAQS in the SEZ for the annual averaging period. However, exceedances are predicted to occur in two small areas to the west of the SEZ and along the N2 to the east. It is noteworthy that these exceedances occur because of the existing sources and are not attributed to the small addition by the 3 000 MW Coega Gas-to-Power Project.

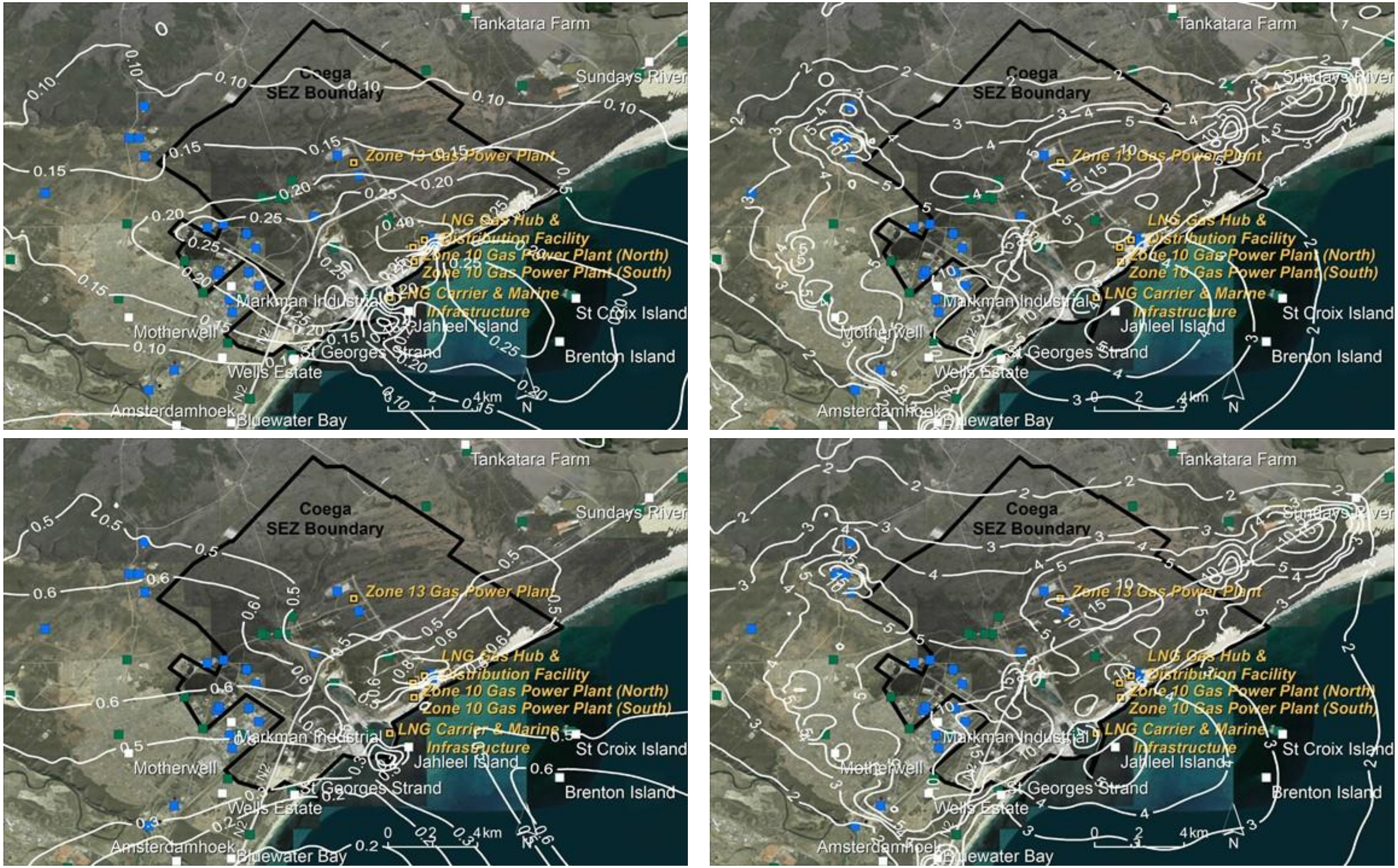


Figure 18: Predicted annual average NO_2 concentrations in µg/m^3 for Scenario 1 the Land-based LNG Terminal and Infrastructure Project (top left), Scenario 2 the Land-based LNG Terminal and Infrastructure Project with baseline (top right), Scenario 3 the 3 000 MW Coega G2P Project (bottom left) and Scenario 4 the 3 000 MW Coega G2P Project and baseline (bottom right)

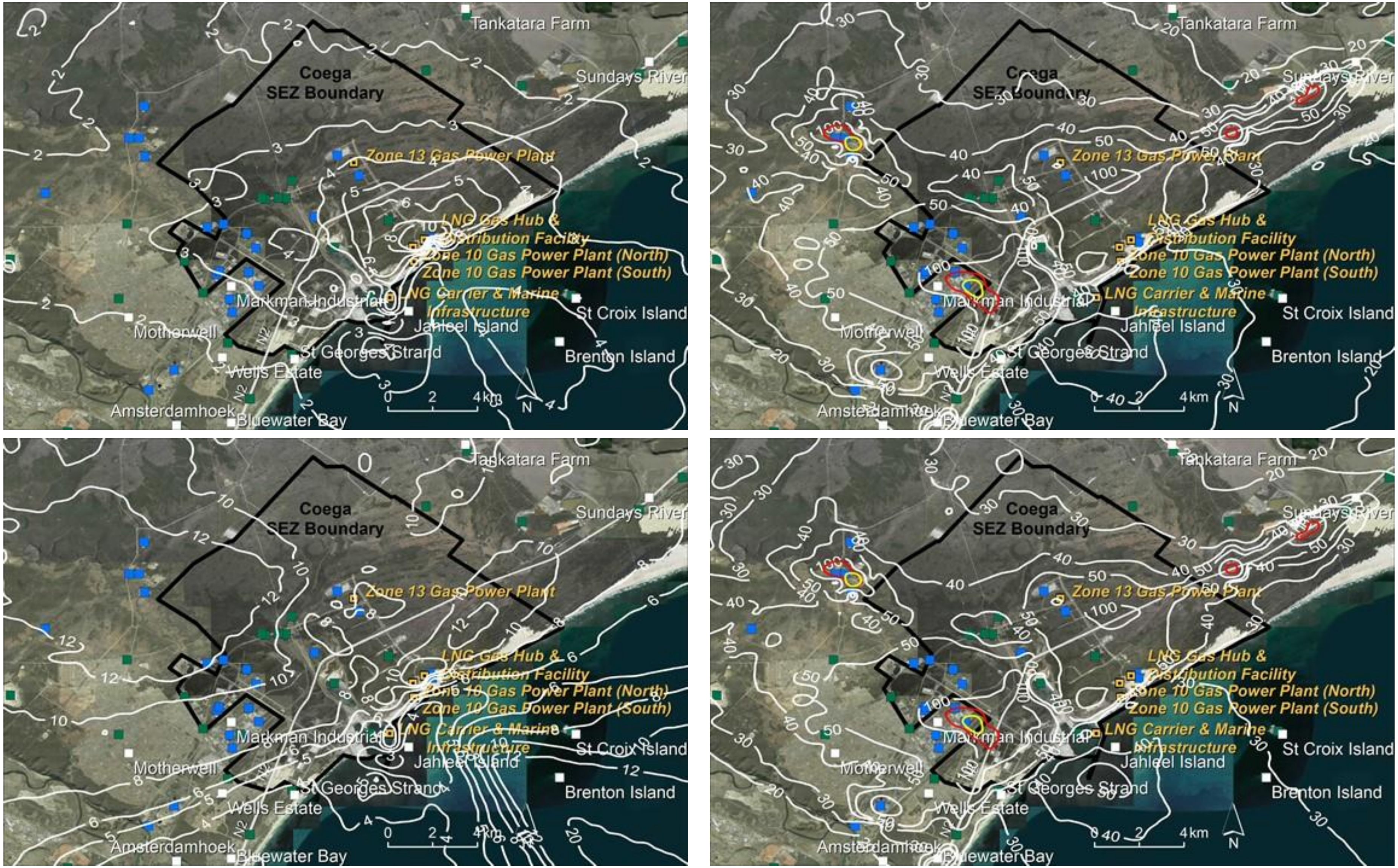


Figure 19: Predicted 99th percentile of the 1-hour NO_2 concentrations in µg/m³ for Scenario 1 the Land-based LNG Terminal and Infrastructure Project (top left), Scenario 2 the Land-based LNG Terminal and Infrastructure Project with baseline (top right), Scenario 3 the 3 000 MW Coega G2P Project (bottom left) and Scenario 4 the 3 000 MW Coega G2P Project and baseline (bottom right)

5.3.2.3 Particulates (PM_{10})

The predicted ambient PM_{10} concentrations are shown and compared for the four scenarios in Figure 20 (annual) and Figure 21 (24-hour).

- For Scenario 1, the Land-based LNG Terminal and Infrastructure Project, the predicted ambient PM_{10} concentrations are very low and well below the NAAQS for the annual and 24-hour averaging periods.
- For Scenario 2, the Land-based LNG Terminal and Infrastructure Project with the current baseline, the predicted annual ambient PM_{10} concentrations are relatively high and exceed the NAAQS over the central parts of the SEZ and just northwest of the SEZ. It is noteworthy that these exceedances occur because of the existing sources and are not attributed to the very small addition by the Land-based LNG Terminal and Infrastructure Project.
- For Scenario 3, the 3 000 MW Coega Gas-to-Power Project, the predicted ambient PM_{10} concentrations are very low and well below the NAAQS for the annual and 24-hour averaging periods.
- For Scenario 4, the 3 000 MW Coega Gas-to-Power Project with the current baseline, the predicted ambient PM_{10} concentrations are relatively high and exceed the NAAQS over the central parts of the SEZ and just northwest of the SEZ. It is noteworthy that these exceedances occur because of the existing sources and are not attributed to the very small addition by the 3 000 MW Coega Gas-to-Power Project.

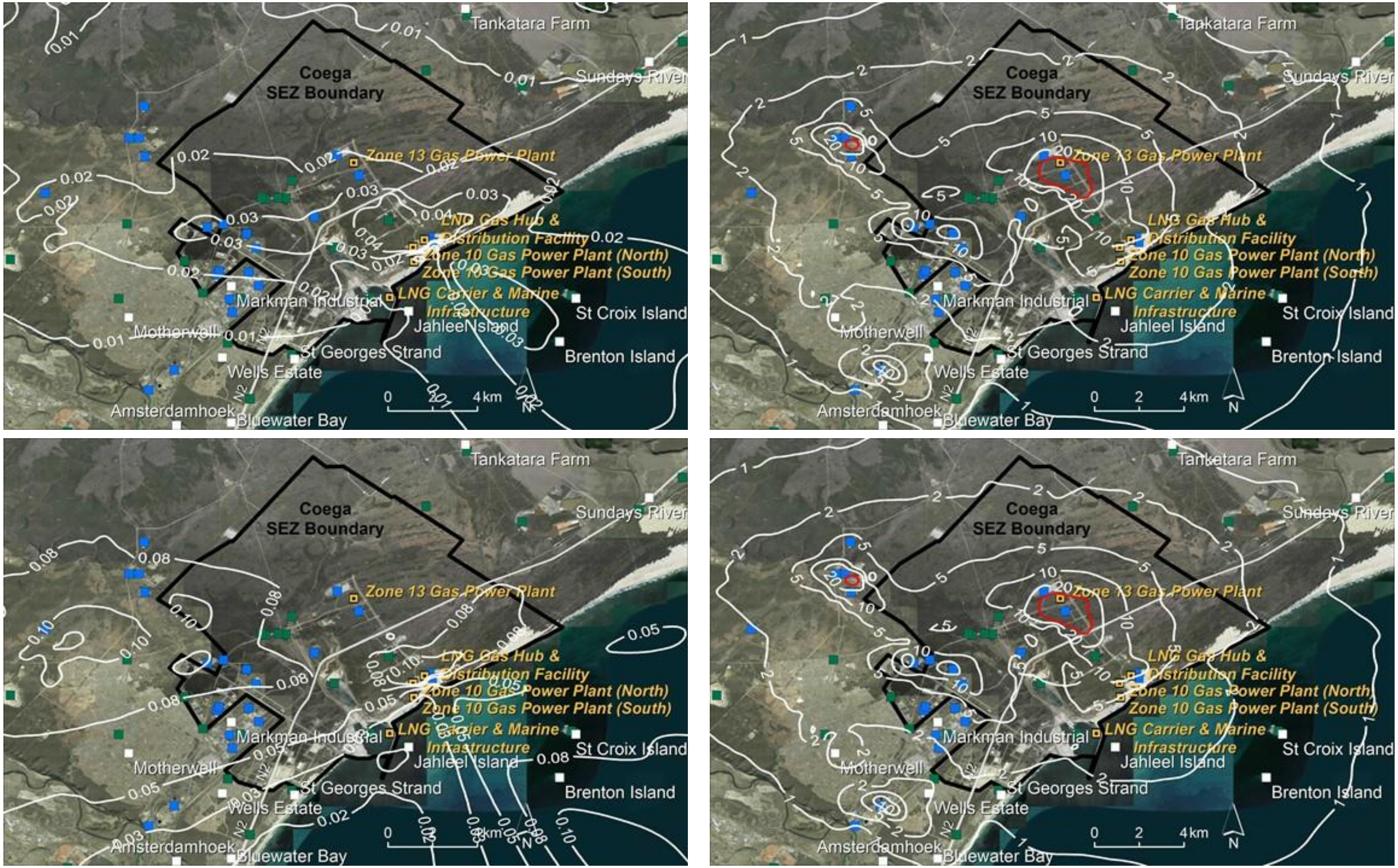


Figure 20: Predicted annual average PM_{10} concentrations in μg/m^3 for 1) for Scenario 1 the Land-based LNG Terminal and Infrastructure Project (top left), Scenario 2 the Land-based LNG Terminal and Infrastructure Project with baseline (top right), Scenario 3 the 3 000 MW Coega G2P Project (bottom left) and Scenario 4 the 3 000 MW Coega G2P Project and baseline (bottom right)

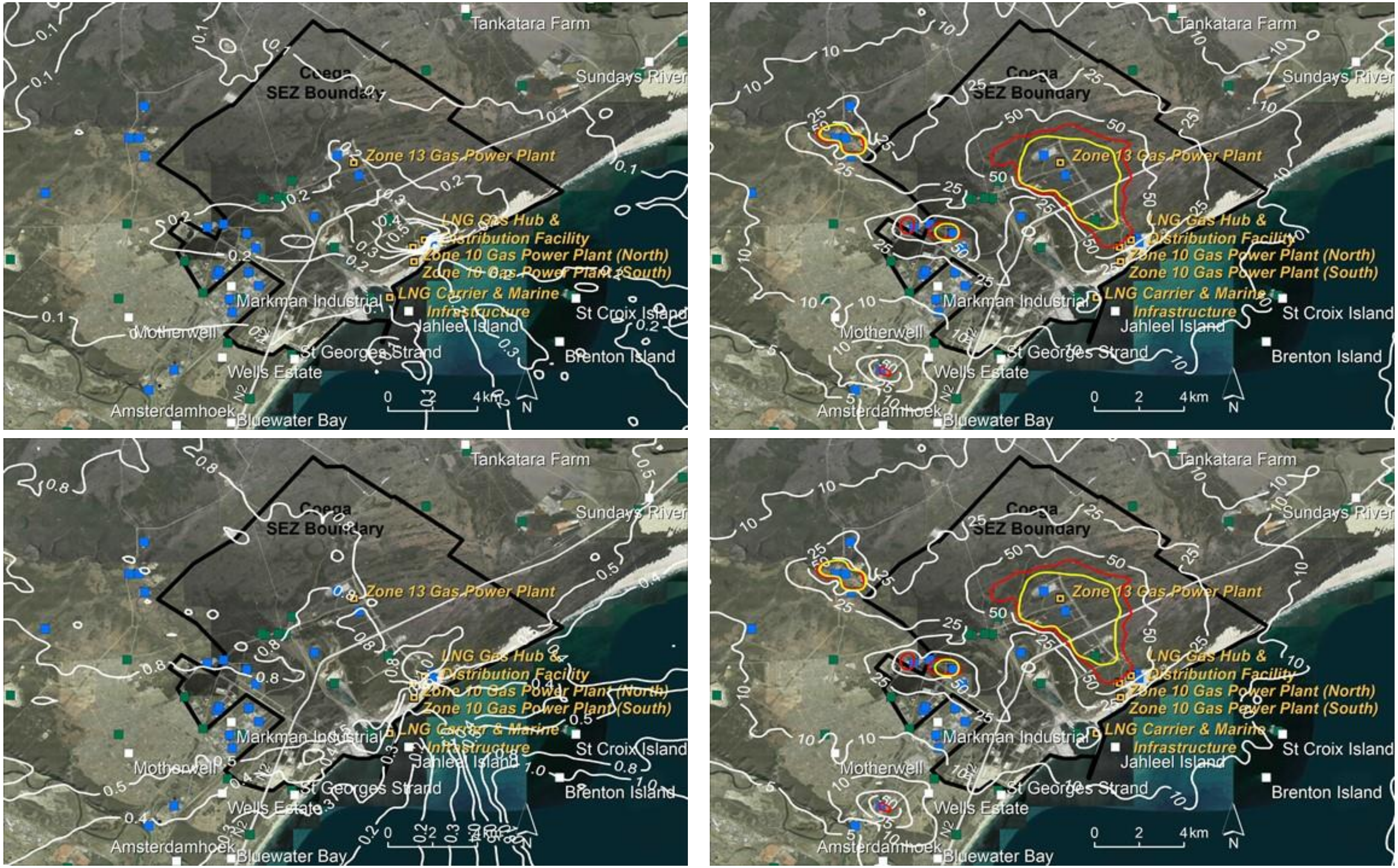


Figure 21: Predicted 99th percentile of the 24-hour PM_{10} concentrations in µg/m³ for Scenario 1 the Land-based LNG Terminal and Infrastructure Project (top left), Scenario 2 the Land-based LNG Terminal and Infrastructure Projectwith baseline (top right), Scenario 3 the 3 000 MW Coega G2P Project (bottom left) and Scenario 4 the 3 000 MW Coega G2P Project and baseline (bottom right)

5.3.2.4 Carbon monoxide (CO)

The predicted ambient CO concentrations are shown and compared for the four scenarios in Figure 22 (8-hour) and Figure 23 (1-hour).

- For Scenario 1, the Land-based LNG Terminal and Infrastructure Project, the predicted ambient CO concentrations are very low and well below the NAAQS for the 8-hour and 1-hour averaging periods.
- For Scenario 2, the Land-based LNG Terminal and Infrastructure Project with the current baseline, the predicted 8-hour and 1-hour CO concentrations are low throughout the SEZ. It is noteworthy that the contribution by the Land-based LNG Terminal and Infrastructure Project to the baseline is very small.
- For Scenario 3, the 3 000 MW Coega Gas-to-Power Project, the predicted ambient CO concentrations are very low and well below the NAAQS for the 8-hour and 1-hour averaging periods.
- For Scenario 4, the 3 000 MW Coega Gas-to-Power Project with the current baseline, the predicted 8-hour and 1-hour CO concentrations are low throughout the SEZ. It is noteworthy that the contribution by the 3 000 MW Coega Gas-to-Power Project to the baseline is very small.

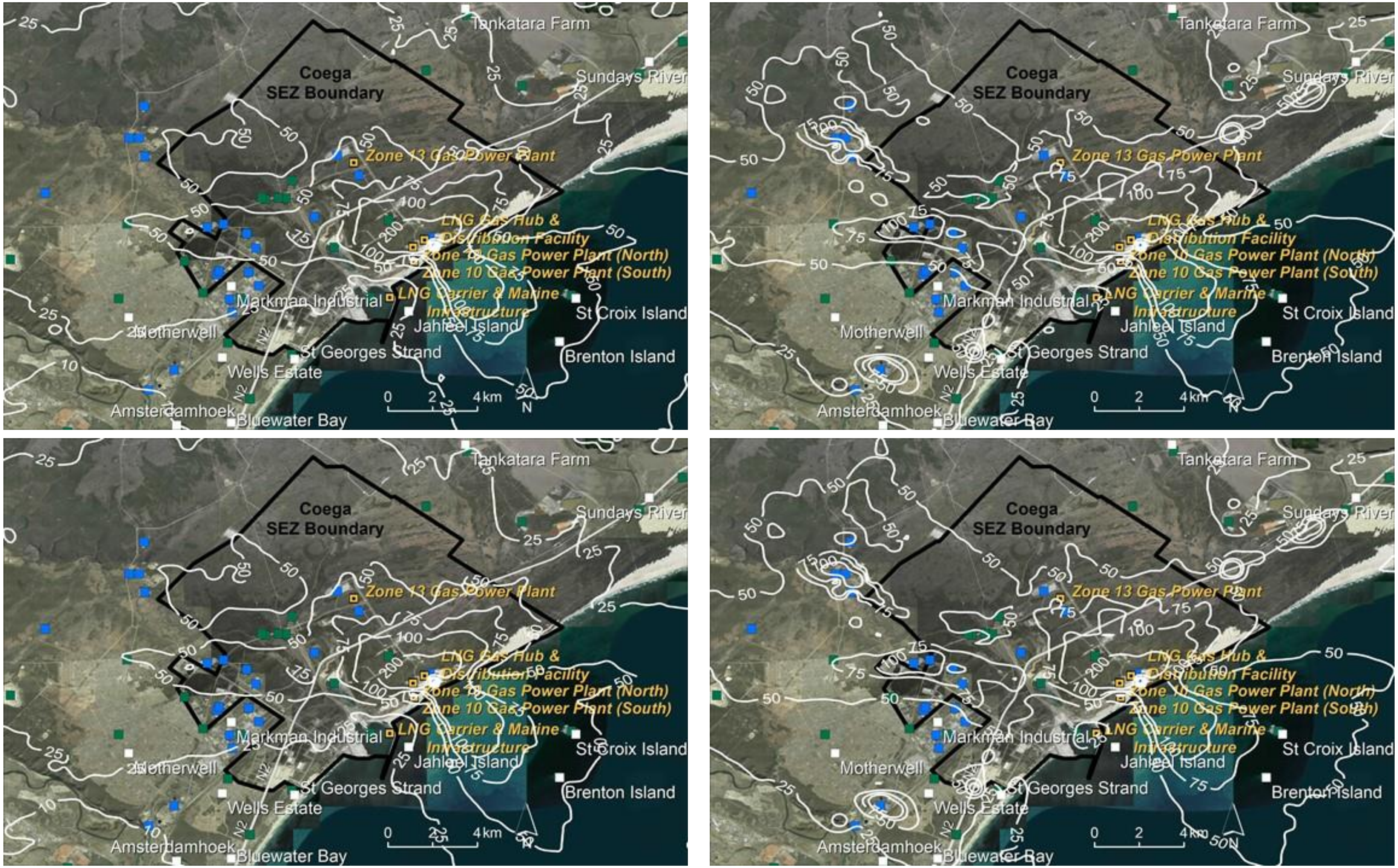


Figure 22: Predicted 8-hour CO concentrations in µg/m³ for Scenario 1 the Land-based LNG Terminal and Infrastructure Project (top left), Scenario 2 the Land-based LNG Terminal and Infrastructure Project with baseline (top right), Scenario 3 the 3 000 MW Coega G2P Project (bottom left) and Scenario 4 the 3 000 MW Coega G2P Project and baseline (bottom right)

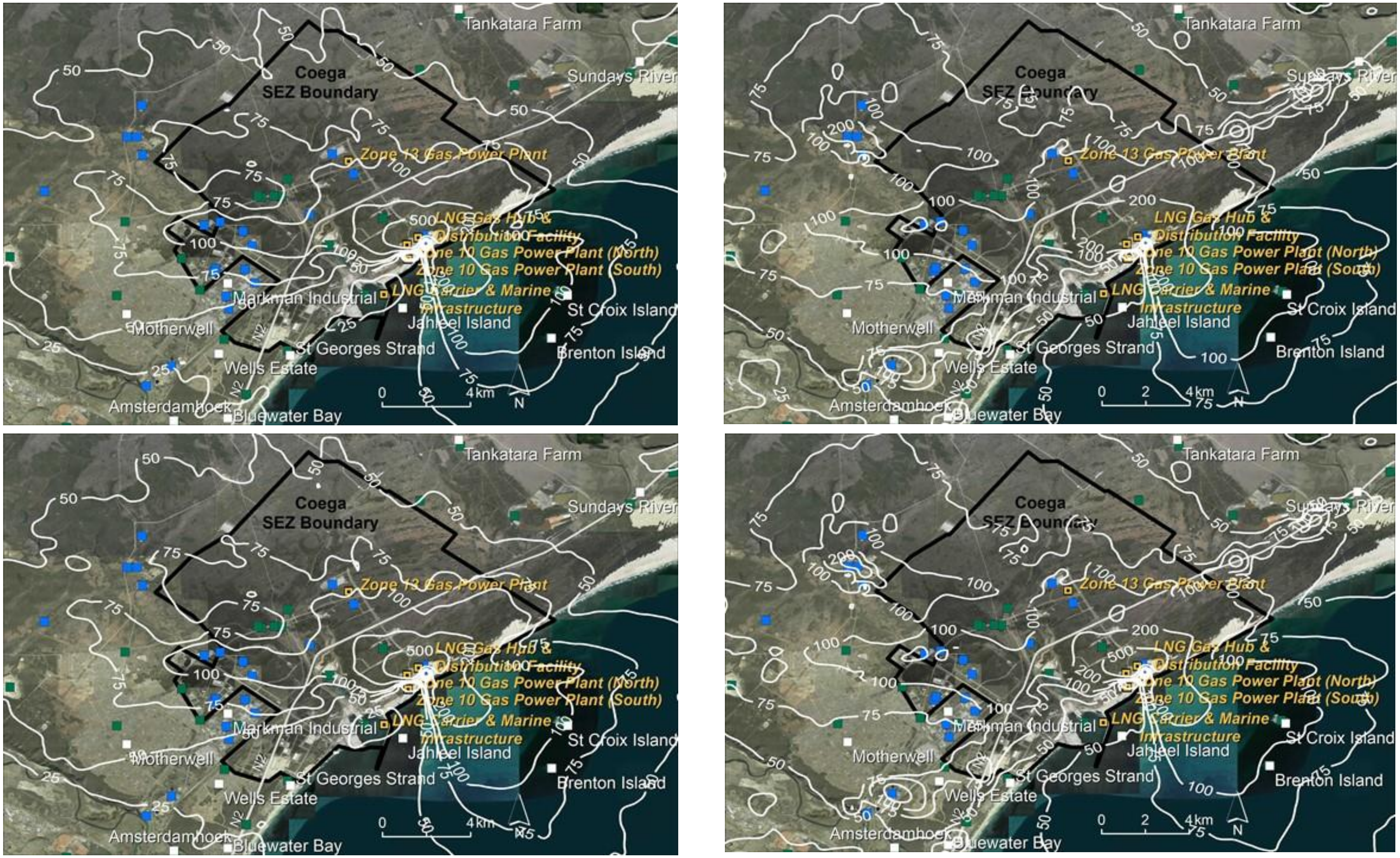


Figure 23: Predicted 1-hour CO concentrations in µg/m³ for Scenario 1 the Land-based LNG Terminal and Infrastructure Project (top left), Scenario 2 the Land-based LNG Terminal and Infrastructure Project with baseline (top right), Scenario 3 the 3 000 MW Coega G2P Project (bottom left) and Scenario 4 the 3 000 MW Coega G2P Project and baseline (bottom right)

5.4 Impact Assessment

5.4.1 Impact Rating Methodology

The assessment of impacts is based on the professional judgement of specialists and according to the impact assessment methodology presented below.

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 criteria that are used to determine impact consequences are presented in Table 29.

Table 29: Criteria used to determine the Consequence of the Impact

Rating	Definition of Rating	Score
A. Extent– the area over which the impact will be experienced		
None		0
Local	Confined to project site of the Coega SEZ	1
Regional	The NMBMM	2
(Inter) national	Nationally or beyond	3
B. Intensity– the magnitude of the impact in relation to the sensitivity of the receiving environment		
None		0
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 time frame for which the impact will be experienced		
None		0
Short-term	Up to 2 years	1
Medium-term	2 to 15 years	2
Long-term	More than 15 years	3

The combined score of these three criteria corresponds to a Consequence Rating (Table 30).

Table 30: Method used to determine the Consequence Score

Combined Score (A+B+C)	0 – 2	3 – 4	5	6	7	8 – 9
Consequence Rating	Not significant	Very low	Low	Medium	High	Very high

Once the consequence has been derived, the probability of the probability of the impact occurring is considered using the probability classifications presented in Table 31.

Table 31: Probability Classification

Improbable	< 40% chance of occurring
Possible	40% - 70% chance of occurring
Probable	> 70% - 90% chance of occurring
Definite	> 90% chance of occurring

The overall significance of impacts is determined by considering consequence and probability using the rating system prescribed in Table 32.

Table 32: Impact Significance Ratings

Significance Rating	Possible Impact Combinations		
	Consequence		**Probability**
Insignificant	Very Low	&	Improbable
	Very Low	&	Possible
Very Low	Very Low	&	Probable
	Very Low	&	Definite
	Low	&	Improbable
	Low	&	Possible
Low	Low	&	Probable
	Low	&	Definite
	Medium	&	Improbable
	Medium	&	Possible
Medium	Medium	&	Probable
	Medium	&	Definite
	High	&	Improbable
	High	&	Possible
High	High	&	Probable
	High	&	Definite
	Very High	&	Improbable
	Very High	&	Possible
Very High	Very High	&	Probable
	Very High	&	Definite

Finally, the status of the impacts are considered (positive or negative impact) and the confidence in the assigned impact significance rating (Table 33).

Table 33: Impact status and confidence classification

Status of impact	
Indication whether the impact is adverse (negative) or beneficial (positive).	+ ve (positive – a 'benefit')
	– ve (negative – a 'cost')
Confidence of assessment	
The degree of confidence in predictions based on available information, specialist judgment and/or specialist knowledge.	Low
	Medium
	High

5.4.2 *Summary of Impacts*

Using the scoring system described above, the potential impact of emissions from the Land-based LNG Terminal and Infrastructure Project on ambient air quality is assessed. Also assessed are the cumulative emissions of the four projects that make up the 3 000 MW Coega Gas-to-Power Project.

The cumulative effect of the Land-based LNG Terminal and Infrastructure Project and the 3 000 MW Coega Gas-to-Power Project on current ambient air quality is assessed.

The impact summary scores for the Land-based LNG Terminal and Infrastructure Project and the 3 000 MW Coega Gas-to-Power Project are captured in Table 34.

The Land-based LNG Terminal and Infrastructure Project:

- For all SO_2, NO_2, CO and PM_{10} the extent of the potential impact is very small and limited to the SEZ. There is no benzene which is emitted so any potential impact irrelevant.
- The predicted ambient concentrations resulting from emissions from the Land-based LNG Terminal and Infrastructure Project are very low and the intensity is rated as irrelevant for SO_2, NO_2, CO and PM_{10}.
- Although the intensity is irrelevant, any impact will endure for the life of the operation. The duration is therefore long term.
- The consequence of the potential impact is therefore very low for SO_2, NO_2, CO and PM_{10} and irrelevant for benzene.
- The intensity is very low, so air quality impacts are improbable.
- The significance rating is therefore considered insignificant for SO_2, NO_2, CO and PM_{10}.
- Air pollutants may have negative health effects even at low concentration. The status of the impact is therefore negative.
- The assessment is based on representative data and has been conducted by an experienced team. A high level of confidence is therefore placed on the findings of the assessment.

The 3 000 MW Coega Gas-to-Power Project:

- For all SO_2, NO_2 and PM_{10}, the extent of the potential impact is small and limited to the SEZ. For CO and benzene the predicted concentrations are very low and the extent of any potential impact is regarded as irrelevant.
- The predicted ambient concentrations resulting from 3 000 MW Coega Gas-to-Power Project emissions are very low and the intensity is rated as low for NO_2 and irrelevant for the other pollutants.
- Although the intensity is low or irrelevant, any impact will endure for the life of the 3 000 MW Coega Gas-to-Power Project. The duration is therefore long term.
- The consequence of the potential impact is therefore low for NO_2 and very low for the other pollutants.

- Although the intensity is low, the probability of air quality impacts from the 3 000 MW Coega Gas-to-Power Project are possible for NO_2, and improbable for the other pollutants.
- The significance rating is considered very low for NO_2 and insignificant for the other pollutants.
- Air pollutants may have negative health effects even at low concentration. The status of the impact is therefore negative.
- The assessment is based on representative data and has been conducted by an experienced team. A high level of confidence is therefore placed on the findings of the assessment.

Cumulative effect of the Land-based LNG Terminal and Infrastructure Project:

- For all SO_2, NO_2, PM_{10} and CO the extent of the potential impact is very small and limited to the site. The cumulative effect in the SEZ is therefore considered negligible.
- The predicted ambient concentrations resulting from the operations are very low and the intensity is rated as very low for all pollutants. They will not contribute to exceedances of the ambient standards. The cumulative effect in the SEZ will be negligible.
- The assessment is based on representative data and has been conducted by an experienced team. A high level of confidence is therefore placed on the findings of the assessment.

Cumulative effect of the 3 000 MW Coega Gas-2-Power Project:

- For all SO_2, NO_2 and PM_{10}, the extent of the potential impact is small and limited to the SEZ. For CO and benzene the predicted concentrations are very low and the extent of any potential impact is regarded as irrelevant. The cumulative effect in the SEZ will therefore be very small or negligible.
- The predicted ambient concentrations resulting from the 3 000 MW Coega Gas-to-Power Project emissions are very low and the intensity is rated as low for NO_2 and irrelevant for the other pollutants. They will not contribute to exceedances of the ambient standards. The cumulative effect in the SEZ will be very small or negligible.
- The assessment is based on representative data and has been conducted by an experienced team. A high level of confidence is therefore placed on the findings of the assessment.

Cumulative effect of the other proposed gas-to-power project in the Coega SEZ

- The proposed Karpowership project in the port of Ngqura is predicted maximum concentrations of SO_2, NO_2 and PM are very low relative to the NAAQS. In all cases the predicted maximum increase is over the Coega SEZ. The maximum predicted concentrations are of 0.09 $\mu g/m^3$ for SO_2, 1.8 $\mu g/m^3$ for NO_2 and 0.4 $\mu g/m^3$ for PM_{10} (uMoya-NILU, 2020).
- The proposed Engie gas-fired power plant will result in very low ambient concentrations of SO_2, NO_2 and PM relative to the NAAQS. In all cases the predicted maximum increase will occur over the Coega SEZ (uMoya-NILU, 2021).

- For SO_2, NO_2 and PM_{10}, the extent of the potential impact of the other gas-to-power projects is small and limited to the SEZ. The contribution will not significantly increase the ambient concentrations and will not result in exceedances of the NAAQS. The cumulative effect in the SEZ will therefore be very small or negligible.
- The predicted ambient concentrations resulting from the power plant emissions are very low and the intensity is rated as low for NO_2 and irrelevant for the other pollutants. It is highly unlikely that they will contribute to exceedances of the ambient standards. The cumulative effect of the gas-to-power projects will be very small or negligible.
- The cumulative assessment of the other gas-to-power projects is based on their respective AIRs.

Table 34: Air quality Impact Assessment summary scores

Description	Pollutants	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence	Reversibility
Land-based LNG Terminal and Infrastructure Project	SO_2	1	0	3	Very low	Improbable	Insignificant	-ve	High	Yes
	NO_2	1	0	3	Very low	Improbable	Insignificant	-ve	High	Yes
	PM_{10}	1	0	3	Very low	Improbable	Insignificant	-ve	High	Yes
	CO	0	0	3	Very low	Improbable	Insignificant	-ve	High	Yes
	Benzene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3 000 MW Coega G2P Project	SO_2	1	0	3	Very low	Improbable	Insignificant	-ve	High	Yes
	NO_2	1	1	3	Low	Probable	Very low	-ve	High	Yes
	PM_{10}	1	0	3	Very low	Improbable	Insignificant	-ve	High	Yes
	CO	0	0	3	Very low	Improbable	Insignificant	-ve	High	Yes
	Benzene	0	0	3	Very low	Improbable	Insignificant	-ve	High	Yes
Cumulative assessment with other gas-to-power projects	SO2	1	0	3	Very low	Improbable	Insignificant	-ve	High	Yes
	NO2	1	0	3	Very low	Improbable	Insignificant	-ve	High	Yes
	PM10	1	0	3	Very low	Improbable	Insignificant	-ve	High	Yes
	CO	0	0	3	Very low	Improbable	Insignificant	-ve	High	Yes
	Benzene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

5.5 Analysis of Emissions' Impact on the Environment

This AIR has focused on potential human health impacts. An assessment of the atmospheric impact of the facility on the environment was therefore not undertaken as part of this AIR.

6. COMPLAINTS

Not relevant to this AIR as this is a proposed facility.

7. CURRENT OR PLANNED AIR QUALITY MANAGEMENT INTERVENTIONS

Air quality management interventions to reduce emissions are deemed to be unnecessary considering the low impact of the project on air quality.

Routine emission measurements and other air quality monitoring may be stipulated by the Licensing Authority in the Atmospheric Emission License (AEL).

8. COMPLIANCE AND ENFORCEMENT ACTIONS

Not relevant to this AIR as this is a proposed facility.

9. SUMMARY AND CONCLUSION

The proposed Coega 3000 MW Integrated Gas-to-Power Project will ultimately include the following components a Liquefied Natural Gas (LNG) terminal and three 1000 MW Gas to Power plants. Two power plants are proposed in Zone 10 (coastal) and one in Zone 13 (inland) of the SEZ. Power generation will be by means of a hybrid of Combined Cycle Gas Turbines (CCGT), Open Cycle Gas Turbines (OCGT), and Reciprocating Engines (RE). Each power plant will use LNG as the primary source of fuel, with diesel and fuel oil as back up fuels. On-site storage of back up fuels will include two 4 000 m^3 tanks for diesel and two 4 000 m^3 tanks for fuel oil.

An air quality assessment for the proposed Land-based LNG Terminal and Infrastructure Project has been conducted. The requirements of the Atmospheric Impact Report (AIR) have been adhered to and the methodology followed the regulatory requirement for dispersion modelling studies.

LNG is a clean fuel. The predicted ambient concentrations of SO_2, NO_2, PM_{10} and CO resulting from emissions from the Land based LNG Terminal and Infrastructure Project are therefore very low. The significance rating for the air quality impacts is insignificant for all pollutants.

Ambient monitoring and dispersion modelling show that ambient concentrations of SO_2 and NO_2 in the Coega SEZ are generally low, but there are some areas where NO_2

exceedances occur. PM_{10} concentrations are relatively high and exceedances of ambient standards were modelled from baseline emission data. The cumulative effect of the proposed operation will be negligible and will not contribute to exceedances of the ambient standards in the SEZ.

The predicted ambient concentrations resulting from the emissions from the CDC project (three 1 000 MW power plants and the infrastructure project) are very low and the intensity is rated as low for NO_2 and irrelevant for the other pollutants. It is highly unlikely that they will contribute to exceedances of the ambient standards. The cumulative effect of the CDC project will be very small or negligible.

The cumulative effect of the gas-to-power projects is also predicted to be very small or negligible. The predicted ambient concentrations resulting from the power plant emissions are very low and the intensity is rated as low for NO_2 and irrelevant for the other pollutants. It is highly unlikely that they will contribute to exceedances of the ambient standards.

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11. FORMAL DECLARATIONS

A declaration of the accuracy of the information contained in this Atmospheric Impact Report is included here. A declaration of the independence of the practitioners in the uMoya-NILU consultancy team that compiled this AIR is also included.

DECLARATION OF ACCURACY OF INFORMATION – APPLICANT

Name of Enterprise: uMoya-NILU Consulting (Pty) Ltd

Declaration of accuracy of information provided:

Atmospheric Impact Report in terms of Section 30 of the Act

I, Mark Zunckel [duly authorised], declare that the information provided in this atmospheric impact report is, to the best of my knowledge, in all respects factually true and correct. I am aware that the supply of false or misleading information to an air quality office is a criminal office in terms of section 51(1)(g) of this Act.

Signed at Durban on this 21 January 2021.

____

SIGNATURE

Managing Director – uMoya-NILU Consulting
CAPACITY OF SIGNATORY

DECLARATION OF INDEPENDENCE – PRACTITIONER

Name of Practitioner: Mark Zunckel

Name of Registered Body: South African Council for Natural Scientific Professionals

Professional Registration Number: 400449/04

Declaration of independence and accuracy of information provided:

Atmospheric Impact Report in terms of Section 30 of the Act

I, Mark Zunckel declare that I am independent of the applicant. I have the necessary expertise to conduct the assessment required for the report and 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 will disclose to the applicant and the air quality officer 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 air quality officer. The information provided in the atmospheric impact report is, to the best of my knowledge, in all respects factually true and correct. I am aware that the supply of false or misleading information to an air quality office is a criminal office in terms of section 51(1)(g) of this Act.

Signed at Durban on this 21 January 2021.

SIGNATURE

Managing Director – uMoya-NILU Consulting
CAPACITY OF SIGNATORY

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

PROPOSED CDC GAS TO POWER PROJECT

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	uMoya-NILU Consulting (Pty) Ltd			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	2	Percentage Procurement recognition	
Specialist name:	Dr Mark Zunckel			
Specialist Qualifications:	PhD, MSc, BSc hons (Meteorology), BSc (Meteorology), N. Dip (Meteorology			
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E-mail:	mark@umoya-nilu.co.za			

2. DECLARATION BY THE SPECIALIST

I, __MARK ZUNCKEL_, declare that –

- 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 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

uMoya-NILU Consulting (Pty) Ltd

Name of Company:

20 January 2021

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, ___MARK ZUNCKEL_____________________, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

uMoya-NILU Consulting (Pty) Ltd

Name of Company

20 January 2021

Date

ZAMANI RADEBE

Signature of the Commissioner of Oaths

20/01/2021

Date

COMMISSIONER OF OATHS
BRANCH MANAGER
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DURBAN NORTH
4053
DATE:

HYPER BY THE SEA
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