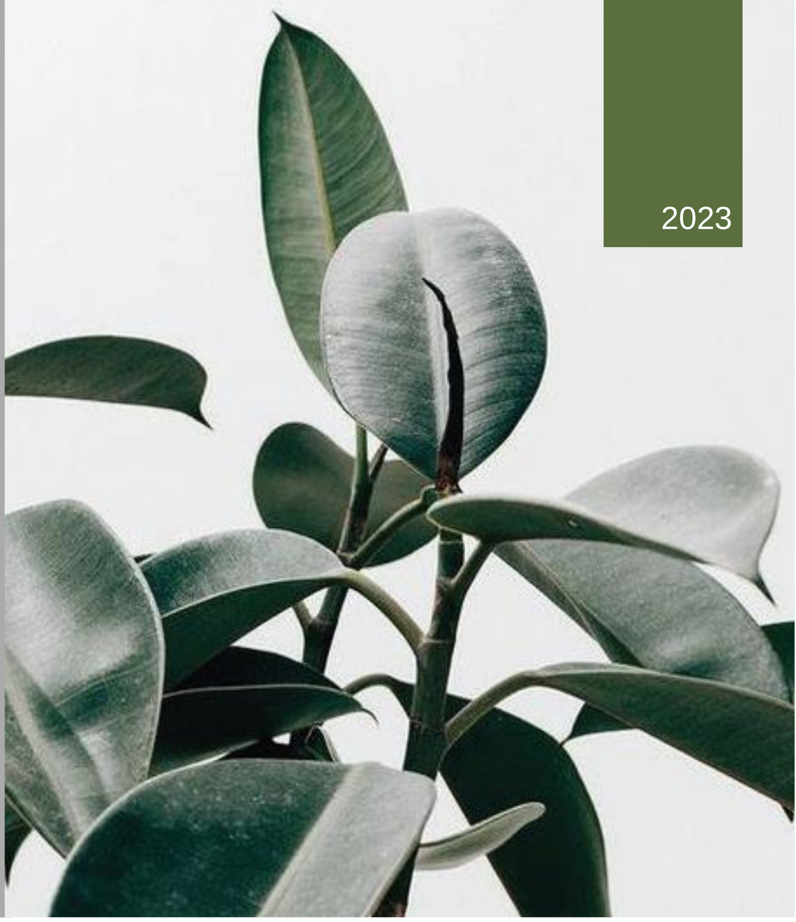

2023

AIR QUALITY IMPACT ASSESSMENT REPORT
FOR
NEOSERVE – A PROPOSED PYROLYSIS PLANT, CHAMDOR, KRUGERSDORP, WEST RAND DISTRICT MUNICIPALITY

GDARDE Reference Number:
002/23-24/W0016

Project Number:
DTS-P-23118

Report Number:
NEO-WA-03-101-23-00

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Report:	Air Quality Impact Assessment Report
Project Title:	Application for a Waste Management License in terms of Section 49(1)(a) of the National Environmental Management: Waste Act, 2008 (Act no. 59 of 2008): for the proposed activities at a site located at 30 Fransen Street, Chamdor, Krugersdorp, Gauteng Province
Location:	30 Fransen Street, Chamdor, Krugersdorp, Gauteng Province
Applicant Name:	Neoserve (Pty) Ltd
Environmental Edge Project Number:	DTS-P-23118
Report Reference Number:	NEO-WA-04-101-23-00
GDARDE Reference:	002/23-24/W0016
Version:	1.0
Date:	31 October 2023

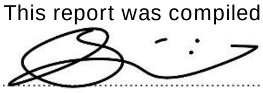
Declaration of Interest:

Environmental Edge, or any of its representatives (we) hereby declare:

1. we have no vested interest (present or prospective) in the project that is the subject of this report as well as its attachments. We have no personal interest with respect to the parties involved in this project.
2. we have no bias with regard to this project or towards the various stakeholders involved in this project.
3. we have not received, nor have we been offered, any significant form of inappropriate reward for compiling this report.

Compiler:

This report was compiled and authorised by:



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DISCLAIMER

Information contained in this report was based on the information received from Neoserve. Where data supplied by the client or other external sources, including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by Environmental Edge (Pty) Ltd for incomplete or inaccurate data supplied by others. We are aware of the fact that there might have been changes since this report was submitted, however this report and its findings is based on the last information received from the client. To the best of our knowledge the assumptions and findings are correct at the time of submission of the specialist reports. Should any of the assumptions or findings prove to be incorrect subsequent to submission of the report, we as the specialist cannot be held accountable.

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EXECUTIVE SUMMARY

Environmental Edge (Pty) Ltd, hereafter referred to as "Environmental Edge", was appointed to compile an Air Quality Impact Assessment Report (AQIAr) as part of an Environmental Impact Assessment (EIA) process, as well a new atmospheric emission license (AEL) application process for the proposed Neoserve (Pty) Ltd (also referred to in this report as "DTS Tyres") pyrolysis plant, hereafter referred to as "the proposed plant", located in Chamdor, Krugersdorp West Rand District, Gauteng Province.

The main objective of the AQIA is to determine the potential impact of emissions associated with the operational activities at the proposed plant on ambient air quality in terms of criteria air pollutants and other non-criteria air pollutants, which include hydrogen halides, metals, ammonia (NH_3), dioxins and furans and total organic compounds (TOCs). As part of the AQIA, a baseline assessment was undertaken to study the receiving area, specifically to determine the prevailing meteorological conditions at the site; establish baseline concentrations of key air pollutants of concern in the area; identify existing sources of emissions; and identify key air quality sensitive receptors (AQSRs) surrounding the project site.

As part of the AQIA, a baseline assessment was undertaken to study the receiving area; specifically, to determine the prevailing meteorological conditions at the site; establish baseline concentrations of key air pollutants of concern in the area; identify existing sources of emissions; and identify key air quality sensitive receptors surrounding the project site.In studying the receiving environment, the following was found:

- Air Quality Sensitive Receptors (AQSRs) in the project area include urban residential areas, educational facilities, clinics and hospitals. Residential areas within a 20 km radius of the study area include Silverfields, Mindalore and Princess to the north-east, Witpoortje 2451Q, Florida Park, Grobler Park and Roodepoort West to the east, and Witpoortjie to the south-east. In addition, the Tshepisong, Kagiso and Sinqobile townships are located south, south-west and north-west of the proposed plant. The town of Krugersdorp is located over 5 km from the site, towards the north.
- The proposed plant is located within an industrial area. The R28, R24, and R41 provincial roads run adjacent to the proposed plant, to the west, north and south, respectively.
- The land use surrounding the proposed plant includes urban built up, commercial, residential, and industrial properties, as well as natural vegetation, grassland, mining areas and informal settlements, with waterbodies/wetlands also located in surrounding areas. The larger area surrounding the proposed plant has rural characteristics.
- Existing key sources of pollution surrounding the proposed plant include urban industrial activities, mining activities, vehicle emissions and solid fuel combustion in nearby urban informal settlements and townships. Waste and resource dumps (i.e. mine tailings) associated with mining activities are additional sources of atmospheric emissions in the area, through wind erosion, and are located north-west and south of the proposed plant.
- Based on MM5 meteorological data obtained from Lakes Environmental for the period January 2019 – December 2021, the area is affected by frequent northerly, north-northeasterly and north-northwesterly winds. Long term air quality impacts are, therefore, expected to be the most significant to the south, south-southwest and south-southeast of operations at the proposed plant.
- The air quality status quo at any project site is usually determined using available monitoring data available from permanent ambient air quality monitoring stations and dustfall networks operated near the project site, which is accessible via the South African Air Quality Information System (SAAQIS) website. The nearest Air Quality Monitoring Station (AQMS) to the proposed

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plant is the Davidsonville AQMS, which is located ~4.6km east of the proposed plant. However, this AQMS seems to be non-operational as there was no ambient air quality data recorded for any of the criteria air pollutants for the past several years. In addition, there are no known dustfall networks in the area. Thus, the air quality status quo at the project site could not be determined in this AQIA.

- Despite the limitation mentioned above (i.e. the lack of background air quality data for the project site), it is noted that the proposed pyrolysis plant, as planned, is not expected to be a major source of incremental particulate, metal and gaseous emissions at the project site due to the inclusion of a smoke/water scrubber in its design.
- The proposed plant is not expected to be a major source of incremental particulate, gaseous or metal emissions at the project site if it is operated at or below the MES for sub-category 8.1.

The main findings of the impact assessment are as follows:

- The key emitting activities at the proposed plant are the pyrolysis reactors, which result in the emission of criteria air pollutants (PM, SO_2, CO and NO_2) and several non-criteria air pollutants (HF, NH_3, TOCs, HCl, etc), which have an impact on ambient air quality.
- One point source, i.e. proposed pyrolysis stack, which triggers sub-category 8.1 (thermal treatment of general and hazardous waste) in terms of S21 of National Environmental Management Air Quality Act (No. 39 of 2004) (NEM: AQA), was the focus of this assessment.
- PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO, HF, HCl, metals, NH_3 and TOCs emission rates from the proposed pyrolysis reactor operations were quantified through an emissions inventory for input into the model. Emission rates were generally low for all pollutants, except NO_2 (i.e. less than 0.1 g/s).
- One scenario was considered in the assessment:
    - New plant standard scenario: where the MES for the proposed plant, i.e. the maximum threshold limit that is allowed for new plants (in terms of PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO, HF, HCl, metals (Cd-Tl, Hg, sum of Pb+ As + Sb +Cr + Co + Cu + Mn + Ni + V), NH_3, dioxins and furans, and TOCs) as per listed activity sub-category 8.1 (thermal treatment of general and hazardous waste) was considered for input into the model.
        - This is representative of potential impacts if the proposed plant were emitting at the acceptable threshold that is permissible for sub-category 8.1 (thermal treatment of general and hazardous waste). The emission standards were converted into emission rates for input into the model.
- Simulated PM_{10} and $PM_{2.5}$ concentrations are well below the NAAQS in both the long and short term.
- Simulated short and long-term gaseous concentrations (NO_2, SO_2 and CO) are low and compliant with the relevant NAAQS.
- Simulated short-term HF, HCl and NH_3 concentrations are well below the relevant Alberta Air Quality Guidelines of 4.9 µg/m^3, 75 µg/m^{3}and 1 400 µg/m^3, respectively.
- Simulated short-term TOC, dioxins and furans and metal concentrations are well below the assessment criteria within the facility boundary, as well as at offsite locations, thus complying with the applicable international standards and guidelines. Furthermore, simulated TOC concentrations are well below the South African NAAQS for benzene in the long-term.
- Simulated emission levels at all AQSRs modelled in the study (as described in Section 5.1) are low, with no exceedances of the applicable NAAQS, or international standards observed, where applicable.

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- Other open-air fugitive emission sources such as vehicle dust entrainment on access roads leading to the plant, as well as the handling of carbon black are also identified as possible sources of emissions at the site. The handling of carbon black will occur intermittently and will be conducted under roof, thus containing any fugitive emissions associated with the handling process within the plant building. Furthermore, the access roads leading to the plant are all paved, thus significantly reducing vehicle dust entrainment due to movement of trucks on these roads. Thus, fugitive emissions from these sources were assumed to be minimal and not included in this assessment Nonetheless, effective and affordable fugitive emission reduction measures should be implemented, where possible and applicable, to reduce the impact of these sources.

To ensure the lowest possible impact on AQSRs and the environment, it is recommended that the air quality management measures as set out in this report should be adopted. These include the mitigation of sources of emission, the management of associated air quality impacts and the monitoring of emissions. Key aspects/recommendations are:

- Fume capture, extraction systems, and /or the pyrolysis stack must be maintained regularly, and operated to specifications, to ensure minimal fugitive emissions during pyrolysis cycles, once the proposed reactors become operational.
- The stack design must be such that the height is above the height of the nearest building (it is advised that a stack height guideline be used). The expected height for the pyrolysis stack is 15m above ground level.
- Continual stack emissions testing is recommended on an annual basis (unless stipulated otherwise in the provisional AEL (PAEL)) to determine the actual emission scenario at the proposed plant. Neoserve should ensure that monitoring is undertaken in accordance with nationally or internationally acceptable methods. Should emissions of PM, SO_2, NO_2, CO, HCl, HF, NH_3, metals, dioxins and furans and TOCs exceed the acceptable MES, appropriate control measures need to be investigated and abatement equipment needs to be installed and/or improved where necessary to achieve compliance with the acceptable emission limits.
- Compliance with PAEL conditions and requirements is recommended, as outlined in Section 7.2 of this report, once the PAEL has been issued.
- As Neoserve are currently busy with an EIA application process, an Environmental Management Programme (EMPr) must be drafted as per the EIA requirements for the proposed plant.

The significance of the air quality impacts on AQSRs for the new plant standard scenario, which is representative of the proposed pyrolysis reactors emitting at the acceptable thresholds that are permissible for sub-category 8.1 (thermal treatment of general and hazardous waste) was found to be low with mitigation. Emissions at the proposed plant should be maintained at or below the MES limits as far as possible. Nonetheless, should the proposed plant ever reach the MES limits, the impact of the two pyrolysis reactors is still predicted to be low inside and beyond the facility boundary for all pollutants.

The “no-go alternative”, which is the option of not fulfilling the proposed project, would result in zero gaseous and particulate emissions being emitted into the air, and thus high positive impacts, with no air quality impacts from the proposed plant on the site or surrounding local area.

All information herein was confirmed by Neoserve. Although Environmental Edge has undertaken general quality checks, it is assumed that all information provided by Neoserve is true and correct.

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LIST OF ABBREVIATIONS

AEL	Atmospheric Emission Licence
APPA	Atmospheric Pollution Prevention Act
AQMP	Air Quality Management Plan
AQMS	Air Quality Monitoring Station
AQSR	Air Quality Sensitive Receptor
As	Arsenic
BA	Basic Assessment
BTEX	Benzene, Toluene, Ethylene, Xylene
Co	Cobalt
Cr	Chromium
Cu	Copper
DEA	Department of Environmental Affairs (now known as the Department of Forestry, Fisheries and the Environment – DFFE)
EA	Environmental Authorisation
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
GDARD	Gauteng Department of Agriculture and Rural Development
GHG	Greenhouse Gas
HCl	Hydrogen Chloride
HEAST	Health Effects Assessment Summary Tables (US Environmental Protection Agency)
HF	Hydrogen Fluoride
Hg	Mercury
MCLM	Mogale City Local Municipality
MES	Minimum Emission Standard
Mn	Manganese
NAEIS	National Atmospheric Emissions Inventory System
NAAQS	National Ambient Air Quality Standards
NDCR	National Dust Control Regulations
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NEM:AQA	National Environmental Management: Air Quality Act
Ni	Nickel
NIOSH	National Institute for Occupational Safety & Health

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NO_2	Nitrogen Dioxide
NH_3	Ammonia
Pb	Lead
PCDD/PCDF	Dioxins and Furans
PM	Particulate Matter
RfC	Reference Concentration
REL	Risk Exposure Limit
SAAQIS	South African Air Quality Information System (SAAQIS
SAGERS	South African Greenhouse Gas Emissions Reporting System
Sb	Antimony
SO_2	Sulphur Dioxide
Tl	Thallium
TOC	Total Organic Compounds
TVOC	Total Volatile Organic Compounds
V	Vanadium
WRDM	West Rand District Municipality
WHO	World Health Organisation

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1. INTRODUCTION

Environmental Edge (Pty) Ltd, hereafter referred to as "Environmental Edge", was appointed to compile an Air Quality Impact Assessment Report (AQIAr) as part of an Environmental Impact Assessment process, as well a new atmospheric emission license (AEL) application process for the proposed Neoserve (Pty) Ltd (also referred to in this report as "DTS Tyres") pyrolysis plant, hereafter referred to as "the proposed plant", located in Chamdor, Krugersdorp, West Rand District Municipality, Gauteng Province.

The main objective of the AQIA is to determine the potential impact of emissions associated with the operational activities at the proposed plant on ambient air quality in terms of criteria air pollutants and other non-criteria air pollutants, which include hydrogen halides, metals, ammonia (NH_3), dioxins and furans and total organic compounds (TOCs). As part of the AQIA, a baseline assessment was undertaken to study the receiving area, specifically to determine the prevailing meteorological conditions at the site; establish baseline concentrations of key air pollutants of concern in the area; identify existing sources of emissions; and identify key air quality sensitive receptors (AQSRs) surrounding the project site.

1.1. Scope of Work

To meet the study objective, the following tasks were included in the scope of work:

- Information collation and review;
- A review of emission sources at the proposed plant;
- A review of regulations governing air quality impacts;
- A study of the receiving environment, including;
  - The location of AQSRs in relation to the proposed plant;
  - Local atmospheric dispersion potential given meteorology, land-use and topography; and
  - The current/status quo ambient air pollution levels.
- Compilation of an emissions inventory for key identified emission sources at the proposed plant;
- Atmospheric dispersion simulations of ground level particulate and gaseous emissions for incremental impacts;
- Compliance and impact assessment;
- The recommendation of suitable management and mitigation measures; and
- The preparation of a comprehensive specialist air quality specialist report.

1.2. Background and Project Description from an Air Quality Perspective

The proposed plant will specialise in the processing of waste tyre and rubber material. Operations at the proposed plant will thus trigger sub-category 8.1 (thermal treatment of general and hazardous waste) in terms of in terms of Section 21 (S21) of the National Environmental Management Air Quality Act (No. 39 of 2004) (NEM: AQA). Therefore, Environmental Authorisation (EA) and an AEL will be required before the commencement of operations at the proposed plant. Environmental Edge were appointed as an independent Environmental Consultant in October 2022, to assist with undertaking all environmental compliance responsibilities, including, but not limited to, carrying out applications of all required environmental permits for activities that will take place at the proposed plant. This AQIAr has been compiled as a supporting document for the application for an EA and the application for a new AEL for the proposed plant.

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The proposed plant will process 30 tonnes of waste tyres or rubber per day (tpd), producing 16.5 tonnes of pyrolysis oil daily. By-products from the process will be carbon black (10.5 tpd) and scrap steel (3 tpd). The raw material, i.e. waste tyres and rubber, will be delivered to the proposed plant using trucks. It is anticipated that two 3.5-ton trucks and one 10-ton truck will be used to deliver the waste tyres and rubber at the plant per day. The pyrolysis oil produced from the processing operations at the plant will be collected every second day by oil tankers (20 tonne) and oil trucks (6 tonne).

The proposed plant will be an XY-8-P batch pyrolysis machine with two pyrolysis reactors, each with a capacity of 10 MT/batch. The heating system will comprise of a burning room operating at a temperature of 500°C using 60 kg/hr of oil, but also fuelled by coal. There will be twelve gas burners and six oil burners, including a draft fan and a blower. The cooling system will comprise of two buffer gas separators, four sets of vertical condensers, two oil tanks with an oil pump, and a cooling water tower with pumps. There will also be gas and smoke purifying systems (i.e. a gas scrubbing system and a smoke/water scrubbing system), with a spraying tower and an absorption tower. Waste gas will be burnt, and this was assumed to be controlled indoors. Following the abatement of flue gas and smoke through the two scrubbing systems, the cleaned gas and/or smoke will be discharged through an individual stack (identified as ST001 in this report). On the other hand, carbon black produced from the pyrolysis process will be discharged though a bin within the plant building.

A process flow diagram for operations at the proposed plant is provided in Figure 1-1, with the plant layout indicated in Figure 1-2. In addition, the location of the proposed plant within the industrial area is shown in Figure 1-3. It must be noted that from Figure 1-3, the proposed pyrolysis operations will be limited to the area outlined in green, while all raw materials (waste tyres and rubber) will be stored at the area outlined in orange. The remaining sections within the site boundary (indicated by blue roofs) belong to other tenants and will be used for other activities.

The pyrolysis process will be a sealed process with no fugitive emissions arising from the pyrolysis plant. Other open-air fugitive emission sources such as vehicle dust entrainment on access roads leading to the plant, as well as the handling of carbon black are also identified as a possible source of emissions at the site. However, the focus of this assessment was on the point sources, i.e. the proposed pyrolysis stack, which triggers sub-category 8.1 (thermal treatment of general and hazardous waste) in terms of S21 of the NEM: AQA. One point source was assessed in this study, i.e. the pyrolysis stack.

The handling of carbon black will occur intermittently and will be conducted under roof, thus fugitive emissions associated with the handling process were assumed to be marginal as they will be contained within the plant building. Furthermore, the access roads leading to the plant are all paved (see Figure 1-3), thus vehicle dust entrainment due to movement of trucks on these roads was also assumed to be marginal. As such, these sources were not included in this assessment. However, emissions associated with these sources can be easily managed and controlled through the implementation of fugitive emission reduction measures.

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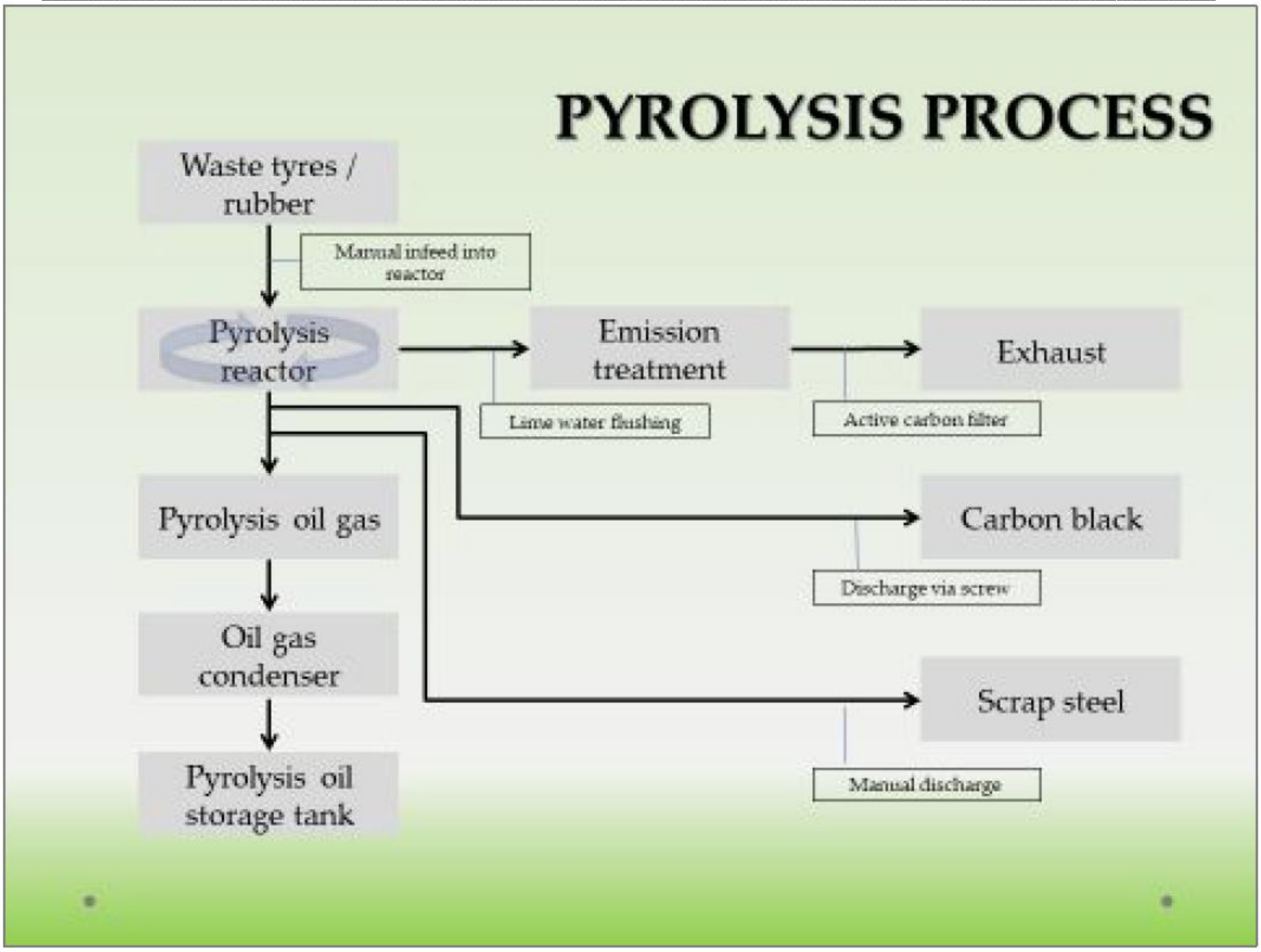

Figure 1-1: Process Flow Diagram for the Proposed Pyrolysis Plant.

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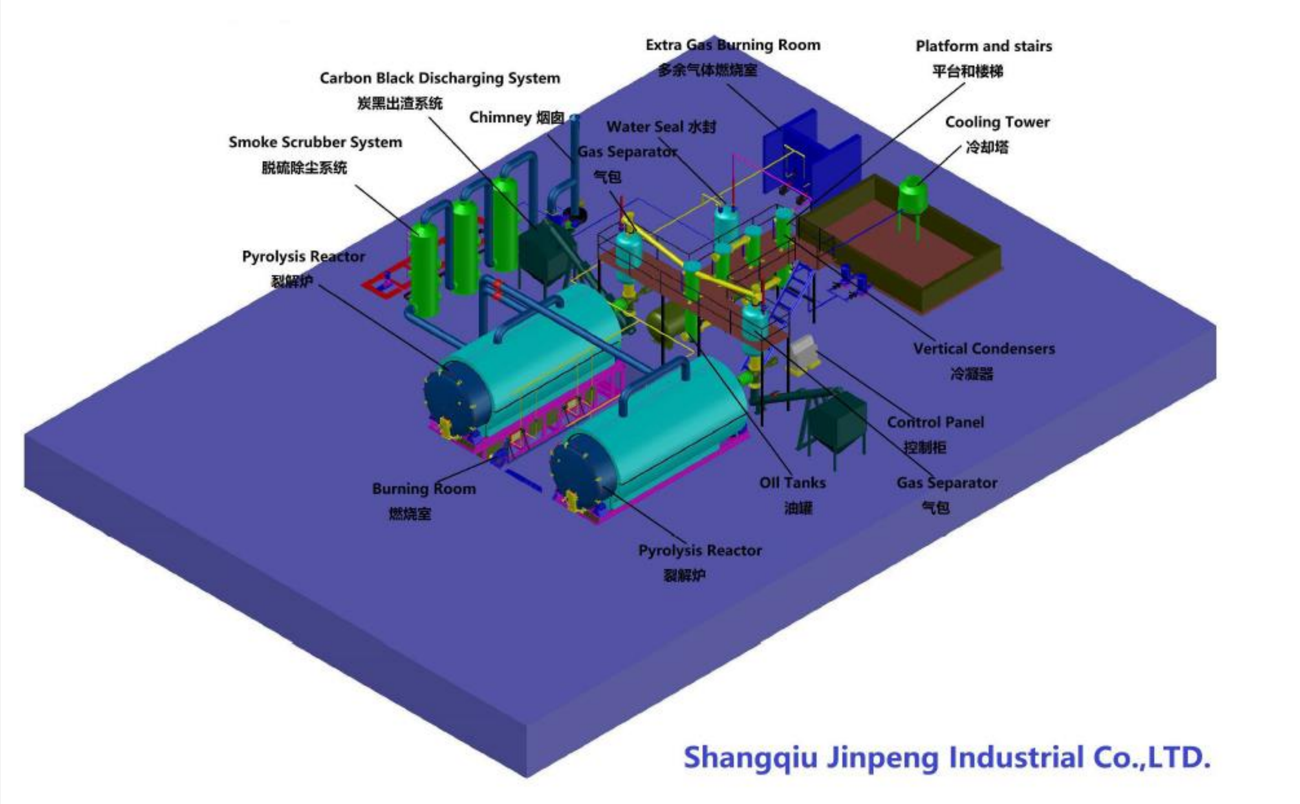

Figure 1-2: Layout of the Proposed Pyrolysis Plant.

Figure 1-3: Location of the Proposed Pyrolysis Plant.

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2. METHODOLOGY

A brief overview of the study methodology is included in this section.

2.1. Information Review

A review of information available for activities proposed to be undertaken at the proposed Neoserve pyrolysis plant was conducted. The following were considered in the review:

- Data supplied by the client via email/personal communication to/with Environmental Edge, which includes the process description, operational hours and emission sources;
- Minimum emission standards applicable to the operational activities at the proposed plant in terms of S21 of the NEM:AQA
- Stack parameters from a similar existing pyrolysis plant, due to lack of stack monitoring data for the new proposed plant.

In concurrence with regulatory requirements, the following was determined from the information review:

- The likelihood of atmospheric emissions being generated by the operational activities at the proposed plant;
- Key sources and pollutants to be included in the emissions inventory; and
- Source parameters.

2.2. The Identification of Regulatory Air Quality Requirements and Assessment Criteria

Air quality requirements and assessment criteria were identified through the careful review of the following:

- The South African National Ambient Air Quality Standards (SA NAAQS), as set out in terms of the National Environmental Management Air Quality Act (Act No. 39 of 2004) (SA NEM:AQA);
- The National Dust Control Regulations (NDCR) (2013), as set out in terms of the National Environmental Management Air Quality Act (Act No. 39 of 2004) (SA NEM:AQA);
- The Alberta Ambient Air Quality Objectives and Guidelines Summary, as set out in terms of the Alberta Environmental Protection and Enhancement Act (EPEA), of 2019; and
- Various internationally published health effect screening guideline levels.

2.3. Study of the Receiving Environment

Physical environmental parameters that influence the dispersion of pollutants in the atmosphere include meteorology, land-use and topography. An understanding of the atmospheric dispersion potential of the area is essential to an air quality impact assessment. Use was made of MM5 modelled meteorological data for the project area. MM5 meteorological data was obtained from Lakes Environmental for the period January 2019 to December 2021. More details about the meteorological data are given in Section 5.2.2.

Google Earth was used to provide insight into the terrain, pollution sources and land use types around the proposed plant. The air quality status quo at any project site is usually determined using ambient air quality monitoring data available from the South African Air Quality Information System (SAAQIS) website. The nearest Air Quality Monitoring Station (AQMS) to the proposed plant is the Davidsonville AQMS, which is located ~4.6km east of the proposed plant. However, this AQMS seems to be malfunctioning as there was no ambient air quality data recorded for any of the criteria air pollutants for the past few years. Thus, the air quality status quo at the project site could not be determined in this AQIA. Particulate matter (PM), sulphur dioxide (SO_2), nitrogen oxides, expressed as nitrogen dioxide (NO_2), hydrogen fluoride (HF), hydrogen chloride (HCl), carbon monoxide (CO), ammonia (NH_3), mercury (Hg), metals, dioxins and furans and total organic compounds (TOCs)

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are the key pollutants of concern emanating from pyrolysis activities at the proposed plant in terms of sub-category 8.1 (thermal treatment of general and hazardous waste).

2.4. Determining the Impact of the Project on the Receiving Environment

Determining the impact of operational activities at the proposed plant on air quality is a key outcome of the current study. To achieve this, an adequate emissions inventory, which takes into account all relevant pollutants associated with operations at proposed plant, had to be compiled in this assessment.

The emissions inventory for the current study includes, PM_{10}, $PM_{2.5}$, SO_2, NO_2, HF, HCl, CO, NH_3, Hg, metals, dioxins and furans and TOCs produced from operation of the pyrolysis reactors. These pollutants were chosen based on the pollutants given under sub-category 8.1 (thermal treatment of general and hazardous waste). Thus, the impact assessment focused on the impact (on air quality) of the above-mentioned pollutants, specifically.

One scenario was considered in the assessment, i.e. the new plant standard scenario. In other words, the maximum emission rate that is allowed in terms of S21 of NEM: AQA was considered in the assessment. The minimum emission standards (MES) were converted into emission rates (g/s) for input into the model. Thus, the emissions inventory was compiled for the proposed pyrolysis reactor operations by making use of the following:

- The MES that are applicable to the proposed plant, i.e. the maximum threshold limit that is allowed for new plants for sub-categories 8.1 (thermal treatment of general and hazardous waste).

Other open-air fugitive emission sources such as vehicle dust entrainment on access roads leading to the plant, as well as the handling of carbon black are also identified as possible sources of emissions at the site. However, emissions from these sources were excluded from the emissions inventory as they were assumed to be marginal (and contained within the plant building in the case of carbon black). Furthermore, the focus of this study was on the point sources (i.e. the proposed pyrolysis stack). Nonetheless, effective and affordable fugitive emission reduction measures should be implemented, where possible and applicable, to reduce the impact of these sources.

In the simulation of gaseous and particulate pollutant concentrations, use was made of the AERMOD dispersion model. Simulated pollutant concentrations were compared to South African National Ambient Air Quality Standards (NAAQS). Comparisons were also made with the Alberta International Air Quality Guidelines and internationally published health effect screening guideline levels to determine compliance, where South African NAAQS were not available. The findings of the above components informed recommendations of air quality management measures, including mitigation and monitoring, where applicable.

3. Assumptions, Limitations and Exclusions

The following important assumptions, exclusions and limitations to the specialist study should be noted:

Assumptions

- All project information required to calculate emissions for processing activities at the proposed plant was provided by the client. Information provided and used as input into the model was assumed to be accurate and complete at the time of modelling.
- Plant operations were assumed to occur for 24 hours a day, 7 days a week, which represents the worst-case scenario.
- Stack parameters such as gas exit velocity, gas exit temperature and volumetric flow rate were not known at the time of the modelling as stack monitoring has not yet been conducted. Therefore, these

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parameters were estimated based on stack parameters at a similar existing pyrolysis plant, which were provided by the client.

- Stack height and stack diameter were estimated based on information provided by the client, unless otherwise specified.
- It was assumed that for each pollutant, the emission rate from each pyrolysis cycle was the same, regardless of how many cycles were run throughout the day.
- Mitigation measures were considered and included:
    - a gas scrubbing system and a smoke/water scrubbing system linked to the pyrolysis stack to reduce emissions associated with the two pyrolysis reactors;
- The location for all the modelled sources (i.e. pyrolysis stack) were assumed based on the information provided by the client.
- Building downwash was considered in this study and each building was assumed to have a standard building height of 7m.

Limitations

- The air quality status quo for the project site could not be determined due to a lack of ambient monitoring data for the area.
- This study was limited to the assessment of point sources, i.e. the proposed pyrolysis stack, which triggers sub-category 8.1 (thermal treatment of general and hazardous waste) in terms of S21 of the NEM: AQA.
- The study is limited by the amount of detailed information that could be provided at the time of modelling.
- Detailed information for each emission source is required for input into the model, such as the dimensions, material throughputs, material characteristics and the exact locality of the sources. In some instances, not all these details are known. To account for the emissions, assumptions and estimates were made where necessary.

Exclusions

- Other open-air fugitive emission sources such as vehicle dust entrainment on access roads leading to the plant, as well as the handling of carbon black, which were also identified as possible sources of emissions at the site, were excluded from this assessment as the associated emissions were assumed to be marginal (and contained within the plant building in the case of carbon black). Furthermore, the focus of this assessment was on the point sources, i.e. the proposed pyrolysis stack, which triggers sub-category 8.1 (thermal treatment of general and hazardous waste) in terms of S21 of the NEM: AQA.
- Background sources of emissions are excluded as the focus of this study was on the proposed Neoserve pyrolysis plant and detailed information for background sources was not available.

4. AIR QUALITY REGULATIONS AND ASSESSMENT CRITERIA

Prior to assessing the impact of current activities on the atmospheric environment, reference needs to be made to environmental regulations and guidelines governing emissions. Air quality guidelines and standards are fundamental to effective air quality management, providing the link between the source of atmospheric emissions and the user of that air at the downstream receptor site. Air quality guidelines and standards are normally given for specific averaging or exposure periods.

The subsections below summarise national and international legislation pertaining to air pollution and criteria and non-criteria air pollutants relevant to this study. A discussion on potential human health impacts

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associated with some of the pollutants included in this AQIAr is also provided. The legislation and guidelines provided below are not exhaustive, but rather aim to identify pertinent sections of the legislation.

4.1. National Regulations

4.1.1. National Environmental Management: Air Quality Act (Act No. 39 of 2004), (NEM:AQA), as amended

The National Environmental Management: Air Quality Act, 2004 (No. 39 of 2004), as amended (referred to as NEM: AQA), has shifted the approach of air quality management from source-based control to receptor-based control. The main objectives of the Act are to;

- to protect the environment by providing reasonable measures for—
  - i. the protection and enhancement of the quality of air in the Republic;
  - ii. the prevention of air pollution and ecological degradation; and
  - iii. securing ecologically sustainable development while promoting justifiable economic and social development; and
- generally to give effect to section 24(b) of the Constitution in order to enhance the quality of ambient air for the sake of securing an environment that is not harmful to the health and wellbeing of people.

The Act provides for the establishment and formulation of NAAQS for substances or mixtures of substances that pose health, well-being or environmental threat. It is possible to create more rigorous standards at the provincial and local levels.

The control and management of emissions in the NEM:AQA relates to the listing of activities that are sources of emissions and the issuing of AELs. Listed activities are defined as activities which "result in atmospheric emissions and are regarded as having a significant detrimental effect on the environment, including human health". Listed activities have been identified by the Minister of the Department of Forestry, Fisheries and the Environment (DFFE) and atmospheric emission standards have been established for each of these activities. These listed activities require an AEL to operate. The issuing of AELs for listed activities is normally the responsibility of the Metropolitan and District Municipalities, except for those associated with mining operations.

In addition, the Minister may declare any substance contributing to air pollution as a priority pollutant. Any industries or industrial sectors that emit these priority pollutants will be required to implement a Pollution Prevention Plan. Municipalities are required to "designate an air quality officer to be responsible for co-ordinating matters pertaining to air quality management in the Municipality". The appointed Air Quality Officer is responsible for the issuing of AELs.

4.1.1.1. Listed Activities and Minimum Emission Standards

The NEM: AQA requires all persons undertaking listed activities in terms of Section 21 of the Act to obtain an AEL. The listed activities and associated MES were issued by the DEA on 31 March 2010 (Government Gazette No. 33064 of 31 March 2010), as amended in:

- 2013 (Government Gazette No. 37054 of 22 November 2013);
- 2015 (Government Gazette No. 38863 of 12 June 2015);
- 2018 (Government Gazette No.41650 of 25 May 2018; Government Gazette No.42013 of 31 October 2018);
- 2019 (Government Gazette No.42472 of 22 May 2019); and
- 2020 (Government Gazette No. 43174 of 27 March 2020).

The proposed Neoserve pyrolysis plant triggers sub-category 8.1 (thermal treatment of general and hazardous waste) in terms of S21 of the NEM: AQA and requires an AEL to operate. An AEL Application will be lodged with the West Rand District Municipality once the application for an EA for the proposed plant has been

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approved and the EA has been issued by the Gauteng Department of Agriculture and Rural Development (GDARD). A description of the listed activity 8.1 is given in Table 4-1 below.

Table 4-1: Listed activities triggered by the proposed Neoserve pyrolysis plant in terms of section 21 of NEM: AQA.

Category	Sub-category	Name of the Listed Activity	Description of the Listed Activity
8	8.1	Thermal Treatment of General and Hazardous Waste	Facilities where general and hazardous waste are treated by the application of heat

Emissions emanating from processing operations at the proposed plant are therefore required to comply with the MES for new plants in terms of Section 21 of NEM: AQA.

South Africa launched an online national reporting system, referred to as the National Atmospheric Emissions Inventory System (NAEIS). The NEM: AQA requires all emission source groups identified in terms of the National Atmospheric Reporting Regulations (Government Gazette No. 38633 of 02 April 2015), to register and report emissions on the NAEIS. The proposed Neoserve pyrolysis plant is classified as a Section 21 emitter and is thus required to report annually and comply with the National Atmospheric Reporting Regulations.

4.1.2. West Rand District Municipality: Draft Air Quality Management Plan (AQMP)

The draft air quality management plan (AQMP) for the West Rand District Municipality (WRDM) was compiled in 2010. The AQMP provides a management tool that can be used and implemented by departments and industry to ensure effective air quality management within the WRDM. The main purpose of the WRDM AQMP is to achieve the following goals:

- Establish an effective and sound basis for planning and management of air quality within the WRDM;
- To manage air quality that will promote human health and wellbeing;
- To encourage sustainable economic development that is not harmful to residents and the ecosystem;
- To allocate accountability to appropriate polluters; and
- To ensure effective communication and public participation.

To achieve the above-mentioned goals, the following air quality planning procedures, aimed at identifying and improving air quality in a given area, consisting of 6 steps, were set to be achieved by the WRDM (Manual for Air Quality Management Planning in South Africa, DEAT, 2008):

1) Translating Goals into Objectives and Targets;
2) Baseline air quality assessment;
3) Development of an Air Quality Management System (AQMS) and gap/problem analysis;
4) Development of intervention strategies;
5) Compiling action plans for implementation; and
6) Evaluation and follow up.

An Implementation Plan was thus identified as the end-result of the WRDM AQMP development process (apart from implementation and yearly monitoring thereof). The Implementation Plan forms the backbone of the WRDM AQMP and is intended to provide a practical methodology for the successful role out of identified priority projects that are aimed at addressing the WRDM's air quality management needs, at all tiers of the air quality management hierarchy. In the Implementation Plan, projects were selected and 'staggered' over a 5-year planning time horizon, based on their relative importance and funding requirements.

The WRDM consists of four local municipalities, namely Mogale City, Randfontein, Westonaria and Merafong City Local Municipalities, but also includes the District Management Area (DMA). The District Municipality is thus also considered to be a cross boundary Municipality. Merafong City Local Municipality includes areas from both the Gauteng and the North-West Provinces within its borders (Source: WRDM AQMP; 2010).

Krugersdorp, the town in which the proposed plant is located, falls, within the Mogale City Local Municipality (MCLM).

Several industries and emission sources were identified in the WRDM AQMP as the key potential pollution sources within the WRDM, including those listed in Table 4-2 (Source: WRDM AQMP; 2010). Chamdor, the industrial area where the proposed plant is located, is the main contributor to air pollution in the MCLM, with the highest percentage of CO (54%) emissions followed by particulate matter (PM) (32.5%) emissions. The area is characterized by small, medium and several large industries with mostly engineering and small spray-painting companies. The major contributors include Fima films, Oil Refinery, Leratong Hospital, Chemico and other industries (Source: MCLM, 2012; Zanokuhle Environmental Sevices, 2013).

Table 4-2: Potential Air Pollution Sources identified within the WRDM (Source: WRDM AQMP; 2010).

Source	Pollutant Origin	Criteria pollutants						
		SO_2	NO_2	O_3	CO	PM_{10}	C_6H_6	Pb
Randfontein								
Aranda	Boiler	X	X		X	X		
B&S Steel Fabrication	-							
Blitz Engineering	-							
Central Hotel	-							
Continental oil Mills	Boiler	X	X		X	X		
Cosmos Dairy	Boiler	X	X		X	X		
Danrec Construction	-					X		
Gemtex	Boiler	X	X		X	X		
Key Mack	-							
Meadow (Astral Foods)	-							
Nola	Boiler	X	X		X	X		
Plascotek	-							
Randfontein Bedding	-							
Randfontein Hospital	-	X	X		X	X		
Small Steel & Electrical Engineering	-							
Supreme Petfood	Boiler	X	X		X	X		
Tiger Brands	-							
Total SA	-							
Ultimate Feeds	-							
Vesuvius Rand Steel	-							
V-oils (Animal Food)	Boiler	X	X		X	X		

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Westonaria								
Duraset	Boiler	X	X		X	X		
First Uranium Ezulwini Mine	-					X		
Goldfield Mine	-					X		
Harmony Gold Mine	-					X		
Infraset	Boiler	X	X		X	X		
Merafong City								
Corobrick Driefontein						X		
Cluster Holdings						X		
Carletonville Transport and Plant Hire		X	X			X		
Fochvile Hospital								
Western Deep Levels Hospital		X	X		X	X		
Leslie Williams Private Hospital		X	X		X	X		
Khutsong Medical Center		X	X		X	X		
Ernest Beeby (Kwik-Fit Carletonville								
Milton-Air Services								
Carletonville Municipality		X	X		X	X		
Fochville Municipality		X	X		X	X		
Heinzger Brick Work		X	X		X	X		
Losberg Explosive Company		X	X		X	X		
West Driefontein GM		X	X		X	X		
West End Brickworks						X		
Wildebeeskuil Stene						X		
Million Air Services								
Henque 2377 CC TA Water Ritw								
Fochville Abattoir								
Durban Roodeport Deep Gold Mine						X		
Harmony Elandsrand Gold Mine						X		
AngloGold Ashanti Mponeng Mine						X		
AngloGold Ashanti Tau Tona Mine						X		
AngoGold Ashanti Savuka Mine						X		
Goldfields Driefontein Gold Mine						X		
DRD Gold (Blyvooruitchzit Mine)						X		

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Mogale City								
Atlas Bakery	Boiler	X	X		X	X		
Berray Motors	-							
Chemico SA (Pty) Ltd	Boiler	X	X		X	X		
Drift Supersand	Quarry					X		
Echo Floors	-							
Exol Oil Refinery (Pty) Ltd	Furnace	X	X		X	X		
Gardernia	Boiler	X	X		X	X		
Gelita South Africa	Boiler	X	X		X	X		
Geratech Zirconium Beneficiation	-							
Grandlawen Dry Cleaners	Boiler	X	X		X	X		
Janho Quarries and Crushing	Quarry					X		
KBW	-							
Krugersdorp Abattoir	Boiler	X	X		X	X		
Lafarge (ready mix)	-					X		
Leratong Hospital	Boiler	X	X		X	X		
Majesty Oil Mills	Boiler	X	X		X	X		
Mogale Alloys	-							
Nimag (Pty) Ltd	-							
Pace Oil	Boiler	X	X		X	X		
Protech Ready Mix	Produce cement ready mix					X		
Roadmix	-							
Sandvic	-							
Sasko	-							
South African Breweries	Boiler	X	X		X	X		
Yusuf Dadoo Hospital	Boiler	X	X		X	X		

4.1.3. Greenhouse Gas (GHG) Regulations

In terms of NEM: AQA, GHG means the gaseous constituents of the atmosphere, both natural and anthropogenic that absorbs and re-emits infrared radiation.

The following six GHGs were declared a priority for air pollution in South Africa on 14 March 2014 by the DEA (Government Gazette No. 37421):

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous Oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulphur hexafluoride (SF_6)

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The DEA has released the National GHG Emission Reporting Regulations (Government Gazette No.40762, dated 3 April 2017), as amended (General Notice 994 in Government Notice 43712 of 11 September 2020). An individual defined in Annexure 1 of these Regulations as a Category A data provider must register their facilities using the online South African Greenhouse Gas Reporting System (SAGERS) (https://ghgreporting-public.environment.gov.za/GHGlanding/) and send an inventory of GHG emissions, activity data and GHG emissions report in the requested format given under Annexure 3 of these regulations on an annual basis.

The SAGERS has been set up by the DFFE specifically to allow for submissions and keeping of GHG emissions inventories. It is a GHG Reporting Module of the NAEIS. This portal is a web-based platform for the registration and submission of GHG emissions data by category A data providers.

Objectives of the SAGERS include:

- Providing a user-tailored platform the category A data providers to register and report their annual GHG emissions data and the associated activity data.
- Providing methodological guidance on the quantification of GHG emissions and the embedded parameters for assessing the annual GHG emissions.
- Facilitating easy access to the parameters and GHG emission factors database embedded into the system.
- Serving as an information hub for data providers for accessing information relevant to the registration and reporting under the GHG Reporting Regulations.
- Providing relevant guidance, templates, guidelines, and information relating to compliance under the GHG Reporting Regulations 2017 published under GNR 275 in Government Gazette 40762 of 03 April 2017, as amended (General Notice 994 in Government Notice 43712 of 11 September 2020) promulgated under the NEM:AQA.

National Pollution Prevention Plan Regulations (Gazette No. 40996) were published on 21 July 2017 by the DEA. A pollution prevention plan will be required should the development:

a) Undertake any of the activities identified in Annexure A of the National GHG Emission Reporting Regulations (Government Gazette No. 40762 of 3 April 2017) as amended (General Notice 994 in Government Notice 43712 of 11 September 2020), which involves the direct emission of GHG in excess of 0.1 Megatonnes (Mt) annually measured as carbon dioxide equivalents ($CO_{2\text{-eq}}$); or
b) Undertake any of the activities identified in Annexure A of the National Pollution Prevention Plan Regulations as a primary activity.

In terms of Annexure A of the National GHG Emission Reporting Regulations (Government Gazette No. 40762 of 3 April 2017), as amended (General Notice 994 in Government Notice 43712 of 11 September 2020), the proposed plant will trigger Category 1B2a (Oil) due to the stationary combustion of oil that will be utilised as a power source for the reactors at the plant. In addition, Category 1B1a (Coal Handling) will be triggered due to the handling of coal, which be a power source for the reactors. Category 4C0 (Waste Pyrolysis) will also be triggered due to the design capacity of each of the reactors, i.e. 10 MT/batch, which exceeds the 100 kg/hour threshold for GHG reporting for this activity. Based on the above, Neoserve would need to register, quantify and report on their GHG emissions on the SAGERS by the 31 March of each year.

4.1.4. Ambient Air Quality Standards and Dust Deposition Standards

The final revised SA NAAQS were published by the Minister of Water and Environmental Affairs in the Government Gazette on 24 of December 2009 and included a margin of tolerance (i.e. frequency of exceedance) and implementation timelines linked to it. SA NAAQS for $PM_{2.5}$ were published on 29 July 2012. The SA NAAQS closely follow WHO interim targets, which are targets for developing countries.

National Dust Control Regulations (NDCR) were promulgated by the DEA on 01 November 2019 (Government Notice R517 of 2018), with the aim of prescribing general measures for dust control in all areas. The NDCR prohibit activities which give rise to dust in such quantities that the dustfall at the boundary or beyond the boundary of the premises where it originates exceeds. The regulated standards for dustfall are as follows:

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a) 600 mg/m²/day averaged over 30 days in residential areas, measured using reference method ASTM D1739.

b) 1 200 mg/m²/day averaged over 30 days in non-residential areas, measured using reference method ASTM D1739.

The NDCR prescribe the method that should be used for undertaking dustfall monitoring, which includes the use of dust bucket stations with a wind shield.

Table 4-3 and Table 4-4 below provide assessment guidelines and standards for criteria air pollutants and dustfall considered in this assessment, respectively.

Table 4-3: Assessment of guidelines and standards for criteria air pollutants considered in the assessment.

Pollutant	Averaging (Exposure period)	Limit Value (μgm^3)	Limit Value (ppb)	Limit Reference Value	Permitted frequency of exceedance
PM_{10}	24-hour	75	Not applicable	SA NAAQS	4
	1-year	40	Not applicable	SA NAAQS	0
$PM_{2.5}$	24-hour	40	Not applicable	SA NAAQS	0
	1-year	20	Not applicable	SA NAAQS	0
SO_2	1-hour	350	134	SA NAAQS	88
	24-hour	125	48	SA NAAQS	4
	1-year	50	19	SA NAAQS	0
NO_2	1-hour	200	106	SA NAAQS	88
	1-year	40	21	SA NAAQS	0
CO	1-hour	30 000	26 000	SA NAAQS	88
	8-hour	10 000	8 700	SA NAAQS	11
Lead (Pb)	1-year	0.5	Not applicable	SA NAAQS	0
Benzene (C_6H_6)	1-year	5	1.6	SA NAAQS	0

Table 4-4: Assessment of guidelines and standards for dustfall considered in the assessment.

Restriction Areas	Averaging (Exposure period)	Dust-fall rate (D)(1)	Limit Value (μgm^3)	Limit Reference Value	Permitted frequency of exceedance
Residential Areas	1 month (30±2-day average)	D < 600	Not applicable	NDCR (2019)	Two within a year, no two sequential months (2)
Non-Residential Areas	1 month (30±2-day average)	600 < D <1200	Not applicable	NDCR (2019)	Two within a year, no two sequential months (2)

Notes:
(1) Dustfall rate in mg/m²/day
(2) Per dustfall monitoring site.

Should a facility exceed the regulated dustfall standards, a dust management plan (DMP) must be developed and submitted to the air quality officer for approval, within three (3) months after submitting a dustfall monitoring report. The DMP must be implemented within a month after of the date of approval, and be updated annually, unless otherwise specified by the air quality officer.

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The proposed Neoserve pyrolysis plant will not result in any significant dust emissions, based on the proposed design of the facility. Additionally, the handling of carbon black will be conducted inside the plant building, with all associated fugitive emissions being contained within.

4.1.5. Other Relevant Legislation

- Pollution Prevention Act (Government Gazette 40996, 21 July 2017); and
- Carbon Tax Act No 15 of 2019 (29 November 2013).

4.2. International Guidelines and Regulations for Non-criteria Pollutants

Typically, when no local ambient air quality criteria exist, or are in the process of being developed, reference is made to international criteria. This serves to provide an indication of the severity of the potential impacts from proposed activities. The most widely referenced international air quality criteria are those published by the World Health Organisation (WHO). However, in the current study, reference has been made to the Alberta Ambient Air Quality Objectives and Guidelines Summary (AEP, Air Policy, 2016, No.2 updated Jan 2019), as set out in terms of the Alberta Environmental Protection and Enhancement Act (EPEA), of 1999. Additionally, reference has been made to various internationally published health effect screening guideline levels. The Alberta Ambient Air Quality Objectives and Guidelines as well as the health effect screening guideline levels have been used to determine compliance, where SA NAAQS are not available (Table 4-5 and Table 4-6).

Published health effect screening guideline levels, which can be used as international air quality criteria for non-criteria pollutants, include the following (AIRSHED, 2019):

- World Health Organization (WHO) guideline values for non-carcinogens and unit risk factor guidelines for carcinogens;
- Chronic and sub-chronic inhalation reference concentrations and cancer unit risk factors published by the US-EPA in its Integrated Risk Information System (IRIS);
- Provisional Peer-Reviewed Toxicity Values (PPRTVs) which represent the second tier of human health toxicity values for the EPA Superfund hazardous waste program, when such value is not available in the EPA's IRIS database (IRIS, the first tier in the Superfund hierarchy of human health toxicity values);
- Acute, sub-acute and chronic effect screening levels published by the Texas Natural Resource Conservation Commission Toxicology and Risk Assessment Division (TARA);
- Reference exposure levels (RELs) published by the Californian Office of Environmental Health Hazard Assessment (OEHHA); and
- Minimal risk levels issued by the US Federal Agency for Toxic Substances and Disease Registry (ATSDR).

Table 4-5: Assessment of guidelines and standards for HF, HCl and NH_3 considered in the assessment.

Pollutant	Averaging (Exposure period)	Limit Value (μgm^3)	Limit Value (ppb)	Limit Reference Value	Permitted frequency of exceedance
HF	1-hour	4.9	50	Alberta Standards	-
HCl	1-hour	75	6	Alberta Standards	-
NH_3	1-hour	1 400	2 000	Alberta Standards	-

Table 4-6: Assessment of guidelines and standards for metals and dioxins and furans considered in the assessment (AIRSHED; 2019).

Pollutant	Averaging (Exposure period)	Limit Value (μgm^3)	Limit Value (ppb)	Limit Reference Value	Permitted frequency of exceedance

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Antimony	1-hour	50.5	-	ATSDR REL	-
	1-year	0.5	-	IRIS RfC	-
Arsenic	1-hour	0.2	-	OEHHA REL	-
	1-year	0.02	-	OEHHA REL	-
Cadmium	1-hour	0.14	-	ATSDR MRL	-
	24-hour	0.9		PPRTV RfC	
	1-year	0.01		WHO Guideline	
Chromium	1-hour	0.1	-	TARA ESL	-
	24-hour	0.3	-	ATSDR MRL	
	1-year	0.01	-	ATSDR MRL	-
Cobalt	1-hour	0.2	-	TARA ESL	-
	24-hour	0.02	-	PPRTV RfC	-
	1-year	0.01	-	PPRTV RfC	-
Copper	1-hour	100	-		-
	1-year	1	-		-
Manganese	1-hour	0.17	-	OEHHA REL	-
	1-year	0.05	-	IRIS RfC	-
Mercury	1-hour	0.6	-	OEHHA REL	-
	24-hour	0.3	-	HEAST RfC	-
	1-year	0.03	-	IRIS RfC	-
Nickel	1-hour	6	-	OEHHA REL	-
	1-year	0.01	-	OEHHA REL	
Total Dioxins	1-year	4.0E-05	-	OEHHA REL	-

Notes:
NIOSH - National Institute for Occupational Safety & Health
HEAST – Health Effects Assessment Summary Tables (US Environmental Protection Agency)
RfC – Reference Concentration
REL – Risk Exposure Limit

4.3. Human Health Impacts – Criteria & Non-Criteria Pollutants

4.3.1. Particulates (PM_{10} & $PM_{2.5}$)

Particles can be classified by their aerodynamic properties into coarse particles, PM_{10} (particulate matter with an aerodynamic diameter equal to or less than 10 µm) and fine particles, $PM_{2.5}$ (particulate matter with an aerodynamic diameter equal to or less than 2.5 µm). The fine particles mostly contain secondary formed aerosols such as sulphates and nitrates, combustion particles and re-condensed organic and metal vapours. The coarse particles mostly contain earth crust materials and fugitive dust from roads and industries (Harrison and van Grieken, 1998) (Fenger, 2002).

In terms of health impacts, particulate air pollution is associated with effects on the respiratory system (WHO, 2000). When looking at human health particle size is an important factor to consider because it controls where in the respiratory system a given particle will be deposited. Fine particles are thought to be more damaging to human health than coarse particles as larger particles do not penetrate deep into the lungs compared to smaller particles. Larger particles are deposited into the extra thoracic part of the respiratory tract while smaller particles are deposited into smaller airways that lead to the respiratory bronchioles (WHO, 2000).

Previous studies suggest that short-term exposure to particulate matter leads to adverse health effects, even at low concentrations of exposure (below 100 µg/m^3). Morbidity effects associated with short-term exposure to particulates include increases in lower respiratory symptoms, medication use and small reductions in lung function. Long-term exposure to low concentrations (~10 µg/m^3) of particulates is associated with mortality and other chronic effects such as increased rates of bronchitis and reduced lung function (WHO, 2000). Those most at risk include the elderly, individuals with pre-existing heart or lung disease, asthmatics and children.

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4.3.2. Hydrogen Fluoride (HF)

Hydrogen fluoride (HF) is a chemical compound that contains fluorine. It can be found as a colourless gas or as a fuming liquid, or it can be dissolved in water (CDC, 2018). It can be called hydrofluoric acid once dissolved in water. HF acid can be formed when compounds that contain fluoride dissolve in water (CDC, 2018). Hydrogen fluoride is a chemical compound that contains fluorine. HF is mainly used in the manufacture of refrigerators, but can also be found in herbicides, and over-the-counter products (CDC, 2018; ATSDR, 2014).

Exposure to HF can occur through numerous ways, such as drinking water, volcanic activity, from coal-fired power plants, industrial activity, inhalation at the workplace, and smoking (EPA, 2016). Hydrogen fluoride is absorbed easily through the skin and into the tissues in the body (CDC, 2018). The fluoride ion penetrates tissues and binds the calcium and magnesium resulting in cell destruction (ATSDR, 2014).

At low concentrations, inhaled HF in the form of a vapour can cause irritation of the nose, throat and eyes. Inhalation at high concentrations can cause death from tissue damage, an irregular heartbeat or from fluid build-up in the lungs. This can lead to partial or full lung collapse (CDC, 2018; ATSDR, 2014). Drinking small amounts of highly concentrated HF, will affect major organs and can lead to death. Depending on the concentration and duration of exposure, when HF comes in contact with skin, it may cause pain, inflammation, and burns (ATSDR, 2014). In extreme cases the tissue damaged caused can also lead to premature death. Effects at low concentration exposure can take between 12 to 24 hours to show (CDC, 2018).

Long term health impacts include chronic lung disease, severe scarring from burns, visual defects and permanent damage to the oesophagus and stomach (CDC, 2018).

4.3.3. Ammonia (NH_3)

Ammonia (NH_3) is a chemical compound occurring naturally and anthropogenically. It is a colourless gas, that has a pungent odour. NH_3 can be pressurised to convert into a liquid. NH_3 can easily dissolve in water, where it exists as ammonium ions (NH^{4+}) (ATSDR, 2004).

Nitrogen is an important component of proteins, genetic material, chlorophyll, and other key organic molecules. Living organisms required NH_3 to survive. NH_3 is important for plant growth, as it can be broken down by bacteria to provide nitrogen-containing nutrient. Nitrogen also assists with controlling algae growth in water ecosystems. NH_3 is excreted by animals and produced during the decay of plants and animals (Vitousek, 1997). NH_3 is produced in our bodies on a daily basis by our organs, and by bacteria within our intestines (ATSDR, 2004).

As NH_3 is a naturally occurring compound, we are continuously exposed to it at low concentrations, in the air, water and soil. NH_3 is regularly being recycled in nature, therefore the compound does not exist for a long time in the environment.

NH_3 has various uses, such as in the manufacture of fertilizers and animal feed. It is also used in the manufacture of fibres, plastics, explosives, paper, and rubber. It is used as a coolant, in metal processing industries (WHO, 2003).

Ammonia has corrosive properties, and symptoms from exposure to ammonia occur to the parts of the body that come into direct contact with the chemical compound. Inhalation of ammonia may cause irritation to both eyes and throat, while direct contact with a highly concentrated form of ammonia may lead to severe burns. Depending on the severity of burns and where they occur, lung disease, blindness and death are likely to occur (ATSDR, 2004).

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4.3.4. Volatile Organic compounds (VOCs)

VOCs are organic compounds with a true vapour pressure higher than 0.13 kPa at 20oC. Even though they exist in trace amounts they are significant in that they play an important role in atmospheric oxidation reactions in the troposphere and can act as a catalyst to produce other hazardous air pollutants. VOCs are often released during the production, use and disposal of household and commercial products including, cleaning agents, paints, varnishes, preservatives, pesticides, wood products, chemicals, adhesives and glues as well as flooring and carpeting products. Similarly, the storage and handling as well as the burning of fuels and products such as petrol, diesel and paraffin are common sources of VOCs. Higher levels of VOCs are generally found in urban environments compared to non-urban areas. However, some VOCs have a relatively long atmospheric life span and can be detected in areas further downwind from the source. Also, trees are a natural source of biogenic VOCs, thus higher VOC concentrations are also found over forested areas.

There are a variety of different types of VOCs (~ > 300) that are released from anthropogenic sources. Of which monoaromatic hydrocarbons are often the most abundant. Monoaromatic hydrocarbon pollutants include the BTEX group: benzene, toluene, ethylbenzene and xylene. BTEX is often measured and used as an indicator to represent other VOCs in air quality studies (Ware *et al.*, 1993; Zabiegala *et al.*, 2010).

Exposure to VOCs via inhalation may cause a variety of health effects depending on the concentration and type of VOC a person is exposed to and the duration of exposure. In general exposure to elevated levels of VOCs over a short duration can potentially cause skin, eyes, nose and throat irritations, headaches, drowsiness, nausea and vomiting. Exposure to low levels of VOCs over a longer duration period may potentially cause cancer, kidney and liver damage, chromosomal aberrations and blood disease (Duarte-Davidson *et al.*, 2001). It is necessary to determine the presence of VOCs, in areas where elevated levels of VOCs may be of concern, to appropriately manage air quality issues and implement mitigation measures.

Benzene is the only VOC that is legislated in terms of the South African National Environmental Management: Air Quality Act (No. 34 of 2004) and is a well-known carcinogen. Studies have shown that exposure to low-high concentrations of benzene can cause leukaemia (Cointreau, 2006; Duarte-Davidson *et al.*, 2001; Vrijheid, 2000; www.WHO.org, 2012). Bridges *et al.*, (2000) and Vrijheid (2000) argue that there should be no standard threshold limit for gases with carcinogenic properties. This suggests that people who are exposed to carcinogenic agents over a long period, irrespective of the concentration, are said to be at some level of risk to adverse health effects.

4.3.5. Sulphur Dioxide (SO_2)

SO_2 originates from the combustion of sulphur-containing fuels and is a major air pollutant in many parts of the world. Health effects associated with exposure to SO_2 include effects on the respiratory system. Being soluble, SO_2 is readily absorbed in the mucous membranes of the nose and upper respiratory tract.

Most information on the acute (short-term) effects of SO_2 is derived from short-term exposure in controlled chamber experiments. These experiments have demonstrated a wide range of sensitivity amongst individuals. Acute exposure of SO_2 concentrations may lead to severe bronchoconstriction in some individuals, while others remain completely unaffected. Response to SO_2 inhalation is rapid with the maximum effect experienced within a few minutes. Continued exposure does not increase the response. Effects of SO_2 exposure are short-lived with lung function returning to normal within a few minutes to hours (WHO, 2000). Exposure to SO_2 over a 24-hour period has shown that when SO_2 concentrations exceed 250 µg/m^3 in the presence of PM (such as sulphates), an exacerbation of symptoms is observed in selected sensitive patients. More recent studies of health impacts in ambient air polluted by industrial and vehicular activities have demonstrated at low levels effects on mortality (total, cardiovascular and respiratory) and increases in hospital admissions. Long-term exposure to SO_2 has been found to be associated with an exacerbation of respiratory

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symptoms and a small reduction in lung function in children in some cases. In adults, respiratory symptoms such as wheezing, and coughing are increased (WHO, 2000).

4.3.6. Nitrogen Dioxide (NO_2)

Nitrogen dioxide (NO_2) is formed through the oxidation of nitic oxide (NO), a primary pollutant emitted from the combustion of stationary sources (heating, power generation) and from motor vehicles. Oxides of nitrogen (NOx) are made up of NO, NO_2 and NO_x, with NO_2 being the most important from a human health point of view. NO_2 is an irritating gas that is absorbed into the mucous membrane of the respiratory tract. The most adverse health effect occurs at the junction of the conducting airway and the gas exchange region of the lungs. The upper airways are less affected as NO_2 is not very soluble in aqueous surfaces. Exposure to NO_2 is linked with increased susceptibility to respiratory infection, increased airway resistance in asthmatics and decreased pulmonary function.

Short term exposure to NO_2, at concentrations greater than 1 880 $\mu g/m^3$, may result in changes in the pulmonary function in adults. Normal healthy people exposed at rest or with light exercise for less than 2 hours to concentrations above 4 700 $\mu g/m^3$, may experience pronounced decreases in pulmonary function (WHO, 2000). Long-term epidemiological studies have been undertaken on the indoor use of gas cooking appliances and health effects. Studies on adults and children under 2 years of age found no association between the use of gas cooking appliances and respiratory effects. Children aged 5 – 12 years have a 20% increased risk for respiratory symptoms and disease for each increase of 28 $\mu g/m^3$ NO_2 concentration, where the weekly average concentrations are in the range of 15 – 128 $\mu g/m^3$. Outdoor studies consistently indicate that children with long-term ambient NO_2 exposures exhibit increased respiratory symptoms that are of a longer duration. However, no evidence is provided for the association of long-term exposures with health effects in adults (WHO, 2000).

4.3.7. Carbon Monoxide (CO)

CO is a tasteless, odourless and colourless gas which has a low solubility in water. In the human body, after reaching the lungs it diffuses rapidly across the alveolar and capillary membranes and binds reversibly with the haem proteins. Approximately 80 - 90% of CO binds to haemoglobin to form carboxyhaemoglobin. This causes a reduction in the oxygen-carrying capacity of the blood which leads to hypoxia as the body is starved of oxygen. Severe hypoxia due to acute poisoning results in headaches, nausea and vomiting, muscular weakness, loss of consciousness, shortness of breath and finally death, depending on the concentration and time of exposure. Poisoning may cause both reversible, short-lasting neurological deficits and severe, often delayed, neurological damage. Neurobehavioral effects include impaired co-ordination, tracking, driving ability, vigilance and cognitive ability (WHO, 2000).

5. THE RECEIVING ATMOSPHERIC ENVIRONMENT

5.1. Local Study Area and Air Quality Receptors

The local study area for the AQIA was selected based on the extent of expected air quality impacts and possible sensitive receptors such as residential areas, educational and health facilities, dwellings and old age homes. A study area of 20 km east-west by 20 km north-south with the proposed Neoserve facility located approximately in the centre, was identified through a desktop study. The study area includes residential areas such as Silverfields, Mindalore and Princess to the north-east, Witpoortje 2451Q, Grobler Park, Florida Park, and Roodepoort West to the east, and Witpoortjie to the south-east. In addition, the Tshepisong, Kagiso and Sinqobile townships are located south, south-west and north-west of the proposed plant. The town of Krugersdorp is located over 5 km from the site, towards the north.

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The proposed plant is located within an industrial area. The R28, R24, and R41 provincial roads run adjacent to the proposed plant, to the west, north and south, respectively (Table 5-1 and Figure 5-2). Ambient concentrations simulated by the dispersion model were also calculated at the sensitive receptors (Section 6.2.3).

Table 5-1: Sensitive Receptor Locations Included in the AQIA (within <20 km radius).

Receptor ID	Receptor Name	UTM Coordinates (35S)		Elevation
		X (m)	Y (m)	Y (m)
SR1	Educational Facility	579374.48	7108253.03	1757.33
SR2	Educational Facility	580111.78	7108384.34	1764.45
SR3	Educational Facility /Dwellings	577680.45	7106900.35	1723.11
SR4	Educational Facility /Dwellings	580157.37	7105956.43	1737.06
SR5	Leratong Hospital	580500.98	7104984.24	1711.23
SR6	Kagiso Dwellings/ Educational Facility	578689.7	7106157.39	1742.25
SR7	Healthcare Facility	575790.92	7105150.25	1690.87
SR8	Floroma Old Age Home	585799.4	7106354.57	1719.63
SR9	Durban Deep Primary School/Dwellings	585667.23	7104973.61	1753.23
SR10	Tornado Park Old Age Home/Dwellings/Educational Facility	588145.2	7105871.13	1727.71
SR11	Soweto Old Age Home	587422.34	7096893.15	1628.15
SR12	Educational Facilities/ Healthcare Facilities/Dwellings	587210.05	7100340.44	1646.85
SR13	Fairland Dwellings/Old Age Homes	594590.67	7109706.07	1592.75
SR14	Healthcare Facilities/Dwellings	585204.71	7109451.59	1757.98
SR15	Muldersdrift Dwellings	584327.76	7120820.41	1423.80
SR16	Rietvlei Dwellings	576696.53	7102195.09	1681.13
SR17	Healthcare Facilities/Dwellings	583042.65	7096998.32	1638.28
SR18	Lenasia Dwellings/Nirvana Old Age Homes	582518.96	7089336.43	1578.84
SR19	Educational Facility /Dwellings	590691.37	7098801.28	1636.94
SR20	Pimville Dwellings	590096.52	7094024.07	1632.09
SR21	Educational Facilities/ Dwellings	588617.76	7098756.87	1631.25
SR22	Mohlakeng Dwellings/ Old Age Homes	569353.77	7098306.43	1686.04
SR23	Tshepisong Dwellings/Educational Facilities	580263.95	7102984.35	1685.33
SR24	Bekkerdal Dwellings	570595.17	7092763.36	1586.22
SR25	Randfontein Dwellings/Educational Facilities	570250.05	7104534.89	1716.09
SR26	Healthcare Facilities/Dwellings	571401.09	7105910.53	1727.02
SR27	Greenhills Dwellings/ Educational Facilities/ Old Age Home	569436.99	7106544.3	1696.21
SR28	West Village Dwellings/Educational Facilities	575125.78	7111015.04	1754.09
SR29	Educational Facilities/ Old Age Homes/Healthcare Facilities/Dwellings	577639.53	7112194.68	1729.53
SR30	Educational Facilities/ Dwellings	575899.39	7114089.3	1688.09
SR31	Healthcare Facilities	574011.13	7117795.83	1676.56

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SR32	Healthcare Facilities	575394.42	7117684.65	1703.26
SR33	Dwellings/Old Age Homes/Educational Facilities	577167.92	7114428.2	1731.36
SR34	Healthcare Facilities/Dwellings/Educational Facilities/Old Age Homes	580673.87	7112946.37	1757.79
SR35	Dwellings/Educational Facilities/Old Age Homes	581847.91	7110930.27	1773.62
SR36	Dwellings/Educational Facilities	568196.24	7105512.05	1692.53
SR37	Toekomrus Dwelling/Educational Facilities	571131.17	7101565.05	1720.37
SR38	Educational Facilities	567533.33	7103430.93	1716.44
SR39	Educational Facilities/Dwellings	581497.39	7097689.09	1602.17
SR40	Educational Facilities	587758.21	7114677.72	1525.43
SR41	Wilro Park Dwellings/Educational Facilties	584724.74	7112081.89	1658.77
SR42	Healthcare Facility	591665.07	7107320.46	1662.26
SR43	Healthcare Facilities/Dwellings/Educational Facilities	590835.27	7105115.97	1706.41
SR44	Healthcare Facilities/Dwellings	589725.81	7103150.57	1702.90
SR45	Chiawelo Dwellings	585724.43	7092657.18	1599.15
SR46	West Rand AH Dwellings	575827.48	7090689.08	1595.89
SR47	Protea Glen Dwellings	580113.42	7093997.41	1597.80
SR48	Middelvlei AH Dwellings	565404.99	7101083.01	1704.43
SR49	Loumarina Dwellings	566027.88	7106234.12	1700.57
SR50	Watervlei Dwellings/Educational Facilities	569279.66	7113080.07	1620.44

5.2. Atmospheric Dispersion Potential

Meteorological mechanisms govern the dispersion, transformation, and eventual removal of pollutants from the atmosphere. The analysis of land-use and topography as well as wind speed, wind direction, temperature and atmospheric stability is necessary to facilitate a comprehensive understanding of the dispersion potential of the site.

5.2.1. *Topography and Land-use*

The topography surrounding the proposed plant is shown by the map in Figure 5-1 below. The facility sits at about 1 742 m above sea level with increasing elevation in surrounding areas within a 20 km radius. Surrounding elevations range from approximately 1 323 m – 1 829 m above sea level. It is likely that the topography of the study area will influence the dispersion of pollutants released by ground level sources.

Land use/cover mainly includes urban built up, commercial, residential, and industrial properties, as well as natural vegetation, grassland, mining areas and informal settlements, with waterbodies/wetlands also located in surrounding areas. The larger area surrounding the proposed plant has rural characteristics (Figure 5-2).

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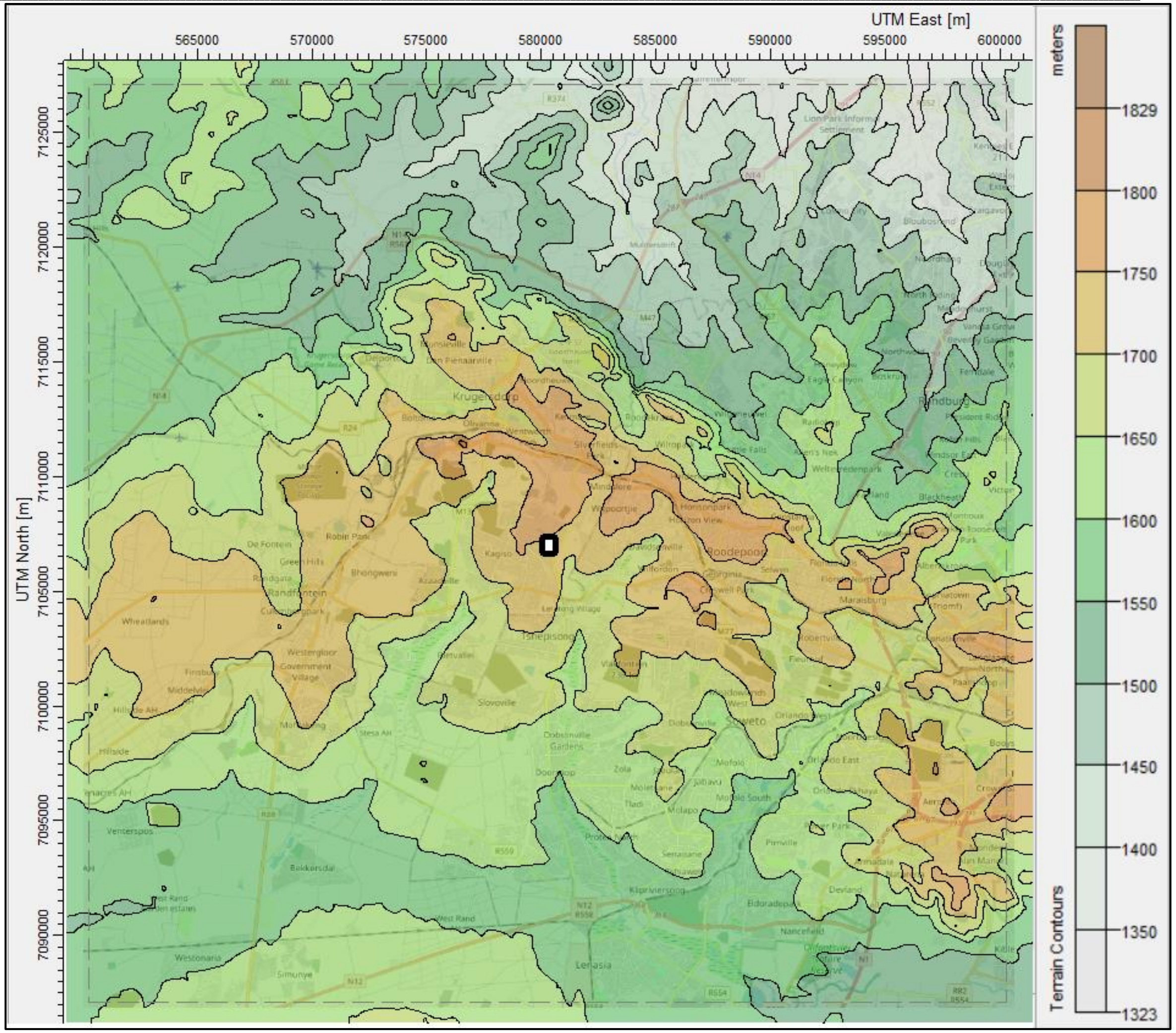

Figure 5-1: Elevation surrounding the proposed pyrolysis plant – marked by black outline (<20 km).

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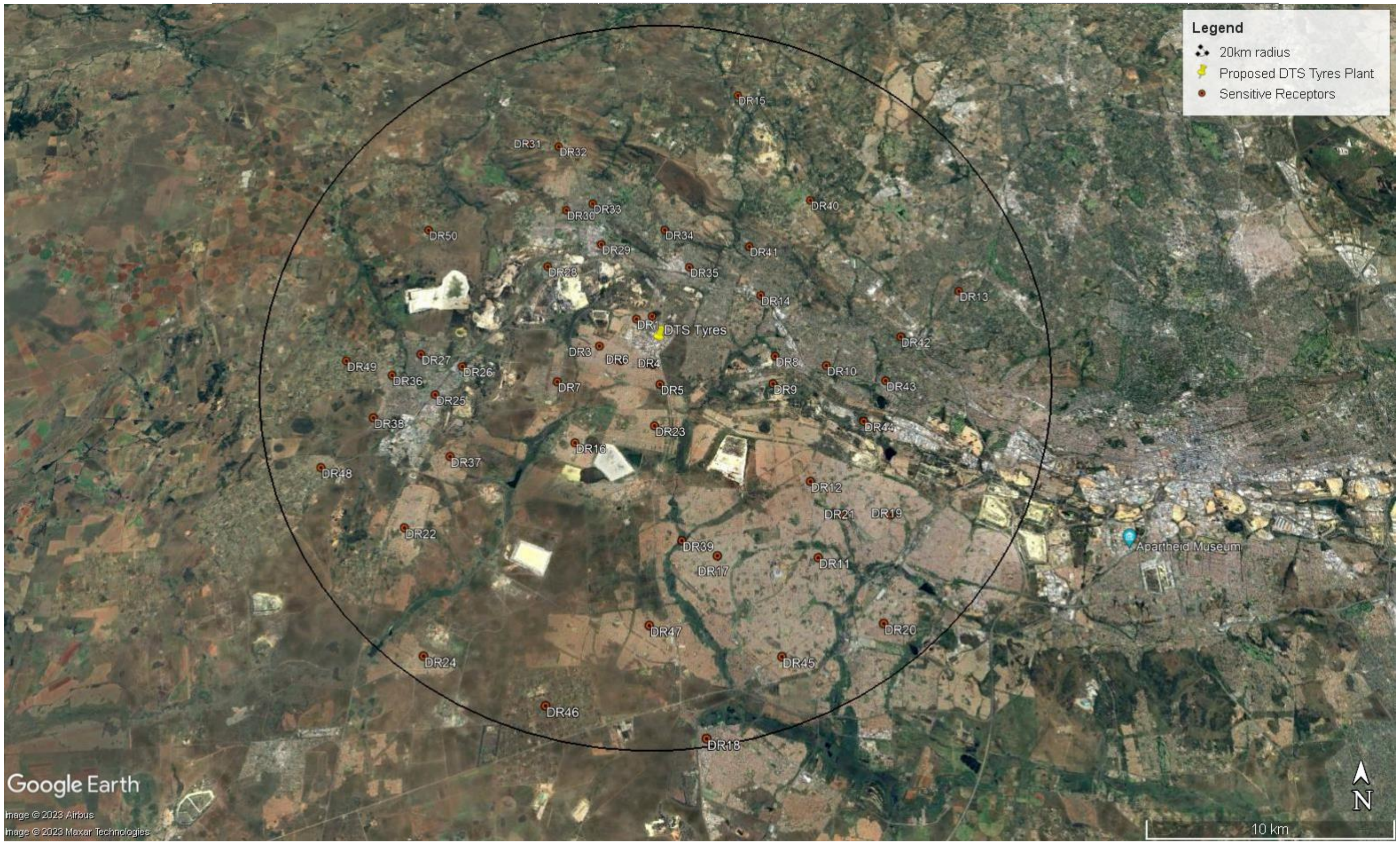

Figure 5-2: Locations of air quality sensitive receptors surrounding the proposed Neoserve pyrolysis plant (<20 km radius).

5.2.2. Surface Wind Field

The wind field determines both the distance of downward transport and the rate of dilution of pollutants. The generation of mechanical turbulence is a function of the wind speed, in combination with the surface roughness. The wind field for the study area is described with the use of wind roses.

Wind roses comprise 16 spokes, which represent the directions from which winds blew during a specific period. The colours used in the wind roses below, reflect the different categories of wind speeds; the yellow area, for example, representing winds in between 2 and 4 m/s. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories. The frequency with which calms occurred, i.e. periods during which the wind speed was below 1 m/s are also indicated.

The data described below is MM5 modelled meteorological data, obtained from Lakes Environmental for the period January 2019 to December 2021. MM5 is a PSU/NCAR meso-scale model used to predict meso-scale and regional-scale atmospheric circulation. The model provides integrated model meteorological data, which can be used in a wide range of applications. This model is often used to create weather forecasts and climate projections. Details of the meteorological data used are summarised in Table 5-2 below.

Table 5-2: Meteorological data details.

Meteorological Data Details	
Met Data Information	Description
Met data type	MM5 AERMET-Ready (Surface & Upper Air Data)
Datum	WGS 84
Closest Town	Johannesburg - South Africa
Time zone	UTC +2 hours
Period of record	January 2019 - December 2021
Met Station Parameters	Description
Anemometer height	13 m
Station base elevation	1 614 m
Upper air adjustment	-2 hours
Grid Cell Information	
Co-ordinates of centre met grid	26.195477ºS, 27.972098ºE
UTM zone	-35
Cell dimension	12 km x 12 km
Surface Met Data	Description
File format	SAMSON file
Output interval	Hourly
Upper Air Data	Description
Format	TD-6201- Fixed Length
Reported in	GMT
Output interval	00Z and 12Z
Models used to process met data	
Model used to process data for wind roses	WR Plot
Model used to process data for AERMOD	AERMET

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Wind roses for the period January 2019 to December 2021 are shown in Figure 5-3. The wind field for the 3-year period (i.e. average wind field) and diurnal period (morning and night-time) is uniform, with frequent northerly, north-northeasterly and north-northwesterly winds. Calm conditions prevailed 3.14% during the recording period with a period average wind speed of 3.10 m/s. During the daytime, the average wind speed is 3.21% and calm conditions prevailed 4.12%. For the evening period, a lower average wind speed of 2.96 m/s was recorded, with calm conditions prevailing for 4.24% of the time.

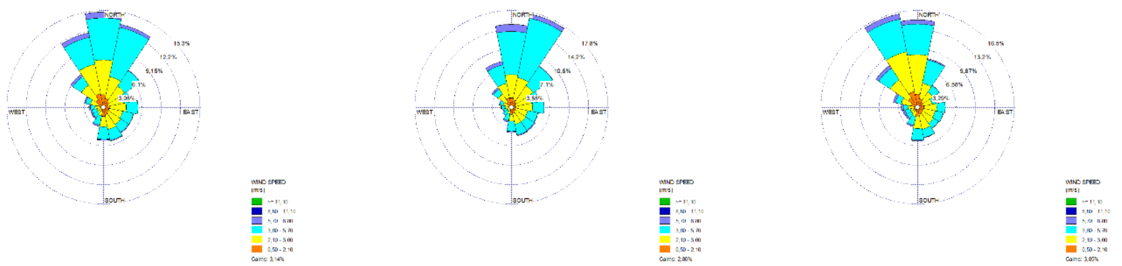

Figure 5-3: Period average wind roses (average, daytime and night-time).

5.2.3. Temperature

Air temperature is important, both for determining the effect of plume buoyancy (the larger the temperature difference between the plume and the ambient air, the higher a pollution plume can rise), and determining the development of the mixing and inversion layers. Minimum, maximum and mean temperatures as recorded at the proposed plant, are shown in Table 5-3. Period average maximum and minimum temperatures were 20.9 °C, and 8.3 °C respectively.

Table 5-3: Minimum, maximum and average temperatures for (2019 – 2021).

°C	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min	10.0	10.0	8.6	6.6	0.1	-0.9	-2.6	-1.2	2.0	4.6	10.1	10.6
Max	31.0	29.2	29.4	27.0	22.8	19.2	19.4	21.9	25.9	29.5	31.1	30.6
Ave	21.6	20.8	19.5	16.0	12.5	8.8	8.3	11.8	15.1	18.2	20.9	20.7

5.2.4. Rainfall

Rainfall has an overall dilution effect and cleanses the air by washing out particles and pollutants suspended in the atmosphere. Monthly total rainfall at the proposed plant for the period January 2019 to December 2021 is presented in Figure 5-4. The area receives, on average 74.3 mm of rainfall per year. Rainfall is mostly received from September to April.

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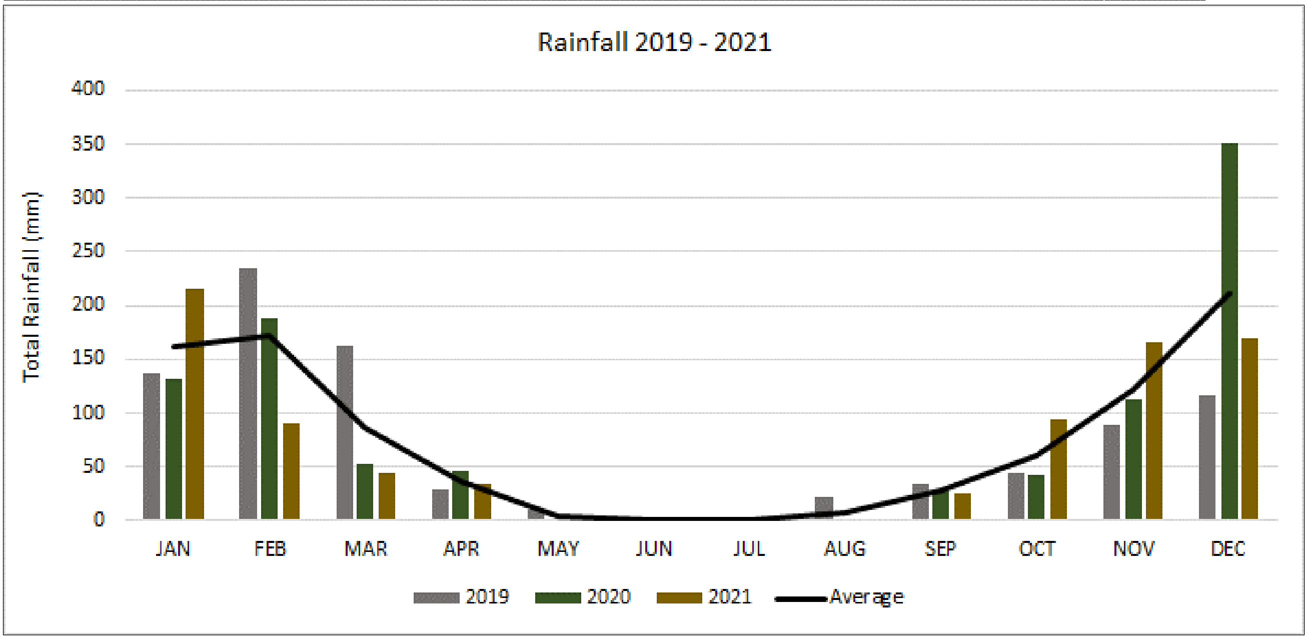

Figure 5-4: Total monthly rainfall for the proposed plant for 2019 - 2021.

5.2.5. Atmospheric Stability

Two parameters describe the atmospheric boundary layer properties: the boundary layer depth and the Monin-Obukhov length. The Monin-Obukhov length (LMo) provides a measure of the importance of buoyancy generated by the heating of the ground and mechanical mixing generated by the frictional effect of the earth's surface. Physically, it can be thought of as representing the depth of the boundary layer within which mechanical mixing is the dominant form of turbulence generation (AIRSHED, 2017; CERC, 2004). The atmospheric boundary layer constitutes the first few hundred metres of the atmosphere. During daytime, the atmospheric boundary layer is characterised by thermal turbulence due to the heating of the earth's surface. Night-times are characterised by weak vertical mixing and the predominance of a stable layer. These conditions are normally associated with low wind speeds and lower dilution potential (AIRSHED, 2017).

The highest concentrations for ground level, or near-ground level releases from non-wind dependent sources would be expected during weak wind speeds and stable (night-time) atmospheric conditions. For elevated releases, unstable conditions will likely result in very high concentrations of poorly diluted emissions close to the stack. This is called looping and occurs mostly during daytime hours. Neutral conditions disperse the plume equally in both the vertical and horizontal planes and the plume shape is referred to as coning. Stable conditions prevent the plume from mixing vertically, although it can still spread horizontally and is called fanning (Tiwary & Colls, 2010; AIRSEHD, 2017). For ground level releases the highest ground level concentrations will likely occur during stable night-time conditions (AIRSHED, 2017).

5.3. Status Quo Air Quality

5.3.1. Sources of Atmospheric Emissions

Several sources of atmospheric emissions (particulates and gases) exist around the proposed plant. These include urban industrial activities, mining activities, vehicle emissions and solid fuel combustion in nearby urban informal settlements and townships. Waste and resource dumps (i.e. mine tailings) associated with mining activities are additional sources of atmospheric emissions in the area, through wind erosion, and are located north-west and south of the proposed plant.

5.3.2. Baseline Ambient Air Pollutant Levels

The air quality status quo at any project site is usually determined using available monitoring data available from permanent ambient air quality monitoring stations and dustfall networks operated near the project site, which is accessible via the South African Air Quality Information System (SAAQIS) website. The nearest Air Quality Monitoring Station (AQMS) to the proposed plant is the Davidsonville AQMS, which is located ~4.6km east of the proposed plant. However, this AQMS seems to be non-operational as there was no ambient air quality data recorded for any of the criteria air pollutants for the past several years. In addition, there are no known dustfall networks in the area. Thus, the air quality status quo at the project site could not be determined in this AQIA.

Despite the limitation mentioned above, it is noted that the proposed pyrolysis plant, as planned, is not expected to be a major source of incremental particulate, metal or gaseous emissions at the project site due to the inclusion of a smoke/water scrubber in its design.

6. IMPACT ASSESSMENT

In this study one scenario was assessed:

- New plant standard scenario: where the MES for the proposed plant, i.e. the maximum threshold limit that is allowed for new plants (in terms of PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO, HF, HCl, metals, dioxins and furans, NH_3 and TOCs) as per listed activity sub-category 8.1 (thermal treatment of general and hazardous waste) was considered for input into the model.
    - This is representative of potential impacts if the proposed plant were emitting at the acceptable threshold that is permissible for sub-category 8.1 (thermal treatment of general and hazardous waste). The emission standards were converted into emission rates for input into the model.

6.1. Atmospheric Emissions Inventory

6.1.1. Point Source (Stack) Parameters and Emissions

There will be one point source at the proposed plant, i.e. the pyrolysis stack, which will be associated to the two pyrolysis reactors. The pyrolysis reactors will use oil and coal as power sources.

Stack emissions monitoring has not yet been conducted at the Neoserve pyrolysis plant as it is a proposed facility. Therefore, all stack parameters were estimated based on stack parameters at a similar existing plant, which were provided by the client. For the scenario considered in this assessment, the S21 MES rates for new plants for sub-category 8.1 (thermal treatment of general and hazardous waste) were considered. In other words, the maximum emission rate that is allowed in terms of S21 of NEM: AQA was considered in the assessment. The MES were converted into emission rates (g/s) for input into the model.

Stack parameters and emission rates used are shown in Table 6-1. The following assumptions were made in this study:

- It was assumed that for each pollutant, the emission rate from each pyrolysis cycle was the same, regardless of how many cycles were run throughout the day.

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Table 6-1: Stack parameters and emissions – New Plant Standard Scenario.

Parameter (1)	New Plant Standard Emission Limits (MES) (4)	Pyrolysis Reactor 1 and 2 Stack (5)
Stack ID	-	ST001
Coordinates	-	-26.195482°S; 27.972103°E
Pyrolysis Reactor design capacity (T)	-	10MT/Batch
Volumetric flow rate (m^3/hr) (6)	-	7650
Diameter (m)	-	0,325
Height (m)	-	15
Gas exit temperature (°C)	-	200
Gas exit velocity	-	25.62
PM emission rate (g/s)	10	0.012
PM_{10} emission rate (g/s) (2,7)	-	0.0061
$PM_{2.5}$ emission rate (g/s) (3,7)	-	0.0061
SO_2 emission rate (g/s) (7)	50	0.061
NO_2 emission rate (g/s) (7)	200	0.25
CO emission rate (g/s) (7)	50	0.061
HF emission rate (g/s) (7)	1	0.0012
HCl emission rate (g/s) (7)	10	0.012
NH_3 emission rate (g/s) (7)	10	0.012
TOCs emission rate (g/s) (7)	10	0.012
Hg emission rate (g/s) (7)	0.05	0.000061
Cd-Tl emission rate (g/s) (7)	0.05	0.000061
Sum of metals emission rate (g/s) (7)	0.5	0.00061
PCDD/PCDF emission rate (g/s) (7)	0.1 ng i-TEQ/Nm^3 under normal conditions and 10% O2	1.23E-10

Notes:

1. Stack parameters were assumed based on stack parameters at a similar existing plant, which were provided by the client.
2. PM_{10} assumed to be 50% of PM.
3. $PM_{2.5}$ assumed to be 5% of PM.
4. Converted the MES rates to g/s using dry volumetric flow rate values from a similar existing plant, which were given by the client.
5. Pyrolysis reactor operations assumed to occur for 24 hours a day, 7 days a week, which represents the worst-case scenario.
6. Normalised volumetric flow = Volumetric flow * (273/ (200+273)), where Stack Exit Temperature = 200°C, and Normal Temperature = 273K.

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7. Emissions (g/s) = MES (mg/Nm³) x Volumetric Flow (Nm³/hr) x 1000 / 3600.

6.1.2. Fugitive Emissions

Other open-air fugitive emission sources such as vehicle dust entrainment on access roads leading to the plant, as well as the handling of carbon black are also identified as a possible source of emissions at the site. However, the focus of this assessment was on the point sources, i.e. the proposed pyrolysis stack, which triggers sub-category 8.1 (thermal treatment of general and hazardous waste) in terms of S21 of the NEM: AQA.

The handling of carbon black will occur intermittently and will be conducted under roof, thus fugitive emissions associated with the handling process were assumed to be marginal as they will be contained within the plant building. Furthermore, the access roads leading to the plant are all paved (see Figure 1-3), thus vehicle dust entrainment due to movement of trucks on these roads was also assumed to be marginal. As such, these sources were not included in this assessment. However, emissions associated with these sources can be easily managed and controlled through the implementation of effective and affordable fugitive emission reduction measures.

6.2. Atmospheric Dispersion Simulations

The assessment of the impact of operations at proposed plant's pyrolysis reactors on the atmospheric environment is discussed in this Section. To assess impact on the environment, the following important aspects need to be considered:

- The criteria against which impacts are assessed (as discussed in Section 4.1.4 and 4.2);
- The location of likely AQSRs (Section 5.1);
- The potential of the atmosphere to disperse and dilute pollutants emitted by the project (Section 5.2);
- Existing ambient pollutant concentrations (Section 5.3); and
- Atmospheric emissions (Section 6.1)

Dispersion models simulate ambient pollutant concentrations as a function of source configurations, emission strengths and meteorological characteristics, thus providing a useful tool to ascertain the spatial and temporal patterns in the ground level concentrations arising from the emissions of various sources. Increasing reliance has been placed on concentration estimates from models as the primary basis for environmental and health impact assessments, risk assessments and emission control requirements. It is therefore important to carefully select a dispersion model for the purpose (AIRSHED, 2017).

6.2.1. Dispersion Model Selection and Inputs

For the current study, the AERMOD dispersion model was used. AERMOD, is a state-of-the-art Planetary Boundary Layer (PBL) air dispersion model, which was developed by the American Meteorological Society and USEPA Regulatory Model Improvement Committee (AERMIC). AERMOD utilizes a similar input and output structure to ISCST3 and shares many of the same features, as well as offering additional features. AERMOD fully incorporates the PRIME building downwash algorithms, advanced depositional parameters, local terrain effects, and advanced meteorological turbulence calculations.

The AERMOD atmospheric dispersion modelling system is an integrated system that includes three modules:

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- A steady-state dispersion model designed for short-range (up to 50 km) dispersion of air pollutant emissions from stationary industrial sources.
- A meteorological data pre-processor (AERMET) for surface meteorological data, upper air soundings, and optionally, data from on-site instrument towers. It then calculates atmospheric parameters needed by the dispersion model, such as atmospheric turbulence characteristics, mixing heights, friction velocity, Monin-Obukov length and surface heat flux.
- A terrain pre-processor (AERMAP) which provides a physical relationship between terrain features and the behaviour of air pollution plumes. It generates location and height data for each receptor location. It also provides information that allows the dispersion model to simulate the effects of air flowing over hills or splitting to flow around hills.

AERMOD includes Plume Rise Model Enhancements (PRIME) building downwash algorithms, which provide a more realistic handling of building downwash effects. PRIME algorithms were designed to address two fundamental features associated with building downwash; enhanced plume dispersion coefficients due to the turbulent wake and to reduce plume rise caused by a combination of the descending streamlines in the lee of the building and the increased entrainment in the wake. AERMOD is suitable for a wide range of near field applications in both simple and complex terrain. The evaluation results for AERMOD, particularly for complex terrain applications, indicate that the model represents significant improvements compared to previously recommended models.

AERMOD has been used in various dispersion modelling studies in the United States and around the world (Perry *et al*., 2004).

Uncertainties are associated with any geophysical model. Therefore, to reduce the margin of error, the model is set up in such a way to minimise the total error. The total uncertainty can be thought of as the sum of three components: the uncertainty due to errors in the model description of atmospheric physics; the uncertainty due to data errors; and the uncertainty due to stochastic processes (turbulence) in the atmosphere. Nevertheless, dispersion modelling is generally accepted as a valid tool to quantify and analyse the atmospheric impact of existing operations and for determination of the impact of proposed operations (AIRSHED, 2017).

Data input into AERMOD includes MM5 meteorological data (surface and upper air) for 01 January 2019 – 31 December 2021. Terrain data at a resolution of 90 m (SRTM90) is used for input into the model, as generated by the terrain pre-processor, AERMAP. A modelling domain of 15 km × 15 km was used. A multi-tier grid with a grid receptor spacing of 250 m (5 km from facility), 500 m (10 km from facility) and 1 000 m (20 km from the facility) (3 tiers) was used. Topographical data was included in the simulations.

6.2.2. Simulation Results

Dispersion simulations were undertaken for the following scenarios to determine:

- Predicted ground-level impacts for PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO, HF, HCl, metals, dioxins and furans, NH_3 and TOCs from the proposed operation of two pyrolysis reactors associated with the new plant standard scenario for Neoserve.

Dispersion simulations were undertaken to determine annual average, 24-hour, 8-hourly, and hourly average ground level concentrations, where applicable, for each of the pollutants considered in the study. Averaging periods were selected to facilitate the comparison of simulated pollutant concentrations to relevant SA NAAQS. In South Africa there are no NAAQS for halides, metals, dioxins and furans, NH_3 and TOCs. Therefore, simulated incremental concentrations for these pollutants are

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compared to the Alberta Ambient Air Quality International Guidelines (AEP, Air Policy, 2016, No.2 updated Jan 2019) and various internationally published health effect screening guideline levels. Simulated TOC concentrations are compared to the benzene annual NAAQS of 5 µg/m^3.

For compliance assessment purposes, the 99th percentile of 1-hour, 8-hour and 24-hour average pollutant concentrations is presented. It should be noted that ambient air quality criteria apply to areas where the Occupational Health and Safety regulations do not apply, i.e. outside the property boundary. Ambient air quality criteria are therefore not occupational health indicators but applicable to areas where the public has access i.e. off-site. Results are discussed in more detail in subsequent sections.

6.2.2.1. Simulated results for the New Plant Standard Scenario.

Maximum simulated pollutant concentrations at the project area are depicted in the isopleths plots in Figure 6-1 to Figure 6-22 for the new plant standard scenario.

Simulated PM_{10} and $PM_{2.5}$ concentrations are well below the NAAQS (i.e. 75 µgm^{3}and 40 µg/m^3 daily and annual limits for PM_{10}, respectively; 40 µg/m^3 and 20 µg/m^3 daily and annual limits for $PM_{2.5}$, respectively) in both the long and short term (Figure 6-1 to Figure 6-4).

Simulated short-term HF, HCl and NH_3 concentrations are well below the assessment criteria within the facility boundary, as well as at offsite locations, thus complying with the Alberta hourly limits of 4.9 µg/m^3 (for HF), 75 µg/m^3 (for NH_3) and 1 400 µg/m^3 (for NH_3) (Figure 6-5 to Figure 6-7). Simulated TOC emissions are also low over the entire project area and in compliance with the annual benzene NAAQS (Figure 6-8). However, there are no national or international standards for VOCs, that we could find, to assess compliance.

Simulated hourly, daily and annual SO_2 concentrations fall well below the assessment criteria over the entire project area in the short and long-term, thus complying with the hourly (350 µg/m^3), daily (125 µg/m^3) and annual (50 µg/m^3) limits (Figure 6-9 and Figure 6-11). Similarly, short and long-term simulated hourly and annual NO_2 concentrations fall below the hourly (200 µg/m^3) and annual (40 µg/m^3) NAAQS(Figure 6-12 to Figure 6-13), while short-term simulated CO concentrations are in compliance with the hourly (30 000 µg/m^3) and 8-hourly (10 000 µg/m^3) NAAQS (Figure 6-14 to Figure 6-15).

All simulated metal concentrations and dioxin/furan concentrations comply with the various international health effect screening guideline levels (Figure 6-16 to Figure 6-22).

Simulated pollutant concentrations at all sensitive receptors modelled in the study (as described in Section 5.1) are low, with no exceedances of the applicable NAAQS and international guidelines if the proposed plant is operated at or below the MES for sub-category 8.1. Maximum simulated ground concentrations at the AQSRs are provided in Table 6-2 and Table 6-3.

Based on the dispersion model output plots and maximum simulated concentrations for the new plant standard scenario in this report, it is not anticipated that the proposed pyrolysis plant operations at Neoserve will result in high negative impacts if the proposed plant is operated at or below the MES for sub-category 8.1, as low concentrations are predicted over the whole project area, with no exceedances of applicable local standards and international guidelines observed. A comparison of the maximum simulated concentrations with local and international standards in given in Table 6-4.

Simulated pollutant concentrations are shown to decrease with increasing distance from the emission source in Figure 6-1 to Figure 6-22. Thus, cumulative impacts for these pollutants will be higher nearer to the proposed plant operations.

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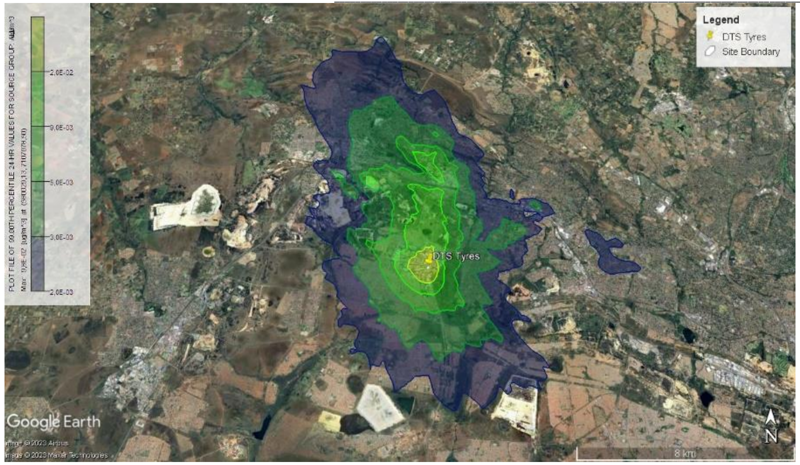

Figure 6-1: Simulated PM_{10} daily average incremental concentrations for the proposed plant-New Plant Standard Scenario (assessment criteria - 75µg/m³).

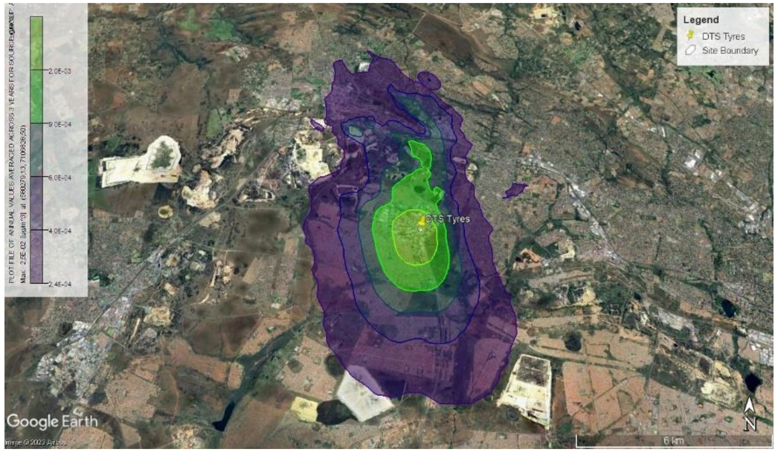

Figure 6-2: Simulated PM_{10} annual average incremental concentrations for the proposed plant-New Plant Standard Scenario (assessment criteria – 40 µg/m³).

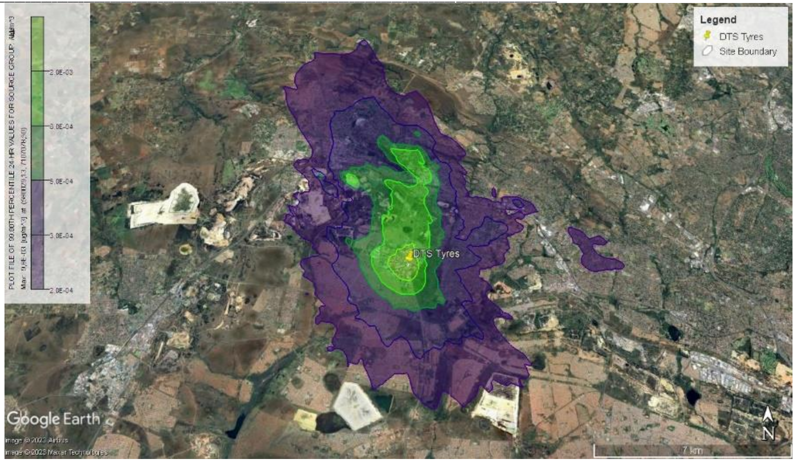

Figure 6-3: Simulated $PM_{2.5}$ daily average incremental concentrations for the proposed plant-New Plant Standard Scenario (assessment criteria – 40 µg/m³).

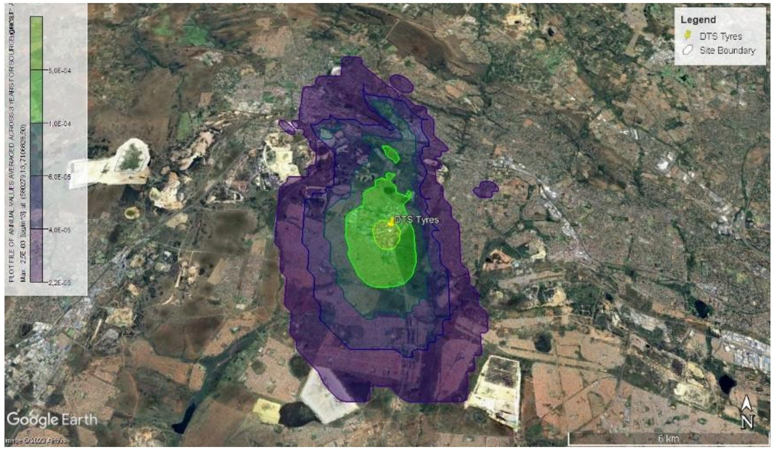

Figure 6-4: Simulated $PM_{2.5}$ annual average incremental concentrations for the proposed plant-New Plant Standard Scenario (assessment criteria – 20 µg/m³).

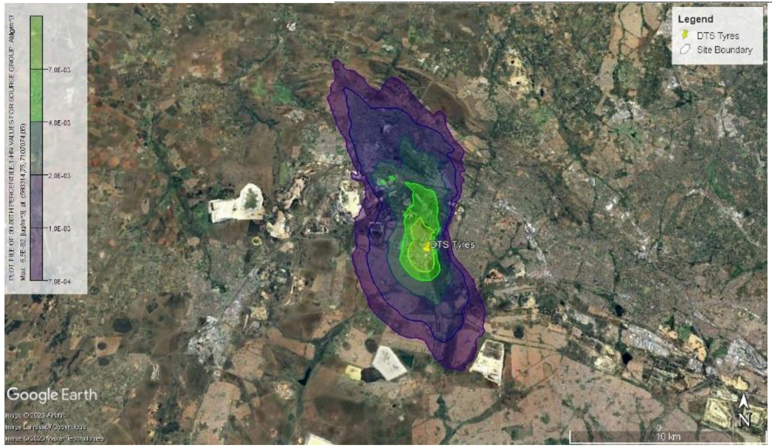

Figure 6-5: Simulated HF hourly average incremental concentrations for the proposed plant-New Plant Standard Scenario -Actual Scenario (assessment criteria – 4.9 µg/m³).

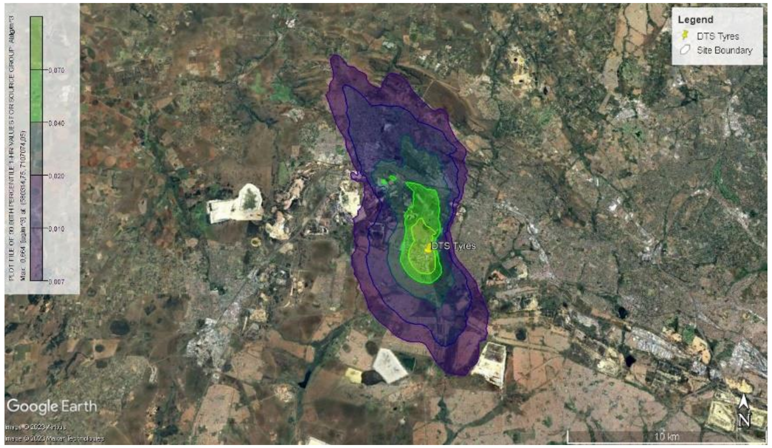

Figure 6-6: Simulated HCl hourly average incremental concentrations for the proposed plant-New Plant Standard Scenario -Actual Scenario (assessment criteria – 75 µg/m³).

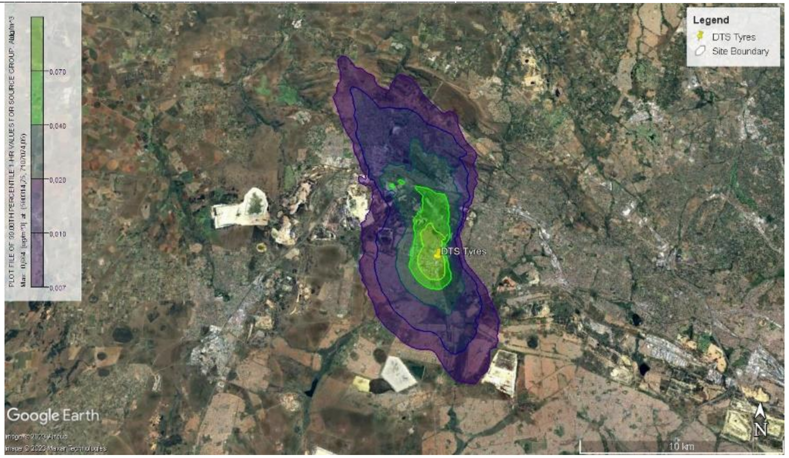

Figure 6-7: Simulated NH_3 hourly average incremental concentrations for the proposed plant-New Plant Standard Scenario (assessment criteria – 1 400 µg/m³).

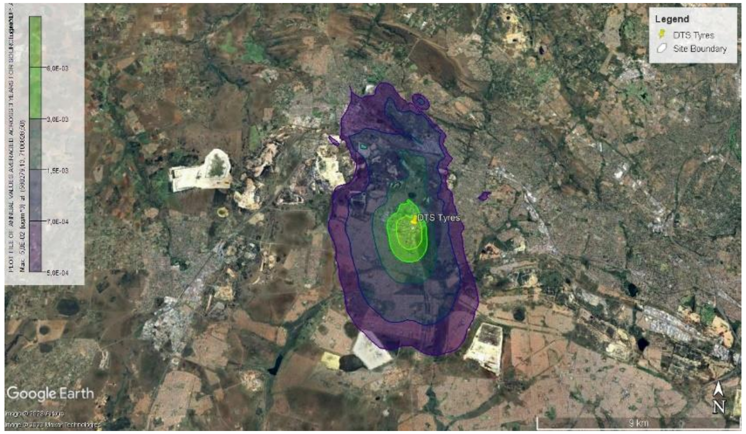

Figure 6-8: Simulated TOCs annual average incremental concentrations for the proposed plant-New Plant Standard Scenario (assessment criteria - – 5 µg/m³).

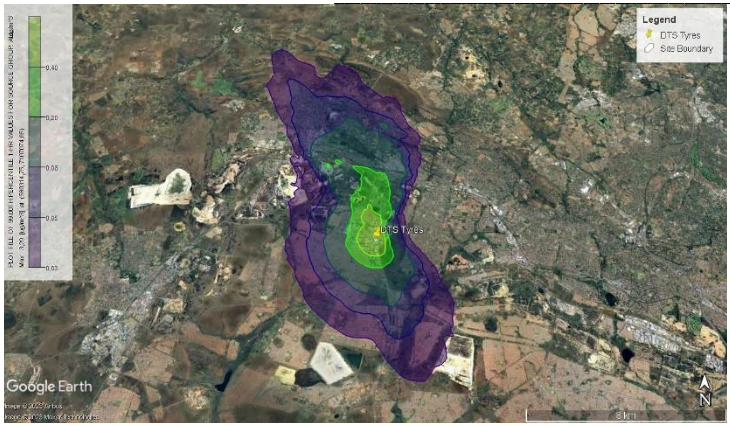

Figure 6-9: Simulated SO_2 hourly average incremental concentrations for The proposed plant-New Plant Standard Scenario (assessment criteria – 350 µg/m^3).

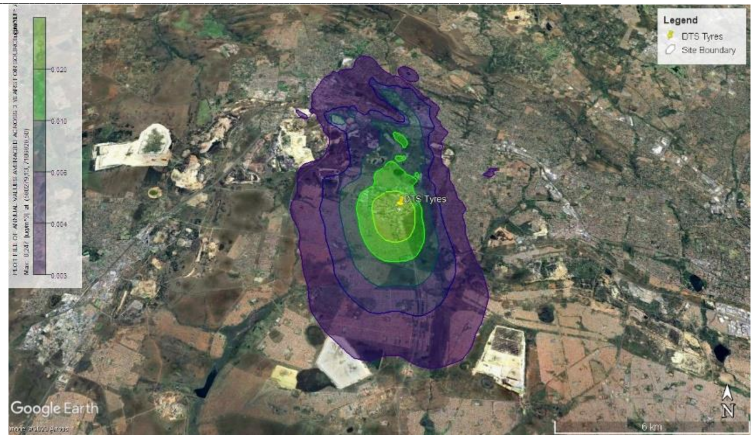

Figure 6-11: Simulated SO_2 annual average incremental concentrations for he proposed plant-New Plant Standard Scenario (assessment criteria – 50 µg/m^3).

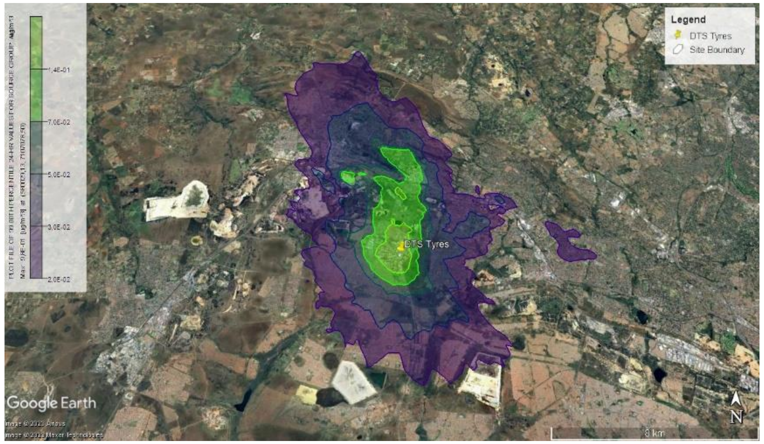

Figure 6-10: Simulated SO_2 daily average incremental concentrations for The proposed plant-New Plant Standard Scenario (assessment criteria – 125 µg/m^3).

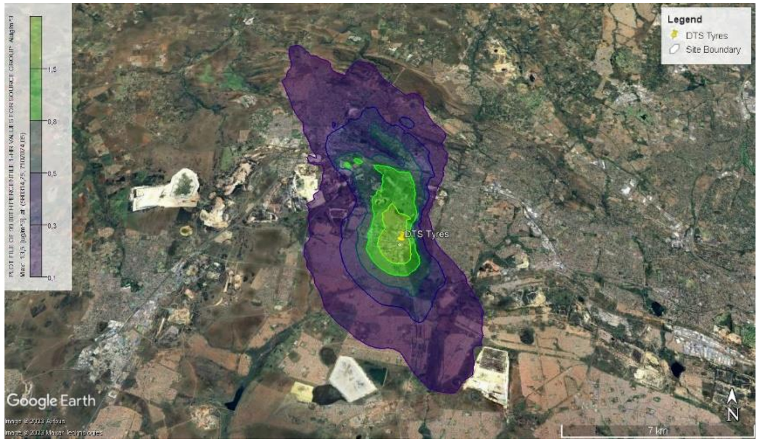

Figure 6-12: Simulated NO_2 hourly average incremental concentrations for The proposed plant-New Plant Standard Scenario (assessment criteria – 200 µg/m^3).

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Figure 6-13: Simulated NO_2 annual average incremental concentrations for the proposed plant-New Plant Standard Scenario (assessment criteria – 40 µg/m³).

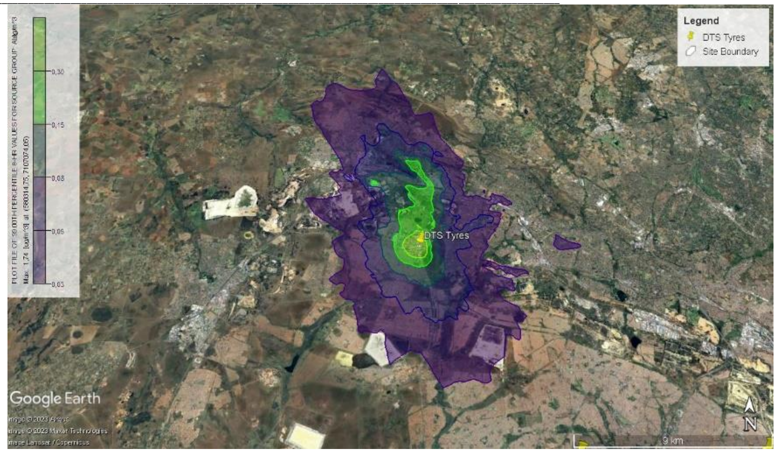

Figure 6-15: Simulated CO 8-hourly average incremental concentrations for the proposed plant-New Plant Standard Scenario (assessment criteria – 10 000 µg/m³).

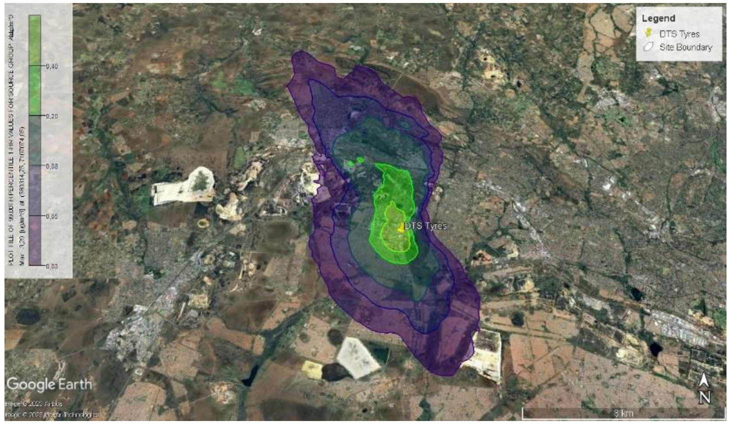

Figure 6-14: Simulated CO hourly average incremental concentrations for the proposed plant-New Plant Standard Scenario (assessment criteria – 30 000 µg/m³).

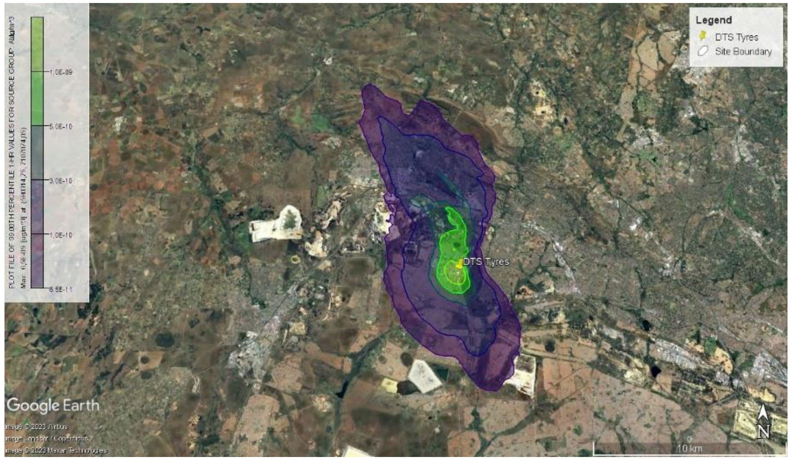

Figure 6-16: Simulated PCDD/PCDF hourly average incremental concentrations for the proposed plant-New Plant Standard Scenario (no assessment criteria).

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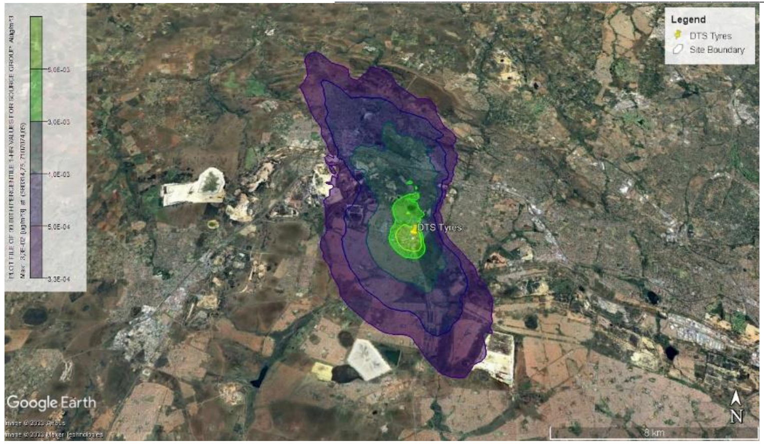

Figure 6-17: Simulated metal hourly average incremental concentrations for the proposed plant-New Plant Standard Scenario (assessment criteria – 0.2 µg/m³).

Figure 6-18: Simulated metal annual average incremental concentrations for the proposed plant-New Plant Standard Scenario (assessment criteria – 0.02 µg/m³).

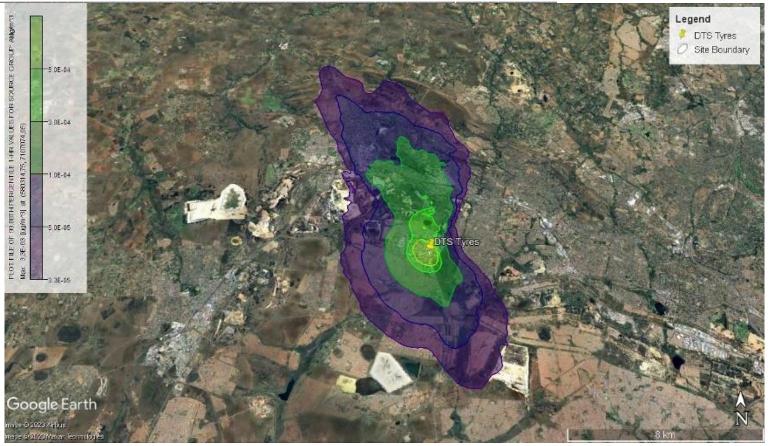

Figure 6-19: Simulated Cd-Tl hourly average incremental concentrations for the proposed plant-New Plant Standard Scenario (assessment criteria – 0.14µg/m³).

Figure 6-20: Simulated Cd-Tl annual average incremental concentrations for the proposed plant-New Plant Standard Scenario (assessment criteria – 0.01 µg/m³).

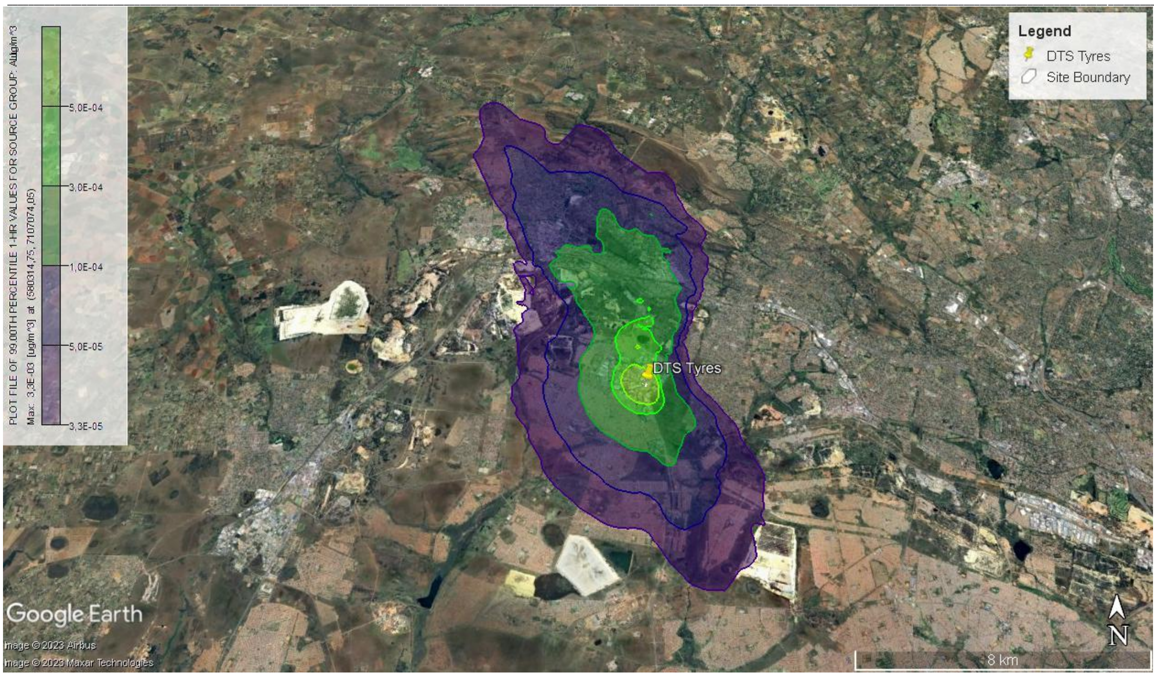

Figure 6-21: Simulated Hg hourly average incremental concentrations for the proposed plant-New Plant Standard Scenario (assessment criteria – 0.6 µg/m³).

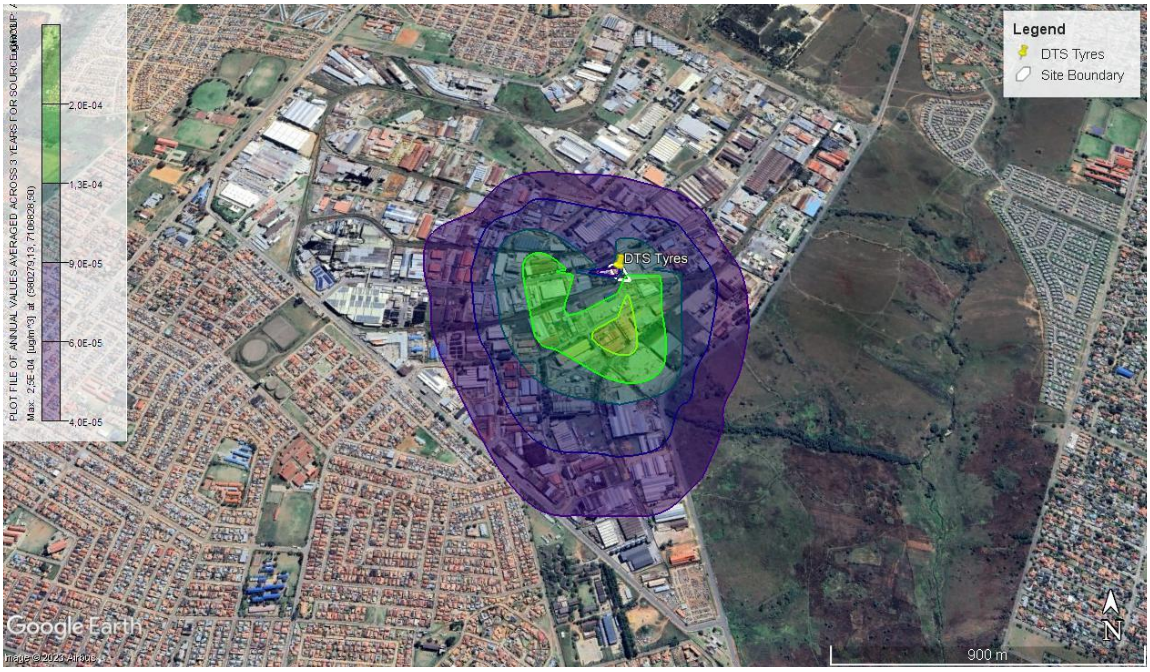

Figure 6-22: Simulated Hg annual average incremental concentrations for the proposed plant-New Plant Standard Scenario (assessment criteria – 0.03 µg/m³).

6.2.3. Maximum Simulated Pollutant Concentrations

Maximum simulated pollutant concentrations at AQSRs (as described in Section 5.1) within 5 km radius of the proposed plant are presented below (Table 6-2 and Table 6-3) for the modelled scenario. A comparison of the maximum simulated concentrations with local and international standards in given in Table 6-4.

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Table 6-2: Simulated PM_{10}, $PM_{2.5}$, CO, SO_2, NO_2 and TOC concentrations at AQSRs – new plant standard scenario.

Receptor ID	INCREMENTAL CONCENTRATIONS (µg/m³)														
	PM_{10} (24H)	PM_{10} (Annual)	$PM_{2.5}$ (24H)	$PM_{2.5}$ (Annual)	SO_2 (Hourly)	SO_2 (Daily)	SO_2 (Annual)	NO_2 (Hourly)	NO_2 (Annual)	CO (1H)	CO (8H)	TVOCs (Annual)	UTM Coordinates (35S)		Elevation
	75	40	40	20	350	125	50	200	40	30 000	10 000	5	X (m)	Y (m)	Y (m)
SR1	0.008	0.001	0.001	0.000	0.237	0.082	0.010	0.970	0.039	0.237	0.151	0.002	579374.48	7108253.03	1757.33
SR2	0.020	0.002	0.002	0.000	0.544	0.197	0.016	2.230	0.066	0.544	0.295	0.003	580111.78	7108384.34	1764.45
SR3	0.004	0.000	0.000	0.000	0.068	0.035	0.005	0.278	0.019	0.068	0.055	0.001	577680.45	7106900.35	1723.11
SR4	0.009	0.003	0.001	0.000	0.261	0.091	0.027	1.069	0.109	0.261	0.164	0.005	580157.37	7105956.43	1737.06
SR5	0.005	0.001	0.000	0.000	0.115	0.048	0.010	0.471	0.041	0.115	0.089	0.002	580500.98	7104984.24	1711.23
SR6	0.005	0.001	0.000	0.000	0.120	0.048	0.008	0.492	0.034	0.120	0.086	0.002	578689.7	7106157.39	1742.26
SR7	0.002	0.000	0.000	0.000	0.025	0.017	0.002	0.104	0.008	0.025	0.033	0.000	575790.92	7105150.25	1690.87
SR8	0.001	0.000	0.000	0.000	0.007	0.014	0.001	0.027	0.004	0.007	0.020	0.000	585799.4	7106354.57	1719.63
SR9	0.002	0.000	0.000	0.000	0.009	0.016	0.001	0.038	0.004	0.009	0.023	0.000	585667.23	7104973.61	1753.23
SR10	0.001	0.000	0.000	0.000	0.004	0.012	0.001	0.018	0.003	0.004	0.014	0.000	588145.2	7105871.13	1727.71
SR11	0.001	0.000	0.000	0.000	0.008	0.009	0.001	0.033	0.003	0.008	0.018	0.000	587422.34	7096893.15	1628.15
SR12	0.001	0.000	0.000	0.000	0.011	0.011	0.001	0.046	0.004	0.011	0.021	0.000	587210.05	7100340.44	1646.85
SR13	0.000	0.000	0.000	0.000	0.001	0.004	0.000	0.006	0.001	0.001	0.004	0.000	594590.67	7109706.07	1592.76
SR14	0.002	0.000	0.000	0.000	0.005	0.020	0.001	0.019	0.004	0.005	0.027	0.000	585204.71	7109451.59	1757.98
SR15	0.001	0.000	0.000	0.000	0.009	0.009	0.001	0.035	0.002	0.009	0.010	0.000	584327.76	7120820.41	1423.8
SR16	0.001	0.000	0.000	0.000	0.021	0.014	0.002	0.086	0.008	0.021	0.026	0.000	576696.53	7102195.09	1681.12
SR17	0.001	0.000	0.000	0.000	0.017	0.011	0.001	0.070	0.005	0.017	0.022	0.000	583042.65	7096998.32	1638.28
SR18	0.001	0.000	0.000	0.000	0.006	0.007	0.001	0.025	0.003	0.006	0.011	0.000	582518.96	7089336.43	1578.84
SR19	0.001	0.000	0.000	0.000	0.005	0.008	0.001	0.020	0.002	0.005	0.012	0.000	590691.37	7098801.28	1636.94
SR20	0.001	0.000	0.000	0.000	0.006	0.007	0.001	0.023	0.002	0.006	0.011	0.000	590096.52	7094024.07	1632.09
SR21	0.001	0.000	0.000	0.000	0.008	0.009	0.001	0.035	0.003	0.008	0.018	0.000	588617.76	7098756.87	1631.26
SR22	0.001	0.000	0.000	0.000	0.006	0.006	0.001	0.023	0.002	0.006	0.009	0.000	569353.77	7098306.43	1686.04
SR23	0.002	0.000	0.000	0.000	0.041	0.022	0.004	0.169	0.016	0.041	0.042	0.001	580263.95	7102984.35	1685.34
SR24	0.000	0.000	0.000	0.000	0.004	0.005	0.000	0.016	0.002	0.004	0.007	0.000	570595.17	7092763.36	1586.22
SR25	0.001	0.000	0.000	0.000	0.009	0.009	0.001	0.035	0.003	0.009	0.013	0.000	570250.05	7104534.89	1716.09
SR26	0.001	0.000	0.000	0.000	0.011	0.011	0.001	0.045	0.004	0.011	0.015	0.000	571401.09	7105910.53	1727.02
SR27	0.001	0.000	0.000	0.000	0.007	0.009	0.001	0.031	0.003	0.007	0.014	0.000	569436.99	7106544.3	1696.21
SR28	0.002	0.000	0.000	0.000	0.020	0.017	0.001	0.082	0.005	0.020	0.025	0.000	575125.78	7111015.04	1754.1

SR29	0.004	0.000	0.000	0.000	0.095	0.041	0.003	0.390	0.013	0.095	0.060	0.001	577639.53	7112194.68	1729.53
SR30	0.002	0.000	0.000	0.000	0.048	0.023	0.002	0.197	0.008	0.048	0.038	0.000	575899.39	7114089.3	1688.09
SR31	0.002	0.000	0.000	0.000	0.031	0.017	0.001	0.127	0.005	0.031	0.029	0.000	574011.13	7117795.83	1676.55
SR32	0.002	0.000	0.000	0.000	0.037	0.020	0.002	0.153	0.006	0.037	0.032	0.000	575394.42	7117684.65	1703.25
SR33	0.003	0.000	0.000	0.000	0.070	0.034	0.002	0.286	0.010	0.070	0.052	0.001	577167.92	7114428.2	1731.36
SR34	0.004	0.000	0.000	0.000	0.066	0.039	0.003	0.271	0.010	0.066	0.059	0.001	580673.87	7112946.37	1757.78
SR35	0.004	0.000	0.000	0.000	0.071	0.044	0.003	0.293	0.014	0.071	0.072	0.001	581847.91	7110930.27	1773.62
SR36	0.001	0.000	0.000	0.000	0.007	0.007	0.001	0.027	0.002	0.007	0.010	0.000	568196.24	7105512.05	1692.53
SR37	0.001	0.000	0.000	0.000	0.008	0.008	0.001	0.034	0.003	0.008	0.014	0.000	571131.17	7101565.05	1720.37
SR38	0.001	0.000	0.000	0.000	0.006	0.008	0.001	0.025	0.002	0.006	0.008	0.000	567533.33	7103430.93	1716.44
SR39	0.001	0.000	0.000	0.000	0.018	0.013	0.001	0.074	0.006	0.018	0.024	0.000	581497.39	7097689.09	1602.17
SR40	0.001	0.000	0.000	0.000	0.002	0.008	0.000	0.010	0.002	0.002	0.009	0.000	587758.21	7114677.72	1525.43
SR41	0.001	0.000	0.000	0.000	0.005	0.010	0.001	0.019	0.003	0.005	0.013	0.000	584724.74	7112081.89	1658.77
SR42	0.001	0.000	0.000	0.000	0.002	0.009	0.000	0.008	0.002	0.002	0.011	0.000	591665.07	7107320.46	1662.26
SR43	0.001	0.000	0.000	0.000	0.003	0.010	0.001	0.012	0.002	0.003	0.011	0.000	590835.27	7105115.97	1706.41
SR44	0.001	0.000	0.000	0.000	0.004	0.007	0.001	0.017	0.002	0.004	0.011	0.000	589725.81	7103150.57	1702.91
SR45	0.001	0.000	0.000	0.000	0.008	0.010	0.001	0.033	0.003	0.008	0.015	0.000	585724.43	7092657.18	1599.15
SR46	0.001	0.000	0.000	0.000	0.005	0.006	0.001	0.020	0.002	0.005	0.010	0.000	575827.48	7090689.08	1595.88
SR47	0.001	0.000	0.000	0.000	0.007	0.008	0.001	0.029	0.003	0.007	0.012	0.000	580113.42	7093997.41	1597.79
SR48	0.001	0.000	0.000	0.000	0.004	0.006	0.000	0.017	0.002	0.004	0.008	0.000	565404.99	7101083.01	1704.43
SR49	0.001	0.000	0.000	0.000	0.005	0.007	0.001	0.021	0.002	0.005	0.010	0.000	566027.88	7106234.12	1700.56
SR50	0.001	0.000	0.000	0.000	0.006	0.009	0.001	0.025	0.003	0.006	0.011	0.000	569279.66	7113080.07	1620.44

Table 6-3: Simulated HF, HCl, NH_3, metal and PCDD/PCDF concentrations at AQSRs –new plant standard scenario.

Receptor ID	INCREMENTAL CONCENTRATIONS (µg/m³)												
	HF (1H)	HCL (1H)	NH_3 (1H)	Hg (1H)	Hg (Annual)	Cd-Tl (1H)	Cd-Tl (Annual)	Metals (1H)	Metals (1Anual)	PCDD/PCDF (1H)	UTM Coordinates (35S)		Elevation
	4.9	75	1 400	0.6	0.003	0.14	0.01	0.2	0.02	n/a	X (m)	Y (m)	Y (m)
SR1	0.005	0.048	0.048	0.000	0.000	0.000	0.000	0.002	0.000	0.000	579374.48	7108253.03	1757.33
SR2	0.011	0.110	0.110	0.001	0.000	0.001	0.000	0.005	0.000	0.000	580111.78	7108384.34	1764.45
SR3	0.001	0.014	0.014	0.000	0.000	0.000	0.000	0.001	0.000	0.000	577680.45	7106900.35	1723.11
SR4	0.005	0.053	0.053	0.000	0.000	0.000	0.000	0.003	0.000	0.000	580157.37	7105956.43	1737.06
SR5	0.002	0.023	0.023	0.000	0.000	0.000	0.000	0.001	0.000	0.000	580500.98	7104984.24	1711.23
SR6	0.002	0.024	0.024	0.000	0.000	0.000	0.000	0.001	0.000	0.000	578689.7	7106157.39	1742.26

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SR7	0.001	0.005	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	575790.92	7105150.25	1690.87
SR8	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	585799.4	7106354.57	1719.63
SR9	0.000	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	585667.23	7104973.61	1753.23
SR10	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	588145.2	7105871.13	1727.71
SR11	0.000	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	587422.34	7096893.15	1628.15
SR12	0.000	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	587210.05	7100340.44	1646.85
SR13	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	594590.67	7109706.07	1592.76
SR14	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	585204.71	7109451.59	1757.98
SR15	0.000	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	584327.76	7120820.41	1423.8
SR16	0.000	0.004	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	576696.53	7102195.09	1681.12
SR17	0.000	0.003	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	583042.65	7096998.32	1638.28
SR18	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	582518.96	7089336.43	1578.84
SR19	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	590691.37	7098801.28	1636.94
SR20	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	590096.52	7094024.07	1632.09
SR21	0.000	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	588617.76	7098756.87	1631.26
SR22	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	569353.77	7098306.43	1686.04
SR23	0.001	0.008	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	580263.95	7102984.35	1685.34
SR24	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	570595.17	7092763.36	1586.22
SR25	0.000	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	570250.05	7104534.89	1716.09
SR26	0.000	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	571401.09	7105910.53	1727.02
SR27	0.000	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	569436.99	7106544.3	1696.21
SR28	0.000	0.004	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	575125.78	7111015.04	1754.1
SR29	0.002	0.019	0.019	0.000	0.000	0.000	0.000	0.001	0.000	0.000	577639.53	7112194.68	1729.53
SR30	0.001	0.010	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	575899.39	7114089.3	1688.09
SR31	0.001	0.006	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	574011.13	7117795.83	1676.55
SR32	0.001	0.008	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	575394.42	7117684.65	1703.25
SR33	0.001	0.014	0.014	0.000	0.000	0.000	0.000	0.001	0.000	0.000	577167.92	7114428.2	1731.36
SR34	0.001	0.013	0.013	0.000	0.000	0.000	0.000	0.001	0.000	0.000	580673.87	7112946.37	1757.78
SR35	0.001	0.014	0.014	0.000	0.000	0.000	0.000	0.001	0.000	0.000	581847.91	7110930.27	1773.62
SR36	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	568196.24	7105512.05	1692.53
SR37	0.000	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	571131.17	7101565.05	1720.37
SR38	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	567533.33	7103430.93	1716.44
SR39	0.000	0.004	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	581497.39	7097689.09	1602.17
SR40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	587758.21	7114677.72	1525.43

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SR41	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	584724.74	7112081.89	1658.77
SR42	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	591665.07	7107320.46	1662.26
SR43	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	590835.27	7105115.97	1706.41
SR44	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	589725.81	7103150.57	1702.91
SR45	0.000	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	585724.43	7092657.18	1599.15
SR46	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	575827.48	7090689.08	1595.88
SR47	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	580113.42	7093997.41	1597.79
SR48	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	565404.99	7101083.01	1704.43
SR49	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	566027.88	7106234.12	1700.56
SR50	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	569279.66	7113080.07	1620.44

Table 6-4: Maximum simulated pollutant concentrations in comparison with the relative standards and guidelines.

Pollutant		Simulated Highest Ground Level Concentration (µg/m^3)				Identified Standards and Guidelines (µg/m^3)				Hazard Index (Concentration divided by guideline. in %)			
		Annual Average	Highest Daily	Highest Hourly	Highest 8-Hourly	Annual Average	Highest Daily	Highest Hourly	Highest 8-Hourly	Annual Average	Highest Daily	Highest Hourly	Highest 8-Hourly
Particulate Matter	PM_{10}	0.03	0.1			40	75			0.1	0.1		
	$PM_{2.5}$	0.003	0.01			20	40			0.01	0.02		
Sulphur Dioxide	SO_2	0.3	1.0	3.3		50	125	350		0.5	0.8	0.9	
Oxides of nitrogen	NOx expressed as NO_2	1.0		13.5		40		200		2.5		6.8	
Carbon monoxide	CO			3.3	1.74			30000	10000			0.01	0.02
Hydrogen chloride	HCl			0.7				75				0.9	
Hydrogen fluoride	HF			0.07				4.9				1.3	

Sum of lead. arsenic. antimony. chromium. cobalt. copper. manganese. nickel. vanadium	Pb+As+Sb+Cr+Co+Cu+Mn+Ni+V	0.002		0.03		0.02		0.2		10		15	
Mercury	Hg	0.003		0.0003		0.03		0.6		11.0		0.04	
Cadmium and Thallium	Cd+Tl	0.003		0.0003		0.01		0.14		33.0		0.2	
Total organic compounds	TOC	0.1				5				1.0			
Ammonia	NH_3			0.1				1400				0.005	
Dioxins and furans	PCDD/PCDF	0.00		6.5E-09		4.0E-05				0.0			

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7. Main Findings and Recommendations

An AQIA was conducted for Neoserve as part of an EIA and new AEL application process for their proposed tyre pyrolysis plant. The main objective of the AQIA was to determine the potential impact of associated with the operational activities at the proposed plant on ambient air quality in terms of criteria air pollutants and other non-criteria air pollutants, which include hydrogen halides, metals, NH_3, dioxins and furans and TOCs. The pollutants assessed in this study were chosen based on pollutants given under sub-category 8.1 (thermal treatment of general and hazardous waste) applicable to the project.

7.1. Main Findings

In studying the receiving environment, the following was found:

- Air Quality Sensitive Receptors (AQSRs) in the project area include urban residential areas, educational facilities, clinics and hospitals. Residential areas within a 20 km radius of the study area include Silverfields, Mindalore and Princess to the north-east, Witpoortje 2451Q, Florida Park, Grobler Park and Roodepoort West to the east, and Witpoortjie to the south-east. In addition, the Tshepisong, Kagiso and Sinqobile townships are located south, south-west and north-west of the proposed plant. The town of Krugersdorp is located over 5 km from the site, towards the north.
- The proposed plant is located within an industrial area. The R28, R24, and R41 provincial roads run adjacent to the proposed plant, to the west, north and south, respectively.
- The land use surrounding the proposed plant includes urban built up, commercial, residential, and industrial properties, as well as natural vegetation, grassland, mining areas and informal settlements, with waterbodies/wetlands also located in surrounding areas. The larger area surrounding the proposed plant has rural characteristics.
- Existing key sources of pollution surrounding the proposed plant include urban industrial activities, mining activities, vehicle emissions and solid fuel combustion in nearby urban informal settlements and townships. Waste and resource dumps (i.e. mine tailings) associated with mining activities are additional sources of atmospheric emissions in the area, through wind erosion, and are located north-west and south of the proposed plant.
- Based on MM5 meteorological data obtained from Lakes Environmental for the period January 2019 – December 2021, the area is affected by frequent northerly, north-northeasterly and north-northwesterly winds. Long term air quality impacts are, therefore, expected to be the most significant to the south, south-southwest and south-southeast of operations at the proposed plant.
- The air quality status quo at any project site is usually determined using available monitoring data available from permanent ambient air quality monitoring stations and dustfall networks operated near the project site, which is accessible via the South African Air Quality Information System (SAAQIS) website. The nearest Air Quality Monitoring Station (AQMS) to the proposed plant is the Davidsonville AQMS, which is located ~4.6km east of the proposed plant. However, this AQMS seems to be non-operational as there was no ambient air quality data recorded for any of the criteria air pollutants for the past several years. In addition, there are no known dustfall networks in the area. Thus, the air quality status quo at the project site could not be determined in this AQIA.
- Despite the limitation mentioned above (i.e. the lack of background air quality data for the project site), it is noted that the proposed pyrolysis plant, as planned, is not expected to be a major source of incremental particulate, metal and gaseous emissions at the project site due to the inclusion of a smoke/water scrubber in its design.

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- The proposed plant is not expected to be a major source of incremental particulate, gaseous or metal emissions at the project site if it is operated at or below the MES for sub-category 8.1.

The main findings of the impact assessment are as follows:

- The key emitting activities at the proposed plant are the pyrolysis reactors, which result in the emission of criteria air pollutants (PM, SO_2, CO and NO_2) and several non-criteria air pollutants (HF, NH_3, TOCs, HCl, etc), which have an impact on ambient air quality.
- One point source, i.e. proposed pyrolysis stack, which triggers sub-category 8.1 (thermal treatment of general and hazardous waste) in terms of S21 of National Environmental Management Air Quality Act (No. 39 of 2004) (NEM: AQA), was the focus of this assessment.
- PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO, HF, HCl, metals, NH_3 and TOCs emission rates from the proposed pyrolysis reactor operations were quantified through an emissions inventory for input into the model. Emission rates were generally low for all pollutants, except NO_2 (i.e. less than 0.1 g/s).
- One scenario was considered in the assessment:
    - New plant standard scenario: where the MES for the proposed plant, i.e. the maximum threshold limit that is allowed for new plants (in terms of PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO, HF, HCl, metals (Cd-Tl, Hg, sum of Pb+ As + Sb +Cr + Co + Cu + Mn + Ni + V), NH_3, dioxins and furans, and TOCs) as per listed activity sub-category 8.1 (thermal treatment of general and hazardous waste) was considered for input into the model.
        - This is representative of potential impacts if the proposed plant were emitting at the acceptable threshold that is permissible for sub-category 8.1 (thermal treatment of general and hazardous waste). The emission standards were converted into emission rates for input into the model.
- Simulated PM_{10} and $PM_{2.5}$ concentrations are well below the NAAQS in both the long and short term.
- Simulated short and long-term gaseous concentrations (NO_2, SO_2 and CO) are low and compliant with the relevant NAAQS.
- Simulated short-term HF, HCl and NH_3 concentrations are well below the relevant Alberta Air Quality Guidelines of 4.9 $\mu g/m^3$, 75 $\mu g/m^3$and 1 400 $\mu g/m^3$, respectively.
- Simulated short-term TOC, dioxins and furans and metal concentrations are well below the assessment criteria within the facility boundary, as well as at offsite locations, thus complying with the applicable international standards and guidelines. Furthermore, simulated TOC concentrations are well below the South African NAAQS for benzene in the long-term.
- Simulated emission levels at all AQSRs modelled in the study (as described in Section 5.1) are low, with no exceedances of the applicable NAAQS, or international standards observed, where applicable.
- Other open-air fugitive emission sources such as vehicle dust entrainment on access roads leading to the plant, as well as the handling of carbon black are also identified as possible sources of emissions at the site. The handling of carbon black will occur intermittently and will be conducted under roof, thus containing any fugitive emissions associated with the handling process within the plant building. Furthermore, the access roads leading to the plant are all paved, thus significantly reducing vehicle dust entrainment due to movement of trucks on these roads. Thus, fugitive emissions from these sources were assumed to be minimal and not included in this assessment Nonetheless, effective and affordable fugitive emission reduction measures should be implemented, where possible and applicable, to reduce the impact of these sources.

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7.2. Recommendations

There are currently no mitigation measures (specifically relating to pyrolysis reactors) in place at Neoserve as it is a proposed facility. However, a stack as well as gas and smoke purifying systems (i.e. a gas scrubbing system and a smoke/water scrubbing system), with a spraying tower and an absorption tower, are planned to be installed for the operational phase, prior to commencement of operations at the proposed plant. The expected pyrolysis stack height is 15m above ground level. Additionally, the handling of carbon black – a by-product from the pyrolysis process, will be undertaken inside the enclosed plant building, which will contain all potential fugitive emissions associated with the material handling within the building.

Emissions at the proposed plant should be maintained at or below the MES limits as far as possible. Nonetheless, should the proposed plant ever reach the MES limits, the impact of the two pyrolysis reactors is still predicted to be low inside and beyond the facility boundary for all pollutants. Once the proposed plant is operational, it is advised that Neoserve conduct emissions monitoring on the pyrolysis stack for the relevant listed activity (sub-category 8.1) and ensure that monitoring is undertaken in accordance with nationally or internationally acceptable methods on an annual basis, unless a different monitoring frequency is specified in the PAEL.

Once the proposed plant is operational, it is also advised that Neoserve have process equipment (including emission control equipment) maintenance plans in place for all the equipment on site. Furthermore, it is recommended that the carbon black discharge bin, located inside the plant building, be fully enclosed to ensure minimum fugitive dust releases within the building. Effective and affordable fugitive emission reduction measures should be investigated and implemented, where possible and applicable, to reduce the impact of any fugitive emission sources (e.g. carbon black handling) at the site.

Once the PAEL for the proposed plant has been issued, it is recommended that Neoserve ensure compliance with the PAEL by implementing the measures provided in Table 7-1.

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Table 7-1: Summary of Recommendations and Monitoring Requirements to ensure AEL Compliance.

Recommendations	Reporting Requirements to authority	Reporting Frequency to authority *(unless otherwise stated in AEL)*
Appoint a responsible person, such as an emission control officer or safety, health & environmental manager, to ensure compliance with the PAEL. This person should be responsible for the following: • Ensure compliance with all AEL conditions; • implementation of all mitigation measures; • compilation and/or storage of relevant documents (such as maintenance checklists, complaints register, etc.). These documents should be readily available in the event of a site inspection; • submitting all required reports (e.g. annual AEL report, stack monitoring reports, etc.); • submitting a summary of complaints (monthly); • Notifying the relevant licensing authority when needed; Undertake/facilitate training for key personnel/contractors or staff to ensure compliance with the internal management plans and AEL conditions.	n/a	n/a
Submit an application to the relevant licensing authority, should any changes be required. The application should be submitted to the relevant licensing authority prior to the changes being made. Any changes to the following will require approval: • Production processes • Production increases • Ownership • Contact details • Type and quantities of input materials • Type and quantities of products • Production equipment • Treatment facilities • Building, plant, site layout or site of works	A renewal/variation/transfer AEL application. Should any changes to the proposed plant occur in the future, Neoserve would need to assess whether an EA is required for any of the proposed changes. An EA, if required, must be obtained prior to any changes being made and the submission of an AEL application.	A renewal/variation/transfer AEL application must be submitted to the authority prior to any potential changes being made. Need to allow at least 90 days for approval in terms of AEL and 6-12 months for an EA (if required).

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Conduct stack emissions monitoring on all stacks for the relevant listed activities and ensure compliance with the MES, with the use of abatement equipment, if required. Ensure that monitoring is undertaken in accordance with nationally or internationally acceptable methods. Ensure proper disposal of abatement equipment waste from the gas and smoke purifying systems (i.e. a gas scrubbing system and a smoke/water scrubbing system), (e.g. sludge, dust, etc) using an approved waste disposal service provider.	Stack emissions monitoring report for each stack (i.e. pyrolysis reactor stack). Abatement equipment waste disposal register and waste disposal certificates should be kept for any waste generated.	Stack monitoring reports required annually (unless otherwise stated in the PAEL) Waste disposal certificates and register should be updated and submitted to the licencing authority when required.
Emissions from all activities associated with the listed activities must be properly extracted and mitigated with appropriate abatement equipment. No leakage of emissions (i.e. from stacks, scrubber units, etc) should occur on site.	Extraction system design and abatement equipment specifications.	As required by the licencing authority **should be kept up to date.
Ensure that all unit processes & apparatus used for undertaking the listed activities in question, and all appliances and mitigation measures for preventing or reducing emissions, are at all times properly maintained and operated.	Maintenance plan Maintenance checklists Vehicle service records	Checklists should be compiled as required: daily/weekly/monthly/quarterly/annually Checklists should be submitted to the licencing authority as required. **maintenance should be carried out as per the requirements in the maintenance plan.*
Submit an annual AEL report within the required timeframe. This report should include: • Compliance audit report; • Summary of major upgrades; • Pollutant monitoring trends; • GHG emissions; • Summary of complaints; • Any other required documentation.	Annual AEL Report AEL compliance audit reports	Annually (unless otherwise stated in the AEL)
Maintain and report monthly to the authority a complaint register. Should a complaint be logged, a report in the required format as per the PAEL, should be submitted to the authority.	Complaint register Complaint investigation report	Complaint register to be reported monthly Complaint investigation report to be submitted if a complaint is received.
Register and report on the NAEIS. Category A (listed activities) are required to report their emissions on the NAEIS annually. The NAEIS is a national emissions inventory.	NAEIS online submission	Annually: from January – March of each year

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An Environmental Management Programme (EMPr) will be compiled for the proposed plant as part of the EIA. All recommendations and conditions contained within the EMPr must be implemented and complied with.	EMPr checklists EMPr compliance audit	As required (checklists) Annually (unless otherwise specified)

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8. IMPACT SIGNIFICANCE

8.1. Impact Assessment Methodology

8.1.1. Determination of Significance of Impacts

Significance is calculated by a synthesis of effect characteristics that include an impact's meaning and severity. Context refers to the regional scale, i.e. location, local, national or global, while intensity is characterized by the severity of the effect, e.g. the degree of variance from background conditions, the size of the affected area, the length of the impact and the overall likelihood.

Significance is an indicator of the importance of the effect, both in terms of physical scale and time scale, and thus demonstrates the degree of mitigation required. For each impact, the total number of points scored shows the extent of the impact's importance. Significance is calculated as shown in Table 8-2 below.

8.1.2. Impact Rating System

Impact assessment must take into account the nature, scale and length of environmental impacts, whether they are positive (beneficial) or negative (negative) or not (detrimental). Each impact is also assessed according to the project stages:

- Operation
- Decommissioning

The proposal for mitigation or optimization of an effect is specific, where appropriate. It also includes a brief discussion of the effect and the reasoning behind the evaluation of its importance.

8.1.3. Rating System Used to Classify Impacts

The following rating system is applicable to the possible effects on the receiving environment and contains an objective impact mitigation assessment. Impacts were combined into one ranking. In assessing the significance of each issue, the following criteria including an allocated point system is used:

Table 8-1: Description of parameters used to determine impact significance.

NATURE		
A brief overview of the effects of the environmental parameters being evaluated in the context of the project is included. This criteria requires a short written statement of the environmental factor that a specific action or behaviour affects.		
GEOGRAPHICAL EXTENT		
This is described as the region over which the effect is transmitted. The magnitude and significance of an effect usually have distinct scales and grouping ranges are often needed. This is also useful in the thorough evaluation of a project in order to better define it.		
1	Site	The impact only affects the site.
2	Local/district	Have affect the local area or district.
3	Province/region	Have affect the entire province or region.
4	International and National	Have affect the entire country.
PROBABILITY		
This describes the chance of occurrence of an impact.		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact is likely occurring (Between a 50% to 75% chance of occurrence).
4	Definite	Impact certainly occurs (Greater than a 75% chance of occurrence).
REVERSIBILITY		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		

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1	Completely reversible	The impact is reversible with implementation of minor mitigation measures.
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources are irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact does not result in the loss of any resources.
2	Marginal loss of resource	The impact results in marginal loss of resources.
3	Significant loss of resources	The impact results in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible Cumulative Impact	The impact would result in negligible to no cumulative effects.
2	Low Cumulative Impact	The impact would result in insignificant cumulative effects.
3	Medium Cumulative impact	The impact would result in minor cumulative effects.
4	High Cumulative Impact	The impact would result in significant cumulative effects.
INTENSITY/ MAGNITUDE		
Describes the severity of an impact.		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/ component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.

Table 8-2: Significance calculation and ratings.

SIGNIFICANCE			
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula: SIGNIFICANCE = (Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity. The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.			
Points	Impact Type	Impact Significance Rating	Description

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>-90	Negative	Negative Very High Impact	The impact have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
-61 to -90	Negative	Negative High Impact	The impact have significant effects and requires significant mitigation measures to achieve an acceptable level of impact.
-31 to -60	Negative	Negative Medium Impact	The impact have moderate negative effects and requires moderate mitigation measures.
-1 to -30	Negative	Negative Low Impact	The impact have negligible negative effects and requires little to no mitigation.
0	Neutral	Positive Medium Impact	The impact have moderate positive effects.
1 to 30	Positive	Positive Low Impact	The impact have minor positive effects.
31 to 60	Positive	Positive Medium Impact	The impact have moderate positive effects.
61 to 90	Positive	Positive High Impact	The impact have significant positive effects.
>90	Positive	Positive Very High Impact	The impact have highly significant positive effects.

Table 8-3: Rating of impacts for modelled scenario – new plant standard scenario.

IMPACT TABLE FORMAT			
	Description	Before Mitigation	After Mitigation
Air Quality	*Air Quality will likely be impacted by the pyrolysis reactor operations at the proposed Neoserve pyrolysis plant, through the emission of criteria and non-criteria air pollutants from reactor operations into the atmosphere. However, a gas scrubber and a smoke/water scrubber will be in place to clean gaseous and particulate emissions before they are released into the atmosphere.*		
Extent (Ex)	*The impact will likely occur and will affect the local area. With implementation of additional, suitable mitigation measures, the impact can be reduced to only affect the project site (i.e. proposed plant area).*	2	1
Probability (Pr)	*Probability of the impact occurring, considering proposed mitigation measures, is probable, but can be reduced to possible with maintenance and servicing of all process equipment, including the proposed abatement equipment, suitable mitigation measures.*	3	2
Reversibility (Re)	*Air quality will likely be impacted by the proposed operations at the pyrolysis plant. However, the impact will be partly reversible with the implementation of proposed mitigation measures. The impact will likely cease upon cessation of operations at Neoserve.*	2	2
Irreplaceable loss of resources (L)	*The impact will likely result in marginal loss of resources.*	2	2
Duration	*The impact of proposed tyre pyrolysis operations at Neoserve on air quality will last for the operational lifecycle of the facility but can be mitigated by human action.*	3	3
Cumulative effect (CE)	*The cumulative impact of the proposed pyrolysis plant operations on air quality will be moderate to low, since the project site is in a non-air quality priority area. Furthermore, the proposed pyrolysis plant, as planned, is not expected to be a major source of incremental pollutant emissions at the project site due to the inclusion of a smoke/water scrubber in its design. Thus, the impact will result in low to medium cumulative effects.*	3	2
Intensity/magnitude (M)	*The impact can alter the functionality or quality of air temporarily, in a way that is barely perceptible, for the duration of the listed activity.*	1	1
Significance Rating	*Negative Low Impact*	-15	-12

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		(Negative Low Impact)	(Negative Low Impact)
Mitigation measures	*Mitigation measures that can be implemented to reduce the impact of pyrolysis reactor operations on air quality are outlined in Section 7.2. These include the installation of extraction systems and stacks, where applicable, and abatement equipment, if required, which will minimise the level of ground level air pollutants; compliance with the MES for sub-category 8.1 (thermal treatment of general and hazardous waste); and compliance to provisional AEL requirements.* *It must be noted that a stack as well as gas and smoke purifying systems (i.e. a gas scrubbing system and a smoke/water scrubbing system), with a spraying tower and an absorption tower are planned to be installed at the proposed plant prior to commencement of operations. The expected stack height is ~15 m above ground level.*		

The significance of the air quality impacts on AQSRs for the new plant standard scenario, which is representative of the proposed pyrolysis reactors emitting at the acceptable thresholds that are permissible for sub-category 8.1 (thermal treatment of general and hazardous waste) was found to be low with mitigation. Emissions at the proposed plant should be maintained at or below the MES limits as far as possible. Nonetheless, should the proposed plant ever reach the MES limits, the impact of the two pyrolysis reactors is still predicted to be low inside and beyond the facility boundary for all pollutants.

The "no-go alternative", which is the option of not fulfilling the proposed project, would result in zero gaseous and particulate emissions being emitted into the air, and thus high positive impacts, with no air quality impacts from the proposed plant on the site or surrounding local area.

9. REFERENCES

AIRSHED Planning Professionals (Pty) Ltd (2017) Air Quality Impact Assessment Report for the proposed expansion project at Dundee Precious Metals, Report No.17SLR16.

AIRSHED Planning Professionals (Pty) Ltd (2019): Air Quality Impact Assessment Report for the Tambarare Pyrolysis Plant.

Alberta Government, 2019: Alberta Ambient Air Quality Objectives and Guidelines Summary, AEP, Air Policy, 2016, No. 2, pg 1-6.

Agency for Toxic Substances and Disease Registry (2004) Public Health Statement Ammonia, https://www.atsdr.cdc.gov/ToxProfiles/tp126-c1-b.pdf
Accessed: 25 November 2019

Agency for Toxic Substances and Disease Registry (2014) Medical Management, Guidelines for Hydrogen Chloride, https://www.atsdr.cdc.gov/MHMI/mmg173.pdf
Accessed: 20 November 2019

Agency for Toxic Substances and Disease Registry (2014) Medical Management Guidelines for Hydrogen Fluoride, https://www.atsdr.cdc.gov/mhmi/mmg11.pdf
Accessed: 22 November 2019

Bridges, O., Bridges, J.W. & Potter, J.F., 2000. The Environmentalist 20: 325. doi:10.1023/A:1006725932558.

Environmental Edge
2016/408248/07
info@environmentaledge.co.za 3 Alice Lane, Sandton, 2196 +27 10 442 9429

Centre for Disease Control and Prevention (2018) Facts About Chlorine
https://emergency.cdc.gov/agent/chlorine/basics/facts.asp
Accessed: 25 November 2019

Centre for Disease Control and Prevention (2018) Facts About Hydrogen Fluoride (Hydrofluoric Acid), https://emergency.cdc.gov/agent/hydrofluoricacid/basics/facts.asp
Accessed: 22 November 2019

Cointreau, S., 2006. Occupational and Environmental Health Issues of Solid Waste Management. Special Emphasis on Middle- and Lower-Income Countries. The World Bank Group, Urban Papers. UP-2 July 2006, Washington, D.C.

CERC. (2004). ADMS Urban Training. Version 2. Unit A.

Department of Environmental Affairs (2004) National Environmental Management: Air Quality Act (Act No. 39 of 2004), Gazette No. 27318, No. R 163

Department of Environmental Affairs (2009) National Ambient Air Quality Standards, Gazette No. 32816, No. R 1210, in terms of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) section 53(0), No. R 827

Department of Environmental Affairs (2012) National Ambient Air Quality Standards for Particulate Matter with Aerodynamic Diameter less than 2.5 Micron Metres, Gazette No. 35463, No. R 486, in terms of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) section 53(0), No R. 827

Department of Environmental Affairs (2013) Listed Activities which Results in Atmospheric Emissions, Gazette No. 37054, No. R 893, in terms of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) section 53(0), No. R 827

Department of Environmental Affairs (2013) Declaration of a Small Boiler as a Controlled Emitter and Establishment of Emission Standards, Gazette No. 36973, No. R 831, in terms of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) section 53(0), No. R 827

Department of Environmental Affairs (2013) National Dust Control Regulations, in terms of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) section 53(0), No R. 827

Department of Environmental Affairs (2014) Regulations Regarding Air Dispersion Modelling (Code of Practice for Air Dispersion Modelling in Air Quality Management in South Africa), Gazette No. 37804, No. R 533, in terms of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) section 53(0), No R. 827

Department of Environmental Affairs (2015) National Atmospheric Emission Reporting Regulations, Gazette No. 38633, No. R. 283, in terms of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) section 53(0), No R. 827

Environmental Edge
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3 Alice Lane, Sandton, 2196
+27 10 442 9429

Department of Environmental Affairs (2018) Draft National Dust Control Regulations, Gazette No. 41650, No. R. 517, in terms of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) section 53(0), No R. 827

Duarte-Davidson, R., Courage, C., Rushton, L. and Levy, L., 2001. Benzene in the environment: an assessment of the potential risks to the health of the population. Occupational and environmental medicine, 58(1), pp.2-13.

Environmental Protection Agency (1994) Health Assessment Document for Chlorine and Hydrogen Chloride. External Review Draft. ECAO-R-065. Environmental Criteria and Assessment Office, Research Triangle Park, NC.

Environmental Protection Agency (2000) Hydrochloric Acid (Hydrogen Chloride), https://www.epa.gov/sites/production/files/2016-09/documents/hydrochloric-acid.pdf
Accessed: 20 November 2019

Environmental Protection Agency (2016) Hydrogen Fluoride (Hydrofluoric Acid) https://www.epa.gov/sites/production/files/2016-10/documents/hydrogen-fluoride.pdf
Accessed: 22 November 2019

Fenger, J. (2000) Urban air quality, In J. Austin, P. Brimblecombe and W. Sturges (eds), Air pollution science for the 21st century, Elsevier, Oxford.

Harrison, R.M. and R.E. van Grieken (1998) Atmospheric Aerosols. John Wiley: Great Britain.

Perry, S.G., Cimorelli, A.J., Paine, R.J., Brode, R.W., Weil, J.C., Venkatram, A., Wilson, R.B., Lee, R.F., and Peters, W.D. (2004) AERMOD: A Dispersion Model for Industrial Source Applications. Part II: Model Performance against 17 Field Study Databases, Journal of Applied Meteorology, 44.

Strategic Environmental Focus (2010): Draft Air Quality Management Plan for the West Rand District Municipality.

Tiwary, A., & Colls, J. (2010). Air pollution: measurement, monitoring and mitigation (3rd Edition ed.). Oxon: Routledge.

Vitousek, P.M., Chair, J.A., Howarth, R.W., Likens, G.E., Matson, P.A., Schindler, D.W., Schlesinger, W.H. and Tilman, G.D. (1997) Human Alteration of the Global Nitrogen Cycle: Causes and Consequences. Issues in Ecology, Vol.1 https://cfpub.epa.gov/watertrain/pdf/issue1.pdf Accessed: 26 November 2019

Vrijheid, M., 2000. Risk of congenital anomaly in relation to residence near hazardous waste landfill sites. PhD thesis, London School of Hygiene & Tropical Medicine. DOI: 10.17037/PUBS.00682274.

World Health Organization, WHO Air Quality Guidelines for Europe, 2nd edition, WHO Regional Office for Europe (2000) Copenhagen, Denmark (WHO Regional Publications, European Series, No 91).

World Health Organisation (WHO) (2003) Ammonia in Drinking-water: Background document for development of WHO Guidelines for Drinking-water Quality. https://www.who.int/water_sanitation_health/dwq/ammonia.pdf
Accessed: 25 November 2019

Zanokuhle Environmental Services (2013): Mogale City Local Municipality - Draft Baseline Assessment Report.

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