Eskom Holdings SOC Limited

ESKOM MINIMUM EMISSION STANDARDS EXEMPTION APPLICATION FOR MATIMBA STATION

December 2024

MATIMBA POWER STATION
DECEMBER 2024

PUBLIC

Eskom Holdings SOC Limited

ESKOM MINIMUM EMISSION STANDARDS EXEMPTION APPLICATION FOR MATIMBA STATION

December 2024

REPORT (DRAFT) PUBLIC

PROJECT NO. 41107109
OUR REF. NO. MATIMBA POWER STATION

DATE: DECEMBER 2024

WSP

Building 1, Maxwell Office Park
Magwa Crescent West, Waterfall City
Midrand, 1685
South Africa

Phone: +27 11 361 1300

WSP.com

QUALITY CONTROL

Issue/revision	First issue	Revision 1
Remarks	Draft Matimba Exemption Report	Final Report – Ministerial Submission
Date	November 2024	10 December 2024
Prepared by	Aiden Stoop Tshepho Mamashela Sihle Dambuza Keenan Seafield Amber Thompson Brian Magongoa Steve Horak David de Waal	B. Keiser
Checked by	Cândida Boavida Anri Scheepers Jared Lodder	A. Scheepers
Signature		Digitally signed by Scheepers, Anri (ZAAS02690) DN: cn=Scheepers, Anri (ZAAS02690), ou=Active, email=Anri.Scheepers@wsp.com Date: 2024.12.10 21:59:49 +02'00'
Authorised by	Brad Keiser	B. Keiser
Signature		Bradley.Keiser@wsp.com 2024.12.10 22:27:43 +02'00'
Project number	41107109	41107109
Report number	7 of 9	7 of 9
File reference	\\corp.pbwan.net\za\Central_Data\Projects\41100xxx\41107109 - ESKOM MES EXEMPTION APPLICATIONS\41 EPA	

INDEX AND REPORT STRUCTURE

CHAPTER	SUB-SECTION	PAGE	CONTENT DESCRIPTION
Executive Summary	N/A	1 – 8	Provides overview of report contents, highlighting key findings, motivations, and exemptions requested.
Ch. 1: Introduction	N/A	9 – 12	Provides introduction to the exemption application report with an overview of the history leading to Eskom submitting this application.
Ch. 2: Station Background	N/A	12 – 15	Provides background to the station, such as generation capacity, location and description of surrounding environment.
Ch. 3: Legal Overview	All	16 – 24	Provides overview of the applicable regulations, ambient standards, Priority Area's, and climate change policy overview.
Ch. 4: Just Energy Transition and Repurposing Plans	All	24 – 28	Provides overview of South Africa's challenges, Eskom's Just Energy Strategy and Repowering and Repurposing plans.
Ch. 5: Eskom Emission Reduction Plan	5.1. Eskom Journey and Overview	29 – 32	Introduces Eskom's Emission Reduction Plans (ERPs), highlighting existing abatement equipment, key emission reduction projects, and timelines to achieve these, as well as discussing the Eskom's Despatch Prioritisation Initiative.
	5.2. Power Station	32 – 40	Describes the relevant power station's current emissions performance, planned emission reduction projects and timelines, the fleet-wide emission trajectory, costs to reach MES compliance, and the requested emission limits for the relevant power station.
	5.3. Eskom Air Quality Offsets	40 - 43	Presents Eskom's Air Quality Offset Programme.
	5.4. National Electricity Supply Issues	44	Discusses challenges facing South Africa's electricity sector, highlighting impacts associated with reduced Security of Supply.
Ch. 6: Health & Environmental Impacts Quality Impacts	6.1. Air Quality Impacts	45 – 50	Presents ambient air quality monitoring data for the region and dispersion modelling predictions for the various scenarios assessed.
	6.2. Health Impacts	51 – 52	Highlights health impacts associated with power station emissions.
	6.3. Water	52 – 54	Highlights water supply considerations for abatement equipment being considered.
	6.4. Waste	54 – 55	Highlights waste considerations for abatement equipment being considered.
	6.5. Climate Change	55 – 57	Presents Eskom's anticipated carbon dioxide emissions trajectory and the impact on this from the SO_2 abatement technology being considered.
Ch. 7: Financial Consequences	7.1. Financial Costs	57 – 60	Presents the financial costs associated with each of the Eskom ERPs, as well as potential impacts on electricity tariffs.
	7.2. Health Benefit Cost Analysis	60 – 64	Presents the findings of the Health Cost Benefit Analysis undertaken for the applications.

CHAPTER	SUB-SECTION	PAGE	CONTENT DESCRIPTION
	7.3. Socio-Economic Impacts	64 – 67	Highlights socio-economic impacts.
Ch. 8: Stakeholder Engagement	All	67 – 70	Presents the stakeholder engagement process followed, including methods of notification and meeting dates and venues.
Ch. 9: Assumptions and Limitations	N/A	70 – 71	Presents the assumption and limitations applicable to the application.
Appendix A	N/A	N/A	Power station specific Atmospheric Impact Report
Appendix B	N/A	N/A	Cumulative airshed Atmospheric Impact Report
Appendix C	N/A	N/A	Cumulative stack only emissions dispersion modelling results
Appendix D	N/A	N/A	Airshed Health Cost Benefit Analysis

ACRONYMS AND ABBREVIATIONS

Acronym/Abbreviation	Definition
AEL	Atmospheric Emissions Licence
AOA	Annual Operational Analyses
AP-HRA	Air pollution health risk assessments
APHR-BCA	Air Pollution Health Risk Benefit Cost Analysis
AQMP	Air Quality Management Plan
AQO	Air Quality Offsets
ARM	Air Resource Management
BAT	Best Available Technology
BCA	Benefit-cost analysis
BPFS	Biodiversity Plan Free State Province
BU	Business Units
CAPEX	Capital Expenditure
CRA	Concept Release Approval
CV	Calorific value
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
DHP	Dust Handling Plant
DSI	Dry Sorbent Injection
DWS	Department of Water and Sanitation
EAF	Energy Availability Factors
EIA	Environmental Impact Assessment
ERF	Exposure-response functions
ERI	Eskom Rotek Industries
ERP	Emission Reduction Plan
ESA	Ecological Support Area
EWE	Extreme Weather Events
FDDM	Fezile Dabi District Municipality
FEPA	Freshwater Ecosystem Priority Areas
FGD	Flue Gas Desulphurisation
GBV	Gender-Based Violence
GCD	Group Capital Department
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GHGP	Greenhouse Gas Protocol
GVA	Gross Value Added
HFPS	High Frequency Power Supplies

Acronym/Abbreviation	Definition
I&AP	Interested and Affected Parties
IDP	Integrated Development Plan
IPCC	Intergovernmental Panel on Climate Change
IPPs	Independent Power Producers
IRP	Integrated Resource Plan
IVRSv	Integrated Vaal River System
LCOE	Levelised cost of electricity
JET	Just Energy Transition
LNB	Low NO_X burner
LPG	Liquid Petroleum Gas
MES	Minimum Emission Standards
MLM	Metsimaholo Local Municipality
Mt	Megatonnes
NAAQS	National Ambient Air Quality Standards
NAQO	National Air Quality Officer
NCCAS	National Climate Change Adaptation Strategy
NCCRP	National Policies such as the Climate Change Response
NDC	Nationally Determined Contribution
NDP	National Development Plan
NECA	National Environmental Consultative and Advisory
NECOM	National Energy Crisis Committee of Ministers
NEMAQUA	National Environmental Management: Air Quality Act
NERSA	National Energy Regulator of South Africa
NGER	National Greenhouse Gas Emission Reporting
NOx	Nitrogen Oxides
NPV	Net Present Value
NWA	National Water Act (No. 36 of 1998)
OEMs	Original Equipment Manufacturers
OFA	Over-fire Air
OIP	Offset Intervention Plan
Opex	Operating Expenditure
PCD	Pollution Control Dam
PF	Pulverised fuel
PJFF	Pulse Jet Fabric Filter
PM	Particulate Matter
PMV	Planning, Monitoring and Verification
PPE	Personal Protective Equipment
PV	Photovoltaic
RR	Relative Risk

Acronym/Abbreviation	Definition
R&R	Repowering and Repurposing
ROI	Return on investment
SAPS	South African Police Service
SAWS	South African Weather Services
SCR	Selective Catalytic Reduction
SO_2	Sulphur dioxide
SPF	Spray Polyurethane Foam
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
VOC	Volatile Organic Compounds
VRESS	Vaal River Eastern Sub-system
VSL	Value of a statistical life
VTAPA	Vaal Triangle Airshed Priority Area
WBCSD	World Business Council for Sustainable Development
WCWDM	Water Conservation and Water Demand Measures
WHO	World Health Organisation
WMO	World Meteorological Organisation
WRI	World Resources Institute
WTP	Willingness to Pay

CONTENTS

TABLES

FIGURES

APPENDICES

APPENDIX D

HEALTH COST BENEFIT ANALYSIS

EXECUTIVE SUMMARY

Eskom Holdings SOC Ltd (Eskom) is South Africa's public electricity utility, supplying about 95% of the country's electricity with a generation capacity exceeding 35,000 MW. Around 90% of its power comes from coal-fired stations, primarily located in the Mpumalanga Highveld, with others in the Free State and Limpopo provinces.

Coal-fired power stations must comply with strict environmental regulations under the National Environmental Management: Air Quality Act (NEM:AQA). Eskom sought postponements and alternative limits to the Minimum Emission Standards (MES) for oxides of nitrogen (NO_X), sulphur dioxide (SO_2) and particulate matter (PM) between 2018 and 2020. These applications were necessary due to several factors, such as the restrictive legal framework, the advanced age of Eskom's power plant fleet, and the technical challenges of reducing emissions. The high costs of emission reduction technologies, which could significantly impact electricity tariffs and the financial stability of the utility, further underscored the need for a phased approach to compliance.

In October 2021, the Department of Forestry, Fisheries, and the Environment (DFFE) granted conditional postponements for some power stations (Grootvlei, Arnot, Komati, Camden, Hendrina, Acacia, and Port Rex Power Stations), provided partial refusals for others (Majuba, Tutuka, Kendal, and Kriel), and rejected the applications for Lethabo, Matla, Medupi, Matimba, and Duvha.

In December 2021 Eskom initiated an appeal process, engaging with the DFFE, and other governmental departments, on the basis that immediate compliance would lead to the shutdown of about 16,000 MW of coal-fired capacity. Eskom emphasised that this would negatively impact the national grid and delay South Africa's energy transition, that flu gas desulphurisation (FGD) retrofit on "six-pack" power stations was not proven to be technically feasible and would be a world first, and that if funding was available to execute the required compliance projects in time to meet the MES, this would result in an approximate increase of 10% on existing electricity tariffs (Eskom, 2020).

In May 2024, the Minister approved the MES suspensions for the power stations set to shut down by 31 March 2030 (Hendrina, Grootvlei, Arnot, Camden, and Kriel) and, under Section 59 of NEM:AQA, instructed Eskom to apply for MES exemptions for the remaining stations (Lethabo, Kendal, Tutuka, Matla, Duvha, Majuba, Matimba, and Medupi). The Minister would then assess each application based on its merits and supporting information.

This report details the exemption application for the Matimba Power Station, highlighting the specific environmental and operational challenges it faces. While the primary focus is on Matimba, the report also addresses broader issues affecting the entire Eskom Fleet. This holistic approach is necessary as a particular station's circumstances cannot be considered in isolation of the entire Eskom Fleet as station performance, emissions impacts, and financial impacts need to be considered cumulatively. By considering the entire Eskom fleet, the report aims to provide a cohesive strategy for achieving compliance while addressing the unique challenges of each power station.

South Africa faces the complex challenge of ensuring energy security, affordability and access, and sustainability, compounded by high unemployment, inequality, unreliable power generation, and reliance on coal. Eskom's Just Energy Transition (JET) Strategy was developed to address these issues. As Eskom's coal plants near the end of their operational life, there is a risk of declining living standards and local community well-being if no action is taken. The JET Strategy aims to develop new energy capacity while ensuring that power station communities benefit from the transition, thus linking the need for new energy sources with socio-economic improvements.

This dual focus forms the core of Eskom's ambition to achieve a just and equitable energy transition. This involves a gradual shift to renewable energy, aligning with South Africa's broader climate goals and global efforts to mitigate climate change. The development of a renewables-dominant power system aims to create jobs and stimulate economic growth, ensuring that communities reliant on coal power plants benefit from the transition. Eskom has identified repowering and repurposing projects as key components of the JET strategy to preserve jobs and utilize existing grid capacity. Prioritizing power stations in Mpumalanga, these projects will leverage existing infrastructure to build new generation capacity, including solar, wind, batteries, and synchronous condensers. Additionally, the plants will be repurposed into new economic centres with training centres, water treatment facilities, manufacturing plants, microgrid assemblies, and aquaponic farms. This approach aims to retain economic activity, create jobs, and generate new economic opportunities for local communities.

Eskom has already commenced with the largest repowering and repurposing project in emerging markets at Komati, expected to have a significant impact by 2030, comprising ~600 direct full-time jobs, ~370MW of renewable generation capacity, and vocational training. Although Matimba is not currently part of Eskom's repowering and repurposing plans since its shutdown phase is intended to commence in 2037, a similar approach will be taken to identify suitable projects and plans aligned with the JET strategy.

To address emission reductions in the Eskom Fleet, Eskom developed an Emission Reduction Plan (ERP) in 2015, with this being updated in 2019 (EERP 2019), 2020 and 2022. In May 2024, as part of the Minister's decision, Eskom were required to review the 2022 ERP, with this having been revised by Eskom in 2024.

Eskom currently has abatement technologies to mitigate PM at all power stations since this is historically the pollutant of most concern considering health impacts, and boilers with Low NO_X design at Medupi, Kendal, Kusile and Camden, with SO_2 abatement technology in the form of flue-gas desulphurisation (FGD) installed at Kusile. Further, Eskom is currently taking steps to further reduce PM emissions at the stations, with several abatement equipment upgrades and refurbishments completed, and currently being undertaken, focusing on projects such as electrostatic precipitator (ESP) refurbishments, high frequency power supply (HFPS) installations, sulphur trioxide (SO_3) plant upgrades, and Dust Handling Plant (DHP) upgrades. In addition to these projects, and ensuring Eskom's commitment to emission reductions, as part of the 2024 ERP, Eskom are also planning and/or evaluating the following to reduce emissions:

- Wet flue gas desulphurisation (FGD) at Medupi (included in previous ERPs)
- Kendal (semi-dry FGD) and Majuba (Duct Sorbent Injection (DSI FGD)) SO_2 reduction projects have been identified as potential alternatives, although are being evaluated as part of this process.
- Low NO_X Burner (LNB) technology at Majuba, Tutuka and Lethabo to mitigate NO_X emissions.
- Despatch Prioritisation Strategy at specific power stations, initiated to reduce SO_2 emissions, however also positively impacting PM and NO_X emissions.
- Efficiency improvement projects under the Generation Recovery Programme to optimise the air-to-fuel ratio which should abate some SO_2 emissions and maximise combustion efficiency.
- The progressive shutdown of coal-fired stations will reduce overall Eskom Fleet emissions.
- Although not a method of reducing emissions at source (i.e. the power stations), the cumulative impact on neighbouring communities is reduced through the air quality offset (addressing emission

sources within the community) projects already implemented by Eskom, therefore Eskom are looking to expand this beyond the 35,000 households originally planned.

As noted above, Despatch Prioritisation is an ERP 2024 strategy for implementation to reduce emissions. With the integration of alternative energy sources into the national grid as per the Integrated Resource Plan (IRP), coal-fired power stations are expected to operate in a load-following mode, resulting in lower running load factors as renewable sources are prioritized. Despatch Prioritisation Strategy aims to reduce SO_2 emissions, especially in older stations, due to the high costs and complexities of installing SO_2 abatement equipment. The Generation Recovery Programme, initiated in March 2023, has improved fleet reliability, enabling better load management. Eskom plans to limit coal station loads to essential levels, using other energy sources to reduce coal consumption, and therefore emissions. However, this strategy depends on the addition of alternative generation sources to the grid. If these sources are delayed or economic growth increases demand, Eskom may be requested by government to operate stations at higher loads, potentially increasing emissions to maintain grid stability.

Key emissions of concern, and regulated by NEM:AQA, are PM, SO_2, and NO_X. The following discussions provide key highlights for each pollutant, considering details such as current performance, planned projects, Eskom Fleet emission reductions and trajectories, and Eskom's exemption request, where applicable. The Eskom Fleet emission reduction trajectories consider four scenario projections:

- ERP 2024 A (PM and NO_X reduction, Despatch Prioritisation strategy, efficiency improvements and SO_2 abatement at Medupi and Kusile), representing Eskom's planned projection.
- ERP 2024 B (As per ERP 2024 A plus SO_2 reduction technology installed at Majuba and Kendal), representing a projection, that with additional guarantees and strategic decisions, could be achieved.
- ERP 2024 C (As per ERP 2024 A and B, plus SO_2 reduction technology at Matimba, Lethabo and Tutuka), representing a projection that would require substantial guarantees and considerations of the significant financial impacts, such as on electricity tariffs.
- Eskom's Security of Supply Projection developed using conservative assumptions such as higher electricity demands due to a growing economy, a delay in IPP projects, and a delay in Kusile U6 generating unit coming online.

PARTICULATE MATTER

While the annual average PM_{10} and $PM_{2.5}$ concentrations show general compliance with the NAAQS (except at Marapong), 24-hour average concentrations are non-compliant with the NAAQS in the Waterberg area; importantly, the non-compliant ambient concentrations are not only due to Eskom emissions but comprise contributions from numerous neighbouring sources of emissions. Cumulatively the Eskom Fleet shows a significant reduction in PM stack emissions in the coming years due to the various abatement projects being implemented. Eskom's emission trajectories for the options of ERP 2024 A, ERP 2024 B, and ERP 2024 C, show identical trajectories as the same PM abatement projects are planned for each. By FY2030, these show a 65-kilo tonne (kt) reduction from FY2025, representing a 74% decrease, due to PM abatement projects implemented in the fleet and stations entering shutdown phase.

From the cumulative dispersion modelling assessing the Eskom Waterberg Fleet emissions (i.e. Medupi and Matimba), PM_{10} annual and 24-hour average concentrations are predicted to remain compliant with the NAAQS, although non-complaint annual and 24-hour average $PM_{2.5}$ concentrations are predicted. Importantly, the conservative approach to the PM simulations must be considered. The predicted ambient PM concentrations are predominantly due to the low-level fugitive sources, rather than the stack emissions themselves; the benefit of the stack emissions reductions, as evident in the trajectories, is over-shadowed by the impacts associated with fugitive emissions. This conclusion is supported by the additional dispersion modelling undertaken to assess particulate matter emissions only from the stacks, which showed full compliance with the annual and 24-hour average PM_{10} and $PM_{2.5}$ National Ambient Air Quality Standards (NAAQS), with no exceedances predicted.

While the abovementioned emission trajectories show significant improvements in the next few years, to offset Eskom PM emissions further, Eskom has introduced an air quality offset (AQO) program, a key component of Eskom's ERP. This program aims to offset PM emissions by implementing interventions that deliver net ambient air quality benefits within communities impacted by Eskom's stations, focusing on PM_{10} and $PM_{2.5}$. In the Waterberg area, interventions to date have focussed on educational initiatives, with further options being considered including introducing cleaner household energy sources, managing waste burning, reforestation, and surfacing bare public grounds. Research into Eskom's potential AQO initiatives is ongoing, focusing on interventions that reduce emissions to create the greatest positive impact in specific communities.

Considering Matimba, daily average concentrations remained below the new plant limit (50mg/Nm^3) between 2019 and 2023, with no exceedances recorded. However, since 2023, PM emissions have increased, exceeding the new plant MES (50mg/Nm^3) with exceedances recorded in FY2023/24. To address the elevated PM emissions, several projects have or will be implemented. Amongst others, key projects include resolving the breakdowns experienced at the ash handling plant (Ash Stacker), which has been completed; retrofitting high frequency power supply (HFPS) to the ESPs; and the continued execution of the SO_3 plant and DHP outage philosophy maintenance strategies that have proven to be beneficial.

While recent elevated PM emissions have occurred, these will be addressed through the maintenance philosophy, with HFPSs being installed in future, as well as the planned Despatch Prioritisation initiative to address SO_2 emissions will further reduce PM emissions. Given this, Matimba will comply with the new plant MES (50mg/Nm^3) by 1 April 2025 and is therefore not requesting exemption from the new plant PM MES.

NITROGEN DIOXIDE

Ambient nitrogen dioxide (NO_2) concentrations in the Waterberg indicate compliance with the annual and hourly NAAQS. Cumulatively, the Eskom Fleet's emission trajectory shows significant decreases, and by FY2030 would have reduced by 292kt (40%), and by a further 574kt (78%) by FY2050. These reductions are predominantly due to the LNB installations at Lethabo, Tutuka, and Majuba, as well as assumed station shutdowns commencing. The dispersion modelling, undertaken to assess each of the trajectories (ERP 2024 A, ERP 2024 B, and ERP 2024 C), shows full compliance with the NAAQS at all receptors.

Currently, Matimba is compliant with the new plant MES (750mg/Nm^3) with no exceedances recorded due to the corner-fired boilers (CFBs). Since NO_X emissions at Matimba are compliant with the new plant MES (750 mg/Nm^3), no NO_X related abatement projects are planned, although the planned Despatch Prioritisation initiative to address SO_2 emissions will further reduce NO_X emissions. Further, given this compliance, no NO_X exemption for Matimba is being requested.

SULPHUR DIOXIDE

From 2021 to 2023, SO_2 concentrations in the Waterberg complied with the annual and short-term (hourly and 24-hour) NAAQS across all monitoring stations. The Eskom Fleet trajectories show similar emissions until FY2032, when Majuba's DSI is completed, after which ERP 2024 B and ERP 2024 C reduce further. ERP 2024 C emissions are lower than ERP 2024 B in 2036, as ERP 2024 C also includes SO_2 abatement at Lethabo and Tutuka. Considering ERP 2024 A (Eskom planned option), by FY2030, a reduction of 555kt (32%) will be achieved across the fleet, with a further reduction of 165kt (14%) to FY2035. The cumulative Waterberg dispersion modelling, undertaken to assess each of these scenarios, predicted non-compliant 24-hour concentrations before completion of the Medupi FGD, although predicted compliant annual and hourly concentrations in all scenarios. Further, once the Medupi FGD is complete, model predictions showed full compliance, even with Matimba simulated without abatement.

Currently, Matimba is compliant with the existing plant limit (3,500mg/Nm^3), with no exceedances of this, although to achieve new plant MES compliance, Matimba would require an FGD, or similar abatement technology. Semi-dry FGD would be the most suitable for Matimba, however Eskom has consistently motivated in previous applications that an FGD at Matimba is not feasible and has therefore not commenced with concept and design. Furthermore, as mentioned previously, once the FGD is operational at Medupi, predicted SO_2 concentrations show compliance with the NAAQS, without an FGD at Matimba, thus further supporting that an FGD is not feasible at Matimba.

Should Matimba be required to install an FGD, installation would only commence in 2030, with a best-case completion date of 2035, with Matimba entering shutdown phase in 2039, well before return on investment is realised. Eskom maintains this position in this application; considering the costs of an FGD (R43 billion nominal Capex and R1 billion Opex annually), timeframes until installation is complete, additional water requirements (180% increase on current Matimba requirements), and the additional waste produced (904kta) requiring a new disposal facility. While CO_2 emissions will also increase due to the FGD, approximately 3.3Mt over Matimba's remaining life, this will have little impact on Eskom's 2031 target for CO_2 emissions from fossil fuel generation.

Since Matimba is unable to comply with the new plant MES without SO_2 abatement technologies, and it is not considered economically feasible to install these, to reduce SO_2 emissions, although recognising not to MES compliance, Matimba will reduce emissions through efficiency improvement projects and Despatch Prioritisation.

Matimba is currently required to comply with a SO_2 monthly average emission limit of 3,500mg/Nm^3 and required to comply with the new plant emission limit of 1,000mg/Nm^3 by 1 April 2025. Since it is not economically feasible to install an FGD at Matimba, Matimba is requesting exemption from the new plant MES (Table 0-2). Important considerations in this request include:

- The currently compliant ambient SO_2 concentrations in the Waterberg, recognising Matimba is currently contributing to these concentrations at current emission rates.
- While the dispersion modelling predicts non-compliant 24-hour ambient concentrations, both the annual and hourly average concentrations are in full compliance with the NAAQS.
- Cumulatively, the Eskom Fleet shows substantial improvements in SO_2 emissions in the coming years.
- The costs associated with the installation of FGD at Matimba, with installation completion only occurring four-years before station shutdown commences.

- Once the FGD at Medupi is installed and considering Medupi's anticipated low emissions (800mg/Nm^3) below the new plant MES, cumulatively, the Waterberg Fleet emissions will reduce, with Medupi offsetting Matimba emissions.

HEALTH COST BENEFIT ANALYSIS

While the above discussions are pollutant specific, careful consideration needs to be given to the health cost benefit analysis (CBA) undertaken for the Eskom Waterberg Fleet, which considers benefits and costs as a combination of pollutants. The CBA uses exposure-response functions (ERFs) to estimate the health benefits in terms of reduced mortality rates due to lower pollutant levels. The value of a statistical life (VSL) is applied to monetize these health benefits. The CBA assessed the implementation of various emission reduction technologies, evaluating the health benefits and costs associated with the ERP 2024 A, ERP 2024 B, and ERP 2024 C projections. The benefit:cost ratios (BCR) need to be interpreted with care. They are meant only to provide a perspective on and inform the decision-making process underlying the scenarios. They are not meant to be interpreted as a definitive answer to making abatement decisions. Decisions involving human health have to be informed by non-economic criteria as well. In addition, with uncertainty inherent in the analysis, the cost benefit ratio should thus not be viewed as absolute, but rather as a relative value from which to compare scenarios (Prime Africa Consult, 2024).

The CBA results show that for all three scenarios (ERP 2024 A, B, and C), the costs of abatement exceed the health benefits, with benefit-cost ratios significantly less than 1. This remains true even under the most optimistic conditions. Even when evaluated at a social discount rate of 2%, all scenarios still show ratios less than 1, indicating that the financial costs are disproportionately high compared to the health benefits.

SUMMARY

Table 0-1 summarises key information associated with each ERP scenario, including the health BCR for the Waterberg Fleet.

Table 0-1 – Eskom Fleet ERP Summaries and Impacts

	ERP 2024 A (Current Plan)	ERP 2024 B (Partial Compliance)	ERP 2024 C (Full MES Compliance)	ERP 2024 A (Current)	ERP 2024 B (Partial Compliance)	ERP 2024 C (Full MES Compliance)
	Eskom Fleet (cumulative)			Matimba		
SO_2 Abatement	Kusile, Medupi FGD	Kusile, Medupi, Kendal (FGD), Majuba (DSI)	Kusile, Majuba, Medupi, Matimba, Kendal, Tutuka, Lethabo (FGD)	-	-	FGD
NO_X Abatement	Majuba, Lethabo, Tutuka LNB	Majuba, Lethabo, Tutuka LNB	Majuba, Lethabo, Tutuka LNB	-	-	-
PM Abatement	Kendal, Matimba, Lethabo, Tutuka, Duvha, Matla PM Projects	Kendal, Matimba, Lethabo, Tutuka, Duvha, Matla PM Projects	Kendal, Matimba, Lethabo, Tutuka, Duvha, Matla PM Projects	Matimba ESPs and SO_3	Matimba ESPs and SO_3	Matimba ESPs and SO_3
CAPEX (nominal)	R77.2 billion	R153.1 billion	R257 billion	R1.4 billion	R1.4 billion	R44.4 billion
OPEX (real pa)	5.6 million	15.5 million	37.3 million	-	-	R1 billion
Benefit: Cost Ratio, Central (Waterberg Only)	0.0007	0.0017	0.0024	-	-	-

Eskom is requesting exemption from the new plant MES for SO_2 at Matimba. Compliance with the SO_2 new plant MES cannot be achieved without abatement. As presented, Eskom maintains its position that installation of an FGD, or similar technology, at Matimba is not feasible, predominantly due to the cost and timeframe of installation, with this only being complete four years before Matimba enters shutdown. Eskom's exemption request is supported by the currently compliant ambient SO_2 concentrations in the area, as well as the dispersion modelling indicating cumulative Eskom contributions to ambient concentrations remain in compliance with the NAAQS once the Medupi FGD is complete. Additionally, once the FGD at Medupi is operational, and without an FGD at Matimba, SO_2 concentrations remain complaint with the NAAQS, further supporting that an FGD at Matimba is not feasible. Further to this, the CBA undertaken for this application indicates the costs to achieve full SO_2 MES compliance (ERP 2024 C) far outweigh the health benefits that will be realised from this compliance, while also concludes that most health benefits, relative to costs, will be achieved in ERP 2024 A, which plans for SO_2 abatement only at Medupi and Kusile.

Strict adherence to the legal framework and regulations (i.e. MES) will require Matimba generating units to be taken offline, which will reduce available capacity in the grid, resulting in an increased degree of loadshedding. Approximately 3,690 MW at Matimba will be at risk, and should generating units be shutdown, will likely trigger load-shedding, and could significantly affect the economy, employment, standard of living, government revenue, electricity supply and investor confidence.

A balanced approach to energy policy is required, aiming to reduce reliance on coal while expanding renewable and lower-emission energy sources, although the roll-out of these transitions has been slow. Aligning with the National Energy Crisis Committee (NECOM) Energy Action Plan, Eskom aims to address the energy gap with immediate solutions such as demand reduction, accelerating the construction of new generation and storage capacity, improving infrastructure, and enhancing Eskom's operational efficiency.

From an economic/financial perspective a defined minimum load factor/take or pay agreement would ensure that the unit costs are acceptable compared to known alternatives, however if consideration could be given to the extension of the station life the economic/financial viability could improve.

While extension of a station's life may provide improved viability, this would mean an extension of South Africa's reliance on coal generation, potentially impacting South Africa's GHG commitments. A possible alternative to consider, would be that if funding is made available Eskom increases its investments in renewables and grid connection by the same amounts that would have been invested in such SO_2 retrofits; this would result in larger economic value add than FGD retrofits, and would progress South Africa's transition to renewables quicker.

Considering the above, and in summary, Matimba will comply with the new plant MES for PM and NO_X, and is requesting exemption from the SO_2 new plant MES until shutdown, and requests the limits presented in Table 0-2 be applied, and are also set as emission targets in terms of the Priority Area Plans. To achieve full MES compliance, a nominal Capex of R44.4 billion would be incurred, with approximately R1 billion annual Opex. To achieve Matimba's partial compliance, as requested herein, a nominal Capex of R1.4 billion will be incurred.

Table 0-2 - Emission limits requested for Matimba

POINT SOURCE CODE	POLLUTANT	MAXIMUM RELEASE RATE*			DURATION OF EMISSIONS
		mg/Nm^3	Average Period	Date To Be Achieved	
SV0013, SV0014, SV0015, SV0002, SV0011, SV0012	SO_2	3,500 mg/Nm^3	Monthly	1 April 2025 - shutdown	Continuous
	NO_X	750 mg/Nm^3	Daily	1 April 2025	Continuous
	PM	50 mg/Nm^3	Daily	1 April 2025	Continuous
*Emission limits requested are for normal operations, so exclude upset, startup, shutdown, or maintenance conditions					

The public participation phase is complete, which commenced on 6 November 2024 and ended 6 December 2024. The comments received during this process have been responded to, as contained within the Stakeholder Engagement Report. The final Exemption Application reports will be submitted to the Minister of the DFFE to consider the applications. Any further comments can be directed to the Minister.

1 INTRODUCTION

Eskom Holdings SOC Ltd (Eskom) is the public electricity utility company of South Africa, as of 2024, Eskom is responsible for supplying approximately 95% of electricity to South Africa's national grid, with an available generation capacity exceeding 35,000 MW (Eskom, 2024). Eskom's role is to help reduce the cost of doing business in South Africa, supporting economic growth, and ensuring a stable electricity supply by delivering power efficiently and sustainably. This mandate is guided by its vision and mission, which aim to enhance the quality of life for people in South Africa and the surrounding region, while maintaining a clean and healthy environment.

Eskom is responsible for generating, transmitting, and distributing electricity across the country and to neighbouring countries such as Namibia, Botswana, Zambia, Zimbabwe, and Mozambique. Approximately 90% of Eskom's generating capacity comes from coal-fired power stations, most of which are located in the Mpumalanga Highveld, with others such as Lethabo Power Station located in the Fezile Dabi District Municipality of the Free State province, and Matimba and Medupi Power Stations located in Limpopo's Waterberg District (Figure 1-1).

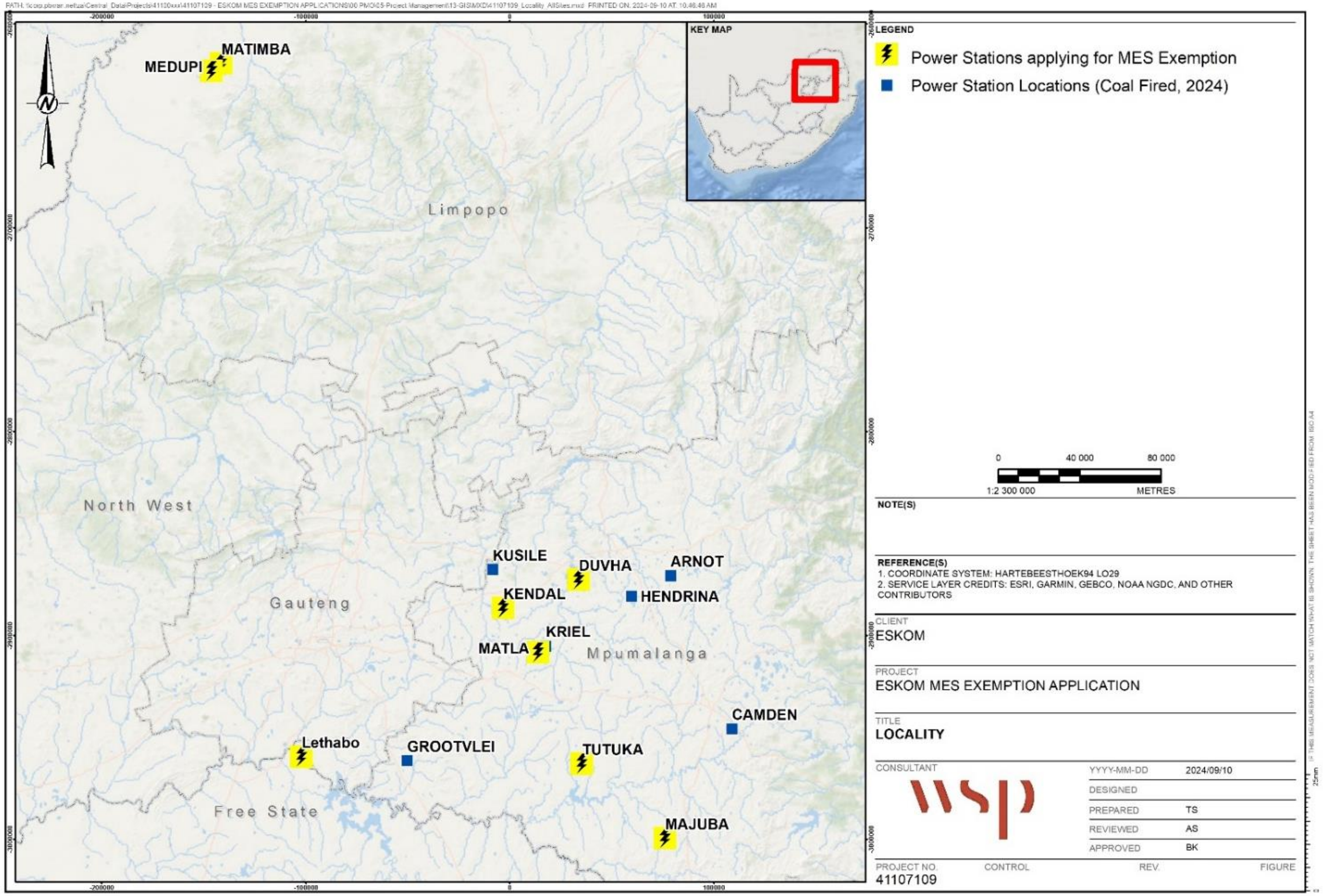


Figure 1-1: Eskom’s coal-fired power station distribution

Coal-fired power stations are subject to strict environmental regulations and monitoring due to their emissions. In terms of the National Environmental Management: Air Quality Act (No. 39 of 2004) (NEM:AQA), all coal and liquid fuel-fired power stations are required to meet the minimum emission standards (MES) contained in GNR 893 that was issued on 22 November 2013 (as amended by GNR 1207 on 31 October 2018) and promulgated in terms of Section 21 of the NEM:AQA. GNR 893 (as amended by GNR 1207) also provides for transitional arrangements in respect of the requirement for existing plants to meet the MES and provides that less stringent ‘existing plant’ limits must be achieved by 1 April 2015 for existing plants, and more stringent ‘new plant’ limits must be achieved by existing plants by 1 April 2020 unless specific legal indulgences are obtained.

Between 2018 and 2020, Eskom submitted applications for postponement, suspension and/or alternative limits to the MES for several of its power stations to the Department of Environmental Affairs (now the Department of Forestry, Fisheries, and the Environment (DFFE)) as the power utility sought more time to implement necessary pollution control technologies for nitrogen oxides (NO_X), sulphur dioxide (SO_2) and particulate matter (PM) emissions. These applications were necessary due to several factors, such as the restrictive legal framework, the advanced age of Eskom's power plant fleet, and the technical challenges of reducing emissions. Eskom's commitment to a Just Energy Transition (JET) and its broader climate change strategy also influenced this decision. The high costs of emission reduction technologies, which could significantly impact electricity tariffs and the financial stability of the utility, further underscored the need for a phased approach to compliance. Eskom's applications aimed to balance its legal obligations with the need to maintain stable electricity supply in South Africa (Eskom, 2020).

In response to Eskom's applications, the DFFE granted conditional postponements for several Power Stations in October 2021 (Grootvlei, Arnot, Komati, Camden, Hendrina, Acacia, and Port Rex Power Stations) through its National Air Quality Officer (NAQO); while partial refusals were issued for Majuba, Tutuka, Kendal, and Kriel Power Stations. However, the postponement applications for Lethabo, Matla, Medupi, Matimba, and Duvha Power Stations were rejected, citing concerns over the potential health impacts and the long-standing environmental challenges posed by emissions from the coal-fired power stations.

Eskom initiated an appeal process for the partial refusals and rejections on 13 December 2021, engaging with the DFFE and other governmental departments, on the basis that immediate compliance would lead to the shutdown of about 16,000 MW of coal-fired capacity. Eskom emphasised that this would negatively impact the national grid and delay South Africa’s energy transition, and that flu gas desulphurisation (FGD) retrofit on “six-pack” power stations was not proven to be technically feasible and would be a world first. Eskom further argued that the cost of full compliance to the MES is estimated at R300 billion; and will not add any additional capacity to the national grid. Eskom added that if funding was available, and if it were possible to execute all the compliance projects in time to meet the requirements, these projects would add at least 10% to the existing electricity tariff.

Subsequently, appeals were lodged in respect of the NAQO’s decisions concerning Eskom’s Kendal, Tutuka, Majuba, Camden, Hendrina, Arnot, Komati, Grootvlei, and Kriel Power Stations on 9 February 2022. These appeals led to the establishment of the National Environmental Consultative and Advisory (NECA) Forum, in August 2022, by the Minister of Forestry, Fisheries and the Environment (Minister) to provide guidance on MES issues.

On the 23rd of May 2024 the Minister issued its decision on the appeals made by Eskom, and other parties, with regards to the NAQO's decision made in October 2021. The decision prescribed that for power stations scheduled to be shutdown by 2030 (Hendrina, Grootvlei, Arnot, Camden, and Kriel Power Stations), Eskom's request to suspend the MES limits was approved, with a further requirement to submit shutdown plans within 12 months to facilitate closure by 31 March 2030. For the remaining power stations, comprising Matla, Duvha, Tutuka, Kendal, Lethabo, Majuba, Matimba, and Medupi, Eskom was instructed to apply for an exemption under Section 59 of the NEM:AQA within 60 days from 23 May 2024. However, thereafter the Minister granted an extension to the 10th of December 2024 to apply for this exemption. The Minister would then assess each application based on its merits and supporting information. As part of this submission, Eskom was directed to notify all relevant stakeholders and provide them an opportunity to comment on the exemption applications, for inclusion in the submission.

Eskom has appointed WSP Group Africa (Pty) Ltd (WSP), as an independent service provider, to support on the exemption applications required in terms of the Minister's decision. This report is specific to the exemption request in terms of Section 59 of the NEM:AQA for the Matimba Power Station.

This report provides a comprehensive overview of the MES exemption application for Matimba Power Station, detailing its background and the legal framework governing its operations. It outlines the Eskom's JET and repurposing plans, along with Eskom's emission reduction strategies and proposed emission limits. The report also examines the health and environmental impacts associated with the power station and discusses the financial consequences of compliance. A summary of the complete Eskom exemption application can be found in the exemption application fleet report available on the WSP website.

This draft MES exemption application report will be made available for public review to provide interested and affected parties (I&APs) the opportunity to comment on the report. Comments received during the public review period will be acknowledged and recorded in the final exemption application report submitted to the Minister for decision-making.

2 STATION BACKGROUND

Matimba power station is a dry cooled coal-fired power plant situated approximately 20 km west of Lephalale in the Limpopo Province, South Africa (Figure 2-1). Commissioned in 1986, the station's final unit was synchronized with the national grid in 1993.

Matimba has an installed capacity of 3,990 MW, comprising six generating units, each with a capacity of approximately 665 MW. These units use tangentially fired, dry-bottom boilers designed for low-quality coal, which is plentiful in the area, and comprise of a boiler, a turbine coupled to a generator-rotor, control and auxiliary support systems.

Coal is sourced from nearby mines, such as the Grootegeluk coal mine, ensuring a steady and cost-effective supply. The planned shutdown for the station is from FY 2037 to FY 2038, with the retirement of its individual units staggered throughout these years. The final shutdown will be subject to obtaining all the necessary governance approvals from the National Energy Regulator of South Africa (NERSA), DFFE, National Treasury, and other relevant authorities.

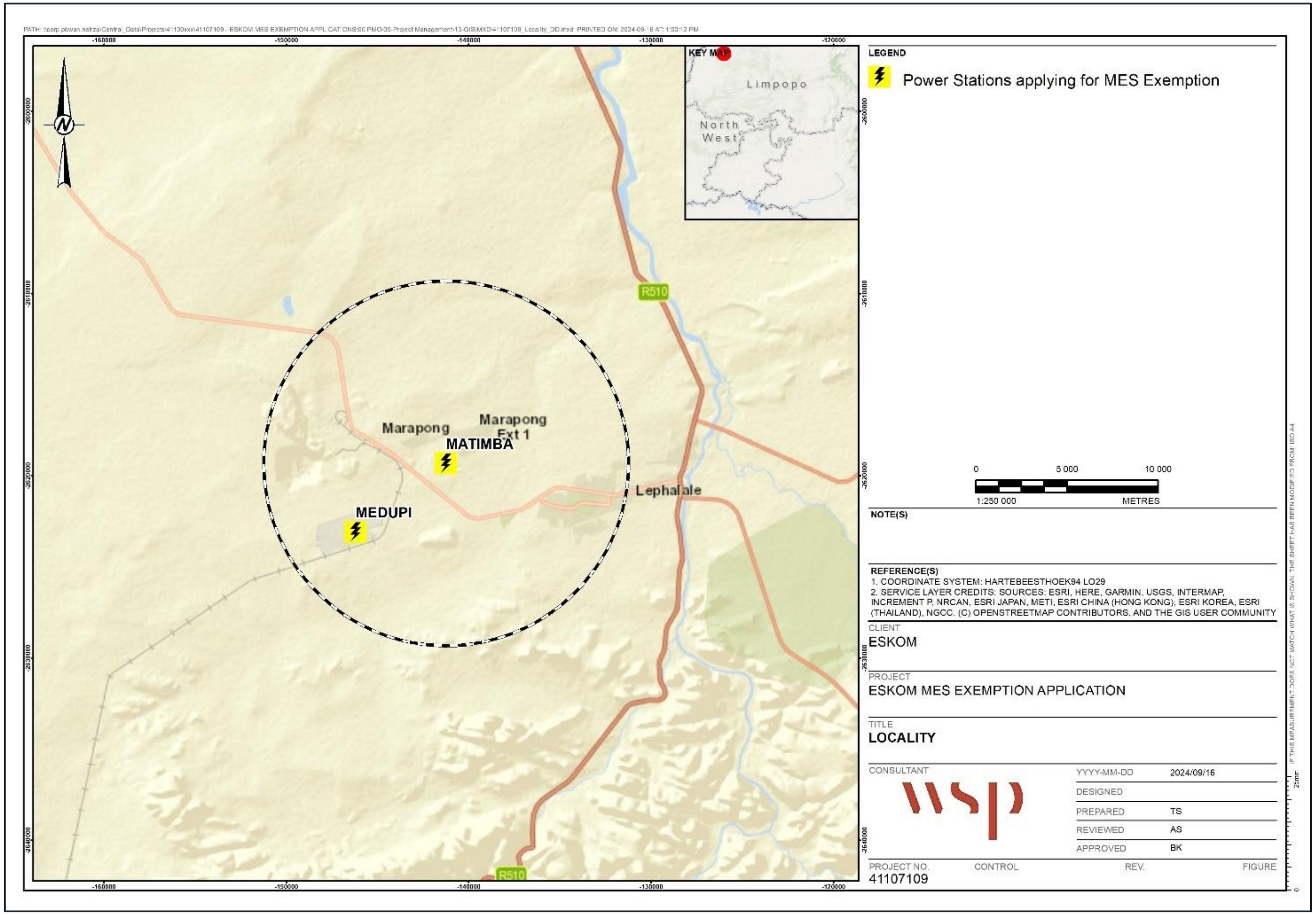


Figure 2-1: Locality Map for Matimba

Land uses in the vicinity of Medupi, as illustrated in Figure 2-2 predominantly comprise of forested lands in all direction of the power station, mines and quarries are located on the northwestern side, patches of cultivated lands and built up areas that are mostly residential. Medupi power station is located 12km northwest, while Grootegeluk Mine is located 13km north of Matimba. Neighbouring densely populated areas comprise Lephalale, Onverwacht and Maropong.

With regards to the delineations of the Limpopo Conservation Plan (2013), large tracts of natural habitat in the study area, are delineated as Ecological Support Areas (ESA 1), while other patches of habitat are delineated ESA 2 on the northern side. The southern side has a corridor of Critical Biodiversity which merges into a protected area due to the presence of the Tierkop Private Nature Reserve on the western side of this corridor.

ESA play an important role in supporting the ecological functioning of critical biodiversity areas or for generating or delivering important ecosystem services. These are areas that are required to support the persistence of species. They need to be maintained in at least an ecologically functional state, but some limited habitat loss may be acceptable. The surrounding area around Medupi therefore serve as support areas for ecological functions.

CBAs constitute the planning units which if not included in the final portfolio (selection of planning units) will result in the pre-defined targets not being achieved. They are therefore identified based in the irreplaceability output of C-Plan. Together with protected areas, CBAs ensures that a viable representative sample of all ecosystem types and species can persist. Therefore, the surrounding areas around Medupi are needed to maintain ecological function.

A channelled valley bottom wetland and a seep wetland can be found on the 9km southeastern of Matimba (Refer to Figure 2-2).

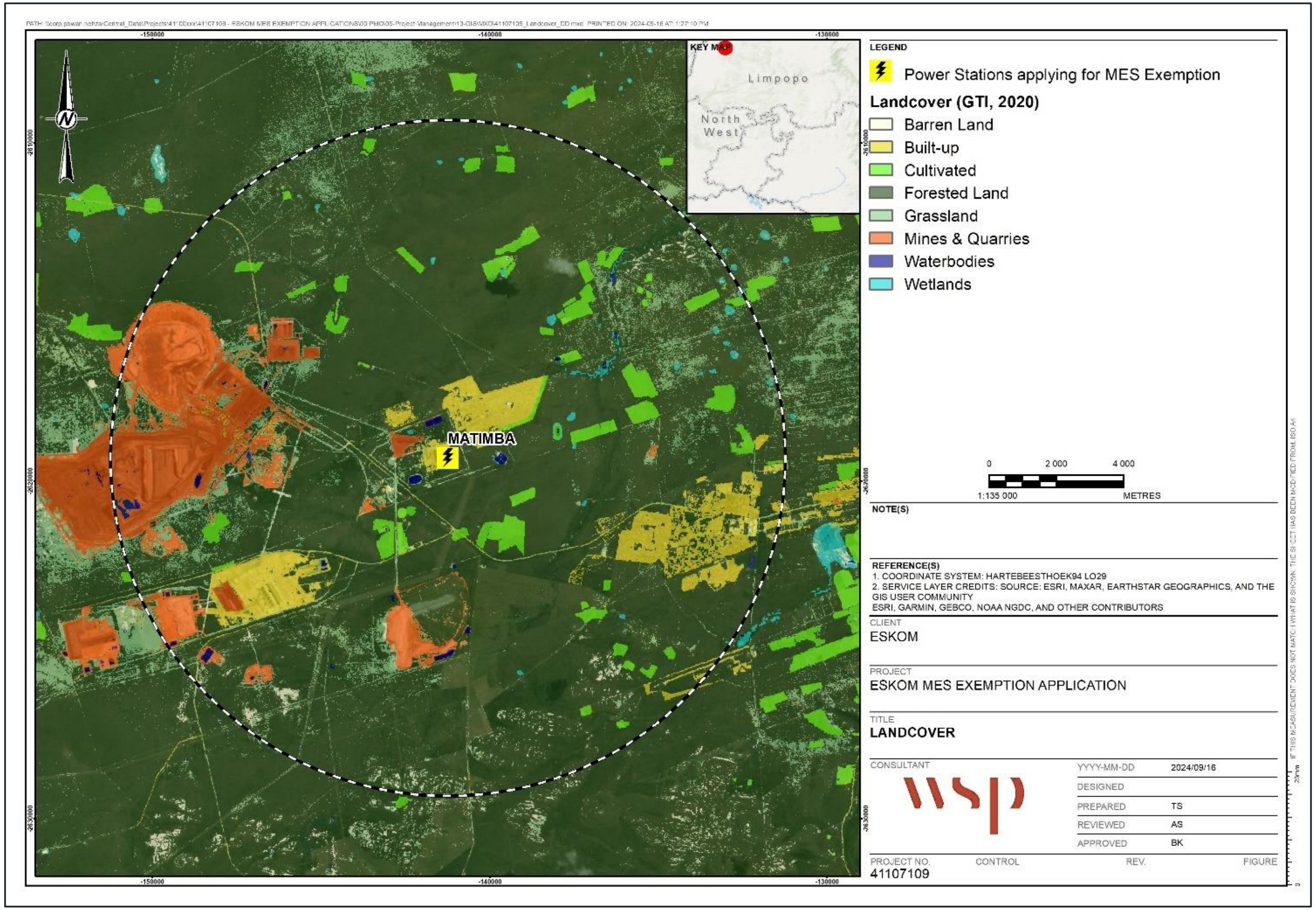


Figure 2-2: Land Cover Map

3 LEGAL FRAMEWORK

3.1 NATIONAL ENVIRONMENTAL MANAGEMENT: AIR QUALITY ACT

The overarching piece of legislation that governs air quality management in South Africa is the NEM:AQA, administered and enforced by the DFFE, Metropolitan, District and Local authorities.

The NEM:AQA focuses on the protection of the environment by providing reasonable measures for:

- The protection and enhancement of air quality.
- The prevention of air pollution and ecological degradation.
- Securing ecologically sustainable development while promoting justifiable economic and social development.
- Give effect to everyone's right *"to an environment that is not harmful to their health and well-being".*

The NEM:AQA is therefore the key legislative framework for managing and controlling air quality in South Africa, particularly with respect to industrial activities such as coal-fired power stations. The Act plays a critical role in regulating air pollution from these facilities, ensuring that emissions are minimised to protect human health and the environment.

3.1.1 SECTION 21 OF THE NATIONAL ENVIRONMENTAL MANAGEMENT: AIR QUALITY ACT – LISTING OF ACTIVITIES

In terms of Section 21 of the NEM:AQA a list of activities which result in atmospheric emissions and which the Minister or MEC reasonably believes, have or may have a significant detrimental effect on the environment, must be promulgated. Sections 22, 36 to 49, 61 and 62 provide additional information regarding the Atmospheric Emissions Licence (AEL) requirements and processes to be followed.

GNR 893 (22 November 2013), as amended, promulgated in terms of the NEM:AQA, contains a list of activities that would require licensing. The activities applicable to Matimba Power Station comprise of:

- Subcategory 1.1: Solid Fuel Combustion Installations.
- Subcategory 2.4: Storage and handling of Petroleum Products.
- Subcategory 5.1: Storage and handling of Ore and Coal.

Matimba was issued with an AEL (ref. H16/1/13-WDM05), in September 2022 by the Waterberg District Municipality for Subcategory 1.1: Solid fuel combustion installations, 2.4 Storage and handling of petroleum products and 5.1 Storage and handling of Ore and Coal. This AEL expires in September 2027.

3.1.2 THE MINIMUM EMISSION STANDARDS

In March 2010, the MES was published in terms of the NEM:AQA. The intent is that by setting these emission limits (known as point source limits), overall air quality at the local or ambient level, as defined by the National Ambient Air Quality Standards (NAAQS), will be maintained. In terms of the NEM:AQA, all of Eskom's coal- and liquid fuel-fired power stations are required to meet the MES contained in GNR 893, and as amended in GNR 1207. The MES also provides transitional arrangements in respect of the requirement for existing plants to meet the MES and provided that less stringent limits had to be achieved by existing plants by 1 April 2015, and more stringent “new plant” limits had to be achieved by existing plants by 1 April 2020. The MES applicable to Matimba Power Station are listed in Table 3-1 below.

Table 3-1 – Minimum emission standards for Category 1: Combustion installations, sub 1.1: Solid fuel installations

SUBCATEGORY 1.1: SOLID FUEL			
Description:		Solid fuels combustion installations used primarily for steam raising or electricity generation.	
Application:		All installations with design capacity equal to or greater than 50 mw heat input per unit, based on the lower calorific value of the fuel used.	
Substance		Plant status	mg/Nm^3 under normal conditions of 10% 0_2, 273 Kelvin and 101,3 kPa.
Common name	Chemical symbol		
Particulate matter	N/A	Existing	100
		New	50
Sulphur dioxide	SO_2	Existing	3,500
		New	1,000
Nitrogen oxides	NO_X	Existing	1,100
		New	750

3.1.3 POSTPONEMENT OR SUSPENSION OF COMPLIANCE TIMEFRAMES

Section 12 of GNR 893 (as amended by GNR 1207) provides for the postponement or suspension of compliance timeframes with the MES under specific conditions. This means that facilities may apply to the NAQO for a postponement or suspension, for a maximum of 5 years, if they are unable to comply with the set standards by the required date.

The applicant must demonstrate current or future projects aimed at ensuring eventual compliance. They should also include an air quality impact assessment detailing the implications of continued emissions on the environment and health and evidence of consultation with I&APs.

Matimba Power Station’s application for a postponement from the MES was rejected by the DFFE in October 2021. This decision was appealed by Eskom in December 2021 and a decision was issued by the Minister in May 2024 which directed Eskom to submit an exemption application in terms of Section 59 of the NEM:AQA.

3.1.4 EXEMPTION FROM MINIMUM EMISSION STANDARDS

Section 59 of the NEM:AQA grants any person, or organ of state, the right to apply for exemption from a provision of NEM:AQA directly to the Minister of DFFE. These exemptions are typically made where compliance with a provision is considered inappropriate often due to requirements being economically or technically unfeasible and exemption are generally time-bound and subject to review by the Minister. The review frequency can vary but often coincides with specific time frames set in the exemption itself.

Section 59 of NEM:AQA provides Eskom the opportunity to apply for exemption from certain provisions of NEM:AQA. In terms of Section 59, Eskom is required to advertise the application in at least two newspapers circulating nationally and give reasons for the application. The approval of an MES exemption application could potentially limit the constitutional rights of South Africans by leading to environmental degradation, posing health risks, and creating economic and social challenges. As such, an approval would likely be issued subject to a range of conditions to limit potential negative impacts.

3.2 THE NATIONAL AMBIENT AIR QUALITY STANDARDS

In terms of Section 9 of the NEM:AQA the Minister identified substances in the ambient air that are believed to present a threat to the health, well-being or the environment and has in respect of those substances, established national standards for ambient air quality. These standards provide the permissible amount or concentration of each of the substances in ambient air. The standards contain the averaging periods, concentrations, frequencies of exceedance, compliance dates and reference methods for select substances.

In 2004, the National Ambient Air Quality Standards (NAAQS) were promulgated to better regulate local air quality. The NAAQS define the acceptable levels of environmental risk associated with human exposure to air pollutants. If an area meets the NAAQS, it is considered to have an air quality that poses a legally acceptable level of risk to the environment and human health in South Africa.

The NAAQS relevant to Matimba Power Station and this exemption application are Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2), and Particulate Matter (PM_{10} and $PM_{2.5}$). These standards aim to ensure the air remains safe for residents living near the power station and reduce the impact of emissions on the environment.

3.3 REGULATION FOR IMPLEMENTING AND ENFORCING PRIORITY AIR QUALITY MANAGEMENT PLANS

The Regulation for Implementing and Enforcing Priority Air Quality Management Plans of 26 August 2024 (GNR 5153) is a draft framework established by the South African government to provide for the implementation and enforcement of a priority area air quality management plans, in terms of sections 19(1)(b) and 19(5) of the NEM:AQA, to strengthen air quality management in identified priority areas with high levels of air pollution. It was published for public comment, allowing stakeholders and the public to provide input before it is finalised. These regulations have coincided with The Vaal Triangle Priority Area air quality management plan (AQMP) Implementation Regulations, published under GNR 614 on 29 May 2009, being repealed.

GNR 5153 is aimed at ensuring that designated priority areas meet national ambient air quality standards. The regulations also establish the mandatory steps for implementing emission reduction and management measures, with the government empowered to monitor their effectiveness and enforce compliance where necessary. They apply to various proponents, including those involved in activities like mining, reclamation, or operating controlled emitters such as power stations. These proponents are required to submit emission reduction and management plans, in terms of the Regulations, within six months of the publication of a priority area AQMP. Once these emission reduction and management plans are approved, they must be implemented within specified timeframes. Additionally, any existing priority area AQMPs, published prior to the commencement of these regulations, must be reviewed by the DFFE within two years to include updated emission reduction targets. These measures ensure that compliance is regularly evaluated and enforced across sectors.

Matimba Power Station is situated in the Waterberg-Bojanala Priority Area (WBPA). This region was declared on 15 June 2012 by the South African government. This declaration was made in response to growing concerns about air pollution in the region, particularly due to the area's industrial and mining activities, including emissions from coal-fired power stations. This region is therefore subject to the WBPA AQMP, published in December 2015, for focused air quality management interventions aimed at reducing industrial emissions and protecting public health.

The WBPA AQMP sought to reduce emissions from industries such as power stations and petrochemical plants, with specific focus on reducing SO_2, NO_x, and PM. These pollutants are linked to heavy industrial activities and high levels of air pollution within the WBPA. Specific emission limits, including those tied to MES for industries, are a cornerstone of the WBPA AQMP. The WBPA AQMP requires industries to meet strict MES values and incorporate Best Available Technology (BAT) for emission reduction. These measures include continuous monitoring and improvements, such as reducing fugitive emissions (unintended releases of pollutants, such as dust or gases from industrial activities). The WBPA AQMP also calls for offsets to reduce pollution in other areas as compensation when targets are not immediately achievable. In addition, industries are encouraged to regularly review and update their emission reduction strategies to align with evolving environmental policies. Industries are also expected to take measures to reduce ground-level ozone precursors, such as NO_x and volatile organic compounds (VOCs), which pose risks to both health and agriculture.

Hotspot Zones within priority areas, where intervention efforts are to be concentrated, are identified based on predicted levels of ambient air pollution from key pollutants and the potential for exposure. Prioritisation of sources are then ranked based on impacts rather than the extent of their emissions. Matimba Power Station is classified as an emission source within the Lephalale Hotspot Zone. This zone is prioritised due to its high levels of industrial activity, particularly from coal-fired power generation, which significantly impacts air quality. As a result, interventions for the WBPA were developed and Matimba Power Station, falling within the power generation sector, is expected to comply with all the applicable listed activities for the MES and reduce fugitive emission to ensure compliance with the NAAQS. However, the implementation of regulations relevant to priority areas by authorities must also be done under the consideration and indulgence of any MES postponements, suspensions and exemptions granted to emitters.

Adherence to the WBPA AQMP, as it currently stands, is not a legal requirement. The WBPA AQMP outlines guidelines and recommended actions for stakeholders in the region to help meet air quality standards. However, while it sets MES and encourages BAT use, its enforcement has been somewhat limited. Non-compliance primarily results in reputational risks or administrative sanctions but is not uniformly enforced across sectors. In terms of the recently published Priority Area Regulations (GNR 5153) the WBPA AQMP must be reviewed within two years of publication of the regulations to include emission reduction targets. Once WBPA is reviewed, stakeholders (such as industries, municipalities, and other entities operating within priority areas like the WBPA) will be required to develop emission reduction and management plans indicating how they will comply with the agreed emission reduction targets. The regulation also provides enforcement mechanisms, including fines or penalties for non-compliance, making adherence to such air quality management plans legally enforceable. Thus, with the new regulation, failure to comply would result in legal consequences, strengthening the overall governance and impact of air quality management in priority areas.

3.4 POLICIES AND LEGISLATION REGARDING CLIMATE CHANGE

Table 3-2 and Table 3-3 outlines relevant policy, guidance and legislation (i.e., includes both International and National policy, guidance and legislation) that provides the framework within which the GHG and climate change issues relevant to Matimba Power Station that have been considered.

Table 3-2 – Applicable climate change related policies, legislation, guidelines and standards - International

POLICY, LEGISLATION, GUIDELINE OR STANDARD	DESCRIPTION
The Intergovernmental Panel on Climate Change (IPCC) is a panel established in 1988 by the World Meteorological Organisation (WMO) and the United Nations Environment Programme (UNEP) to provide independent scientific advice on climate change. This first assessment report of the IPCC served as the basis for negotiating the United Nations Framework Convention on Climate Change (UNFCCC). The Intergovernmental Panel on Climate Change (IPCC) is a scientific body established by the United Nations in 1988. Its main role is to provide policymakers with regular assessments of the scientific basis of climate change, its impacts, and possible adaptation and mitigation strategies. While the IPCC does not have direct regulatory authority, its reports and findings play a crucial role in shaping global climate policies and informing decision-makers on how to address climate change.	The IPCC policy guides climate science, adaptation strategies, and emission reduction targets. Developers are encouraged to align with IPCC assessments to mitigate climate risks, manage water resources, and ensure compliance with environmental regulations. Stakeholder engagement and access to climate finance can benefit from this alignment, enhancing Project credibility. IPCC data aids in risk assessment and long-term planning, informing decisions on infrastructure design and Project sustainability. In summary, the integration of IPCC policies into the operations of developers supports climate resilience and aligns with global climate goals. The IPCC advocates for urgent global actions to mitigate climate change, mainly by GHG emissions.
The Paris Agreement, which was adopted in December 2015, is an international accord within the United Nations Framework Convention on Climate Change (UNFCCC). Its main objective is to limit global warming to well below 2 degrees Celsius above pre-industrial levels, with efforts to limit it to 1.5 degrees Celsius. To achieve this, the agreement aims to enhance the global response to climate change by strengthening countries' abilities to deal with the impacts of climate change and reducing greenhouse gas emissions (2015)	The Paris Agreement does not single out specific industries, rather it sets a framework for nations to develop and submit their own Nationally Determined Contributions (NDCs). These NDCs are country-specific climate action plans that outline the measures and targets each country will undertake to contribute to the global effort in combating climate change. These targets include reductions in emissions from various sectors, including the energy sector, where coal combustion activities play a role. South Africa’s commitments are discussed below. The Paris Agreement also emphasises transparency and accountability. Countries are required to regularly report on their GHG emissions and progress towards their NDCs. The Paris Agreement seeks to limit global temperature increases to below 2°C, striving for 1.5°C, through GHG emission reductions. South Africa's commitments under the Paris Agreement is to reduce national emissions.

POLICY, LEGISLATION, GUIDELINE OR STANDARD	DESCRIPTION
Greenhouse Gas Protocol (GHGP)	The GHGP is a joint initiative of the World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD), which arose out of the need to help countries and companies account for, report, and mitigate emissions, based on a report that identified an action agenda to address climate change that included the need for standardised measurement of GHG emissions. The GHGP provides accounting and reporting standards, sector guidance, calculation tools and training for businesses and local and national governments. It has created a comprehensive, global, standardised framework for measuring and managing emissions from private and public sector operations, value chains, products, cities and policies to enable GHG reductions across the board. This protocol provides a global standard for measuring and managing GHG emissions.

Table 3-3 - Applicable policies, legislation, guidelines and standards - National

Policy, legislation, guideline or standard	Description
NATIONAL POLICY AND STRATEGY	
South Africa’s National Climate Change Response Policy White Paper (NCCRP) (2011)	The National Climate Change Response Policy is a comprehensive strategy to address both mitigation and adaptation in the short, medium and long term (up to 2050). Strategies are specified for the following areas: ▪ Carbon Pricing. ▪ Water Agriculture and commercial forestry. ▪ Health. ▪ Biodiversity and ecosystems. ▪ Human settlements. ▪ Disaster risk reduction and management. The policy has two main objectives: first, to manage inevitable climate change impacts through interventions that build and sustain social, economic and environmental resilience and emergency response capacity. Secondly, to make a fair contribution to the global effort to stabilise GHG concentrations in the atmosphere. The NCCRP outlines South Africa’s vision for transitioning to a low-carbon economy.
National Climate Change Adaptation Strategy (NCCAS) (2020)	The NCCAS provides a common vision of climate change adaptation and climate resilience for South Africa, and outlines priority areas for achieving this vision. It draws on South Africa's National Climate Change Response Policy (NCCRP) (DEA 2011), the National Development Plan (NDP) (NPC 2011), the adaptation commitments included in its NDC, sector adaptation plans, provincial adaptation plans and local government adaptation plans. The main objective of the strategy is to provide guidance across all levels of government, sectors, and stakeholders affected by climate variability and change. It should also serve as the country's National Adaptation Plan and fulfils the commitment to its international obligations under the Paris Agreement. The NCCAS aims to enhance the country’s climate resilience and adaptability.

<table>
<tr><th>Policy, legislation, guideline or standard</th><th>Description</th></tr>
<tr><td colspan="2">NATIONAL POLICY AND STRATEGY</td></tr>
<tr><td>South Africa's Nationally Determined Contributions (NDC) (2021)</td><td>South Africa updates and enhances its NDC under the Paris Agreement, meeting its obligation under Article 4.9 to communicate NDCs every five years, and responding to the requests in paragraphs 23 to 25 of decision 1/CP.21. The NDC was updated in 2021 to account for developments and increased ambitions since the first submission.
Climate mitigation targets have been updated to:
<table>
<tr><th>Year</th><th>Target</th><th>Corresponding period of implementation</th></tr>
<tr><td>2025</td><td>South Africa's annual GHG emissions will be in a range from 398-510 Mt CO_2-eq.</td><td>2021-2025</td></tr>
<tr><td>2030</td><td>South Africa's annual GHG emissions will be in a range from 350-420 Mt CO_2-eq.</td><td>2026-2030</td></tr>
</table>
The NDC outlines adaptation goals and highlights planned mitigation and adaptation efforts and associated costs. The updated NDC highlights the importance of securing access to large-scale international climate finance
South Africa's NDC includes emission reduction targets under the Paris Agreement.</td></tr>
<tr><td colspan="2">National Legislation and Regulations</td></tr>
<tr><td>South African National Greenhouse Gas Emission Reporting (NGER) Regulations (2017)</td><td>The Reporting Regulations adheres to the NEM:AQA. The purpose of the National Greenhouse Gas Emissions Reporting Regulations is to introduce a single national reporting system for the transparent reporting of greenhouse gas emissions, which will be used to maintain a National Greenhouse Gas Inventory, allow South Africa to meet its UNFCCC reporting obligations and to inform the formulation and implementation of legislation and policy.
The emission sources and data providers who are covered by the Regulations are set out in Annexure 1 and Regulation 4. Energy is included as a sector. The Regulations also set out the reporting requirements, calculation methodology, verification procedure (to be carried out by the National Inventory Unit) and penalties (which include fines and imprisonment).
These regulations mandate reporting of GHG emissions to ensure transparency and accountability.</td></tr>
<tr><td>Declaration of Priority Pollutants and Pollution Prevention Plans (2018)</td><td>Under Section 29 of the NEM:AQA, Government Notice 710 of 2017 (Government Gazette 40996), GHGs (carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6)) have been declared as priority pollutants. Further, persons falling within the list of production processes, specified in Annexure A, which involves emission of GHGs in excess of 0.1 Mt annually are required to prepare and submit to the Minister pollution prevention plans for approval in line with NEM:AQA, Government Notice 712 of 2017 (Government gazette 40996). On 22 May 2018, in Government Notice 513 in Government Gazette 41642, the Minster of Environmental Affairs amended the National Pollution Prevention Plan Regulations (published in Notice 712 on 21 July 2017). In terms of this amendment, the first pollution prevention plan was due on or before 21 June 2018.
A first pollution prevention plan must cover a period from the date of promulgation of these Regulations up to 31 December 2020 and the subsequent pollution prevention plans must cover periods of five calendar years each.
This policy focuses on reducing priority pollutants, including GHGs.</td></tr>
<tr><td>South African Carbon Tax Act (2019)</td><td>The Act imposes a tax on carbon dioxide equivalent (CO_2e) GHG emissions. The tax follows the polluter pays principle to ensure that high emitting companies are accountable for their contribution to climate change.</td></tr>
</table>

Policy, legislation, guideline or standard	Description
NATIONAL POLICY AND STRATEGY	
	The South African Carbon Tax Act, 2019 establishes a framework for calculating and applying carbon tax, but the actual tax liability for an emitter would depend on various elements, including: - Emission Levels - Allowances and Thresholds - Carbon Budgets - Renewable Energy Tax Incentives - Sector-Specific Factors - Compliance and Reporting The specific tax amount paid by the station would be determined through calculations based on these factors and the applicable tax rates specified in the Carbon Tax Act. The Act provides a structure for progressively increasing carbon tax rates over time. The Carbon Tax Act imposes a tax on GHG emissions to encourage reductions.
Draft National Guideline for the Consideration of Climate Change Implications in Applications for Environmental Authorisation, AEL and WML (2021)	On 25 June 2021, the Minister of Forestry, Fisheries and the Environment published a Notice under the National Environmental Management Act (No. 107 of 1998) (NEMA) seeking public comment on a draft National Guideline for the consideration of climate change implications in applications for environmental authorisation, atmospheric emission licences and waste management licences. The draft National Guideline aims to create a consistent approach for the incorporation of climate change considerations in EIAs, WMLs and AELs. The guidelines outline a methodological approach for minimum requirements for consideration when conducting climate change assessments has been considered in compiling this report. This guideline advises integrating climate change considerations into environmental decisions, aiming to ensure that projects minimise their climate impacts.
South African Climate Change Bill (2022)	The Climate Change Bill was introduced in Parliament in February 2022. It will be the first South African legal framework in response to climate change impacts. The Climate Change Bill was passed on Thursday, 25 April 2024 by the Parliament of the Republic of South Africa. The Bill aims to enable effective development of climate change responses through a long-term transition to a climate-resilient and low-carbon society and economy, while considering sustainable development. The Bill aims to contribute fairly to global GHG stabilisation, conforms to South African international climate change obligations and commitments to protect and preserve our planet for current and future generations. The Bill provides two main mechanisms to reduce the country's greenhouse gas emissions: Section 21 of the Bill obliges the Minister to determine a national greenhouse gas emissions trajectory. This trajectory must be set in consultation with Cabinet. The trajectory must specify a national greenhouse gas emission reduction objective. This objective must be informed by South Africa's current and Projected greenhouse gas emissions and be consistent with South Africa's international obligations. Section 22 of the Bill deals with sectoral emissions targets. According to section 22, the Minister must identify greenhouse gas emitting sectors and sub-sectors that should be subject to sectoral emissions targets. The Minister must then set sectoral emissions targets for each sector, in consultation with the relevant Minister responsible for that sector. These targets must align with the national greenhouse gas emissions trajectory. The Minister responsible for each sector must then implement each sectoral target through a range of planning instruments, policies, measures, and programmes.

Policy, legislation, guideline or standard	Description
NATIONAL POLICY AND STRATEGY	
	The sectoral emissions targets (SETs) “are greenhouse gas emissions reduction targets, either qualitative or quantitative, applicable to sectors or sub-sectors over a period” and implemented at the level of national government. SETs are allocated for coal-fired power stations under that Draft Sectoral Emissions Target Report (April 2024) that is out for public comment. The SETs are therefore a critical component in aligning sectoral level targets with the national commitment of the NDC. The Climate Change Bill seeks to establish a legal framework for addressing climate change in South Africa.

4 JUST ENERGY TRANSITION AND REPURPOSING PLANS

4.1 INTRODUCTION

South Africa is grappling with the energy trilemma: how to simultaneously ensure energy security, affordability and access, and sustainability. At the same time, South Africa’s national context of high unemployment and inequality, unreliable performance of the current power generation fleet, and reliance on coal-fired generation in the electricity sector make the energy trilemma uniquely complex.

It was with this context in mind that Eskom’s JET Strategy was developed, which is focused on resolving all components of the energy trilemma, by delivering on the 5 “E”s: Energy, Economy, Employment, Equity, and Environment.

As Eskom’s existing power plants gradually reach their end of life, the standard of living, quality of life and state of surrounding communities are at risk of decline if no mitigation actions are taken. While developing new energy capacity to resolve the energy trilemma is critical, a considered approach that ensures power station communities share in the benefits of the transition is of equal importance.

For Eskom’s JET Strategy, a clear link is seen between the need to build new energy capacity and the importance of ensuring the transition offers a second life to power station communities. The combination of these aims, are not mutually exclusive, form the core of Eskom’s JET ambition.

4.2 JET STRATEGY AND ENERGY BROADER POLICY LANDSCAPE

The purpose of the JET Strategy is to provide a consolidated view of the approach that will be taken to build Eskom’s future portfolio, optimising for economic growth and development, the reduction of emissions, the creation of jobs, and equitable socio-economic development. These objectives necessitate the gradual, but decisive, development of renewable energy generation, aligned to the 5 Es of Eskom’s JET.

Transitioning in a socially and economically responsible manner is aligned to South Africa’s broader policy goals in the context of the global effort to mitigate climate change. Given the country’s vulnerability to climate change and its commitment to an inclusive energy transition, South Africa chose to be part of the transition to a low-carbon, socially inclusive future, by announcing a revised NDC of ~350-420 megatonnes (Mt) of carbon dioxide equivalent (CO_2e) per annum at COP26 in 2021. The country’s stated objectives are in line with the global direction of travel, including for other developing countries.

The revised Eskom JET Strategy is an updated version of the original JET Strategy approved in 2021. The revised JET Strategy adjusts the positioning of the original JET Strategy slightly by acknowledging the context of the ongoing energy crisis and the national generation strategy, as well as the debt relief conditions subsequently announced by National Treasury. The revised strategy details financing and partnership options that are available to support the execution of JET and the socio-economic impact of JET. The original JET Strategy assumed that Eskom would largely execute on JET projects through debt financing. Given the debt relief conditions, the revised strategy indicates that Eskom will not be able to execute on all the projects on the balance sheet and thus external collaboration models must be explored.

The JET Strategy, Generation Strategy and Energy Crisis Management Strategy are interdependent, together contributing to address all components of the energy trilemma. The Energy Crisis Management Programme emanates predominantly from new generation capacity not coming online as anticipated in the Integrated Resource Plan (IRP) 2010 and IRP 2019 and Eskom's lower than expected plant energy availability factors (EAF). However, it should be noted that since the IRP was last updated in 2019, the EAF has improved with the latest state of system briefing held on 26 August 2024 indicating an EAF of 67.02% (July MTD).

A review of the coal plant shutdown schedules, as part of the Generation Strategy was prompted due to low plant EAFs. As these schedules are subject to change going forward, the JET Strategy has been decoupled from the shutdown of coal-fired power stations. Recognising the JET Strategy as separate from shutdown is important, as the focus of the JET on new capacity additions and socio-economic projects for power station communities should proceed regardless of specific shutdown timelines. The JET Strategy, which focuses on Repurposing and Repowering existing power stations and developing new renewable energy capacity, will proceed regardless of any specific shutdown schedule.

The Energy Crisis Strategy and the Eskom JET Strategy overlap on grid access, since a key factor limiting new build is Transmission's current constraints in evacuating additional generating capacity in prime wind and solar regions. The JET Strategy promotes build in Mpumalanga, where there is established grid infrastructure, and where repowering of coal power stations is possible while they are still operational.

The Generation Strategy and JET Strategy overlap where repowering and repurposing (R&R) and other socio-economic initiatives provide a second life to coal power plants and their surrounding communities. In the nexus of all three strategies lies a low-carbon future that contributes to solving all components of the energy trilemma (**Figure 4-1**).

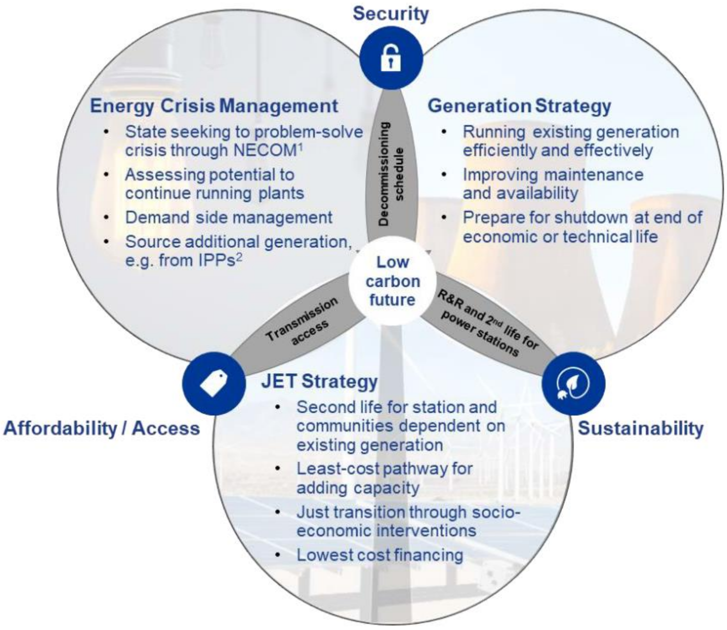


Figure 4-1 - The Energy Crisis Management, Generation and JET strategies are interdependent, but have different areas of focus (Eskom JET, 2023)

The Energy Crisis Management Strategy, amongst other factors, focuses on assessing the potential for the continued operation of coal plants, management of energy demand and sourcing additional generation through Independent Power Producers (IPPs) and/or National Energy Crisis Committee of Ministers (NECOM). The Generation Strategy has different, but overlapping, focal areas: running existing generation efficiently and effectively, improving the maintenance and EAFs of power stations, and preparing for power stations that are reaching the end of their useful lives.

The JET Strategy focuses on offering a second life for coal power stations and the communities that depend on existing generation, figuring a pathway for new build Eskom capacity in alignment with the IRP to enhance energy security, and defining Eskom's planned socio-economic interventions to ensure the energy transition is truly Just.

The main purpose of the IRP is stated as: "*to ensure security of electricity supply necessary by balancing supply with demand, while considering the environment and cost of supply".* With this in mind, Eskom's JET Strategy is in alignment with the IRP and seeks to balance its commitments of electricity demand, environmental obligations and cost of electricity supply to customers.

4.2.1 REPOWERING AND REPURPOSING PLANS

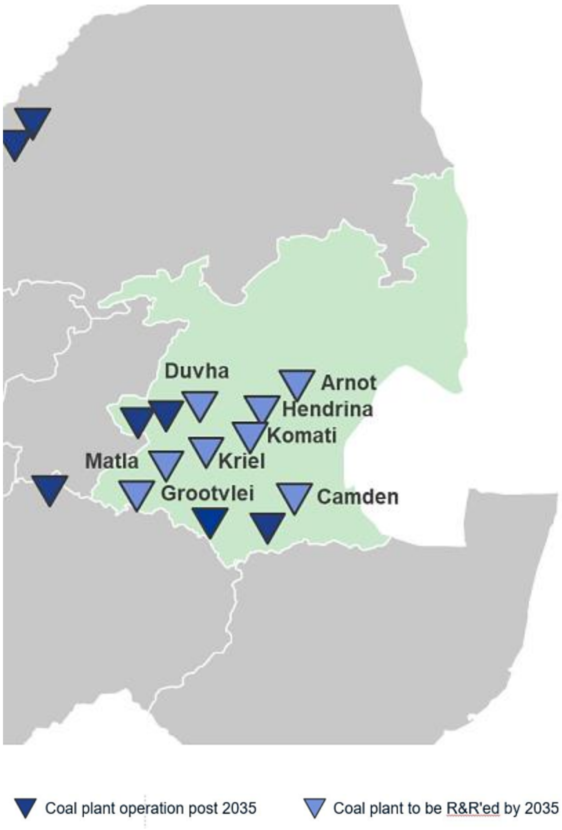


Figure 4-2 - Location and expected R&R for coal power stations with a focus on Mpumalanga

As discussed above, the development of a renewables-dominant power system aims to create jobs and stimulate economic growth. To ensure that communities currently reliant on coal power plants benefit from this transition specifically, Eskom has further identified repowering and repurposing projects to create economic opportunities in these communities. These projects will be a key component of the JET as Eskom seeks to repower and repurpose existing coal plants to preserve jobs and utilise existing grid capacity. Power stations in Mpumalanga, depicted in Figure 4-2, will be prioritised.

As per the plan, coal plants will be repowered by leveraging the existing infrastructure to build new generation capacity including solar, wind, batteries and/or synchronous condensers. The plants will also be repurposed into new centres of economic activity with training centres, water treatment facilities, manufacturing plants, microgrid assemblies and modern aquaponic farms as potential initiatives. Therefore, a Just transition for local communities, through these Repurposing and Repowering activities which will help to retain economic activity, create jobs, and create new economic opportunities.

Eskom has already commenced with the implementation of the largest repowering and repurposing project in emerging markets at the Komati Power Station. The Komati repowering and repurposing projects are expected to have a significant impact by 2030, including the following:

- ~660 estimated direct full-time jobs and ~8700 additional temporary jobs created.
- ~370 MW of renewable generation capacity, replacing remaining ~100 MW of operational capacity at Komati when it was shutdown in 2022.
- ~200 people are expected to be trained in different vocations annually.

Approximately $497 million dollars has been secured in funding from the World Bank for this project. Some examples of projects currently underway at Komati that are contributing to the stated impact include a renewable technical training facility, agrivoltaics plants and a containerised microgrid assembly. Komati is the pilot project for the repurposing of a shutdown power plant, with the total cost of repurposing projects estimated at ~R434,5 million.

Potential repowering and repurposing projects were identified through socio-economic impact analyses employed to identify opportunities to offer a second life to power station communities. These initiatives are shortlisted through three filters to ensure the prioritised initiatives have maximum positive impact:

1. **Viability filter** uses on-site resources and findings of socio-economic impact analyses to understand which projects are implementable.
2. **Relevance filter** removes projects that are duplicated or do not have goals aligned with the JET Strategy.
3. **Prioritisation filter** places greatest focus on initiatives that have a meaningful impact on job creation and local economies, unlock other initiatives, and are cost-effective. This process also ensures that projects that are infeasible due to lack of funding, capabilities or regulatory compliance are deprioritised, as well as projects that lack demand for initiative outcomes or have low technological maturity.

The prioritisation filter leverages four stages to identify the optimal socio-economic initiative portfolio for Eskom to implement by itself, partner to implement, or support implementation. The four stages are:

1. **Project attractiveness** considers the sustainable and quality jobs the initiative creates, the capital expenditure (CAPEX) required to implement the initiative, the broader contribution the initiative will have on the economy, and the catalytic effect of the initiative on other initiatives in the area. The outcome of this stage is a ranked list of initiatives based on their attractiveness and relevance to the JET objectives.
2. **Feasibility assessment** considers the allocated or available funding for the initiative, the ease of implementation of the initiative, whether there are any regulatory constraints in Eskom pursuing the initiative, the maturity of the technology associated with the initiative, and whether the implementation of the initiative is dependent on another initiative. The outcome of this stage is the initiatives being categorised into initiatives Eskom to implement by itself, partner to implement, or support implementation based on how feasible the initiative is for Eskom to implement. Only initiatives that Eskom chooses to implement by itself, or partner to implement, will move on to the third stage and have business cases developed.
3. **High-level business case development** for the top 5-10 initiatives from stage two. The high-level business case will include aspects such as net present value (NPV) calculation, profitability, and time to deliver.
4. **Full business case and decision on Eskom's role** considering the value for Eskom based on the portfolio value add and strategic importance of the initiative. The outcome of this stage is the initiatives to be funded by Eskom are submitted for approval.

The current longlist of socio-economic initiatives that are being considered in the prioritisation stage has grown to over 130 projects, and this list will continue to grow as Eskom's JET Strategy is implemented. Socio-economic initiatives are essential in ensuring that communities currently reliant on coal power stations have livelihoods protected and benefit from the energy transition.

Although Matimba Power Station is not currently part of Eskom's Repowering and Repurposing Plans since its decommissioning date is post 2035, a similar approach will be taken as described above in order to identify suitable projects and plans in line with this strategy. Eskom is currently investigating possible repowering, repurposing and alternative projects for multiple sites some of which may be considered of relevance to Matimba (Eskom, 2024).

5 ESKOM EMISSION REDUCTION PLAN

5.1 ESKOM JOURNEY AND OVERVIEW

Coal-fired power stations are subject to strict environmental regulations and monitoring due to their emissions. All coal-fired power stations are required to meet the MES contained in GNR 893 that was issued on 22 November 2013 (as updated by GNR 1207 on 31 October 2018) and promulgated in terms of Section 21 of the NEM: AQA.

Between 2018 and 2020, Eskom submitted applications for postponement, suspension and/or alternative limits to the MES for several of its power stations to the DFFE as the power utility sought more time to implement necessary pollution control technologies for NO_X, SO_2 and PM emissions.

To address emission reductions, Eskom developed an Emission Reduction Plan (ERP) in 2015, with this being updated in 2019 (EERP 2019), 2020 and 2022. In May 2024, as part of the Minister's decision, Eskom were required to review the 2022 ERP, with this having been revised by Eskom in 2024.

Currently installed emission abatement equipment at each station within the Eskom Fleet are presented in Table 5-1.

Table 5-1 – Current installed abatement on Eskom Fleet

STATION	CURRENT INSTALLED ABATEMENT
Lethabo	Electrostatic precipitators (ESPs), sulphur trioxide (SO_3) plant, and high frequency power supplies (HFPS) to mitigate PM emissions.
Medupi	Pulse Jet Fabric Filter (PJFF) to mitigate PM emissions Low NO_X Burner (LNB) to mitigate NO_X emissions
Matla	ESPs, HFPS (Unit (U) 1, U2, U4 and U6), and SO_3 plant to mitigate PM emissions
Duvha	ESPs and SO_3 Plants (U4, U5, U6), fabric filters (U1, U2), HFPS (U5) to mitigate PM emissions
Tutuka	ESPs, HFPS (U4, U5, U6) to mitigate PM emissions
Kendal	ESPs, HFPS and SO_3 plant to mitigate PM emissions. Low NO_X boilers designed to mitigate NO_X emissions
Majuba	PJFF to mitigate PM emissions
Matimba	ESPs and SO_3 plant to mitigate PM emissions Low NO_X boilers designed to mitigate NO_X emissions
Kusile	Wet FGD, PJFFP to mitigate PM emissions Low NO_X Burner (LNB) to mitigate NO_X emissions
Arnot	PJFFP to mitigate PM emissions
Kriel	ESP Upgrade, HFPS installation (in progress) and SO_3 plant to mitigate PM emissions
Camden	PJFFP to mitigate PM emissions, LNB to mitigate NO_X emissions
Hendrina	PJFFP to mitigate PM emissions
Grootvlei	PJFFP to mitigate PM emissions, 4-units offline

Eskom's focus on PM emission reduction is aligned with the ambient monitoring data from the stations located in the Waterberg; importantly these stations represent cumulative ambient concentrations with Eskom not being the sole contributor to measured concentrations. The Waterberg monitoring stations indicate non-compliance with the PM_{10} and $PM_{2.5}$ NAAQS, with annual exceedances at Marapong, while 24-hr exceedances also occurred more than the permitted frequency of exceedances at Marapong and Medupi.

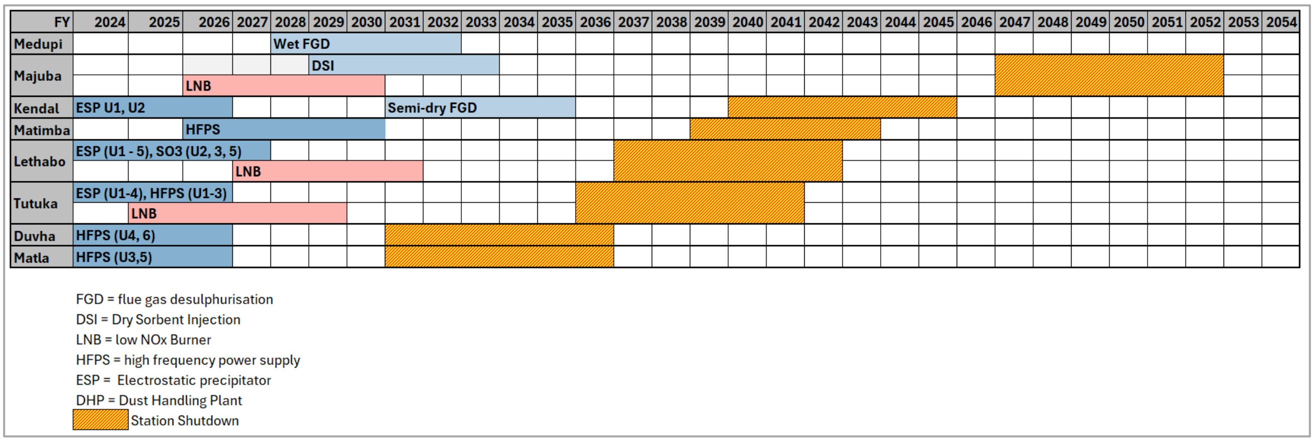
While PM has been the critical focus, NO_X and SO_2 emission reduction projects have also been considered. However, unlike PM, ambient NO_2 and SO_2 concentrations in the Waterberg for 2021 – 2023 remain below the annual SO_2 and NO_2 NAAQS; although exceedances of the short-term SO_2 averaging periods (10-minute, hourly, 24-hour, as applicable) of the NAAQS were measured, their frequency of occurrence remained below the permitted frequency of exceedance, remaining compliant with relevant standards. No short-term exceedances of the NO_2 NAAQS were recorded.

Following Eskom's review of the 2022 ERP, and to ensure continued focus on emission reductions, Eskom developed the 2024 ERP. In addition to the various abatement equipment upgrades and refurbishments currently being undertaken at each station, predominantly addressing PM emissions through ESP refurbishments, HFPS upgrades, SO_3 plant upgrades, and Dust Handling Plant (DHP) upgrades, many of which are already complete, Eskom are also planning and/or evaluating the following to reduce emissions:

- Wet flue gas desulphurisation (FGD) at Medupi (included in previous ERPs)
- Kendal (semi-dry FGD) and Majuba (Duct Sorbent Injection (DSI FGD)) SO_2 reduction projects have been identified as potential alternatives, although are being evaluated as part of this process.
- Low NO_X Burner (LNB) technology at Majuba, Tutuka and Lethabo to mitigate NO_X emissions.
- Despatch Prioritisation Strategy at specific power stations, initiated to reduce SO_2 emissions, however also positively impacting PM and NO_X emissions.
- Efficiency improvement projects under the Generation Recovery Programme to optimise the air-to-fuel ratio which should abate some SO_2 emissions and maximise combustion efficiency.
- The progressive shutdown of coal-fired stations will reduce overall Eskom Fleet emissions.
- Although not a method of reducing emissions at source (i.e. the power stations), the cumulative impact on neighbouring communities is reduced through the air quality offset (addressing emission sources within the community) projects already implemented by Eskom, therefore Eskom are looking to expand this beyond the 35,000 households originally planned.

Figure 5-1 illustrates Eskom's planned or estimated installation dates, linked to the 2024 ERP, for abatement equipment upgrades, retrofits, and new installations. This installation schedule considers:

- Time required to secure funding for each project.
- Lead time required to procure, design, manufacture, and begin installations.
- The outage schedule to allow generating units to be taken offline for upgrades / retrofitting while not impacting grid supply i.e. ensuring sufficient generating capacity remains across the stations to avoid loadshedding.
- To ensure sufficient capacity remains in the grid, generally only a single generating unit at a station can be taken offline at a time, particularly with regards to the long installation timelines of the equipment.



FGD = flue gas desulphurisation
DSI = Dry Sorbent Injection
LNB = low NOx Burner
HFPS = high frequency power supply
ESP = Electrostatic precipitator
DHP = Dust Handling Plant
▨ Station Shutdown

Figure 5-1 - Eskom's abatement equipment installation schedule

Coal beneficiation as a method of reducing SO_2 emissions has been investigated by Eskom and research continues. Investigations to date illustrate the potential for sulphur reduction but various complexities in terms of implementation need to be confirmed and managed such as the energy intensive nature of the process, increased coal mined, and the generation of additional wastewater and coal discards/solid waste. The financial and contractual implications of beneficiation also need to be assessed and shown to be positive for Eskom. Given these uncertainties Eskom has not included any benefit associated with coal beneficiation in the ERP and emission reduction calculations. Any emission reduction identified in this area in future will be considered additional to the 5% improvement in emissions associated with efficiency improvement projects.

Similarly, investigations completed to assess emission reductions using coal with a lower sulphur content confirm that for Eskom to obtain coal with low(er) sulphur content will, in most cases, require sourcing a washed product. This will result in Eskom acquiring coal from the same source pool that services the export market. Purchasing export market coal will result in a significant cost increase for Eskom and this filter though as an increase in electricity prices.

5.1.1 DESPATCH PRIORITISATION STRATEGY

With the addition of alternate energy sources (wind and solar) on to the national grid planned in the draft IRP, the existing coal fired power stations are expected to provide additional flexibility to the system through increased variability in a load following mode of operation, as well as providing back-up to the variable intermittent non-dispatchable renewable technologies, as well as providing ancillary services, inertia etc. which are not provided by the inverter-based renewable technologies. This essentially results in lower running load factors for these stations as the renewable energy sources will be given priority dispatch over the fossil fuelled stations. Furthermore, South Africa's commitments under the Paris Agreement (with the upcoming revision of the NDC) is expected to result in a new GHG emissions target for 2035. Considering an indicative limit of 125-140 Mt CO_2 per annum from fossil fuel generation from 2031, this equates to average load factors of 40-45% for stations operating in 2031 and between 48% to 55% for stations operating beyond 2035, i.e. after Matla and Duvha shutdown. While the MES and climate change regulatory process are legally separate it is useful to note both ERP 2024 A and the security of supply projection are aligned with Eskom's current pollution prevention plan running to December 2025. Future CO_2 trajectories will be based on the updated pollution prevention plan and IRP, NDC, and Sectorial Emission Targets (SET).

Despatch Prioritisation of renewables reduces SO_2 emissions given the costs associated with SO_2 abatement equipment, complexities of installation, and the age of most stations within the Eskom fleet where return on investment may not be realised. The recent improvement in the reliability of the fleet, allowing Eskom to adopt increased use of Despatch Prioritisation to reduce emissions, is due to a variety of reasons, although most critically the successful implementation of the Generation Recovery Programme. This programme was initiated in March 2023 focusing on specific projects targeting major and minor breakdowns and has improved the generating capacity at stations, allowing improved load management.

To limit emission loads Eskom will not run coal stations at maximum loads but will rather aim to limit the loads to only what is required for system adequacy making maximum use of other available energy sources for generation, resulting in less coal burnt. This reduction in load will result in a reduction in the levels of total emissions from Eskom into the atmosphere. Although the objective is to reduce SO_2 emissions, given the reduced coal burnt, NO_X and PM emissions will also be positively impacted.

Although Despatch Prioritisation will lead to reduced emissions, it is noted this is based on other power generation sources being added to the grid, allowing Eskom to reduce loads overtime. The addition of these alternative generation sources is outside of Eskom's control, and therefore should these not materialise within anticipated timeframes or there is an increase in economic growth, to avoid constraining the economy and ensure continued grid stability and security of supply, in terms of national energy planning Eskom may be required to operate stations at higher loads with increased emissions.

5.2 MATIMBA POWER STATION

Eskom's predominant power generation technology is through using pulverised coal with approximately 90% of its current generating capacity coming in this form of power stations. One of the 14 coal-fired power stations is the Matimba Power Station.

Matimba is a dry cooled power station, designed to generate 3,990MW, with the first unit commissioned in 1987, obtaining its coal supply from the adjacent Exxaro Grootegeluk Colliery. In terms of the Integrated Resource Plan and the Eskom Consistent Data Set, coal-fired power stations are generally planned for decommissioning after 50 years although can be subject to review based on plant conditions, financial requirements and security of supply requirements, although for the purposes of this application, a 50-year life is assumed. Intended shutdown of Matimba is FY2039, with shutdown complete by FY2043, although approval from NERSA would be required.

5.2.1 CURRENT STATION PERFORMANCE AND EMISSION LEVELS

5.2.1.1 Sulphur Dioxide

Measured daily average SO_2 emissions at Matimba between 2019 and 2024 were 2,522 mg/Nm^3 (over-estimation as this includes upset conditions) remaining below the existing limit of 3,500 mg/Nm^3, with no exceedances of the daily average limit occurring in FY2023/24. Although the recorded average is compliant with the existing limit, this exceeds the new plant MES (1,000 mg/Nm^3).

SO_2 emissions are impacted by the variation in coal quality and the high sulphur content in the coal received. When batches of high sulphur coal are received, the daily average SO_2 emissions increase corresponding to the monitoring results of the coal quality. The high sulphur content in the coal received is an inherent property of the coal available in the Waterberg coal seams. To comply with the new plant MES, the station would need to retrofit SO_2 abatement technologies.

5.2.1.2 Oxides of Nitrogen

Measured daily average NO_X emissions between 2019 and 2024 averaged 441 mg/Nm^3 (over-estimation as this includes upset conditions) remaining below the new plant MES of 750 mg/Nm^3, with no exceedances of the daily average new plant MES occurring in FY2023/24. Matimba has corner fired boilers (CFB), with combustion staged which lowers NO_X emissions, resulting in compliance with the new plant MES.

5.2.1.3 Particulate Matter

During the period 2019 to 2024, Matimba had managed a daily average concentration of 36 mg/Nm^3 (worst-case as this includes upset conditions) complying with the new plant limit of 50 mg/Nm^3. However, since 2023, increases in PM emissions are evident, peaking in 2024 (January – August 2024), with an average concentration of 68 mg/Nm^3 (worst-case as this includes upset conditions), exceeding the new plant limit. Further, during FY2023/24, 886 exceedances (cumulative across all generating units) of the new plant limit have occurred during normal operations, while between April 2024 – October 2024 147 exceedances were recorded.

Matimba's outage philosophy was adjusted to cater for grid capacity constraints, with outage intervals shifted from two-year to three-year outages. Due to this, scheduled maintenance on the ESP could not be completed, with high levels of erosion of the collecting plates and distribution screens identified, impacting performance. During FY2024 the station was also negatively impacted by breakdowns on the ash handling plant (the Ash Stacker) which created space constraints at the plant, affecting the ESP performance due to the unavailability of the ash stacker.

5.2.2 EMISSION REDUCTION PROJECTS AND TIMELINES

5.2.2.1 Sulphur Dioxide

Various investigations were undertaken of the different SO_2 reduction technologies that are operating successfully in the field, all of which were taken through a qualitative technology evaluation undertaken by Eskom. The criteria selected for the evaluation facilitated a process of screening which of the technologies are feasible for recommendation for the Eskom fleet. The basis of the evaluation considered reagent availability in South Africa, the maturity of the technology, technology performance (removal efficiency), and complexity of the retrofit.

Of the technologies investigated, the semi-dry FGD was identified as the most appropriate for Matimba. However, Eskom has consistently indicated in its postponement applications that given the age of Matimba and reaching end of life, cost and complexity of implementation, and the general compliance of ambient SO_2 concentrations in the area, that implementation of any SO_2 reduction technology is not feasible and therefore has not undertaken further detailed planning to install SO_2 reduction technology.

Assuming Eskom was required now to implement SO_2 semi-dry FGD, construction and installation of this could only start in FY2031 as concept and design have not commenced, with execution taking five to six years to complete on all generating units. A best-case completion date of FY2035 would be achieved considering the project milestones, with Matimba entering shutdown phase from FY2039. Given the costs to install and operate an FGD (discussed further in section 5.6) and considering this would only be fully complete two to three years before shutdown phase commences, and therefore well before return on investment (ROI) is realised, Eskom considers it not practically feasible or beneficial to South Africa.

Matimba cannot reach the new plant SO_2 MES without an FGD, or similar SO_2 abatement, therefore, to reduce SO_2 emissions, although not to MES compliance, Matimba is planning:

- Despatch Prioritisation Strategy, based on future anticipated loads considering the current IRP and Eskom production plans. This Despatch Prioritisation will also positively impact PM and NO_X emissions.
- Efficiency improvements to optimize the air-to-fuel ratio which should abate some SO_2 emissions and maximize combustion efficiency. This requires in part, ensuring optimal mill firing configuration and design level pulverized fuel (PF) particle size distribution.

Should the anticipated additional capacity projections of the IRP be delayed, on which Eskom has determined future load requirements, resulting in the need for higher loads to meet electricity demand, Eskom's planned Despatch Prioritisation Strategy may not have the anticipated impact on emissions.

5.2.2.2 Oxides of Nitrogen

Matimba has CFB's with staged combustion which lowers NO_X emissions, and therefore an LNB, or similar technology, is not being considered at Matimba. Matimba is compliant with the new plant MES.

However, the station does have an outage maintenance philosophy to attend to combustion process optimization which includes fuel oil burner optimization and milling plant reliability. Emphasis would be placed on the maintenance strategies and to ensure that all maintenance activities are executed accordingly.

5.2.2.3 Particulate Matter

To address the recent elevated PM emissions, Matimba will be retrofitting HFPSs to the ESPs, with this due to commence in FY2026 with completion in FY2031. In conjunction with this, the ESP, SO_3 plant and DHP outage philosophy maintenance strategies will continue to be executed that have proven to be beneficial. Further, the challenges experienced with the ash plant have been resolved, which was the predominant cause of recent elevated emissions.

With the additional technology to supplement the performance of the ESP, and continuing with the maintenance philosophy, there will be a reduction in PM emissions. While Matimba, on average, shows compliance with the new plant MES, these projects will aid in reducing the irregular emissions, which have exceeded the new plant MES on occasions.

5.2.3 EMISSION REDUCTION TRAJECTORY

As discussed previously, various initiatives are underway and/or planned to further mitigate emissions at Matimba. While these initiatives will impact Matimba emissions positively, they cannot be considered in isolation from the total Eskom Fleet emissions. Given this, and the intent of Eskom to make a fleet exemption application, Eskom considered various emission reduction scenarios (ERP alternatives) based on present planning assumptions considering the various abatement initiatives undertaken, planned or being evaluated, energy demand, station shutdowns, and the positive impact of Despatch Prioritisation. No detailed stochastic energy systems analysis, such as is done for the Integrated Resource Plan (IRP), was completed for this exemption application process given time constraints. The energy projections used for the ERP alternatives were based on presently available planning assumptions and Eskom internal projections. Considering security of supply, a fourth emission projection was included, representing an upper emission limit projection based on more conservative assumptions than the original ERP alternatives with the aim to ensure security of electricity supply in the absence of any stochastic energy system analysis is provided. The trajectories considered comprised:

- ERP 2024 A (PM and NO_X reduction, Despatch Prioritisation strategy, efficiency improvements, and SO_2 abatement at Medupi and Kusile), representing Eskom's planned projection.
- ERP 2024 B (As per ERP 2024 A plus SO_2 reduction technology installed at Majuba and Kendal), representing a projection, that with additional guarantees and strategic decisions, could be achieved.
- ERP 2024 C (As per ERP 2024 A and B, plus SO_2 reduction technology at Matimba, Lethabo and Tutuka), representing a projection that would require substantial guarantees and considerations of the significant financial impacts, such as on electricity tariffs.
- Eskom's Security of Supply Projection developed using conservative assumptions such as higher electricity demands due to a growing economy, a delay in IPP projects, and a delay in Kusile U6 generating unit coming online.

Each ERP alternative emission trajectory considered, as well as the Security of Supply trajectory, and abatement projects linked to each are illustrated and discussed in the following sections. These sections consider a 2025 baseline for comparative purposes which better represents Eskom's current performance in meeting national demand as opposed to 2019, when loadshedding was in place, constraining the economy and reducing demand. For the following sections, it is assumed that the proposed FGD retrofit type (where applicable) on a 'six-pack' power station has proven to be technically feasible, notwithstanding that it would be a world-first.

5.2.3.1 Sulphur Dioxide

Eskom assessed three scenario options for this exemption application, namely the ERP 2024 A, ERP 2024 B, and ERP 2024 C (Figure 5-2), and given certain limitations of these (noted previously), a fourth option was included representing the Security of Supply projection. Scenario ERP 2024 A assumed only the FGD installation at Kusile and Medupi (completion in 2031) with no other stations receiving SO_2 abatement technology. Scenario ERP 2024 B assumed SO_2 abatement installations at Kusile, Medupi, Kendal, and Majuba, representing a potentially practical option based on previous investigations. Scenario ERP 2024 C assumed full SO_2 MES compliance, with SO_2 abatement installed at Kusile, Matimba, Medupi, Kendal, Majuba, Lethabo, and Tutuka (Matla and Duvha were not given FGD as it cannot be practically installed given their shutdown before 2035).

As illustrated, all three scenarios remain similar until FY2032, when the Majuba DSI takes effect, followed by the Kendal FGD, resulting in ERP 2024 B and ERP 2024 C having lower emissions than ERP 2024 A. In FY2036, ERP 2024 C reduces further due to a combination of SO_2 abatement technology at Lethabo and Tutuka, and the shutdown of Duvha and Matla. While actual emissions show a reduction between scenario ERP 2024 B and ERP C, approximately 72% in 2036, considering the dispersion modelling, ground-level concentrations for ERP 2024 B shows full compliance with the SO_2 NAAQS, with no short-term exceedances predicted. While the ERP 2024 C assumes SO_2 abatement at Lethabo and Tutuka, in addition to the already planned stations, the installation of these would only be complete one to two years before shutdown of each station commences; ground-level concentrations in Eskom's ERP 2024 B scenario still show full compliance with the NAAQS, therefore the benefit of installing SO_2 abatement at Lethabo and Tutuka is not realised.

Considering ERP 2024 A, by FY2030, compared to FY2025 (actuals), Eskom Fleet SO_2 emissions are anticipated to have reduced by 555kt, representing a 32% reduction in emissions. In FY2035, compared to FY2030, a further reduction of 165kt (14%) is anticipated, and by FY2040 a further 6% reduction is anticipated. Between FY2025 and FY2050, a total SO_2 emissions reduction of 85% (1.45Mt) is estimated.

Regarding Eskom’s Security of Supply projection, representing an upper emissions limit, emissions increase to FY2026, remaining above the ERP 2024 A, B, and C projections, although by FY2030 shows a 482kt (27%) reduction and is more closely aligned with the ERP projections. By FY2035, the Security of Supply projection shows a further reduction of 294kt (23%) and aligns more closely with the ERP projections, and from FY2036 shows closer alignment until FY2050. Crucially, although this is an upper emissions projection, the same trend of emission reductions year on year is evident from FY2026.

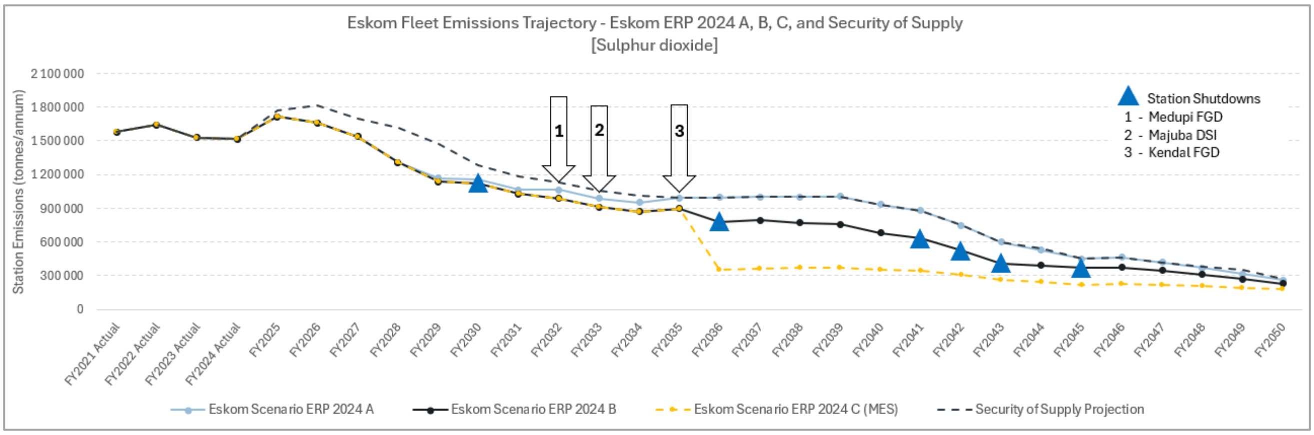


Figure 5-2 –Eskom Fleet sulphur dioxide emission trajectories

5.2.3.2 Oxides of Nitrogen

NO_X emission trajectories associated with ERP 2024 A, ERP 2024 B, ERP 2024 C and the Security of Supply are illustrated in Figure 5-3. All Scenario’s ERP 2024 A, ERP 2024 B, and ERP 2024 C assume the same NO_X abatement installed; that is LNBs at Tutuka, Majuba, and Lethabo, therefore the emission trajectory for each is the same, while the Security of Supply includes this abatement this is based on an increased electricity demand.

From FY2025, emissions are anticipated to reduce in the coming years due to the burner efficiency improvement projects, Despatch Prioritisation initiated to address SO_2 emissions, station shutdowns assumed to be complete by FY2030 (Grootvlei, Camden, Hendrina, Arnot, and Kriel), Duvha and Matla assumed to be entering shutdown phase in FY2031, and the completion of the LNB abatement on Tutuka (FY2029), Majuba (FY2030), and Lethabo (FY2031). By FY2030, compared to FY2025 (actuals), Eskom Fleet NO_X emissions are anticipated to have reduced by 292kt, representing a 40% reduction. Emissions remain stable until FY2041, after which further reductions will occur due to stations entering shutdown. Between FY2025 and FY2050, a total NO_X emissions reduction of 78% (574kt) is estimated.

Considering Eskom’s Security of Supply projection, representing an upper emissions limit, emissions increase to FY2026, remaining above the ERP 2024 A, B, and C projections, given the conservativeness of the Security of Supply projection, although by FY2030 shows a 256kt (33%) reduction and is more closely aligned with the ERP projections. By FY2035, a further 151kt (29%) reduction is estimated and aligns more closely with the ERP projections and shows closer alignment until FY2041. As noted, although this is an upper emissions projection, the same trend of emission reductions year on year is evident from FY2026.

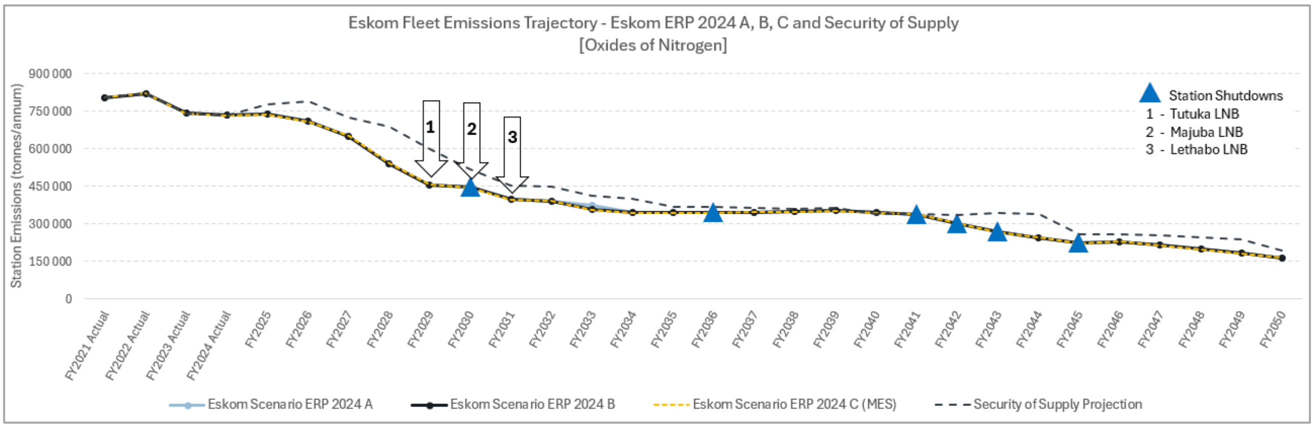


Figure 5-3 –Eskom Fleet oxides of nitrogen emission trajectories

5.2.3.3 Particulate Matter

PM emission trajectories associated with ERP 2024 A, ERP 2024 B, ERP 2024 C and the Security of Supply are illustrated in Figure 5-4. As noted, all alternatives considered the same PM abatement installed at Tutuka, Matla, Duvha, Kendal, Lethabo, and Matimba, so have the same trajectories, while the Security of Supply trajectory includes these projects as well as increased generation to meet demand assumptions.

From FY2025, emissions are anticipated to reduce sharply until FY2028 due to the PM abatement projects at Tutuka, Matla, Duvha, Kendal and Lethabo, as well as the progression of the assumed shutdown phases at Grootvlei, Hendrina, Arnot, Kriel, and Camden. From FY2030, PM emissions remain consistently low, showing further reductions from FY2040 due to stations assumed to be entering shutdown phases. By FY2030, compared to FY2025 (actuals), Eskom Fleet PM emissions are anticipated to have reduced by 65kt, representing a 74% reduction, after which emissions will gradually reduce as stations enter shutdown. Between FY2025 and FY2050, a total PM emissions reduction of 94% (82kt) is estimated.

Considering Eskom's Security of Supply projection, representing an upper emissions limit, emissions show a similar trend to the ERP projections, although are marginally higher between FY2026 to FY2030 due to the conservativeness of this projection. By FY2030, a PM reduction of 64kt (71%) is estimated, with a further reduction by FY2035 of 6.5kt (25%). As noted, this is an upper emissions projection, the same trend of emission reductions year on year is evident from FY2026.

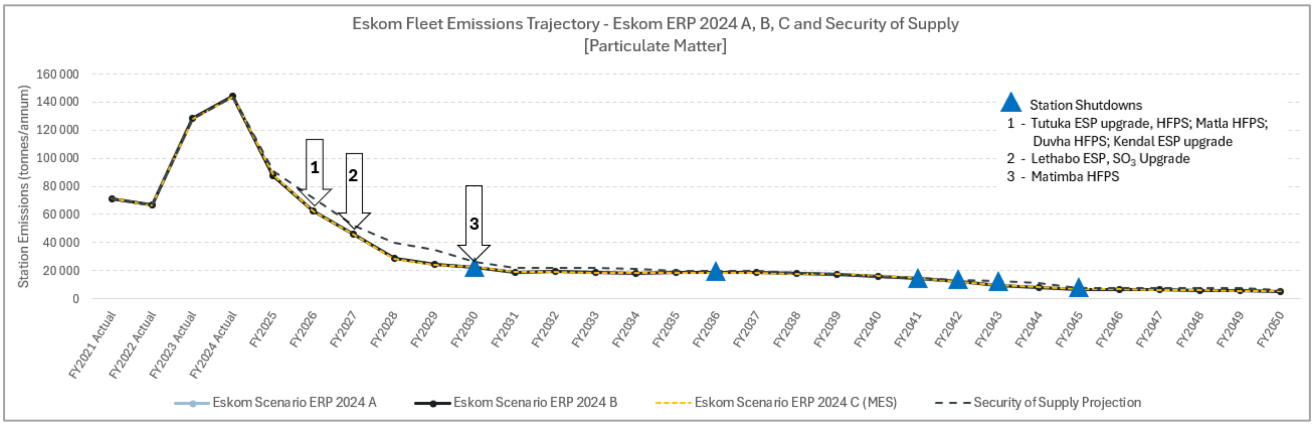


Figure 5-4 –Eskom Fleet particulate matter trajectories

5.2.3.4 Establishment of an Emission Reduction Trajectory

The scenarios described above have referred to emission reduction trajectory in terms of PM, NO_X and SO_2. With scenario ERP 2024 A showing emission reductions by FY2030 for PM (65kt), NO_X (292kt), and SO_2 (555kt), while the Eskom security of supply projection also shows reductions by FY2030 for PM (64kt), NO_X (256kt) and SO_2 (482kt). While the MES and climate change regulatory process are legally separate it is useful to note both ERP 2024 A and the security of supply projection are aligned with Eskom's current pollution prevention plan running to December 2025. Future CO_2 trajectories will be based on the updated pollution prevention plan and IRP, NDC, and Sectorial Emission Targets (SET).

The Priority Area regulations and priority area plans refer to emission reduction targets, with the draft HPA plan indicating that industry should obtain a 40% reduction in total emissions by 2030 from a 2019 base. The emission reduction projections described above are based on the best available assessment of what Eskom is required to generate from coal stations in terms of the nationally driven IRP process and Eskom planning. Neither of these processes are static and they are influenced by a range of factors including economic growth rates, IPP production and national climate change commitments. If economic growth increases and there are substantive delays in the provision of non-coal-based generation then the Eskom coal fleet may be asked to ensure security of supply which will result in an increase in emissions above the trajectories predicted in this application. As such Eskom believes it would be inappropriate for the setting of specific legally binding emission reduction targets at either a fleet or station level and request exemption from any such requirements where they are enforced through air quality related legal mechanisms.

5.2.4 MATIMBA'S PROPOSED EMISSION LIMITS

As contained within Matimba's AEL (ref. no. H16/1/13-WDM05), Matimba is required to meet the following MES concentration limits:

- Particulate matter:
  - 50 mg/Nm^3 daily average current, and post 1 April 2025
- Oxides of nitrogen:
  - 750 mg/Nm^3 daily average current, and 750 mg/Nm^3 post 1 April 2025
- Sulphur dioxide:

- 3,500 mg/Nm^3 monthly average current, and 1,000 mg/Nm^3 post 1 April 2025. It is noted the AEL currently indicates 500mg/Nm^3, however according to the MES amendment (GNR 1207, 2018), existing plants are to comply with a new plant MES of 1,000mg/Nm^3.

Matimba currently complies with the new plant NO_X MES, and while recent elevated PM emissions occurred, these will be addressed through the maintenance philosophy, with HFPSs being installed in future; therefore, Matimba is not requesting exemption from the new plant NO_X or PM MES. Since it is not feasible to install FGD at Matimba, as presented herein, Matimba is requesting exemption from the new plant SO_2 MES until shutdown.

While Eskom recognise the importance of pollution concentrations in a stack, of equal importance is the total mass of pollutants emitted from a stack which are directly related to environmental impacts. As presented in Section 5.2.3 Eskom's cumulative mass of pollutants emitted show decreases between FY2025 – FY2050. The dispersion model considered Eskom's anticipated loads and associated emissions, on average, so modelled concentrations are lower than the limits requested herein. The limits requested by Eskom will allow for increased loads according to demand, however as indicated in Section 5.2.3. Eskom's total mass of emissions is anticipated to decline year on year.

Table 5-2 presents Matimba's requested emission limits, applicable to normal operating conditions, so excluding start-up or shutdown, upset conditions and maintenance periods. Key considerations to the requested concentration limits include:

- Particulate matter:
  - Matimba is compliant with the new plant MES therefore no PM exemption is requested.
- Oxides of nitrogen:
  - Matimba is compliant with the new plant MES therefore no NO_X exemption is requested.
- Sulphur dioxide:
  - Measured ambient SO_2 concentrations comply with the NAAQS in the Waterberg area.
  - Cumulatively, the Eskom Fleet shows substantial reductions in SO_2 emissions, as presented previously.
  - According to the dispersion modelling (section 6.1) annual and hourly average ground-level SO_2 concentrations due to the Eskom Waterberg Fleet emissions, under all modelling scenarios, are below the NAAQS, with no exceedances of the hourly NAAQS predicted.
    - Exceedances of the 24-hour NAAQS are predicted, above the permitted frequency of exceedance for Scenario A and B. However, once the Medupi FGD installation is complete, cumulative 24-hour concentrations will be compliant with the NAAQS (Scenario C).
  - Existing ambient SO_2 concentrations in the Waterberg area comply with the NAAQS, and since it is not economically feasible to install SO_2 abatement at Matimba, Matimba will manage SO_2 emissions through Despatch Prioritisation Strategy and efficiency improvements.

The emission limits being requested for Matimba are presented in Table 5-2, and be considered to also be set as Eskom's emission targets in terms of the Priority Area Plans.

Table 5-2 – Emission limits requested for Matimba

POINT SOURCE CODE	POLLUTANT	MAXIMUM RELEASE RATE*			DURATION OF EMISSIONS
		mg/Nm^3	Average Period	Date To Be Achieved	
SV0013, SV0014, SV0015, SV0002, SV0011, SV0012	SO_2	3,500 mg/Nm^3	Monthly	1 April 2025 - shutdown	Continuous
	NO_X	750 mg/Nm^3	Daily	1 April 2025	Continuous
	PM	50 mg/Nm^3	Daily	1 April 2025	Continuous
*Emission limits requested are for normal operations, so exclude upset, startup, shutdown, or maintenance conditions					

5.2.5 COSTS TO REACH MES COMPLIANCE

As noted previously, semi-dry FGD is the most suitable technology for Matimba, but Eskom finds it infeasible due to the plant's age, costs, and compliance with ambient SO_2 levels. If required to implement it now, construction could start in FY2031, with completion by FY2035 and shut-down by FY2039. Certainty around cost is only reached once the contract has been awarded and will be accurate to within 90%.

Currently, and based on FY2023/24, the projects already approved at Matimba comprise:

- HFPS (PM compliance):
  - Capex ≈ R1.4 billion

Should SO_2 MES compliance be enforced at Matimba, the semi-dry FGD costing is based on Medupi costing. However, critically, Medupi is FGD ready, and all due consideration was taken when it's costing was conducted. With a brownfield project like Matimba, a site characterization would be required which could potentially increase estimated costs. Compliance with the SO_2 MES at Matimba would require an FGD retrofit, at an estimated Capex of R43 billion and Opex of R1,04 billion.

5.3 ESKOM AIR QUALITY OFFSETS

According to the *Air Quality Offsets Guideline (Government Gazette No. 39833 of March 2016) (hereafter referred to as 'the Air Quality Offsets Guideline')*: *"In the air quality context, an offset is an intervention, or interventions, specifically implemented to counterbalance the adverse and residual environmental impact of atmospheric emissions in order to deliver a net ambient air quality benefit within, but not limited to, the affected airshed where ambient air quality standards are being or have the potential to be exceeded and whereby opportunities and need for offsetting exist."* (Republic of South Africa, National Environmental Management: Air Quality Act, 2004 9Act No.39 of 2004), Air Quality Offsets Guideline., Air Quality Offsets Guideline, 2016)

Whilst Eskom continues to persevere in improving ambient air quality through the reduction of emissions in the existing coal-fired fleet, retrofitting abatement technology and diversifying the energy fleet is extremely costly. This will impact all of South Africa financially, while also taking a long time to implement. Air quality offsets (AQOs) afford the opportunity to address emission sources directly within vulnerable communities, and to target greater improvement in community-experienced air quality than is achievable from other approaches. Such offsets are more cost-effective and can result in meaningful improvements in air quality within a shorter period.

Eskom embarked on their first AQO programme in 2016, following the National Air Quality Officer's decision that each power station must develop and implement an offset programme targeting particulate matter (PM_{10} and $PM_{2.5}$) concentration reduction in the ambient environment. Eskom's first AQO Plans, initially submitted for the Nkangala District Municipality, Gert Sibande District Municipality, and Lethabo Power Station, were approved by the National Air Quality Officer, together with the relevant Atmospheric Emission Licensing authorities, in September 2016. These were later updated and resubmitted in April 2021, with updates provided annually. Eskom's AQO Plans cover the period April 2016 to March 2025.

5.3.1 ESKOM'S AIR QUALITY OFFSET JOURNEY

Eskom began their first AQO initiative in 2011 with a pre-feasibility study to identify potential strategies to best meet the offset requirements of their Atmospheric Emissions Licenses (AELs). Several initiative implementation trials took place in Kwazamokuhle (a township near Hendrina Power Station, Mpumalanga) from 2013 to 2017, before Eskom's 2016/2017 Offset Implementation Plan was finally formulated. Interventions within the programme target domestic fuel burning for heating and cooking in the Highveld region, particularly Kwazamokuhle and Ezamokuhle, whilst interventions target both domestic fuel burning and domestic waste burning in the Vaal. Presently, the AQO Plans are being executed in stages across various communities in proximity to Eskom coal-fired power stations in both the Highveld and Vaal regions.

Table 5-3 outlines the main interventions completed and planned as part of Eskom's AQO Programme (Eskom, 2024).

Table 5-3 - Air Quality Offset Interventions

Phase	Power station	Settlement	No of Houses	Start	End	Comments
Phase 1	Hendrina	Kwazamokuhle	3700	2021	2024	Completed
	Majuba	Ezamokuhle	2100	2021	2024	Completed
	Lethabo	Sharpeville		2021	2024	Completed
Phase 2a	Tutuka	Sivukile	1160	April 2024	Dec 2025	Contract terminated. Tender to be reissued
	Kendal	Phola	66073	Nov 2024	Oct 2029	In the procurement phase – Contract being negotiated.
Phase 2b	Matla	Emzimnoni	3440	April 2025	Mar 2030	Budget secured. In the procurement phase.
	Duvha	Masakhane	886	April 2025	Mar 2030	Budget secured. In the procurement phase.
	Kriel	Thubelihle	2390	April 2025	Mar 2030	Budget secured. In the procurement phase.
	Arnot	Silobela	2003	April 2025	Mar 2030	Budget secured. In the procurement phase.
	Lethabo	Refengkotso	500	April 2025	Mar 2030	Budget secured. In the procurement phase.
	Lethabo	Boitshepiville	N/A	April 2025	Mar 2030	Budget secured. In the procurement phase.
Phase 2c	Camden	New Ermelo	935	Sept 2025	Aug 2030	Budget approval outstanding
	Grootvlei	Grootvlei village/Ntorwane	2000	Sept 2025	Aug 2030	Budget approval outstanding
	Camden	Nederland	1660	Sept 2025	Aug 2030	Budget approval outstanding

Phase	Power station	Settlement	No of Houses	Start	End	Comments
	Duvha	eMalahleni	2000	Sept 2025	Aug 2030	Budget approval outstanding

5.3.1.1 Air Quality Offset Impact Assessment

The effectiveness of Eskom's AQO Plans depend on how well the interventions are planned, monitored and verified. Eskom has established a Planning, Monitoring and Verification (PMV) contractor, to provide PMV services for Phase 1 of Eskom's AQO Plan at Kwazamokuhle, Ezamokuhle and Sharpeville. Three key indicators will be monitored before, during and after offset implementation, namely the state of ambient air, emissions and quality of life (Air Resource Management (ARM), 2024). Over every monitoring period, the AQO project scenario (as it took place) will be compared to a credible baseline scenario (i.e., the situation that would have been the case if the project were not implemented). The principal indicator of success of the intervention will be related to a change in exposure to air pollution and nett emissions avoided as a result of Eskom AQO interventions. Further PMV activities and studies are still needed to understand the improvement in ambient air quality because of the AQO interventions. Various project effectiveness surveys have been completed in Ezamokuhle and Kwazamokuhle to assess the impact of Eskom's AQO interventions, as summarised below.

The calculated the net reduction in emissions associated with the AQO rollout in Kwazamokuhle and Ezamokuhle (approximately 4,255 households), which shows a notable reduction in annual PM_{10} (132 tons), $PM_{2.5}$ (123 tons) annually, as well as CO, SO_2, NO_2, VOCs and methane emissions to air. Indoor PM_{10} and $PM_{2.5}$ monitoring in participating households in Ezamokuhle showed a notable decrease in indoor pollution concentrations following the AQO interventions. Furthermore, data collected from questionnaires distributed to Kwazamokuhle's and Ezamokuhle's participating households showed that 84% and 85%, respectively, of respondents were completely satisfied with the intervention, as it improved their quality of life (Air Resource Management (ARM), 2024), (Eskom, Progress Report, March 2024). Post-intervention monitoring and surveys are scheduled for Sharpeville in 2025. Eskom have quantified the air quality impact of AQO waste interventions at Sharpeville by calculating the nett emissions avoided and developing an air dispersion model. The net emissions avoided associated with the first three clean-up campaigns show the greatest potential reduction is of PM_{10} (16,01 tons) and $PM_{2.5}$ (15,96 tons), with notable reductions in potential NO_2 (3,32 tons) and SO_2 (0,33 tons) emissions also observed. Results of the dispersion modelling exercise predict potential air quality improvements due to emissions avoided from the first three waste clean-up campaigns (Air Resource Management (ARM), 2024).

5.3.2 ESKOM'S MATIMBA AIR QUALITY OFFSETS OPPORTUNITIES

Marapong and Lephalale townships are located within the Waterberg-Bojanala Priority Area (WBPA), proximate to Matimba Power Station (Department of Environmental Affairs, 2014). Over the past three years, concentrations recorded at the Marapong village and Medupi (offsite) air quality monitoring stations show non-compliance of ambient PM_{10} and $PM_{2.5}$ and compliance of ambient SO_2 concentrations with the National Ambient Air Quality Standards (NAAQS). Data recorded at the Lephalale air quality monitoring station shows compliance of ambient PM_{10}, $PM_{2.5}$ and SO_2 concentrations recorded at Lephalale are compliant. According to the WBPA Air Quality Management Plan (AQMP), over 70% of total PM_{10} emissions in the area are a result of mining activities, with industrial emissions contributing approximately 27% (Eskom, 2021 - 2023). The WBPA AQMP also found that sulphur dioxide (SO_2) emissions are mainly a result of fossil fuel combustion by industry in the area, contributing 99.9% towards total emissions. Research completed by the North-West University confirmed that Matimba, and the nearby Medupi power station, are the most significant contributors to SO_2 emissions in the area (North-West University, Emissions Inventory, 2024). However, the WBPA AQMP found that, despite the significant SO_2 emissions to air, ambient SO_2 concentrations were relatively low in comparison to the NAAQS. When taking a closer look at the monitoring data, it was observed that ambient SO_2 concentrations in the community of Marapong, where 20% of households use wood as their primary energy source, are notably influenced by biomass fuel burning (North-West University, 2024). Furthermore, the WBPA AQMP found that the main contributing source to ambient PM_{10} and $PM_{2.5}$ exceedances within Marapong was biomass fuel burning (Department of Environmental Affairs, 2014).

Eskom established a contract with the North-West University to better understand the need and opportunities for air quality offset projects targeting local sources of SO_2 and particulate emissions in Marapong (Eskom, 2024). Following completion of their research into the current state of air quality, emission sources and potential air quality offset opportunities, possible interventions were identified, as listed below:

- "Clean Household Energy Program: Introducing cleaner energy sources, particularly LPG or electric cookers, to replace coal and biomass for cooking and heating. Based on our preliminary analysis of the community survey results, the primary energy sources for cooking in Marapong are electricity (70%), wood (20%), and gas (10%). In contrast, Steenbokpan predominantly relies on wood (80%), with electricity accounting for only 20%. Wood usage in these communities is therefore a major contributing factor to local emissions.
- Waste Burning Management: Implementing measures to reduce the open burning of waste in households and community spaces, including the introduction of waste collection services and educating the public on the health impacts of waste burning. From the emissions verification exercise conducted in Marapong, it was established that the residents practice open dumping and burning of all their wastes, and this contributes to PM pollution in the township.
- Reforestation and Greening of Spaces: Planting trees to act as windbreakers and creating green spaces that provide ground coverage to help prevent the transport of pollutants, including dust. These natural barriers mitigate the spread of airborne particles from roadways and industrial activities, improving local air quality.
- Surfacing of Bare Public Grounds: Surfacing of pavements, school yards, and sports fields would minimize dust generation from exposed soil and improve the overall aesthetic and health environment of the community."

The pre-feasibility study conducted by the North-West University indicates the need and opportunity for air quality offsets exist for Marapong and the surrounding communities, and that air quality offsets are a viable solution for emissions reduction (North-West University, 2024). The above AQO interventions were recommended for further investigation as they have the potential to create the greatest positive impact in Marapong and surrounding communities through SO_2 and particulate emissions control and reduction. Further investigation is required, including a feasibility study to ascertain their viability, effectiveness, and cost-effectiveness for air pollution reduction in the local community.

5.4 NATIONAL ELECTRICITY SUPPLY ISSUES

South Africa's electricity system has been strained over the past 10-12 years and was not able to provide sufficient power to meet demand due to breakdowns causing reduced capacity, and recurrent loadshedding had to be implemented to protect the system. The electricity crisis has been severely damaging to the South African economy, with no sectors untouched by these impacts. Mining and industry were severely impacted, with outputs reduced, resulting in a loss in investor confidence leading to postponed or cancelled investments into South Africa. Further, power outages led to impacts on quality of medical care, cold food chain storage facilities, failure of equipment in sanitation, bulk water, and sewerage facilities, to name a few. Outside of this, South African citizens experienced day to day difficulties, such as extended commutes to work due to power failures, increased crime due to lighting outages and lack of communications, and difficulties to prepare food.

The eventual objective of the energy policy is to reduce reliance on coal and to expand electricity generation through renewable and/or lower emission options, the reality of this unfortunately, is that the roll-out of these projects is not at the desired rate, with the South African power generation system remaining insecure. Importantly, and adding to the challenges of transitioning to renewables, is that 1GW of coal produces far more energy than 1GW of wind or solar PV. Therefore, much more solar or wind capacity is needed to produce the same amount of energy as coal combustion. To ensure adequate energy margin in the grid, to either start reducing the amount of coal burnt and/or allowing for the upgrading and retrofitting of abatement technologies, various initiatives will be required to ensure energy security is not jeopardized.

Eskom intends to align with the National Energy Crisis Committee (NECOM) Energy Action Plan of combining immediate solutions to address the energy gap, such as demand reduction, accelerating the building of generation and storage capacity, expanding and improving infrastructure, and 'fixing' Eskom. The sourcing of power (Independent Power Producers-IPP), an externality that Eskom has no control over but certainly welcomes, is a longer-term strategy that will aid in fast tracking the decommissioning of power plants reaching end of life. Since these processes are complex, involving multiple parties and stakeholders, the time for them to take effect is difficult to determine and plan.

The amount of electricity Eskom is required to supply is defined through the Integrated Resource Plan (IRP). A draft IRP was published on 4 January 2024 and an update of this plan is expected. For the modelling work undertaken for this application Eskom was informed by the draft IRP 2023 and its own production plan projections over the periods until 2030 and then beyond. Due to time constraints no specific energy system modelling exercise was completed for this application.

As indicated above there are a range of factors which impact on energy demand nationally and security of supply and in terms of what Eskom is required to deliver. Changes in these factors and the assumptions they create will impact on the requirement for Eskom generation and some of the impacts and assessments presented in this application. A review of this application in light of the revision of the IRP is recommended.

6 HEALTH & ENVIRONMENTAL IMPACTS

6.1 AIR QUALITY IMPACTS

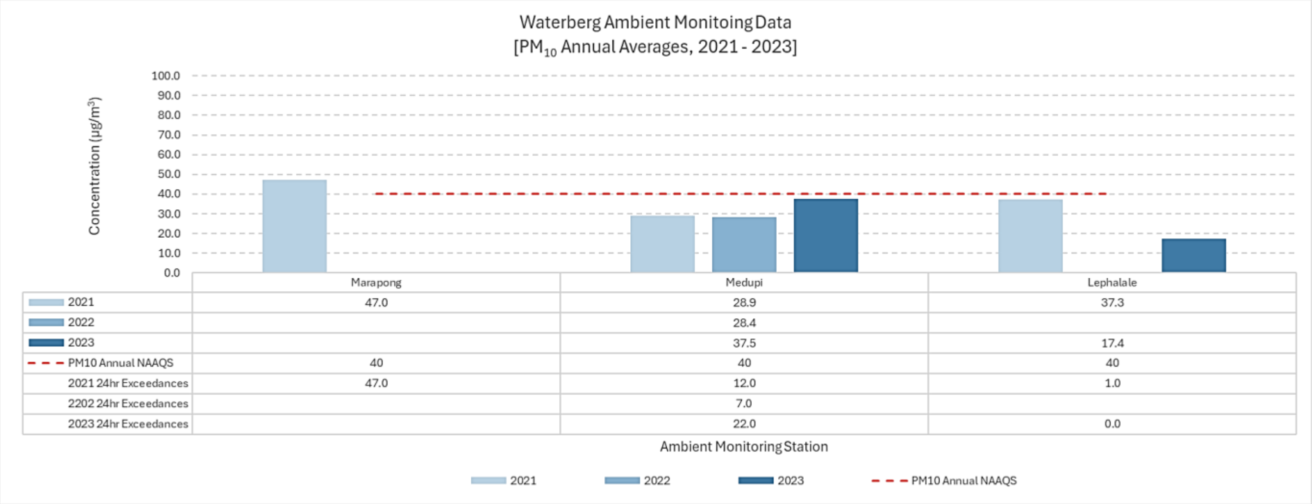
6.1.1 BASELINE AMBIENT AIR QUALITY MONITORING DATA

Ambient air quality monitoring stations in the Waterberg considered in this exemption application comprised Eskom owned stations and South African Weather Services (SAWS) stations, for the period 2021 - 2023. Although a minimum data recovery of 90% is required, as stipulated by the SANAS TR 07-03 (SANAS, 2012), for the purposes of this report, data recovery of 50% and greater were considered. The stations considered for both Medupi and Matimba were Marapong, Medupi (both Eskom owned) and Lephalale (SAWS).

Figure 6-1 illustrates annual average PM_{10} concentrations and exceedances of the 24-hour average NAAQS measured in 2021 – 2023; no data was recovered from the Marapong station in 2022 and 2023, nor Lephalale in 2022. Except for Marapong, which exceeded the annual NAAQS, all other annual averages remained compliant with the NAAQS, although Medupi does show elevated concentrations. Considering 24-hour averages, both Marapong and Medupi indicate non-compliance with the 24-hour NAAQS given the number of exceedances measured each year, which exceeded the permitted frequency of exceedances (four exceedances are permitted per calendar year).

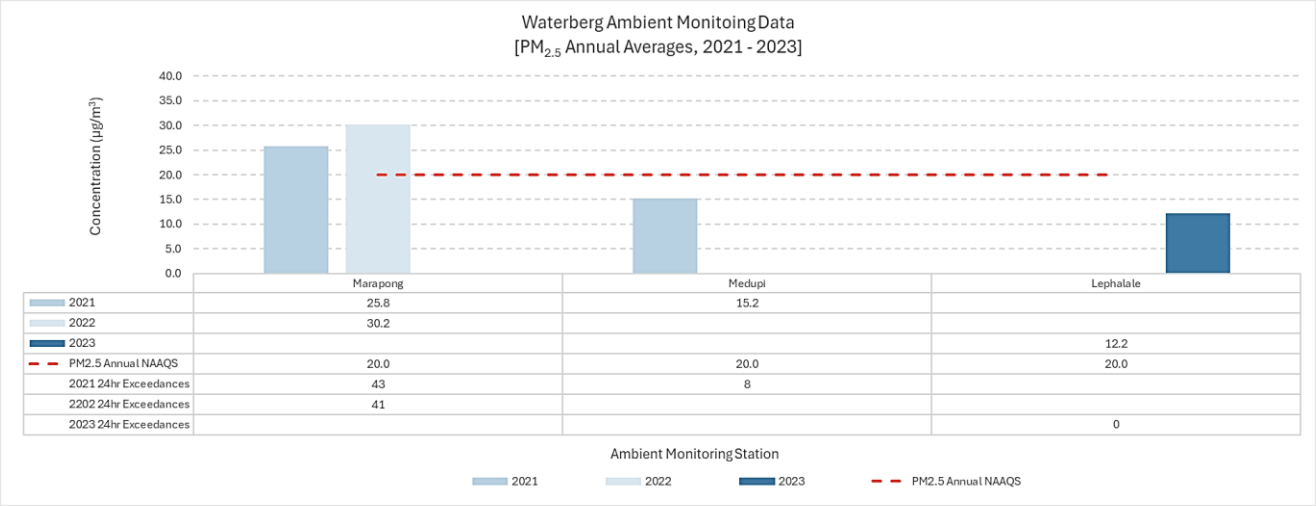
Considering $PM_{2.5}$ concentrations, as illustrated in Figure 6-2, non-compliance with the annual NAAQS is evident at Marapong, with Medupi and Lephalale showing compliance with the annual $PM_{2.5}$ NAAQS, although this should be viewed with caution given the missing data. While Medupi showed compliance with the annual NAAQS in 2021, the number of 24-hour exceedances recorded exceeded the permitted frequency of exceedances. 24-Hour exceedances at Marapong also exceeded the permitted frequency of exceedances, with four exceedances permitted per calendar year.

While PM concentrations show general compliance with the NAAQS, the standards should be considered as becoming saturated, and therefore the contributing emission sources in the area should receive focus. Key sources of emissions in the area comprise mining, Medupi and Matimba, exposed areas and domestic fuel burning.



	Marapong	Medupi	Lephalale
2021	47.0	28.9	37.3
2022		28.4	
2023		37.5	17.4
PM10 Annual NAAQS	40	40	40
2021 24hr Exceedances	47.0	12.0	1.0
2202 24hr Exceedances		7.0	
2023 24hr Exceedances		22.0	0.0

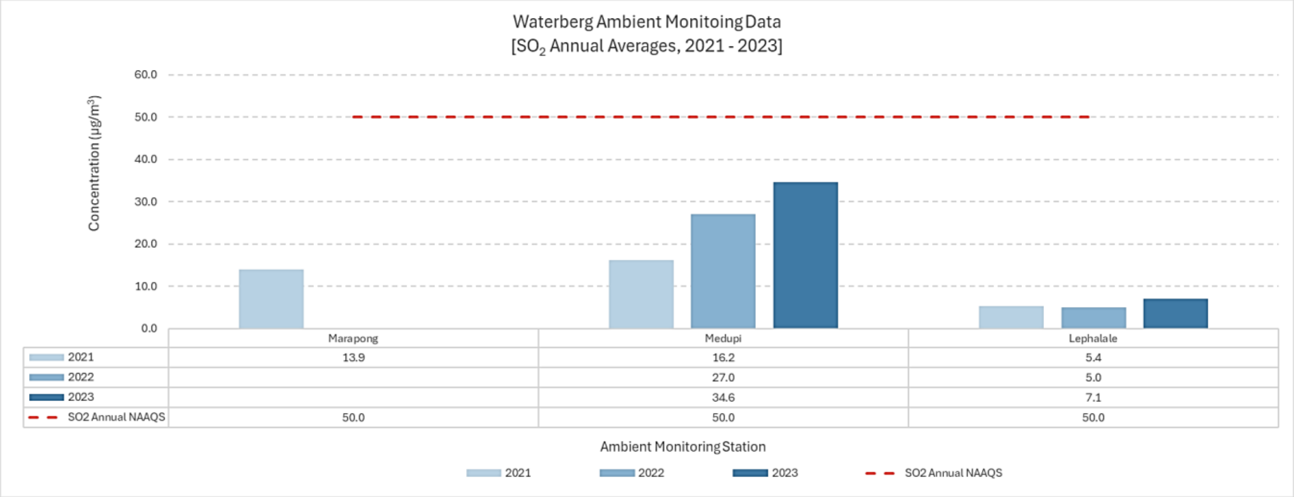
Figure 6-1 - Waterberg ambient PM_{10} concentrations, 2021 – 2023



	Marapong	Medupi	Lephalale
2021	25.8	15.2	
2022	30.2		
2023			12.2
PM2.5 Annual NAAQS	20.0	20.0	20.0
2021 24hr Exceedances	43	8	
2202 24hr Exceedances	41		
2023 24hr Exceedances			0

Figure 6-2 - Waterberg ambient PM$_{2.5}$ concentrations, 2021 – 2023

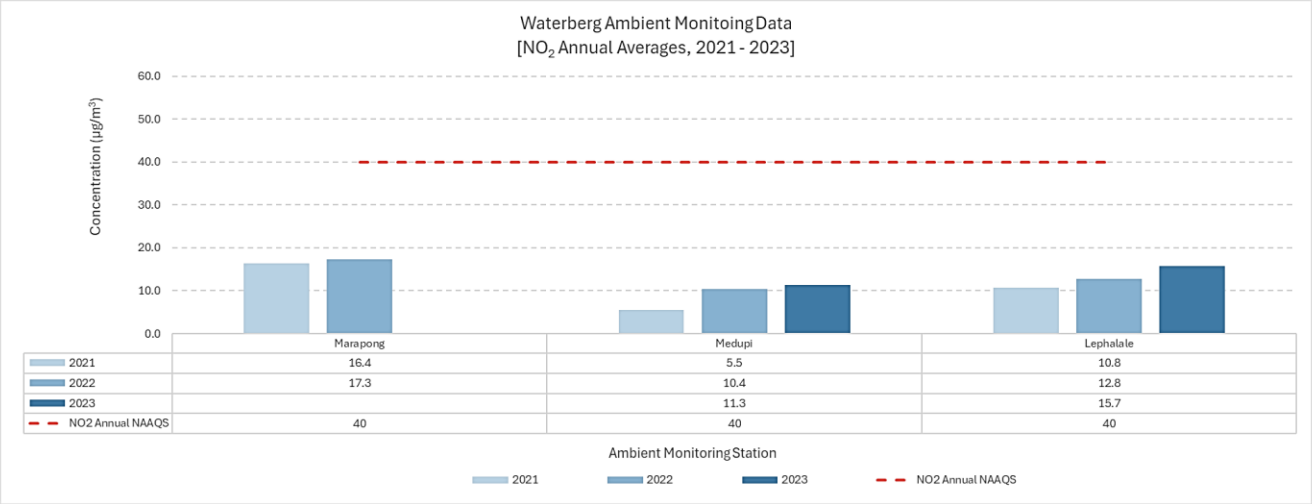
SO_2 measured concentrations in the Waterberg for the period 2021 – 2023 are presented in Figure 6-3. Annual average concentrations across the ambient monitoring network indicate compliance with the annual NAAQS, with no stations exceeding the NAAQS in any year. Highest concentrations were measured at Medupi, which exhibits an increasing trend in SO_2 concentrations year on year, although remaining below the annual NAAQS. Although not presented in Figure 6-3, exceedances of the short-term NAAQS (10-minute, hourly and 24-hour) were recorded at all stations, although importantly these remained below the permitted frequency of exceedance.



	Marapong	Medupi	Lephalale
2021	13.9	16.2	5.4
2022		27.0	5.0
2023		34.6	7.1
SO2 Annual NAAQS	50.0	50.0	50.0

Figure 6-3 - Waterberg ambient SO_2 concentrations, 2021 – 2023

NO_2 measured concentrations in the Waterberg for the period 2021 – 2023 are presented in Figure 6-4. Annual average concentrations across the network indicate compliance with the annual NAAQS, with no stations exceeding the NAAQS in any year. Highest concentrations were typically measured at Marapong. Further, no hourly exceedances of the NAAQS were recorded at any of the stations, illustrating the generally low NO_2 concentrations in the area.



	Marapong	Medupi	Lephalale
2021	16.4	5.5	10.8
2022	17.3	10.4	12.8
2023		11.3	15.7
NO2 Annual NAAQS	40	40	40

Figure 6-4 - Waterberg ambient NO_2 concentrations, 2021 – 2023

6.1.2 DISPERSION MODELLING – CUMULATIVE AIR QUALITY IMPACTS

CALPUFF dispersion modelling was undertaken by uMoya-NILU Consulting (Pty) Ltd, as contained within the Cumulative Waterberg AIR (report uMN219-24, 2024) to assess various operational scenarios anticipated by Eskom at Medupi and Matimba in the coming years for SO_2, NO_X, and PM (PM_{10} and $PM_{2.5}$), namely:

- **Scenario 1 (Current):** The baseline scenario using actual monthly stack emissions for 2021-2023 and fugitive emissions from the ash dump.
- **Scenario A (2025):** Eskom's planned 2025 stack emissions, representing anticipated station performance between 2025 – 2030, including fugitive emissions from the ash dump.
- **Scenario B (2031) / ERP 2024 A:** Eskom's planned 2031 stack emissions, representing anticipated station performance between 2031 – 2035, including fugitive emissions from the ash dump and the Medupi wet FGD.
- **Scenario C (2036) / ERP 2024 B:** Eskom's planned 2036 stack emissions, representing anticipated station performance from 2036 onwards, including fugitive emissions from the ash dump, and including the Medupi wet FGD.
- **Scenario D (MES) / ERP 2024 C:** Full compliance with the MES from 2036, including wet FGD at Medupi and semi-dry FGD at Matimba.

Table 6-1 presents maximum ground level concentrations predicted at sensitive receptors and monitoring stations (only the highest concentration and predicted exceedances presented) associated with each operational scenario. While the focus of the assessment is on stack emissions, and SO_2 in particular, the inclusion of fugitive PM emissions provides a holistic understanding of the Medupi and Matimba power stations contribution to ambient PM_{10} and $PM_{2.5}$ concentrations. Key findings from this AIR comprise:

- For SO_2:
    - Maximum predicted annual concentrations at all receptors remain well below the annual NAAQS in all scenarios.
    - Exceedances of the 24-hour NAAQS are predicted, exceeding the permitted number of exceedances (12 in a three-year period) in Scenario A and B, while exceedances remain below

  - the permitted frequency in Scenario C following completion of the Medupi wet FGD, with no exceedances predicted in Scenario 1 and D.
  - No exceedances of the hourly NAAQS are predicted at receptors in all scenarios.
- For NO_2:
  - Maximum predicted concentrations remain well below all averaging periods of the NAAQS at all receptors for the five scenarios.
  - No short-term exceedances due to the cumulative Medupi and Matimba emissions are predicted to occur.
- For PM_{10} and $PM_{2.5}$:
  - Predicted concentrations are attributed to stack emissions and low-level fugitive sources (ash dumps and stockpiles).
    - The inclusion of the fugitive sources was done assuming most the area is exposed and available for entrainment, while in reality only a small portion of the modelled area would be exposed to entrainment due to the vegetated sides and wet areas of the dump. This approach can be considered as an over-estimate.
  - The PM emissions from stacks and fugitive sources are not speciated into PM_{10} and $PM_{2.5}$, rather all PM emitted is assumed to be PM_{10}, and all PM emitted is assumed to be $PM_{2.5}$, considered environmentally conservative.
  - Maximum PM_{10} annual concentrations predicted at sensitive receptors, inclusive of the ambient monitoring stations, are predicted to remain below the annual NAAQS, with a maximum concentration of 17.7$\mu g/m^3$ predicted to occur at a receptor.
    - Exceedances of the 24-hour PM_{10} NAAQS are predicted in Scenarios 1, A, and B, although these remain well below the permitted frequency of exceedance (12 in a three-year period). No 24-hour exceedances are predicted in Scenarios C and D.
  - Despite the conservative assumption that $PM_{2.5}$ is equivalent to PM in the modelling simulations, predicted annual average $PM_{2.5}$ concentrations still remain below the annual $PM_{2.5}$ NAAQS at all receptors in Scenarios 1 and A (prior to 2030). Exceedances of the more stringent $PM_{2.5}$ annual NAAQS, coming into effect in 2030, are predicted in Scenarios B, C, and D.
    - Numerous 24-hour exceedances are predicted in all scenarios, well above the permitted frequency of exceedance, although this must be viewed conservatively given the assumption that PM is $PM_{2.5}$. This frequency of exceedance increases from Scenario B due to the more stringent $PM_{2.5}$ NAAQS coming into effect in 2030.
  - Further, considering the proximity of the exceedances to Medupi and Matimba, as noted in the uMoya-Nilu AIR (report uMN219-24, 2024), the elevated PM can mostly be attributed to the low-level fugitive sources, which have poor buoyancy and disperse poorly, as opposed to the stack emissions which are released at a height of 200m above ground-level, with considerable buoyancy, and so disperse well.
  - Given the conservative approach to the fugitive emission source simulations, and that this provided an absolute worst-case emission scenario, and based on recommendations received from uMoya-Nilu, Eskom undertook an additional cumulative modelling scenario, assessing only PM, SO_2, and NO_X stack emissions from the Waterberg Fleet. NO_X and SO_2 emissions were included to ensure secondary particulate formation is accounted for. Key findings from this include:

  - Predicted PM_{10} and $PM_{2.5}$ concentrations, including secondary particulate formation, indicated full compliance with the NAAQS, with no 24-hour exceedances predicted within the modelling domain.
  - The maximum PM_{10} annual and 24-hour average predicted was 1.7µg/m^3 and 17.9µg/m^3, respectively, predicted in Scenario A, remaining well below the NAAQS.
  - The maximum $PM_{2.5}$ annual and 24-hour average predicted was 1.5µg/m^3 and 16.8µg/m^3, respectively, predicted in Scenario A, remaining well below the NAAQS.
  - This additional modelling confirms ground-level concentrations due to Eskom stack emissions remain well below the NAAQS, with the elevated concentrations originally predicted being influenced by the low-level fugitive sources, rather than the stack emissions.

- Comparing measured annual average NO_X and SO_2 concentrations to model predictions, predicted annual averages are lower than measured, which is expected as Eskom activities are not the only source contributing to ambient concentrations.
- While predicted annual average PM_{10} and $PM_{2.5}$ concentrations at the Marapong and Lephalale monitoring stations are lower than measured concentrations, at Medupi predicted concentrations are higher than measured. As highlighted in the uMoya-Nilu AIR (Report uMN219-24,2024), this is contrary to expectations as the monitoring station measures all sources, and this is likely due to the low data recovery at the Medupi station. Further to this, and although not specifically highlighted in the uMoya-Nilu AIR, this could also be a result of the worst-case assumptions applied to the simulation of the fugitive sources (ash dumps), which likely provided an over-estimate of emissions.

Table 6-1 - Predicted maximum annual and short-term ground level concentrations occurring at selected receptors and ambient monitoring stations for each operational scenario (uMoya-NILU, report uMN219-24, 2024)

Pollutant			
Predicted maximum SO$_2$	**Annual**	**24-hour (P99)**	**1-hour (P99)**
Scenario 1 (Current)	9.4	120.3 (0)	226.2 (0)
Scenario A (2025)	14	195.5 (24)*	332.4 (0)
Scenario B (2031)	11.7	186.9 (18)*	315.1 (0)
Scenario C (2036)	8.5	152.4 (7)*	202.4 (0)
Scenario D (MES)	3.5	52.4 (0)	90.1 (0)
NAAQS limit value	**50**	**125 (12)***	**350 (264)***
Predicted maximum NO$_2$	**Annual**	**-**	**1-hour (P99)**
Scenario 1 (Current)	1.1	-	31.3 (0)
Scenario A (2025)	2.0	-	50.9 (0)
Scenario B (2031)	1.6	-	47.7 (0)
Scenario C (2036)	1.5	-	40.9 (0)
Scenario D (MES)	1.5	-	40.9 (0)
NAAQS limit value	**40**	**-**	**200 (264)***
Predicted maximum PM$_{10}$	**Annual**	**24-hour (P99)**	**-**
Scenario 1 (Current)	17.4	78.3 (1)	-
Scenario A (2025)	17.7	79.7 (1)	-
Scenario B (2031)	17.6	75.8 (1)	-
Scenario C (2036)	17.3	74.0 (0)	-
Scenario D (MES)	17.1	70.4 (0)	-
NAAQS limit value	**40**	**75 (12)***	**-**
Predicted maximum PM$_{2.5}$	**Annual**	**24-hour (P99)**	**-**
Scenario 1 (Current)	17.4	78.3 (92)	-
Scenario A (2025)	17.7	79.7 (92)	-
Scenario B (2031)	17.6	75.8 (270)*	-
Scenario C (2036)	17.3	74.0 (269)*	-
Scenario D (MES)	17.1	70.4 (269)	-
NAAQS limit value	**20**	**40 (12)***	**Up to 31 Dec 2029**
	15	**25 (12)***	**From 01 Jan 2030**

Note: Red text represents non-compliances, with exceedance counts in brackets.
*Regulations provide for permitted frequency of exceedance per calendar year; 4 exceedances per year of a 24-hour standard, and 88 exceedances per year of an hourly standard. Since the model simulated three years, these permissible exceedance counts represent a three-year period.

6.2 HEALTH IMPACTS

A coal-fired power station releases impurities into the air during coal combustion in the boiler. These pollutants are released through stacks, where they are diluted and endure chemical transformations before ultimately reaching the surface. Here, they may be inhaled or impact the physical environment. The pollutants include SO_2, NO_X, polycyclic aromatic hydrocarbons, and trace substances such as mercury.

The effects of coal combustion-associated air pollution on health are recognised worldwide. The sensitive receptors mainly consist of schools, hospitals, and other locations where children, the elderly, and the infirm might reside. While many factors impact air quality, air pollution exposure in communities near coal-fired power stations is significantly higher than areas without these facilities.

Air emissions are responsible for a variety of detrimental health effects. Examples of these effects include respiratory diseases, lung cancer, cardiovascular diseases, and neurodevelopmental disorders. Potential health impacts associated with power station emissions are outlined below:

- SO_2 that potentially contributes to respiratory illnesses (chronic bronchitis, nasal, throat and lung irritations, asthma attacks) and cardiovascular disease.
- $PM_{2.5}$ is the air pollutant responsible for the most significant health issues and premature mortality. $PM_{2.5}$ is more likely to penetrate and accumulate on the surface of the deeper lung regions. Furthermore:
  - Short-term exposure to $PM_{2.5}$ is linked to premature mortality, acute and chronic bronchitis, asthma attacks, and other respiratory symptoms, as well as heart or lung distress. Infants, children, and older individuals who have preexisting cardiac or lung diseases are more likely to experience these adverse health effects.
  - Long-term exposure to $PM_{2.5}$ (months to years) has been associated with reduced lung function growth in children and premature death, particularly in those with chronic heart or lung diseases.
- PM_{10} contributes to adverse health effects as it is more likely to deposit on the surfaces of the larger airways of the upper lung region, inducing tissue damage and lung inflammation.
  - There is evidence of the adverse effects of short-term exposure on respiratory health.
  - The consequences of prolonged exposure to PM_{10} are less certain, although studies indicate a correlation between respiratory mortality and long-term PM_{10} exposure.
- Nitrogen oxides contribute to respiratory illnesses (e.g., respiratory infection, asthma, chronic bronchitis) and smog.
- Mercury and other heavy metals have been associated with neurological and developmental impairment in humans.

Noting the above issues, the NAAQS described in section 3.2 above were established to protect air quality and public health. Compliance with the standard in an area implies that the area is exposed to an acceptable level of risk from air quality impacts and air quality related health issues. This does not imply that there is no risk associated with lower levels of pollutants in the atmosphere but there is arguably no acceptable risk to some pollutants and the NAAQS thus represent what is considered acceptable in the South African context. The benefit-cost analysis discussed below attempts to put a financial cost on these health impacts.

Considering the existing activities in each airshed impacting air quality, ensuring improvement in air quality in the area and public health requires a targeted, practical and integrated approach to emissions management in the area.

It can also be noted that unplanned electricity outages through load shedding can also result in health impacts due to challenges with the availability of medical facilities, water provision and food storage challenges for example.

6.3 WATER

6.3.1 WATER DEMAND OF FGD SYSTEM

FGD systems are used to remove SO_2 from exhaust flue gases of fossil-fuel power plants and other industrial processes. FGD technology includes wet, dry and semi-dry processes. Retrofitting with FGD technology is required at all power stations to meet the MES for SO_2. Wet FGD technology is planned at Medupi, with semi-dry FGD evaluated for Kendal and DSI FGD evaluated for Majuba. Should the MES be enforced on the remaining Eskom power stations, Matimba, Lethabo, and Tutuka would receive semi-dry FGDs.

Wet FGD while having higher efficiency in SO_2 removal (up to 98%), has higher operational complexity and environmental impact due to its high-water usage. Semi-dry processes have a lower water requirement and a smaller footprint, with no wastewater production, simplifying water management but also requiring an increase in water usage. However, SO_2 removal has a slightly lower efficiency than wet FGD.

Dry FGD processes produce less waste and use less water, reducing the need for extensive water treatment facilities. However, it may produce more solid waste, requiring adequate disposal solutions. The dry FGD process has a slightly lower efficiency (up to 90%) but simpler operation and lower environmental impact in terms of water usage. The lower water usage makes dry FGD systems more suitable for regions with limited water resources (such as South Africa).

The Eskom Emission Reduction Plan includes the implementation of wet and semi-dry FGD technology options due to the higher efficiencies that would be required to reduce SO_2 emissions to levels compliant with the MES. This will result in an increase in water demand across the fleet. This additional water demand is not necessarily available over the short-term specifically in the catchments of operation of the power stations such as the Mokolo River System). Very limited development potential exists, which requires that any water increases be addressed by an appropriate mix of supply and demand side measures. While power generation is a strategic water use in terms of the National Water Act (Act No. 36 of 1998), and as such receives water at an assurance level of supply of 99.5% due to the importance of electricity for the socio-economic growth of this country, water supply is not necessarily available to meet an increase in water requirements. Water security is thus at risk.

6.3.2 WATER SUPPLY

The raw water supply to the Eskom power stations is sourced directly from two water resource supply systems, *viz*, (1) Mokolo River system for supply to the Medupi and Matimba power stations, (2) Integrated Vaal River System (Vaal, Thukela and Usutu catchments) for supply to Matla, Majuba, Duvha, Tutuka, Kendal and Lethabo power stations.

Power generation is identified as a strategic water use in terms of the National Water Act (Act No. 36 of 1998) and is provided with the highest assurance of supply (99.5 %) in the operation of all water resource systems in the country (National Water Resources Strategy -3 (NWRS-3), DWS 2023). However, a key goal of the NWRS-3 is reducing water demand, and while water supply for electricity generation is afforded priority it is not unlimited and has to be balanced with other strategic objectives of the NWRS-3. The NWRS-3 does refer to the disadvantage of the proposed FGD technology with its high-water usage, and due to water scarcity in the country, recommends further research on alternative technologies and options to meet the future Eskom water demand (DWS, NWRS-3, 2023). Future allocations to meet the increased water supply, should FGD's be installed, to Eskom can thus not be guaranteed, if it's not aligned with the strategic goals of the NWRS-3 and imperatives to reduce water demand, increase water conservation and improve water use efficiency.

6.3.3 MATIMBA POWER STATION

Matimba is in the Sandloop catchment (A42J) of the Mokolo River catchment area. Water requirements to the power station is supplied from the Mokolo River System scheme via a pipeline from Mokolo Dam, with a current allocation, combined with Matimba, of 14.5 million m^3/a. The future projected water allocations to Medupi Power Station with the implementation of FGD technology has been included in the demands of the Mokolo Supply System, increasing progressively from 2026 onwards. Medupi and Matimba are authorised to abstract a further 13.94 million m^3/a from MCWAP-2A, with the total water allocation being available to both stations totalling 28.44 million m^3/a (abstraction is authorised until 2051). The water balance of the Mokolo system has accounted for the future implementation of FGD technology at Medupi.

Should full MES compliance be enforced, a semi-dry FGD would be the preferred option for Matimba. The summary of the current allocation and potential changes to the water requirements at Matimba are shown in Table 6-2.

Table 6-2 - Summary of Water and Waste Changes with implementation of Semi-Dry FGD

VARIABLE	UNIT	
Water allocation (Mokolo WSS, 2023)	million m^3/a	3.12
Additional water requirement	million m^3/a	5.621
	%	180

The assessment indicates that with the semi-dry FGD at Matimba there will be a significant increase in water requirements to operate and a requirement for additional disposal capacity for the waste product. These changes will require an increase in the water allocation from the Mokolo River System Scheme. The almost 2-fold increase in water requirements specifically will have a significant impact on the water balance of the power station, requiring additional water management interventions. As the water use is consumptive, with a dry byproduct there will however be minimal wastewater generation.

It is expected that the additional water requirement for Matimba Power station will be met through the allocations from the Mokolo Supply System (MCWAP 1 and 2A), however Phase 2A only being available from 2028. Based on the 2023/2024 DWS Annual Operational Analyses (AOA) conducted for the Mokolo River System, deficit in the water supply in the Mokolo catchment is expected in 2025. All scenarios analysed for the AOA indicated that a shortage of water and the risk of violating the assurance of supply to Eskom could happen as early as 2025 (prior to FGD technology). Severe water restrictions will be required from 2025 to 2028 for all users (including Matimba power stations for its current water requirement). Water security in the Mokolo catchment is projected to be low between 2025 to 2028.

As FGD implementation is only expected beyond 2030, the risk to the water supply from the Mokolo River Scheme will be alleviated/low with the MCWAP-2A expected to be commissioned at that stage to meet the projected water requirements of the users of the Mokolo River System. The cost of water will however be higher. Water security will however still be a risk should the MCWAP-2A be delayed beyond 2028. If this is the case, current and future increased water supply to Matimba will be impacted, including the ability to implement the FGD process.

Although Matimba will be installing semi-dry FGD to reduce SO_2 emissions, the implications of this will impact the longer-term sustainability of the water resources, the receiving environment, and Eskom's commitment to Environmental, Social, Governance (ESG) to alleviate strain on water usage and availability.

6.4 WASTE

FGD is a process used to reduce SO_2 emissions from coal-fired power plants by capturing sulphur compounds in the flue gas. While FGD significantly improves air quality and helps meet environmental regulations, it also introduces new waste management challenges. The FGD process typically produces a byproduct known as calcium sulphates (gypsum in the case of wet FGDs), which, based on DFFE waste management requirements, must be managed and stored separately from existing waste streams like ash. Implementing FGD increases both the volume of waste generated and the complexity of waste handling infrastructure. Since co-disposal is not permitted by DFFE, stations will be required to design and construct new facilities to accommodate the gypsum, which requires additional approvals, water management, operational adjustments, and new handling infrastructure. This added waste stream, combined with the increased water use needed for the FGD process, can substantially impact the overall environmental footprint of the facility, making waste management a critical aspect of FGD implementation.

While Eskom does not intend to install FGD technology at Matimba Power Station, should compliance with the SO_2 MES be enforced, requiring FGD technology, the process will result in the production of Gypsum (by-product) that will require storage on a waste facility, depending on the materials waste classification.

At Matimba, due to FGD, approximately 904 kt per annum (ktpa) of gypsum will be produced in addition to the ash production of approximately 5 Mtpa. Starting in 2031, the first year will see 150 kt of gypsum produced, followed by 301 kt in the second year, continuing to increase annually until the full 904 ktpa is reached, beginning to decrease annually with the start of the Matimba shutdown phase in 2038.

The existing ash disposal facility was originally designed to handle ash residue and particulate matter collected through current abatement processes. The introduction of gypsum from the FGD process, however, will significantly affect the way waste streams are managed. Ash and gypsum differ in particle size, and density, which could challenge the existing infrastructure. Since DFFE does not permit co-disposal, Eskom will need to specifically construct a disposal facility for gypsum. Water management, specifically, will be impacted, as gypsum handling introduces different moisture retention and drainage requirements compared to ash. Currently, water from ash disposal is managed with established runoff and containment systems, but the addition of gypsum will necessitate more rigorous water controls to prevent contamination, requiring additional infrastructure and permitting. Addressing water impacts will be critical, as water management often presents the greatest challenge in waste handling.

As noted previously, the existing storage facilities would not be used for storage (co-disposal) of gypsum that will be produced. As such, the need for design, approval and construction of new disposal facilities will be triggered. The design and regulatory approvals for new facilities will require extensive planning and budget allocations.

Based on WSP's high-level review and assessment of the information provided by Eskom, the following concluding remarks are made:

- The implementation of semi-dry FGD technology at Matimba will be a challenging exercise for waste management, particularly the safe and effective disposal of the gypsum by-product.
- Should co-disposal, albeit not recommended by WSP, not be applicable, safe handling of the gypsum by-product will necessitate the constructing a new (lined) storage facility.
- Design, regulatory approvals and permits, construction and start-up safe operation of a new storage facility for gypsum will incur significant capital expenditure and timeframes.
- WSP has not assessed the capacity of the current ash handling equipment (conveyors), and it is not clear whether the increase of waste would be managed by existing infrastructure, which would require detailed investigation.
- Separating the waste streams to different facilities will necessitate the handling of ash and gypsum on separate conveyors. Installation of an additional conveyor system to handle the gypsum will therefore lead to a substantial increase in CAPEX and OPEX.
- From a high-level assessment, it appears that the CAPEX and Opex associated with the required waste handling infrastructure may outweigh the potential benefits of implementing FGD. This suggests it might be financially inappropriate for a station with a limited remaining operational life.

6.5 CLIMATE CHANGE

Eskom has identified the contribution of their operations on global climate change in terms Greenhouse Gases (GHGs) emitted as carbon dioxide emissions as a significant issue. Due to this, the organisation has identified the need for a Climate Change Policy as well as the Generation Division Adaptation to Climate Change Plan. Both the plan and policy are developed to combat Eskom's vulnerability to acute and chronic effects that climate change may have on Eskom's infrastructure and systems and its plan to reduce its contribution to global climate change.

The Eskom Climate Change Policy applies all of Eskom's Divisions and subsidiaries. This Policy is in line with South Africa's National Policies such as the Climate Change Response (NCCRP) White Paper, 2011; the National Development Plan (NDP), 2030; South Africa's updated Nationally Determined Contribution (NDC), which has been submitted to the secretariat of the UNFCCC; the Paris Agreement; and the recently implemented Climate Change Act (2024), which will provide for a coordinated and integrated national response to climate change and its impacts.

The Eskom Climate Change Policy is supported by the approved Eskom JET Strategy, which demonstrates how Eskom will transition away from coal-fired power to more sustainable, lower emitting electricity sources. Eskom sees the JET as a pivotal point in Eskom's future which supports the national goals to decrease GHG emissions, promote job creation through reskilling and stimulate economic growth. The overall monitoring protocols will also be guided by the Climate Change Act (2024) and all other relevant climate change regulations and strategies.

As emphasised in the Eskom policy, South Africa's revised NDC will significantly impact Eskom, as most mitigation in the updated NDC target needs to come from the electricity sector which now accounts for approximately 41% of South Africa's GHG emissions. Eskom will need to decommission multiple coal-fired power stations over the next decade for South Africa to align to the objectives of international climate agreements. This means that coal-fired power stations would need to be supplemented with generation capacity from renewable and lower carbon technologies to meet South Africa's climate change commitments while maintaining security of supply. Preliminary analysis by the department shows that greenhouse gases from fossil fuel power generation will need to be limited to 125 – 140Mt CO_2 per annum in 2030 for South Africa to remain within the upper end of the NDC for 2030. While a new NDC is still being developed for 2035, the range (125 – 140 Mt CO_2 per annum) is maintained in the modelling from 2031.

GHG emissions from carbon dioxide are presented for the Eskom's Generation Business Unit, inclusive of all coal-fired power stations, in Figure 6-5. While the MES and climate change regulatory process are legally separate it is useful to note both ERP 2024 A and the security of supply projection are aligned with Eskom's current pollution prevention plan running to December 2025. Future CO_2 trajectories will be based on the updated pollution prevention plan and IRP, NDC, and Sectorial Emission Targets (SET).

This illustrates the anticipated CO_2 emissions trajectory, based on Eskom's anticipated loads, for the 2025 to 2050 operational period. Eskom's anticipated coal-fired load, in turn, assumes a time and full roll out of new electricity generation capacity to meet growing demand. Eskom's CO_2 emissions trajectory, without the enforcement of full MES compliance, shows a decreasing trend over time, predominantly driven by stations decommissioning and reduced loads at other stations. CO_2 emissions are anticipated to reduce from approximately 192Mt in 2025 to 63Mt in 2050, representing an approximate decrease of 67%. This is aligned with Eskom's and Government's aspirations in terms of climate change.

Should compliance with the MES be enforced, specifically with the new plant SO_2 MES, requiring the need to install FGDs at Lethabo, Tutuka, and Matimba, in addition to the already planned FGDs at Medupi and Kendal, CO_2 emissions would increase. This increase is predominantly due to the increase in the auxiliary power requirements to supply the FGD, considering Eskom's Scope 1 emissions. Although these are the emissions Eskom would be responsible for (i.e. in accordance with direct accounting and reporting of carbon emissions), other considerations due to the installation of FGDs with regards to CO_2 emissions are manufacturing, transportation, construction, and installation of the FGD itself, potential increase in mining activities due to the additional limestone (sorbent) required, emissions associated with the transport of limestone, most likely from the Northern Cape and emissions due to the end of life decommissioning of the FGD unit.

Figure 6-5 also illustrates the anticipated increase in CO_2 emissions with the addition of the abovementioned FGDs. Although seemingly insignificant, the addition of the FGDs would result in an approximate increase in CO_2 emissions of 25Mt between 2025 and 2050 across the coal-fired fleet, representing a 0,9% increase in Eskom's estimated emissions. This estimate only considers the auxiliary power requirements of the FGD, and although not responsible for Eskom to report, also the estimated CO_2 emissions due to sorbent transport from the Northern Cape. Further, the estimated 25Mt increase represents an approximate annual contribution to South Africa's 2030 Nationally Determined Contributions (NDC) budget of 0.4% (on average from 2030 – 2050), with a peak CO_2

contribution anticipated in 2026/27 of approximately 2Mt due to the FGD installations, representing a 0.6% contribution to SA's 2030 NDC budget[1].

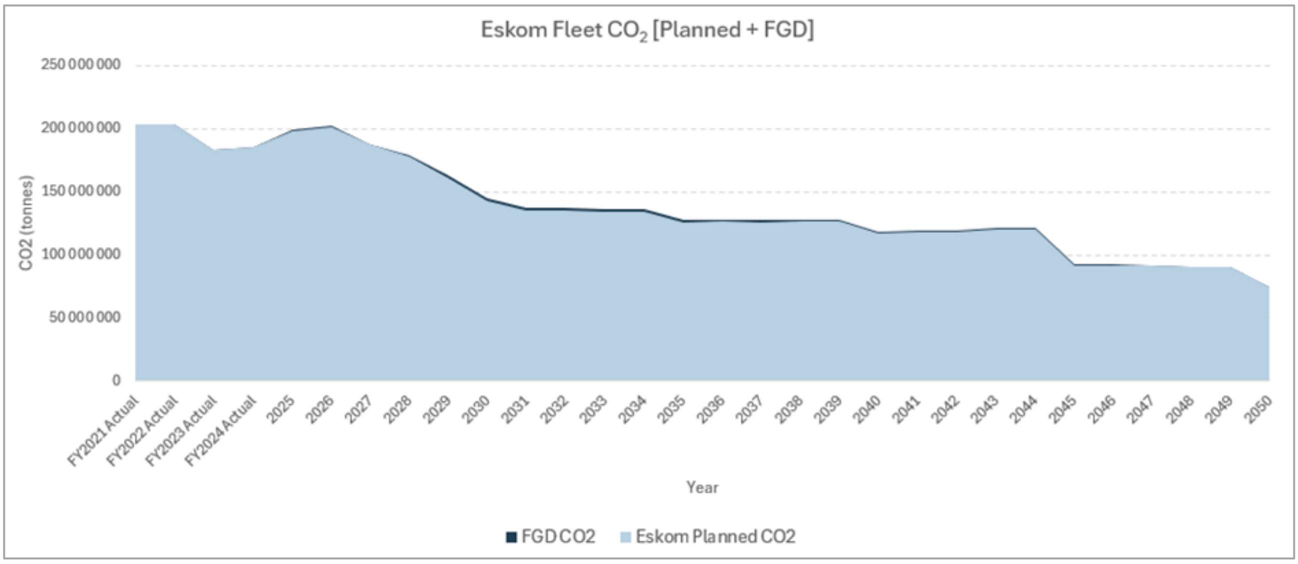


Figure 6-5 – Eskom coal-fired fleet CO_2 emission trajectory and contribution from FGDs

7 FINANCIAL CONSEQUENCES

7.1 FINANCIAL COSTS

Previous assessments completed as part of the MES and NECA process have shown that attempting to install the technology required to meet new plant SO_2 limits (wet-FGD) at stations by 2025 was unfeasible from a technical, economic and project-implementation perspective, apart from Medupi that was designed for a FGD retrofit, the other plants were not (Eskom 2021). Given the previous analysis and the time and other constraints influencing the present exemption applications only the two most potentially viable SO_2 reduction implementations (Majuba and Kendal) were assessed as part of this exemption application.

The assessments completed previously, included an analysis of the Levelised Cost of Electricity (LCOE) to compare the viability of FGD investments at stations with other options like gas or renewables. They also used stochastic electricity systems modelling to understand the full impact of FGD implementations. The studies indicated that retrofitting the plants with FGD would increase the cost of electricity produced due to the high capital and operating cost of FGD and the limited remaining life of the plants. (Eskom, 2020). Full implementation might have resulted in an increase in the average electricity tariff of around 10%, whereas the partial implementation scenarios would have a lesser impact – depending on the scenario. Studies also showed that the shutdown of multiple stations to

---

[1] The contribution of the SA NDC lower emissions target is based on CO_2e, whereas the emissions from the FDG are based only on CO_2. It is understood that CO_2 is the largest GHG contributor for the project.

enable the rapid implementation of FGD would result in significant security of supply issues which would result in massive levels of load shedding and a resultant destruction of the economy.

With an average age of the coal fleet being almost 40 years old, the long lead time to implement retrofits results in a limited economic life remaining post retrofit of the FGD. Assuming it was technically feasible to retrofit (which is a significant risk), and ignoring the unserved energy and load shedding, even with the increased cost, in the short term the plants would be cost competitive, relative to the comparable alternatives which could be deployed in the same time frames. These alternatives included that of running the OCGTs at 20% p.a. load factor and load shedding of the remaining demand in the earlier years. In the latter years with the increased cost due to the FGD, the plants would need to run at guaranteed higher load factors i.e. have a higher output, to remain competitive with comparable alternatives.

Two years have passed since the last detailed analysis, which now further limits the remaining useful life over which to recover any financial investment.

Eskom has maintained in all previous applications, that the costs associated with retrofitting FGD to any of its plant outweighs the benefits. This has been rejected by the NAQO, and partially by the NECA panel advising the Minister and in the Ministers Appeal decision. Although, in the case of Medupi, the report by the NECA indicated that FGD was very costly and would require Medupi to be offline for 80 additional days per year for six years, increasing load shedding risks (DFFE, 2024).

From a national strategic and risk perspective, if it is considered necessary for Eskom to implement a SO_2 abatement project at an Eskom station beyond Kusile and Medupi, and if it is proven to be technically feasible, it would be necessary to source funding against the background of guaranteed cost -reflective tariffs. From an economic/financial perspective a defined minimum load factor/take or pay agreement would ensure that the units costs are acceptable compared to known alternatives however if consideration could be given to the extension of the station life the economic/financial viability could improve. Given the quantum of the requirement investment, it is probable that Eskom would require fiscal support in order to raise funding for additional abatement projects beyond Kusile and Medupi. There might also be implications regarding possible carbon tax and carbon budget allocation target adjustments with the increase in load factor and extended plant life.

With the current uncertainties in the context of the pre-concept phase of planning and not yet having performed the thorough stochastic systems modelling process (based on any updated IRP), factoring in the range of possible outcomes on all the key input variables, it would be reckless for Eskom to make unconditional commitments to any SO_2 reduction implementation. Any commitments must be subject to completion of the mentioned systems modelling process as well as the completion of a detailed technical implementation feasibility study/ pilot. If retrofit proves technically unfeasible, a relief from obligations and commitments should be obtained. This might include SO_2 exemption for relevant stations, depending on the system's alternatives and the potential requirement for the stations to continue operating, as established through the stochastic systems modelling process.

Any Eskom commitments or authority decision should also incorporate an economic viability threshold. The market tendering processes should indicate that if costs exceed the estimates made for purposes of these commitments by a defined degree (which could be linked to budgets, operational cost caps etc), the decision will need to be revisited. Such thresholds should not just be defined in terms of project costs but rather in terms of economic/financial viability, factoring in the likely system alternatives in the event of these power plants not continuing to be operated.

The decision on any SO_2 reduction implementation must consider the benefit of SO_2 reduction from the power stations, against the opportunity cost of such SO_2 reduction. A possible alternative solution is that if funding is available Eskom increases its investments in renewables and grid connection by the same amounts that would have been invested in such SO_2 retrofits, this would result in larger economic value add than FGD retrofits.

7.1.1 COST ANALYSIS FOR MES COMPLIANCE AT KENDAL

Kendal has a lower operating cost and higher load factor than most stations, however it has a relatively short useful life post retrofit to recover the high FGD retrofit cost, resulting in marginal financial and economic viability. Kendal will need to sustain higher load factors than presently planned, to remain competitive with alternative options in an unconstrained power system context, where these alternatives would potentially be the lowest-cost Risk Mitigation Independent Power Producer Program (RMIPPPP) type of projects (The RMIPPP program called for dispatchable technologies including a combination of wind, solar, gas, diesel etc). Like Majuba, if the power system continues to be highly constrained, where the alternatives include OCGTs and the cost of inadequate supply (load shedding/ unserved energy etc) then Kendal could be much cheaper thus economically and financially very viable even at very low load factors, and with the cost of the retrofit included and assuming technical feasibility is proven

It should however be noted that 9.5 years post retrofit for a significant investment is very short. Kendal will be approximately 40 years old by the time the retrofit is complete and will only operate for a full 5 years with all 6 units running with the retrofit, assuming it is delivered on time. In the context of such a short remaining life, consistently higher load factors of a minimum 40% are required to sustain viability within the future market competing with alternative options of potentially the lowest-cost RMIPPPP type of projects. The assumption of a longer remaining life could improve Kendal's competitiveness and make it viable at lower load factors, from a purely economic/financial perspective.

The capital expenditure (Capex) required to ensure SO_2 compliance at Kendal is estimated at R44,4 billion, while the annual Opex is estimated at R1,04 billion. Additionally, the costs associated with Kendal achieving its proposed maximum daily limits for PM is R1,43 billion.

7.1.2 COST ANALYSIS FOR MES COMPLIANCE AT MAJUBA

Despite Majuba having a longer remaining life than Kendal (17 Years post retrofit) and DSI FGD being lower in cost (and technically less efficient relative to the Wet and Semi-dry FGDs), Majuba's high operating cost, even before considering the additional capex, makes the economic and financial viability of the DSI FGD investment challenging.

At low load factors e.g., below 50%, the LCOE for Majuba will probably not be competitive with alternative options in an unconstrained power system, where these alternatives would potentially be the lowest-cost RMIPPP program type of projects Under a constrained power system scenario, where the alternatives include OCGTs and the cost of load shedding/unserved energy, then Majuba with DSI FGD could have a lower cost and be economically and financially viable even at low load factors (assuming it is technically feasible).

With the identified implementation risks, a sensitivity was performed assuming the implementation of DSI FGD is delayed by three years. The LCOE increased i.e. the option became more expensive. For it to remain competitive with alternative options, a minimum load factor of approximately 60% is required.

Which technology to deploy and Majuba's likely range of load factors results in uncertainty, which could only be established and quantified trough the stochastic systems modelling process. Depending on the outcome of such modelling process it might also be appropriate to justify the continued operation of Majuba (with or without the retrofit) based on strategic risk considerations.

The Capex required to ensure SO_2 compliance at Majuba is estimated at R13,1 billion, while the annual Opex is estimated at R1,04 billion. Additionally, the costs associated with Majuba achieving its proposed maximum daily limits for NO_X is R1,1 billion.

7.1.3 ERP NOMINAL COSTS AND TARIFF IMPACTS

Table 7-1 presents estimated nominal costs associated with each ERP option. The total nominal cost of all Eskom ERP scenarios has been estimated by Eskom at a Class 2 accuracy, implying a variance between -15% and +20%. Increases in Eskom capital costs impact on the electricity tariff paid by consumers. The extent of any tariff increases is influenced by multiple factors including the extent and timing of funding and projected energy sales. Implementation of the ERP scenarios with additional SO_2 reduction requirements could increase the electricity tariff by between 3 and 10% from current levels. Work to confirm the extent of increases utilising Eskom NERSA applicable methodologies will be undertaken.

Table 7-1 – Eskom Fleet ERP financial summary

	ERP 2024 A	ERP 2024 B	ERP 2024 C
	ESKOM FLEET (CUMULATIVE)		
SO_2 Abatement	Kusile, Medupi FGD	Kusile, Medupi, Kendal (FGD), Majuba (DSI)	Kusile, Matimba, Medupi, Kendal, Tutuka, Lethabo (FGD), and Majuba (DSI)
NO_X Abatement	Majuba, Lethabo, Tutuka LNB	Majuba, Lethabo, Tutuka LNB	Majuba, Lethabo, Tutuka LNB
PM Abatement	Kendal, Matimba, Lethabo, Tutuka, Duvha, Matla PM Projects	Kendal, Matimba, Lethabo, Tutuka, Duvha, Matla PM Projects	Kendal, Matimba, Lethabo, Tutuka, Duvha, Matla PM Projects
Capex (nominal)	R77.2 billion	R134.6 billion	R256.9 billion
Opex (real, pa)	R2.1 billion	R4.2 billion	R6.3 billion

7.2 HEALTH COST BENEFIT ANALYSIS

The combustion of fossil fuels by power stations results in the emission of several atmospheric pollutants, that include PM, NO_2, and SO_2. Atmospheric pollutants have numerous negative effects on human health and may increase the risk of premature mortality.

Technologies exist to reduce these emissions and therefore also their negative health effects. Abatement technologies for power stations include FGD and Direct Sorbent Injection (DSI), for SO_2 reduction; installation of HFPS to improve ESP efficiency to reduce PM emissions.

A benefit-cost analysis (BCA) allows for trade-offs between different scenarios to be compared to support decision making.

The aim of the cost-benefit study was to estimate the incremental health benefits associated with abatement technology options as well as plant decommissioning, to achieve or move towards compliance with the new MES of the DFFE.

7.2.1 METHODOLOGY

An integrated Air Pollution Health Risk Benefit Cost Analysis (APHR-BCA) model was developed to model the impacts of three different abatement scenarios as developed by Eskom. The APHR-BCA was developed following the General Principles of the World Health Organisation, WHO (WHO, 2016a), for performing air pollution health risk assessments (AP-HRA). In summary, the methodology proceeded through several steps, as set out in Figure 7-1.

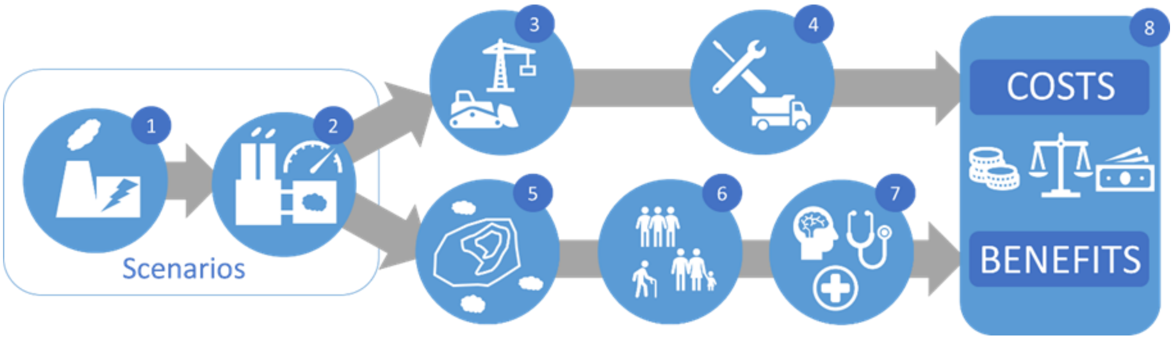


Figure 7-1 – APHR-BCA Methodology

7.2.2 HEALTH BENEFITS RESULTING FROM AIR POLLUTION ABATEMENT

The WHO (2016a) recommends that the health risk in a population, associated with air pollution, is to be estimated using exposure-response functions (ERFs). ERFs are based on Relative Risk (RR) estimates derived from primary epidemiological studies. These RR functions estimate the likelihood of health outcomes occurring in a population exposed to a higher level of air pollution relative to that in a population with a lower exposure level. RR is usually expressed as the proportional increase in the assessed health outcome risk incidence associated with a given increase in pollutant concentrations, measured in µg/m^3. The WHO (2016a) notes that "*the RR estimate cannot be assigned to a specific person; it describes risk in a defined population, not individual risk.*"

Ideally, ERF studies and their RRs should be determined based on primary epidemiological studies focussing on the exposed population. In the absence of such studies, as in the case of South Africa, the WHO (2016a) recommends using ERFs from other countries.

The health outcomes were selected based on the latest WHO systematic reviews from 2020 and 2021 that were conducted for the update of the WHO Global Air Quality guidelines. The health outcome that was considered in this study is all-cause mortality. Morbidity was not considered in this study as comprehensive data on morbidity studies is not widely available. Additionally, there are issues relating the transferability of data from one population to another in terms of country and culture as populations have different sensitivities to pollutant exposure (WHO 2000).

Pollution levels, chemical composition and health care systems are typically very different in other settings, and this would affect the accuracy of the ERFs. It is important to understand at what level interval the ERFs would result in significant differences in health outcome incidences. As a result, the WHO (2016a) advises performing an assessment of the uncertainty of the analysis; in this case therefore this requires an assessment related to a lack of knowledge about one or more components of the integrated Health BCA Model. Variation resulting from relevant uncertainty factors was assessed through performing sensitivity analysis in the BCA.

Interpretation of the risk of premature mortality must be done with care. It is to be noted firstly that these numbers are indicators of health risk at a population level. The relative risk estimate inherent in the ERF is a metric of the likelihood of an adverse health outcome, and it cannot be attributed to an individual person. It can thus be used to quantify risk to a defined population (and not to an individual), (WHO 2016a) and how this risk would vary between various mitigation scenarios.

In this study, the ERFs obtained from the latest WHO systematic reviews, focussed exclusively on mortality and thus a monetary measure of mortality was required in order to perform benefit-cost analyses. In air pollution benefit-cost analyses, the concept of value of a statistical life (VSL) is commonly used to monetise mortality related benefits of air pollution reduction. The concept of a VSL is frequently misunderstood. It does not measure the intrinsic value of a human life, and neither does it value the economic productivity of a human. Rather, VSL is estimated by dividing an individual's willingness to pay (WTP) to reduce health risk, by the likelihood of risk reduction. Robinson and Hammitt (2009) defines VSL to represent the rate at which an individual is willing to exchange their own income for a small reduction in their own mortality risk over a particular time period. VSL is not the value that a person, society or the government would place on reducing mortality rates with certainty, but it is rather a representation of the rate at which a person views a change in the money available for spending as equivalent to a small change in their own mortality risk (Robinson et al., 2018).

Primary WTP studies for mortality risk reductions have not been done in South Africa. The VSL for South Africa in the BCA was determined by using the methodology as advised by Viscusi and Masterman (2017) and Robinson et al. (2018) with a base VSL from the U.S, GNI per capita for income measures and adjusted by income elasticity. As advised by Robinson et al. (2018), a sensitivity analysis is conducted to explore various VSL estimates.

7.2.3 SCENARIO ASSESSMENT

The three scenarios evaluated in the BCA study, against a baseline included:

- Scenario ERP 2024 A (PM reduction, generating load capped, air quality offsets and SO_2 reduction at Medupi).
- Scenario ERP 2024 B (As per ERP 2024 B).
- Scenario ERP 2024 C (Full compliance with MES for PM, NO_X and SO_2 for both Medupi and Matimba Power Stations).

A key difference in the scenarios is the number of stations which are installed with SO_2 reduction technology in the form of wet-Flue Gas Desulphurisation (FGD) or semi-dry FGD. The focus on SO_2 reduction is important given the extent to which it is anticipated to impact on air quality and public health and the very significant cost of SO_2 reduction.

Health benefits associated with each scenario were calculated against the baseline (FY 25) that took into account the anticipated increase in loads in the coming years from 2025 and assumed no additional abatement technologies installed and both stations would continue to emit air pollution at their current rates until decommissioning.

- The health benefits of ERP 2024 A deliver immediate impact from 2024. At Medupi Wet FGD is commissioned from 2028 to 2032. Both stations already operate at NO_X = 750 mg/Nm^3. Medupi already has Fabric Filter Plant (FFP) for PM reduction. Matimba station is equipped with ESP + HPPS for optimisation of PM reduction. These increase the associated health benefits until 2039.

Hereafter the associated health benefits reduce as Matimba decommissions between 2039 and 2043. Medupi station decommissions much later from 2065 and the health benefits from the Wet FGD continue until final closure of the station.

- The health benefits of ERP 2024 B include those as discussed for ERP 2024 A above. In addition, efficiency and coal improvement projects reduce total sulphur and carbon emissions by 5% for Medupi and Matimba from 2024 onwards.
- The health benefits of ERP 2024 C include those as discussed for ERP 2024 A and B above. Semi-dry FGD is installed at Matimba by 2035, however the associated health benefits are effectively negated as Matimba starts to decommission in 2039.

With respect to the abatement costs associated with each scenario:

- The total Capex and Opex costs of abatement are identical to 2024.
- ERP 2024 A implementation starts in 2025 with Matimba ESP + HFPS technology and in 2028 with Medupi, Wet FGD installation. After 2032 only operational costs continue at Medupi.
- ERP 2024 B is the same as ERP 2024 A discussed above.
- ERP 2024 C is the same as described for ERP 2024 A and B. In addition, implementation starts in 2031 with Matimba semi-dry FGD. The Capex costs decrease after 2032 as Medupi Wet FGD is fully installed and only the Capex of the Matimba semi-dry FGD remains until 2035 whereafter only operational costs remain. After closure of Matimba in 2043 only Medupi continues to operate.

The BCA ratios need to be interpreted with care. They are meant only to provide a perspective on and inform the decision-making process underlying the scenarios. They are not meant to be interpreted as a definitive answer to making abatement decisions. Decisions involving human health have to be informed by non-economic criteria as well. In addition, with uncertainty inherent in the analysis, the cost benefit ratio should thus not be viewed as absolute, but rather as a relative value from which to compare scenarios.

The BCA results are provided in Table 7-2. In the upper estimates the lower costs and higher VSL are used and in the lower estimates the higher costs and lower VSL are used as recommended by Robinson et al. 2018.

- The BCA central ratio of ERP 2024 A is significantly less than 1, indicating that costs of abatement far exceed the health benefits. This ratio remains below 1 even in the most optimistic (upper) parameters of the sensitivity analysis. The reasons for this include the implementation of FGDs at Medupi in conjunction with the small population that benefits. This scenario has a total nominal cost of R58,660 million.
- The BCA ratio of ERP 2024 B is also significantly less than 1, indicating that costs of abatement far exceed the health benefits. This ratio remains below 1 even in the most optimistic (upper) parameters of the sensitivity analysis. The same reasons apply as for ERP 2024 A above. This scenario has a total nominal cost of R58,660 million.
- The BCA ratio of ERP 2024 C is also significantly less than 1, indicating that costs of abatement far exceed the health benefits. This ratio remains below 1 even in the most optimistic (upper) parameters of the sensitivity analysis. This scenario has a larger discrepancy in NPV of health benefits and NPV of costs due to implementation of FGDs at both Medupi and Matimba and the small population that benefits. This scenario has a total nominal cost of R101,670 million.
- Evaluation of the BCA ratios at a social discount rate of 2% delivers similar results, with all three scenarios ratios remaining less than 1.

Table 7-2 - BCA ratios (lower and upper ranges) for each scenario (discounted at Eskom WACC)

	ERP 2024 A		**ERP 2024 B**		**ERP 2024 C**	
Million Rands	Lower	Upper	Lower	Upper	Lower	Upper
NPV of Costs	-18,970	-13,437	-18,970	-13,437	-27,716	-19,632
NPV of Benefits	3	17	8	39	16	83
NPV of Benefits minus Costs	-18,967	-13,420	-18,962	-13,398	-27,700	-19,549
Benefit: Cost Ratio (range)	0.0002	0.0012	0.0004	0.0029	0.0006	0.0042
Benefit: Cost Ratio (central)	0.0007		0.0017		0.0024	

7.3 SOCIO-ECONOMIC IMPACTS

The following section of the report discusses the importance of Matimba Power Station to the local economy of the region and the potential socio-economic impacts of not obtaining MES exemption for Matimba Power Station. Such a scenario may result in a shutdown or load-shedding.

7.3.1 IMPACT ON THE ECONOMY

The GVA (Gross Value Added) of Lephalale Local Municipality (LLM) was valued at R27.9 billion in 2023 (constant prices), which accounts for around 16.6% of the district economy's GVA and 4.3% of Limpopo's (Quantec Easydata, 2024). Lephalale has three main economic activities: mining, energy generation, agriculture, finance and business. The mining sector currently contributes 35.1% to the local economy and is by far the most significant economic sector within the municipality. The mining sector can be attributed to Exxaro's Grootegeluk Mine, located within the municipality and near Matimba and Medupi Power Stations. The Waterberg Coal Field is estimated to contain a resource base of 50 billion tonnes, of which 12.5 billion can be mined by opencast mining.

The utilities sector (12.8%) and the finance and business sector (8.5%) are the next biggest economic contributors to the local economy. The main utility sector contributors are the Medupi and Matimba Power Stations. The reliance of the local economy on the mining and energy generation sector is significant, and any impact on the performance of these sectors will be detrimental to the local economy. With the largest coal reserves in the country and the two power stations, sustainability in these sectors seems to be secure in the near future. The power stations provide a significant amount of electricity to the national grid and, therefore, have an impact outside the local municipality and district.

The utility sector (electricity, gas and water) contributes roughly R3,5 billion to the local economy. However, the reliance of the mining, manufacturing, and other economic sectors on the utility sector makes it a vital sector within the regional and local economy.

The main economic sectors in these areas include mining, electricity generation, agriculture and the finance and business sectors. The Medupi Power Station supports the mining sector, which is by far the largest economic sector in the local and district municipalities. Maintaining a stable energy supply ensures the local economy remains robust and productive.

Over the last decade, the LLM economy had an average growth rate of 3.2%, more than double the national growth rate of 1.2% over the past 10 years. The significant global challenges experienced over the last decade, specifically COVID-19, have contributed to a slight decline in growth of -1.5% in

2020/2021. Over the previous two years, double-digit growth signals a significant economic recovery within the local economy.

If the station is required to shut down due to a negative MES decision this would lead to a variety of economic impacts.

Medupi Power Station supplies electricity to the national grid. Should the station be required to shut down and there is no adequate alternative supply, the loss of this generation capacity on the national grid could result in the reintroduction of load-shedding. Maintaining a stable energy supply ensures the economy remains robust and productive.

Maintaining a stable national energy supply supports the national and local economy, including employment and associated livelihood requirements. The operation of Medupi Power Station contributes to this. Goods and services providers, among others, benefit from the power station's consistent supply and operational stability. Amongst others, the agriculture sector feeds into the agro-processing industry, which utilises electricity for manufacturing. Both these sectors contribute significantly to job creation and economic growth.

Maintaining a reliable power supply is crucial for economic growth. Avoiding load-shedding helps prevent economic downturns and supports growth trajectories. Reliable operations also bolster investor confidence, attracting investment to the area and the country.

7.3.2 IMPACT ON EMPLOYMENT

The LLM population increased by 23,721 between 2011 and 2022 to 139,487, representing an increase of 20.5% over 11 years (United Nations, 2024). The municipality's population is estimated to increase to 152,418 in 2030, 165,554 in 2040, and 171,470 in 2045. The gender distribution of the municipality was almost equal, with females representing 49.9% and males 50.1% of the population in 2022 (Stats SA, 2022). People between 15 and 64 years old represent 66.4% of the population. The young represent 28.8%, and the elderly 4.9% (Stats SA, 2022).

In 2023, the unemployment rate of LLM was 20.7%. This rate is significantly lower than the national unemployment rate of 33.0% (Quantec Easydata, 2024). The municipality has 36,959 employed people, and 9,625 are classified as unemployed. The non-economically active population amounts to 37,438 people. A substantial percentage of the population is classified as non-economically active. This aspect translates to a growing youthful population that will enter the workforce over the coming years, thus emphasising the need for job creation within the local municipality.

Matimba Power Station will employ an estimated 560 people in 2024, according to Eskom (Eskom, 2024), and with an unemployment rate of over 20% in the municipality, sustaining these jobs is crucial. Key employment opportunities rely on the power station's operations, including off-site suppliers, operational and maintenance contractors, and indirect employment opportunities. These additional and indirect employment opportunities are also vital to the successful operation of the power station.

The 3 200 employees at Exxaro's Grootegeluk Mine will also be vulnerable to unemployment should Matimba or Medupi Power Stations be forced to shut down due to the high costs of the FGD abatement project as they are the main coal supplier (Lephalale Local Municipality, 2024).

There are over 36,000 people employed in LLM across all economic sectors, all of which rely on electricity for their day-to-day operations. Any disruptions in the electricity supply or a return to significant load shedding will risk some of these jobs.

As Matimba Power Station contributes 7.9% to the national grid, its impact is felt at local, district municipality and national levels. The impact on employment will thus be felt nationwide should there be a significant reduction in electricity generation at Matimba Power Station.

Granting Matimba Power Station the exemption requested in this application will allow the facility to be operational at the current staffing levels. Maintaining staffing levels will secure the income of the surrounding communities, and local businesses and services will be able to continue operating.

Social impacts of potential job losses as a result of changed operations due an adverse MES decision can include:

- Increase in the unemployment rate within the area. The loss of jobs at the power station will increase the amount of people of working age who are unemployed.
- A sudden loss of income can result in drastic changes in lifestyle and the inability to meet necessities.
- Unemployment creates additional stress in families, resulting in tensions and possible disintegration.
- Being unemployed can result in alienation, shame and stigma.
- Increase in crime, including Gender Based Violence (GBV). The impacts associated with job losses can result in social disintegration, which may increase crime and GBV levels.
- Skilled workers are more likely to seek and find employment outside the area, resulting in an exodus of skills.
- With a decrease in disposable income, the standard of living is often reduced.

7.3.3 IMPACT ON THE STANDARD OF LIVING

As discussed, Matimba Power Station is responsible for many employment/jobs within the local communities and municipalities and supports off-site suppliers, OEMs, and indirect employment opportunities. All these employees earn a salary to support their families and increase direct spending in these areas.

The household earnings are used for housing, transportation, food, medical expenses, school fees, etc. With these earnings, the families continue their standard of living. However, should the power station operate at reduced capacity, the standard of living of some individuals in the local communities will be reduced due to lost employment.

Should security of supply be impacted and load-shedding return, the standard of living will be impacted as access to electricity is reduced, and households will have to rely on other energy sources such as household solar or burning carbon fuels. These energy sources have financial and health impacts, lowering the standard of living.

7.3.4 IMPACT ON GOVERNMENT REVENUE

Matimba Power Station is responsible for water revenues to the municipality and the Department of Water Affairs. The continued operation of the power station will allow for the collection of these rates, taxes and revenues.

7.3.5 IMPACT ON ELECTRICITY SUPPLY TO THE NATIONAL GRID

The Matimba Power Station currently has a nominal capacity of 3690 MW, which amounts to around 7,9% of the national grid capacity and is thus crucial to the sustainability of the national grid (Eskom, 2024). According to Eskom, it is pivotal to the recovery plan to sustain the performance at the best-performing stations within the fleet (Medupi, Matimba, Lethabo, and Peaking Power Stations). It is vital to guard the performance at these current flagship stations by implementing best practices and driving operational excellence (Eskom, 2024).

The loss of this generation capacity on the national grid without the availability of replacement capacity would be significant and could impact on the national security of supply and result in the reintroduction of load-shedding, resulting in a decline in economic activity and growth in the local, regional and national economies. The impact on capacity if the station is removed from the grid is discussed in more detail in the introduction and Section 5.2 of this report.

The socio-economic impacts should be considered in the context of the impact of compliance on security of energy supply. As was shown through scenario modelling in 2021/22, full compliance (whether immediate of even over a period of several years) could potentially limit the constitutional rights of South Africans by leading to severe energy deficits, at minimum constraining GDP growth and economic recovery, at worst causing total catastrophic economic collapse. Even at the minimum impact it would increase unemployment, reduce job creation, reduce government tax revenue, increase poverty and the associated malnutrition and health implications, with (even at this minimum impact level) a far greater health consequence than a delayed and more prolonged phase-out of carbon emissions.

8 STAKEHOLDER ENGAGEMENT

The Ministers Decision issued in May 2024 requires that: "Eskom must ensure that all relevant organs of state, interested and affected parties are notified of its applications for exemption and provided with an opportunity to comment thereon."

Based on this requirement, a public participation process based on the requirements of the EIA Regulations have been undertaken. Public participation is understood to be a series of inclusive and culturally appropriate interactions aimed at providing stakeholders with opportunities to express their views, so that these can be considered and incorporated into the decision-making process.

8.1 PUBLIC PARTICIPATION

8.1.1 IDENTIFICATION OF KEY STAKEHOLDERS

The stakeholder engagement commenced with the compilation of a stakeholder database to include relevant stakeholders, such as Commenting Authorities, State Owned Enterprises, business landowners/users, and Ward Councillors, as well as any other I&APs who may be interested or affected by the project.

Relevant authorities (organs of state) have been automatically registered as I&APs. In accordance with the EIA Regulations, 2014 all other persons must request in writing to be placed on the register, submit written comments, or attend meetings to be registered as stakeholders and included in future communication regarding the application.

Section 41 of the EIA Regulations, 2014 states that written notices must be given to identified stakeholders as outlined in the table below.

Table 8-1 - I&AP Identification

NEMA REQUIREMENT	DISCUSSION
(i) the owner or person in control of that land if the applicant is not the owner or person in control of the land	The applicant is the landowner.
(ii) the occupiers of the site where the activity is or is to be undertaken or to any alternative site where the activity is to be undertaken	The applicant is the landowner and occupant.
(iii) owners and occupiers of land adjacent to the site where the activity is or is to be undertaken or to any alternative site where the activity is to be undertaken	The landowners and occupant of adjacent properties will be notified of the proposed application by newspaper advert, site notices placed around the proposed site and also emails and SMS for those already registered in the database.
(iv) the municipal councillor of the ward in which the site or alternative site is situated and any organisation of ratepayers that represent the community in the area	The Ward Councillor has been included in the stakeholder database and will be notified by newspaper, received personal email and SMS notifications.
(v) the municipality which has jurisdiction in the area	The District Municipality as well as the Local Municipality have been included in the stakeholder database and will be notified by newspaper, received email and SMS notifications.
(vi) any organ of state having jurisdiction in respect of any aspect of the activity	The organs of state will be notified by newspaper, email and SMS notifications.
(vii) any other party as required by the competent authority.	All tiers of government, namely, national, provincial, local government and parastatals have been included on the stakeholder database and were notified by newspaper, received email and SMS notifications. Inclusive of: ▪ DFFE ▪ Department of Energy ▪ Department of Water and Sanitation

8.1.2 MES EXEMPTION APPLICATIONS ANNOUNCEMENT

The exemption application process will be announced for public comment for a period of 30 days from **06 November 2024 to 06 December 2024**. Additionally, the technical report along with an electronic version of the comment sheet will be placed on the WSP Group Africa (Pty) Ltd (WSP) website as well as the WSP Datafree website to be accessed by the public at the following links: https://www.wsp.com/en-ZA/services/public-documents and https://wsp-engage.com/.

8.1.2.1 DIRECT NOTIFICATION

8.1.2.1.1 Email notifications

Notification of the exemption application will be issued to registered I&APs and stakeholders, via email on **06 November 2024**. The purpose of the notification was to offer registered I&APs and stakeholders the opportunity to comment on the application process. A total of 830 registered stakeholders were notified via email.

8.1.2.1.2 SMS

Notification of the exemption application will be issued to registered I&APs and stakeholders, via SMS on **06 November 2024**. The purpose of the notification was to offer registered I&APs and stakeholders the opportunity to comment on the application process. A total of 1,321 registered stakeholders were notified via sms.

8.1.2.1.3 Site notices

The EIA Regulations, 2014 require that site notices be fixed at places conspicuous to the public at the boundary or on the fence of the site where the activity (to which the application relates) is to be undertaken, as well as at any alternative sites. Posters (in English, Afrikaans and Sepedi), conforming to the size specifications as per the EIA Regulations, 2014 will be placed on **06 November 2024.** Six posters in each language (where relevant) were placed for each power station.

8.1.3 AVAILABILITY OF TECHNICAL REPORTS

The exemption reports were made available for public comment at the public places outlined in Table 8-2.

Table 8-2 - Public Availability of Exemption Report

LOCATION	ADDRESS
Matimba Power Station	Nelson Mandela Dr, Lephalale
Lephalale Municipality Library	Corner Joe Slovo and Douwater Avenue, Lephalale
Marapong Library	916 Phukubye Street, Marapong
WSP Website	https://www.wsp.com/en-ZA/services/public-documents
Data-free Website	https://wsp-engage.com/

8.1.4 ADVERTISEMENT

Notification of the exemption application as well as opportunity to comment on the application process was issued to the general public via advertisements published in the newspapers outlined in Table 8-3, in **October and November 2024**, in English in all national newspapers and one other language in local newspapers. As mentioned above, the purpose of the advertisement was to notify the general public of the application, inform the public about the public meetings, and provide an opportunity to register on the project database and provide input into the process.

Table 8-3 - Placement of Adverts

LOCATION	DATE OF PUBLICATION
City Press (Regional Newspaper)	Sunday 3 November 2024
Sunday Times (National Newspaper)	Sunday 3 November 2024
Beeld (National Newspaper)	Sunday 3 November 2024
Star (National Newspaper)	Sunday 3 November 2024
Daily Sun (National Newspaper)	Wednesday 6 November 2024
Mogol Pos (Local Newspaper)	Friday 1 November 2024

8.1.5 PUBLIC MEETINGS

Public meetings will be convened for the project team to present the application to stakeholders as well as gather feedback from them. These meetings offer the stakeholders an opportunity to participate in the decision-making process and ensures that their voices are heard. Meetings will be convened at the locations outlined in Table 8-4 translation services will be available at the meetings and hard copy summaries of key documents will be made available at the physical meetings.

Table 8-4 - Date, venue and time of public meeting

VENUE	ADDRESS	DATE	TIME
Eskom Academy of Learning	Dale Road, Midrand	26 November 2024	10:00
Mogol Club	Cnr. George Wells Rd & Nelson Mandela Drive Lephalale	28 November 2024	10:00
Marapong Hall	458 Phukubje Street, Extension 2 Marapong	28 November 2024	18:00
Online Meeting	Microsoft Teams Meeting	29 November 2024	13:00

8.1.6 COMMENTS AND RESPONSES

Following the receipt of comments from I&APs, a Comments and Response Report (“CRR”) will be prepared and submitted to the Minster.

Proof of stakeholder engagement undertaken will be included in the submission to the Minister.

9 ASSUMPTIONS AND LIMITATIONS

The following assumptions, limitations and exclusions are applicable to this application:

- A 50-year operational life for the power stations has been assumed for this application.
- It is assumed the emission trajectories for scenario options of ERP 2024 A, ERP 2024 B, and ERP 2024 C, as provided by Eskom, are accurate and representative of reality and future anticipated plans.
- It is assumed current emissions data, as provided by Eskom, used to assess compliance to emission limits, and used as input to the dispersion models, are accurate and representative of existing operations.
- It is assumed abatement projects, as proposed by Eskom, will be undertaken as presented within the timeframe commitments, to the best of Eskom’s ability i.e. should outage schedules and grid capacity allow.
- Operational challenges identified at the stations, and confirmed by Eskom, are assumed to be accurate of current operational conditions at the stations.
- Results from the dispersion modelling, discussed herein, are assumed to accurately represent emissions data provided.
- Due to time constraints, the Security of Supply emission projection could not be assessed in the dispersion modelling.
- Ambient monitoring data, as contained herein, is assumed to accurately represent existing ambient air quality within the various airsheds.
- Qualitative technology evaluations, particularly relating to SO_2 abatement technologies, were undertaken by Eskom. This application assumes these evaluations, and the preferred technologies from these, accurately reflect the most appropriate technology for a particular station. WSP’s involvement in this application, and high-level understanding of Eskom stations, does indicate the technologies selected are most suitable, considering all aspects, such as costs, timeframes to commission, water requirements, retrofitting complexities, waste management, and emission

reduction efficiencies. Despite this, WSP cannot be held responsible should more appropriate technologies be identified in the future.
- Shutdown dates provided by Eskom are not within Eskom’s legal mandate to decide, but require prior approval from NERSA, which may not necessarily be granted should security of supply be jeopardised.

10 REFERENCES

(2024, September 10). Retrieved from SAAQIS: https://saaqis.environment.gov.za/

Adesina, J. A. et al. (2022). *Assessment of criteria pollutants contributions from coal-fired plants and domestic solid fuel combustion at the South African industrial highveld. Cleaner Engineering and Technology, 6, 100358. .*

Air Resource Management (ARM). (2024). *Offsets Research: Proposal for the expansion of Eskom's AQO Programme in the Highveld and Vaal, Rev: 02[ESK-A16-AQOE-02].*

Air Resource Management. (2024). *Offsets Research: Proposal for the expansion of Eskom's AQO Program in the Highveld and Vaal, Rev: 00 [ESK-A16-AQOE-00].*

BizNews. (n.d.). *The devastating impact of power cuts on South Africa's economy*. Retrieved from BizNews: https://www.biznews.com/energy/2023/02/01/devastating-impacts-power-cuts-sa-economy

CarbonBrief. (2020). *Global coal power*. Retrieved from CarbonBrief: https://www.carbonbrief.org/mapped-worlds-coal-power-plants/

DEA, D. o. (2014). *The Waterberg-Bojanala Priority Area Air.* Pretoria: Department of Environmental Affairs (DEA).

Department of Environmental Affairs . (December 2014). *Waterberg-Bojanala Priority Area Draft Air Quality Management Plan.*

Department of Environmental Affairs. (2011). *Highveld Priority Management Plan.* Pretoria: Department of Environmental Affairs.

Department of Environmental Affairs. (2014). *Waterberg-Bojanala Priority Area Draft Air Quality Management Plan.*

Department of Environmental Affairs. (2018, October 26). The 2017 National Framework for Air Quality Management in the Republic of South Africa, Government Gazette No. 41996. Pretoria, Gauteng Province, South Africa: Government Printing Works. Retrieved from www.gpwonline.co.za

Department of Forestry, Fisheries and the Environment. (2024). *Report of the NECA Forum to the Minister of Forestry Fisheries and the Environment on the Appeals Relating to Eskom's Power Stations.*

DFFE. (2024). *Report of the National Environmental Consultative and Advisory Forum pertaining to the Appeals relating to Eskom's Power Stations.*

Eskom. (2020). *APPLICATION AND MOTIVATION FOR EXEMPTION, POSTPONEMENT AND SUSPENSION FROM THE MINIMUM EMISSIONS STANDARDS COMPLIANCE TIMEFRAMES FOR ESKOM'S COAL-FIRED POWER STATIONS IN THE HIGHVELD.*

Eskom. (2020). *Application for alternative limits and postponement or exemption of the minimum emissions standards compliance timeframes for the Medupi power station.*

Eskom. (2021 - 2023). *Monitoring Stations Data.*

Eskom. (2021, MArch). *Air Quality Offset Implementation Plans for Lethabo Power Station: March 2021 Update [ENV21-R053].* Retrieved from Eskom: https://www.eskom.co.za/wp-content/uploads/2021/08/AQoffsetplanFezileDabiMarch2021update.pdf

Eskom. (2021). *ASH MANAGEMENT IN ESKOM*. Retrieved from https://www.eskom.co.za/wp-content/uploads/2021/08/CO-0004-Ash-Management-Rev-15.pdf

Eskom. (2021). *Initial Financial Analysis of MES policy option.*

Eskom. (2023). *Eskom*. Retrieved October 17 , 2024, from https://www.eskom.co.za/eskom-releases-its-results-for-the-2022-23-financial-year/

Eskom. (2024).

Eskom. (2024). *Comment made during the review of an exemption report by Eskom, 2024.*

Eskom. (2024). *Eskom Air Quality Offset Plans: Progress Report March 2024 [GEM24-DOC015].*

Eskom. (2024, September 19). *Eskom Socioeconomic Impact Assessment Study Area in Mpumalanga.* Retrieved from Eskom: www.eskom.co.za

Eskom. (2024). *Generation Division Business Plan FY 2025.* Eskom Generation Division.

Eskom. (2024). *Professional Services Contract Task Instruction.*

Eskom. (2024). *Professional Services Contract Task Instruction (Contract No: 4600074103).*

Eskom. (2024). *Quarterly Update on the Implementation of Eskom's Minimum Emission Standards Postponement Commitment: June 2024 [GEM24-L266].*

Eskom. (2024). *Quarterly update on the implementation of minimum emission standards postponement commitment.*

Eskom. (2024). *Recent Communication with Eskom.*

Eskom. (Air Quality Offset Project, 2024). *Air Quality Offset Project – Steering Committee.*

Eskom. (August 2024). *Eskom Licensing Authority – NAQO Meeting, Eskom Input (23 August 2024 rev 1.1).*

Eskom. (ENV21-R053, 2021). *Air Quality Offset Implementation Plans for Lethabo Power Station: March 2021 Update*. Retrieved from https://www.eskom.co.za/wp-content/uploads/2021/08/AQoffsetplanFezileDabiMarch2021update.pdf

Eskom Licensing Authority. (2024). *NAQO Meeting, Eskom Input .*

Eskom. (March 2021). *AAir Quality Offsets Implementation Plan for Gert Sibande District Municipality: Tutuka, Majuba, Camden and Grootvlei Power Stations: March 2021 update [ENV21-R052] .*

Eskom. (March 2021). *Air Quality Offsets Implementation Plan for Nkangala District Municipality: Hendrina, Arnot, Komati, Kriel, Matla, Kendal and Duvha Power Stations: March 2021 update .*

Eskom. (March, 2021). *Air Quality Offsets Implementation Plan for Gert Sibande District Municipality: Tutuka, Majuba, Camden and Grootvlei Power Stations: March 2021 update [ENV21-R052] .*

Eskom. (Monitoring Data). *Data provided by Eskom from their operated monitoring stations.*

Eskom. (n.d, n.d n.d). *Eskom Divisions - Medupi Projects*. Retrieved from Eskom Divisions - Medupi Projects: https://www.eskom.co.za/eskom-divisions/gx/coal-fired-power-stations/medupi-projects/

Eskom. (n.d, n.d n.d). *Lethabo Power Station - Heritage*. Retrieved from Lethabo Power Station - Heritage: https://www.eskom.co.za/heritage/lethabo-power-station/

Eskom. (n.d, n.d n.d). *Matla Power Station - Heritage*. Retrieved from Matla Power Station - Heritage: https://www.eskom.co.za/heritage/matla-power-station-2/

Eskom. (Progress Report, March 2024). *Eskom Air Quality Offset Plans: Progress Report March 2024 [GEM24-DOC015].*

Eskom. (Quarterly Update, June 2024). *Quarterly Update on the Implementation of Eskom's Minimum Emission Standards Postponement Commitment: June 2024 [GEM24-L266].*

Exxaro. (2024, September 18). *Exxaro Operations Grootgeluk*. Retrieved from Exxaro: https://www.exxaro.com/operations/where-we-operate/?location=grootegeluk

Exxaro. (2024, September 18). *Exxaro Operations Grootgeluk*. Retrieved from Exxaro: https://www.exxaro.com/operations/where-we-operate/?location=grootegeluk

Exxaro. (2024, September 13). *Where We Operate* . Retrieved from Exxaro.com: https://www.exxaro.com/operations/where-we-operate/

Genesis Analytics. (2023). *Socio-Economic Impact Assessment of the Repowering and Repurposing of Kendal Power Station.* Johannesburg: Genesis Analytics Consortium.

Govan Mbeki Municipality. (2022). *2022-2027 Fifth Generation Intergrated Development Plan.*

Lephalale Local Municipality. (2024, September 18). *Lephalale Local Municipality Background*. Retrieved from Lephalale Local Municipality: http://www.lephalale.gov.za/

Lephalale Municipality. (2024). *Intergrated Development Plan.* Retrieved from http://www.lephalale.gov.za/Documents/Final%20IDP%202024-25(04).pdf

Metsimaholo Local Municipality. (2024). *Draft 2024/2025 Reviewed Integrated Development Plan: Metsimaholo LM.* Retrieved from https://www.metsimaholo.gov.za/download/idp-5-year-plan-2022-23-2026-27/

Metsimaholo Local Municipality. (n.d.). *Draft 2024/2025 Reviewed Integrated Development Plan: Metsimaholo LM.* Retrieved from https://www.metsimaholo.gov.za/download/idp-5-year-plan-2022-23-2026-27/

Moolman, S. (2022). *Power Optimal*. Retrieved October 18, 2024, from https://poweroptimal.com/2021-update-eskom-tariff-increases-vs-inflation-since-1988/

Municipalities of South Africa. (2024). *Fezile Dabi District Municipality (DC20)*. Retrieved from Municipalities of South Africa: https://municipalities.co.za/overview/107/fezile-dabi-district-municipality

North-West University. (2024). *Identification and Evaluation of Air Quality Offset Opportunities in Marapong Township State of Air Quality for Marapong Township Final Report .*

North-West University. (2024). *Identification and Evaluation of Air Quality Offset Opportunities in Marapong Township, Emissions Inventory for Marapong Township Final Report .*

North-West University. (2024). *Pre-feasibility study for potential offset opportunities for Marapong Township.*

North-West University. (2024). *Pre-feasibility study for potential offset opportunities for Marapong Township.*

North-West University. (Emissions Inventory, 2024). *Identification and Evaluation of Air Quality Offset Opportunities in Marapong Township, Emissions Inventory for Marapong Township Final Report.*

Prime Africa Consult. (2024). *Air Pollution Health Risk Benefit Cost Analysis for exemption power stations in the Highveld Priority Area.*

Quantec Easydata. (2024, September). *Quantec Standardised Regional*. Retrieved from https://www.easydata.co.za/

Republic of South Africa. (1996). Constitution of the Republic of South Africa (Act No. 108 of 1996). Cape Town, Western Cape Province, South Africa: Government Printing Works. Retrieved from www.gpwonline.co.za

Republic of South Africa. (2005, February 24). National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004). Government Gazette No. 27318, Notice No. 163. Cape Town, Western Cape Province, South Africa: Government Printing Works. Retrieved from www.gpwonline.co.za

Republic of South Africa. (Government Gazette 43418, 2020). *Government Notice 655 (2020) Government Gazette 43418: National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004), Draft Second Generation Air Quality .*

Republic of South Africa. (Government Gazette 50985, 2024). *Government Gazette 50985: National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004), Consultation on the Draft Second-Generation Highveld Priority Area Air Quality Management Plan.*

Republic of South Africa, G. N. (2016). *National Environmental Management: Air Quality Act, 2004 9Act No.39 of 2004), Air Quality Offsets Guideline.* Government Gazette 39833.

Republic of South Africa, G. N. (Air Quality Offsets Guideline, 2016). *National Environmental Management: Air Quality Act, 2004 9Act No.39 of 2004), Air Quality Offsets Guideline.* Government Gazette 39833.

Republic of South Africa, Government Gazette 50985. (Air Quality Act, (2024)). *) Government Gazette 50985: National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004), Consultation on the Draft Second-Generation Highveld Priority Area Air Quality Management Plan.*

Republic of South Africa, Government Notice 533 (2014) Government Gazette 37804. (2004). *National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004), Regulations Regarding Air Dispersion Modelling.*

Seriti. (2020). *New Vaal Social and Labour Plan 2020/21 - 2024/25.*

South African Police Service. (2024). *First Quarter Crime Statistics 2024/2025.* Retrieved from https://www.saps.gov.za/services/crimestats.php

Stats SA. (2022). *Dataset: Descriptive by Municipality*. Retrieved from SuperWEB2: https://superweb.statssa.gov.za/webapi/jsf/tableView/tableView.xhtml

Stats SA. (2022). *Dataset: Descriptive by Municipality*. Retrieved from SuperWEB2: https://superweb.statssa.gov.za/webapi/jsf/tableView/tableView.xhtml

Stats SA. (2022). *Dataset: Descriptive by Municipality*. Retrieved from SuperWEB2: https://superweb.statssa.gov.za/webapi/jsf/tableView/tableView.xhtml

Stats SA. (2022). *Dataset: Descriptive by Municipality*. Retrieved from SuperWEB2: https://superweb.statssa.gov.za/webapi/jsf/tableView/tableView.xhtml

Stats SA. (2024). *Key Statistics*. Retrieved from Stats SA: https://census.statssa.gov.za/#/province/9/2

Stats SA. (n.d.). *Dataset: Descriptive by Municipality*. Retrieved from SuperWEB2: https://superweb.statssa.gov.za/webapi/jsf/tableView/tableView.xhtml

Stats SA. (n.d.). *Govan Mbeki*. Retrieved from Stats SA: https://www.statssa.gov.za/?page_id=993&id=govan-mbeki-municipality

uMoya-NILU. (2024). *Atmospheric Impact Report in Support of the Application for Exemption from the Minimum Emission Standards for Lethabo Power Station, Report No.: uMN215-24.*

United Nations. (2024). *World Population Prospects 2024*. Retrieved from UN Department of Economic and Social Affairs Population Division: https://population.un.org/wpp/

United States Environmental Protection Agency. (2024, August). *Clinical Outcomes Related to Particulate Matter Exposure and Cardiovascular Disease*. Retrieved from https://www.epa.gov/air-research/clinical-outcomes-related-particulate-matter-exposure-and-cardiovascular-disease

Appendix A

POWER STATION SPECIFIC ATMOSPHERIC IMPACT REPORT

ATMOSPHERIC IMPACT REPORT IN SUPPORT OF THE APPLICATION FOR EXEMPTION FROM THE MINIMUM EMISSION STANDARDS FOR MATIMBA POWER STATION

Final
04 November 2024

Report issued by:

uMoya-NILU Consulting (Pty) Ltd
P O Box 20622
Durban North, 4016
South Africa

Report issued to:

WSP Group Africa (Pty) Ltd
Building 1, Maxwell Office Park
Magwa Crescent West, Waterfall City
Midrand, 1685
South Africa

Report Details

Client:	WSP Group Africa (Pty) Ltd
Report title:	Atmospheric Impact Report in Support of the Application for Exemption from the Minimum Emission Standards for Matimba Power Station
Project:	uMN920-24
Report number:	uMN213-24
Version:	Final 04 November 2024
Prepared by:	uMoya-NILU Consulting (Pty) Ltd, P O Box 20622, Durban North 4016, South Africa
Authors:	Mark Zunckel, Atham Raghunandan and Nopasika Xulu

When used in a reference this document should be cited as follows:
uMoya-NILU (2024): Atmospheric Impact Report in Support of the Application for Exemption from the Minimum Emission Standards for Matimba Power Station, Report No.: uMN213-24, November 2024.

Front page picture credit: https://www.eskom.co.za/eskom-divisions/gx/coal-fired-power-stations/

EXECUTIVE SUMMARY

Eskom operates a fleet of 14 coal-fired power stations, collectively generating more than 39 000 MW of electricity. The combustion of coal to generate steam for the generation of electricity is a Listed Activity in terms of the National Environmental Management: Air Quality Act (Act No. 39 of 2004). Eskom holds Atmospheric Emission Licenses (AELs) for the respective power plants and is obligated to operate these plants according to conditions specified in the respective AELs. Minimum Emission Standards (MES) for Listed Activities were published in 2010 (DEA, 2010) including compliance timeframes for existing and new plants, however existing activities had to comply with the MES for new plants by 30 April 2020 unless specific approvals were obtained.

Between 2018 and 2020, Eskom submitted applications to the Department of Forestry, Fisheries and the Environment (DFFE) based on an internally approved Emission Reduction Plan, which defined which power stations would have emission reduction technology installed and when. The National Air Quality Officer (NAQO) made decisions on these applications in 2019, which were not in favour of Eskom. Eskom appealed the NAQO's decision, and the Minister established the National Environmental Consultative and Advisory (NECA) Forum to advise her on the issue. The Minister ruled on the Eskom appeals on 22 May 2024 and granted the suspension of the Minimum Emission Standards (MES) at five (5) power stations up to 31 March 2030, namely Arnot, Camden, Grootvlei, Hendrina and Kriel. The Minister further directed Eskom to submit an application in terms of Section 59 of the National Environmental Management: Air Quality Act for the exemption of the MES for eight (8) power stations that will continue to operate post 2030. These are Duvha, Kendal, Lethabo, Majuba, Matimba, Matla, Medupi and Tutuka.

In terms of the Minister's ruling, Eskom Holdings SOC Ltd appointed WSP Group Africa (Pty) Ltd to prepare the necessary applications. WSP Group Africa (Pty) Ltd sub-contracted uMoya-NILU Consulting (Pty) Ltd to prepare the associated Atmospheric Impact Reports (AIRs) (DEA, 2013a) to support these applications.

Matimba Power Station (hereafter referred to as Matimba) stack emissions currently meets the MES for oxides of nitrogen (NO_X) and particulate matter (PM). However, the current emissions of sulphur dioxide (SO_2) do not comply with the MES. This AIR for Matimba supports Eskom's application for exemption from the MES for new plants for SO_2 and assesses Eskom's proposed emission reduction strategy for Matimba.

Matimba is located in the Waterberg-Bojanala Priority Area on Farm Grootestryd in the Lephalale Local Municipality, about 13 km to the west of the town of Lephalale. It has a base load generation capacity of 3 990 MW, generated in 6 units. Matimba operates three Listed Activities in terms of the AEL issued on 27 September 2022. These are listed in Table E-1. The applicable MES are listed in Table E-2.

Table E-1: Current authorisations related to air quality

Atmospheric Emission License	Date of Certificate	Listed Activity Category	Sub-category	Listed Activity Process Description
H16/1/13-WDM05	Issue: 27 Sept 2022 Expire: 30 Sept 2026	1	1.1	Solid Fuel Combustion Installations
		2	2.4	Storage and Handling of Petroleum Products
		5	5.1	Storage and Handling of Ore and Coal

Table E-2: Minimum Emission Standards in mg/Nm^3

Substance or mixture of substances		Subcategory 1.1
Common name	Chemical symbol	MES under normal conditions of 10% O_2, 273 Kelvin and 101.3 kPa.
Particulate matter	N/A	50
Oxides of nitrogen[a]	NO_X	750
Sulphur dioxide	SO_2	1 000[b]

(a): Expressed as NO_2

(b): Gazette 43174, GN421 of 27 March 2020

Shutdown of Matimba is planned from 2039 to 2043. In the meantime, Eskom plans to improve the collection efficiency of particulates with the installation of High Frequency Power Supply technology from 2025.

Five emission scenarios capture these reduction plans and are assessed for Eskom's application for exemption of the MES for Matimba. These are:

Scenario 1 (Current): The baseline scenario using actual monthly stack emissions for 2021-2023 and fugitive emissions from the coal stockyard and ash dump.

Scenario A (2025): Eskom's planned 2025 stack emissions, representing anticipated station performance between 2025 – 2030, including fugitive emissions from the coal stockyard and ash dump.

Scenario B (2031): Eskom's planned 2031 stack emissions, representing anticipated station performance between 2031 – 2035, including fugitive emissions from the coal stockyard and ash dump.

Scenario C (2036): Eskom's planned 2036 stack emissions, representing anticipated station performance from 2036 onwards, including fugitive emissions from the coal stockyard and ash dump.

Scenario D (MES): Full compliance with the MES, including fugitive emissions from the coal stockyard and ash dump.

The annual average emissions for the five scenarios are presented in Table E-3.

Table E-3: Stack emission rates and equivalent emission concentrations for Matimba

Scenario	**Stack**	**Emission rate (tonnes/year)**			**Emission concentration @ 10% O_2 and average load (mg/Nm^3)**		
		NO_X	**SO_2**	**PM**	**NO_x**	**SO_2**	**PM**
1[a]	Stack 1	28 921	150 457	2 648	291	1 514	27
	Stack 2	28 921	150 457	2 648	291	1 514	27
A	Stack 1	28 346	150 830	1 820	545	2 900	35
	Stack 2	28 346	150 830	1 820	545	2 900	35
B	Stack 1	18 118	103 026	1 243	510	2 900	35
	Stack 2	18 118	103 026	1 243	510	2 900	35
C	Stack 1	20 872	112 752	1 432	510	2 755	35
	Stack 2	20 872	112 752	1 432	510	2 755	35
D	Stack 1	20 872	33 825	1 432	510	827	35
	Stack 2	20 872	33 825	1 432	510	827	35
MES					**750**	**1000**	**50**

(a): Average from actual monthly emissions

The CALPUFF dispersion model is used to predict ambient concentrations of SO_2, NO_2, PM_{10} and $PM_{2.5}$ resulting from Matimba stack emissions and fugitive emissions of PM from the coal stockyard and the ash dump for the five scenarios. While the focus of the assessment is on the stack emissions, the inclusion of fugitive PM emissions provides a holistic understanding of Matimba's contribution to ambient PM_{10} and $PM_{2.5}$ concentrations. Modelling is done according to the modelling regulations and 3-years of hourly surface and upper air meteorological data is used.

In the body of the report the predicted ambient SO_2, NO_2, PM_{10} and $PM_{2.5}$ concentrations are presented as isopleth maps over the modelling domain. In this executive summary the maximum predicted annual SO_2, NO_2, PM_{10} and $PM_{2.5}$ concentrations and the 99th percentile concentration of the 24-hour and 1-hour predicted concentrations are presented in Table E-4.

For SO_2, the predicted concentrations are attributed only to the stack emissions. The predicted annual average and 1-hour maximum concentrations for the 5 scenarios are relatively low and comply with the limit values of the respective National Ambient Air Quality Standards (NAAQS). The highest of these predictions occurs for Scenario B (2031), and then systematically decrease with progressive years and the corresponding stack emission reductions. For the 24-hour maximum concentration, the limit value is exceeded for Scenario A (2025) and Scenario B (2031) emissions. Thereafter they decrease to relatively low concentrations and comply with the NAAQS.

For NO_2, the predicted concentrations are attributed only to the stack emissions. The maximum predicted concentrations for the 5 scenarios are low relative to the limit values of the respective NAAQS. The highest of these predictions occurs for Scenario B (2031), and then systematically decrease in progressive years with the corresponding stack emission reductions.

For PM_{10} and $PM_{2.5}$, the predicted concentrations are attributed to stack emissions and the low-level fugitive sources (coal stockyard and ash dump). The PM emissions are not speciated into PM_{10} and $PM_{2.5}$, rather all PM emitted is assumed to be PM_{10}, and all PM emitted is assumed to be $PM_{2.5}$. Included in the predicted concentrations is the formation of secondary particulates from SO_2 and NO_2 stack emissions. Together, this represents a worse-case emission scenario for PM_{10} and $PM_{2.5}$.

For PM_{10} and $PM_{2.5}$, the maximum predicted concentrations exceed the limit values of the respective NAAQS. The predicted concentrations are similar for all of the scenarios as these occur close to the power station and are dominated by the fugitive sources. The stack emissions generally have an effect some distance from the source, while low-level emission have an effect close to the source.

Table E-4: Maximum predicted ambient annual SO_2, NO_2, PM_{10} and $PM_{2.5}$ concentrations in µg/m³ and the predicted 99th percentile concentrations for 24-hour and 1-hour averaging periods, with the South African NAAQS

Pollutant	**SO_2**		
Predicted maximum SO_2	**Annual**	**24-hour**	**1-hour**
Scenario 1 (Current)	6.6	84.0	160.0
Scenario A (2025)	13.7	**207.8**	**409.0**
Scenario B (2031)	15.7	**221.8**	**464.9**
Scenario C (2036)	14.3	**214.7**	**410.9**
Scenario D (MES)	4.3	64.4	123.3
NAAQS	50	125	350
Predicted maximum NO_2	**Annual**		**1-hour**
Scenario 1 (Current)	0.8		22.0
Scenario A (2025)	1.9		59.3
Scenario B (2031)	2.0		64.1
Scenario C (2036)	2.0		59.0
Scenario D (MES)	2.0		59.0
NAAQS	40		200
Predicted maximum PM_{10}	**Annual**	**24-hour**	
Scenario 1 (Current)	**88.9**	**262.1**	
Scenario A (2025)	**89.1**	**262.2**	
Scenario B (2031)	**89.1**	**260.7**	
Scenario C (2036)	**89.1**	**261.3**	
Scenario D (MES)	**88.8**	**257.4**	
NAAQS	40	75	
Predicted maximum $PM_{2.5}$	**Annual**	**24-hour**	
Scenario 1 (Current)	**88.9**	**262.1**	
Scenario A (2025)	**89.1**	**262.2**	
Scenario B (2031)	**89.1**	**260.7**	
Scenario C (2036)	**89.1**	**261.3**	
Scenario D (MES)	**88.8**	**257.4**	
NAAQS	20	40	Up to 31 Dec 2029
	15	25	From 01 Jan 2030

For SO_2, the predicted concentrations are attributed only to the stack emissions. The maximum predicted ambient concentrations are relatively low for all averaging periods at all identified sensitive receptors in Scenario 1 (Current) and Scenario D (MES). For the proposed emissions in Scenario A (2025), Scenario B (2031) and Scenario C (2036) the predicted annual average concentrations also comply with the respective NAAQS. However, for these proposed emission scenarios the predicted 24-hour concentrations exceed the limit value of the NAAQS at up to 9 sensitive receptor points, but on fewer occasions that permitted and are therefor compliant with the NAAQS.

For NO_2, the predicted concentrations are attributed only to the stack emissions. The maximum predicted ambient concentrations are relatively low for all averaging periods at all of the identified sensitive receptors in all five scenarios.

For PM_{10} and $PM_{2.5}$, the predicted concentrations are attributed to stack emissions and low-level fugitive sources (coal stockyard and ash dump). The PM emissions are not speciated into PM_{10} and $PM_{2.5}$, rather all PM emitted is assumed to be PM_{10}, and all PM emitted is assumed to be $PM_{2.5}$. Included in the predicted concentrations is the formation of secondary particulates from SO_2 and NO_2 stack emissions. Together, this represents a worse-case emission scenario for PM_{10} and $PM_{2.5}$, and is a very conservative approach. The stack emissions generally have an effect some distance from the source, while low-level emissions have an effect close to the source.

For PM_{10} and $PM_{2.5}$, the predicted annual average concentrations are below the limit values of the NAAQS at all sensitive receptor points in all five scenarios.

The predicted 24-hour PM_{10} concentrations exceed the limit value at four sensitive receptor points in Scenario 1 (Current), Scenario A (2025), Scenario B (2031) and in Scenario C (3026), and at one sensitive receptor point in Scenario D (MES). The predicted 24-hour $PM_{2.5}$ concentrations exceed the limit value in all five scenarios. For Scenario 1 (Current) and Scenario A (2025) exceedances are predicted at 11 sensitive receptors. With the implementation of the limit value of 25 µg/m^3 in 2030, the exceedances are predicted at 18 sensitive receptors for Scenario B (2031), Scenario C (2036) and Scenario D (MES).

Noteworthy findings from the modelling results for SO_2 may be summarised as follows:

i) Ambient SO_2 concentrations are attributed to the stack emissions only.
ii) For Scenario 1 (Current): Predicted concentrations comply with the NAAQS for all averaging periods throughout the modelling domain.
iii) For Scenario A (2025): Predicted concentrations comply with the NAAQS for all averaging periods throughout the modelling domain, except for the predicted 99th percentile concentrations which exceed the limit value of the 24-hour and 1-hour NAAQS.
iv) For Scenario B (2031): Predicted concentrations comply with the NAAQS for all averaging periods throughout the modelling domain, except for the predicted 99th percentile concentrations which exceed the limit value of the 24-hour and 1-hour NAAQS.
v) For Scenario C: (2036): Predicted concentrations comply with the NAAQS for all averaging periods throughout the modelling domain, except for the predicted 99th percentile concentrations which exceed the limit value of the 24-hour and 1-hour NAAQS.
vi) For Scenario D: Predicted concentrations comply with the NAAQS for all averaging periods throughout the modelling domain.

Noteworthy findings from the modelling results for NO_2 may be summarised as:

i) Ambient NO_2 concentrations are attributed to the stack emissions only.
ii) Predicted concentrations comply with the NAAQS for all averaging periods throughout the modelling domain, for all scenarios.

Noteworthy findings regarding PM_{10} and $PM_{2.5}$ may be summarised as:

i) Fugitive emissions from the ash dump have resulted in a number of complaints relating to dust.

ii) Ambient PM_{10} and $PM_{2.5}$ concentrations are attributed to the stack emissions and the low-level fugitive sources. The stack emissions generally have an effect some distance from the source, while low-level emission have an effect close to the source.

iii) In the modelling the conservative assumption is made firstly that the total PM emission is PM_{10}, and secondly, the total PM emission is $PM_{2.5}$.

iv) For PM_{10} and $PM_{2.5}$, the predicted annual average concentrations comply with the NAAQS at all of the sensitive receptor points in all five scenarios.

v) Exceedance of the limit value of the 24-hour NAAQS for PM_{10} and $PM_{2.5}$ are predicted in all five emission scenarios.

vi) The predicted 99th percentile of the 24-hour PM_{10} concentrations are exceed the limit value at four sensitive receptor points in Scenario 1 (Current), Scenario A (2025), Scenario B (2031) and in Scenario C (3026), and at one sensitive receptor point in Scenario D (MES).

vii) The predicted 99th percentile of the 24-hour $PM_{2.5}$ concentrations exceed the limit value in all five scenarios. For Scenario 1 (Current) and Scenario A (2025), exceedances are predicted at 11 sensitive receptors. With the implementation of the limit value of 25 $\mu g/m^3$ in 2030, exceedances are predicted at 18 sensitive receptors for Scenario B (2031), Scenario C (2036) and Scenario D (MES).

Given the conservative approach to the fugitive emission source simulations, and that this has provided an absolute worst-case emission scenario, and based on recommendations received from uMoya-Nilu, Eskom will be undertaking an additional modelling scenario, assessing only PM, SO_2, and NOx stack emissions. NOx and SO_2 emissions will be included in this scenario to ensure secondary particulate formation is accounted for. This will provide improved insight to impacts directly related to stack emissions, which are the focus of this exemption application.

ACKNOWLEDGEMENT

Jared Lodder, Yakeen Kowlas and Lehlohonolo Sello from WSP Group Africa (Pty) Ltd are acknowledged for processing the ambient air quality and wind data for the baseline assessment.

GLOSSARY OF TERMS AND ACRONYMS

AEL	Atmospheric Emission Licence
AIR	Atmospheric Impact Report
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
EIA	Environmental Impact Assessment
FGD	Flue-gas desulfurisation
g/s	Grams per second
kPa	Kilo Pascal
MES	Minimum Emission Standards
mg/Nm^3	Milligrams per normal cubic meter refers to emission concentration, i.e. mass per volume at normal temperature and pressure, defined as air at 20°C (293.15 K) and 1 atm (101.325 kPa)
NAAQS	National Ambient Air Quality Standards
NAQO	National Air Quality Officer
NECA	National Environmental Consultative and Advisory
NEM-AQA	National Environment Management: Air Quality Act, 2004 (Act No. 39 of 2004)
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
USEPA	United States Environmental Protection Agency
µm	Micro meter (1 µm = 10^{-6} m)

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

Eskom operates a fleet of 14 coal-fired power stations, collectively generating more than 39 000 MW of electricity. The combustion of coal to generate steam for the generation of electricity is a Listed Activity in terms of the National Environmental Management: Air Quality Act (Act No. 39 of 2004). Eskom holds Atmospheric Emission Licenses (AELs) for the respective power plants and is obligated to operate these plants according to conditions specified in the respective AELs. Minimum Emission Standards (MES) for Listed Activities were published in 2010 (DEA, 2010) including compliance timeframes for existing and new plants, however existing activities had to comply with the MES for new plants by 30 April 2020.

Between 2018 and 2020, Eskom submitted applications to the Department of Forestry, Fisheries and the Environment (DFFE) based on an internally approved Emission Reduction Plan, which defined which power stations in the fleet would have emission reduction technology installed and when. The National Air Quality Officer (NAQO) made decisions on these applications in 2019, which were not in favour of Eskom. Eskom appealed the NAQO's decision, and the Minister established the National Environmental Consultative and Advisory (NECA) Forum to advise her on the issue.

The Minister ruled on the Eskom appeals on 22 May 2024. She granted the suspension of the Minimum Emission Standards (MES) at five (5) power stations up to 31 March 2030. She further directed Eskom to submit an application in terms of Section 59 of the National Environmental Management: Air Quality Act for the exemption of the MES for eight (8) power stations that will continue to operate post 2030. The five power stations that will close by 2030 are Arnot, Camden, Grootvlei, Hendrina and Kriel. The eight power stations that will operate post 2030 are Duvha, Kendal, Lethabo, Majuba, Matimba, Matla, Medupi and Tutuka.

In terms the Minister's ruling, Eskom Holdings SOC Ltd appointed WSP Group Africa (Pty) Ltd to prepare the necessary applications. WSP Group Africa (Pty) Ltd sub-contracted uMoya-NILU Consulting (Pty) Ltd to prepare the associated Atmospheric Impact Reports (AIRs) (DEA, 2013a) to support these applications.

Matimba Power Station (hereafter referred to as Matimba) is located in the Waterberg-Bojanala Priority Area on Farm Grootestryd in the Lephalale Local Municipality, about 13 km to the west of the town of Lephalale. It has a base load generation capacity of 3 990 MW, generated in 6 units. Matimba will remain in operation until planned shutdown is completed by 2043. This AIR for Matimba supports Eskom's application for exemption from the MES until shutdown.

2. ENTERPRISE DETAILS

2.1 Enterprise Details

The details of Matimba are summarised in Table 2-1.

Table 2-1: Enterprise details

Entity Name:	Eskom Holdings SOC Limited
Trading as:	Matimba Power Station
Type of Enterprise, e.g. Company/Close Corporation/Trust, etc.:	State Owned Company
Company/Close Corporation/Trust Registration Number (Registration Numbers if Joint Venture):	2002/015527/30
Registered Address:	Megawatt Park, Maxwell Drive, Sunninghill, Sandton
Postal Address:	P. O. Box 1091, Johannesburg, 2000
Telephone Number (General):	+27 11 800 3861
Fax Number (General):	
Company Website:	www.eskom.co.za
Industry Type/Nature of Trade:	Electricity Generation
Land Use Zoning as per Town Planning Scheme:	Agricultural/Heavy industry
Land Use Rights if outside Town Planning Scheme:	Not applicable
Responsible Person:	Caroline Obakeng Majotja
Emissions Control Officer:	+27 14 763 8402
Telephone Number:	+27 79 522 4773
Cell Phone Number:	+27 14 763 3616
Fax Number:	MabotjO@eskom.co.za
Email Address:	+27 79 522 4773
After Hours Contact Details:	Caroline Obakeng Majotja

2.2 Location and extent of the power station

Matimba Power Station is located in the Waterberg-Bojanala Priority Area on Farm Grootestryd in the Lephalale Local Municipality, about 13 km to the west of the town of Lephalale. The relevant site information is provided in Table 2-2. Its relative location is illustrated in Figure 2-1 and Figure 7-1.

Table 2-2: Site information

Physical Address of the Licensed Premises:	Lephalale: Farm Grootestryd 465 LO
Description of Site:	Farm Grootestryd 465 LO
Property Registration Number (Surveyor-General Code):	N/A
Coordinates (latitude, longitude) Centre of Operations (Decimal Degrees):	Latitude: 23.668333°S Longitude: 27.610555°E
Coordinates (UTM) Centre of Operations (UTM 35S):	Northing: 7382359.63 m S Easting: 562259.08 m E
Extent (km²):	4.25
Elevation Above Mean Sea Level (m):	880
Province:	Limpopo Province
District/Metropolitan Municipality:	Waterberg District Municipality
Local Municipality:	Lephalale Local Municipality
Designated Priority Area (if applicable):	Waterberg-Bojanala Priority Area

2.3 Description of surrounding land use

The Code of Practice for Air Dispersion Modelling in Air Quality Management in South Africa (DEA, 2014a) recommends the Land Use Procedure as sufficient for determining the urban/rural status of a modelling domain. The classification of the study area as urban or rural is based on the Auer method (Auer, 1978), as specified in the US EPA guideline on air dispersion models (US EPA, 2005). From the Auer's method, areas typically defined as rural include residences with grass lawns and trees, large estates, metropolitan parks and golf courses, agricultural areas, undeveloped land and water surfaces. An area is defined as urban if it has less than 35% vegetation coverage or it falls into one of the use types in Table 2-3.

Table 2-3: Land types, use and structures and vegetation cover

Type	Use and Structures	Vegetation
I1	Heavy industrial	Less than 5 %
I2	Light/moderate industrial	Less than 5 %
C1	Commercial	Less than 15 %
R2	Dense single / multi-family	Less than 30 %
R3	Multi-family, two-story	Less than 35 %

Matimba is located in the Lephalale Local Municipality on Farm Grootestryd, about 13 km to the west of the town of Lephalale. The overall land use in the area surrounding Matimba is mining activities, industry and agriculture. Figure 2-1 shows the relative location of Matimba and a circle of 5 km radius around the power station. There are three relatively large residential areas, namely Marapong, Onverwacht and Lephalale. Marapong arcs from the north-northeast to the east-northeast and is less than 1 km from the power station. The Lephalale-Marapong housing complex is 1.2 km to the northwest. Lephalale is 13 km to the east-southeast of Matimba. The Medupi Power Station (industry) is 6 km southwest of Matimba and the Grootegeluk Coal Mine (mining) is located west and southwest of Matimba.

Figure 2-1: Relative location of Matimba showing a 5 km radius from the centre of the site (Google Earth, 2024)

The US Environmental Protection Agency (USEPA, 2024a) recognise Sensitive Receptors as areas which include, but are not limited to hospitals, schools, daycare facilities, elderly housing and convalescent facilities or specialised healthcare facilities. These are areas where the occupants are more susceptible to the adverse effects of exposure to toxic chemicals, pesticides and other pollutants. The California Air Resources Board (CARB, 2024) identify Sensitive Receptors as children, elderly, asthmatics and others who are at a heightened risk of negative health outcomes due to exposure to air pollution.

The locations where these sensitive receptors congregate are considered sensitive receptor locations and therefore include hospitals, schools and day care centres, and other such locations. Three ambient air quality monitoring stations (AQMS) and 34 sensitive receptors were identified within 30 km of Matimba (Table 2-4).

Table 2-4: Ambient monitoring stations and sensitive receptors within 30 km of Matimba

Receptor	UTMx	UTMy
Eskom Marapong AQMS - Monitoring Station	564.044	7383.715
Eskom Medupi AQMS - Monitoring Station	554.985	7374.552
SAWS Lephalale-NAQI AQMS - Monitoring Station	573.617	7380.786
Phegelelo Senior Secondary	563.060	7384.177
Contractors Village	561.293	7383.583
Ditheku Primary School	562.976	7384.276
Ditheko pramary School	564.691	7383.858
Marapong Training Centre	563.087	7383.465
Marapong Clinic	564.193	7383.464
Tielelo Secondary School	562.969	7384.035
Grootegeluk Medical Centre - Community Center	563.210	7383.421
Lephalale College	569.911	7380.730
Nelsonskop Primary School	563.913	7383.543
Hansie En Grietjie Pre-Primary School	569.673	7380.666
Sedibeng Special School for the Deaf and Disabilities	570.930	7379.738
Kings College	568.333	7379.208
Bosveld Primary School	569.400	7379.308
Lephalale Medical Hospital	562.938	7383.634
Ellisras Hospital	571.713	7381.273
Laerskool Ellisras Primary School	576.067	7382.620
Hoerskool Ellisras Secondary School	575.189	7382.498
Marlothii Learning Academy	575.455	7382.359
Hardekool Akademie vir C.V.O	577.372	7382.412
Lephalale Clinic	576.044	7382.374
Ons Hoop	573.075	7392.408
Ramabara's	584.098	7373.114
Kremetartpan	537.357	7361.300
Mbala Private Camp	549.972	7352.418
Steenbokpan	541.767	7375.229
Receptor	535.001	7391.411
Receptor	560.399	7395.005
Receptor	545.208	7400.388

Receptor	UTMx	UTMy
Receptor	559.690	7413.301
Receptor	583.382	7409.354
Receptor	587.468	7399.238
Tholo Bush Estate	586.073	7355.407
Receptor	568.868	7354.021

2.4 Emission Control Officer

Matimba's Emission Control Officer (ECO) is Caroline Obakeng Majotja. See Table 2-1 for contact details.

2.5 Atmospheric Emission License (AEL) and other Authorisations

The Atmospheric Emissions Licence (AEL) held by Matimba was issued by the Waterberg District Municipality on 27 September 2022. The AEL concerns three Listed Activities (Table 2-5) and specifies permissible stack emission concentrations for particulate matter (PM), sulphur dioxide (SO_2) and oxides of nitrogen (NO_X).

Table 2-5: Current authorisations related to air quality

Atmospheric Emission License	Date of Certificate	Listed Activity Category	Sub-category	Listed Activity Process Description
H16/1/13-WDM05	Issue: 27 Sept 2022 Expire: 30 Sept 2026	1	1.1	Solid Fuel Combustion Installations
		2	2.4	Storage and Handling of Petroleum Products
		5	5.1	Storage and Handling of Ore and Coal

2.6 Modelling contractor

The dispersion modelling for this AIR is conducted by:

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

See Annexure 2 for abridged CV's

2.7 Terms of Reference

The Terms of Reference are to prepare an Atmospheric Impact Report (AIR) according to regulations prescribing the format of an AIR (DEA, 2013a) to support the application for exemption of the MES for Matimba Power Station. In so doing, five emission scenarios are assessed for Eskom's application for exemption of the MES for Matimba.

Scenario 1 (Current): The baseline scenario using actual monthly stack emissions for 2021-2023 and fugitive emissions from the coal stockyard and ash dump.
Scenario A (2025): Eskom's planned 2025 stack emissions, representing anticipated station performance between 2025 – 2030, including fugitive emissions from the coal stockyard and ash dump.
Scenario B (2031): Eskom's planned 2031 stack emissions, representing anticipated station performance between 2031 – 2035, including fugitive emissions from the coal stockyard and ash dump.
Scenario C (2036): Eskom's planned 2036 stack emissions, representing anticipated station performance from 2036 onwards, including fugitive emissions from the coal stockyard and ash dump.
Scenario D (MES): Full compliance with the MES, including fugitive emissions from the coal stockyard and ash dump.

2.8 Assumptions

The following assumptions are relevant to this AIR:

a) No ambient monitoring is done in this assessment, rather available ambient air quality data is used.
b) The assessment of potential human health impacts is based on predicted (modelled) ambient concentrations of SO_2, NO_2, PM_{10} and $PM_{2.5}$ and the health-based National Ambient Air Quality Standards (NAAQS).
c) Emissions data used in this AIR have been provided by Eskom and are deemed to be accurate and representative of operating conditions in the respective scenarios.
d) The PM emissions are not speciated into PM_{10} and $PM_{2.5}$, rather all PM emitted is assumed to be PM_{10}, and all PM emitted is assumed to be $PM_{2.5}$. This represents a worse-case emission scenario for PM_{10} and $PM_{2.5}$.
e) Assumptions regarding emissions from the ash dump are included in Section 5.4.

3. NATURE OF THE PROCESS

3.1 Listed Activity or Activities

As a measure to reduce emissions from industrial sources and to improve ambient air quality, Listed Activities and associated Minimum Emission Standards (MES) were initially published in 2010 in Government Notice 248 (DEA, 2010) with the most recent revision applicable in 2010 (Government Notice 421, DEA, 2020). The Listed Activities relevant to Matimba Power Station are listed in Table 3-1.

Table 3-1: Details of the Listed Activity for Matimba Power Station according to GN 248 (DEA, 2010) and its revisions (DEA, 2013b, 2019,2020)

Category of Listed Activities	Sub-category of Listed Activity	Description of Listed Activity	Description and Application of the Listed Activity
1: Combustion Installations	1.1: Solid Fuel Combustion Installations	Solid fuels combustion installations used primarily for steam raising or electricity generation.	All installations with design capacity equal to or greater than 50 MW heat input per unit, based on the lower calorific value of the fuel used.
2: Petroleum Industry, the production of gaseous and liquid fuels as well as petrochemicals from crude oil, coal, gas or biomass	2.4: Storage and handling of petroleum products	Petroleum products storage tanks and product transfer facilities.	All permanent immobile liquid storage facilities at a single site with a combined storage capacity of greater than 1 000 cubic metres.
5: Mineral Processing, Storage and Handling	5.1: Storage and Handling of Ore and Coal	Storage and handling of ore and coal not situated on the premises of a mine or works as defined in the Mines Health and Safety Act 29/1996.	Locations designed to hold more than 100 000 tons.

3.2 Process Description

Eskom Holdings SOC Limited is a South African utility that generates, transmits and distributes electricity. The bulk of that electricity is generated by large coal-fired power stations that are situated close to the sources of coal. Matimba is one such station. Matimba has a base load generation capacity of 3 990 MW, generated in 6 units, each with an installed capacity of approximately 686 MW.

Matimba receives coal from the nearby mines. The coal is conveyed to the coal stockyard on site where it is milled to pulverised fuel and fed to the six boilers. Combustion of the coal in the boilers heats water to superheated steam, which drives the turbines. In turn, the turbines drive the generators which generate electricity.

3.3 Air pollutants resulting from the process

3.3.1 Air pollutants

Atmospheric emissions depend on the fuel composition and rate of consumption, boiler design and operation, and the efficacy of pollution control devices. Emissions from the boilers are emitted via two stacks and include sulphur dioxide (SO_2), oxides of nitrogen ($NO + NO_2 = NO_X$) and particulate matter (PM).

SO_2 is produced from the combustion of sulphur bound in coal. The stoichiometric ratio of SO_2 to sulphur dictates that 2 kg of SO_2 are produced from every kilogram of sulphur combusted. The coal used by the Matimba Power Station has a sulphur content of less than 1%. NO_X is produced from thermal fixation of atmospheric nitrogen in the combustion flame and from oxidation of nitrogen bound in the coal. The quantity of NO_X produced is directly proportional to the temperature of the flame.

The non-combustible portion of the fuel remains as solid waste. The coarser, heavier waste is called 'bottom ash' and is extracted from the boiler, and the lighter, finer portion is 'fly ash' and is usually suspended in the flue gas, and in the absence of any emission control would be emitted as PM through the stack. The coal used at Matimba has an ash content of between 30 and 40%.

3.3.2 National Ambient Air Quality Standards

National Ambient Air Quality Standards (NAAQS) (DEA, 2009, 2012) apply to the pollutants emitted by Matimba. The NAAQS consists of a 'limit' value and a permitted frequency of exceedance. The limit value is the fixed concentration level aimed at reducing the harmful effects of a pollutant. The permitted frequency of exceedance represents the acceptable number of exceedances of the limit value expressed as the 99th percentile. Compliance with the ambient standard implies that the frequency of exceedance of the limit value does not exceed the permitted tolerance. The NAAQS for SO_2, NO_2, PM_{10} and $PM_{2.5}$ are presented in Table 3-2.

Table 3-2: NAAQS for pollutants relevant to Matimba

Pollutant	Averaging period	Limit value (µg/m³)	Tolerance
SO_2	1 hour	350	88
	24 hour	125	4
	1 year	50	0
NO_2	1 hour	200	88
	1 year	40	0
PM_{10}	24 hour	75	4
	1 year	40	0
$PM_{2.5}$	24 hour	40 (25[a])	4
	1 year	20 (15[a])	0

(a): Applicable from 01 January 2030

3.4 Unit Processes

A summary of the different unit process at Matimba is provided in Table 3-3. The relative location of these at Matimba is shown in Figure 3-1.

Table 3-3: Unit processes at Matimba

Unit Process	Function of Unit Process	Batch or Continuous Process
Boiler Unit 1	Generation of electricity from coal	Continuous
Boiler Unit 2	Generation of electricity from coal	Continuous
Boiler Unit 3	Generation of electricity from coal	Continuous
Boiler Unit 4	Generation of electricity from coal	Continuous
Boiler Unit 5	Generation of electricity from coal	Continuous
Boiler Unit 6	Generation of electricity from coal	Continuous
Coal stockyard	Storage of coal	Continuous
Fuel oil storage tanks	Storage of fuel oil	Continuous
Ashing facility	Storage of ash	Continuous

Figure 3-1: Relative location of the different process units at Matimba

4. TECHNICAL INFORMATION

4.1 Raw materials used

The permitted raw materials consumption rate, the permitted production rates and the energy sources at Matimba are listed in Table 4-1 to Table 4-3 according to the AEL.

Table 4-1: Raw Materials Used

Type	Maximum Permitted Consumption Rate	Design Consumption Rate	Actual Average Consumption Rate	Unit
Coal	1 500 000	1 500 000	1 500 000	Tonnes/month
Fuel oil	1 200	1 200	40 000	Tonnes/month
Water	400	400	unknown	Megalitres/month

Table 4-2: Production and by-products rates

Product/by-product	Maximum Production capacity permitted (volume)	Units (quantity/period)
Electricity	4 000	MW
Ash	6 570 000	Tonnes/month

Table 4-3: Materials used in energy sources

Raw Material	Maximum Permitted Consumption Rate	Unit	Material Characteristics (Monthly Average)
Bituminous Coal	1 500 000	Tonnes/ month	Sulfur content: 0.8 – 1.6 % Ash content: 30 – 40 %
Fuel oil	1 200	Tonnes/ month	Sulfur content: 3.5 max% Ash content: 0.1 %

4.2 Appliances and Abatement Equipment Control Technology

Abatement equipment control technology at Matimba is presented in Table 4-4. An Electrostatic Precipitator (ESP) and a Sulphur Plant are installed on each generation unit, i.e. 6 ESPs and 6 Sulphur plants. It should be noted that the abatement equipment is only for the control of PM emissions. NO_x and SO_2 emissions are currently not controlled Matimba.

Table 4-4: Appliance and abatement equipment control technology currently used at Matimba Power Station

Unit	Appliance Name	Appliance Type /Description	Appliance Function / Purpose
1 to 6	Electrostatic Precipitator (ESP)	Electrostatic Precipitator (ESPs)	An ESP removes particles from the flue stream using the force of an induced electrostatic charge on the ash particle that is then attracted to and held on a plate. The efficiency of ESPs is dependent on the electrical resistivity of the ash particles (and the particle size). SO_3 injection decreases the resistivity of the particles, and significantly improves the performance of the ESP.
1 to 6	SO_3 plant (i.e. Flue Gas Conditioning plant)	SO_3 Injection	

5. ATMOSPHERIC EMISSIONS

5.1 Point Source Parameters

The physical stack parameters and emission parameters for stacks at Matimba are listed in Table 5-1 and Table 5-2 respectively.

Table 5-1: Matimba stack parameters

Stack ID	Point Source Code	Source Name	Stack Orientation	UTMx	UTMy	Height of Release (m)		Diameter at Stack Tip (m) [a]
						Above Ground	Above nearest bldg	
Stack 1	Boiler unit 1-3	SV Unit 1-3	Vertical	562 317	7382 199	250	225	12.3
Stack 2	Boiler unit 4-6	SV Unit 4-6	Vertical	562 259	7382 446	250	225	12.3

(a) Individual boiler flues have a diameter of approximately 8.275 m. The combined stack diameter is 12.3 m.

Table 5-2: Matimba stack emission parameters

Scenario	Stack ID	Actual Gas Exit Temp (K)	Actual Gas Volumetric Flow (Am^3/s)	Normal Gas Volumetric Flow (Nm^3/s)[b]	Actual Gas Exit Velocity (m/s)[c]
Scenario 1 (Current)	Stack 1	408	4 159	2 307	35
	Stack 2	408	4 159	2 307	35
Scenario A (2025)	Stack 1	408	2 174	1 206	18.3
	Stack 2	408	2 174	1 206	18.3
Scenario B (2031)	Stack 1	408	1 485	824	12.5
	Stack 2	408	1 485	824	12.5
Scenario C (2036)	Stack 1	408	1 711	949	14.4
	Stack 2	408	1 711	949	14.4
Scenario D (MES)	Stack 1	408	1 711	949	14.4
	Stack 2	408	1 711	949	14.4

(b): Normal flow corrected to 10% O_2, 101 kPa and 273.15K

(c): The average of the actual gas exit velocity was used in the simulations

5.2 Point Source Emission Rates (Emission scenarios)

Five emission scenarios are assessed to support Eskom's application for exemption from the MES at Matimba. These are:

Scenario 1 (Current): The baseline scenario using actual monthly stack emissions for 2021-2023 and fugitive emissions from the coal stockyard and ash dump.
Scenario A (2025): Eskom's planned 2025 stack emissions, representing anticipated station performance between 2025 – 2030, including fugitive emissions from the coal stockyard and ash dump.
Scenario B (2031): Eskom's planned 2031 stack emissions, representing anticipated station performance between 2031 – 2035, including fugitive emissions from the coal stockyard and ash dump.
Scenario C (2036): Eskom's planned 2036 stack emissions, representing anticipated station performance from 2036 onwards, including fugitive emissions from the coal stockyard and ash dump.
Scenario D (MES): Full compliance with the MES, including fugitive emissions from the coal stockyard and ash dump.

The emission rates and equivalent emission concentrations that apply for the five scenarios that are used in the dispersion modelling are shown in Table 5-3. The boiler units operate continuously, i.e. 24 hours a day.

Table 5-3: Stack emission rates and equivalent emission concentrations for Matimba

Scenario	Stack	Emission rate (tonnes/year)			Emission concentration @ 10% O_2 and average load (mg/Nm^3)		
		NO_x	SO_2	PM	NO_x	SO_2	PM
1[a]	Stack 1	28 921	150 457	2 648	291	1 514	27
	Stack 2	28 921	150 457	2 648	291	1 514	27
A	Stack 1	28 346	150 830	1 820	545	2 900	35
	Stack 2	28 346	150 830	1 820	545	2 900	35
B	Stack 1	18 118	103 026	1 243	510	2 900	35
	Stack 2	18 118	103 026	1 243	510	2 900	35
C	Stack 1	20 872	112 752	1 432	510	2 755	35
	Stack 2	20 872	112 752	1 432	510	2 755	35
D	Stack 1	20 872	33 825	1 432	510	827	35
	Stack 2	20 872	33 825	1 432	510	827	35
MES					**750**	**1000**	**50**

(a): Average from actual monthly emissions

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

Matimba is required to conduct continuous emission measurements. Maximum emissions during start-up, shut-down, maintenance or upset conditions are accounted for in the actual monthly emissions provided to the modelling team. These conditions are therefore incorporated into the simulations for Scenario 1 (Current).

5.4 Fugitive Emissions

The methodology to estimate emission rates of particulates from the coal stockyard and ash dumping activities for the power station is described in this section.

A general equation for emission estimation is: E = A x EF x (1-ER/100)
where: E = emissions;
A = activity rate;
EF = emission factor; and
ER = overall emission reduction efficiency (%)

An emission factor is a representative value that relates the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. These factors are usually expressed as the weight of the pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant (e.g., kg of particulate emitted per tonne of coal crushed). Such factors facilitate estimation of emissions from various sources of air pollution. In most cases, these factors are simply averages of all available data of acceptable quality, and are generally assumed to be representative of long-term averages for all facilities in the source category (USEPA, 2024b).

The emission factors used for the calculation of particulates in this study are the most recent factors published in the United States Environmental Protection Agency (US EPA), AP 42, Fifth Edition, Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources, Chapter 13: Section 13.2.4 Aggregate Handling and Storage Piles; Section 13.2.5 Industrial Wind Erosion; (USEPA, 2024b).

Wind entrainment of dust and PM_{10} from the coal stockpile and ash dump is a function of the physical size of the facility and the nature of the exposed surface, i.e. the moisture content, silt content, amount of vegetation cover, size of the particles on the surface and wind speed. Characteristics of the coal stockpile and ash dump at the power station is shown in Table 5-4.

Table 5-4: Characteristics of the coal stockpile and ash dump at the Power Station

Parameter	Coal stockpile	Ash dump
Quantity of material stored (tonnes/year)	1 999 239	3 966 084
Moisture content (%)	4.5	27
Silt content (%)	2.2	80
Exposed surface area (m^2)	283 538	2 172 869
Height (m)	18	64
Dry area (%)	100	80
Dust abatement method	Wetting - Water	Spraying of dust using water during operation, top soil and vegetation coverage at incremental heights
Material transfer method and ashing system	Conveyors (front end loaders in case of emergency)	Dry (delivered by trucks)

As a mitigation measure, water is sprayed onto the coal stockpiles occasionally to reduce dust generation. In this assessment, the coal stockpile is assessed under worst case conditions (e.g. drought conditions), where it is assumed that no water will be sprayed onto the coal stockpile and 100% of the area is exposed to wind erosion.

The ash dump, by nature, is generally in a damp state depending on rainfall conditions, and if the ash is pumped onto the ash dump in a fluid state or trucked in. Rising green walls will provide vegetation cover on the sides and it is expected that most of the ash dump area exposed at the top will include a wet beach area. These initiatives, together with occasional wetting will reduce the amount of dust entrainment from the ash dump. In this assessment, the ash dump is modelled under worst case conditions (e.g. drought conditions), where it is assumed that it is mostly dry and 80% of the surface area is exposed to wind erosion, providing a worst-case (environmentally conservative) scenario. The annual emission rates for the coal stockpiles and ash dump is shown in Table 5-5.

Table 5-5: Fugitive sources at Matimba Power Station

Source name	Emission (tonnes/year)		
	TSP	PM_{10}	$PM_{2.5}$
Coal stockpile	45.5	22.7	8.8
Ash Dump	12 132.2	6 066.1	2 426.4

5.5 Emergency Incidents

A record is maintained for all emergency incidents occurring at Eskom Power Stations reported in terms of section 30 of the National Environmental Management Act. In Eskom's 2022/23 financial year five Sec 30 incidents were reported by Matimba. Four incidents were reported in the 2023/24 financial year.

6. BASELINE CONDITIONS

The description of the baseline conditions of the area provide an understanding on the receiving atmospheric environment so that changes as a result of the application for exemption of the MES can be assessed. The baseline description therefore includes an overview of the climatology and meteorology of the area, and an assessment of ambient air quality over the last three years measured at monitoring stations in the area. Other sources of air pollution in the area are also discussed.

6.1 Climate and meteorology

6.1.1 Temperature and rainfall

The climate of a given location is affected by its latitude, terrain and altitude, as well as nearby water bodies and their currents. Climates are classified according to the average and the typical ranges of different variables, most commonly temperature and precipitation.

Matimba is located at 23.67 °S and 27.62 °E, and 880 m above sea level. It experiences a hot semi-arid (BSh) climate according to the Köppen Climate Classification. Summer days are generally hot with maximum temperatures often exceeding 31 °C, and summer nights are mild. Winter days are mild and nights are cold. The average daily temperatures at Lephalale are illustrated in Figure 6-1. The area receives an average of 383 mm of rainfall annually, with nearly 90% of the rainfall occurring in the summer months between October and March (Figure 6-1). Rainfall seldom occurs in winter.

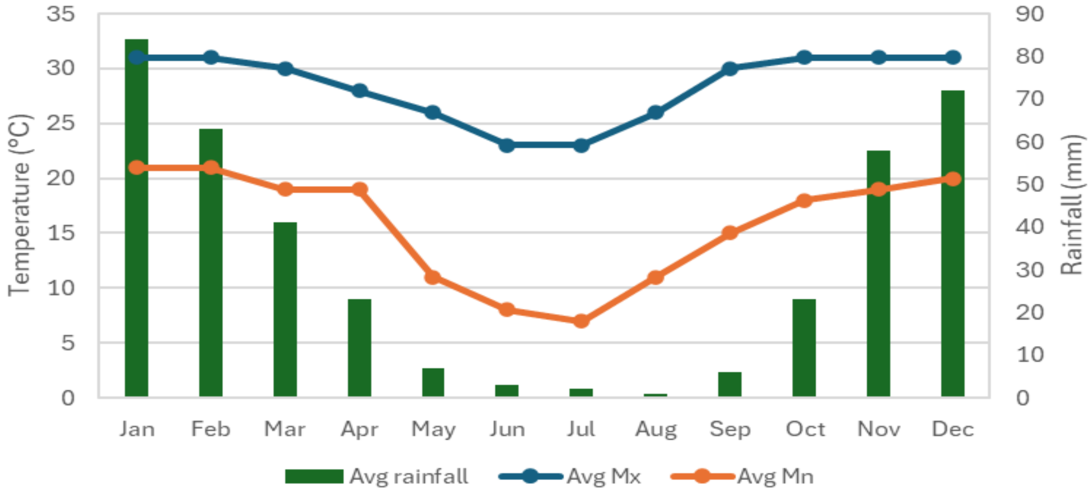


Figure 6-1: Average monthly maximum and minimum temperatures and average monthly rainfall at Lephalale (https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/lephalale_south-africa_7730334)

6.1.2 Wind

A windrose illustrates the frequency of hourly wind from the 16 cardinal wind directions, with wind indicated from the direction it blows, i.e. easterly winds blow from the east. It also illustrates the frequency of average hourly wind speed in six wind speed classes.

The annual windrose at Marapong is presented in Figure 6-2 for the 3-year period, 2021 to 2023. At Matimba the wind is generally light with wind speeds seldom reaching more than 6 m/s (Figure 6-2). The wind is almost exclusively from the sector northeast to easterly (Figure 6-3). A high frequency of calm winds occur at Marapong (nearly 24 %).

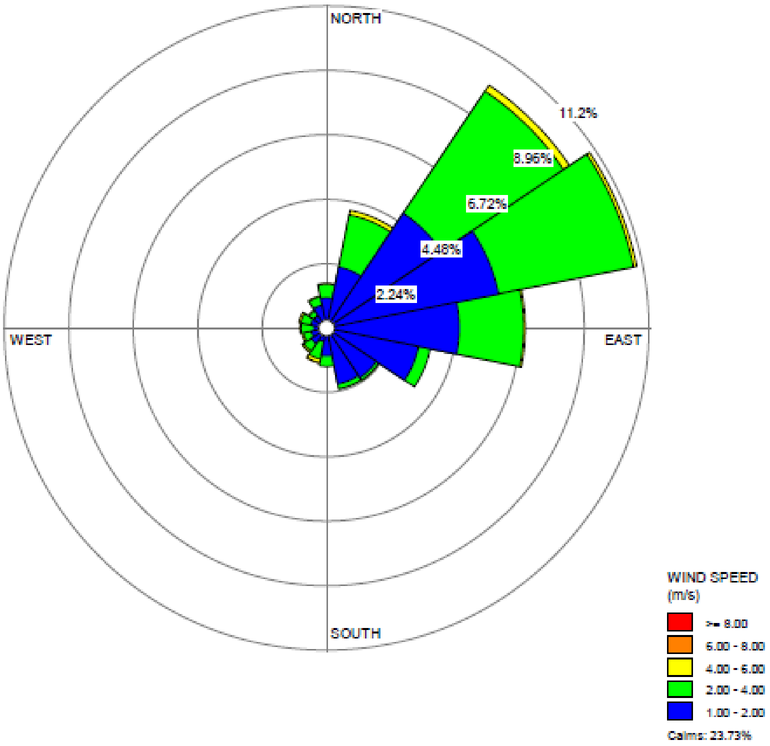
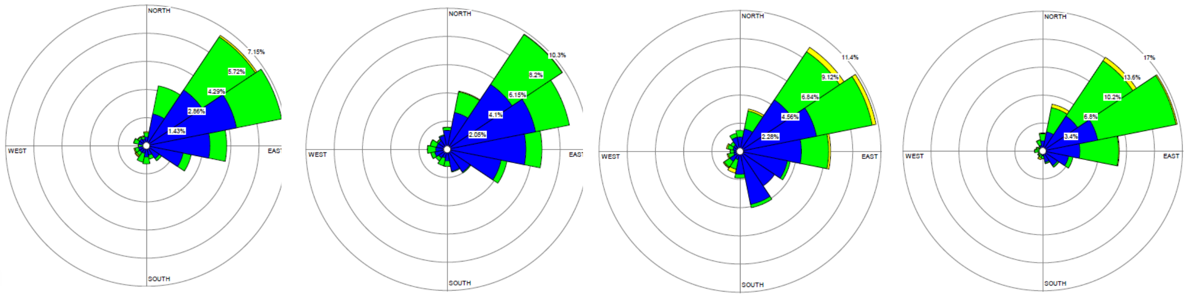
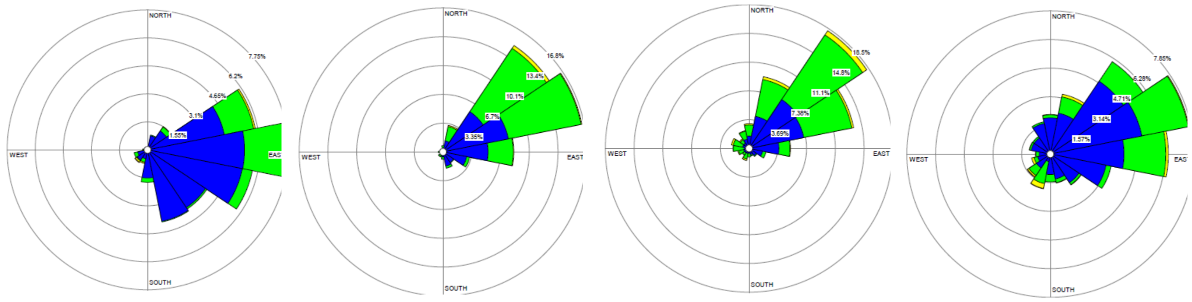


Figure 6-2: Annual windrose at the Marapong AQMS



Summer **Autumn** **Winter** **Spring**



00-06 h **06-12 h** **12-18 h** **18-24 h**

Figure 6-3: Seasonal (top) and diurnal (bottom) windroses at the Marapong AQMS

6.1.3 Air Pollution Dispersion Potential

The air pollution dispersion of an area refers to the ability of atmospheric processes, or meteorological mechanisms, to disperse and remove pollutants from the atmosphere. Dispersion comprises both vertical and horizontal components of motion. The vertical component is defined by the stability of the atmosphere and the depth of the surface mixing layer. The horizontal dispersion of pollution in the boundary layer is primarily a function of the wind field and atmospheric stability. The wind speed determines the rate of downwind transport and wind direction and the variability in wind direction determines the general path of the pollutant. Atmospheric stability, or instability, determines the ability of the atmosphere to mix and dilute pollutants. Stability is a function of solar radiation (thermal turbulence) and wind speed and surface roughness, which induce mechanical turbulence. The dispersion potential of an area therefore experiences diurnal and seasonal changes.

By day, with strong insolation (in-coming solar radiation) and stronger winds, the dispersion potential is generally efficient through vertical dilution and horizontal dispersion. The dispersion potential is generally better on summer days than winter days. At night, as the surface temperature inversion develops, the lowest layer of the atmosphere becomes more stable, reaching a maximum at sunrise. As a result, the dispersion potential typically becomes less efficient during the night and the poorest conditions generally occur at sunrise. Thermal turbulence disappears when the sun sets, and mechanical turbulence decreases as the wind speeds drops at night. Pollutants tend to accumulate near the point of release under these conditions, particularly if these are released close to ground level. The dispersion potential is generally poorer on winter nights than summer nights.

In the Matimba study area, the dispersion potential is expected to be relatively good during the day in summer and winter as a result of daytime temperatures and a relatively high frequency of moderate winds. Summer rainfall is an important removal mechanism for air pollutants. Night-time surface temperature inversions are prevalent in winter and tend to trap pollutants that are released at or near ground level. Generally, there is better air pollution dispersion in summer when air pollutants disperse easily, compared with winter when pollutants can accumulate in stable night-time conditions.

6.2 Ambient air quality

Agricultural and mining activities, as well as residential areas, are the key land use activities surrounding Matimba Power Station. There are three relatively large residential areas, namely Marapong, Onverwacht and Lephalale around Matimba. Marapong arcs from the north-northeast to the east-northeast and is less than 1 km from Matimba Power Station. Lephalale is 14 km to the east of Matimba and between them is the Onverwacht residential area, 6 km from Matimba. The Medupi Power Station (industry) is 6 km southwest of Matimba and the Grootegeluk Coal Mine (mining) is 5 km west-northwest of Matimba.

Three ambient air quality monitoring stations (AQMS) are located relatively close to Matimba. The Eskom Marapong AQMS (Marapong AQMS) is 2.2 km northeast, Eskom Medupi AQMS (Medupi AQMS) is 10.6 km southwest, and the SAWS Lephalale AQMS (Lephalale AQMS) is 11.3 km east-southeast.

Ambient air quality at the three AQMS will be influenced by local (nearby) sources, but ambient concentrations measured at these AQMS will also be influenced by emissions from Medupi and Matimba Power Stations. Local sources of air pollution near the three AQMS include agriculture activities, domestic fuel and waste burning, vehicle emissions, mining activities and power generation. The Exxarro Grootegeluk Mine and Afrimat Kuipesbult Quarry are significant mining activities and the Matimba Power Station is 6 km northeast of Medupi.

Pollutant concentrations measured at the three AQMS for 2021 to 2023 are presented here and are referenced against the respective NAAQS (Table 3-2).

6.2.1 Data recovery

Data recovery for the Marapong AQMS was relatively low for all pollutants for all years and below the minimum requirement of 90% as stipulated by the SANAS TR 07-03 (SANAS, 2012). Data recovery for SO_2 (2021), NO_2 (2021 and 2022), PM_{10} (2021) and $PM_{2.5}$ (2021 and 2022) was between 50% and 89.9%. These data are included in this discussion, but must be viewed with caution.

Data recovery for the Medupi AQMS was above 90% for SO_2 (2021), NO_2 (2022), PM_{10} (2021) and $PM_{2.5}$ (2021), meeting the minimum requirement of 90% (SANAS, 2012). Data recovery for SO_2 (2022 and 2023), NO_2 (2021 and 2023) and PM_{10} (2022 and 2023) was between 50% and 89.9%, which is below the minimum requirement. These data are included in this discussion, but must be viewed with caution.

Data recovery for the Lephalale AQMS was above 90% for SO_2 (2021), however data recovery for SO_2 (2022 and 2023), NO_2 (2021 to 2023), PM_{10} (2021 and 2023) and $PM_{2.5}$ (2023) was between 50% and 89.9%. These data are included in this discussion, but must be viewed with caution.

Pollutants with a data recovery below 50% in a single year were not considered in this baseline discussion. These are highlighted in bold in Table 6-1.

Table 6-1: Data recovery at the Marapong, Medupi and Lephalale AQMS's from 2021 to 2023

Year	Data recovery (%)			
	SO_2	NO_2	PM_{10}	$PM_{2.5}$
Marapong AQMS				
2021	59.5	50.4	71.9	67.6
2022	**38.9**	59.4	**43.9**	59.8
2023	**0**	**0**	**0**	**0**
Medupi AQMS				
2021	97.9	86.6	93.2	96.5
2022	75.2	90.4	56.5	**35.4**
2023	71.5	80.1	62.1	**27.8**
Lephalale AQMS				
2021	96.1	64.1	51.4	**48.9**
2022	73.2	71.0	**34.2**	**29.0**
2023	58.0	74.9	59.6	57.7
Note:	Data recovery for the Marapong and Medupi AQMS's are based on 10-minute average data, while the Lephalale AQMS is based on 1-hour average data.			

6.2.2 Sulphur Dioxide (SO_2)

Marapong AQMS

- The 10-min average (Figure 6-4) SO_2 concentrations exceeded the 10-min (500 µg/m³) NAAQS in 2021 (23 times), however remaining compliant as 526 exceedances of the 10-min NAAQS are permitted per calendar year.
- The 1-hour average (Figure 6-5) SO_2 concentrations exceeded the 1-hour (350 µg/m³) NAAQS in 2021 (sixteen times), thus compliant with the respective NAAQS as 88 exceedances of the 1-hour NAAQS are permitted per calendar year.
- The 24-hour average (Figure 6-6) SO_2 concentrations exceeded the 24-hour (125 µg/m³) NAAQS in 2021 (one time), thus compliant with the respective NAAQS as four exceedances of the 24-hour NAAQS are permitted per calendar year.
- The annual average SO_2 concentrations for 2021 (13.9 µg/m³) remained below the annual average NAAQS (50 µg/m³), thus compliant with the respective NAAQS.

Medupi AQMS

- The 10-min average (Figure 6-4) SO_2 concentrations exceeded the 10-min (500 µg/m³) NAAQS in 2021 (34 times), 2022 (75 times) and 2023 (53 times), thus compliant with the respective NAAQS as 526 exceedances of the 10-min NAAQS are permitted per calendar year.
- The 1-hour average Figure 6-5) SO_2 concentrations exceeded the 1-hour (350 µg/m³) NAAQS in 2021 (eighteen times), 2022 (27 times) and 2023 (21 times), thus compliant with the respective NAAQS as 88 exceedances of the 1-hour NAAQS are permitted per calendar year.
- The 24-hour average (Figure 6-6) SO_2 concentrations exceeded the 24-hour (125 µg/m³) NAAQS in 2021 (one time), 2022 (one time) and 2023 (one time), thus compliant with the respective NAAQS as four exceedances of the 24-hour NAAQS are permitted per calendar year.
- The annual average SO_2 concentrations for 2021 (16.2 µg/m³), 2022 (27.0 µg/m³) and 2023 (34.6 µg/m³) remained below the annual average NAAQS (50 µg/m³), thus compliant with the respective NAAQS.

Lephalale AQMS

- The 1-hour average (Figure 6-5) SO_2 concentrations exceeded the 1-hour (350 µg/m³) NAAQS in 2023 (two times), thus compliant with the respective NAAQS as 88 exceedances of the 1-hour NAAQS are permitted per calendar year. The 1-hour average SO_2 concentrations remained below the 1-hour (350 µg/m³) NAAQS in 2021 and 2022, with no exceedances recorded, thus compliant with the respective NAAQS.
- The 24-hour average (Figure 6-6) SO_2 concentrations remained below the 24-hour (125 µg/m³) NAAQS between 2021 and 2023, with no exceedances recorded, thus compliant with the respective NAAQS.
- The annual average SO_2 concentrations for 2021 (5.4 µg/m³), 2022 (5.0 µg/m³) and 2023 (7.1 µg/m³) remained below the annual average NAAQS (50 µg/m³), thus compliant with the respective NAAQS.

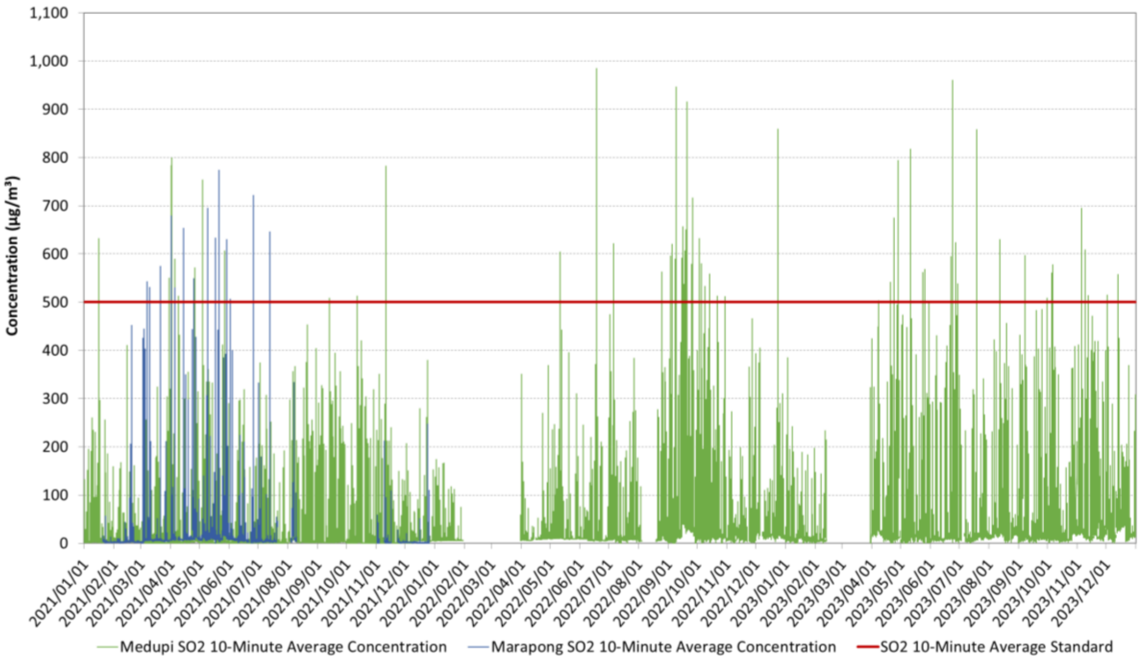


Figure 6-4: 10-minute average SO_2 concentrations at Marapong, Medupi and Lephalale AQMS for 2021 to 2023

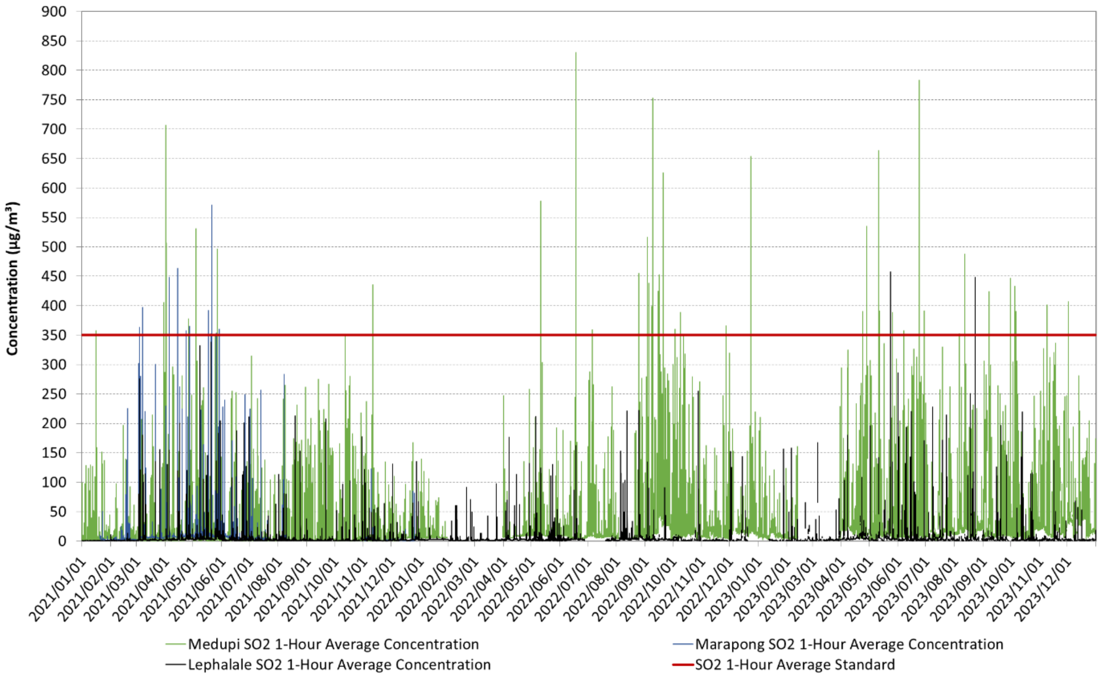


Figure 6-5: 1-hour average SO_2 concentrations at Marapong, Medupi and Lephalale AQMS for 2021 to 2023

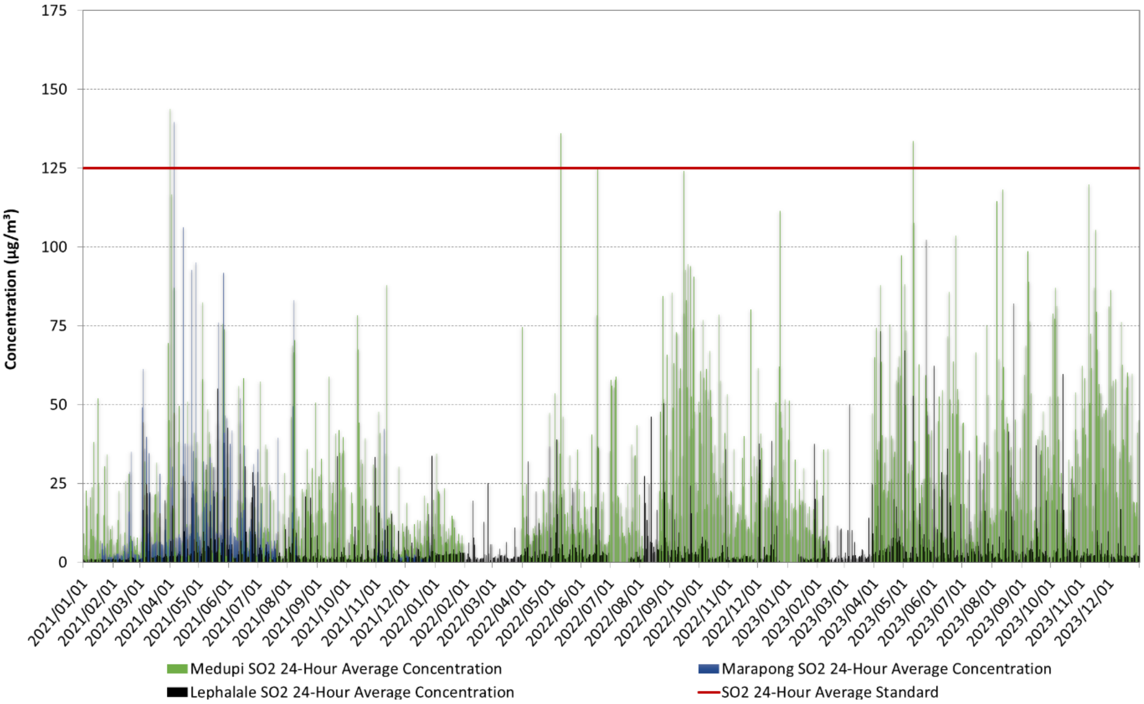


Figure 6-6: 24-hour average SO_2 concentrations at Marapong, Medupi and Lephalale AQMS for 2021 to 2023

6.2.3 Nitrogen Dioxide (NO_2)

Marapong AQMS

- The 1-hour average (Figure 6-7) NO_2 concentrations remained below the 1-hour NAAQS (200 µg/m³) for 2021 and 2022, with no exceedances recorded, thus compliant with the respective NAAQS.
- The annual average NO_2 concentrations for 2021 (16.4 µg/m³) and 2022 (17.3 µg/m³) remained below the annual average NAAQS (40 µg/m³), thus compliant with the respective NAAQS.

Medupi AQMS

- The 1-hour average (Figure 6-7) NO_2 concentrations remained below the 1-hour NAAQS (200 µg/m³) between 2021 and 2023, with no exceedances recorded, thus compliant with the respective NAAQS.
- The annual average NO_2 concentrations for 2021 (5.5 µg/m³), 2022 (10.4 µg/m³) and 2023 (11.3 µg/m³) remained below the annual average NAAQS (40 µg/m³), thus compliant with the respective NAAQS.

Lephalale AQMS

- The 1-hour average (Figure 6-7) NO_2 concentrations remained below the 1-hour NAAQS (200 µg/m³) between 2021 and 2023, with no exceedances recorded, thus compliant with the respective NAAQS.
- The annual average NO_2 concentrations for 2021 (10.8 µg/m³), 2022 (12.8 µg/m³) and 2023 (15.7 µg/m³) remained below the annual average NAAQS (40 µg/m³), thus compliant with the respective NAAQS.

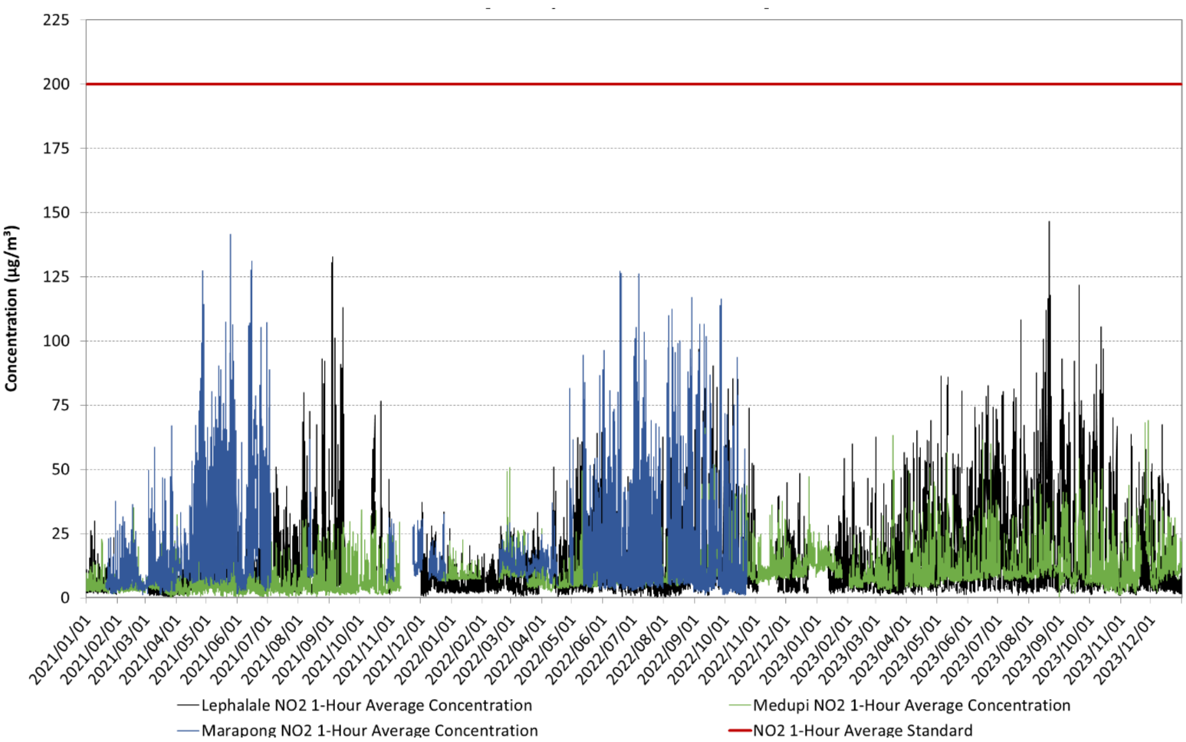


Figure 6-7: 1-hour average NO_2 concentrations at Marapong, Medupi and Lephalale AQMS for 2021 to 2023

6.2.4 Particulates (PM_{10} and $PM_{2.5}$)

Marapong AQMS

- The 24-hour average (Figure 6-8) PM_{10} concentrations exceeded the 24-hour average NAAQS (75 µg/m³) in 2021 (47 times), thus is non-compliant with the respective NAAQS as four exceedances per year are permitted.
- The annual average PM_{10} concentrations for 2021 (47.0 µg/m³) exceeded the annual average NAAQS (40 µg/m³), thus is non-compliant with the respective NAAQS.
- The 24-hour average (Figure 6-9) $PM_{2.5}$ concentrations exceeded the 24-hour average NAAQS (40 µg/m³) in 2021 (43 times) and 2022 (41 times), thus are non-compliant with the respective NAAQS as four exceedances per year are permitted.
- The annual average $PM_{2.5}$ concentrations for 2021 (25.8 µg/m³) and 2022 (30.2 µg/m³) exceeded the annual average NAAQS (20 µg/m³), thus are non-compliant with the respective NAAQS.

Medupi AQMS

- The 24-hour average (Figure 6-8) PM_{10} concentrations exceeded the 24-hour average NAAQS (75 µg/m³) in 2021 (12 times), 2022 (seven times) and 2023 (22 times), thus are non-compliant with the respective NAAQS as four exceedances per year are permitted.
- The annual average PM_{10} concentrations for 2021 (28.9 µg/m³), 2022 (28.4 µg/m³) and 2023 (37.5 µg/m³) remained below the annual average NAAQS (40 µg/m³), thus compliant with the respective NAAQS.
- The 24-hour average (Figure 6-9) $PM_{2.5}$ concentrations exceeded the 24-hour average NAAQS (40 µg/m³) in 2021 (eight times), thus is non-compliant with the respective NAAQS as four exceedances per year are permitted.

- The annual average $PM_{2.5}$ concentrations for 2021 (15.2 µg/m³) is below the annual average NAAQS (20 µg/m³), thus compliant with the respective NAAQS.

Lephalale AQMS

- The 24-hour average (Figure 6-8) PM_{10} concentrations exceeded the 24-hour average NAAQS of 75 µg/m³ once in 2021, with no exceedances in 2023, thus compliant with the respective NAAQS as four exceedances per year are permitted.
- The annual average PM_{10} concentrations for 2021 (37.3 µg/m³) and 2023 (17.4 µg/m³) remained below the annual average NAAQS (40 µg/m³), thus compliant with the respective NAAQS.
- The 24-hour average (Figure 6-9) $PM_{2.5}$ concentrations in 2023 remained below the 24-hour average NAAQS (40 µg/m³) with no exceedances recorded, thus compliant with the respective NAAQS.
- The annual average $PM_{2.5}$ concentrations for 2023 (15.2 µg/m³) remained below the annual average NAAQS (20 µg/m³), thus compliant with the respective NAAQS.

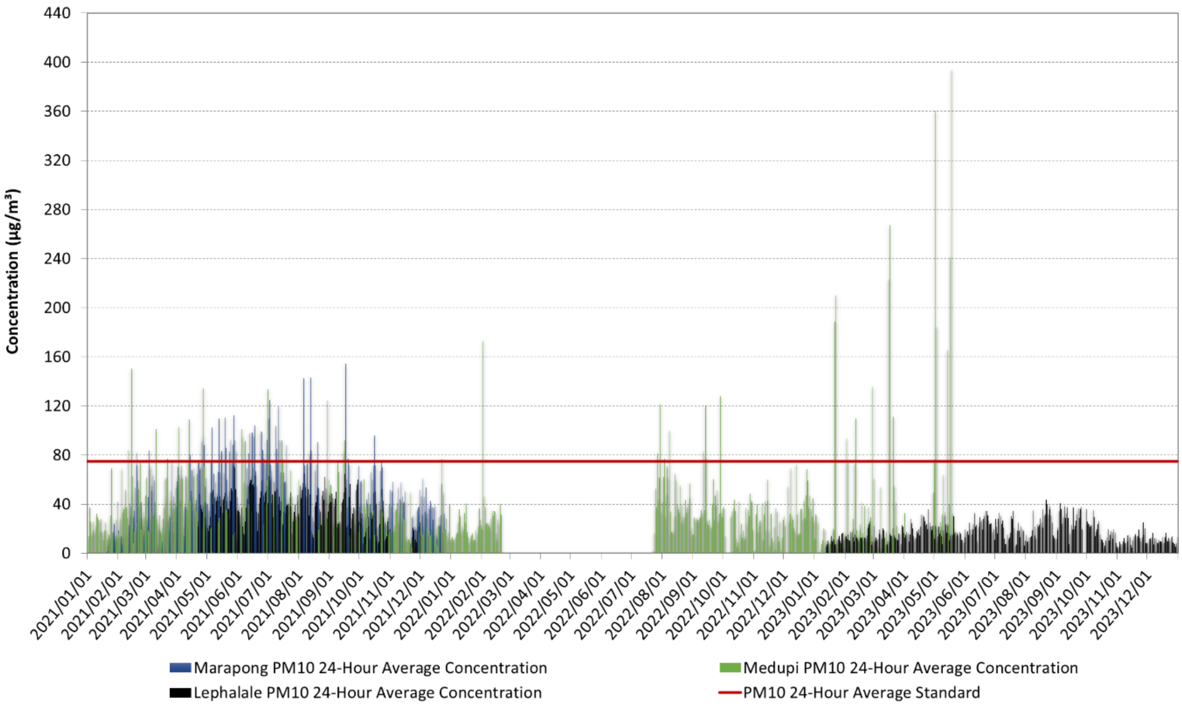


Figure 6-8: 24-hour average PM_{10} concentrations at Marapong, Medupi and Lephalale AQMS for 2021 to 2023

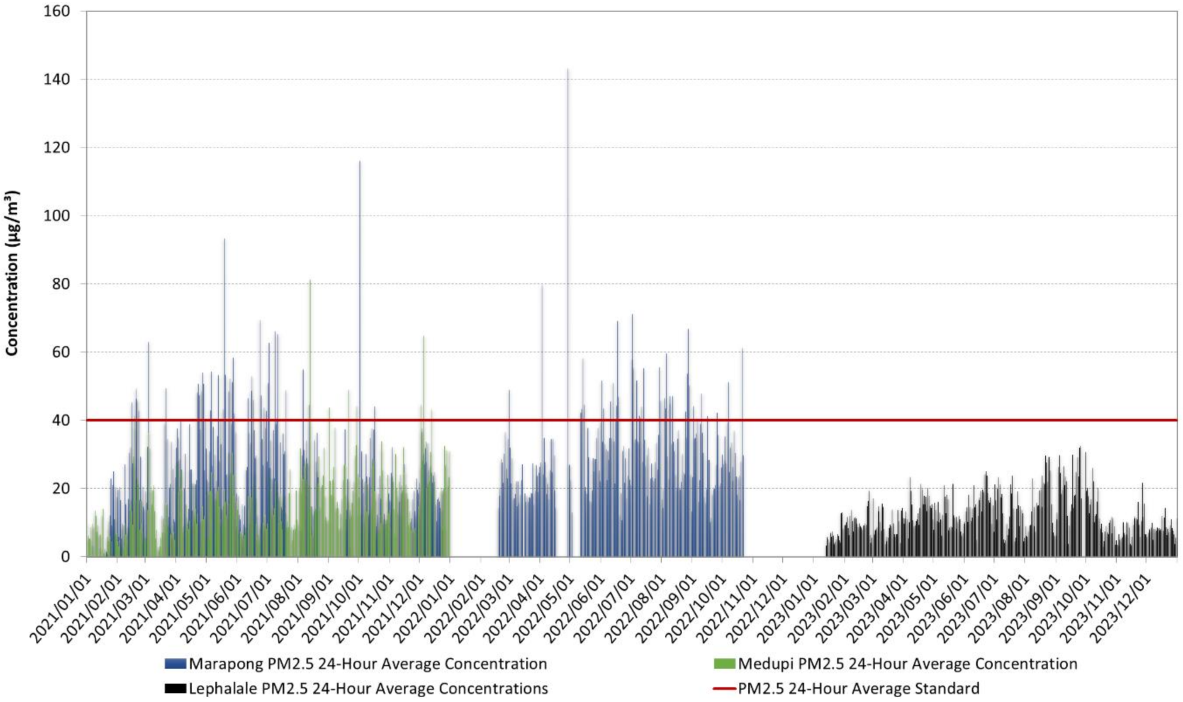


Figure 6-9: 24-hour average $PM_{2.5}$ concentrations at Marapong, Medupi and Lephalale AQMS for 2021 to 2023

6.2.5 Ambient pollutant summary

A summary of exceedances of the limit value of the NAAQS for all pollutants is presented in Table 6-2.

Despite the proximity of several sources of SO_2 and NO_2 to the three monitoring sites, including Medupi and Matimba Power Station, no exceedances of the NAAQS for SO_2 and NO_2 were recorded during the period 2021 to 2023.

The key pollutants of concern however, are PM_{10} and $PM_{2.5}$. During the period 2021 to 2023, numerous exceedances of the NAAQS limit value for both the 24-hour and annual average for PM_{10} and $PM_{2.5}$ were recorded at both monitoring sites. The exceedances are attributed to the proximity of sources of particulates at these monitoring sites.

Table 6-2: Pollutant exceedance summary at the Marapong, Medupi and Lephalale AQMS from 2021 to 2023

Pollutant	Averaging Period	Concentration	Permitted Number of Exceedances	2021	2022	2023
Marapong AQMS						
SO_2	10-min	500 $\mu g/m^3$	526	23	- (1)	- (1)
	1-hour	350 $\mu g/m^3$	88	16	- (1)	- (1)
	24-hour	125 $\mu g/m^3$	4	1	- (1)	- (1)
	1-year	50 $\mu g/m^3$	0	0	- (1)	- (1)
NO_2	1-hour	200 $\mu g/m^3$	88	0	0	- (1)
	1-year	40 $\mu g/m^3$	0	0	0	- (1)
PM_{10}	24-hour	75 $\mu g/m^3$	4	47	- (1)	- (1)
	1-year	40 $\mu g/m^3$	0	1	- (1)	- (1)
$PM_{2.5}$	24-hour	40 $\mu g/m^3$	4	43	41	- (1)
	1-year	20 $\mu g/m^3$	0	1	1	- (1)
Medupi AQMS						
SO_2	10-min	500 $\mu g/m^3$	526	34	75	53
	1-hour	350 $\mu g/m^3$	88	18	27	21
	24-hour	125 $\mu g/m^3$	4	1	1	1
	1-year	50 $\mu g/m^3$	0	0	0	0
NO_2	1-hour	200 $\mu g/m^3$	88	0	0	0
	1-year	40 $\mu g/m^3$	0	0	0	0
PM_{10}	24-hour	75 $\mu g/m^3$	4	12	7	22
	1-year	40 $\mu g/m^3$	0	0	0	0
$PM_{2.5}$	24-hour	40 $\mu g/m^3$	4	8	- (1)	- (1)
	1-year	20 $\mu g/m^3$	0	0	- (1)	- (1)
Lephalale AQMS						
SO_2	10-min	500 $\mu g/m^3$	526	- (2)	- (2)	- (2)
	1-hour	350 $\mu g/m^3$	88	0	0	2
	24-hour	125 $\mu g/m^3$	4	0	0	0
	1-year	50 $\mu g/m^3$	0	0	0	0
NO_2	1-hour	200 $\mu g/m^3$	88	0	0	0
	1-year	40 $\mu g/m^3$	0	0	0	0
PM_{10}	24-hour	75 $\mu g/m^3$	4	1	- (1)	0
	1-year	40 $\mu g/m^3$	0	0	- (1)	0
$PM_{2.5}$	24-hour	40 $\mu g/m^3$	4	- (1)	- (1)	0
	1-year	20 $\mu g/m^3$	0	- (1)	- (1)	0
Notes:	(1) Data recovery below 50%; thus, exceedances are not presented. (2) The Lephalale AQMS does not measure data in 10-minute intervals. Values in red indicate non-compliance against the respective standard.					

7. IMPACT OF ENTERPRISE ON THE RECEIVING ENVIRONMENT

7.1 Dispersion Modelling

7.1.1 Models used

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

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

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

7.1.2 TAPM and CALPUFF parameterisation

The TAPM diagnostic meteorological model is used to generate a 3-dimensional temporally and spatially continuous meteorological field for 2021, 2022 and 2023 in hourly increments for the modelling domain.

TAPM is set-up in a nested configuration of three domains, centred on Matimba. The outer domain is 600 km by 600 km at a 24 km grid resolution, the middle domain is 300 km by 300 km at a 12 km grid resolution and the inner domain is 75 km by 75 km at a 3 km grid resolution (Figure 7-1). The nesting configuration ensures that topographical effects on meteorology are captured and that meteorology is well resolved and characterised across the boundaries of the inner domain. Twenty-seven vertical levels are modelled in each nest from 10 m to 5 000 m, with a finer resolution in the lowest 1 000 m. The subset of the entire TAPM model output in the form of pre-processed gridded surface meteorological data fields is input into the dispersion model.

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

The CALPUFF modelling domain covers an area of 4 356 km^2, where the domain extends 66 km (west-east) by 66 km (north-south) (Figure 7-1). It consists of a uniformly spaced receptor grid with 0.5 km spacing, giving 17 424 grid cells (132 x 132 grid cells).

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

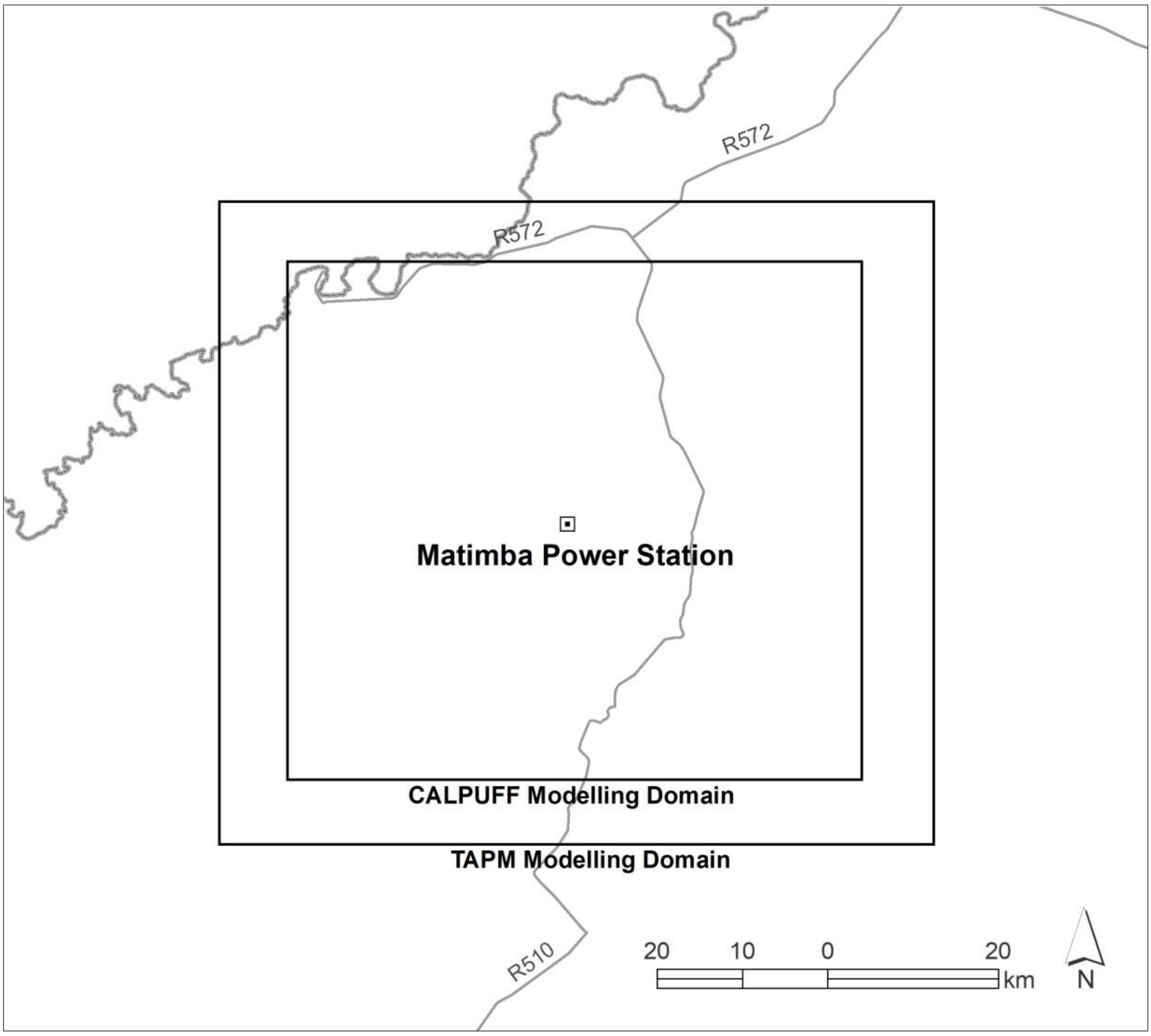


Figure 7-1: TAPM and CALPUFF modelling domain centred on Matimba

The CALPUFF modelling suite provides for the chemical conversion of SO_2 and NO_X emissions to secondary particulates. The predicted PM_{10} and $PM_{2.5}$ concentrations in this AIR include direct emissions of PM plus secondary particulates formed from Eskom's emissions.

The parameterisation of key variables that will apply in CALMET and CALPUFF are indicated in Table 7-1 and Table 7-2 respectively.

Table 7-1: Parameterisation of key variables for CALMET

Parameter	Model value
12 vertical cell face heights (m)	0, 20, 40, 80, 160, 320, 640, 1000, 1500, 2000, 2500, 3000, 4000
Coriolis parameter (per second)	0.0001
Empirical constants for mixing height equation	Neutral, mechanical: 1.41 Convective: 0.15 Stable: 2400 Overwater, mechanical: 0.12
Minimum potential temperature lapse rate (K/m)	0.001
Depth of layer above convective mixing height through which lapse rate is computed (m)	200
Wind field model	Diagnostic wind module
Surface wind extrapolation	Similarity theory
Restrictions on extrapolation of surface data	No extrapolation as modelled upper air data field is applied
Radius of influence of terrain features (km)	5
Radius of influence of surface stations (km)	Not used as continuous surface data field is applied

Table 7-2: Parameterisation of key variables for CALPUFF

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

7.1.3 Model accuracy

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

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

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

7.1.4 Assessment scenarios

Five emission scenarios are assessed for Eskom's application for exemption of MES for Matimba. These are:

Scenario 1 (Current): The baseline scenario using actual monthly stack emissions for 2021-2023 and fugitive emissions from the coal stockyard and ash dump.
Scenario A (2025): Eskom's planned 2025 stack emissions, representing anticipated station performance between 2025 – 2030, including fugitive emissions from the coal stockyard and ash dump.
Scenario B (2031): Eskom's planned 2031 stack emissions, representing anticipated station performance between 2031 – 2035, including fugitive emissions from the coal stockyard and ash dump.
Scenario C (2036): Eskom's planned 2036 stack emissions, representing anticipated station performance from 2036 onwards, including fugitive emissions from the coal stockyard and ash dump.
Scenario D (MES): Full compliance with the MES, representing the unattainable scenario.

7.2 Dispersion Modelling Results

The dispersion modelling results are compared with the NAAQS for SO_2, NO_2, PM_{10} and $PM_{2.5}$ (Table 3-2). It is not possible to apportion the PM_{10} and $PM_{2.5}$ portion of the total PM emitted from the Matimba stacks, so the PM emission is conservatively modelled as PM_{10} and $PM_{2.5}$. The CALPUFF modelling suite provides for the chemical conversion of SO_2 and NO_X to secondary particulates, i.e. sulphate and nitrate in the modelling results. The predicted PM_{10} and $PM_{2.5}$ concentrations presented here include direct emissions of PM plus secondary particulates formed from Matimba's emissions.

The 99th percentile predicted ambient SO_2, NO_2, PM_{10} and $PM_{2.5}$ concentrations from the dispersion modelling for Matimba for the five scenarios are presented as isopleth maps over the modelling domain. The DEA (2012c) recommend the 99th percentile concentrations for short-term assessment with the NAAQS since the highest predicted ground-level concentrations can be considered outliers due to complex variability of meteorological processes. In addition, the limit value in the NAAQS is the 99th percentile.

7.2.1 Maximum predicted ambient concentrations

The maximum predicted annual SO_2, NO_2, PM_{10} and $PM_{2.5}$ concentrations and the 99th percentile of the 24-hour and 1-hour predicted concentrations are discussed here and are listed in Table 7-3 for the 5 scenarios. Exceedances of the limit value of the NAAQS are shown in red font.

For SO_2, the predicted concentrations are attributed only to the stack emissions. The maximum predicted ambient concentrations are relatively low for all averaging periods in Scenario 1 (Current) and Scenario D (MES). For the proposed emissions in Scenario A (2025), Scenario B (2031) and Scenario C (2036), the predicted annual average concentrations also comply with the respective NAAQS. However, for these proposed emission scenarios the predicted 99th percentile of the 24-hour and 1-hour concentrations exceed the limit value of the NAAQS.

For NO_2, the predicted concentrations are attributed only to the stack emissions. The maximum predicted concentrations for the 5 scenarios are low relative to the limit values of the respective NAAQS.

For PM_{10} and $PM_{2.5}$, the predicted concentrations are attributed to stack emissions and the low-level fugitive sources (coal stockyard and ash dump). The PM emissions are not speciated into PM_{10} and $PM_{2.5}$, rather all PM emitted is assumed to be PM_{10}, and all PM emitted is assumed to be $PM_{2.5}$. In other words, $PM = PM_{10} = PM_{2.5}$. This is a worst-case environmental assumption that overestimates the ambient PM_{10} and $PM_{2.5}$ concentrations. Included in the predicted PM_{10} and $PM_{2.5}$ concentrations is the formation of secondary particulates from SO_2 and NO_2 stack emissions.

Close to the power station the low-level fugitive sources have the greatest influence on predicted PM_{10} and $PM_{2.5}$ ambient concentrations, while the stack emissions have an influence further from the power station. Included in the predicted concentrations is the formation of secondary particulates from SO_2 and NO_2 stack emissions.

For PM_{10} and $PM_{2.5}$, the maximum predicted concentrations exceed the limit values of the respective NAAQS. The predicted concentrations are similar for all scenarios as these occur close to the power station and primarily a result of the fugitive sources which are the same for all scenarios (see Table 5-5).

Table 7-3: Maximum predicted ambient annual SO_2, NO_2, PM_{10} and $PM_{2.5}$ concentrations in µg/m³ and the predicted 99th percentile concentrations for 24-hour and 1-hour averaging periods, with the South African NAAQS

Pollutant	SO_2		
Predicted maximum SO_2	**Annual**	**24-hour**	**1-hour**
Scenario 1 (Current)	6.6	84.0	160.0
Scenario A (2025)	13.7	**207.8**	**409.0**
Scenario B (2031)	15.7	**221.8**	**464.9**
Scenario C (2036)	14.3	**214.7**	**410.9**
Scenario D (MES)	4.3	64.4	123.3
NAAQS	50	125	350

Predicted maximum NO_2	**Annual**		**1-hour**
Scenario 1 (Current)	0.8		22.0
Scenario A (2025)	1.9		59.3
Scenario B (2031)	2.0		64.1
Scenario C (2036)	2.0		59.0
Scenario D (MES)	2.0		59.0
NAAQS	40		200
Predicted maximum PM_{10}	**Annual**	**24-hour**	
Scenario 1 (Current)	**88.9**	**262.1**	
Scenario A (2025)	**89.1**	**262.2**	
Scenario B (2031)	**89.1**	**260.7**	
Scenario C (2036)	**89.1**	**261.3**	
Scenario D (MES)	**88.8**	**257.4**	
NAAQS	40	75	
Predicted maximum $PM_{2.5}$	**Annual**	**24-hour**	
Scenario 1 (Current)	**88.9**	**262.1**	
Scenario A (2025)	**89.1**	**262.2**	
Scenario B (2031)	**89.1**	**260.7**	
Scenario C (2036)	**89.1**	**261.3**	
Scenario D (MES)	**88.8**	**257.4**	
NAAQS	20	40	Up to 31 Dec 2029
	15	25	From 01 Jan 2030

7.2.2 Predicted concentrations at AQMS and sensitive receptors

The predicted annual SO_2, NO_2, PM_{10} and $PM_{2.5}$ concentrations and the 99th percentile of the 24-hour and 1-hour predicted concentrations at AQMS (Table 7-4) and the sensitive receptor points in the modelling area are presented in Table 7-5 to Table 7-9. Exceedances of the limit value of the NAAQS are shown in red font.

A comparison of the annual averages is shown in Table 7-4 at the Matimba AQMS. For all pollutants the predicted ambient concentrations are lower than the monitored concentrations, except at the Medupi AQMS where the monitored and predicted PM_{10} concentrations are similar and predicted $PM_{2.5}$ is higher than the measured concentrations. It is expected that modelled concentrations are lower than the AQMS concentrations since the emissions in the model are limited to the power station sources only, while the AQMS are exposed to all sources. The predicted concentrations provide an indication of the contribution of the power station sources at these points. At the Medupi AQMS, the measured PM_{10} concentration appear to be strongly influenced by Matimba PM emissions.

Table 7-4: Measured annual average concentration at the Marapong, Medupi and Lephalale AQMS compared with predicted concentrations in µg/m³

AQMS	Pollutant	2021	2022	2023	Predicted
Marapong	SO_2	13.9	-	-	3.7
Medupi		16.2	27.0	34.6	5.3
Lephalale		5.4	5.0	7.1	3.0
Marapong	NO_2	16.4	17.3	-	0.4
Medupi		5.5	10.4	11.3	0.7
Lephalale		10.8	12.8	15.7	0.3
Marapong	PM_{10}	47.0	-	-	5.8
Medupi		28.9	28.4	37.5	28.6
Lephalale		37.3	-	17.4	1.5
Marapong	$PM_{2.5}$	25.8	30.2	-	5.8
Medupi		15.2	-	-	28.6
Lephalale		-	-	12.2	1.5

For SO_2 the predicted ambient concentrations are relatively low for all averaging periods at all identified sensitive receptors in Scenario 1 (Current) and Scenario D (MES). For the proposed emissions in Scenario A (2025), Scenario B (2031) and Scenario C (2036), the predicted annual average and 99th percentile concentrations of the 1-hour concentrations also comply with the respective NAAQS at all sensitive receptors. However, for these proposed emission scenarios the predicted 99th percentile of the 24-hour concentrations exceed the limit value of the NAAQS at up to 9 sensitive receptor points. The NAAQS provides for 4 exceedances of the 24-hour $PM_{2.5}$ limit value per year, implying that 12 exceedances are permitted for the 3-year modelling period. At these sensitive receptors, a maximum of 9 exceedances are predicted in each of the scenarios, indicating compliance with the NAAQS.

For NO_2 the predicted ambient concentrations are relatively low for all averaging periods at all identified sensitive receptors in all five scenarios.

For PM_{10} and $PM_{2.5}$, it must be remembered that the predicted concentrations are attributed to stack emissions and the low-level fugitive sources (coal stockyard and ash dump). Furthermore, the particulate emissions are not speciated into PM_{10} and $PM_{2.5}$, but rather all PM emitted is assumed to be PM_{10}, and all PM emitted is assumed to be $PM_{2.5}$. In addition, the predicted PM_{10} and $PM_{2.5}$ concentrations account for the formation of secondary particulates from SO_2 and NO_2 stack emissions. This is a very conservative approach.

For PM_{10} and $PM_{2.5}$, the predicted annual average concentrations are below the limit values of the NAAQS at all sensitive receptor points in all five scenarios.

The predicted 99th percentile of the 24-hour PM_{10} concentrations exceed the limit value at four receptor points in Scenarios 1 (Current), A (2025), B (2031), and C (2036) and one receptor in scenario D (MES).four sensitive receptor points in all five scenarios.

The predicted 99th percentile of the 24-hour $PM_{2.5}$ concentrations are also exceed the limit value in all five scenarios. For Scenario 1 (Current) and Scenario A (2025) exceedances are predicted at 11 sensitive receptors. With the implementation of the limit value of 25 µg/m^3 in 2030, the exceedances are predicted at 18 sensitive receptors for Scenario B (2031), Scenario C (2036) and Scenario D (MES).

The NAAQS provides for 4 exceedances of the 24-hour PM_{10} and $PM_{2.5}$ limit value per year, implying that 12 exceedances are permitted for the 3-year modelling period. For the sensitive receptors where the 24-hour PM_{10} limit is exceeded, a maximum of 1 exceedance is predicted in each of the scenarios, indicating compliance with the NAAQS. For the sensitive receptors where the 24-hour $PM_{2.5}$ limit is exceeded, more than 12 exceedances are predicted at up to 11 of these receptors in all scenarios, indicating non-compliance with the NAAQS.

Table 7-5: Predicted concentrations in µg/m^3 at the sensitive receptors for Scenario 1 (Current), together with the limit value of the NAAQS and number of exceedances (NoE)

	SO$_2$				NO$_2$		PM$_{10}$ Total			PM$_{2.5}$ Total		
	1-hr	**24-hr**	**NoE**	**Ann**	**1-hr**	**Ann**	**24-hr**	**NoE**	**Ann**	**24-hr**	**NoE**	**Ann**
Receptor	**350**	**125**	**12**	**50**	**200**	**40**	**75**	**12**	**40**	**40**	**12**	**20**
Phegelelo Senior Secondary	53.1	73.5		3.4	4.5	0.4	63.8		5.4	**63.8**	**16**	5.4
Contractors Village	53.2	63.5		2.9	4.1	0.3	**75.3**	1	9.2	**75.3**	**28**	9.2
Ditheku Primary School	53.1	69.4		3.3	4.4	0.4	62.8		5.4	**62.8**	**16**	5.4
Ditheko pramary School	73.3	73.3		3.7	7.5	0.4	**76.8**	1	5.3	**76.8**	12	5.3
Marapong Training Centre	59.6	75.6		3.5	4.7	0.4	73.8		6.1	**73.8**	**22**	6.1
Marapong Clinic	66.4	73.5		3.8	6.6	0.5	**86.3**	1	5.9	**86.3**	**21**	5.9
Tielelo Secondary School	53.2	75.7		3.5	4.3	0.4	65.5		5.6	**65.5**	**17**	5.6
Grootegeluk Medical Centre - Community Center	63.9	70.6		3.6	4.7	0.4	69.5		6.2	**69.5**	**22**	6.2
Lephalale College	92.7	54.6		3.4	10.6	0.4	38.4		2.5	38.4		2.5
Nelsonskop Primary School	64.9	70.2		3.8	5.8	0.5	**78.9**	1	6.0	**78.9**	**20**	6.0
Hansie En Grietjie Pre-Primary School	93.8	56.5		3.5	10.7	0.4	39.0		2.6	39.0		2.6
Sedibeng Special School for the Deaf and Disabilities	86.4	51.5		3.3	10.0	0.4	32.1		2.0	32.1		2.0
Kings College	87.5	60.5		3.7	10.2	0.4	38.5		2.6	38.5		2.6
Bosveld Primary School	89.1	61.1		3.5	10.2	0.4	35.9		2.3	35.9		2.3
Lephalale Medical Hospital	56.9	74.2		3.5	4.5	0.4	68.4		6.0	**68.4**	**19**	6.0
Ellisras Hospital	78.8	46.2		3.1	9.2	0.3	31.8		1.9	31.8		1.9
Laerskool Ellisras Primary School	77.4	40.9		2.7	8.1	0.3	23.2		1.4	23.2		1.4
Hoerskool Ellisras Secondary School	77.8	43.9		2.8	8.4	0.3	23.9		1.5	23.9		1.5
Marlothii Learning Academy	77.8	41.5		2.8	8.1	0.3	23.7		1.4	23.7		1.4
Hardekool Akademie vir C.V.O	74.8	38.8		2.6	7.4	0.3	22.4		1.2	22.4		1.2
Lephalale Clinic	76.3	40.9		2.7	8.0	0.3	23.4		1.4	23.4		1.4
Ons Hoop	76.3	48.3		2.6	7.1	0.3	24.1		1.4	24.1		1.4
Ramabara's	70.3	35.1		2.6	6.7	0.3	11.1		0.6	11.1		0.6
Kremetartpan	104.9	31.8		3.8	13.5	0.4	16.9		2.3	16.9		2.3
Mbala Private Camp	72.6	25.6		2.7	8.8	0.3	6.8		0.6	6.8		0.6
Steenbokpan	90.4	32.8		3.4	11.5	0.4	64.9		10.5	**64.9**	**38**	10.5

Receptor	55.5	26.3		1.9	5.6	0.2	17.1		1.8	17.1		1.8
Receptor	53.1	36.6		2.2	4.8	0.2	33.2		2.3	33.2		2.3
Receptor	42.3	30.1		1.6	3.7	0.2	12.1		1.0	12.1		1.0
Receptor	29.0	20.7		1.1	2.0	0.1	8.1		0.5	8.1		0.5
Receptor	30.6	19.8		1.1	2.0	0.1	8.5		0.4	8.5		0.4
Receptor	42.6	26.2		1.5	3.4	0.1	9.8		0.5	9.8		0.5
Tholo Bush Estate	58.6	20.1		2.0	5.6	0.2	4.6		0.4	4.6		0.4
Receptor	76.8	24.6		2.8	8.6	0.3	5.2		0.5	5.2		0.5

Table 7-6: Predicted concentrations in µg/m³ at the sensitive receptors for Scenario A (2025), together with the limit value of the NAAQS and number of exceedances (NoE)

	SO_2				NO_2		PM_{10} Total			$PM_{2.5}$ Total		
	1-hr	24-hr	NoE	Ann	1-hr	Ann	24-hr	NoE	Ann	24-hr	NoE	Ann
Receptor	350	125	12	50	200	40	75	12	40	40	12	20
Phegelelo Senior Secondary	119.7	**162.8**	5	7.7	12.9	1.0	63.9		5.5	**63.9**	**16**	5.5
Contractors Village	111.3	124.9		6.5	11.6	0.8	**77.0**	1	9.3	**77.0**	**28**	9.3
Ditheku Primary School	119.3	**146.4**	4	7.4	13.4	1.0	62.8		5.6	**62.8**	**16**	5.6
Ditheko pramary School	176.1	109.1		7.4	23.0	1.0	**76.4**	1	5.4	**76.4**	12	5.4
Marapong Training Centre	125.8	**174.1**	4	8.0	13.6	1.1	74.2		6.2	**74.2**	**22**	6.2
Marapong Clinic	167.2	**126.9**	1	7.8	21.8	1.0	**86.7**	1	6.0	**86.7**	**21**	6.0
Tielelo Secondary School	115.0	**170.9**	6	7.9	11.9	1.0	65.9		5.7	**65.9**	**17**	5.7
Grootegeluk Medical Centre - Community Center	141.1	**164.0**	3	8.2	16.5	1.1	69.6		6.3	**69.6**	**22**	6.3
Lephalale College	185.1	58.9		5.7	23.8	0.7	38.5		2.6	38.5		2.6
Nelsonskop Primary School	159.0	**129.7**	1	7.9	19.0	1.0	**78.9**	1	6.2	**78.9**	**21**	6.2
Hansie En Grietjie Pre-Primary School	183.7	61.9		5.8	24.5	0.7	39.2		2.6	39.2		2.6
Sedibeng Special School for the Deaf and Disabilities	161.9	61.5		5.5	20.3	0.6	31.9		2.1	31.9		2.1
Kings College	186.0	82.4		6.5	25.0	0.8	38.4		2.7	38.4		2.7
Bosveld Primary School	176.3	73.4		6.0	22.7	0.7	35.9		2.4	35.9		2.4
Lephalale Medical Hospital	113.2	**172.4**	8	8.1	11.7	1.1	68.7		6.1	**68.7**	**19**	6.1
Ellisras Hospital	152.4	58.3		5.2	18.9	0.6	31.0		2.0	31.0		2.0
Laerskool Ellisras Primary School	134.9	51.8		4.4	15.5	0.5	22.9		1.5	22.9		1.5
Hoerskool Ellisras Secondary School	140.0	52.1		4.6	16.3	0.5	23.8		1.5	23.8		1.5
Marlothii Learning Academy	137.8	51.0		4.5	15.9	0.5	23.2		1.5	23.2		1.5
Hardekool Akademie vir C.V.O	122.5	50.0		4.2	13.8	0.4	22.0		1.3	22.0		1.3
Lephalale Clinic	132.8	51.1		4.4	15.2	0.5	22.8		1.5	22.8		1.5
Ons Hoop	132.7	56.8		4.0	14.4	0.4	24.6		1.5	24.6		1.5
Ramabara's	91.1	43.3		3.5	9.5	0.3	10.6		0.7	10.6		0.7
Kremetartpan	133.9	45.6		5.8	17.4	0.7	17.0		2.5	17.0		2.5
Mbala Private Camp	102.1	33.1		4.2	13.2	0.5	7.6		0.7	7.6		0.7
Steenbokpan	155.3	45.7		5.8	19.8	0.7	65.6		10.7	**65.6**	**38**	10.7

Receptor	79.4	32.8		2.6	8.6	0.3	17.5		1.8	17.5		1.8
Receptor	100.1	59.2		3.5	10.6	0.4	33.8		2.4	33.8		2.4
Receptor	65.3	36.8		2.2	6.4	0.2	13.0		1.0	13.0		1.0
Receptor	42.3	25.0		1.3	3.2	0.1	8.2		0.5	8.2		0.5
Receptor	42.7	23.0		1.4	3.3	0.1	8.6		0.5	8.6		0.5
Receptor	60.0	30.4		2.0	5.1	0.2	9.5		0.6	9.5		0.6
Tholo Bush Estate	58.5	22.2		2.3	6.0	0.2	4.7		0.4	4.7		0.4
Receptor	97.6	30.0		3.7	11.2	0.4	5.7		0.6	5.7		0.6

Table 7-7: Predicted concentrations in µg/m³ at the sensitive receptors for Scenario B (2031), together with the limit value of the NAAQS and number of exceedances (NoE)

	SO_2				NO_2		PM_{10} Total			$PM_{2.5}$ Total		
	1-hr	24-hr	NoE	Ann	1-hr	Ann	24-hr	NoE	Ann	24-hr	NoE	Ann
Receptor	350	125	12	50	200	40	75	12	40	25	12	15
Phegelelo Senior Secondary	131.0	**158.0**	7	7.6	15.5	0.9	62.7		5.5	**62.7**	**57**	5.5
Contractors Village	132.1	**153.0**	4	7.4	13.7	0.9	**76.3**	1	9.2	**76.3**	**92**	9.2
Ditheku Primary School	129.7	**149.9**	4	7.4	14.7	0.9	62.0		5.5	**62.0**	**57**	5.5
Ditheko pramary School	222.1	124.5		8.3	27.9	1.0	**75.1**	1	5.4	**75.1**	**54**	5.4
Marapong Training Centre	143.6	**155.3**	4	8.1	16.3	1.0	72.2		6.2	**72.2**	**73**	6.2
Marapong Clinic	198.7	**132.0**	1	8.8	23.9	1.1	**85.5**	1	6.0	**85.5**	**65**	6.0
Tielelo Secondary School	125.6	**162.2**	9	7.7	14.1	0.9	64.0		5.7	**64.0**	**62**	5.7
Grootegeluk Medical Centre - Community Center	147.0	**154.5**	4	8.3	18.6	1.0	68.1		6.3	**68.1**	**74**	6.3
Lephalale College	176.0	55.0		5.6	21.3	0.6	36.9		2.5	**36.9**	7	2.5
Nelsonskop Primary School	181.7	**141.4**	4	8.7	22.2	1.1	**77.7**	1	6.1	**77.7**	**74**	6.1
Hansie En Grietjie Pre-Primary School	179.0	57.5		5.7	21.7	0.6	37.5		2.6	**37.5**	7	2.6
Sedibeng Special School for the Deaf and Disabilities	161.0	49.6		5.3	19.1	0.6	30.7		2.0	**30.7**	1	2.0
Kings College	187.7	72.3		6.3	23.1	0.7	36.7		2.6	**36.7**	8	2.6
Bosveld Primary School	175.1	57.8		5.9	21.5	0.7	34.2		2.3	**34.2**	3	2.3
Lephalale Medical Hospital	128.4	**158.0**	7	8.0	13.8	1.0	66.4		6.0	**66.4**	**66**	6.0
Ellisras Hospital	147.2	53.4		4.8	16.9	0.5	29.7		1.9	**29.7**	1	1.9
Laerskool Ellisras Primary School	117.6	40.5		3.8	12.1	0.4	21.3		1.4	21.3		1.4
Hoerskool Ellisras Secondary School	121.2	42.8		4.0	13.2	0.4	22.1		1.5	22.1		1.5
Marlothii Learning Academy	119.0	42.0		3.9	12.6	0.4	21.6		1.5	21.6		1.5
Hardekool Akademie vir C.V.O	106.5	39.0		3.6	10.7	0.3	20.9		1.2	20.9		1.2
Lephalale Clinic	115.1	41.6		3.8	11.8	0.4	21.3		1.4	21.3		1.4
Ons Hoop	117.4	47.7		3.5	11.3	0.3	22.5		1.4	22.5		1.4
Ramabara's	72.8	31.3		2.9	7.1	0.3	9.1		0.6	9.1		0.6
Kremetartpan	102.8	33.6		4.8	12.2	0.5	16.2		2.4	16.2		2.4
Mbala Private Camp	79.5	25.3		3.5	9.6	0.4	6.5		0.7	6.5		0.7
Steenbokpan	123.8	40.0		5.2	15.0	0.6	64.4		10.6	**64.4**	**129**	10.6

Receptor	66.5	27.9		2.2	6.5	0.2	16.7		1.8	16.7		1.8
Receptor	94.3	46.8		2.9	9.2	0.3	31.5		2.3	**31.5**	4	2.3
Receptor	54.8	27.8		1.8	4.6	0.2	11.8		1.0	11.8		1.0
Receptor	33.1	16.7		1.0	2.4	0.1	7.1		0.5	7.1		0.5
Receptor	33.6	19.8		1.1	2.5	0.1	7.7		0.4	7.7		0.4
Receptor	45.9	24.4		1.5	3.4	0.1	8.4		0.5	8.4		0.5
Tholo Bush Estate	43.7	16.3		1.7	3.9	0.1	4.1		0.3	4.1		0.3
Receptor	74.8	23.1		3.0	8.1	0.3	5.0		0.5	5.0		0.5

Table 7-8: Predicted concentrations in µg/m³ at the sensitive receptors for Scenario C (2036), together with the limit value of the NAAQS and number of exceedances (NoE)

	SO_2				NO_2		PM_{10} Total			$PM_{2.5}$ Total		
	1-hr	24-hr	NoE	Ann	1-hr	Ann	24-hr	NoE	Ann	24-hr	NoE	Ann
Receptor	350	125	12	50	200	40	75	12	40	25	12	15
Phegelelo Senior Secondary	123.5	**144.7**	6	7.4	14.1	1.0	63.0		5.5	**63.0**	**57**	5.5
Contractors Village	128.6	**150.5**	1	6.7	14.3	0.9	**75.4**	1	9.2	**75.4**	**91**	9.2
Ditheku Primary School	118.9	**141.5**	1	7.2	13.3	0.9	62.1		5.5	**62.1**	**57**	5.5
Ditheko pramary School	200.3	110.7		7.6	25.8	1.0	**75.8**	1	5.4	**75.8**	**54**	5.4
Marapong Training Centre	127.8	**162.4**	2	7.8	14.8	1.0	72.5		6.2	**72.5**	**73**	6.2
Marapong Clinic	174.1	123.0		8.1	22.5	1.1	**86.2**	1	6.0	**86.2**	**65**	6.0
Tielelo Secondary School	116.1	**151.7**	6	7.6	13.1	1.0	64.9		5.7	**64.9**	**61**	5.7
Grootegeluk Medical Centre - Community Center	137.6	**150.4**	2	8.0	16.9	1.0	68.0		6.3	**68.0**	**74**	6.3
Lephalale College	172.2	52.0		5.4	22.7	0.6	36.4		2.5	**36.4**	7	2.5
Nelsonskop Primary School	156.9	**133.5**	1	8.0	19.6	1.0	**77.7**	1	6.1	**77.7**	**74**	6.1
Hansie En Grietjie Pre-Primary School	174.4	52.9		5.5	23.1	0.6	37.0		2.6	**37.0**	7	2.6
Sedibeng Special School for the Deaf and Disabilities	155.6	51.8		5.1	19.6	0.6	30.8		2.0	**30.8**	1	2.0
Kings College	176.3	71.3		6.0	23.1	0.7	36.8		2.6	**36.8**	8	2.6
Bosveld Primary School	167.9	59.2		5.6	21.1	0.7	33.9		2.3	**33.9**	3	2.3
Lephalale Medical Hospital	116.8	**164.0**	6	7.7	12.2	1.0	66.8		6.0	**66.8**	**66**	6.0
Ellisras Hospital	144.6	47.4		4.7	17.4	0.5	29.8		1.9	**29.8**	1	1.9
Laerskool Ellisras Primary School	116.6	43.2		3.8	12.7	0.4	21.5		1.4	21.5		1.4
Hoerskool Ellisras Secondary School	119.8	42.7		4.0	13.7	0.4	22.4		1.5	22.4		1.5
Marlothii Learning Academy	117.4	42.7		3.9	13.4	0.4	21.8		1.5	21.8		1.5
Hardekool Akademie vir C.V.O	106.4	40.9		3.6	11.2	0.4	20.6		1.2	20.6		1.2
Lephalale Clinic	113.6	41.8		3.8	12.6	0.4	21.3		1.4	21.3		1.4
Ons Hoop	114.8	48.9		3.5	12.3	0.4	23.0		1.4	23.0		1.4
Ramabara's	75.0	33.1		2.9	7.5	0.3	9.5		0.6	9.5		0.6
Kremetartpan	107.9	37.4		5.0	13.7	0.6	16.5		2.4	16.5		2.4
Mbala Private Camp	84.5	27.8		3.6	10.6	0.4	6.6		0.7	6.6		0.7
Steenbokpan	128.1	38.9		5.2	16.3	0.6	64.8		10.6	**64.8**	**129**	10.6

Receptor	67.7	28.7		2.2	6.9	0.2	16.8		1.8	16.8		1.8
Receptor	92.6	51.4		3.0	9.3	0.3	32.1		2.3	**32.1**	4	2.3
Receptor	55.4	27.8		1.8	4.9	0.2	11.8		1.0	11.8		1.0
Receptor	33.9	20.8		1.1	2.6	0.1	7.4		0.5	7.4		0.5
Receptor	36.0	20.2		1.2	2.8	0.1	7.9		0.4	7.9		0.4
Receptor	48.5	26.0		1.6	3.8	0.1	8.5		0.5	8.5		0.5
Tholo Bush Estate	47.5	17.6		1.8	4.5	0.2	4.2		0.3	4.2		0.3
Receptor	78.0	23.2		3.1	8.9	0.3	5.3		0.5	5.3		0.5

Table 7-9: Predicted concentrations in µg/m^3 at the sensitive receptors for Scenario D (MES), together with the limit value of the NAAQS and number of exceedances (NoE)

	SO_2				NO_2		PM_{10} Total			$PM_{2.5}$ Total		
	1-hr	24-hr	NoE	Ann	1-hr	Ann	24-hr	NoE	Ann	24-hr	NoE	Ann
Receptor	350	125	12	50	200	40	75	12	40	40	12	20
Phegelelo Senior Secondary	37.0	43.4		2.2	14.1	1.0	58.5		5.3	**58.5**	**57**	5.3
Contractors Village	38.6	45.2		2.0	14.3	0.9	71.4		9.0	**71.4**	**91**	9.0
Ditheku Primary School	35.7	42.5		2.2	13.3	0.9	57.9		5.3	**57.9**	**57**	5.3
Ditheko pramary School	60.1	33.2		2.3	25.7	1.0	70.9		5.2	**70.9**	**54**	5.2
Marapong Training Centre	38.3	48.7		2.3	14.8	1.0	68.5		6.0	**68.5**	**73**	6.0
Marapong Clinic	52.2	36.9		2.4	22.5	1.1	**81.1**	1	5.8	**81.1**	**65**	5.8
Tielelo Secondary School	34.8	45.5		2.3	13.1	1.0	60.4		5.5	**60.4**	**61**	5.5
Grootegeluk Medical Centre - Community Center	41.3	45.1		2.4	16.9	1.0	64.0		6.1	**64.0**	**74**	6.1
Lephalale College	51.6	15.6		1.6	22.7	0.6	33.1		2.3	**33.1**	7	2.3
Nelsonskop Primary School	47.1	40.0		2.4	19.6	1.0	73.3		5.9	**73.3**	**74**	5.9
Hansie En Grietjie Pre-Primary School	52.3	15.9		1.6	23.1	0.6	33.7		2.4	**33.7**	7	2.4
Sedibeng Special School for the Deaf and Disabilities	46.7	15.5		1.5	19.6	0.6	27.3		1.8	**27.3**	1	1.8
Kings College	52.9	21.4		1.8	23.1	0.7	33.1		2.4	**33.1**	8	2.4
Bosveld Primary School	50.4	17.8		1.7	21.1	0.7	30.5		2.1	**30.5**	3	2.1
Lephalale Medical Hospital	35.0	49.2		2.3	12.2	1.0	62.7		5.8	**62.7**	**66**	5.8
Ellisras Hospital	43.4	14.2		1.4	17.4	0.5	26.3		1.7	**26.3**	1	1.7
Laerskool Ellisras Primary School	35.0	13.0		1.1	12.7	0.4	18.2		1.2	18.2		1.2
Hoerskool Ellisras Secondary School	35.9	12.8		1.2	13.7	0.4	19.1		1.3	19.1		1.3
Marlothii Learning Academy	35.2	12.8		1.2	13.4	0.4	18.4		1.2	18.4		1.2
Hardekool Akademie vir C.V.O	31.9	12.3		1.1	11.2	0.4	17.5		1.0	17.5		1.0
Lephalale Clinic	34.1	12.5		1.1	12.6	0.4	18.0		1.2	18.0		1.2
Ons Hoop	34.4	14.7		1.1	12.3	0.4	19.5		1.2	19.5		1.2
Ramabara's	22.5	9.9		0.9	7.5	0.3	7.2		0.4	7.2		0.4
Kremetartpan	32.4	11.2		1.5	13.7	0.6	14.1		2.1	14.1		2.1
Mbala Private Camp	25.3	8.3		1.1	10.6	0.4	4.8		0.5	4.8		0.5
Steenbokpan	38.4	11.7		1.6	16.3	0.6	62.5		10.4	**62.5**	**129**	10.4

Receptor	20.3	8.6		0.7	6.9	0.2	14.7		1.6	14.7		1.6
Receptor	27.8	15.4		0.9	9.3	0.3	28.8		2.1	**28.8**	4	2.1
Receptor	16.6	8.3		0.5	4.9	0.2	9.6		0.9	9.6		0.9
Receptor	10.2	6.2		0.3	2.6	0.1	5.8		0.4	5.8		0.4
Receptor	10.8	6.1		0.3	2.8	0.1	6.0		0.3	6.0		0.3
Receptor	14.6	7.8		0.5	3.8	0.1	6.6		0.4	6.6		0.4
Tholo Bush Estate	14.2	5.3		0.5	4.5	0.2	2.5		0.2	2.5		0.2
Receptor	23.4	7.0		0.9	8.9	0.3	3.4		0.3	3.4		0.3

7.2.3 Isopleth maps

Isopleth maps of predicted ambient SO_2, NO_2, PM_{10} and $PM_{2.5}$ concentrations are presented in the following sections. The predicted concentrations are shown as isopleths, lines of equal concentration, in µg/m^3 for the respective NAAQS averaging periods. The isopleths are depicted as coloured lines on the various maps, corresponding to a particular predicted ambient concentration. Areas within red isopleths indicate an area where exceedances of the respective NAAQS limit value are predicted to occur. Sensitive receptors are represented by green squares and AQMS are represented by white dots.

The South African NAAQS permits 4 exceedances of the 24-hour or daily limit value per annum, implying 12 permitted exceedances in a three-year modelling period. For the 24-hour or daily isopleth maps, areas within burgundy isopleths indicate areas where more than 12 exceedances of the limit value is predicted over a 3-year period. The predicted 24-hour concentrations in these areas do not comply with the NAAQS.

The South African NAAQS also permits 88 exceedances of the 1-hour or hourly limit value per annum, implying 264 permitted exceedances in a three-year modelling period. For the 1-hour or hourly isopleth maps, areas within burgundy isopleths indicate areas where more than 264 exceedances of the limit value is predicted over a 3-year period. The predicted 1-hour concentrations in these areas do not comply with the NAAQS.

7.2.3.1 Sulphur dioxide (SO_2)

The isopleth maps showing the predicted annual average SO_2 concentrations clearly demonstrate the effect of the predominant northeasterly winds, with dispersion generally to the southwest of the power plant. In all scenarios the highest predicted annual average concentrations occur between 10 and 15 km to the southwest of the power station.

The slight increase in SO_2 emission and a reduction in stack exit velocity from Scenario 1 (Current) to Scenario A (2025) is seen by an increase in the predicted annual average concentrations and affected area. The reduction in emissions and a reduction in stack exit velocity from Scenario A (2025) to Scenario B (2031) is seen by a slight decrease in the predicted concentrations and slight change in the affected area. The increase in stack exit velocity from Scenario B (2031) to Scenario C (2036) is seen by a slight decrease in predicted concentrations and a slight change in the affected area. The large reduction in emissions from Scenario C (2036) to Scenario D (MES) is seen by a large decrease in the predicted concentrations and the affected area.

The predicted 24-hour and 1-hour SO_2 concentrations show the same trend between scenarios as the annual predictions with the change in emissions and exit velocities. The predicted 99th percentile of the 24-hour and 1-hour ambient concentrations are high in Scenario A (2025) Scenario B (2031) and Scenario C (2036) and exceed the limit value of the respective NAAQS. In these scenarios, the predicted 24-hour and 1-hour ambient concentrations exceed the limit value of the respective NAAQS up to approximately 10 km around Matimba.

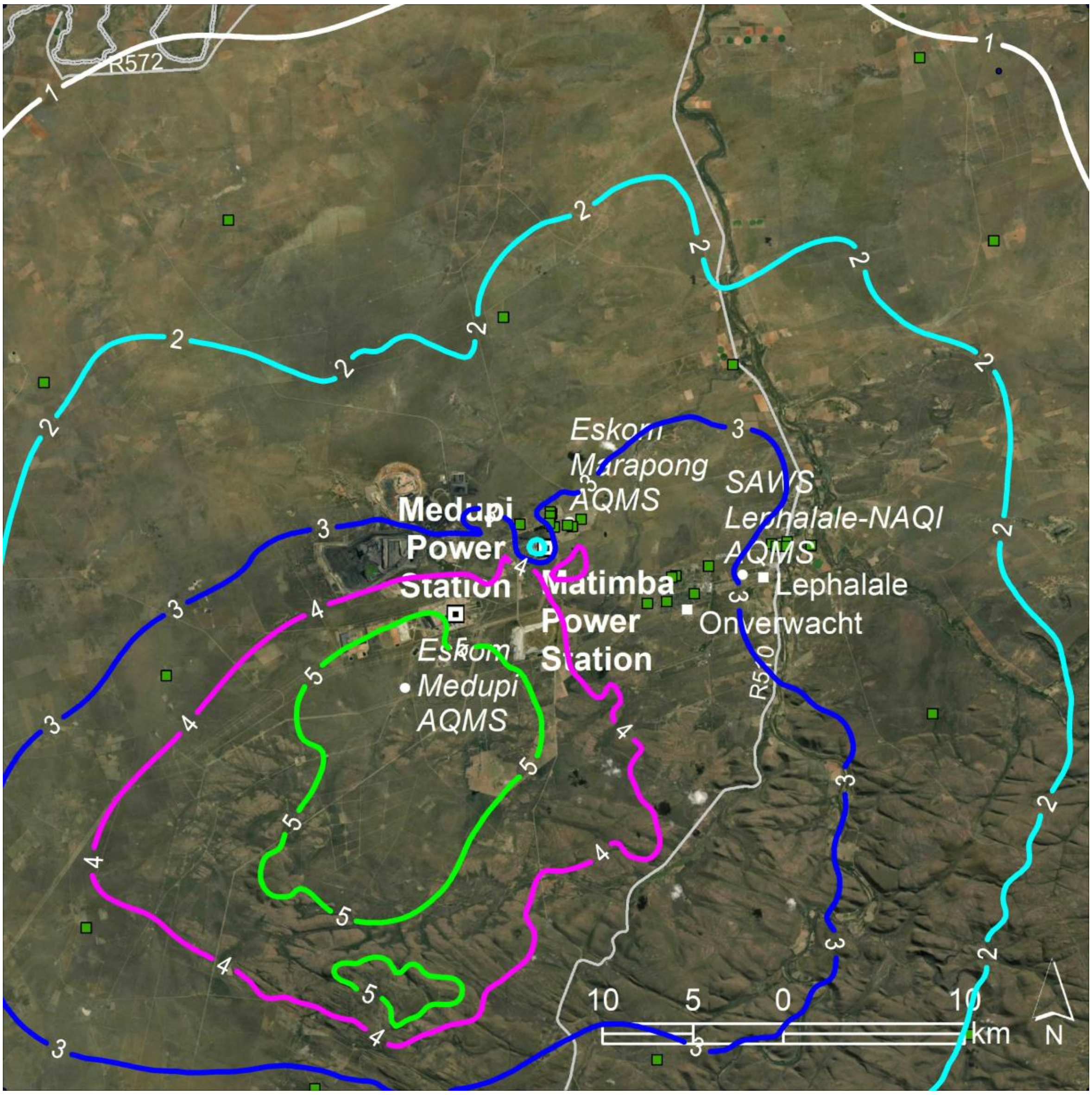


Figure 7-2: Predicted annual average SO_2 concentrations in µg/m³ resulting from emissions from Matimba: Scenario 1 (Current) (NAAQS Limit is 50 µg/m³)

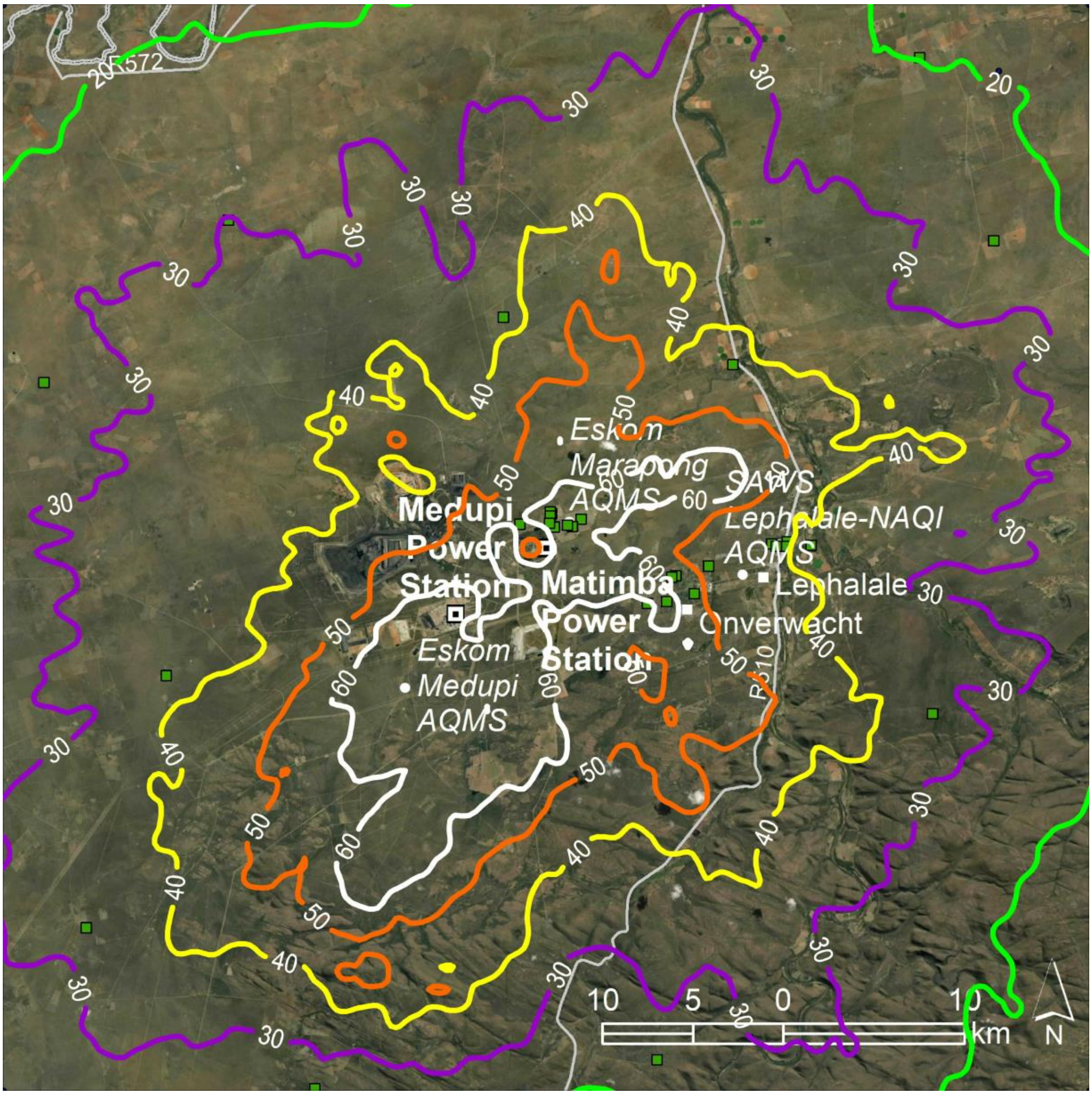


Figure 7-3: Predicted 99th percentile 24-hour SO_2 concentrations in μg/m^3 resulting from emissions from Matimba: Scenario 1 (Current) (NAAQS Limit is 125 μg/m^3)

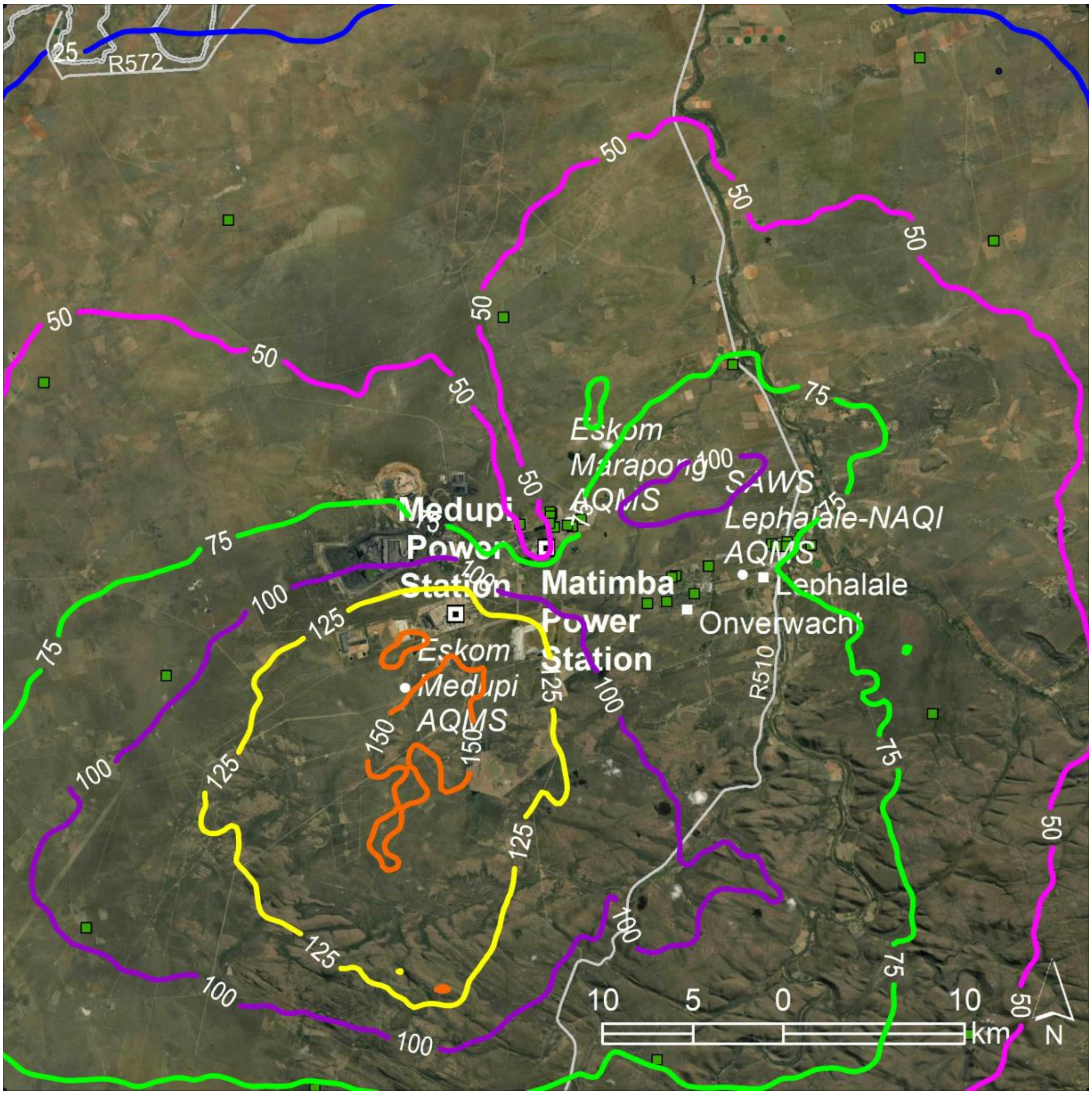


Figure 7-4: Predicted 99th percentile 1-hour SO_2 concentrations in µg/m³ resulting from emissions from Matimba: Scenario 1 (Current) (NAAQS Limit is 350 µg/m³)

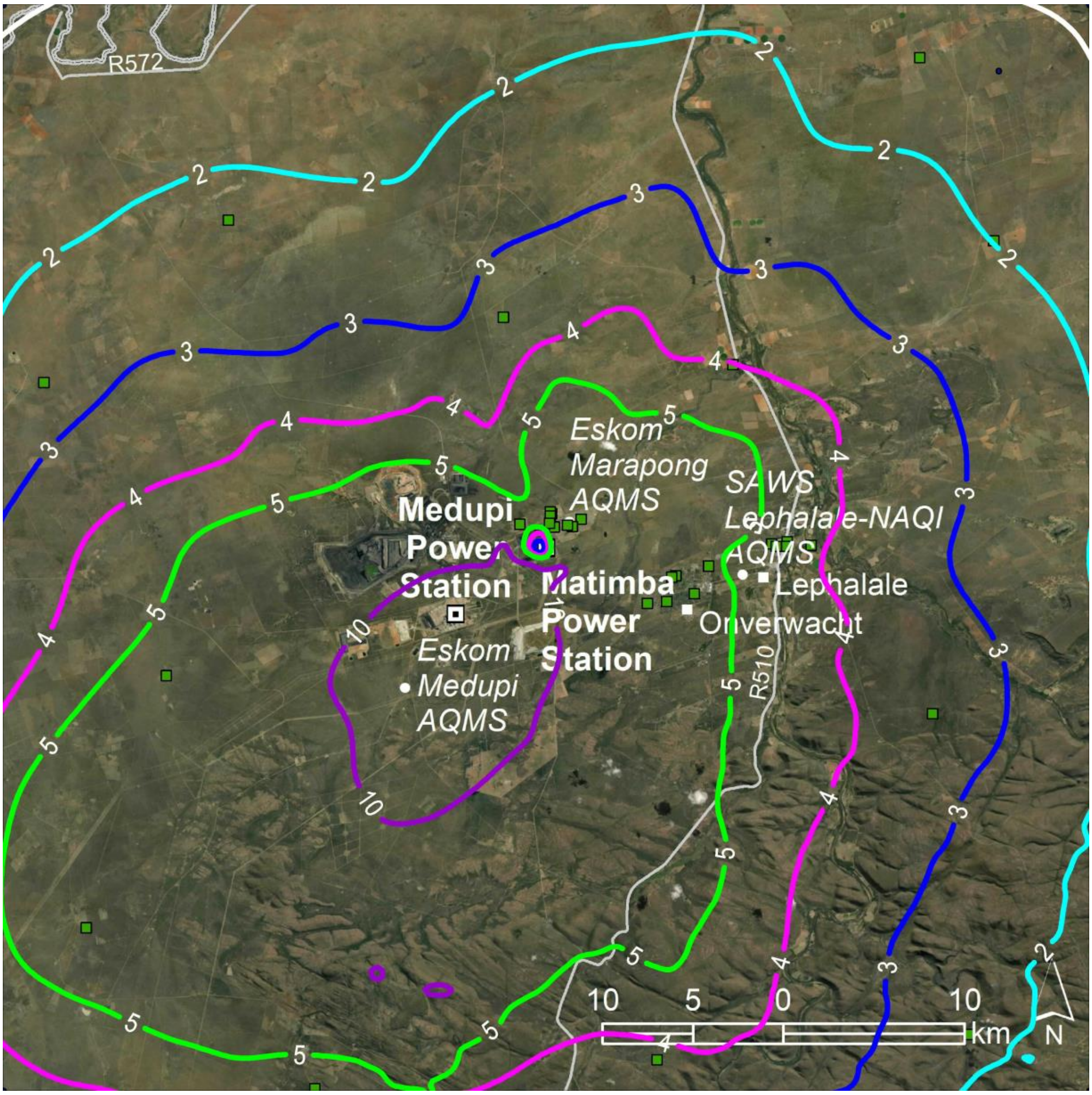


Figure 7-5: Predicted annual average SO_2 concentrations in µg/m^3 resulting from emissions from Matimba: Scenario A (2025) (NAAQS Limit is 50 µg/m^3)

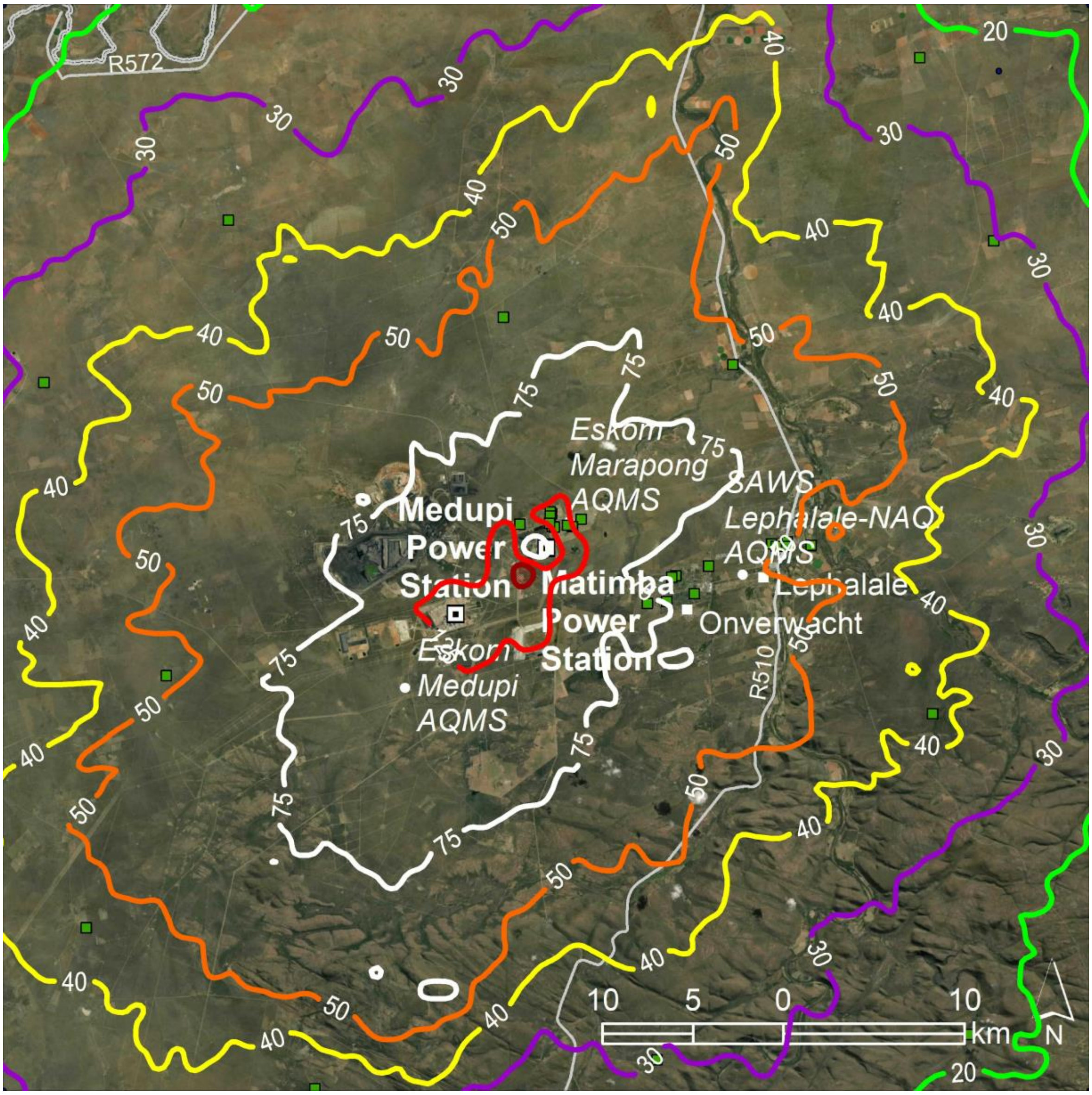


Figure 7-6: Predicted 99th percentile 24-hour SO$_2$ concentrations in µg/m^3 resulting from emissions from Matimba: Scenario A (2025) (NAAQS Limit is 125 µg/m^3)

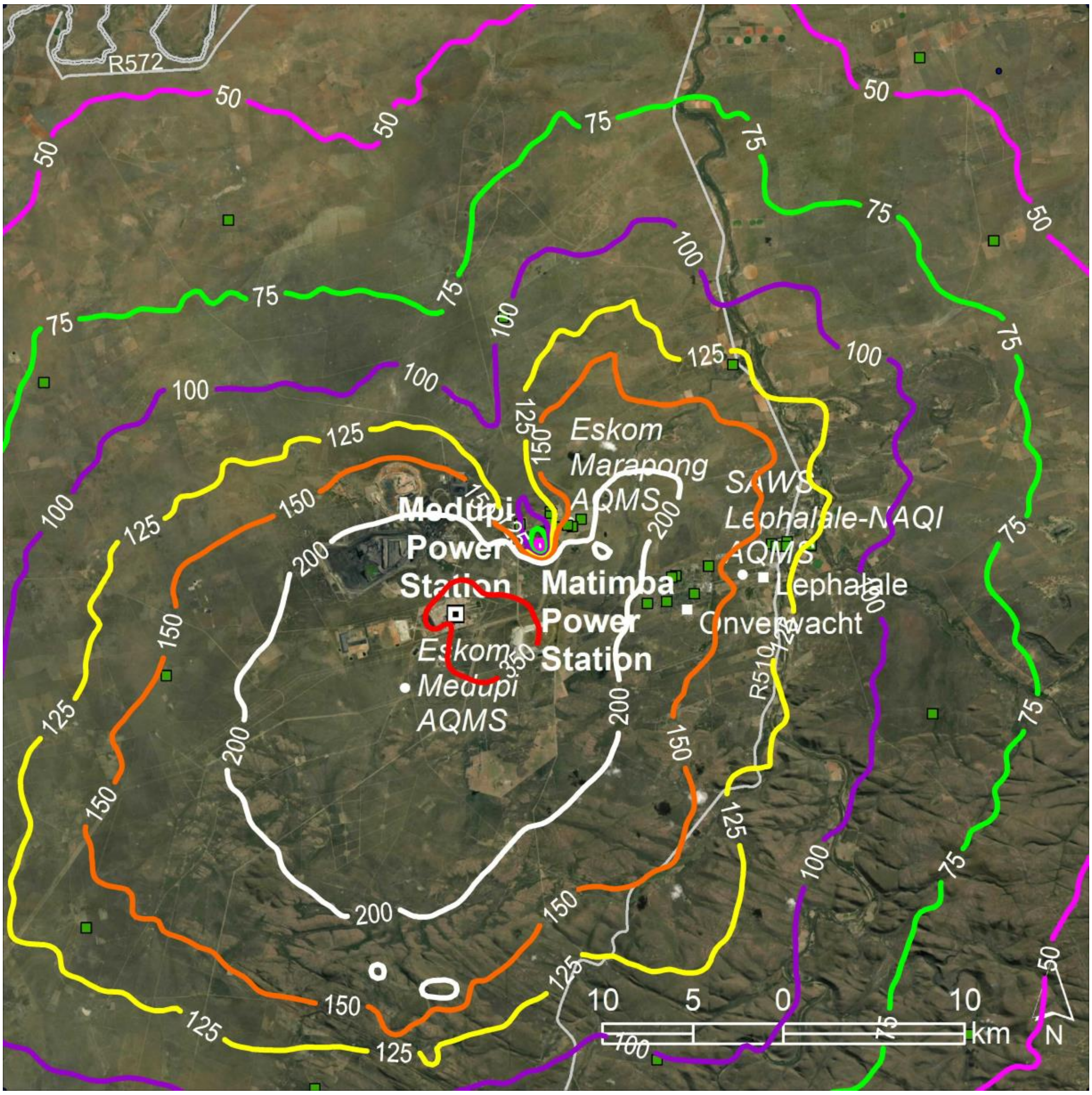


Figure 7-7: Predicted 99th percentile 1-hour SO_2 concentrations in µg/m³ resulting from emissions from Matimba: Scenario A (2025) (NAAQS Limit is 350 µg/m³)

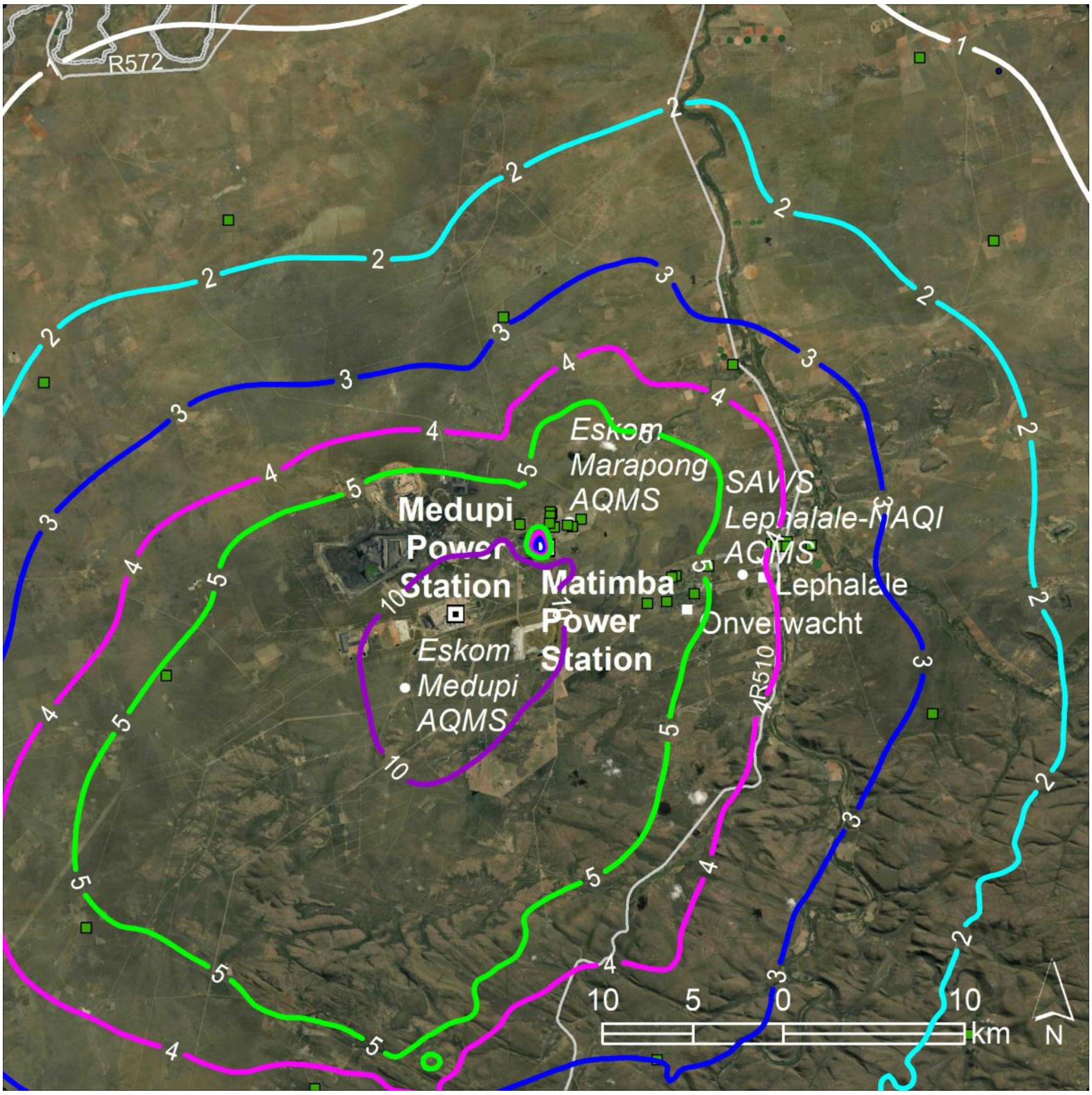


Figure 7-8: Predicted annual average SO_2 concentrations in µg/m³ resulting from emissions from Matimba: Scenario B (2031) (NAAQS Limit is 50 µg/m³)

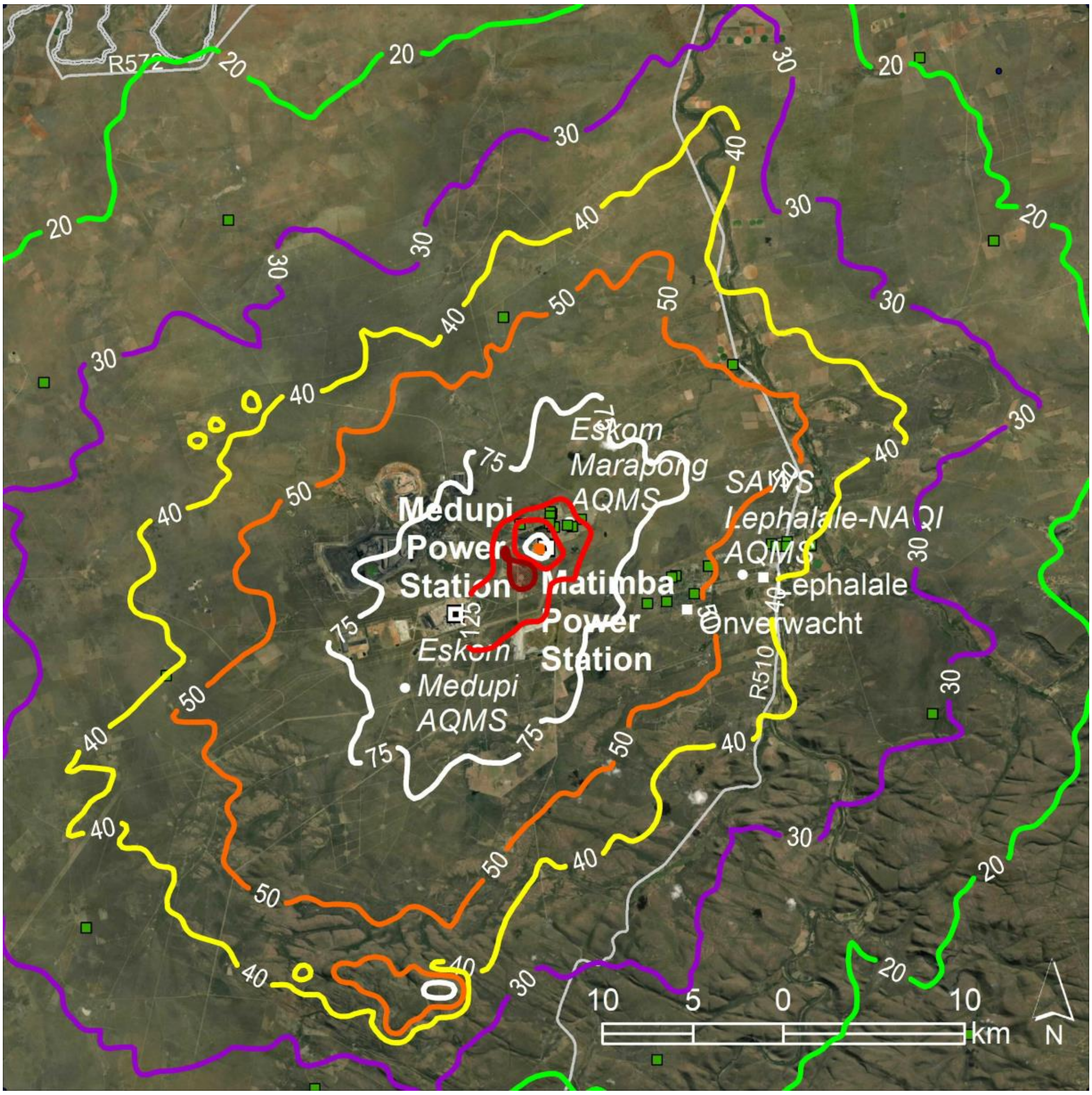


Figure 7-9: Predicted 99th percentile 24-hour SO_2 concentrations in µg/m^3 resulting from emissions from Matimba: Scenario B (2031) (NAAQS Limit is 125 µg/m^3)

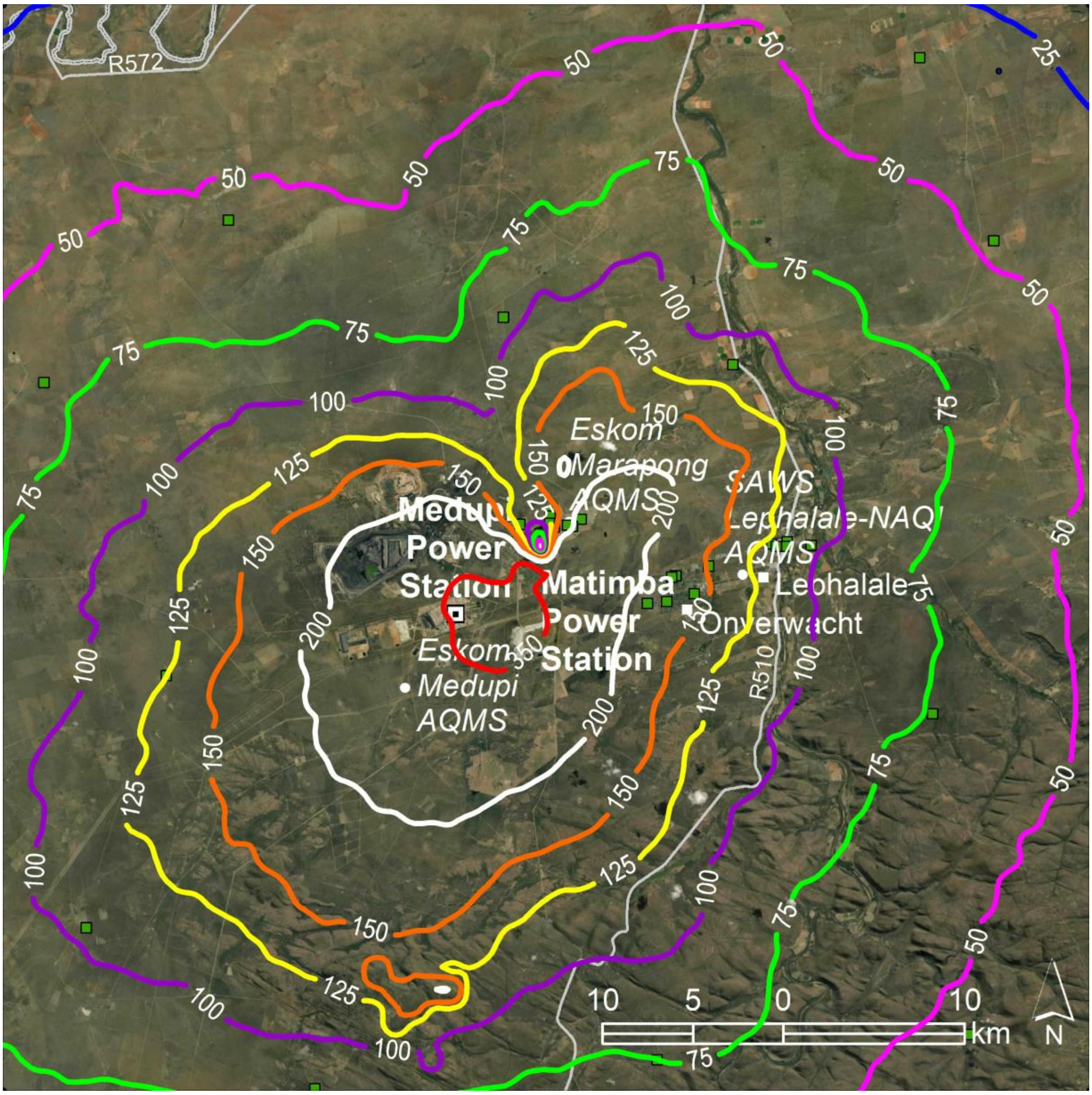


Figure 7-10: Predicted 99th percentile 1-hour SO_2 concentrations in µg/m^3 resulting from emissions from Matimba: Scenario B (2031) (NAAQS Limit is 350 µg/m^3)

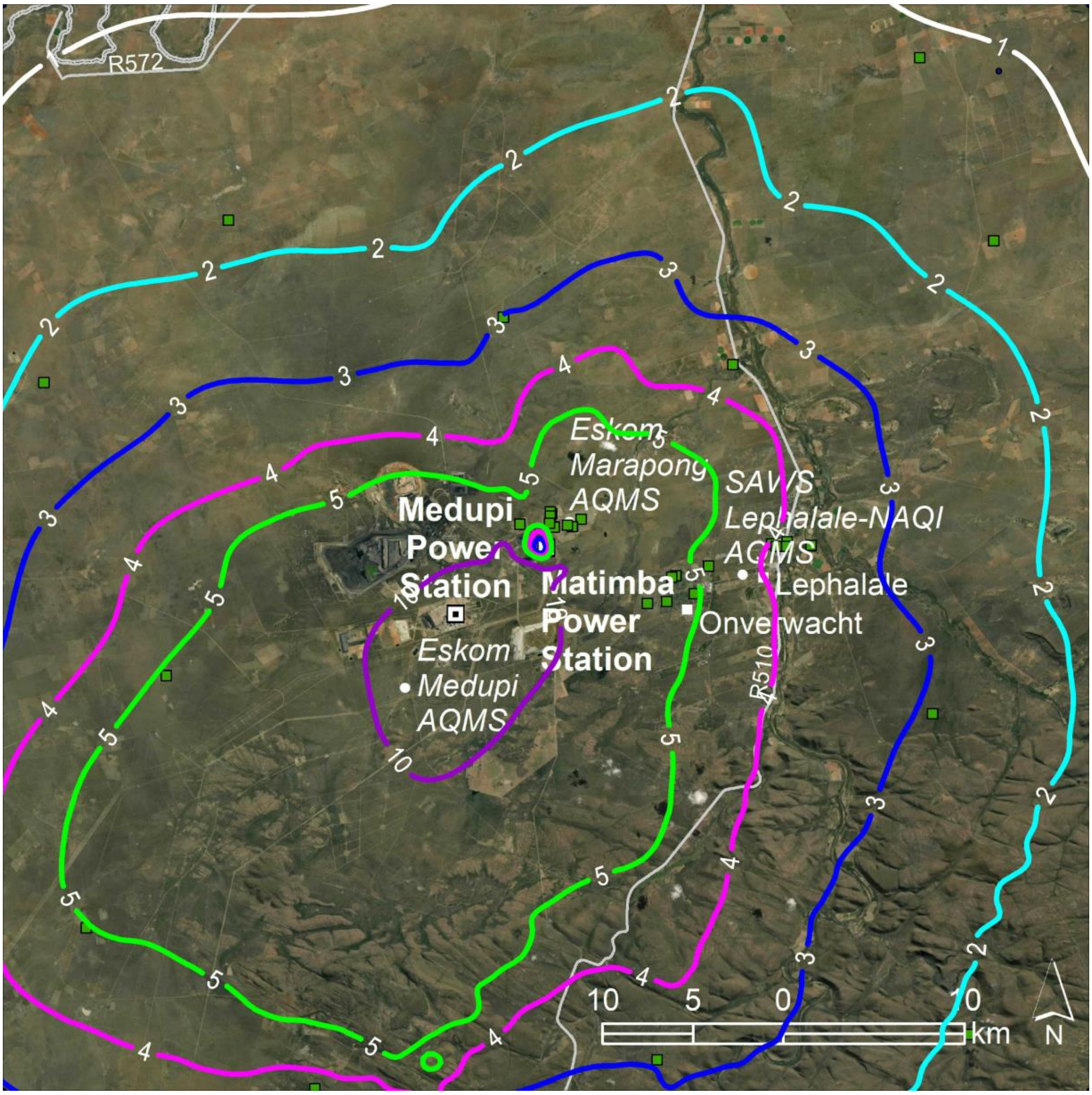


Figure 7-11: Predicted annual average SO_2 concentrations in µg/m^3 resulting from emissions from Matimba: Scenario C (2036) (NAAQS Limit is 50 µg/m^3)

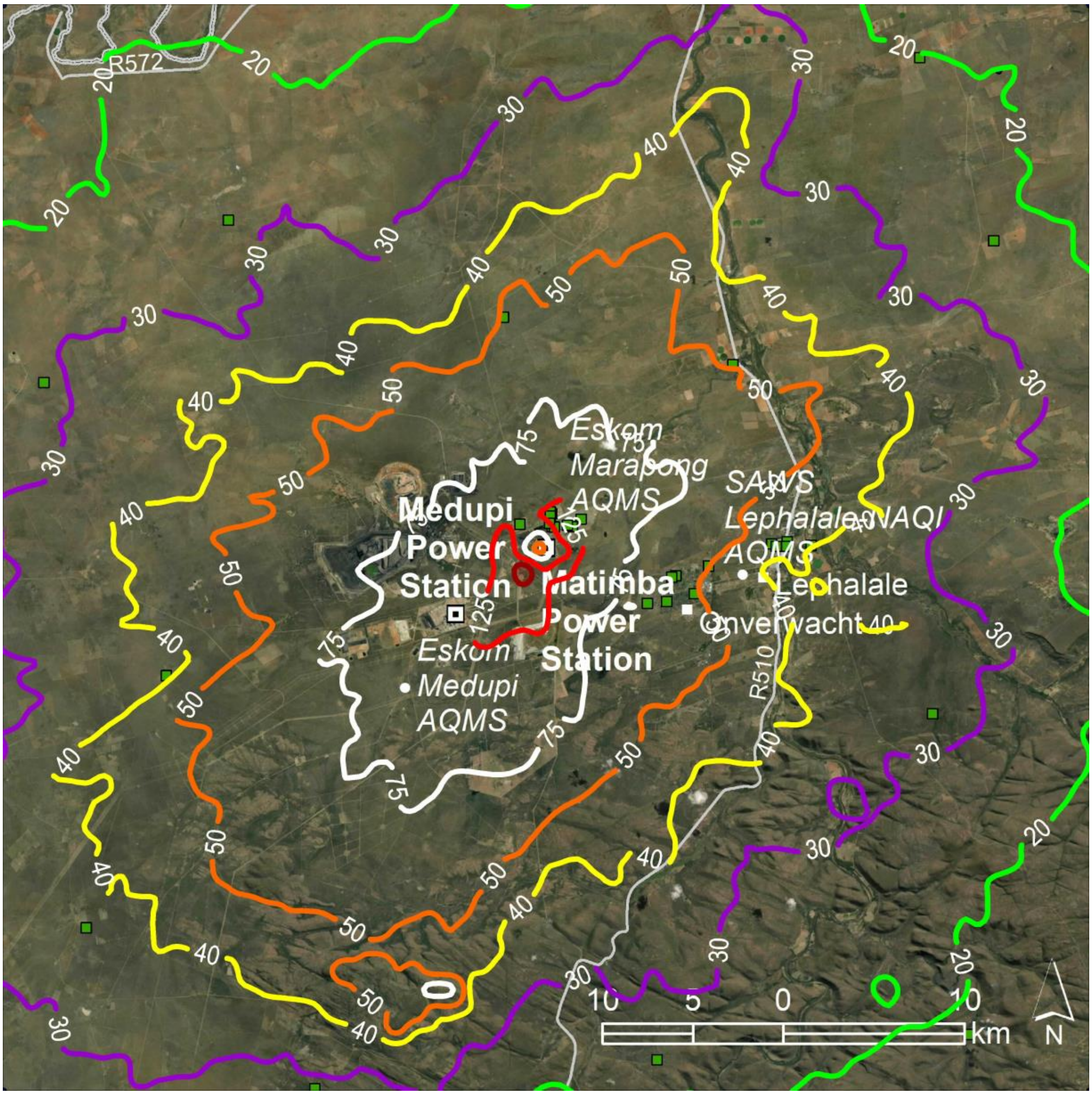


Figure 7-12: Predicted 99th percentile 24-hour SO_2 concentrations in µg/m^3 resulting from emissions from Matimba: Scenario C (2036) (NAAQS Limit is 125 µg/m^3)

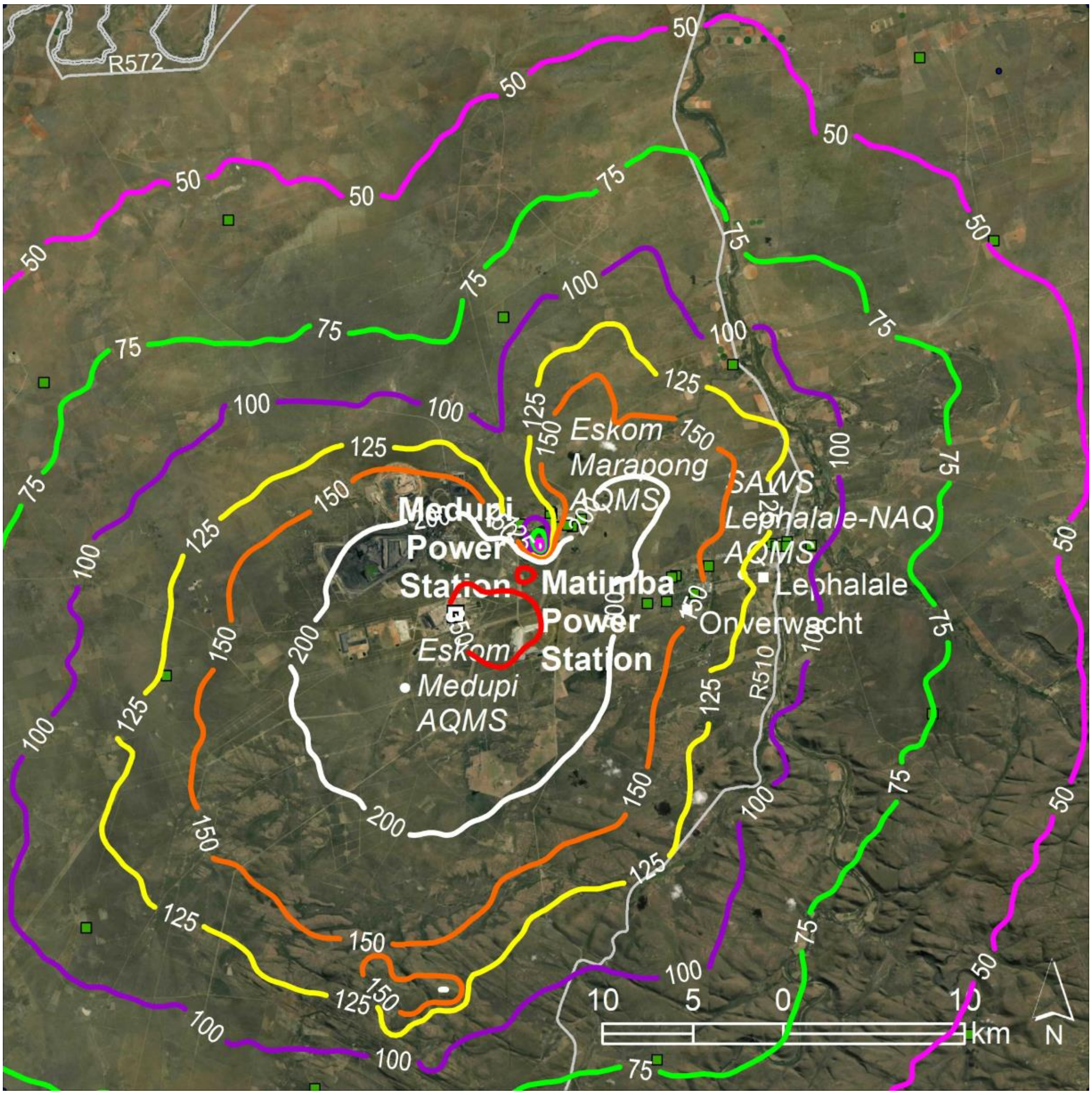


Figure 7-13: Predicted 99th percentile 1-hour SO_2 concentrations in µg/m³ resulting from emissions from Matimba: Scenario C (2036) (NAAQS Limit is 350 µg/m³)

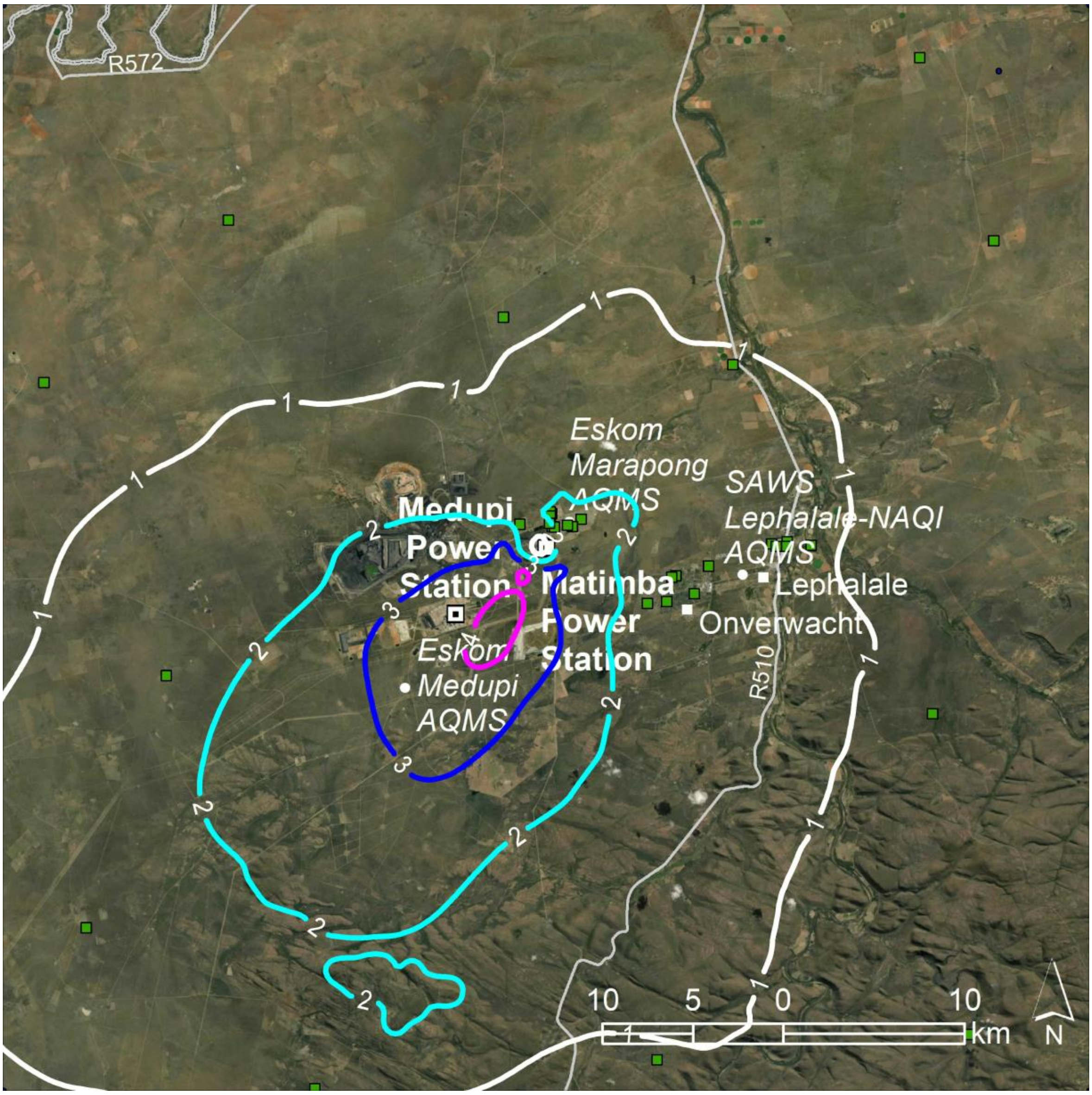


Figure 7-14: Predicted annual average SO_2 concentrations in µg/m^3 resulting from emissions from Matimba: Scenario D (MES) (NAAQS Limit is 50 µg/m^3)

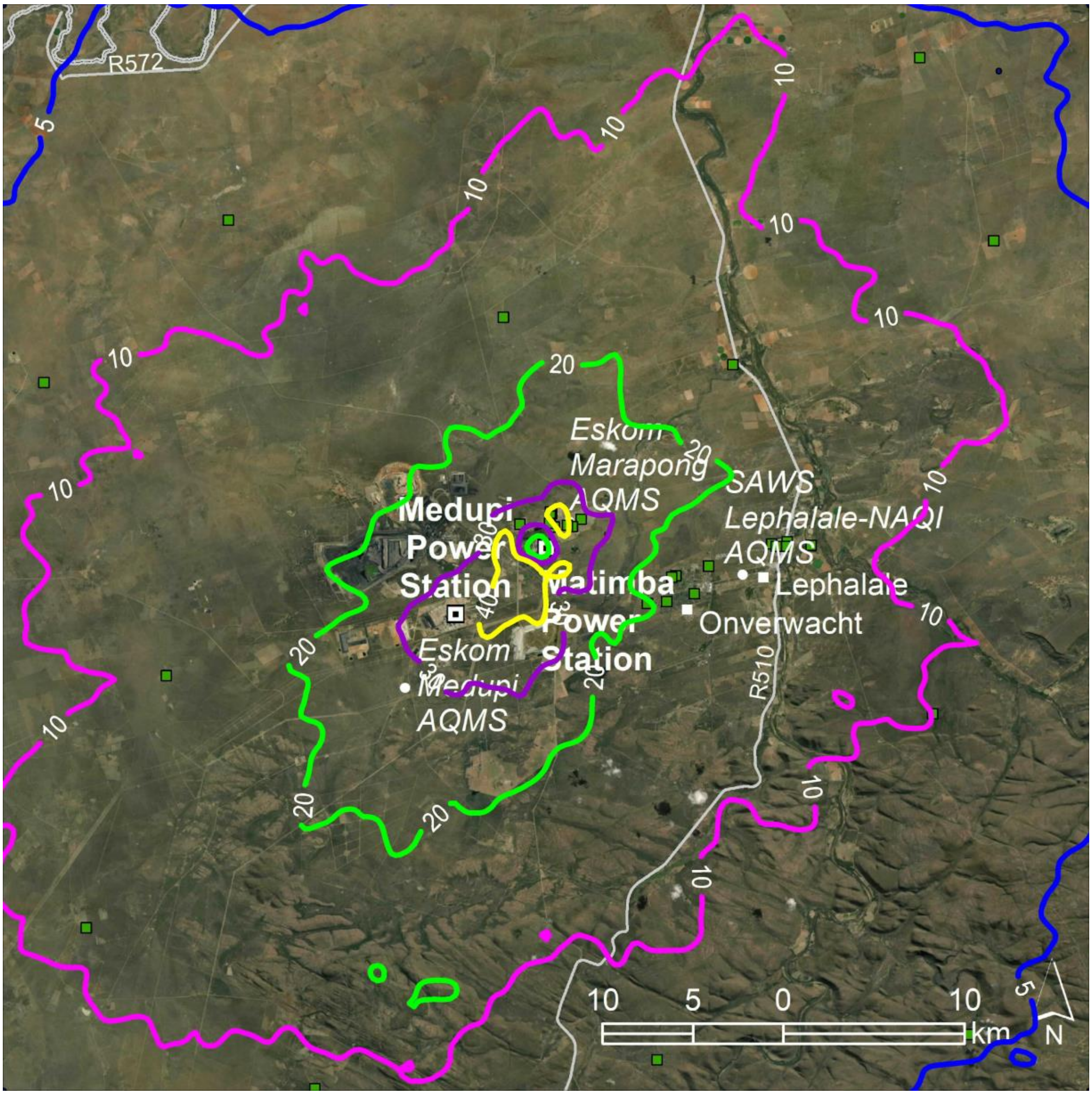


Figure 7-15: Predicted 99th percentile 24-hour SO_2 concentrations in µg/m³ resulting from emissions from Matimba: Scenario D (MES) (NAAQS Limit is 125 µg/m³)

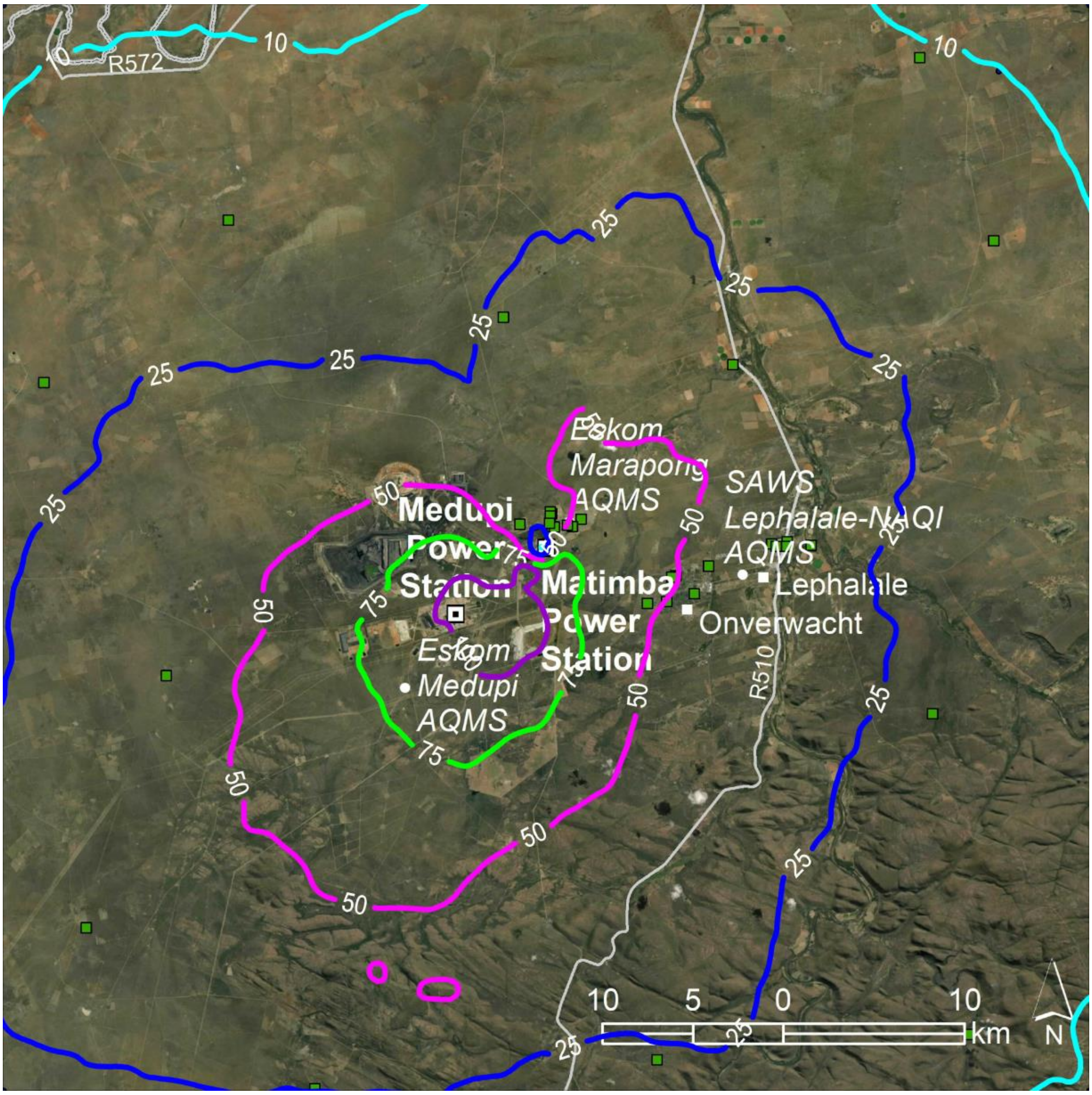


Figure 7-16: Predicted 99th percentile 1-hour SO_2 concentrations in µg/m^3 resulting from emissions from Matimba: Scenario D (MES) (NAAQS Limit is 350 µg/m^3)

7.2.3.2 Nitrogen dioxide (NO_2)

The isopleth maps showing the predicted annual average NO_2 concentrations clearly demonstrate the effect of the predominant northeasterly winds, with dispersion generally to the southwest of the power plant.

In all scenarios the predicted annual average concentrations are relatively low and well below the NAAQS throughout the modelling domain. The highest predicted concentrations occur approximately 10 km to the southwest of the power station. The slight decrease in emission and a reduction in stack exit velocity from Scenario 1 (Current) to Scenario A (2025) is seen by an increase in the predicted concentrations and affected area. The large reduction in emissions and a reduction in stack exit velocity from Scenario A (2025) to Scenario B (2031) is seen by a slight increase in the predicted concentrations and slight change in the affected area.

The predicted 1-hour NO_2 concentrations show the same trend between scenarios as the annual predictions with the change in emissions and exit velocities. In all scenarios the predicted concentrations are relatively low and well below the NAAQS throughout the modelling domain. The highest predicted concentrations occur approximately 10 km to the southwest of the power station.

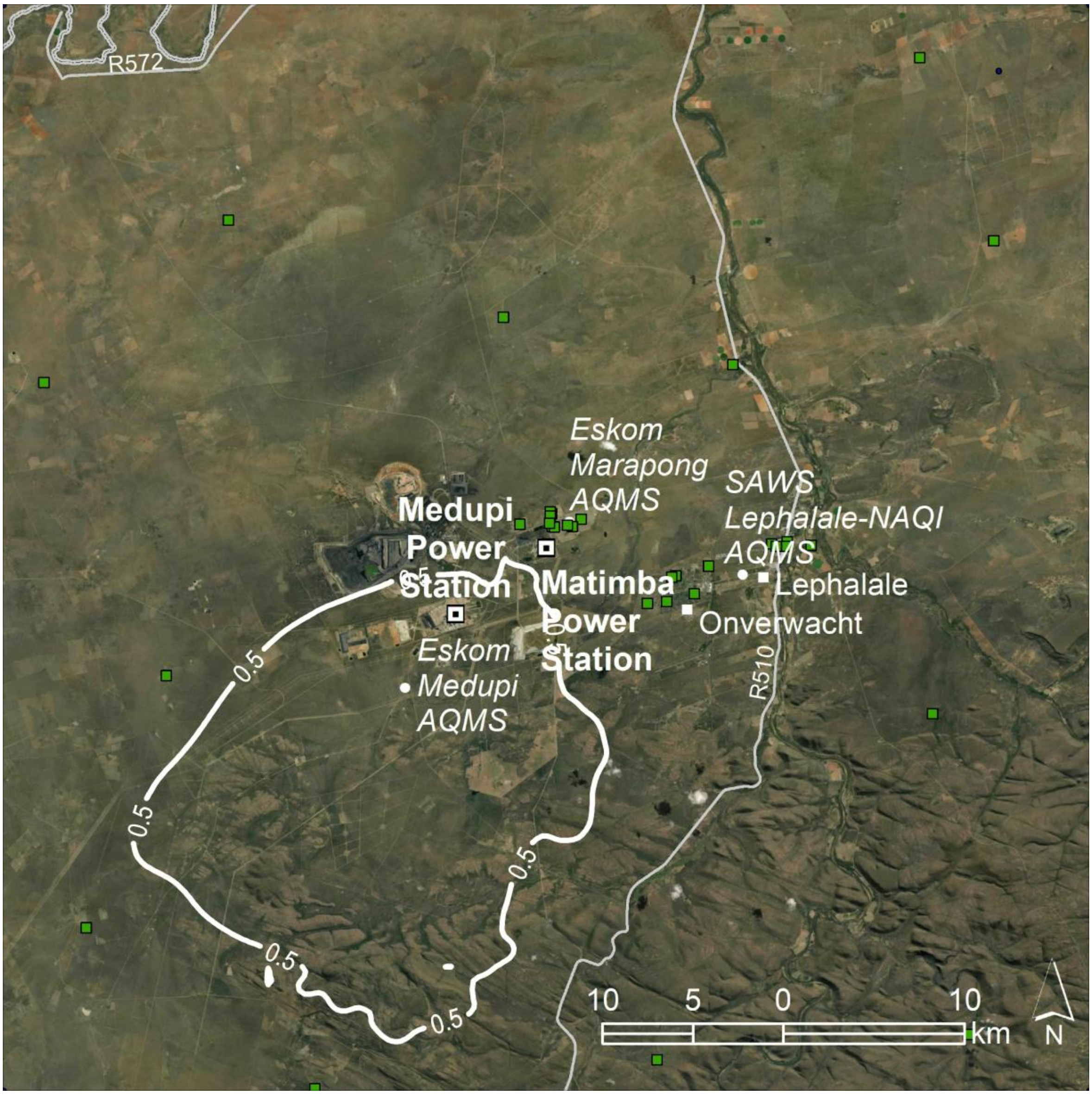


Figure 7-17: Predicted annual average NO_2 concentrations in µg/m^3 resulting from emissions from Matimba: Scenario 1 (Current) (NAAQS Limit is 40 µg/m^3)

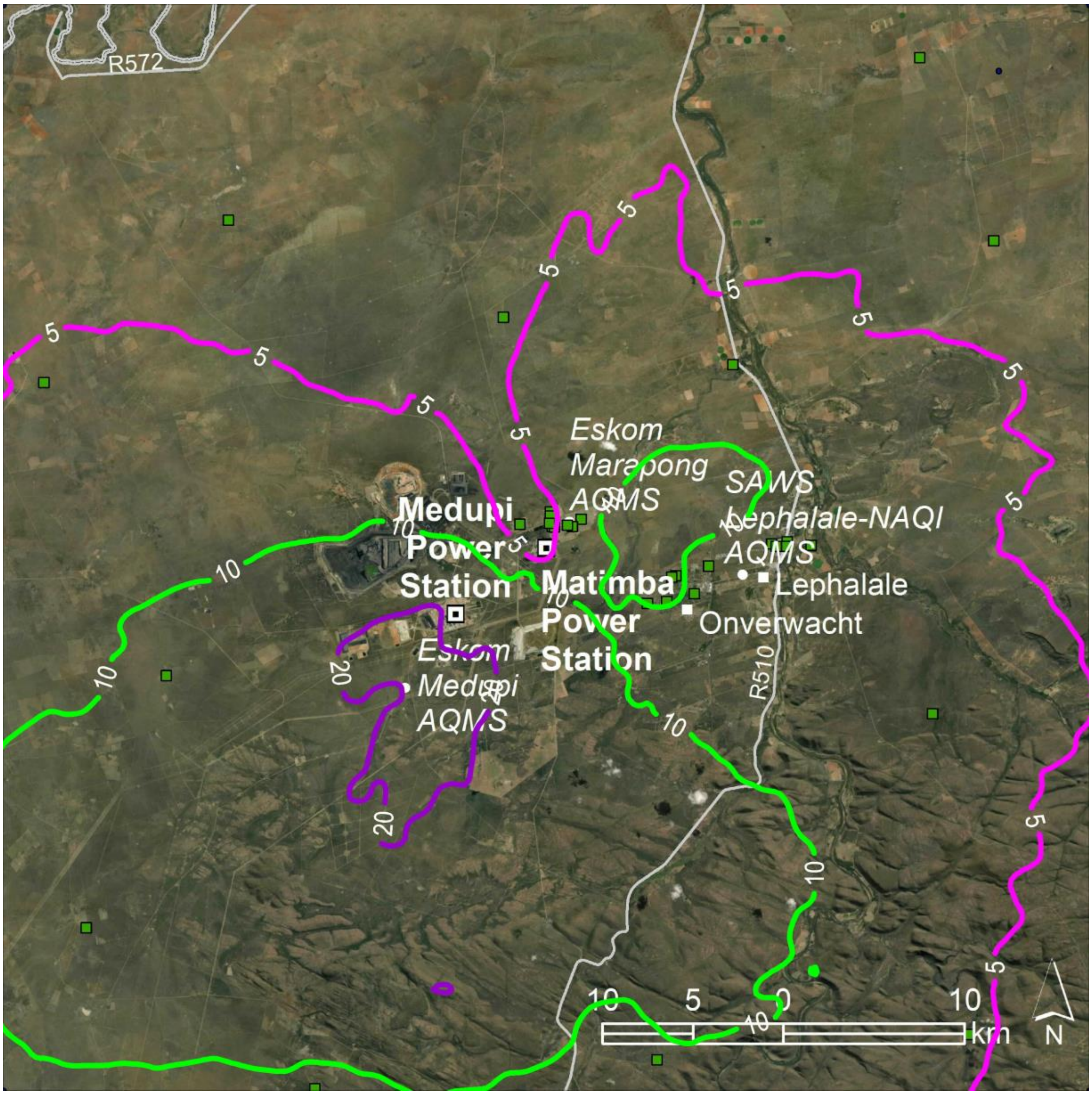


Figure 7-18: Predicted 99th percentile 1-hour NO_2 concentrations in µg/m³ resulting from emissions from Matimba: Scenario 1 (Current) (NAAQS Limit is 200 µg/m³)

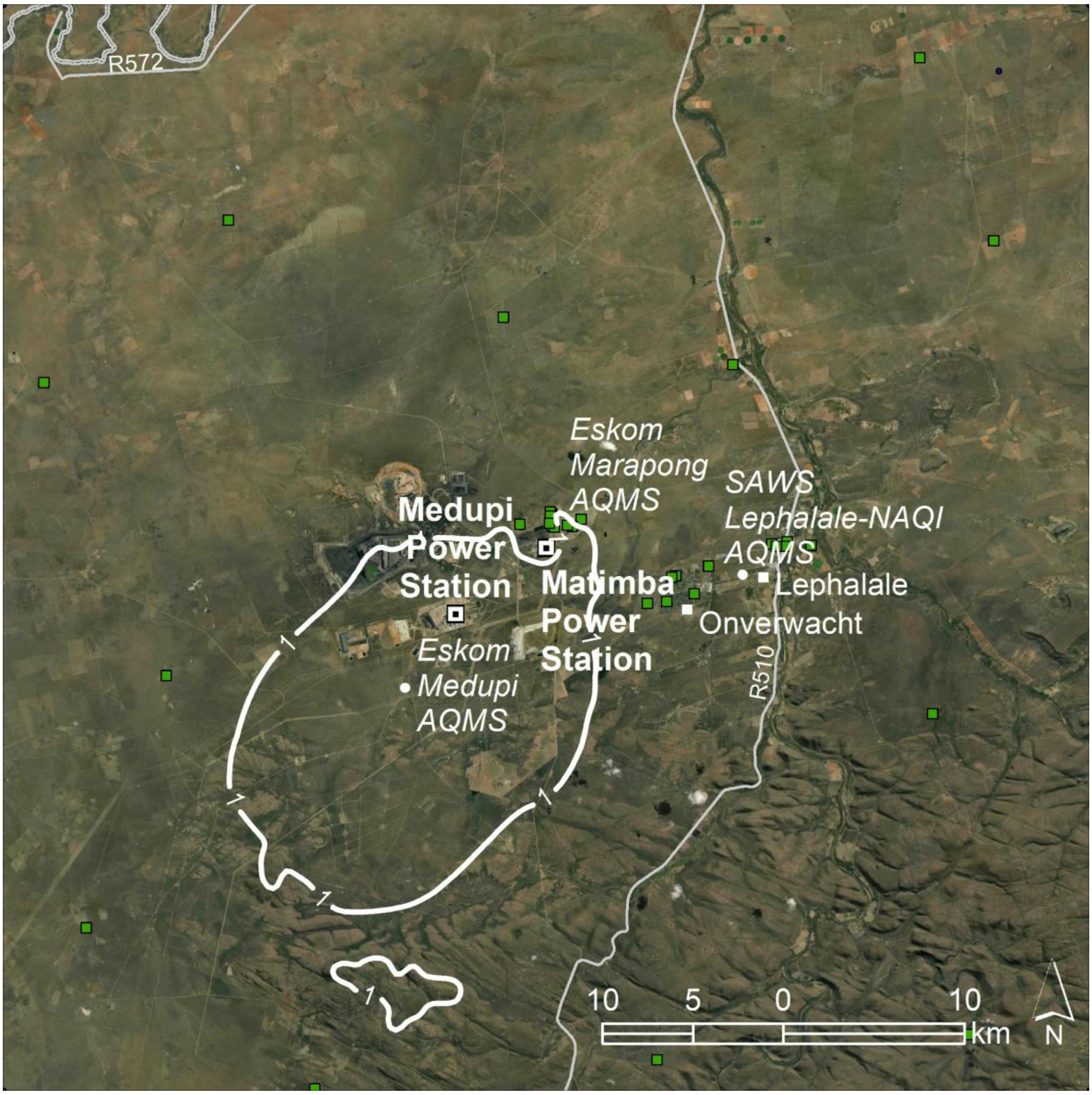


Figure 7-19: Predicted annual average NO_2 concentrations in µg/m^3 resulting from emissions from Matimba: Scenario A (2025) (NAAQS Limit is 40 µg/m^3)

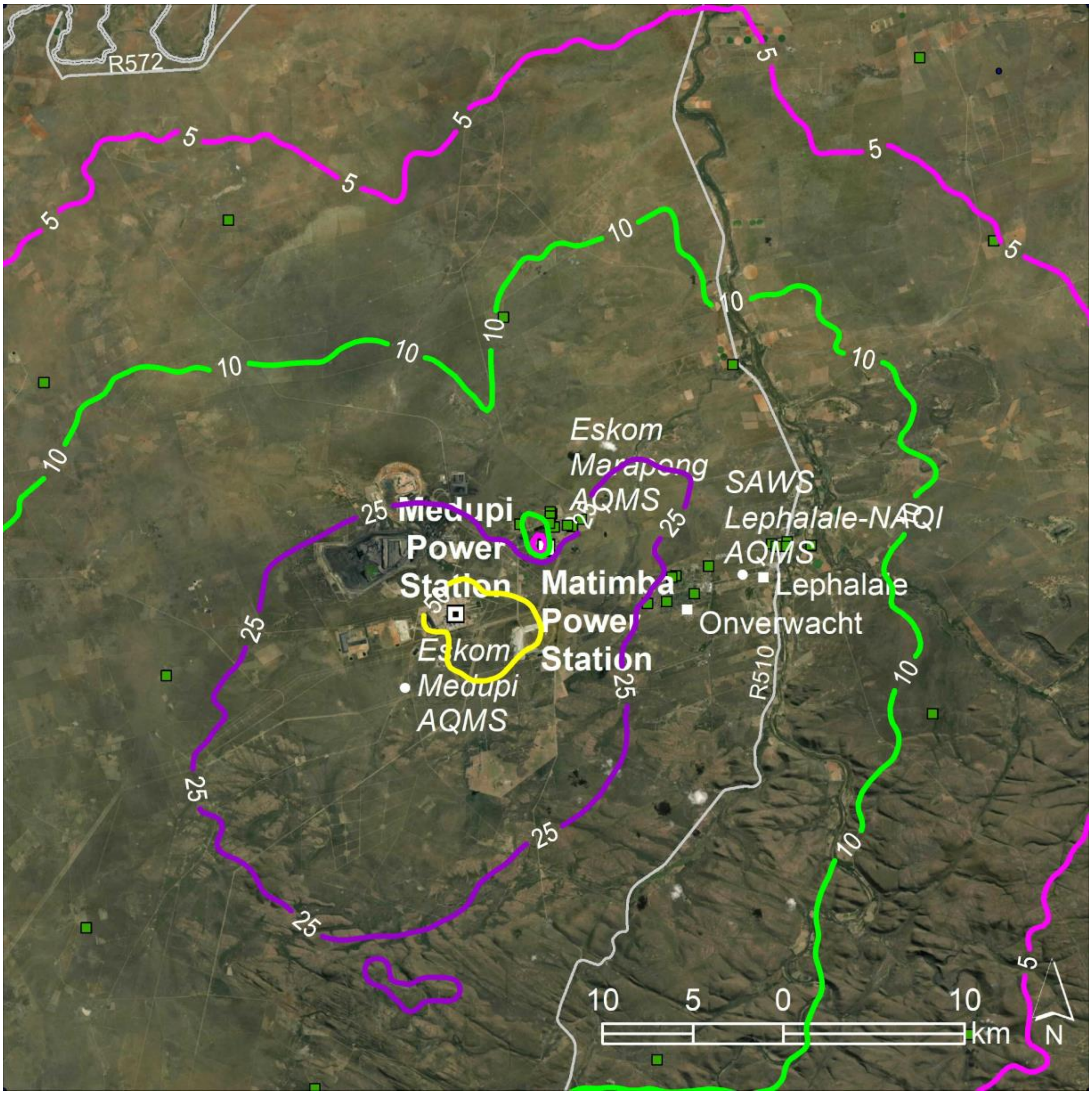


Figure 7-20: Predicted 99th percentile 1-hour NO_2 concentrations in µg/m^3 resulting from emissions from Matimba: Scenario A (2025) (NAAQS Limit is 200 µg/m^3)

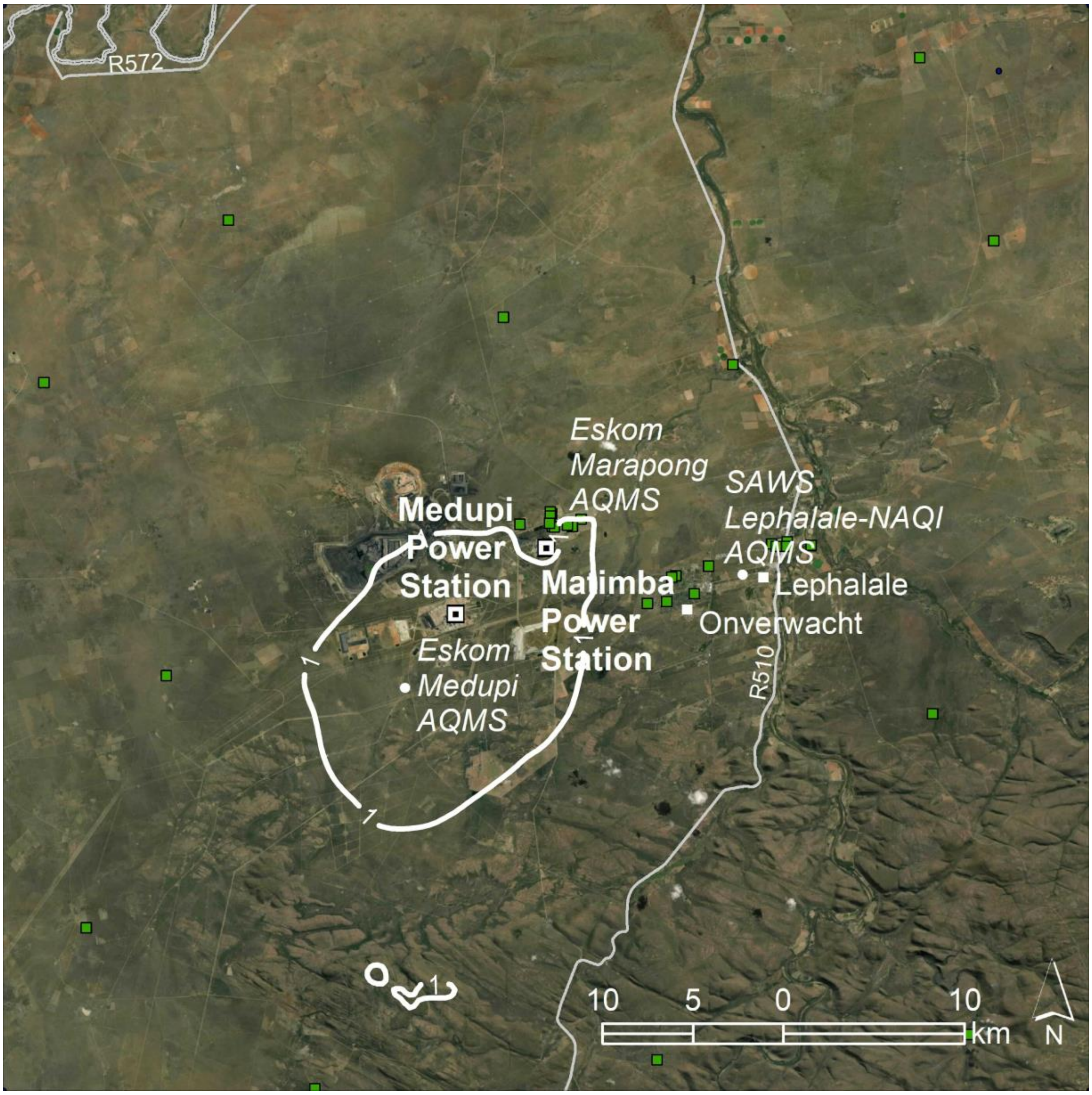


Figure 7-21: Predicted annual average NO_2 concentrations in µg/m^3 resulting from emissions from Matimba: Scenario B (2031) (NAAQS Limit is 40 µg/m^3)

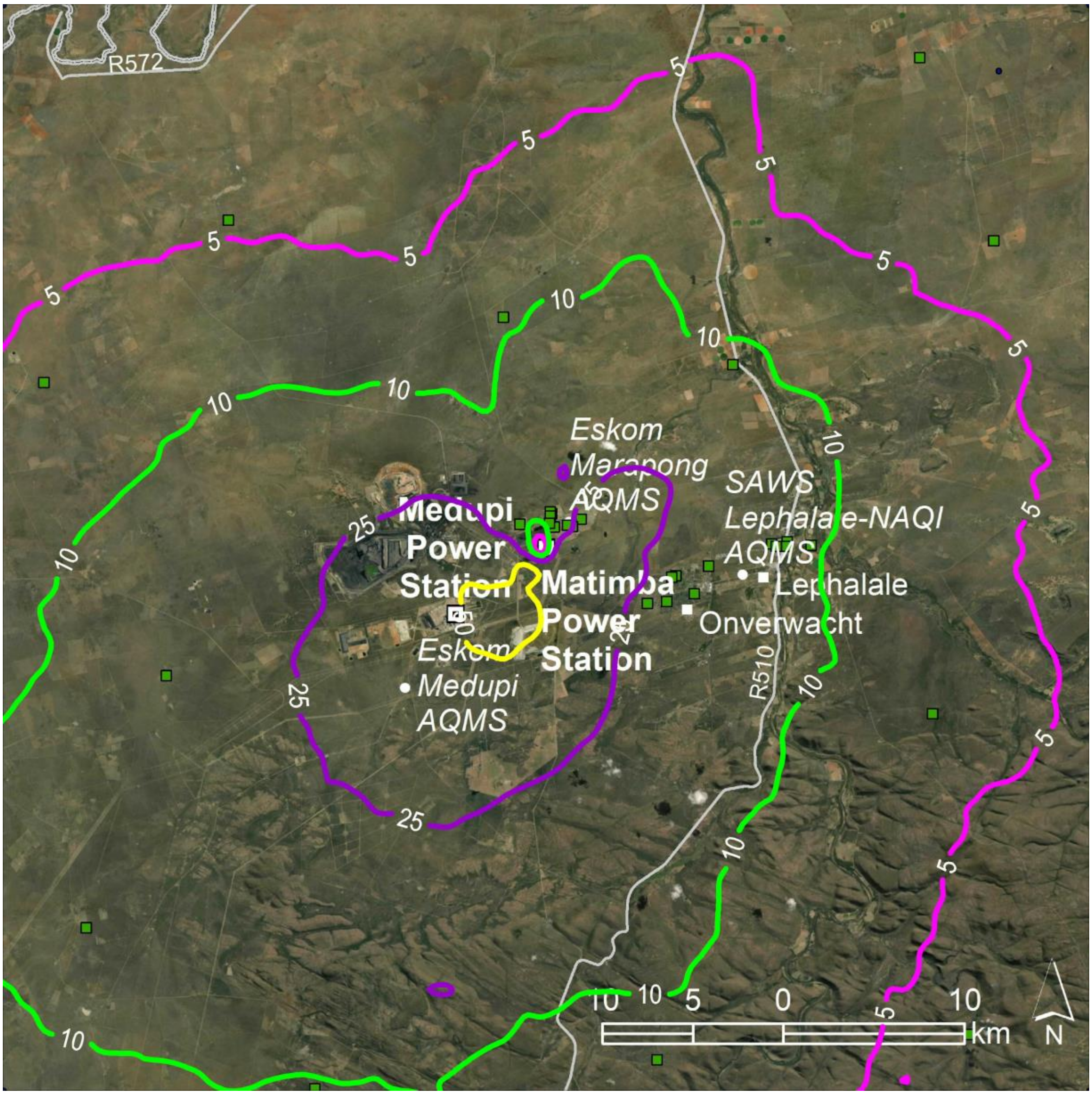


Figure 7-22: Predicted 99th percentile 1-hour NO_2 concentrations in µg/m^3 resulting from emissions from Matimba: Scenario B (2031) (NAAQS Limit is 200 µg/m^3)

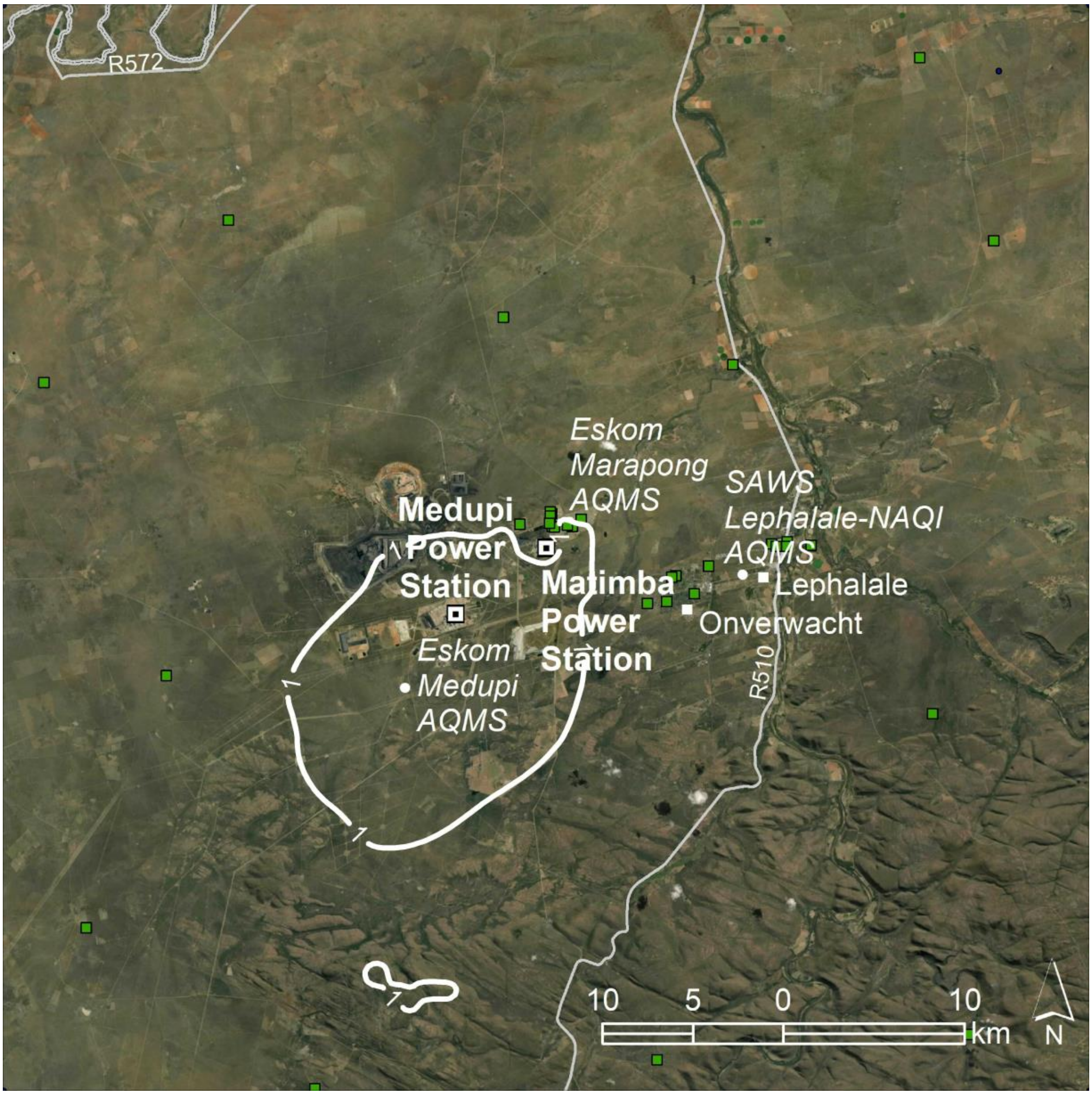


Figure 7-23: Predicted annual average NO_2 concentrations in µg/m^3 resulting from emissions from Matimba: Scenario C (2036) (NAAQS Limit is 40 µg/m^3)

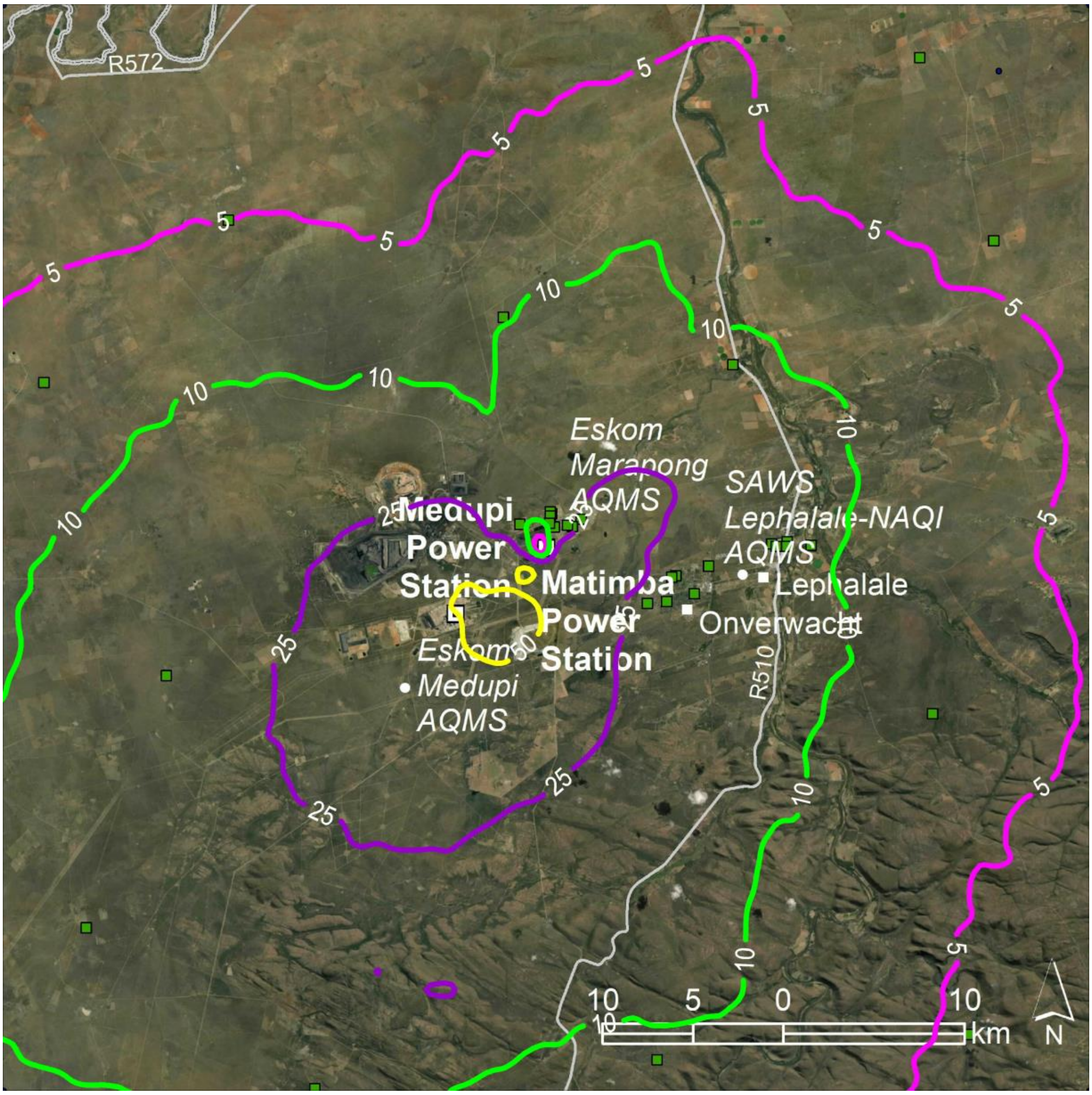


Figure 7-24: Predicted 99th percentile 1-hour NO_2 concentrations in µg/m³ resulting from emissions from Matimba: Scenario C (2036) (NAAQS Limit is 200 µg/m³)

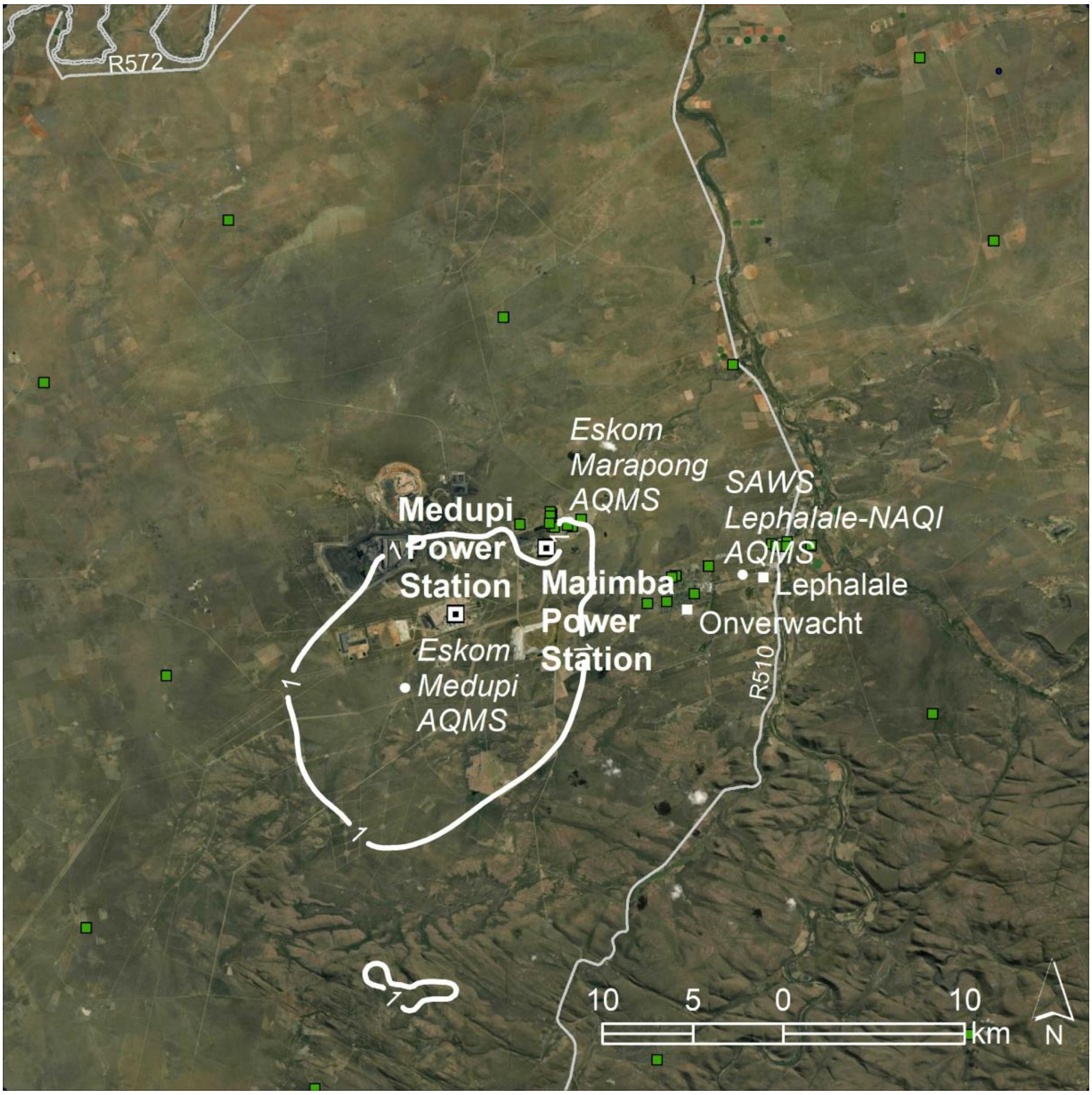


Figure 7-25: Predicted annual average NO_2 concentrations in µg/m^3 resulting from emissions from Matimba: Scenario D (MES) (NAAQS Limit is 40 µg/m^3)

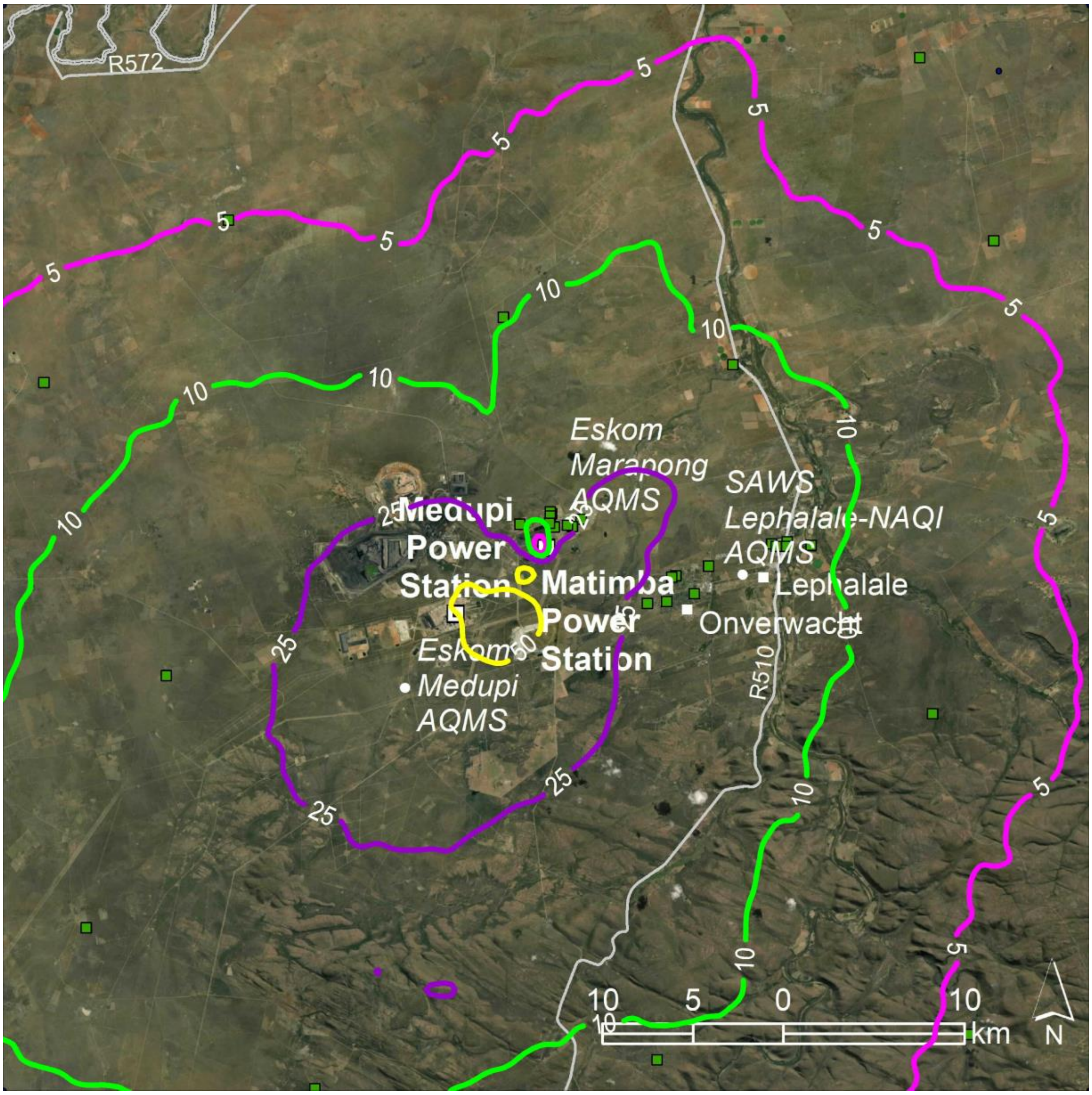


Figure 7-26: Predicted 99th percentile 1-hour NO_2 concentrations in µg/m³ resulting from emissions from Matimba: Scenario D (MES) (NAAQS Limit is 200 µg/m³)

7.2.3.3 Particulates (PM_{10})

The isopleth plots for PM_{10} are similar for all scenarios due to the significant contribution of the low-level fugitive sources to the ambient concentrations. The fugitive emission from the coal stockyard and the ash dump are the same for all scenarios, hence the similarity in the model results for the five scenarios. The effect on ambient PM_{10} concentrations of changes in the stack PM emissions is masked in the model output by the effect of the fugitive sources, i.e. the decrease in PM stack emissions in Scenario A (2025), and then in Scenario B (2031) and the increase in Scenario C (2036) and Scenario D (MES) are not seen in the model output.

In all scenarios the predicted annual average concentrations exceed the NAAQS of 40 $\mu g/m^3$ in an area up to approximately 10 km from the power station. The area where the predicted 24-hour concentrations exceed the limit value of 75 $\mu g/m^3$ extends from 5 km up to 15 km from the power station to the southwest.

The NAAQS provides for 4 exceedances of the 24-hour limit value per year, implying 12 exceedances in the 3-year modelling period. The shaded area in the figures below indicate where 13 or more exceedances occur and is the area that does not comply with the NAAQS. There are no sensitive receptors in this area that do not comply with the NAAQS in all scenarios.

It must be remembered that the predictions are conservative given the assumption that TPM = PM_{10} = $PM_{2.5}$. Remembering too that the fugitive emission have the greatest effect on ambient concentrations close to the source, while the effect of the stack emissions is generally further from the power station.

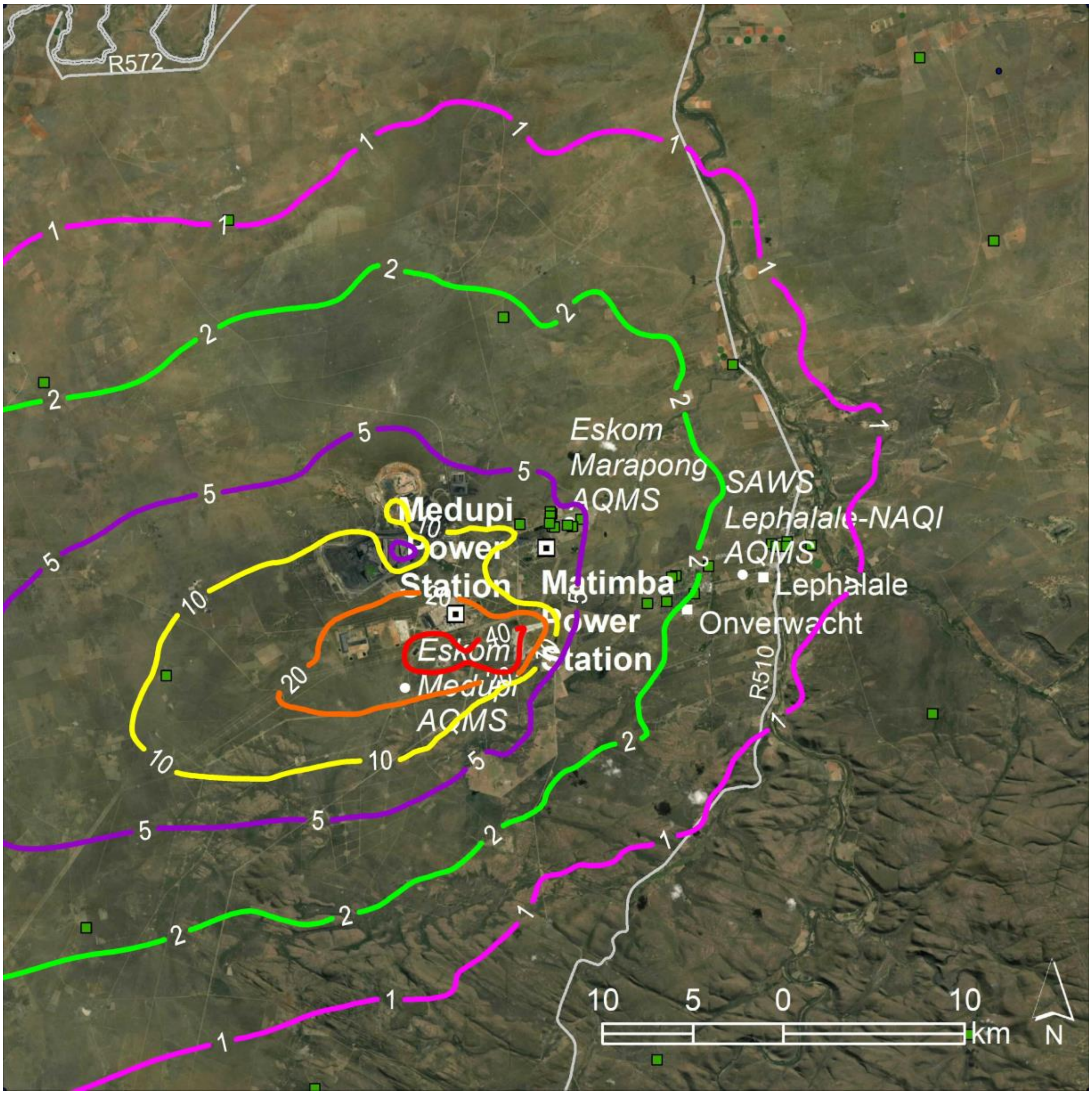


Figure 7-27: Predicted annual average PM_{10} concentrations in µg/m^3 resulting from emissions from Matimba: Scenario 1 (Current) (NAAQS Limit is 40 µg/m^3)

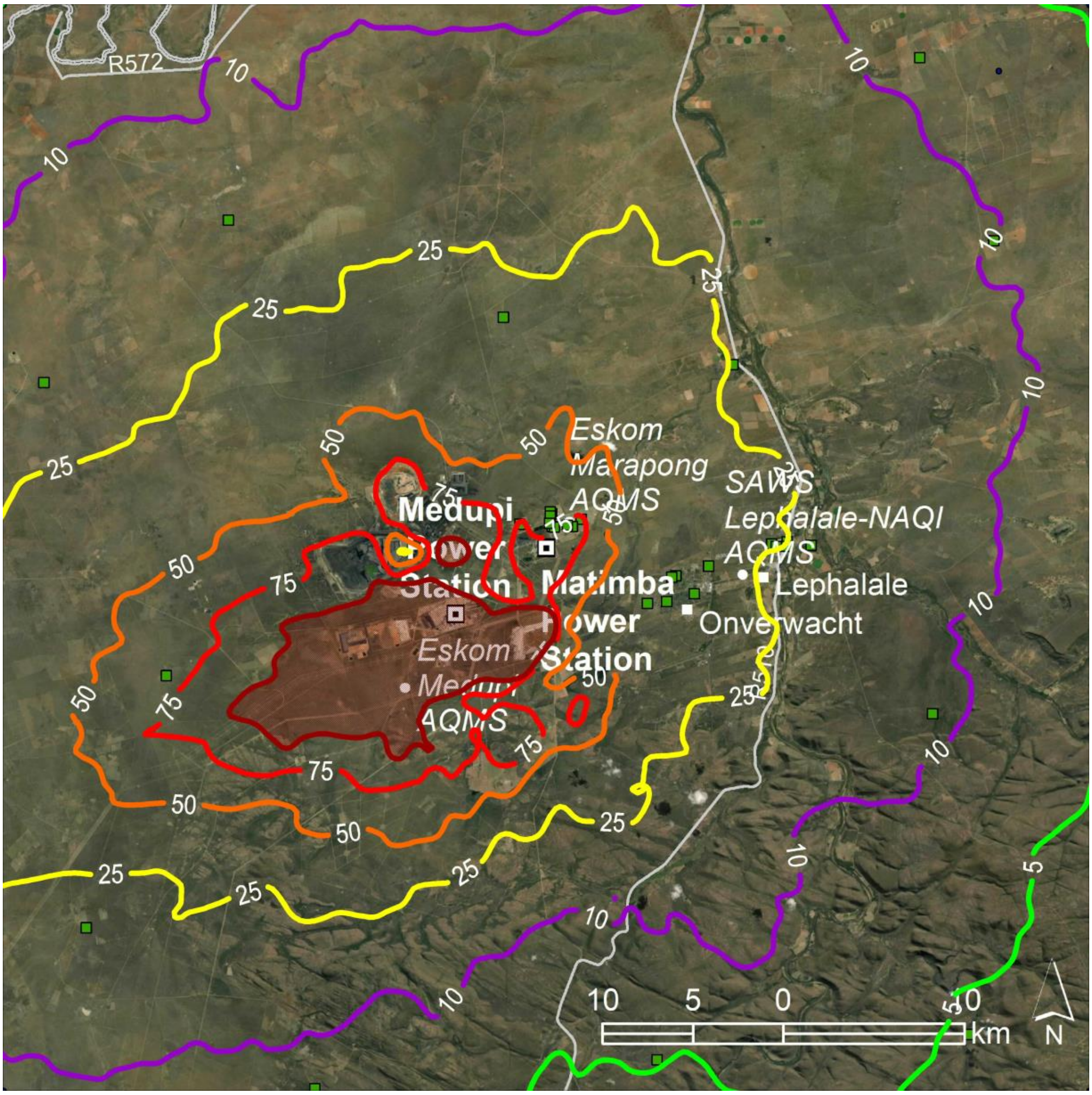


Figure 7-28: Predicted 99th percentile of the 24-hour PM_{10} concentrations in µg/m³ resulting from emissions from Matimba: Scenario 1 (Current) (NAAQS Limit is 75 µg/m³)

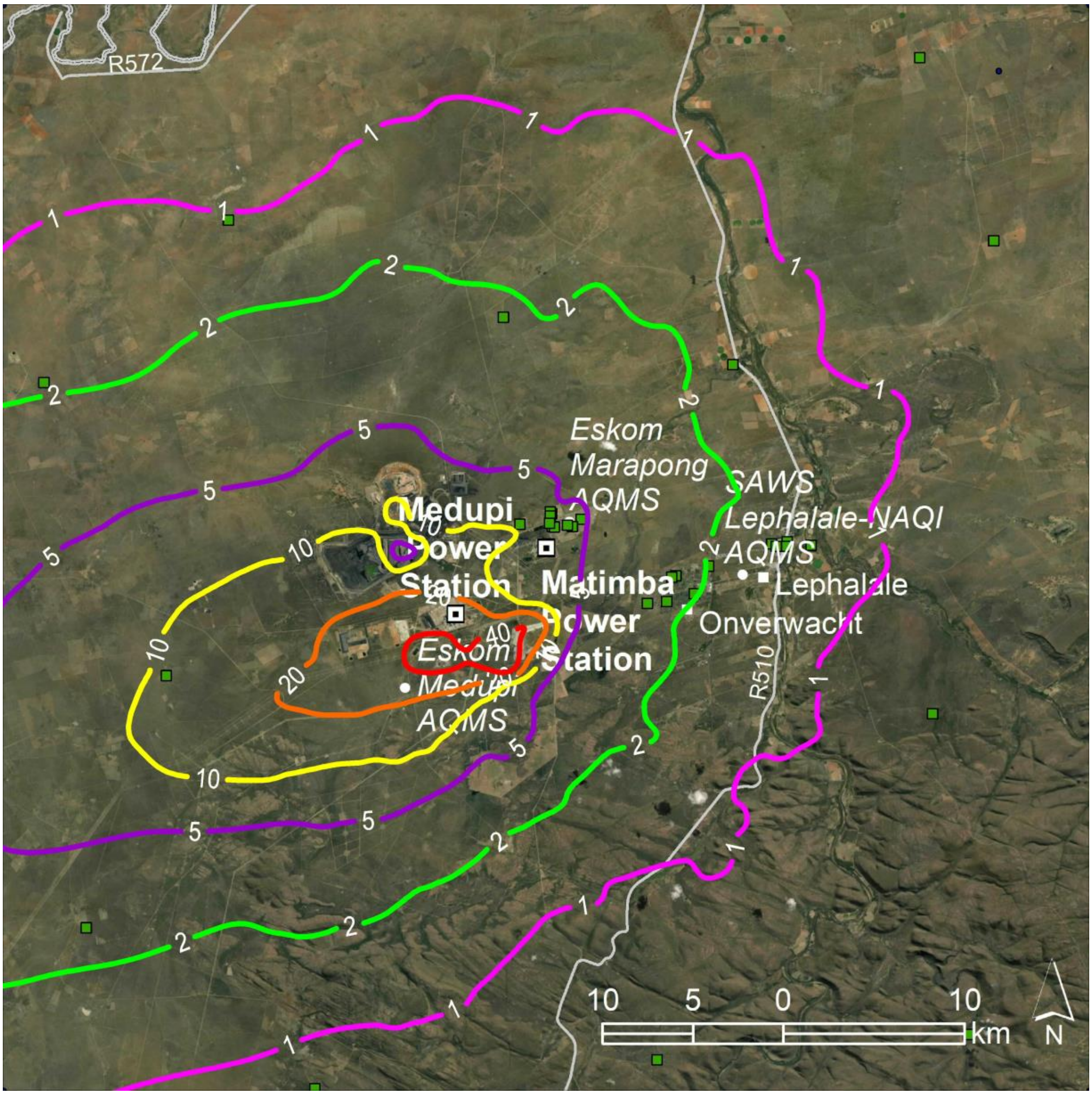


Figure 7-29: Predicted annual average PM$_{10}$ concentrations in µg/m^3 resulting from emissions from Matimba: Scenario A (2025) (NAAQS Limit is 40 µg/m^3)

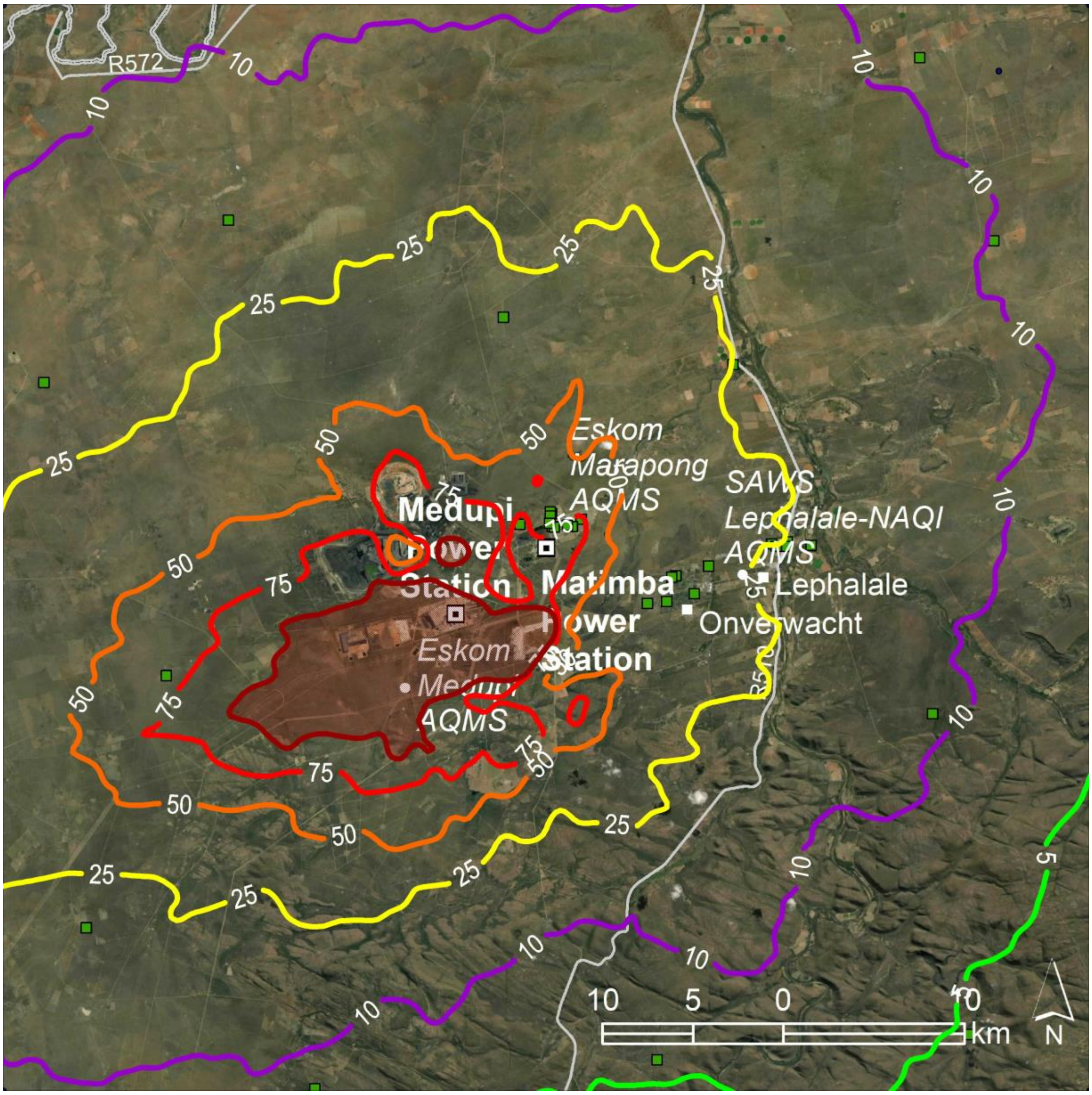


Figure 7-30: Predicted 99th percentile of the 24-hour PM$_{10}$ concentrations in µg/m^3 resulting from emissions from Matimba: Scenario A (2025) (NAAQS Limit is 75 µg/m^3)

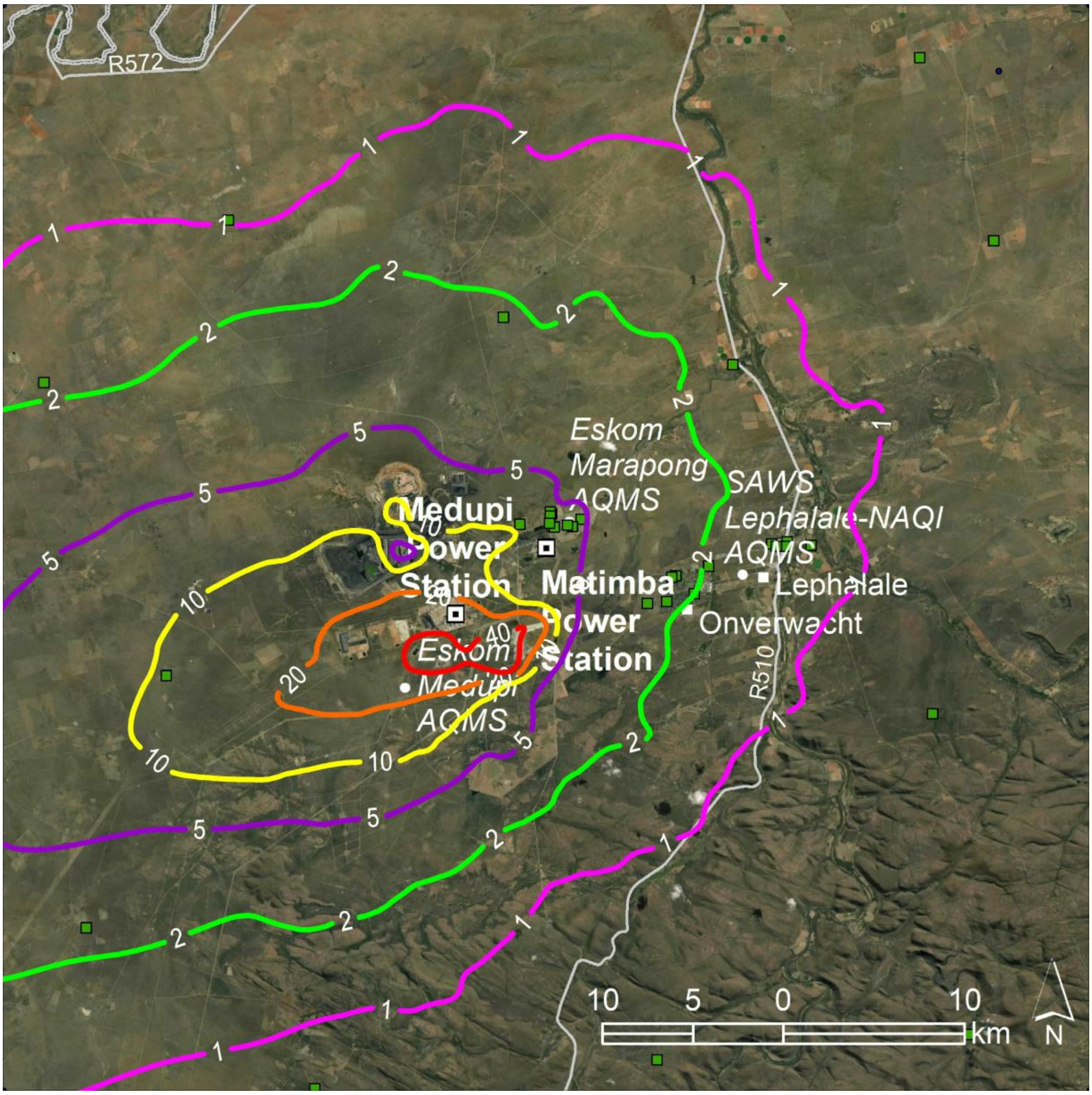


Figure 7-31: Predicted annual average PM_{10} concentrations in µg/m^3 resulting from emissions from Matimba: Scenario B (2031) (NAAQS Limit is 40 µg/m^3)

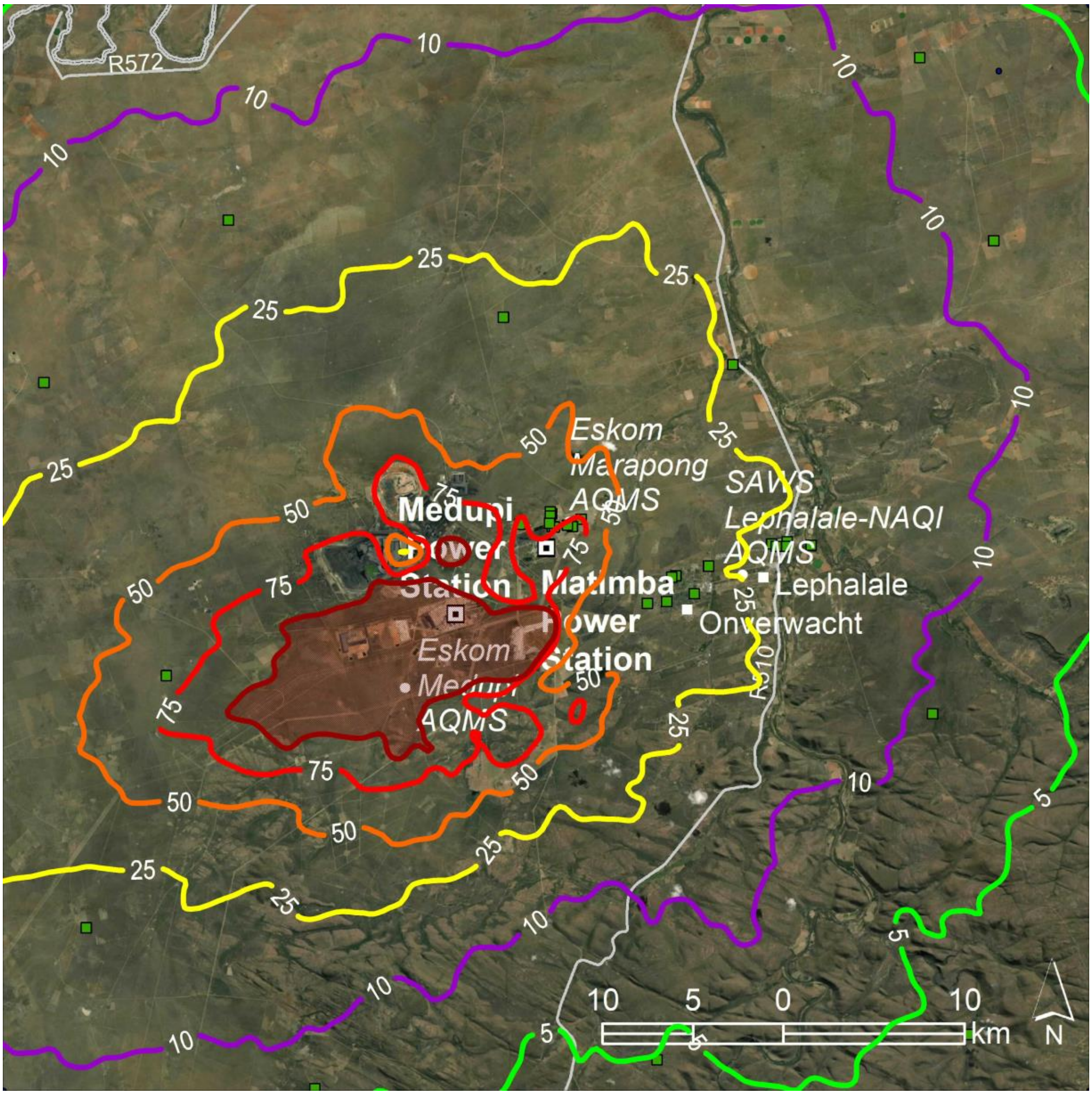


Figure 7-32: Predicted 99th percentile of the 24-hour PM_{10} concentrations in µg/m^3 resulting from emissions from Matimba: Scenario B (2031) (NAAQS Limit is 75 µg/m^3)

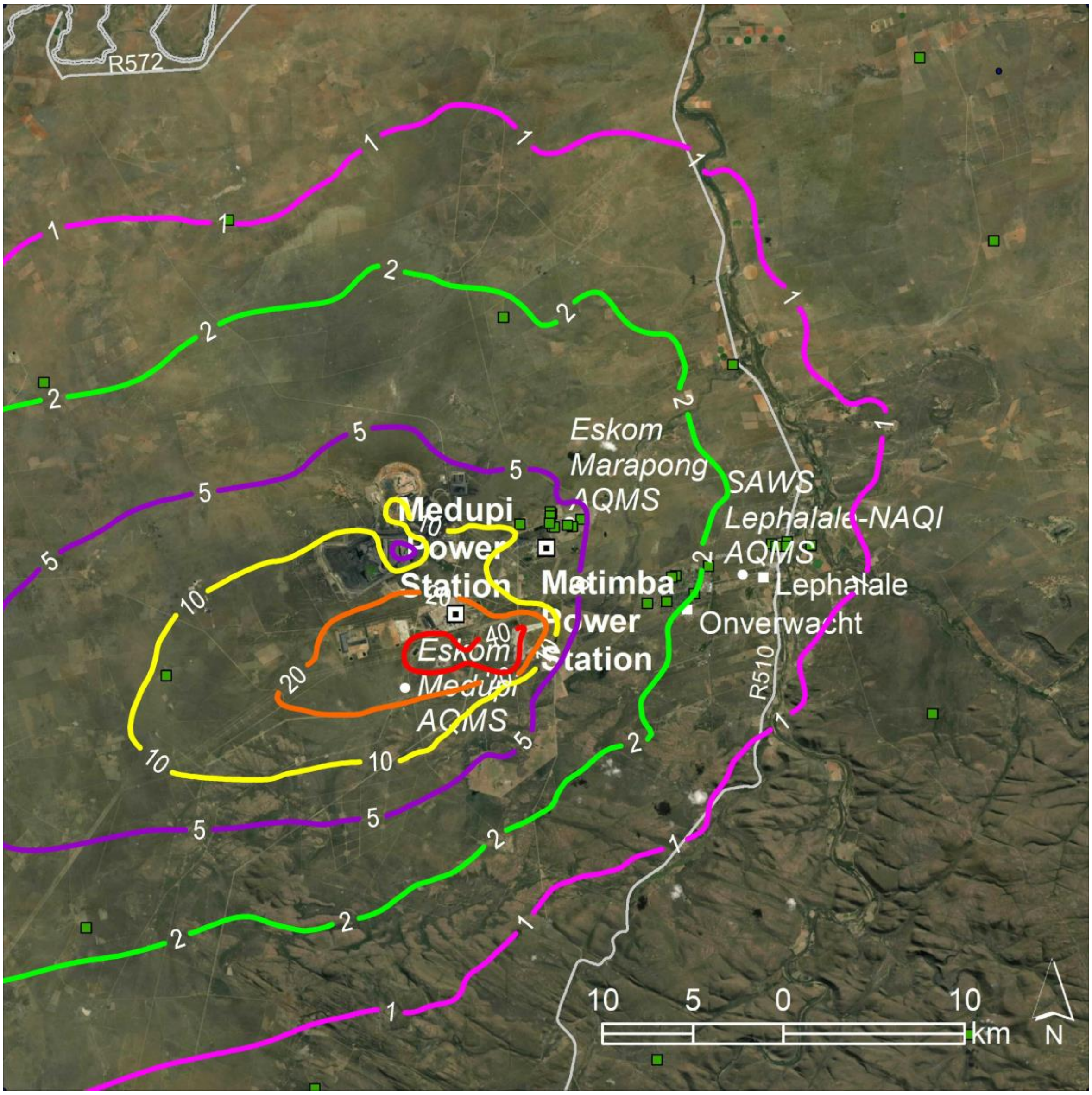


Figure 7-33: Predicted annual average PM_{10} concentrations in µg/m^3 resulting from emissions from Matimba: Scenario C (2036) (NAAQS Limit is 40 µg/m^3)

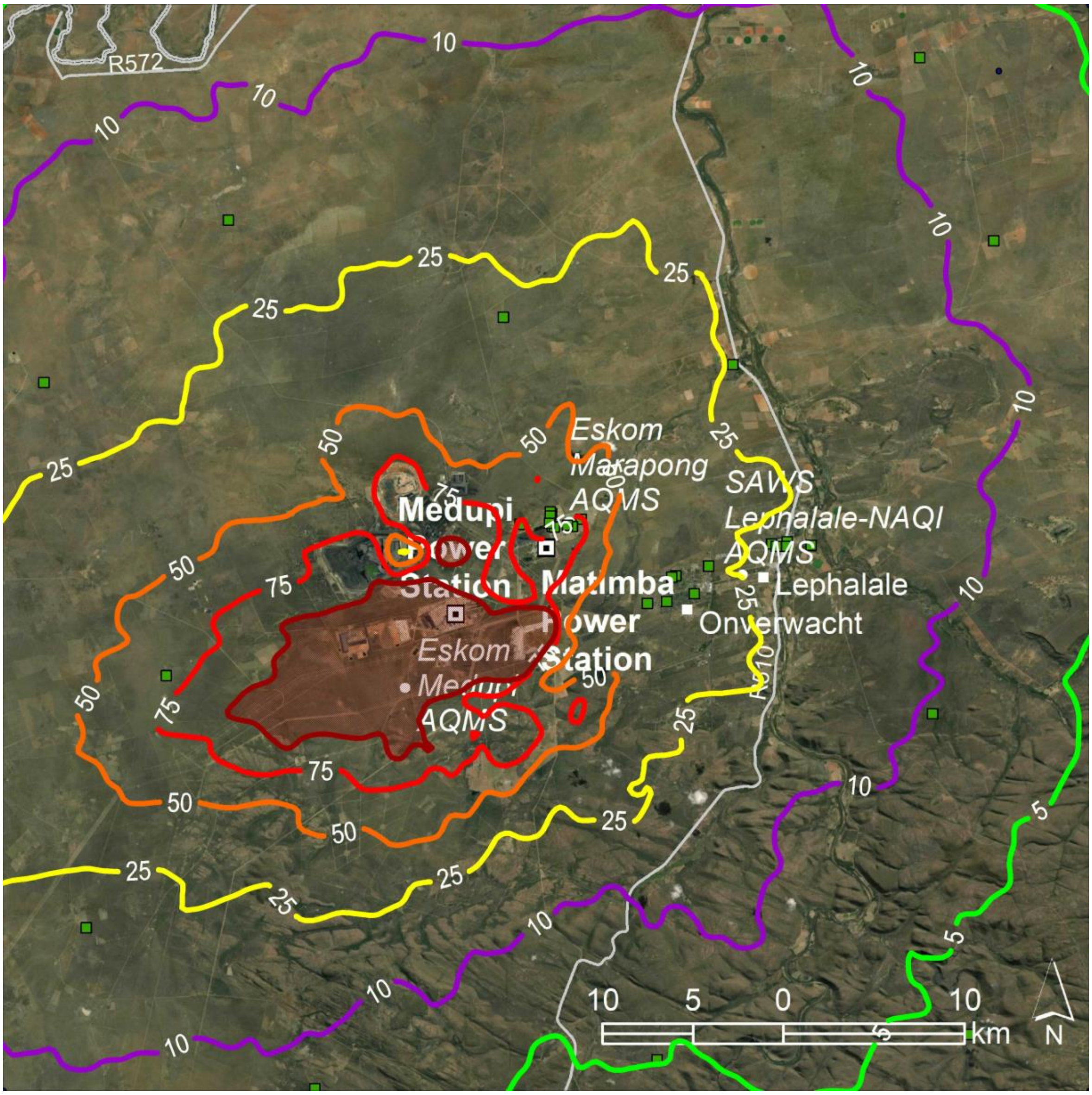


Figure 7-34: Predicted 99th percentile of the 24-hour PM_{10} concentrations in µg/m³ resulting from emissions from Matimba: Scenario C (2036) (NAAQS Limit is 75 µg/m³)

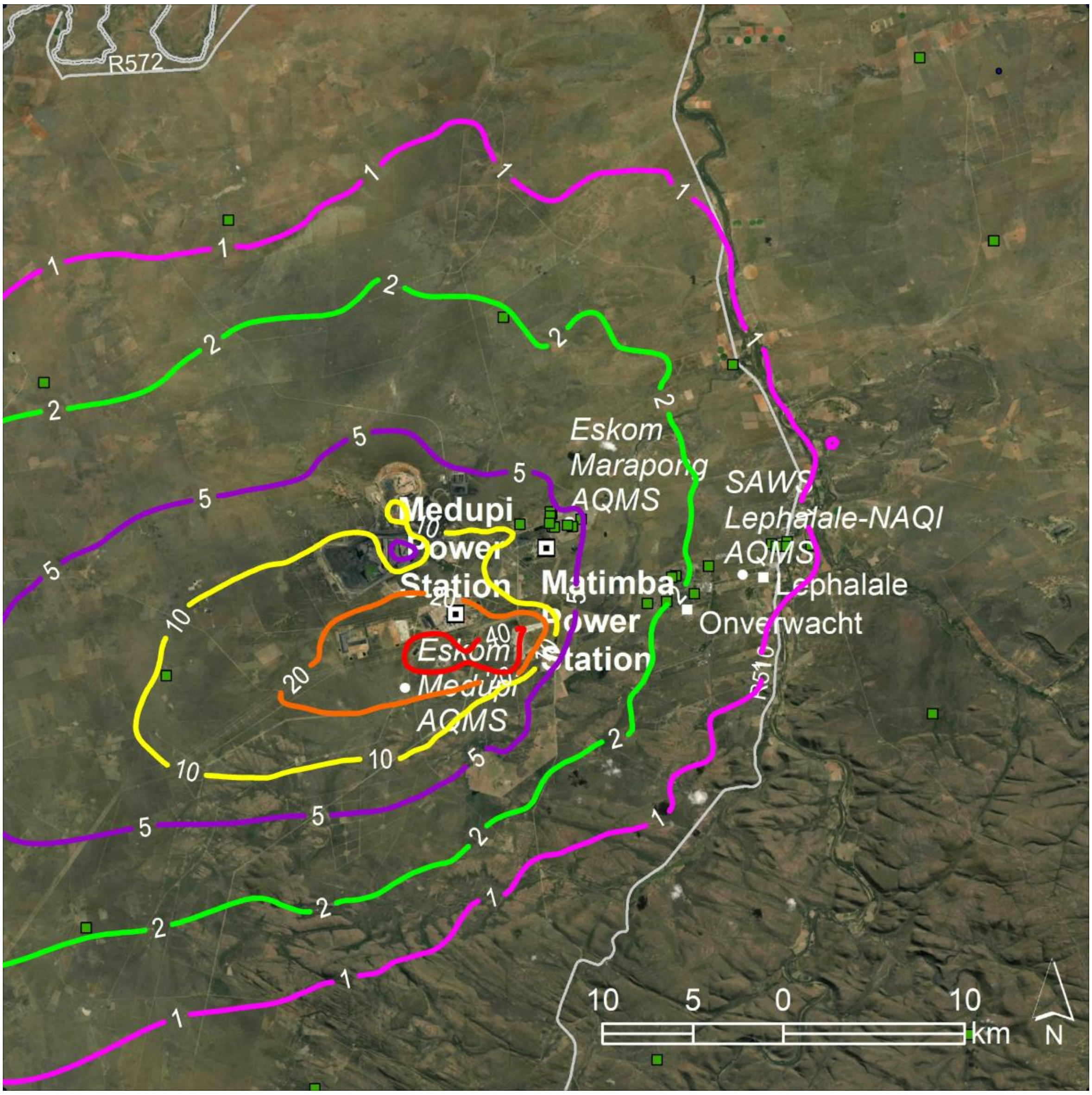


Figure 7-35: Predicted annual average PM_{10} concentrations in µg/m^3 resulting from emissions from Matimba: Scenario D (MES) (NAAQS Limit is 40 µg/m^3)

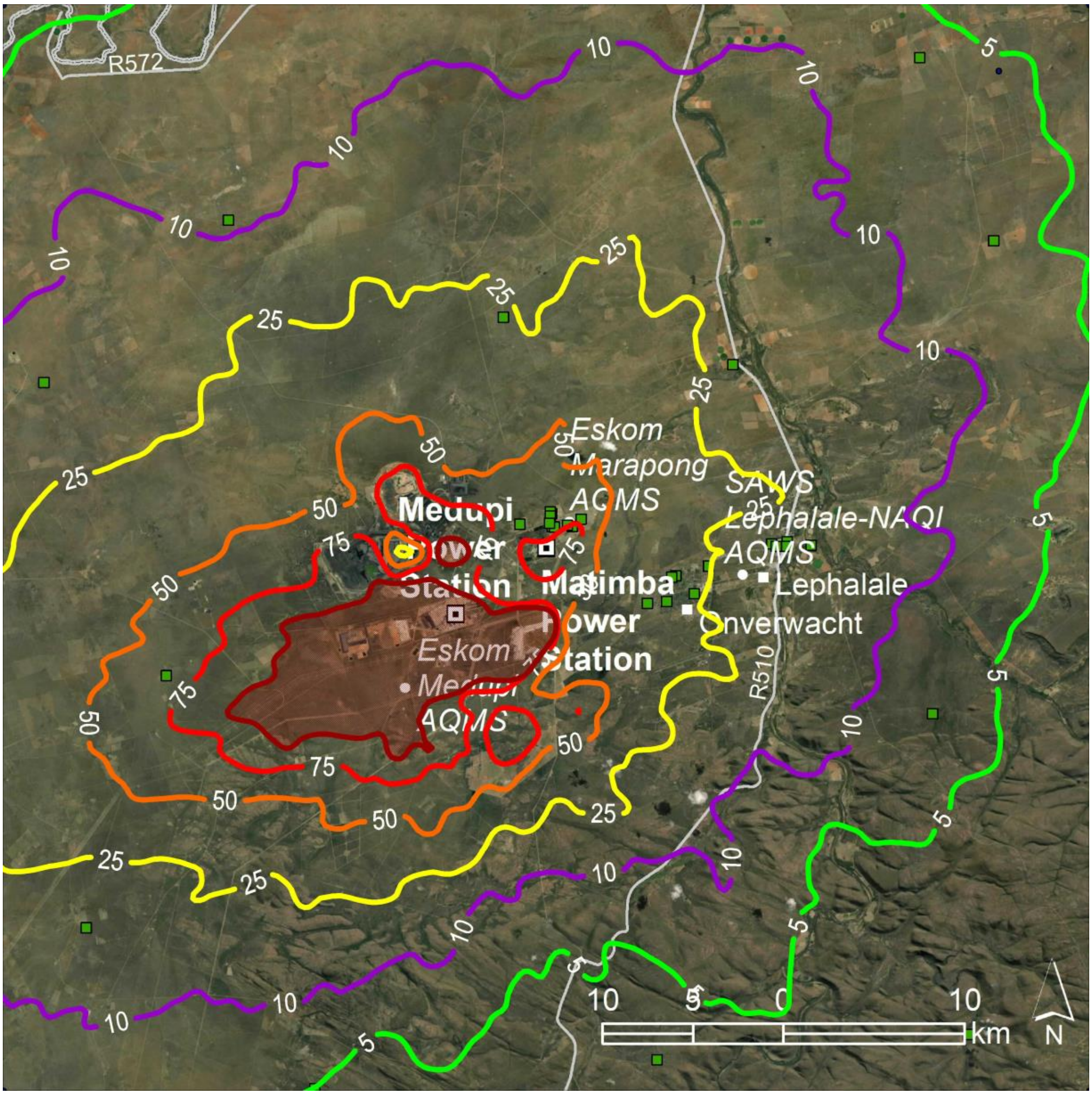


Figure 7-36: Predicted 99th percentile of the 24-hour PM_{10} concentrations in µg/m^3 resulting from emissions from Matimba: Scenario D (MES) (NAAQS Limit is 75 µg/m^3)

7.2.3.4 Particulates ($PM_{2.5}$)

The isopleth plots for $PM_{2.5}$ are similar for all scenarios due to the significant contribution of the low-level fugitive sources to the ambient concentrations. The fugitive emission from the coal stockyard and the ash dump are the same for all scenarios, hence the similarity in the model results for the five scenarios. The effect on ambient PM_{10} concentrations of changes in the stack PM emissions is masked in the model output by the effect of the fugitive sources, i.e. the decrease in PM stack emissions in Scenario A (2025), and then in Scenario B (2031) and the increase in Scenario C (2036) and Scenario D (MES) are not seen in the model output.

In Scenario 1 (Current) and Scenario A (2025) the predicted annual average $PM_{2.5}$ concentrations exceed the NAAQS of 20 $\mu g/m^3$ in an area up to 10 km south and southwest of the power station. With the stricter limit value of 15 $\mu g/m^3$ from 01 January 2023 the area where the NAAQS is exceeded is increases to approximately 15 km, also to the south and southwest of the power station.

In Scenario 1 (Current) and Scenario A (2025) the predicted 24-hour concentrations exceed the NAAQS of 40 $\mu g/m^3$ in a large area to the south and southwest of the power station. With the stricter limit value of 25 $\mu g/m^3$ from 01 January 2023 the area where the NAAQS is exceeded is increased.

The NAAQS provides for 4 exceedances of the 24-hour limit value per year, implying 12 exceedances in the 3-year modelling period. The shaded area in the figures below indicate where 13 or more exceedances occur and is the area that does not comply with the NAAQS. There are 10 sensitive receptors in this area for Scenario 1 (Current) and Scenario A (2025); and 11 sensitive receptors in this area for Scenario B (2031), Scenario C (2036) and Scenario D (MES), indicating non-compliance with the NAAQS.

It must be remembered that the predictions are conservative given the assumption that TPM = PM_{10} = $PM_{2.5}$. Remembering too that the fugitive emission have the greatest effect on ambient concentrations close to the source, while the effect of the stack emissions is generally further from the power station.

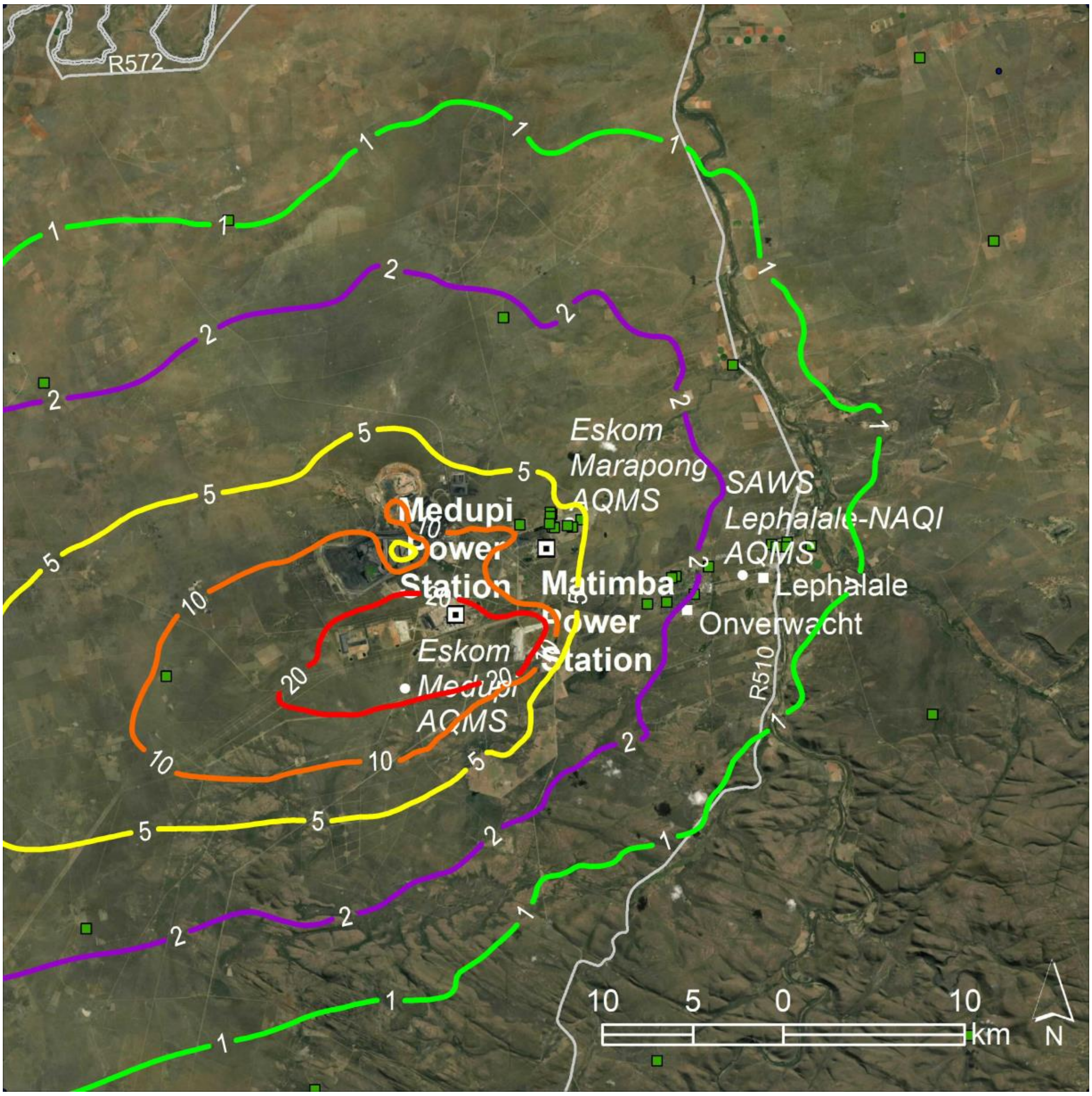


Figure 7-37: Predicted annual average $PM_{2.5}$ concentrations in µg/m^3 resulting from emissions from Matimba: Scenario 1 (Current) (NAAQS Limit is 20 µg/m^3)

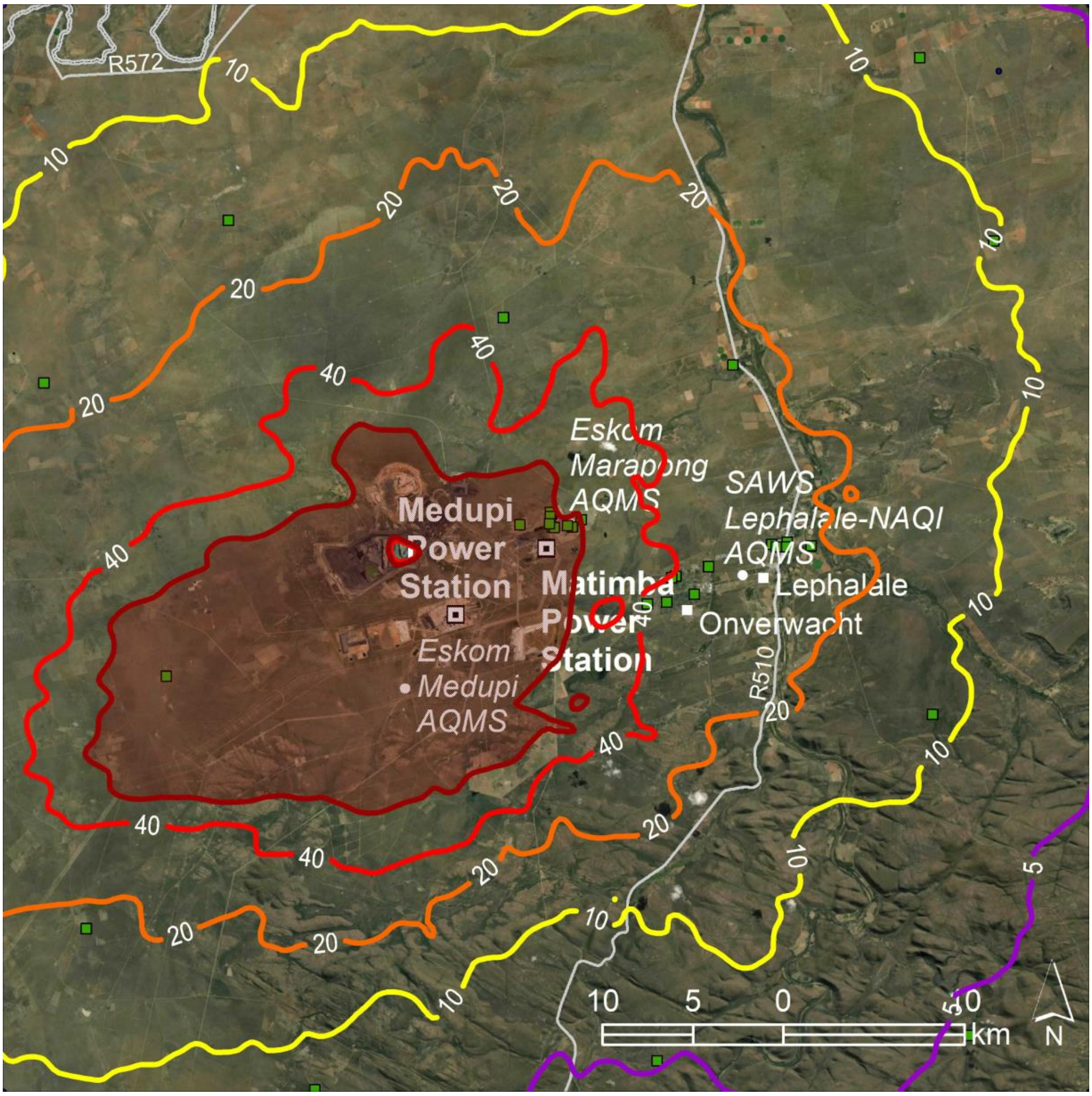


Figure 7-38: Predicted 99th percentile of the 24-hour PM$_{2.5}$ concentrations in µg/m^3 resulting from emissions from Matimba: Scenario 1 (Current) (NAAQS Limit is 40 µg/m^3)

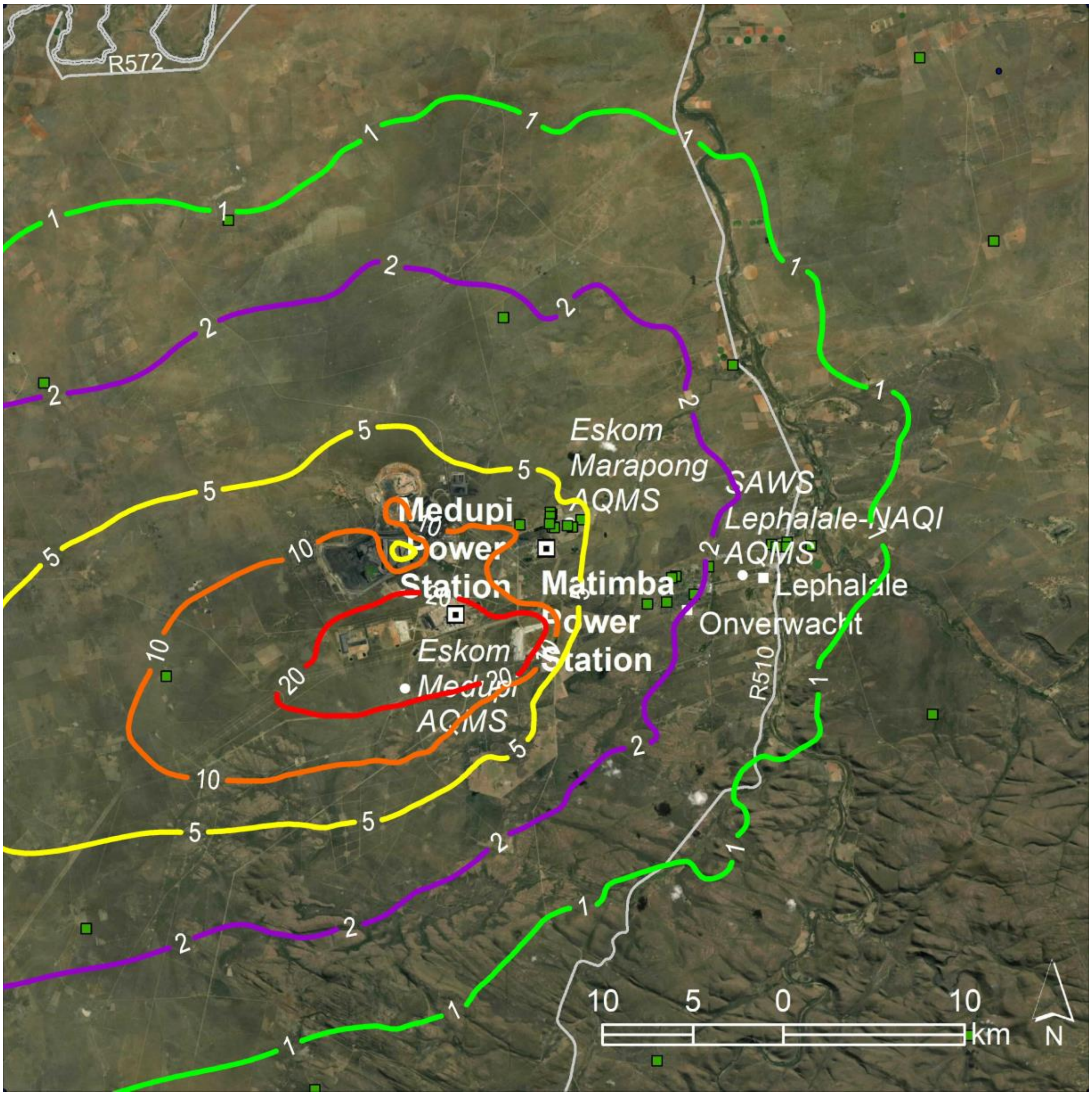


Figure 7-39: Predicted annual average $PM_{2.5}$ concentrations in µg/m^3 resulting from emissions from Matimba: Scenario A (2025) (NAAQS Limit is 20 µg/m^3)

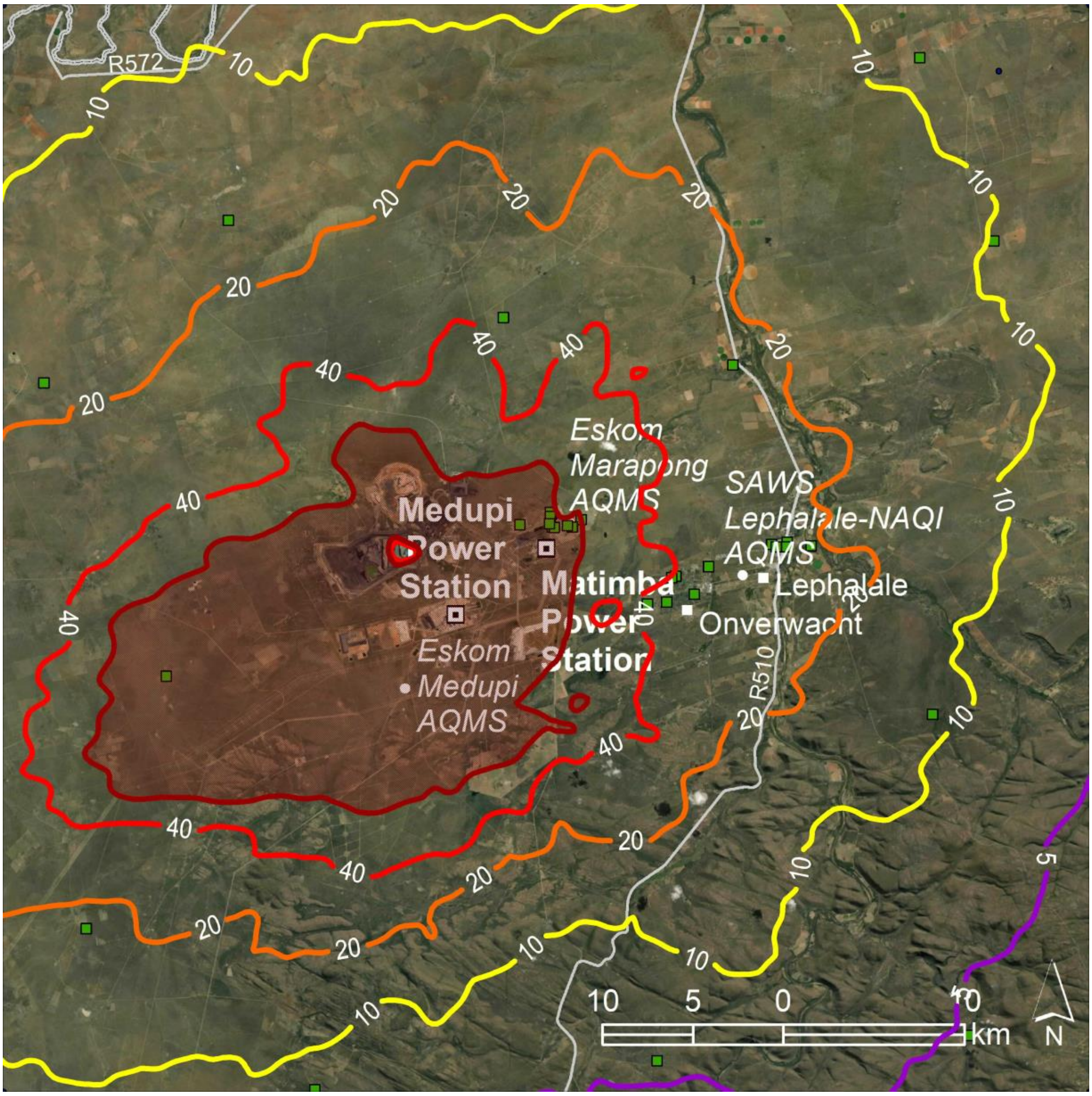


Figure 7-40: Predicted 99th percentile of the 24-hour $PM_{2.5}$ concentrations in µg/m³ resulting from emissions from Matimba: Scenario A (2025) (NAAQS Limit is 40 µg/m³)

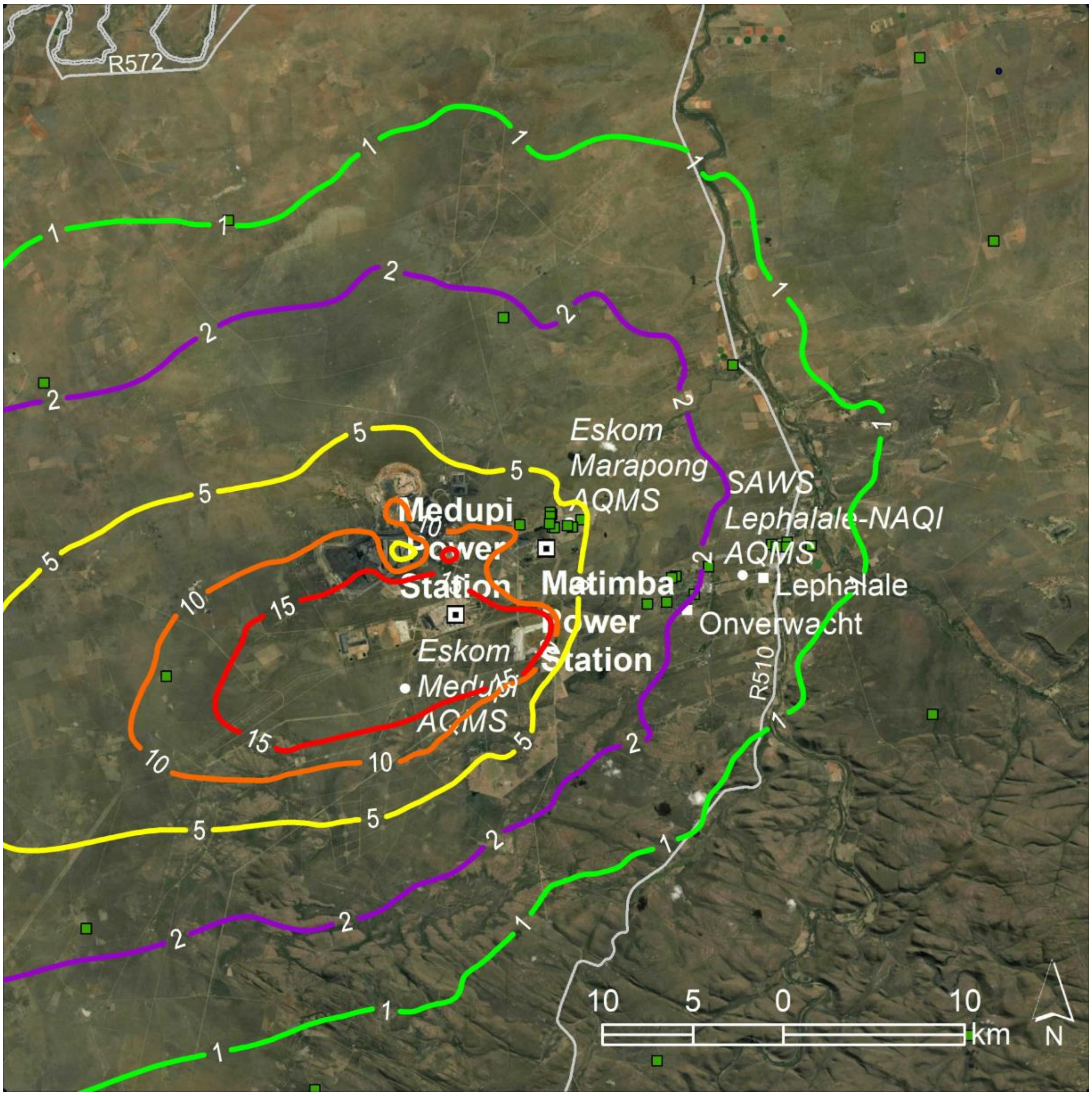


Figure 7-41: Predicted annual average $PM_{2.5}$ concentrations in µg/m^3 resulting from emissions from Matimba: Scenario B (2031) (NAAQS Limit is 15 µg/m^3)

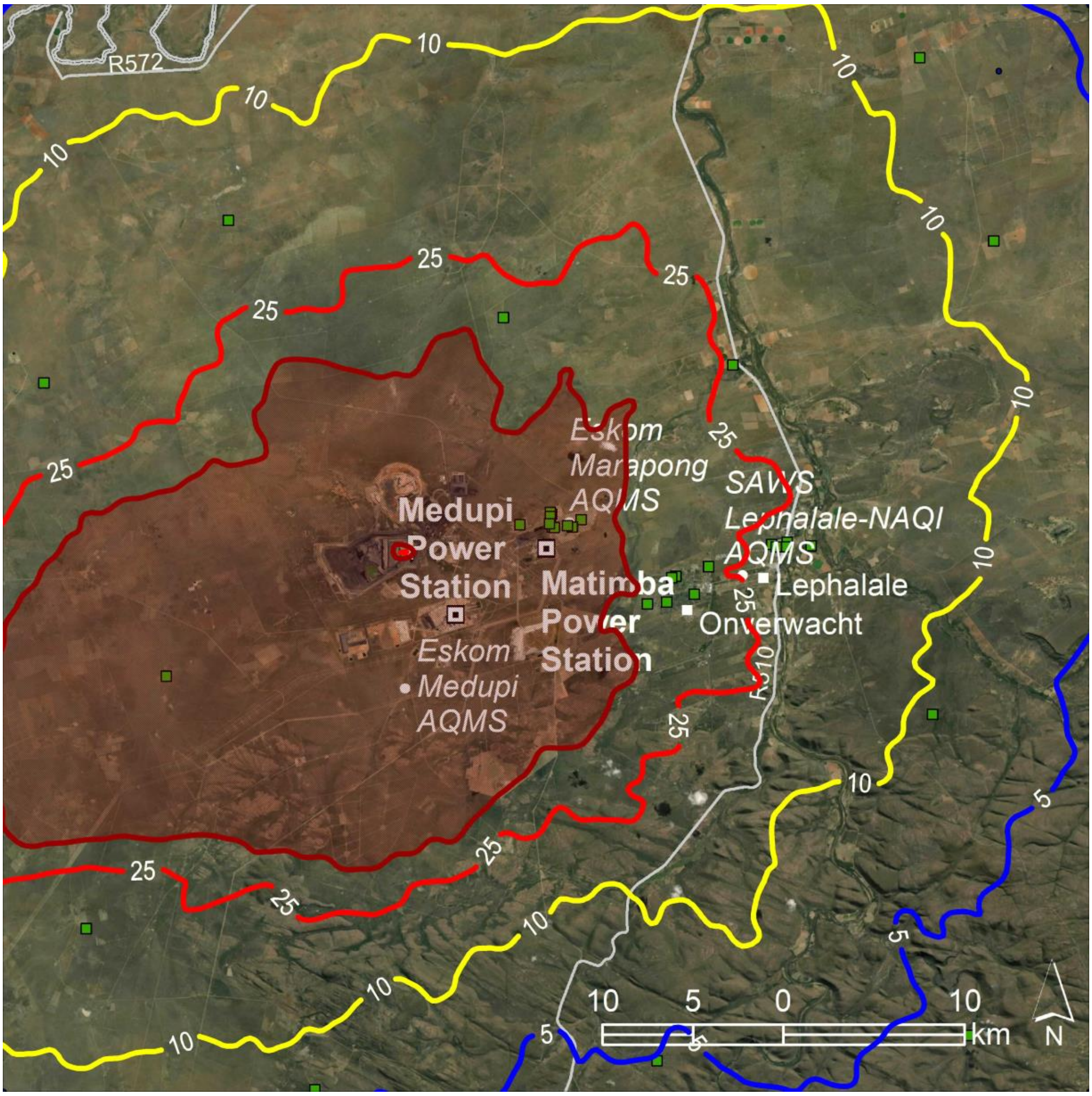


Figure 7-42: Predicted 99th percentile of the 24-hour PM2.5 concentrations in µg/m³ resulting from emissions from Matimba: Scenario B (2031) (NAAQS Limit is 25 µg/m³)

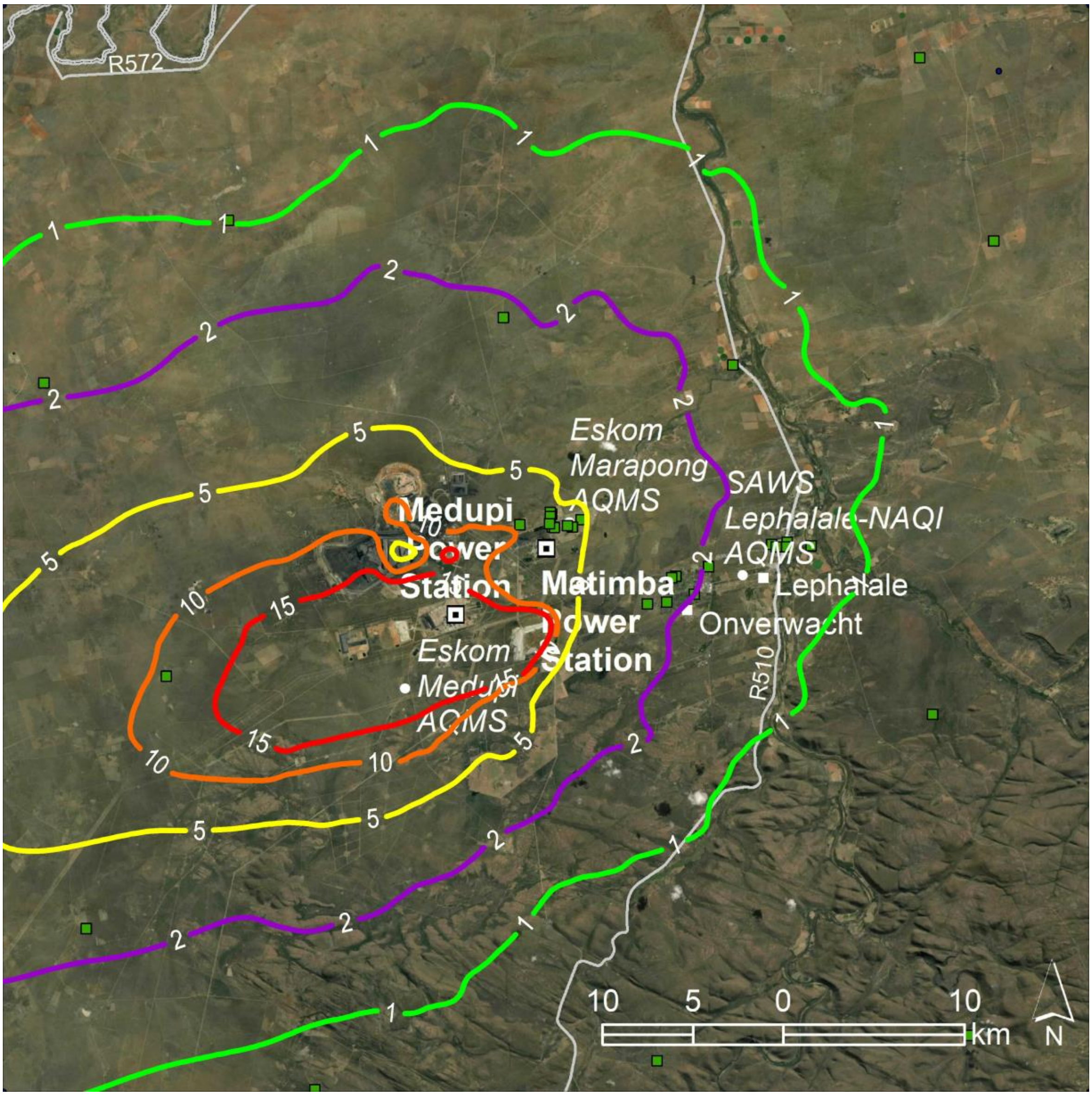


Figure 7-43: Predicted annual average $PM_{2.5}$ concentrations in µg/m^3 resulting from emissions from Matimba: Scenario C (2036) (NAAQS Limit is 15 µg/m^3)

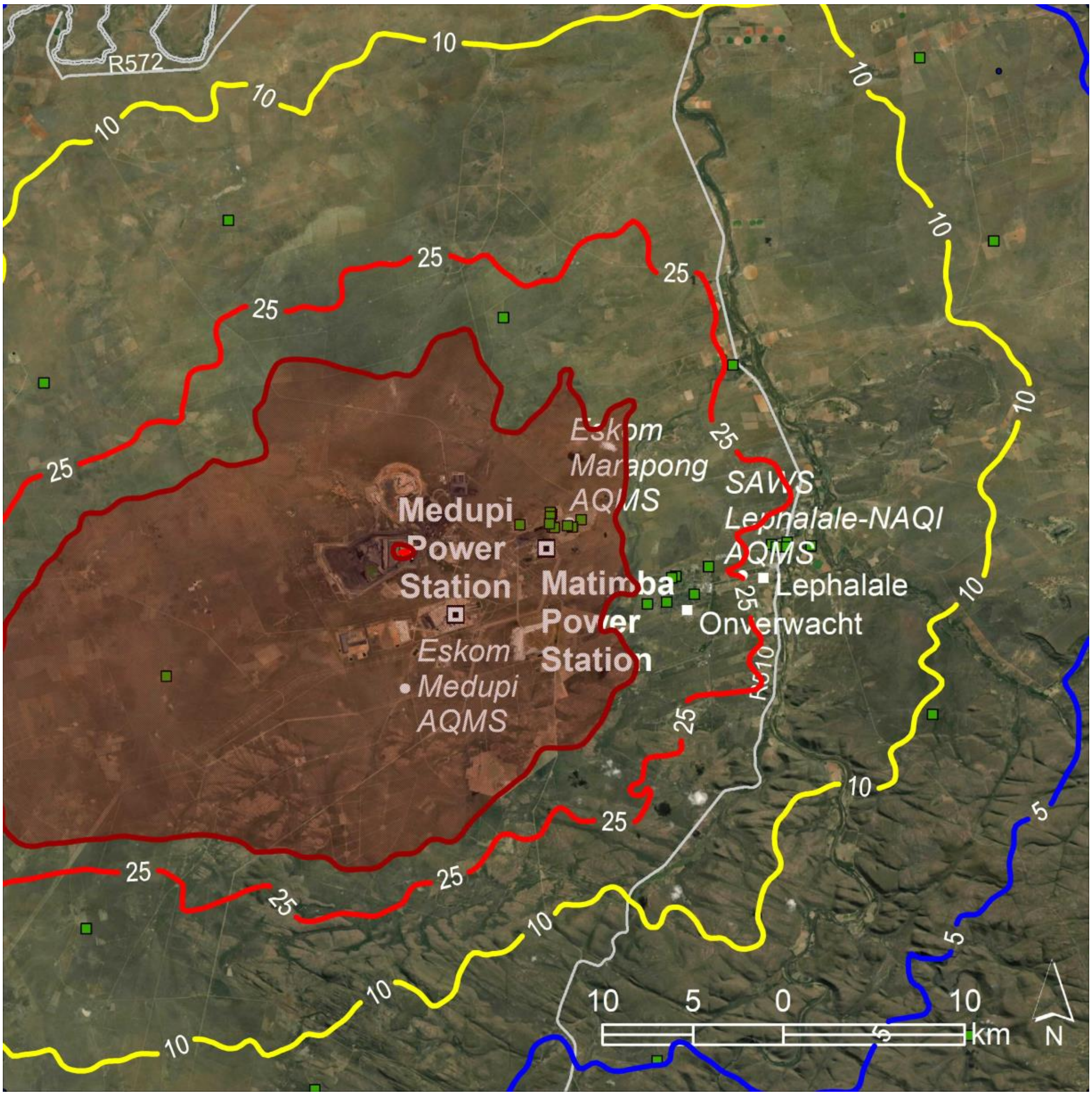


Figure 7-44: Predicted 99th percentile of the 24-hour PM2.5 concentrations in µg/m³ resulting from emissions from Matimba: Scenario C (2036) (NAAQS Limit is 25 µg/m³)

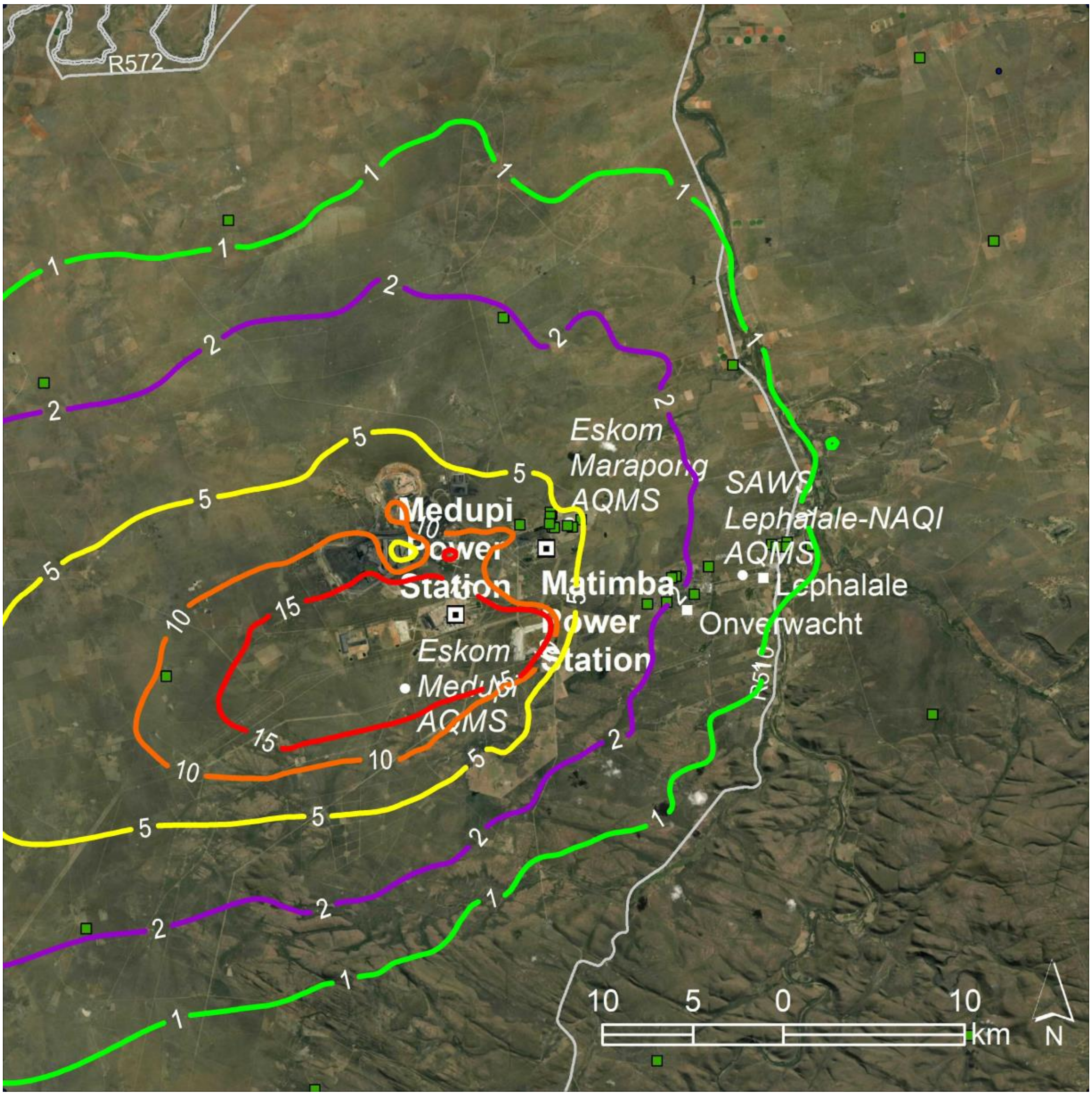


Figure 7-45: Predicted annual average $PM_{2.5}$ concentrations in µg/m^3 resulting from emissions from Matimba: Scenario D (MES) (NAAQS Limit is 15 µg/m^3)

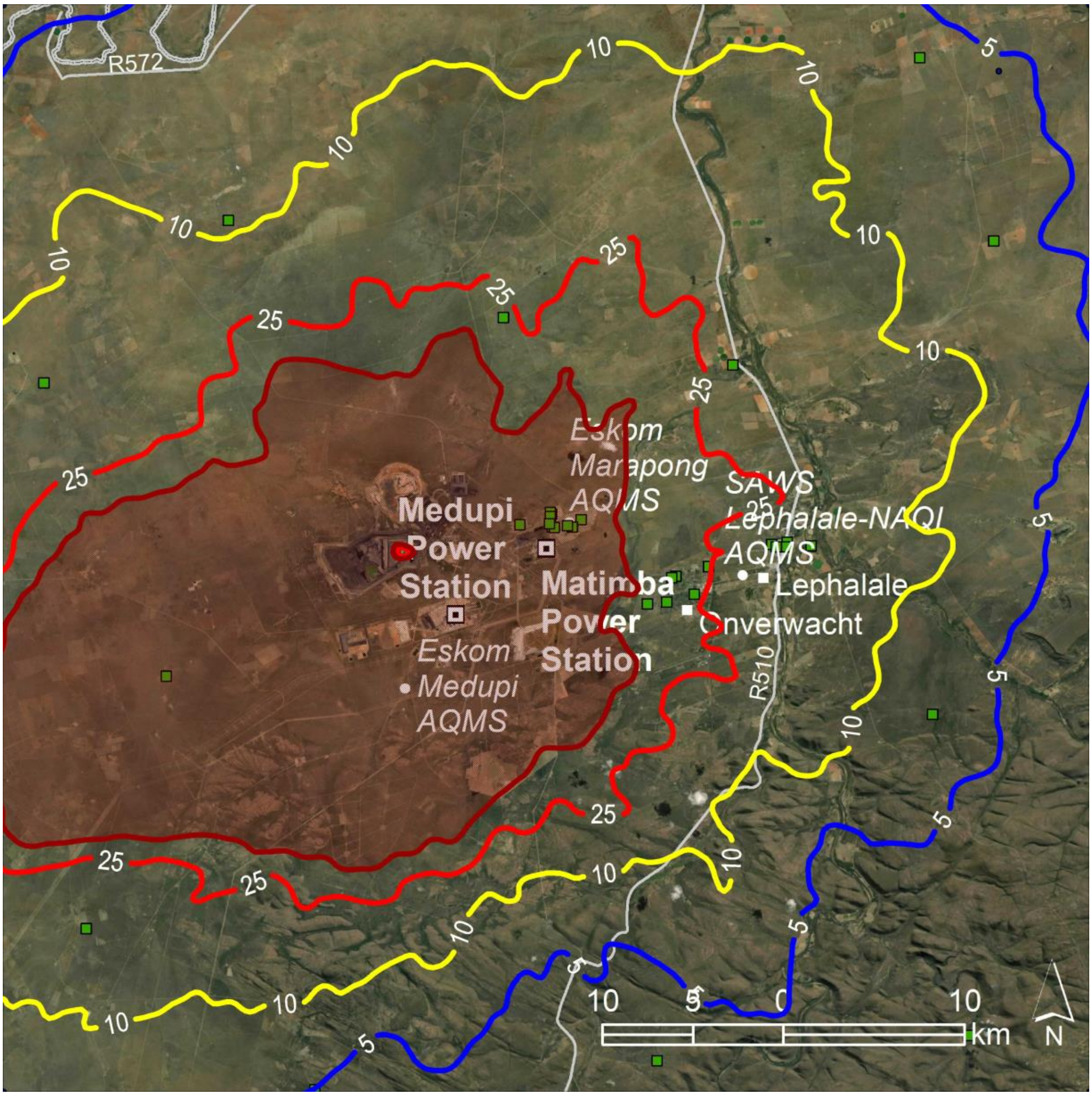


Figure 7-46: Predicted 99th percentile of the 24-hour PM2.5 concentrations in µg/m³ resulting from emissions from Matimba: Scenario D (MES) (NAAQS Limit is 25 µg/m³)

7.3 Analysis of Emissions' Impact on the Environment

This AIR has focused on potential human health impacts, comparing modelled concentrations of SO_2, NO_2, PM_{10} and $PM_{2.5}$ with the respective health-based NAAQS. An assessment of the atmospheric impact of the facility on the environment was therefore not undertaken as part of this AIR.

8. COMPLAINTS

Matimba maintains a complaints register. Air quality related complaints were received during the 3-year assessment period, 2021 to 2023. The complaints concerned the ash dump with one (1) in 2021, two (2) in 2022 and six (6) in 2023.

9. CURRENT OR PLANNED AIR QUALITY MANAGEMENT INTERVENTIONS

An Electrostatic Precipitator (ESP) and a Sulphur Conditioning Plant are installed on each generation unit, i.e. 6 ESPs and 6 Sulphur Conditioning Plants for the control of PM emissions. The station will be installing High Frequency Power supplies to further improve PM emission performance.

The present plan boilers are low NOx so MES limits are met.

SO_2 emissions are currently not controlled at Matimba and it is not intended to install SO_2 control technologies

10. COMPLIANCE AND ENFORCEMENT ACTIONS

No compliance notices have been issued to Matimba.

11. SUMMARY AND CONCLUSION

In this AIR five emission scenarios are assessed for Matimba to support Eskom's application for exemption from the MES for SO_2 using dispersion modelling to simulate the resultant ambient concentrations. The five sequential scenarios from current emissions to 2036 capture Eskom's emission reduction strategy. These are from Scenario 1 using actual emissions from 2021 to 2023, Scenario A using proposed 2025 emissions, Scenario B using proposed 2031 emissions, Scenario C using proposed 2036 emissions and Scenario D which assumes the MES to demonstrate the relative effect of compliance.

Noteworthy findings from the modelling results for SO_2 may be summarised as follows:

i) Ambient SO_2 concentrations are attributed to the stack emissions.

ii) For Scenario 1 (Current): Predicted concentrations comply with the NAAQS for all averaging periods throughout the modelling domain.

iii) For Scenario A (2025): Predicted concentrations comply with the NAAQS for all averaging periods throughout the modelling domain, except for the predicted 99th percentile concentrations which exceed the limit value of the 24-hour and 1-hour NAAQS.

iv) For Scenario B (2031): Predicted concentrations comply with the NAAQS for all averaging periods throughout the modelling domain, except for the predicted 99th percentile concentrations which exceed the limit value of the 24-hour and 1-hour NAAQS.

v) For Scenario C: (2036): Predicted concentrations comply with the NAAQS for all averaging periods throughout the modelling domain, except for the predicted 99th percentile concentrations which exceed the limit value of the 24-hour and 1-hour NAAQS.

vi) For Scenario D: Predicted concentrations comply with the NAAQS for all averaging periods throughout the modelling domain.

Noteworthy findings from the modelling results for NO_2 may be summarised as:

i) Ambient NO_2 concentrations are attributed to the stack emissions only.

ii) Predicted concentrations comply with the NAAQS for all averaging periods throughout the modelling domain, for all scenarios.

Noteworthy findings regarding PM_{10} and $PM_{2.5}$ may be summarised as:

i) Fugitive emissions from the ash dump have resulted in a number of complaints relating to dust.

ii) Ambient PM_{10} and $PM_{2.5}$ concentrations are attributed to the stack emissions and the low-level fugitive sources. The stack emissions generally have an effect some distance from the source, while low-level emission have an effect close to the source.

iii) In the modelling the conservative assumption is made firstly that the total PM emission is PM_{10}, and secondly, the total PM emission is $PM_{2.5}$.

iv) For PM_{10} and $PM_{2.5}$, the predicted annual average concentrations comply with the NAAQS at all of the sensitive receptor points in all five scenarios.

v) Exceedance of the limit value of the 24-hour NAAQS for PM_{10} and $PM_{2.5}$ are predicted in all five emission scenarios.

vi) The predicted 99th percentile of the 24-hour PM_{10} concentrations are exceed the limit value at four sensitive receptor points in Scenario 1 (Current), Scenario A (2025), Scenario B (2031) and in Scenario C (3026), and at one sensitive receptor point in Scenario D (MES).

vii) The predicted 99th percentile of the 24-hour $PM_{2.5}$ concentrations exceed the limit value in all five scenarios. For Scenario 1 (Current) and Scenario A (2025), exceedances are predicted at 11 sensitive receptors. With the implementation of the limit value of 25 $\mu g/m^3$ in 2030, exceedances are predicted at 18 sensitive receptors for Scenario B (2031), Scenario C (2036) and Scenario D (MES).

Given the conservative approach to the fugitive emission source simulations, and that this has provided an absolute worst-case emission scenario, and based on recommendations received from uMoya-Nilu, Eskom will be undertaking an additional modelling scenario, assessing only PM, SO_2, and NOx stack emissions. NOx and SO_2 emissions will be included in this scenario to ensure secondary particulate formation is accounted for. This will provide improved insight to impacts directly related to stack emissions, which are the focus of this exemption application.

12. REFERENCES

Auer, A.H. (1978): Correlation of Land Use and Cover with Meteorological Anomalies, Journal of Applied Meteorology, 17:636-643.

CARB (2024): https://ww2.arb.ca.gov/capp-resource-center/community-assessment/sensitive-receptor-assessment.

CSIRO (2008): TAPM V4. User Manual. Prepared by Peter Hurley, CSIRO Marine and Atmospheric Research Internal Report No. 5, October 2008, ISBN: 978-1-921424-73-1.

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

DEA (2010): Listed Activities and Associated Minimum Emission Standards identified in terms of Section 21 of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004), Government Gazette 33064, Notice No. 248 of 31 March 2010.

DEA (2012): National Ambient Air Quality Standard for Particulate Matter of Aerodynamic Diameter less than 2.5 micrometers, Notice 486, 29 June 2012, Government Gazette, 35463.

DEA (2013a): Regulations Prescribing the Format of the Atmospheric Impact Report, Government Gazette 36904, Notice No. 747 of 11 October 2013.

DEA (2013b): Listed Activities and Associated Minimum Emission Standards identified in terms of Section 21 of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004), Government Gazette 37054, Notice No. 893 of 22 November 2013.

DEA (2014a): Code of Practice for Air Dispersion Modelling in Air Quality Management in South Africa, Government Notice R.533, Government Gazette, no. 37804, 11 July 2014.

DEA (2014b): Environmental Assessment Regulations, 2014 identified in terms of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004), Government Gazette 38282, Notice No. R 982 of 4 December 2014.

DEA (2019): Listed Activities and Associated Minimum Emission Standards identified in terms of Section 21 of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004), Government Gazette 42472, Notice No. 893 of 22 May 2019.

DEA (2020): Listed Activities and Associated Minimum Emission Standards identified in terms of Section 21 of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004), Government Gazette 43174, Notice No. 421 of 27 March 2020.

Hurley, P. (2000): Verification of TAPM meteorological predictions in the Melbourne region for a winter and summer month. Australian Meteorological Magazine, 49, 97-107.

Hurley, P.J., Blockley, A. and Rayner, K. (2001): Verification of a prognostic meteorological and air pollution model for year-long predictions in the Kwinana industrial region of Western Australia. Atmospheric Environment, 35(10), 1871-1880.

Hurley, P.J., Physick, W.L. and Ashok, K.L. (2002): The Air Pollution Model (TAPM) Version 2, Part 21: summary of some verification studies, CSIRO Atmospheric Research Technical Paper No. 57, 46 p.

SANAS (2012): Tr 07-03 Supplementary Requirements for the Accreditation of Continuous Ambient Air Quality Monitoring Stations (pp. 112).

USEPA (1995): A user's guide for the CALPUFF dispersion model (version 5). Prepared by Scire, J., Strimaitis, D. and Yamartino, Robert.

USEPA (2005): Revision to the Guideline on Air Quality Models: Adoption of a Preferred General Purpose (Flat and Complex Terrain) Dispersion Model and Other Revisions, 40 CFR Part 51, US Environmental Protection Agency 40 CFR Part 51.

USEPA (2024a): https://www.epa.gov/newenglandhc/environmental-issues-concern-urban- communities-resources.

USEPA (2024b): Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources. Chapter 13: Miscellaneous Sources. http://www.epa.gov/ttn/chief/ap42/ch13/index.html.

13. FORMAL DECLARATIONS

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

DECLARATION OF ACCURACY OF INFORMATION – APPLICANT

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

Declaration of accuracy of information provided:

Atmospheric Impact Report in terms of Section 30 of the Act

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

Signed at Durban on this 27th day of October 2024.

SIGNATURE

Managing Director – uMoya-NILU Consulting
CAPACITY OF SIGNATORY

DECLARATION OF INDEPENDENCE – PRACTITIONER

Name of Practitioner: Mark Zunckel

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

Professional Registration Number: 400449/04

Declaration of independence and accuracy of information provided:

Atmospheric Impact Report in terms of Section 30 of the Act

I, Mark Zunckel declare that I am independent of the applicant. I have the necessary expertise to conduct the assessment required for the report and will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant. I will disclose to the applicant and the air quality officer all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the air quality officer. The information provided in the atmospheric impact report is, to the best of my knowledge, in all respects factually true and correct. I am aware that the supply of false or misleading information to an air quality office is a criminal office in terms of section 51(1)(g) of this Act.

Signed at Durban on this 27th of October 2024.

SIGNATURE

Managing Director – uMoya-NILU Consulting
CAPACITY OF SIGNATORY

ANNEXURE 1: NEMA REGULATION – APPENDIX 6

Specialist Reports as per the NEMA EIA Regulations, 2014 (as amended), must contain the information outlined in According to Appendix 6 (1) of the Regulations. Table A1 indicates where this information is included in the AIR.

Table A1: Prescribed contents of the Specialist Reports (Appendix 6 of the EIA Regulations, 2014)

Relevant section in GNR. 982	Requirement description	Relevant section in this report
(a) details of—	(i) the specialist who prepared the report; and	Section 2.76
	(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	Section 2.7 6 & Annexure 2
(b)	a declaration that the specialist is independent in a form as may be specified by the competent authority;	Section 13
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	Section 1 , 2.1 & 2.73.2
(cA)	an indication of the quality and age of base data used for the specialist report;	Section 5 &, 6, 7
(cB)	a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 6.1
(d)	the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Site investigation not applicable
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 5 & 6.27
(f)	details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 2.2 & 2.36.3 & 6.4
(g)	an identification of any areas to be avoided, including buffers;	None identified
(h)	a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 6.37.2
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge; Note: Uncertainties should be qualified within the report – there will always be uncertainties due to gaps in knowledge should also be qualified – a gap is to record that not all knowledge can be obtained for a study.	Section 2.98 & 7.1.3
(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 6.47
(k)	any mitigation measures for inclusion in the EMPr;	Section 97

Relevant section in GNR. 982	Requirement description	Relevant section in this report
	Note: We need to include whether these mitigation measures (excluding ongoing monitoring) can be practically implemented prior to commencement or not.	
(l)	any conditions for inclusion in the environmental authorisation;	Section 9
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 9
(n) a reasoned opinion—	(i) whether the proposed activity, activities or portions thereof should be authorised;	Section 11
	(iA) regarding the acceptability of the proposed activity or activities; and	Section 11
	(ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan; Note: We need to include whether these mitigation measures (excluding ongoing monitoring) can be practically implemented prior to commencement or not.	Section 11
(o)	a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 1
(p)	a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	
(q)	any other information requested by the competent authority.	
(2)	Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Section 1 & 3 & 6.2.1

ANNEXURE 2: CURRICULUM VITAE

MARK ZUNCKEL

uMOYA-NILU

Firm : uMoya-NILU (Pty) Ltd
Profession : Air quality consultant
Specialization : Air quality assessment, air quality management planning, air dispersion modelling, boundary layer meteorology, project management
Position in Firm : Managing director and senior consultant
Years with Firm : Since 1 August 2007
Nationality : South African
Year of Birth : 1959
Language Proficiency : English and Afrikaans

EDUCATION AND PROFESSIONAL STATUS

Qualification	Institution	Year
National Diploma (Meteorology)	Technikon Pretoria	1980
BSc (Meteorology)	Univ. of Pretoria	1984
BSc Hons (Meteorology)	Univ. of Pretoria	1988
MSc	Univ. of Natal	1992
PhD	Univ. Witwatersrand	1999

Registered Natural Scientist: South African Society for Natural Scientific Professionals
Ex-Council Member: National Association for Clean Air
Member: National Association for Clean Air

EMPLOYMENT AND EXPERIENCE RECORD

Period	**Organisation details and responsibilities/roles**
1976 – May 1992	South African Weather Bureau : Observer, junior forecaster, senior forecast, researcher, assistant director
June 1992 – July 2007	CSIR: Consultant and researcher, Research group Leader: Atmospheric Impacts
August 2007 to present	uMoya-NILU Consulting: Managing Director and senior air quality consultant

Key and Recent Project Experience:

1996	Project leader & Principal researcher: Atmospheric impact assessment for the proposed Mozal aluminium smelter in Maputo, Mozambique.

1996	Project leader & Principal researcher: Dry sulphur deposition during the Ben MacDhui High Altitude Trace Gas and Transport Experiment (BATTEX) in the Eastern Cape.
1997	Project leader & Principal researcher: Atmospheric impact assessment of the proposed capacity expansion project for Alusaf in Richards Bay.
1997	Project leader & Principal researcher: The Uruguayan ambient air quality project with LATU.
1997	Principal researcher on the Air quality specialist study for the Strategic Environmental Assessment on the industrial and urban hinterland of Richards Bay.
1997	Project leader & Principal researcher: Feasibility study for the implementation of a fog detection system in the Cape Metropolitan area: Meteorological aspects.
2001	Project leader & Principal researcher: Air quality specialist study for the Environmental Impact Assessment for the proposed expansion of the Hillside Aluminium Smelter, Richards Bay.
2001-03	Researcher: The Cross Border air Pollution Impact (CAPIA) project. A 3-year modelling and impacts study in the SADC region.
2002	Project leader & Principal researcher: Air quality assessment specialist study for the proposed Pechiney Smelter at Coega.
2002	Project leader & Principal researcher: Air quality assessment specialist study for the proposed N2 Wild Coast Toll Road.
2002-05	Project leader on the NRF project – development of a dynamic air pollution prediction system
2004	Project leader on the specialist study for expansion at the Natal Portland Cement power station at Simuma, KwaZulu-Natal.
2004-05	Researcher: National Air Quality Management Plan implementation project for Department Environmental Affairs and Tourism.
2005	Researcher in the assessment of air quality impacts associated with the expansion of the Natal Portland Cement power station at Port Shepstone.
2006-07	Project team leader of a multi-national team to develop the National Framework for Air Quality Management for the Department of Environment Affairs and Tourism
2007	Air quality assessment for Mutla Early Production System in Uganda for ERM Southern Africa on behalf of Tullow Oil.
2007-10	Lead consultant on the development of a dust mitigation strategy fro the Bulk Terminal Saldanha and an ambient guideline for Fe_2O_3 dust for Transnet Projects and on-going monitoring.
2008	Lead consultant on the Air quality status quo assessment and scoping for the EIA for the Sonangol Refinery
2008-09	Lead consultant on the development of the air quality management plan for the Western Cape Provincial. Department of Environmental Affairs and Development Planning.
2008-10	Lead consultant on the development of the Highveld Priority Area air quality management plan for the Department of Environmental Affairs and Tourism.
2008	Lead consultant in the development of an odour management and implementation strategy for eThekwini, focussing on Wastewater Treatment Works and odourous industrial sources
2008&10	Lead consultant on the Air Quality Specialist Study for the EIA for the proposed Kalagadi Manganese Smelter at Coega

2008	Lead consultant on the Air Quality Assessment for the Proposed Construction and Operation of a Second Cement Mill at NPC-Cimpor, Simuma near Port Shepstone.
2008	Lead consultant on the Air Quality Specialist Study Report for the New Multi-Purpose Pipeline Project (NMPP) for Transnet Pipelines.
2008	Lead consultant on the Air quality assessment for the proposed UTE Power Power station and RMDZ coal mine at Moatize, Mozambique for Vale.
2008-09	Lead consultant on the Dust source apportionment study for the Coedmore region in Durban for NPC-Cimpor.
2009	Consultant on the Air quality specialist study for the upgrade of the Kwadukuza Landfill, KwaZulu-Natal
2009-10	Lead consultant on the Audit of ambient air quality monitoring programme and air quality training for air quality personnel at PetroSA
2010	Lead consultant on the Qualitative assessment of impact of dust on solar power station at Saldanha Bay
2010	Lead consultant on the Air quality specialist study for the EIA for the Kalagadi Manganese Smelter at Coega
2009-10	Lead consultant on the Air quality specialist study for the Environmental Management Framework for the Port of Richards Bay
2010	Lead consultant on the Air quality status quo assessment and abatement planning at Idwala Carbonates, Port Shepstone
2010	Lead consultant on the Air quality status quo assessment and abatement planning at Sappi Tugela, Mandeni
2010–11	Air quality status quo assessment and revision of the Air Quality Management Plan for City of Johannesburg
2010	Lead consultant on the Air quality status quo assessment and abatement planning at First Quantum Mining’s Bwana Mkubwa and Kansanshi mines, Zambia
2010–11	Lead consultant on the Air quality specialist study for the EIA for the Alternative Fuel and Resources Project at Simuma, Port Shepstone
2010–11	Lead consultant on the Air quality specialist study for the EIA for the Coke Oven re-commissioning at ArcelorMittal Newcastle
2010	Qualitative air quality assessment for the EIA for the Mozpel sugar to ethanol project , Mozambique
2011	Development of the South African Air Quality Information System – Phase II The National Emission Inventory
2011	Ambient baseline monitoring for Riversdale’s Zambezi Coal Project in Tete, Mozambique
2010-11	Ambient quality baseline assessment for the Ncondeze Coal Project, Tete Mozambique
2011-12	Air quality assessment for the mining and processing facilities at Longmin Platinum in Marikana
2012	Air quality assessment for the proposed LNG and OLNG power stations in Mozambique
2012	Modelling study in Abu Dhabi for the transport and deposition of radio nuclides
2012	Air quality assessment for the proposed manganese ore terminal at the Ngqura Port
2012-13	Air quality management plan development for Stellenbosch Municipality
2012-12	Air quality management plan development for the Eastern Cape Province

2013	Air quality specialist for Tullow Oil Waraga-D and Kinsinsi environmental audit in Uganda
2013	Air quality specialist study for the EIA for the Thabametsi IPP station
2013	Air quality management plan for the Ugu District Municipality
2013-14	Air quality specialist study for the application for postponement of the minimum emission standards for 9 Eskom power stations
2014	Air quality specialist study for the application for postponement applications of the minimum emission standards for the Engen Refinery in Merebank, Durban
2014-15	Baseline assessment and AQMP development for the uThungulu District Municipality
2013-15	Baseline assessment, AQMP and Threat Assessment for the Waterberg-Bojanala Priority Area
2014-15	Review of the 2007 AQMP for eThekwini Municipality, including metropolitan emission inventory development for all sectors, i.e. industrial, transport, waste management, biomass burning, residential fuel burning, dispersion modelling and strategy development
2014-14	Dispersion modelling study for Richards Bay Minerals
2015	Air quality assessment for Rainbow Chickens at Hammersdale
2015	Air quality status quo assessment and planning for TNPA ports in South Africa
2016- 7	Lead author of the National State of Air Report for 2005 to 2015, including national emission inventory development for all sectors, i.e. industrial, transport, waste management, biomass burning, residential fuel burning
2016	Air quality assessment for Kanshansi Mine, Solwesi, Zambia
2016	Assessment of air quality impacts associated with activities at the Venetia Mine, Limpopo Province
2016	Assessment of air quality impacts associated with activities at the Komati Anthracite Mine, Mpumalanga Province
2016	Air quality assessment for the proposed Powership Project at the Port of Nacala, Mozambique
2016	Air quality assessment for the proposed Richards Bay Gas to Power Project
2017	Baseline assessment and review of the 2009 AQMP for Gauteng Province, including emission inventory development for all sectors, i.e. industrial, transport, waste management, biomass burning, residential fuel burning, and dispersion modelling
2017	Baseline assessment and air quality management plan for Northern Cape Province
2017	Air quality assessment for the EIA for the Thabametsi Power Station in Limpopo Province
2017	Air quality assessment for the EIA for the proposed Tshivasho Power Station in Limpopo Province
2018	Air quality assessment for the EIA for the proposed Bellmall Thermal Power station in Ekurhuleni
2018	Air quality assessment for the EIA for the proposed Simba Oil mini Refinery in Tororo, Uganda
2018-19	Air dispersion modelling for input to the Atmospheric Reports for the postponement application for 14 Eskom power stations
2019	Air quality impact assessment for the proposed NamPower expansion project in Walvis Bay
2019	Air quality assessment for the mine expansion project at the Akanani Mine

2019	Air quality impact assessment for the proposed power power station at Nacala, Mozambique
2020	AIR for the KarpowershipSA proposal in the Ports of Ngqura, Richards Bay and Saldanha Bay
2020	AIR for the Coega Development Corporation gas-to-power project at 4 sites in the CDC
2020	AIRs for 10 Eskom coal-fired power power stations on the Highveld to support their postponement application
2020	AIR for the proposed Azure Power gas-to-power project in the Western Cape
2021	Air quality assessment for the proposed optimisation project at Beeshoek Iron Ore Mine, Postmasburg, Northern Cape
2021	AIR for the proposed Frontier Power Gas-to-Power project at Saldanha Bay, Western Cape
2021	AIR for the 2021 shutdown and start-up at Engen Refinery in Merebank
2021	AIR for the proposed expansion of the Swartkops Ore handling facility in Port Elizabeth, Eastern Cape
2016-21	AEL compliance monitoring for Joseph Grieveson, Durban, including dust fallout monitoring and reporting
2018-21	Dust fallout and HF monitoring and reporting for Hulamin, Richards Bay
2018-21	Dust fallout and H_2S monitoring and reporting for at KwaDukuza Landfill for Dolphin Coast Landfill Management (DCLM)
2019-21	AEL compliance monitoring for Umgeni Iron and Steel Foundry, including dust fallout monitoring and reporting

PUBLICATIONS

Author and co-author of 34 articles in scientific journals, chapters in books and conference proceedings. Author and co-author of more than 300 technical reports and presented 47 papers at local and international conferences.

ATHAM
RAGHUNANDAN

uMOYA-NILU

Firm : uMoya-NILU Consulting (Pty) Ltd
Profession : Air Quality Consultant
Specialization : Meteorological and Atmospheric Dispersion Modelling, Air Quality Specialist Studies, Project Management, Data Processing, Emission Inventories
Position in Firm : Senior Air Quality Consultant
Years with Firm : 14 years (appointed in 2008)
Nationality : South African
Year of Birth : 1977
Language Proficiency :English (mother tongue), Afrikaans (fair)

EDUCATION AND PROFESSIONAL STATUS

Qualification	Institution	Year
M.A. (Atmospheric Sciences)	University of Natal, Durban	2003
B.A. Hons. (Environmental Sciences)	University of Durban–Westville	2001
B.Paed. (Education)	University of Durban–Westville	2000

Memberships:

- National Association for Clean Air (NACA)
- South African Society for Atmospheric Sciences (SASAS)
- South African Council of Educators (SACE)

EMPLOYMENT AND EXPERIENCE RECORD

Period	Organisation details and responsibilities/roles
Jan 2003 – Oct 2008	CSIR: Consultant/Researcher in Air Quality Group, Research Group Leader – Air Quality Research Group
Nov 2008 – present	uMoya-NILU: Senior Air Quality Consultant

Key and Recent Project Experience:

2003	Baseline air dispersion modelling study for Natal Portland Cement (Pty) Ltd – Simuma Power station, Port Shepstone – Modelling and Reporting
2004	Air Quality Screening Study for MOZAL 3 – Modelling and Reporting
2005	Air Quality Specialist Study for the Proposed Kudu Combined Cycle Gas Turbine Power Station at Oranjemund, Namibia (Site D) – Modelling and Reporting
2005	Air Quality Specialist Study for the Proposed Kudu Combined Cycle Gas Turbine Power Power station at Uubvlei, Namibia – Modelling and Reporting
2005	Air Quality Specialist Study for a Proposed Cement Milling, Storage and Packaging Facility and a Second Clinker Kiln at Natal Portland Cement (Pty) Ltd – Simuma Power station, Port Shepstone – Modelling and Reporting
2005	Technology Review: Air quality specialist study for the Coega Aluminium Smelter at Coega, Port Elizabeth – Modelling and Reporting
2005	Assessment of Development Scenarios for Hillside Aluminium using Sulphur Dioxide (SO_2) as an Ambient Air Quality Indicator – Modelling and Reporting
2005	Air Quality Scoping Study for Eskom’s Proposed Open Cycle Gas Turbine Power Station at Atlantis – Modelling and Reporting
2005	Air Quality Specialist Study for Eskom’s Proposed Open Cycle Gas Turbine Power Station at Atlantis, Western Cape – Modelling and Reporting
2005	Air Quality Specialist Study for the Proposed Tata Steel Ferrochrome Project at Richards Bay – Alton North Site – Modelling and Reporting
2005	Air Quality Audit for the Amathole District Municipality - Compilation of detailed emissions inventory
2006	A Regional Scale Air Dispersion Modelling Study for Northeastern Uruguay – Modelling and Reporting

2006	Air Dispersion Modelling Study for Natal Portland Cement (Pty) Ltd for the Proposed AFR Programme at the Simuma Power station, Port Shepstone – Modelling and Reporting
2007	Development of an air quality management strategy for particulate matter at the Bulk Terminal Saldanha - Project Leader and Reporting
2007	Air Quality and Human Health Specialist Study for the Proposed Coega Integrated LNG to Power Project (CIP) within the Coega Industrial Zone, Port Elizabeth, South Africa - Project Leader, Modelling and Reporting
2008	Dispersion Modelling for the Proposed Coega Aluminium Smelter (CAL) at Port Elizabeth - Project Leader, Modelling and Reporting
2008	Modelled and Measured Vertical Ozone Profiles over Southern Africa (as part of the Young Researcher Establishment Fund (2005-2008)) - Project Leader
2008	Air Quality Specialist Study for the Proposed N2 Wild Coast Toll Highway - Project Leader, Modelling and Reporting
2008	Initial Air Quality Impact Assessment for the Proposed Illovo Ethanol Power station in Mali, West Africa - Project Leader, Modelling and Reporting
2008	Modelling Mercury Stack Emissions from South African Coal-fired Power Power stations – Modelling and Reporting
2009	Air Quality Management Plan for the Western Cape Province – Baseline Assessment – Modelling
2009	Proposed Exxaro AlloyStream™ Manganese Project in the Coega Industrial Development Zone: Air Quality Impact Assessment – Modelling and Reporting
2009	Air Quality Specialist Study for the Kalagadi Manganese Smelter at Coega, Eastern Cape – Modelling and Reporting
2009	Qualitative Air Quality Impact Assessment for the Wearne Platkop Quarry – Modelling and Reporting
2009	Specialist Air Quality Study for the Vopak Terminal Durban Efficiency Project – Modelling
2009	Qualitative Air Quality Impact Assessment for the Proposed ETA STAR Coal Mine at Moatize, Mozambique – Modelling and Reporting
2009	Specialist Air Quality Study for the Kwadukuza Landfill Upgrade Project – Modelling and Reporting
2010	Ambient dust assessment at Saldanha Bay for the period October 2006 to September 2009 for Transnet Bulk Terminal Saldanha – Reporting
2010	Dust Impact Assessment for the Proposed Saldanha Bay Pilot PV power station – Reporting
2010	Modelling Particulate Emission Concentration Scenarios for Eskom's Kriel Power Station – Modelling and Reporting
2010	Air Quality Dispersion Modelling for MOZAL, Mozambique – Modelling and Reporting
2010	Air Quality Management Plan for the Highveld Priority Area – Air Quality Baseline Assessment for the Highveld Priority Area – Modelling
2010	Ambient Air Quality Modelling and Monitoring at Sappi, Mandeni – Modelling and Reporting
2010	Dust Impact Study at Idwala Carbonates – Modelling and Reporting
2010	Air quality specialist study for the EIA for the proposed re-commissioning of an existing coke oven battery at ArcelorMittal South Africa, Newcastle Works – Modelling

2010	Air quality specialist study for the proposed storage and utilisation of alternative fuels and resources at NPC-Cimpor's Simuma facility, Port Shepstone, KwaZulu-Natal – Modelling and Reporting
2010	Air quality status quo assessment and abatement planning at First Quantum Mining's Bwana Mkubwa and Kansanshi mines, Zambia – Modelling
2010	Air quality specialist study for the proposed briquetting power station at the Mafube Colliery – Modelling and Reporting
2011	Air quality modelling study for the Copeland reactor at Sappi Stanger – Modelling and Reporting
2011	Air quality modelling study for the Copeland reactor at Sappi Tugela – Modelling and Reporting
2011	Air quality monitoring and modelling study for the Copeland reactor at Mpact Paper, Piet Retief – Modelling and Reporting
2011	Air Quality Study for the Basic Environmental Assessment for the Proposed Biomass Co-Firing Facility at the Arnot Power Station – Modelling and Reporting
2011	Assessment of Scenarios for Developing and Implementing a Sulphur Dioxide Emissions Licensing Strategy for Hillside Aluminum – Modelling and Reporting
2011-12	Air quality assessment for the mining and processing facilities at Lonmin Platinum in Marikana – Modelling and Reporting
2012	Development of an Air Quality Management Plan for Anglo's Mafube Colliery in Mpumalanga – Modelling and Reporting
2012	Air quality assessment for the proposed manganese ore terminal at the Ngqura Port – Modelling and Reporting
2012	Air Quality Impact Assessment for NPC Cimpor – Modelling and Reporting
2013	Air Quality Impact Assessment for Proposed AfriSam Power station in Coega – Modelling
2013	Air quality assessment for the Orion Engineered Carbons Co-Gen Power station – Modelling
2013	Air quality assessment for the Orion Engineered Carbons - Main Boiler – Modelling
2013	Air quality assessment for the EIA for the Sekoko Coal Mine – Modelling and Reporting
2013	Air quality specialist study for the EIA for the Thabametsi IPP station – Modelling and Reporting
2013	Air quality specialist study for the EIA for the Mamathwane Common User facility – Modelling and Reporting
2013-14	Air quality specialist study for the application for postponement of the minimum emission standards for 16 Eskom power stations: Acacia, Arnot, Camden, Duvha, Grootvlei, Hendrina, Kendal, Komati, Kriel, Lethabo, Majuba, Matimba, Matla, Madupi, Tutuka, Port Rex – Modelling and Reporting
2014	Air quality specialist study for the application for postponement of the minimum emission standards for the Engen Refinery in Merebank, Durban – Modelling and Reporting
2013-14	Baseline assessment and air quality management plan for the Waterberg-Bojanala Priority Area – Modelling

2013	Air Quality Specialist Study for the EIA for the Pandora Platinum Mine Joint Venture – Modelling and Reporting
2013	Air Quality Specialist Study for the EIA for the Proposed New Tailings Storage Facility (TD8) and Associated Infrastructure at Lonmin’s Western Platinum Mine and Eastern Platinum Mine – Modelling and Reporting
2015	Waterberg-Bojanala Priority Area Air Quality Management Plan and Threat Assessment – Modelling
2015	Air Quality Management Plan for eThekwini Municipality – Modelling and Reporting
2015	Air Quality Management Plan for the uThungulu District Municipality – Modelling and Reporting
2015	Dispersion Modelling for Richards Bay Minerals – Modelling and Reporting
2015	Atmospheric Impact Report in support of Sancryl Chemicals’s application for a verification to the existing AEL as a result of the introduction of Ethyl Acrylate and Vinyl Acetate, Prospecton – Modelling and Reporting
2016	Dispersion Modelling Study for the City of Johannesburg – Modelling and Reporting
2016	Air Quality Specialist Study for the Department of Energy’s Emergency Power IPP Project at Richards Bay and Saldanha Bay – Modelling and Reporting
2016	Atmospheric Impact Report in support of the EIA for the Proposed Gas to Power Power station in Zone 1F of the Richards Bay IDZ – Modelling and Reporting
2016	Atmospheric Impact Report for the EIA for the proposed Tshivhaso Coal-fired Power Power station, Lephalale – Modelling and Reporting
2016	TNPA Air Quality Study – Dispersion Modelling for 8 Ports in South Africa: Port of Richards Bay, Durban, East London, Ngqura, Port Elizabeth, Mossel Bay, Cape Town and Saldanha Bay – Modelling and Reporting
2016	Atmospheric Impact Report for Durran's Calcination Power station – Modelling and Reporting
2016	Air Quality Assessment for the EIA for the Floating Power Power station in Nacala, Mozambique – Modelling and Reporting
2016	Ambient Air Quality Assessment for 2016 for Kansanshi Mining Plc – Modelling and Reporting
2016	Air Quality Impact Assessment for the EIA for the Proposed Hilli FLNG Project in Cameroon – Modelling and Reporting
2016	Kansanshi Smelter and TSF1 Modelling Scenarios for Kansanshi Mining Plc – Modelling and Reporting
2016	Air Quality Assessment the Proposed Accommodation Facility at the Venetia Mine in Limpopo – Modelling and Reporting
2016	Atmospheric Impact Report in support of the EIA for the Proposed Optimisation of the Process Power station at Nkomati Anthracite Mine – Modelling and Reporting
2017	Atmospheric Impact Report in support of the DRDAR Atmospheric Emission License (AEL) application for the proposed replacement and use of an incinerator at their State Veterinary Laboratories located in Grahamstown, Middelburg and Queesntown in the Eastern Cape – Modelling and Reporting
2017	Baseline Assessment and Review of the 2009 AQMP for Gauteng Province, including emission inventory development for all sectors, i.e. industrial,

	transport, waste management, biomass burning, residential fuel burning, and dispersion modelling – Modelling and Reporting
2017	Baseline Assessment and Air Quality Management Plan for Northern Cape Province – Modelling and Reporting
2017	Atmospheric Impact Report in support of Maloka Machaba Surfacing's application for an Atmospheric Emission License (AEL) for a proposed asphalt power station located in Polokwane – Modelling and Reporting
2017	Assessment of modelling scenarios involving an increase in the open area of the cone on the Common Stack for the pretreater, reformer and CHD furnaces at Engen Refinery – Modelling and Reporting
2017	Atmospheric Impact Report in support of the Atmospheric Emission License (AEL) application and stack-height assessment for the proposed Thabametsi Power Power station near Lephalale, Limpopo – Modelling and Reporting
2017	Dispersion Modelling Study for the Beeshoek Mine, near Postmasburg, Northern Cape – Modelling and Reporting
2018	Air quality assessment for the EIA for the proposed Bellmall Thermal Power station in Ekurhuleni – Modelling and Reporting
2018	Air quality assessment for the EIA for the proposed Simba Oil mini Refinery in Tororo, Uganda – Modelling and Reporting
2018-19	Air dispersion modelling for input to the Atmospheric Reports for the postponement application for 14 Eskom power stations – Modelling and Reporting
2019	Air quality impact assessment for the proposed NamPower expansion project in Walvis Bay – Modelling and Reporting
2019	Air quality assessment for the mine expansion project at the Akanani Mine – Modelling and Reporting
2019	Air quality impact assessment for the proposed power power station at Nacala, Mozambique – Modelling and Reporting
2019	Atmospheric Impact Report in Support of the Atmospheric Emission License (AEL) Amendment Application and Basic Assessment for Dow Southern Africa - New Germany – Modelling and Reporting
2019	Atmospheric Impact Report in support of Tau-Pele Construction's application for an Atmospheric Emission License (AEL) for a proposed emulsion and asphalt power station located in Indwe, Eastern Cape – Modelling and Reporting
2019	Atmospheric Impact Report in Support of the EIA for the Proposed Material Source and Processing Sites Along the N3 Between Durban and Hilton, KwaZulu-Natal: RCL1, RCL9 and Harrison's Quarry – Modelling and Reporting
2019	Atmospheric Impact Report in Support of the Atmospheric Emission License (AEL) Amendment Application and Basic Assessment for the Vopak Efficiency (Growth 4) Expansion Project, Durban, South Africa – Modelling and Reporting
2020	AIR for the KarpowershipSA proposal in the Ports of Ngqura, Richards Bay and Saldanha Bay – Modelling and Reporting
2020	AIR for the Coega Development Corporation gas-to-power project at 4 sites in the CDC – Modelling and Reporting
2020	AIRs for 10 Eskom coal-fired power power stations on the Highveld to support their postponement application – Modelling and Reporting

2020	AIR for the proposed Azura Power gas-to-power project in the Western Cape – Modelling and Reporting
2020	Atmospheric Impact Report for the proposed 315 MW LPG Power Power station at Saldanha Bay – Modelling and Reporting
2021	Air quality assessment for the proposed optimisation project at Beeshoek Iron Ore Mine, Postmasburg, Northern Cape – Modelling and Reporting
2021	Air quality assessment for the proposed expansion at Akanani Mine in Limpopo – Modelling and Reporting
2021	AIR for the proposed Frontier Power Gas-to-Power project at Saldanha Bay, Western Cape
2021	AIR for the 2021 shutdown and start-up at Engen Refinery in Merebank – Modelling and Reporting
2021	AIR for the proposed expansion of the Swartkops Ore handling facility in Port Elizabeth, Eastern Cape – Modelling and Reporting
2021	Atmospheric Impact Report in support of the Proposed 200 MW Engie CB Hybrid Power Project in the Coega Special Economic Zone (SEZ) – Modelling and Reporting
2021	Air Quality Impact Assessment for the proposed Mining of TSF-1 at the Stibium Mopani Mine near Gravelotte, Limpopo Province – Modelling and Reporting
2021	Addendum to the Atmospheric Impact Report in support of the proposed Mulilo-Total 200 MW Gas-fired Power Station, Coega Special Development Zone, Eastern Cape – Reporting
2021	Air Quality Assessment for the EIA for the Tete 1 400 MW Coal-Fired Power Power station, Tete Province, Mozambique – Modelling and Reporting
2021	Atmospheric Impact Report in support of Tugela Asphalt's application for an Atmospheric Emission License (AEL) for a proposed asphalt power station located in Mandini, KwaZulu-Natal – Modelling
2021	Atmospheric Impact Report for Nkomati Mine – Modelling and Reporting
2022	Emission Inventory for Lanxess for 2021 – Reporting
2022	Annual Report for Puregas: Atmospheric Emission License - Submission to the City of Ekurhuleni in compliance with the Atmospheric Emission Licence of the facility for the Reporting Period Year 2021 – Reporting
2022	Emission Inventory for Puregas for 2021 – Reporting
2022	Emission Inventory for Dow Advanced Materials for 2020 – Reporting
2022	Atmospheric Impact Report for the Engen Cape Town Terminal – Modelling and Reporting

PUBLICATIONS

Author and co-author of 5 articles in scientific journals and conference proceedings. Author and co-author of more than 200 technical reports for external contract clients. Presented 4 papers at local conferences. A full list of publications, conference papers and contract reports is available on request.

NOPASIKA XULU

Firm : uMoya-NILU (Pty) Ltd
Profession : Senior Air Quality Consultant
Specialization : Air Quality Assessment, Air Dispersion Modelling; Project Management; Data Analysis; Report Writing and Reviews
Position in Firm : Senior Air Quality Consultant
Years with Firm : Since 27 March 2023
Nationality : South African
Year of Birth : 1985
Language Proficiency : English and IsiZulu (read, write. Speak)

EDUCATION AND PROFESSIONAL STATUS

Qualification	Institution	Year
BSc. Environmental Studies	Univ. of Witwatersrand	2011
BSc Hons (Env. Studies)	Univ. of Witwatersrand	2012
BSc MSc (Env Sciences)	NWU Potchefstroom	2017

EMPLOYMENT AND EXPERIENCE RECORD

Period	Organisation details and responsibilities/roles
Oct 2016 – Dec 2018	Gondwana Environmental Solutions (Pty) Ltd: Air Quality Management Plans; Report Writing; Business Development and Marketing, Researcher,
July 2019 – March 2023	Rayten Engineering Solutions (Pty) Ltd: Air Quality Consultant, Project Management; Report Writing and Review; Data Analysis; Dispersion Modelling and Air Quality Impact Assessment; Research; Compiling Atmospheric Emission License (AEL) Applications; Populating National Atmospheric Emissions Inventory System; AEL Compliance Auditing; Dust Emission Reduction Plans; Greenhouse Gas Emissions Inventory Reporting; Facilitating/ Attending meetings; Liaising with Clients and Suppliers.

March 2023 – Present: uMoya – Nilu Consulting (Pty) Ltd Senior Air Quality Consultant, Dispersion Modelling and Air Quality Impact Assessments; Project Management

Key Project Experience:

2019 – 2023: Project Leader: Air Quality Impact Assessment projects (Harmony Moab Khotsong; EzeeTile Bloemfontein, EzeeTile Mokopane; Transvaal Galvanizers; Duho Drying; Lingaro Drying; Nama Copper Pty Ltd) Project Leader: AEL Applications and Reporting (Harmony Kopanang Operations; Harmony Mponeng Operations; Sibanye Gold Mines; Sibanye Platinum Mines; TotalEnergies Marketing; Matt Cast Supplies CC; Independent

Crematorium SA; City of Tshwane Crematorium; Buffalo City Municipality Crematorium; Wahl Industries; Transvaal Galvanizers)

2014 – 2017: Researcher: Air Quality Assessment in low-income residential areas in the Highveld

---

Publications: Author: Xulu, N.A., Piketh, S.J. Feig,G.T., Lack, D.A and Garland,R.M., (2020).Characterizing Light Absorbing Aerosols in a Low –Income Settlement in South Africa. Aerosol Air Quality Aerosol Air Quality Research. https://doi.org/10.4209/aaqr.2019.09.004

CONTACT INFORMATION:

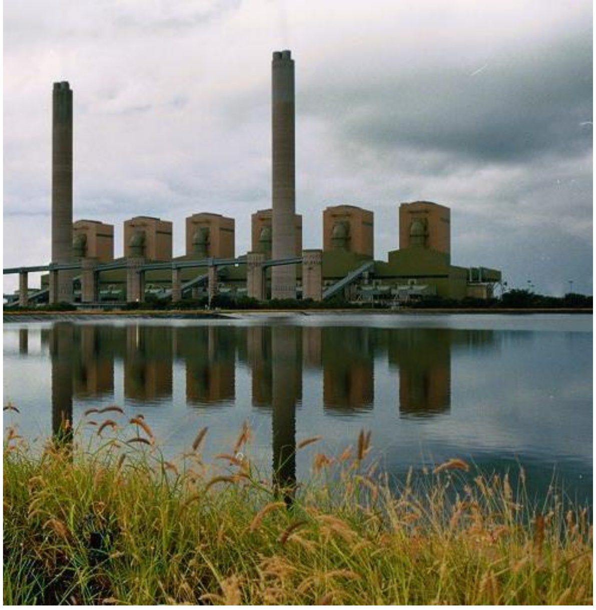
Email: nopasika@umoya-nilu.co.za
Phone: +27 63 1289 447

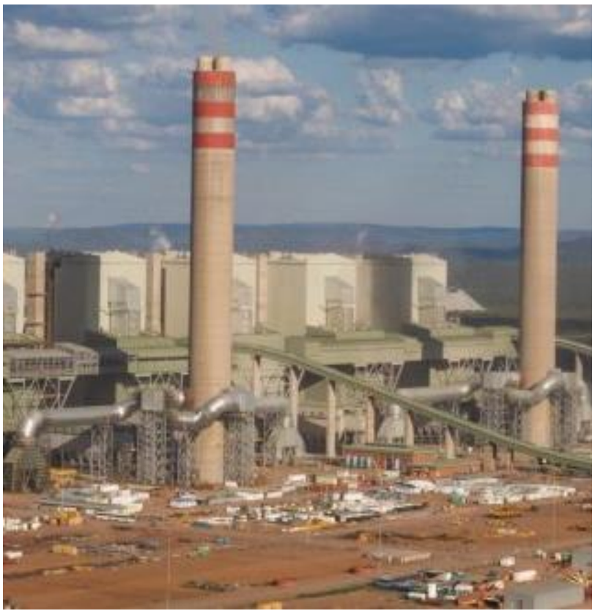
Appendix B

CUMULATIVE ATMOSPHERIC IMPACT REPORT

Public

ATMOSPHERIC IMPACT REPORT IN SUPPORT OF THE APPLICATION FOR EXEMPTION FROM THE MINIMUM EMISSION STANDARDS FOR ESKOM'S COAL-FIRED POWER STATIONS IN THE WATERBERG (A CUMULATIVE ASSESSMENT)





Final
4 November 2024

Report issued by:

uMoya-NILU Consulting (Pty) Ltd
P O Box 20622
Durban North, 4016
South Africa

Report issued to:

WSP Group Africa (Pty) Ltd
Building 1, Maxwell Office Park
Magwa Crescent West, Waterfall City
Midrand, 1685
South Africa

Report Details

Client:	WSP Group Africa (Pty) Ltd
Report title:	Atmospheric Impact Report in Support of the Application for Exemption from the Minimum Emission Standards for Eskom's Coal-Fired Power Stations in the Waterberg (A Cumulative Assessment)
Project:	uMN920-24
Report number:	uMN219-24
Version:	Final 4 November 2024
Prepared by:	uMoya-NILU Consulting (Pty) Ltd, P O Box 20622, Durban North 4016, South Africa
Authors:	Mark Zunckel, Atham Raghunandan and Nopasika Xulu

When used in a reference this document should be cited as follows:
uMoya-NILU (2024): Atmospheric Impact Report in Support of the Application for Exemption from the Minimum Emission Standards for Eskom's Coal-Fired Power Stations in the Waterberg (A Cumulative Assessment), Report No.: uMN219-24, November 2024.

Front page picture credit: https://www.eskom.co.za/eskom-divisions/gx/coal-fired-power-stations/

EXECUTIVE SUMMARY

Eskom operates a fleet of 14 coal-fired power stations, collectively generating more than 39 000 MW of electricity. The combustion of coal to generate steam for the generation of electricity is a Listed Activity in terms of the National Environmental Management: Air Quality Act (Act No. 39 of 2004). As such, Eskom holds Atmospheric Emission Licenses (AEL) for the respective power stations and is obligated to operate these power stations according to conditions specified in the respective AELs. Minimum Emission Standards (MES) for Listed Activities were published in 2010 (DEA, 2010) including compliance timeframes for existing and new plants had to comply with the MES for new plants by 30 April 2020.

Between 2018 and 2020, Eskom submitted applications to the Department of Forestry, Fisheries and the Environment (DFFE) based on an internally approved Emission Reduction Plan, which defined which power stations would have emission reduction technology installed and when. The National Air Quality Officer (NAQO) made decisions on these applications in 2019, which were not in favour of Eskom. Eskom appealed the NAQO's decision, and the Minister established the National Environmental Consultative and Advisory (NECA) Forum to advise her on the issue. The Minister ruled on the Eskom appeals on 22 May 2024 and granted the suspension of the Minimum Emission Standards (MES) at five (5) power stations on the Highveld up to 31 March 2030, namely Arnot, Camden, Grootvlei, Hendrina and Kriel. She further directed Eskom to submit an application in terms of Section 59 of the National Environmental Management: Air Quality Act for the exemption of the MES for eight (8) power stations that will continue to operate post 2030. These are Duvha, Kendal, Lethabo, Majuba, Matla and Tutuka on the Highveld and Medupi and Matimba in the Waterberg.

In terms the Minister's ruling Eskom Holdings SOC Ltd appointed WSP Group Africa (Pty) Ltd to prepare the necessary applications. WSP sub-contracted uMoya-NILU Consulting (Pty) Ltd to prepare the associated Atmospheric Impact Reports (AIRs) to support the applications. In response, AIRs have been prepared to support the exemption applications for the individual power stations. This AIR collectively assesses the two power stations in the Waterberg-Bojanala Priority Area, i.e. Medupi and Matimba, to provide further supporting information for the exemption applications. They are relatively close together in the Lephalale Local Municipality, just west of the town of Lephalale.

Eskom intends to systematically reduce emissions resulting from the fleet of coal-burning power stations. Three emission reduction trajectories from Eskom's financial ERP models are described here and illustrated in Figure E1 for NO_X, SO_2 and PM.

> **ERP 2024 A**: Eskom continue as planned, which includes all PM and NOx abatement projects and FGD at Kusile – This is why ERP 2024 A = B = C for NOx & PM (only security of supply differs) – by the time Grootvlei, Kriel, Arnot, Hendrina, Camden, Duvha and Matla are shutdown, Eskom will be fully compliant with NO_X and PM MES through the fleet.
>
> **ERP 2024 B**: 2024 A as above, but also FGD at Medupi, DSI at Majuba, and FGD at Kendal, hence the improvement from 2036 in SO_2 for ERP 2024 B. This is Eskom's middle-ground scenario; doing more than 2024 A, but not doing 2024 C.

ERP 2024 C: All of 2024 A and 2024 B above, but also FGD at Lethabo and Tutuka. Although this shows big improvement in SO_2 vs ERP 2024 B, this is a combination of Lethabo & Tutuka FGD, and actually probably more from shutdown of Duvha & Matla – station shutdowns have bigger impact on SO_2 reduction than FGD. When you look at the modelling results, ERP 2024 B already well within NAAQS (this is our model Scenario C), so enforcing ERP 2024 C not really justifiable, especially considering all the other negative impacts of FGD (age of Tutuka & Lethabo, costs, waste, water etc.).

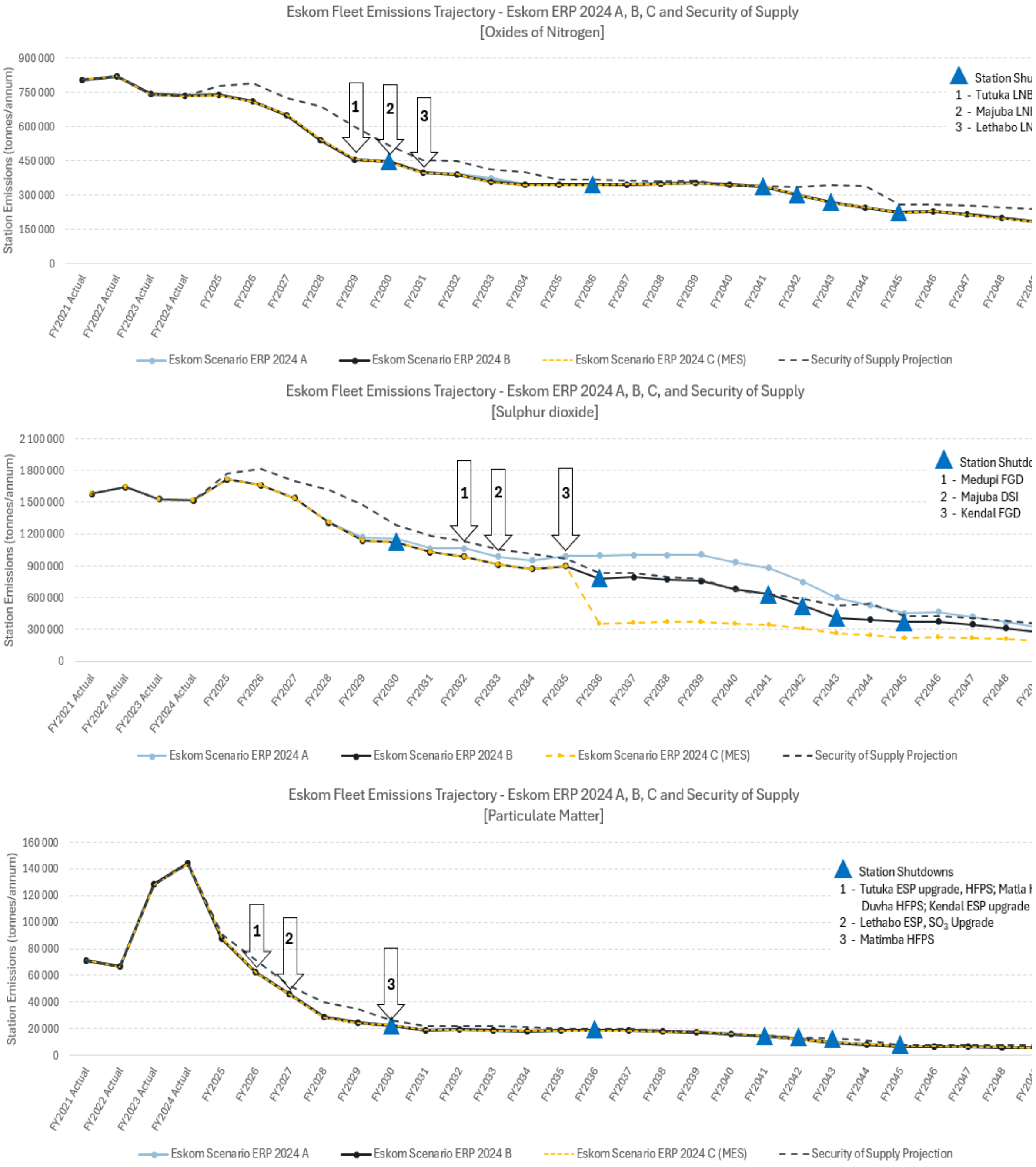
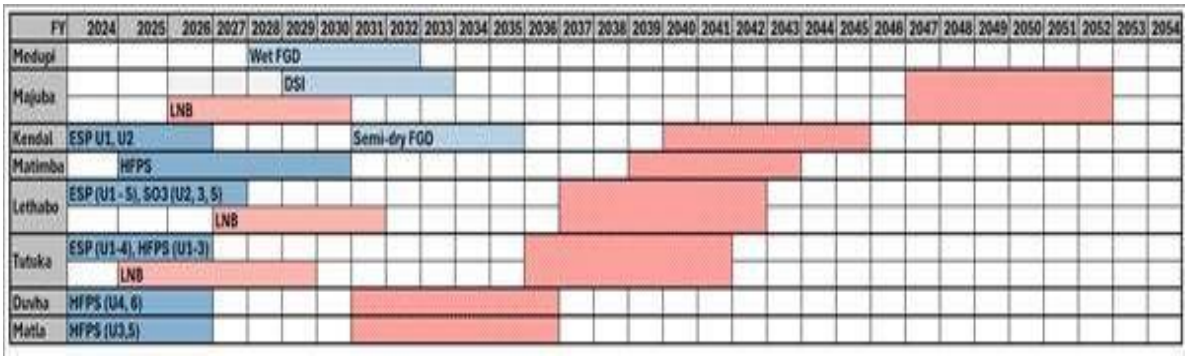


Figure E-1: Eskom's fleet emission trajectory NO_X (top), SO_2 (middle) and PM (bottom)

The proposed schedule for the installation of NO_X, PM and SO_2 emission reduction technologies and the shutdown schedule for power stations is shown in Figure E-2.



FGD: flue gas desulphurisation
DSI: Dry Sorbent Injection
LNB: low NO_X Burner
HFPS: high frequency power supply
ESP: Electrostatic precipitator
DHP: Dust Handling Plant
▨ Station Shutdown

Figure E-2: Emission reduction installation schedule and the planned shutdown of power stations

This AIR for the Waterberg power stations collectively assesses Medupi and Matimba to provide supporting information for the exemption applications for the two individual power stations. In so do doing, 5 emission scenarios are assessed for the two power stations. These are:

Scenario 1 (Current): The baseline scenario using actual monthly stack emissions for 2021-2023 and fugitive emissions from the coal stockyards and the ash dumps (No FGD installed).
Scenario A (2025): Eskom's planned 2025 stack emissions, representing anticipated station performance between 2025 – 2030, including fugitive emissions from the coal stockyards and the ash dumps (No FGD installed).
Scenario B (2031): Eskom's planned 2031 stack emissions, representing anticipated station performance between 2031 – 2035, including fugitive emissions from the coal stockyards and the ash dumps (No FGD installed but load reduction).
Scenario C (2036): Eskom's planned 2036 stack emissions, representing anticipated station performance from 2036 onwards, including fugitive emissions from the coal stockyards and the ash dumps (FGD installed at Medupi).
Scenario D (MES): Full compliance with the MES, including fugitive emissions from the coal stockyards and the ash dumps (FGD installed at Medupi and Matimba).

The annual average SO_2, NO_X and PM emission rates in tonnes per annum and the equivalent emission concentrations in mg/Nm^3 for Medupi and Matimba for the five scenarios are presented in Table E-1.

Table E-1: Annual emissions from the Matimba and Medupi Power Stations and the corresponding emission concentrations

Scenario	**Stack**	**Emission rate (tonnes/annum)**			**Emission concentration @ 10% O_2 and average load (mg/Nm^3)**		
		NO_X	**SO_2**	**PM**	**NO_x**	**SO_2**	**PM**
		Medupi Power Station					
1[a]	Stack 1	25 577	123 502	1 314	257	1 343	13
	Stack 2	25 577	123 502	1 314	257	1 343	13
A	Stack 1	34 716	134 340	1 663	522	2 020	25
	Stack 2	34 716	134 340	1 663	522	2 020	25
B	Stack 1	20 770	80 374	1 273	522	2 020	32
	Stack 2	20 770	80 374	1 273	522	2 020	32
C	Stack 1	23 447	31 263	1 438	375	500	23
	Stack 2	23 447	31 263	1 438	375	500	23
D	Stack 1	23 447	31 263	1 438	375	500	23
	Stack 2	23 447	31 263	1 438	375	500	23
		Matimba Power Station					
1[a]	Stack 1	28 921	150 457	2 648	291	1 514	27
	Stack 2	28 921	150 457	2 648	291	1 514	27
A	Stack 1	28 346	150 830	1 820	545	2 900	35
	Stack 2	28 346	150 830	1 820	545	2 900	35
B	Stack 1	18 118	103 026	1 243	510	2 900	35
	Stack 2	18 118	103 026	1 243	510	2 900	35
C	Stack 1	20 872	112 752	1 432	510	2 755	35
	Stack 2	20 872	112 752	1 432	510	2 755	35
D	Stack 1	20 872	33 825	1 432	510	827	35
	Stack 2	20 872	33 825	1 432	510	827	35
MES					**750**	**1000**	**50**

(a): Average from actual monthly emissions

Fugitive emissions of particulates result from coal storage and handling, and from ashing activities at the power stations. The estimated annual PM_{10} emission rates are shown in Table E-2. These are assumed to be the same for all five scenarios.

Table E-2: Fugitive sources of PM_{10} at the Medupi and Matimba Power Stations

Power station	**Source name**	**Emission (tonnes/year)**
		PM_{10}
Medupi	Coal Yard	86.6
	Excess Coal Yard	30.4
	Ash Dump	1 951
Matimba	Coal Yard	22.7
	Ash Dump	6 066

The CALPUFF dispersion model is used to predict ambient concentrations of SO_2, NO_2, PM_{10} and $PM_{2.5}$ resulting from Medupi and Matimba operating together. The dispersion modelling simulates the stack emissions (PM, SO_2, NO_X) and fugitive emissions (PM) from the coal stock yard and the ash dump for the five scenarios. While the focus of the assessment is on the stack emissions, the inclusion of fugitive PM emissions provides a holistic understanding of the contribution of the two power stations to ambient PM_{10} and $PM_{2.5}$

concentrations. Modelling is done according to the modelling regulations and 3-years of hourly surface and upper air meteorological data is used.

The PM emissions from the stacks and fugitive sources are not speciated into PM_{10} and $PM_{2.5}$. Rather all PM emitted is assumed to be firstly PM_{10} in the modelling and assesses against the National Ambient Air Quality Standards (NAAQS) for PM_{10}. Secondly, all PM emitted is assumed to be $PM_{2.5}$ in the modelling and assesses against the NAAQS for $PM_{2.5}$. The predicted PM_{10} and $PM_{2.5}$ concentrations also include the formation of secondary particulates from SO_2 and NO_2 stack emissions. Together, this represents a worse-case environmental scenario for PM_{10} and $PM_{2.5}$. The stack emissions generally have an effect some distance from the source as they are released well above ground level and are buoyant. Fugitive emissions are released close to ground level and without any buoyancy they have an effect close to the source.

In the body of the report the predicted ambient SO_2, NO_2, PM_{10} and $PM_{2.5}$ concentrations are presented as isopleth maps over the modelling domain. The predicted concentrations at 51 identified receptor points in the study area are included Appendix 2 of this report. In this executive summary the maximum predicted annual SO_2, NO_2, PM_{10} and $PM_{2.5}$ concentrations and the 99th percentile concentration of the 24-hour and 1-hour predicted concentrations in the modelling domain are discussed below.

For SO_2, the predicted concentrations are attributed only to the stack emissions. The maximum predicted annual average concentrations for the 5 scenarios are low relative to the limit values of the respective NAAQS. The predicted the 99th percentile of the 24-hour SO_2 concentrations and the predicted 1-hour concentrations exceeded the limit value of the NAAQS in Scenario A (2025) Scenario B, (2031) and in Scenario C (2036). The predicted maximum SO_2 concentration occur within 15 km to the southwest of the two power stations. Noteworthy is the compliance with actual emissions in Scenario 1 (Current) and Scenario D (MES) which assumes that the MES are attained.

For NO_2, the predicted concentrations are attributed only to the stack emissions. The predicted maximum annual concentration and predicted 99th percentile of the 24-hour concentrations are low relative to the limit values of the respective NAAQS for the 5 scenarios. The predicted maximum NO_2 concentration also occur within 15 km to the southwest of the two power stations.

For PM_{10} and $PM_{2.5}$, the maximum predicted annual average concentrations exceed the limit values of the respective NAAQS in all scenarios. Similarly, the predicted 99th percentile of the 24-hour PM_{10} and $PM_{2.5}$ concentrations exceeds the limit value of the NAAQS. The predicted maximum PM_{10} and $PM_{2.5}$ concentrations occur within 10 km southwest of the two power stations.

The predicted ambient concentrations of SO_2 and NO_2 resulting from power station stack emissions are lower than the concentrations measured at the respective AQMS in the Waterberg. This is to be expected since AQMS are exposed to all sources of SO_2 and NO_2 while the model includes only the power station stack emissions. At the monitoring stations, the predicted and monitored SO_2 and NO_2 concentrations comply with the respective NAAQS.

For PM_{10} and $PM_{2.5}$ the predicted ambient concentrations result from the power station stack emissions and the fugitive low-level sources, i.e. the coal stock yard and the ash dumps at each power station. At the Marapong and Lephalale AQMS the modelled concentrations are considerably lower than the monitored concentrations. This is to be expected since AQMS are exposed to all sources of PM_{10} and $PM_{2.5}$. The difference between the predicted concentrations and the measured concentrations provides an indication of the contribution of other emission sources at the respective AQMS.

At the Medupi AQMS however the modelled PM_{10} and $PM_{2.5}$ concentrations are generally higher than the monitored concentrations, contrary to expectation as the AQMS is exposed to more sources. Noteworthy is the poor data recovery at the Medupi AQMS, especially in 2022 and 2023. In these years for PM_{10} it was only 56% and 62%, and for $PM_{2.5}$ it was 35% and 28%. Data is deemed acceptable if recovery is 90% or more. In this data of 50% or more was used, so the results need to be viewed with caution, otherwise that data was not used in averaging.

The predicted SO_2 and NO_2 concentrations are below the respective limit values of the NAAQS for all averaging period in all 5 emission scenarios at all sensitive receptors. Similarly, the predicted annual average PM_{10} and $PM_{2.5}$ concentrations are below the limit values of the NAAQS at all sensitive receptor points in all five scenarios.

Exceedance of the 24-hour limit value of the NAAQS for PM_{10} and $PM_{2.5}$ are predicted in all five scenarios at several of sensitive receptor points. For Scenario A (2025) the exceedances of the limit value for PM_{10} occur at most sensitive receptor points. For $PM_{2.5}$, the limit value of the NAAQS changes from 40 $\mu g/m^3$ to 25 $\mu g/m^3$ in 2030, resulting in an increase in the number of receptor points where the limit value is exceeded. The reader is reminded that PM is assumed to be $PM_{2.5}$ is compared to the stringent NAAQS for $PM_{2.5}$.

Noteworthy findings from the modelling results may be summarised as:

i) Ambient SO_2 and NO_2 concentrations are attributed to the stack emissions only, while ambient PM_{10} and $PM_{2.5}$ concentrations are attributed to the stack emissions and the low-level fugitive sources. The stack emissions generally have an effect some distance from the source, while low-level emissions have an effect close to the source.

ii) The predicted ambient concentrations are lower than the monitored concentrations for all pollutants at all AQMS, except at the Medupi AQMS where predicted and measured are higher in general. It is expected that measured concentrations will be higher than modelled since AQMS are exposed to all sources of the pollutants while the modelled concentrations result from power station emission only.
The difference between the modelled concentrations and the measured concentrations are indicative of the contribution of other sources at the respective AQMS.
The PM_{10} and $PM_{2.5}$ data recovery rate at the Medupi AQMS in 2022 and 2023 was poor so it is likely that the reported averages are unreliable.

iii) For Scenario 1 (Current):
   a. Predicted SO_2 and NO_2 concentrations comply with the NAAQS for all averaging periods throughout the modelling domain.

    b. Predicted PM_{10} and $PM_{2.5}$ concentrations comply with the NAAQS, except close to the power stations where the limit value of the 24-hour NAAQS are exceeded as a result of the fugitive sources. Exceedances of the limit value for PM_{10} are predicted once at 2 sensitive receptor points respectively and thereof compliant with the NAAQS. For $PM_{2.5}$ exceedances of the limit value were predicted at 17 sensitive receptor points, at 10 of which the limit value was exceeded more than 12 times, hence non-compliant with the NAAQS.

iv) For Scenario A (2025):
    a. Predicted annual and 1-hour SO_2 concentrations comply with the NAAQS throughout the modelling domain, but exceedances of the 24-hour limit value are predicted at 10 sensitive receptor points.
    b. Predicted NO_2 concentrations comply with the NAAQS for all averaging periods throughout the modelling domain.
    c. Predicted PM_{10} and $PM_{2.5}$ concentrations comply with the NAAQS, except close to the power stations where the limit value of the 24-hour NAAQS are exceeded as a result of the fugitive sources. Exceedances of the limit value for PM_{10} are predicted once at 5 sensitive receptor points respectively and thereof compliant with the NAAQS. For $PM_{2.5}$ exceedances of the limit value were predicted at 17 sensitive receptor points, at 10 of which the limit value was exceeded more than 12 times, hence non-compliant with the NAAQS.

v) For Scenario B (2031):
    a. Predicted annual and 1-hour SO_2 concentrations comply with the NAAQS throughout the modelling domain, but exceedances of the 24-hour limit value are predicted at 10 sensitive receptor points.
    b. Predicted NO_2 concentrations comply with the NAAQS for all averaging periods throughout the modelling domain.
    c. Predicted PM_{10} and $PM_{2.5}$ concentrations comply with the NAAQS, except close to the power stations where the limit value of the 24-hour NAAQS are exceeded as a result of the fugitive sources. The number of predicted exceedances for PM_{10} decrease to 2, while the number of exceedances for $PM_{2.5}$ increase to 27 sensitive receptor points. The increase corresponds to the more stringent $PM_{2.5}$ limit value of 25 $\mu g/m^3$ which is implemented in 2030. At 14 of these points limit value was exceeded more than 12 times, hence non-compliant with the NAAQS.

vi) For Scenario C: (2036):
    a. Predicted annual and 1-hour SO_2 concentrations comply with the NAAQS throughout the modelling domain, but exceedances of the 24-hour limit value are predicted at 9 sensitive receptor points.
    b. Predicted NO_2 concentrations comply with the NAAQS for all averaging periods throughout the modelling domain.
    c. Predicted PM_{10} and $PM_{2.5}$ concentrations comply with the NAAQS, except close to the power stations where the 24-hour limit value of the NAAQS for $PM_{2.5}$ are exceeded as a result of the fugitive sources. Exceedances of the limit value for $PM_{2.5}$ are predicted at 25 sensitive receptor points. At 14 of these points limit value was exceeded more than 12 times, hence non-compliant with the NAAQS.

vii) For Scenario D:
    a. Predicted SO_2 and NO_2 concentrations comply with the NAAQS for all averaging periods throughout the modelling domain.

b. Predicted PM_{10} and $PM_{2.5}$ concentrations comply with the NAAQS, except close to the power stations where the 24-hour limit value of the NAAQS for $PM_{2.5}$ are exceeded as a result of the fugitive sources. Exceedances of the limit value for $PM_{2.5}$ are predicted at 25 sensitive receptor points. At 14 of these points limit value was exceeded more than 12 times, hence non-compliant with the NAAQS.

Given the conservative approach to the fugitive emission source simulations, and that this has provided an absolute worst-case emission scenario, and based on recommendations received from uMoya-Nilu, Eskom will be undertaking an additional modelling scenario, assessing only PM, SO_2, and NO_X stack emissions. NO_X and SO_2 emissions will be included in this scenario to ensure secondary particulate formation is accounted for. This will provide improved insight to impacts directly related to stack emissions, which are the focus of this exemption application.

ACKNOWLEDGEMENT

Jared Lodder, Yakeen Kowlas and Lehlohonolo Sello from WSP Group Africa (Pty) Ltd are acknowledged for processing the ambient air quality and wind data for the baseline assessment.

GLOSSARY OF TERMS AND ACRONYMS

AEL	Atmospheric Emission Licence
AIR	Atmospheric Impact Report
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
EIA	Environmental Impact Assessment
FGD	Flue-gas desulfurisation
g/s	Grams per second
kPa	Kilo Pascal
MES	Minimum Emission Standards
mg/Nm^3	Milligrams per normal cubic meter refers to emission concentration, i.e. mass per volume at normal temperature and pressure, defined as air at 20^{o}C (293.15 K) and 1 atm (101.325 kPa)
NAAQS	National Ambient Air Quality Standards
NAQO	National Air Quality Officer
NECA	National Environmental Consultative and Advisory
NEM-AQA	National Environment Management: Air Quality Act, 2004 (Act No. 39 of 2004)
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
USEPA	United States Environmental Protection Agency
μm	Micro meter (1 μm = 10^{-6} m)

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

Eskom operates a fleet of 14 coal-fired power stations in South Africa, collectively generating more than 39 000 MW of electricity. The combustion of coal to generate steam for the generation of electricity is a Listed Activity in terms of the National Environmental Management: Air Quality Act (Act No. 39 of 2004). Eskom holds Atmospheric Emission Licenses (AEL) for the respective power stations and is obligated to operate these power stations according to conditions specified in the respective AELs. Minimum Emission Standards (MES) for Listed Activities were published in 2010 (DEA, 2010) including compliance timeframes for existing and new plants. Existing activities had to comply with the MES for new plant by 30 April 2020.

Between 2018 and 2020, Eskom submitted applications to the Department of Forestry, Fisheries and the Environment (DFFE) based on an internally approved Emission Reduction Plan, which defined which power stations would have emission reduction technology installed and when. The National Air Quality Officer (NAQO) made decisions on these applications in 2019, which were not in favour of Eskom. Eskom appealed the NAQO's decision, and the Minister established the National Environmental Consultative and Advisory (NECA) Forum to advise her on the issue. The Minister ruled on the Eskom appeals on 22 May 2024 and granted the suspension of the Minimum Emission Standards (MES) at five (5) power stations on the Highveld up to 31 March 2030, namely Arnot, Camden, Grootvlei, Hendrina and Kriel. The Minister further directed Eskom to submit an application in terms of Section 59 of the National Environmental Management: Air Quality Act for the exemption of the MES for eight (8) power stations that will continue to operate post 2030. These are Duvha, Kendal, Lethabo, Majuba, Matla and Tutuka on the Highveld and Medupi and Matimba in the Waterberg.

In terms the Minister's ruling Eskom Holdings SOC Ltd appointed WSP Group Africa (Pty) Ltd to prepare the necessary applications. WSP Group Africa (Pty) Ltd sub-contracted uMoya-NILU Consulting (Pty) Ltd to prepare the associated Atmospheric Impact Reports (AIRs) (DEA, 2013a) to support the applications. While AIRs have been prepared to support the respective suspension and exemption applications for the individual power stations, this AIR collectively assesses the two coal-fired power stations in the in the Waterberg-Bojanala Priority Area, i.e. Medupi and Matimba. The intention of this cumulative AIR is to provide further supporting information for the exemption applications for the two individual power stations. Both Medupi and Matimba with valid AEL's (Table 1-1) with information regarding their respective AELs and proposed shutdown dates.

Table 1-1: AEL information

Power Station	Installed capacity	AEL	Dates	Shutdown date
Medupi	4 760 MW	H16/1/13-AEL/M1/R1	Expire: 01 Dec 2025	2071
Matimba	3 990MW	H16/1/13-WDM05	Expire: 27 Sept 2027	2043

2. ENTERPRISE DETAILS

2.1 Enterprise Details

Eskom enterprise details are summarised in Table 2-1.

Table 2-1: Enterprise information

Entity Name:	Eskom Holdings SOC Limited
Type of Enterprise, e.g. Company/Close Corporation/Trust, etc.:	State Owned Company
Company Registration Number:	2002/015527/30
Registered Address:	Megawatt Park, Maxwell Drive, Sunninghill, Sandton
Postal Address:	P. O. Box 1091, Johannesburg, 2000
Telephone Number (General):	+27 11 800 3861
Fax Number (General):	
Company Website:	www.eskom.co.za
Industry Type/Nature of Trade:	Electricity Generation
Land Use Zoning as per Town Planning Scheme:	Agricultural/Heavy industry
Land Use Rights if outside Town Planning Scheme:	Not applicable

2.2 Location and extent of the power stations

Medupi and Matimba are located in the Waterberg-Bojanala Priority Area, in the Waterberg District Municipality and are about 6 km apart, west-southwest and west and of the town of Lephalale respectively. Medupi is on the Farm Naauwontkomen about 16 km from Lephalale. Matimba is on the Farm Grootestryd about 13 km from Lephalale. Their relative location is illustrated in Figure 2-1.

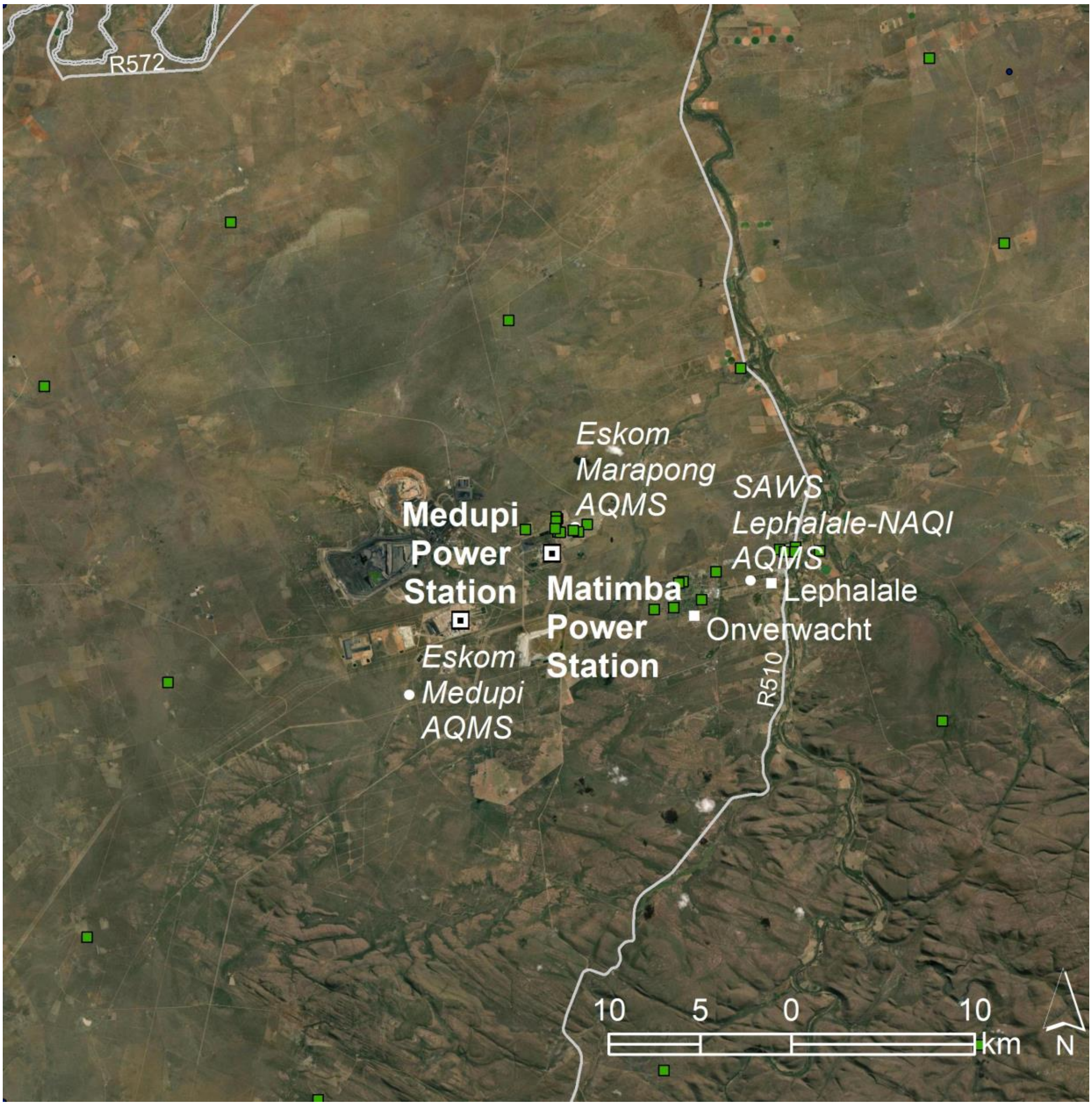


Figure 2-1: Relative location of the Medupi and Matimba coal-fired Power Stations in the modelling domain shown by white squares, with sensitive receptors shown by green squares

2.3 Description of surrounding land use

The Code of Practice for Air Dispersion Modelling in Air Quality Management in South Africa (DEA, 2014a) recommends the Land Use Procedure as sufficient for determining the urban/rural status of a modelling domain. The classification of the study area as urban or rural is based on the Auer method (Auer, 1978), as specified in the USEPA guideline on air dispersion models (USEPA, 2005). From the Auer's method, areas typically defined as rural include residences with grass lawns and trees, large estates, metropolitan parks and golf courses, agricultural areas, undeveloped land and water surfaces. An area is defined as urban if it has less than 35% vegetation coverage or it falls into one of the use types in Table 2-2.

Table 2-2: Land types, use and structures and vegetation cover

Type	Use and Structures	Vegetation
I1	Heavy industrial	Less than 5 %
I2	Light/moderate industrial	Less than 5 %
C1	Commercial	Less than 15 %
R2	Dense single / multi-family	Less than 30 %
R3	Multi-family, two-story	Less than 35 %

Generally the individual power stations are located in rural areas where the surrounding land use is primarily agriculture and includes coal mining. The surrounding land-use includes amongst others, urban areas with residential, commercial and recreational areas, industrial areas, agriculture, mining, forestry, undeveloped areas and conservation areas.

The US Environmental Protection Agency (USEPA, 2024) recognise Sensitive Receptors as areas which include, but are not limited to, hospitals, schools, daycare facilities, elderly housing and convalescent facilities or specialised healthcare facilities. These are areas where the occupants are more susceptible to the adverse effects of exposure to toxic chemicals, pesticides and other pollutants. The California Air Resources Board (CARB, 2024) identify Sensitive Receptors as children, elderly, asthmatics and others who are at a heightened risk of negative health outcomes due to exposure to air pollution.

The locations where these sensitive receptors congregate are considered sensitive receptor locations and therefore include hospitals, schools and day care centres, and other such locations. Three ambient air quality monitoring stations (AQMS) and 51 sensitive receptor points were identified within 30 km of Medupi and Matimba (Table 2-3).

Table 2-3: Sensitive receptors in the Waterberg

Receptor	UTMx	UTMy
Eskom Marapong AQMS - Monitoring Station	564.044	7383.715
Eskom Medupi AQMS - Monitoring Station	554.985	7374.552
SAWS Lephalale-NAQI AQMS - Monitoring Station	573.617	7380.786
Phegelelo Senior Secondary	563.060	7384.177
Contractors Village	561.293	7383.583
Ditheku Primary School	562.976	7384.275
Ditheko Primary School	564.691	7383.858
Marapong Training Centre	563.087	7383.465
Marapong Clinic	564.193	7383.463
Tielelo Secondary School	562.969	7384.035
Grootegeluk Medical Centre - Community Center	563.210	7383.420
Lephalale College	569.911	7380.730
Nelsonskop Primary School	563.913	7383.542
Hansie en Grietjie Pre-Primary School	569.673	7380.666
Sedibeng Special School for the Deaf and Disabilities	570.930	7379.738
Kings College	568.333	7379.207
Bosveld Primary School	569.400	7379.308
Lephalale Medical Hospital	562.938	7383.633
Ellisras Hospital	571.713	7381.272
Laerskool Ellisras Primary School	576.067	7382.619

Receptor	**UTMx**	**UTMy**
Hoerskool Ellisras Secondary School	575.189	7382.497
Marlothii Learning Academy	575.455	7382.359
Hardekool Akademie vir C.V.O	577.372	7382.411
Lephalale Clinic	576.044	7382.374
Ons Hoop	573.075	7392.408
Woudend	573.771	7422.152
Ramabara's	584.098	7373.114
Ga-Shongoane	608.321	7391.282
Bulge River	570.571	7332.998
Kaingo Mountain Lodge	582.064	7338.855
Community	557.518	7338.134
Kiesel	517.256	7348.639
Kremetartpan	537.357	7361.299
Mbala Private Camp	549.972	7352.418
Steenbokpan	541.767	7375.229
Receptor	535.001	7391.410
Sandbult	528.616	7377.834
Hardekraaltjie	526.176	7399.999
Receptor	560.399	7395.005
Receptor	545.208	7400.388
Receptor	559.690	7413.300
Receptor	583.382	7409.353
Receptor	587.468	7399.237
Ditaung	605.602	7401.960
Letlora	592.779	7416.528
Receptor	526.899	7365.394
Glenover	516.500	7360.781
Oxford Safaris	510.472	7376.086
Receptor	518.190	7387.978
Tholo Bush Estate	586.073	7355.406
Receptor	568.868	7354.021
Receptor	599.331	7360.083
Cheetah Safaris	537.952	7340.196
Rhinoland Safaris	607.228	7376.566

2.4 Atmospheric Emission License (AEL) and Other Authorisations

Medupi and Matimba have valid Atmospheric Emissions Licence (AEL) issued by the Waterberg District Municipality. The AEL numbers, issue dates and expiry dates are listed in Table 2-4. Both AELs concern three Listed Activities.

Table 2-4: Current authorisations related to air quality

Power Station	Atmospheric Emission License	Expiry Date	Listed Activity		Listed Activity Process Description
			Category	Sub-category	
Medupi	H16/1/13-AEL/M1/R1	01 Dec 2025	1 2 5	1.1 2.4 5.1	Solid Fuel Combustion Installations Storage and Handling of Petroleum Products Storage and Handling of Ore and Coal
Matimba	H16/1/13-WDM05	27 Sep 2027			

2.5 Modelling contractor

The dispersion modelling for this AIR is conducted by:

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

See Annexure 2 for abridged CV’s

2.6 Terms of Reference

The terms of reference for this AIR are to assesses the cumulative effect of the two coal-fired power in the Waterberg (Medupi and Matimba) to provide support for the applications for the individual power stations. In so do doing, 5 emission scenarios are assessed for the two power stations. These scenarios are:

Scenario 1 (Current): The baseline scenario using actual monthly stack emissions for 2021-2023 and fugitive emissions from the coal stockyards and the ash dumps (No FGD installed).

Scenario A (2025): Eskom's planned 2025 stack emissions, representing anticipated station performance between 2025 – 2030, including fugitive emissions from the coal stockyards and the ash dumps (No FGD installed).

Scenario B (2031): Eskom's planned 2031 stack emissions, representing anticipated station performance between 2031 – 2035, including fugitive emissions from the coal stockyards and the ash dumps (No FGD installed but load reduction).

Scenario C (2036): Eskom's planned 2036 stack emissions, representing anticipated station performance from 2036 onwards, including fugitive emissions from the coal stockyards and the ash dumps (FGD installed at Medupi).

Scenario D (MES): Full compliance with the MES, including fugitive emissions from the coal stockyards and the ash dumps (FGD installed at Medupi and Matimba).

2.7 Assumptions

The following assumptions are relevant to this AIR:

a) No ambient monitoring is done in this assessment, rather available ambient air quality data is used.
b) The assessment of potential human health impacts is based on predicted (modelled) ambient concentrations of SO_2, NO_2, PM_{10} and $PM_{2.5}$ and the health-based National Ambient Air Quality Standards (NAAQS).
c) Emissions data used in this AIR have been provided by Eskom and are deemed to be accurate and representative of operating conditions in the respective scenarios.
d) The PM emissions are not speciated into PM_{10} and $PM_{2.5}$, rather all PM emitted is assumed to be PM_{10}, and all PM emitted is assumed to be $PM_{2.5}$. This represents a worse-case emission scenario for PM_{10} and $PM_{2.5}$.
e) Assumptions regarding emissions from the coal yards and ash dumps are included in Section 4.4

3. NATURE OF THE PROCESS

3.1 Listed Activity or Activities

As a measure to reduce emissions from industrial sources and to improve ambient air quality, Listed Activities and associated Minimum Emission Standards (MES) were initially published in 2010 in Government Notice 248 (DEA, 2010) with the most recent revision applicable in 2020 (Government Notice 421, DEA, 2020).

The Listed Activities relevant to all the coal-fired power stations are listed in Table 3-1.

Table 3-1: Details of the Listed Activity for coal-fired power stations according to GN 248 (DEA, 2010) and its revisions (DEA, 2013b, 2019 2020)

Category of Listed Activities	Sub-category of Listed Activity	Description of Listed Activity	Description and Application of the Listed Activity
1: Combustion Installations	1.1: Solid Fuel Combustion Installations	Solid fuels combustion installations used primarily for steam raising or electricity generation.	All installations with design capacity equal to or greater than 50 MW heat input per unit, based on the lower calorific value of the fuel used.
2: Petroleum Industry, the production of gaseous and liquid fuels as well as petrochemicals from crude oil, coal, gas or biomass	2.4: Storage and handling of petroleum products	Petroleum products storage tanks and product transfer facilities.	All permanent immobile liquid storage facilities at a single site with a combined storage capacity of greater than 1 000 cubic metres.
5: Mineral Processing, Storage and Handling	5.1: Storage and Handling of Ore and Coal	Storage and handling of ore and coal not situated on the premises of a mine or works as defined in the Mines Health and Safety Act 29/1996.	Locations designed to hold more than 100 000 tons.

3.2 Process Description

Eskom Holdings SOC Limited is a South African utility that generates, transmits and distributes electricity. The bulk of that electricity is generated by large coal-fired power stations that are situated close to the sources of coal. Medupi and Matimba are such power stations with a base load generation capacity of 4 584 MW and 3 990 MW, respectively.

The generic process is that coal is received at the power station's coal stockyard from nearby mines It is milled to pulverised fuel and fed to the boilers. Combustion of the coal in the boilers heats water to superheated steam, which drives the turbines. In turn, the turbines drive the generators which generate electricity. Medupi and Matimba each have six generation units.

Typical process units at a coal-fired power station are listed in Table 3-2.

Table 3-2: Unit processes at a coal-fired power station

Unit Process	Function of Unit Process	Batch or Continuous Process
Boiler Unit 1	Generation of electricity from coal	Continuous
Boiler Unit 2	Generation of electricity from coal	Continuous
Boiler Unit 3	Generation of electricity from coal	Continuous
Boiler Unit 4	Generation of electricity from coal	Continuous
Boiler Unit 5	Generation of electricity from coal	Continuous
Boiler Unit 6	Generation of electricity from coal	Continuous
Coal stockyard	Storage of coal	Continuous
Fuel oil storage tanks	Storage of fuel oil	Continuous
Ashing facility	Storage of ash	Continuous

3.3 Air pollutants resulting from the process

3.3.1 Air pollutants

Atmospheric emissions depend on the fuel composition and rate of consumption, boiler design and operation, and the efficacy of pollution control devices. Emissions from the boilers are emitted via two stacks and include sulphur dioxide (SO_2), oxides of nitrogen ($NO + NO_2 = NO_X$) and Particulate Matter (PM).

SO_2 is produced from the combustion of sulphur bound in coal. The stoichiometric ratio of SO_2 to sulphur dictates that 2 kg of SO_2 are produced from every kilogram of sulphur combusted. The coal used by the Matimba Power Station has a sulphur content (wt %) of less than 1 %. NO_X is produced from thermal fixation of atmospheric nitrogen in the combustion flame and from oxidation of nitrogen bound in the coal. The quantity of NO_X produced is directly proportional to the temperature of the flame.

The non-combustible portion of the fuel remains as solid waste. The coarser, heavier waste is called 'bottom ash' and is extracted from the boiler, and the lighter, finer portion is 'fly ash' and is usually suspended in the flue gas, and in the absence of any emission control would be emitted as PM through the stack. The coal used at Matimba has an ash content of between 30 and 40%.

3.3.2 National Ambient Air Quality Standards

National Ambient Air Quality Standards (NAAQS) (DEA, 2009, 2012) apply to the pollutants emitted by Medupi and Matimba. The NAAQS consists of a 'limit' value and a permitted frequency of exceedance. The limit value is the fixed concentration level aimed at reducing the harmful effects of a pollutant. The permitted frequency of exceedance represents the acceptable number of exceedances of the limit value expressed as the 99th percentile. Compliance with the ambient standard implies that the frequency of exceedance of the limit value does not exceed the permitted tolerance. The NAAQS for SO_2, NO_2, PM_{10} and $PM_{2.5}$ are presented in Table 3-3.

Table 3-3: NAAQS for pollutants relevant to Medupi and Matimba

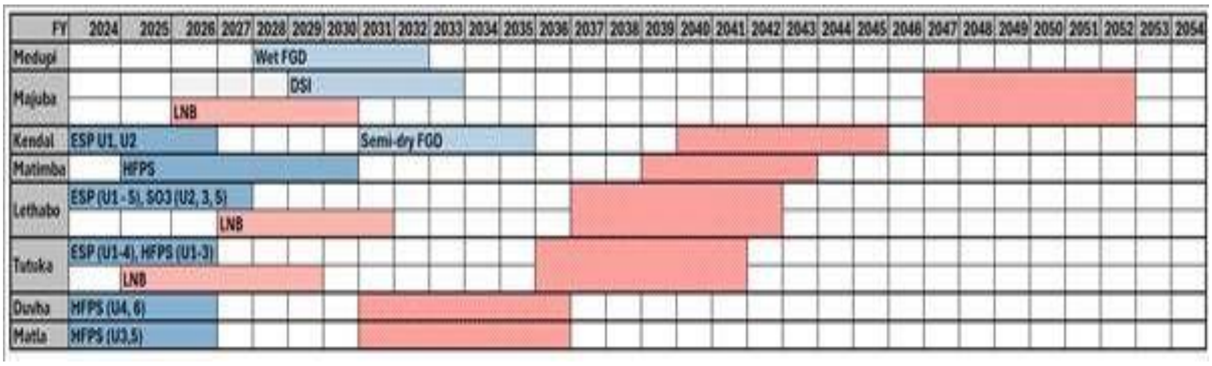
Pollutant	Averaging period	Limit value (µg/m^3)	Tolerance
SO_2	1 hour	350	88
	24 hour	125	4
	1 year	50	0
NO_2	1 hour	200	88
	1 year	40	0
PM_{10}	24 hour	75	4
	1 year	40	0
$PM_{2.5}$	24 hour	40 (25[a])	4
	1 year	20 (15 [a])	0

(a): Applicable from 01 January 2030

4. ATMOSPHERIC EMISSIONS

4.1 Point Source Emission Rates (Emission scenarios)

Eskom intends to systematically reduce emissions resulting from the fleet of coal-burning power stations. This includes the systematic introduction of emission reduction technologies, and the shutdown of power stations by 2045. The proposed schedule to 2050 for the installation of NO_X, PM and SO_2 emission reduction technologies and the shutdown schedule for power stations is shown in Figure 4-1. The key planned intervention for Medupi is the installation of wet-FGD.



FGD: flue gas desulphurisation

DSI: Dry Sorbent Injection

LNB: low NO_X Burner

HFPS: high frequency power supply

ESP: Electrostatic precipitator

DHP: Dust Handling Plant

▨ Station Shutdown

Figure 4-1: **Emission reduction installation schedule and the planned shutdown of power stations**

Shutdown of Matimba is planned from 2039 to 2043, while Medupi will remain operational until at least 2071. The total NO_X, SO_2 and PM emission resulting from operational coal-fired power stations at selected milestones from current emissions to 2050 are compared in Table 4-1.

Table 4-1: Total NO_X, SO_2 and PM emissions in tonnes from all operational fleet of coal-fired power stations at selected milestones

Years	NO_X	SO_2	PM
2025	108 743	570 139	6 924
2031	77 663	355 778	4 916
2036	89 267	289 280	5 650
2045	61 177	80 949	3 671
2050	61 889	83 753	3 714

Three emission reduction trajectories from Eskom's financial ERP models are described here and illustrated in Figure 4-2 to Figure 4-4 for NOx, SO_2 and PM:

ERP 2024 A: Eskom continue as planned, which includes all PM and NOx abatement projects and FGD at Kusile – This is why ERP 2024 A = B = C for NOx & PM (only security of supply differs) – by the time Grootvlei, Kriel, Arnot, Hendrina, Camden, Duvha and Matla are shutdown, Eskom will be fully compliant with NO_X and PM MES through the fleet.

ERP 2024 B: 2024 A as above, but also FGD at Medupi, DSI at Majuba, and FGD at Kendal, hence the improvement from 2036 in SO_2 for ERP 2024 B. This is Eskom's middle-ground scenario; doing more than 2024 A, but not doing 2024 C.

ERP 2024 C: All of 2024 A and 2024 B above, but also FGD at Lethabo and Tutuka. Although this shows big improvement in SO_2 vs ERP 2024 B, this is a combination of Lethabo & Tutuka FGD, and actually probably more from shutdown of Duvha & Matla – station shutdowns have bigger impact on SO_2 reduction than FGD. When you look at the modelling results, ERP 2024 B already well within NAAQS (this is our model Scenario C), so enforcing ERP 2024 C not really justifiable, especially considering all the other negative impacts of FGD (age of Tutuka & Lethabo, costs, waste, water etc.).

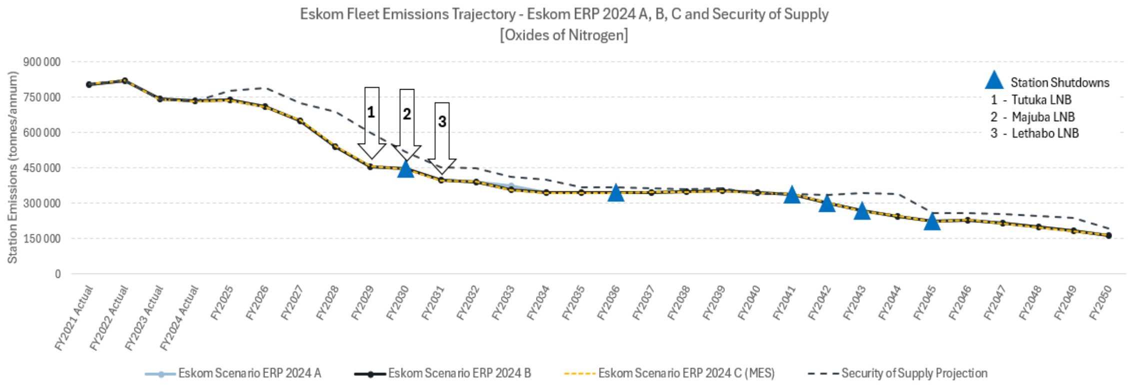


Figure 4-2: Eskom's fleet emission trajectory for NO_X

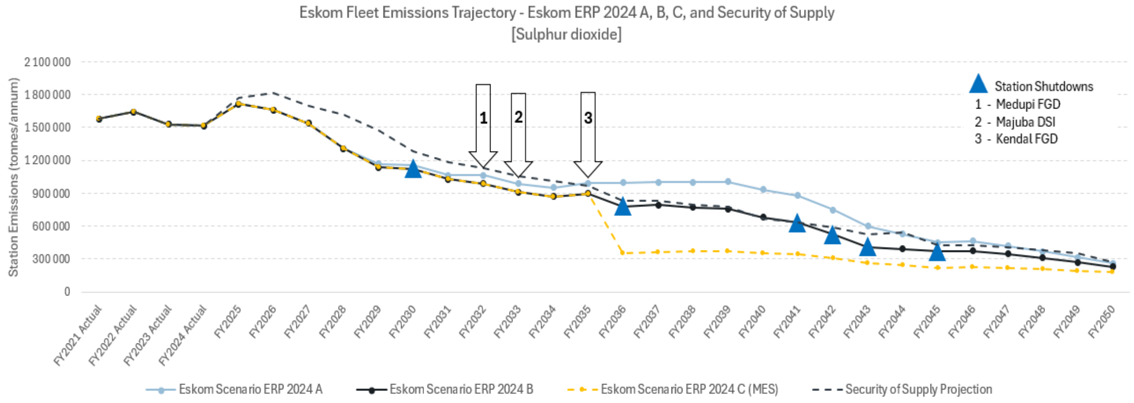


Figure 4-3: Eskom's fleet emission trajectory for SO_2

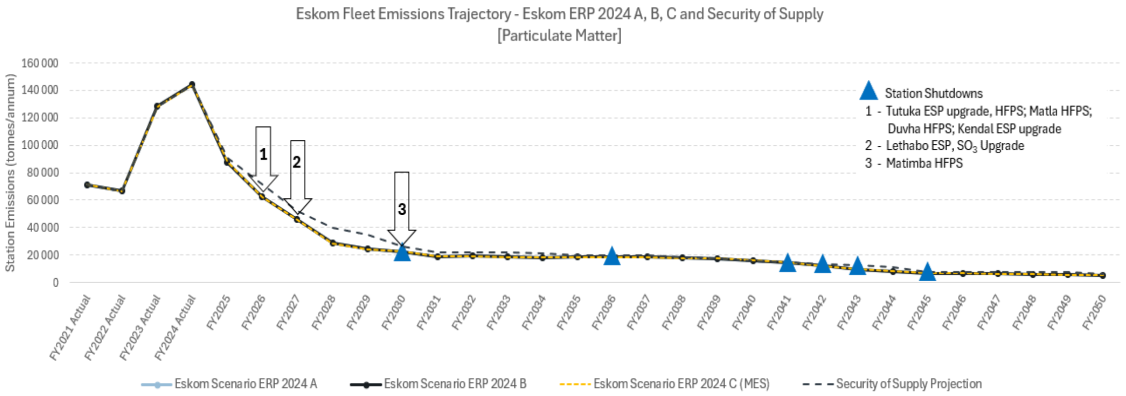


Figure 4-4: Eskom's fleet emission trajectory for PM

4.2 Point Source Parameters

Stack parameters for the individual power stations are not provided here, but are included in the respective AIRs (uMoya-NILU, 2024a, uMoya-NILU, 2024b).

The estimated emission rates and equivalent emission concentrations that are used in the dispersion modelling for the two stacks are shown in Table 4-2. The maximum anticipated emissions during each period are used for simulation in the model. The boiler units are assumed to operate continuously, i.e. 24 hours a day. Since each future scenario is a snapshot of period of operation (e.g. Scenario A = 2025 to 2030), the maximum anticipated emissions during that period, in a single year was selected for simulation in the model.

Table 4-2: Annual emissions from the Matimba and Medupi Power Stations and the corresponding emission concentrations

Scenario	Stack	Emission rate (tonnes/annum)			Emission concentration @ 10% O_2 and average load (mg/Nm^3)		
		NO_X	SO_2	PM	NO_x	SO_2	PM
		Medupi Power Station					
1[a]	Stack 1	25 577	123 502	1 314	257	1 343	13
	Stack 2	25 577	123 502	1 314	257	1 343	13
A	Stack 1	34 716	134 340	1 663	522	2 020	25
	Stack 2	34 716	134 340	1 663	522	2 020	25
B	Stack 1	20 770	80 374	1 273	522	2 020	32
	Stack 2	20 770	80 374	1 273	522	2 020	32
C	Stack 1	23 447	31 263	1 438	375	500	23
	Stack 2	23 447	31 263	1 438	375	500	23
D	Stack 1	23 447	31 263	1 438	375	500	23
	Stack 2	23 447	31 263	1 438	375	500	23
		Matimba Power Station					
1[a]	Stack 1	28 921	150 457	2 648	291	1 514	27
	Stack 2	28 921	150 457	2 648	291	1 514	27
A	Stack 1	28 346	150 830	1 820	545	2 900	35
	Stack 2	28 346	150 830	1 820	545	2 900	35
B	Stack 1	18 118	103 026	1 243	510	2 900	35
	Stack 2	18 118	103 026	1 243	510	2 900	35
C	Stack 1	20 872	112 752	1 432	510	2 755	35
	Stack 2	20 872	112 752	1 432	510	2 755	35
D	Stack 1	20 872	33 825	1 432	510	827	35
	Stack 2	20 872	33 825	1 432	510	827	35
MES					**750**	**1000**	**50**

(a): Average from actual monthly emissions

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

All power stations are required to conduct continuous emission measurements. Emissions include maximum emissions during start-up, shut-down, maintenance or upset conditions are accounted for in the actual monthly emissions used in Scenario 1 (Current) in this assessment.

4.4 Fugitive Emissions

The methodology to estimate emission rates of particulates from the coal stockyard and ash dumping activities for the power stations is described in this section.

A general equation for emission estimation is: E = A x EF x (1-ER/100)

where: E = emissions;
A = activity rate;
EF = emission factor; and
ER = overall emission reduction efficiency (%)

An emission factor is a representative value that relates the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. These factors are usually expressed as the weight of the pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant (e.g., kg of particulate emitted per tonne of coal crushed). Such factors facilitate estimation of emissions from various sources of air pollution. In most cases, these factors are simply averages of all available data of acceptable quality and are generally assumed to be representative of long-term averages for all facilities in the source category (USEPA, 2024b).

The emission factors used for the calculation of particulates in this study are the most recent factors published in the United States Environmental Protection Agency (US EPA), AP 42, Fifth Edition, Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources, Chapter 13: Section 13.2.4 Aggregate Handling and Storage Piles; Section 13.2.5 Industrial Wind Erosion; (USEPA, 2024b).

Wind entrainment of dust and PM_{10} from the coal stockpile and ash dump is a function of the physical size of the facility and the nature of the exposed surface, i.e. the moisture content, silt content, amount of vegetation cover, size of the particles on the surface and wind speed. Characteristics of the coal stockpile and ash dump at the power station is shown in Table 4-3.

As a mitigation measure, water is sprayed onto the coal stockpiles occasionally to reduce dust generation. In this assessment, the coal stockpile is assessed under worst case conditions (e.g. drought conditions), where it is assumed that no water will be sprayed onto the coal stockpile and 100% of the area is exposed to wind erosion.

The ash dump, by nature, is generally in a damp state depending on rainfall conditions, and if the ash is pumped onto the ash dump in a fluid state or trucked in. Rising green walls will provide vegetation cover on the sides and it is expected that most of the ash dump area exposed at the top will include a wet beach area. These initiatives, together with occasional wetting will reduce the amount of dust entrainment from the ash dump.

In this assessment, the ash dumps are modelled under worst case conditions (e.g. drought conditions), where it is assumed that it is mostly dry and 80% of the surface area is exposed to wind erosion, providing a worst-case (environmentally conservative) scenario. The annual emission rates for the coal stockpiles and ash dumps are shown in Table 4-4.

Table 4-3: Characteristics of the coal stockpile and ash dumps at the Medupi and Matimba Power Stations

	Medupi Power Station			**Matimba Power Station**	
Parameter	**Coal stockpile**	**Excess Coal stockpile**	**Ash dump**	**Coal stockpile**	**Ash dump**
Quantity of material stored (tonnes/year)	2 814 200	14 420 972	19 290 207	1 999 239	3 966 084
Moisture content (%)	4.5	4.5	27	4.5	27
Silt content (%)	2.2	2.2	80	2.2	80
Exposed surface area (m^2)	379 867	1 042 153	698 447	283 538	2 172 869
Height (m)	20	30.7	46.44	18	64
Dry area (%)	100	100	80	100	80
Dust abatement method	Wetting - Water	Wetting - Water	Spraying of dust using water during operation, top soil and vegetation coverage at incremental heights	Wetting - Water	Spraying of dust using water during operation, top soil and vegetation coverage at incremental heights
Material transfer method and ashing system	Conveyors (front end loaders in case of emergency)	Conveyors (front end loaders in case of emergency)	Dry (delivered by truck)	Conveyors (front end loaders in case of emergency)	Dry (delivered by trucks)

Table 4-4: Fugitive sources of PM_{10} at the Medupi and Matimba Power Stations

Power station	**Source name**	**Emission (tonnes/year)**
		PM_{10}
Medupi	Coal Yard	86.6
	Excess Coal Yard	30.4
	Ash Dump	1 951
Matimba	Coal Yard	22.7
	Ash Dump	6 066

5. BASELINE CONDITIONS

The description of the baseline conditions of the area provides an understanding on the receiving atmospheric environment so that changes as a result of the application for exemption of the MES can be assessed. The baseline description therefore includes an overview of the climatology and meteorology of the area, and an assessment of ambient air quality over the last three years measured at monitoring stations in the area. Other sources of air pollution in the area are also discussed.

5.1 Climate and meteorology

5.1.1 Temperature and rainfall

The climate of a given location is affected by its latitude, terrain and altitude, as well as nearby water bodies and their currents. Climates are classified according to the average and the typical ranges of different variables, most commonly temperature and precipitation.

The Waterberg experiences a hot semi-arid (BSh) climate according to the Köppen Climate Classification. Summer days are generally hot with maximum temperatures often exceeding 31 °C, and summer nights are mild. Winter days are mild and nights are cold. The average daily temperatures at Lephalale are illustrated in Figure 5-1. The area receives an average of 383 mm of rainfall annually, with nearly 90% of the rainfall occurring in the summer months between October and March (Figure 5-1). Rainfall seldom occurs in winter.

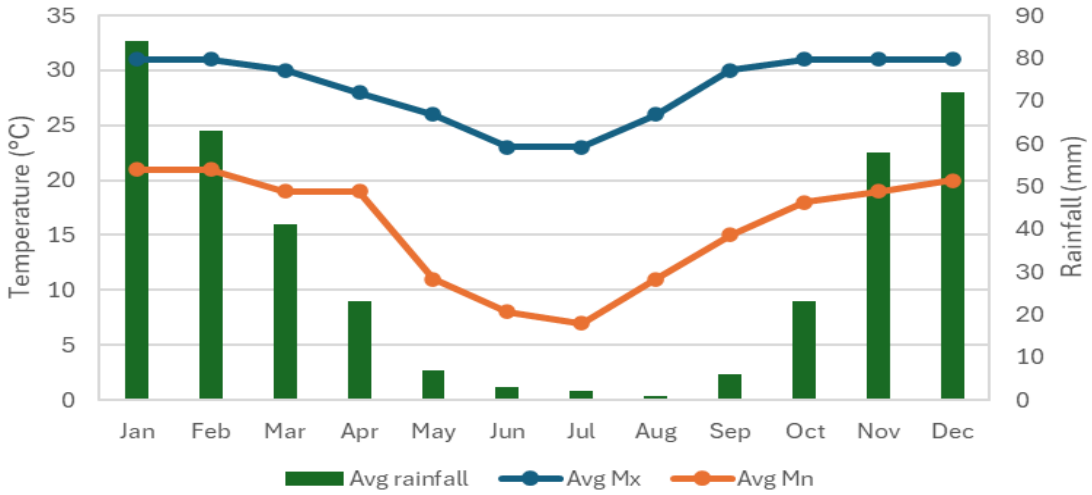


Figure 5-1: Average monthly maximum and minimum temperatures and average monthly rainfall at Lephalale (https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/lephalale_south-africa_7730334)

5.1.2 Wind

Windroses illustrate the frequency of hourly wind from the 16 cardinal wind directions, with wind indicated from the direction it blows, i.e. easterly winds blow from the east. It also illustrates the frequency of average hourly wind speed in six wind speed classes.

The annual windrose at Marapong is presented in Figure 5-2 for the 3-year period, 2021 to 2023. At Medupi the wind is generally light with wind speeds seldom reaching more than 6 m/s (Figure 5-2). The wind is almost exclusively from the sector northeast to easterly, except in the winter when they tend to the east-southeast (Figure 5-3). A high frequency of calm winds occur (nearly 24 %).

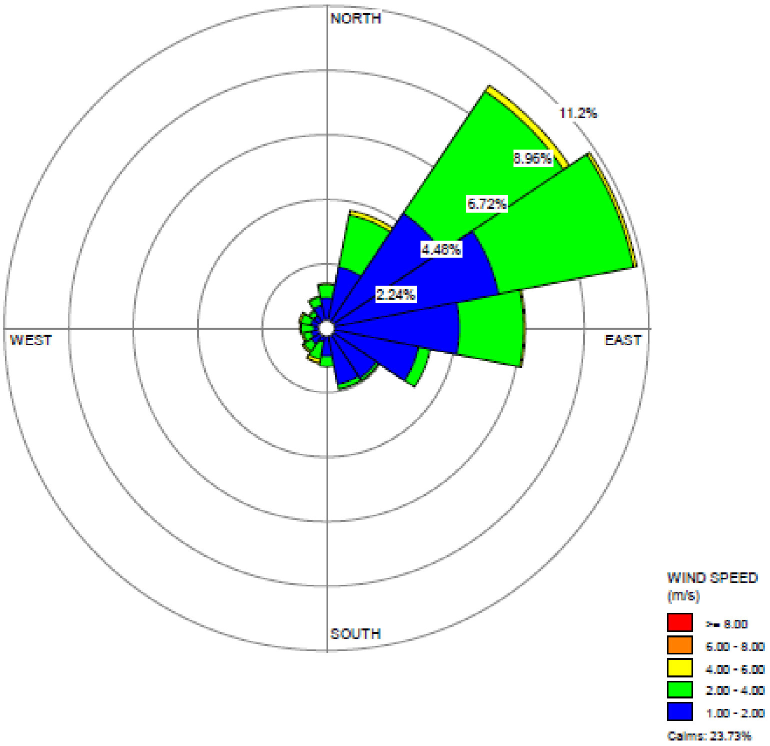
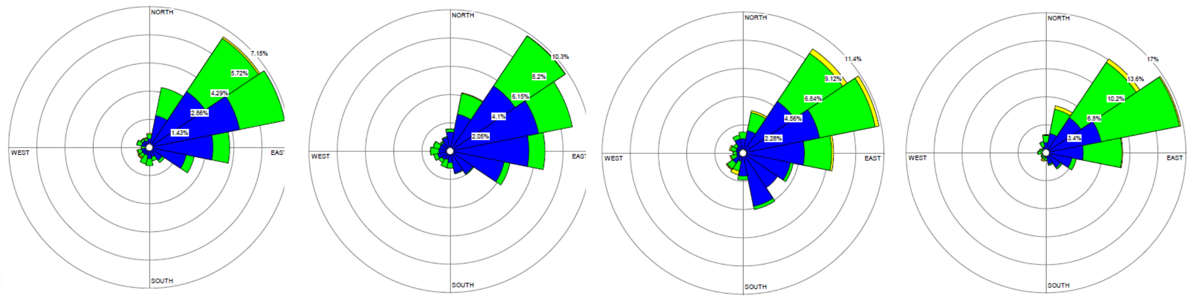
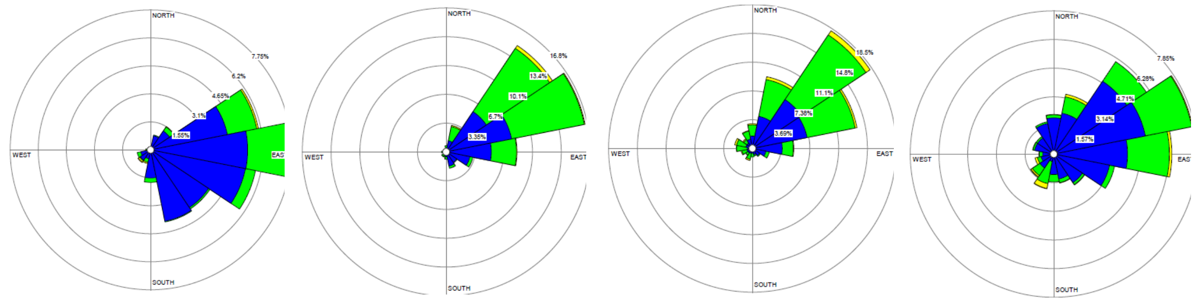


Figure 5-2: Annual windrose at the Marapong AQMS



Summer **Autumn** **Winter** **Spring**



00-06 h **06-12 h** **12-18 h** **18-24 h**

Figure 5-3: Seasonal (top) and diurnal (bottom) windroses at the Marapong AQMS

5.1.3 Air Pollution Dispersion Potential

The air pollution dispersion of an area refers to the ability of atmospheric processes, or meteorological mechanisms, to disperse and remove pollutants from the atmosphere. Dispersion comprises both vertical and horizontal components of motion. The vertical component is defined by the stability of the atmosphere and the depth of the surface mixing layer. The horizontal dispersion of pollution in the boundary layer is primarily a function of the wind field and atmospheric stability. The wind speed determines the rate of downwind transport and wind direction and the variability in wind direction determines the general path of the pollutant. Atmospheric stability, or instability, determines the ability of the atmosphere to mix and dilute pollutants. Stability is a function of solar radiation (thermal turbulence) and wind speed and surface roughness, which induce mechanical turbulence. The dispersion potential of an area therefore experiences diurnal and seasonal changes.

By day, with strong insolation (in-coming solar radiation) and stronger winds, the dispersion potential is generally efficient through vertical dilution and horizontal dispersion. The dispersion potential is generally better on summer days than winter days. At night, as the surface temperature inversion develops, the lowest layer of the atmosphere becomes more stable, reaching a maximum at sunrise. As a result, the dispersion potential typically becomes less efficient during the night and the poorest conditions generally occur at sunrise. Thermal turbulence disappears when the sun sets, and mechanical turbulence decreases as the wind speeds drops at night. Pollutants tend to accumulate near the point of release under these conditions, particularly if these are released close to ground level. The dispersion potential is generally poorer on winter nights than summer nights.

In the Matimba study area the dispersion potential is expected to be relatively good during the day in summer and winter as a result of daytime temperatures and a relatively high frequency of moderate winds. Summer rainfall is an important removal mechanism for air pollutants. Night-time surface temperature inversions are prevalent in winter and tend to trap pollutants that are released at or near ground level. Generally, there is better air pollution dispersion in summer when air pollutants disperse easily, compared with winter when pollutants can accumulate in stable night-time conditions. The tall power station stacks together with hot buoyant emissions ensure that pollutants are released above the surface inversion.

5.2 Ambient air quality

Agricultural and mining activities, as well as residential areas, are the key land use activities surrounding Medupi and Matimba. There are three relatively large residential areas, namely Marapong, Onverwacht and Lephalale. Marapong arcs from the north-northeast to the east-northeast and is less than 1 km from Matimba Power Station and 8 km northeast of Medupi. Lephalale is 18 km to the east of Medupi and between them is the Onverwacht residential area, 13 km from Medupi. The Matimba Power Station (industry) is 6 km northeast of Medupi and the Grootegeluk Coal Mine (mining) is 4 km north-northwest of Medupi.

Three ambient air quality monitoring stations (AQMS) are located relatively close to Medupi and Matimba. These are the Eskom Marapong AQMS (Maragpong AQMS) which is 2.2 km northeast of Medupi, Eskom Medupi AQMS (Medupi AQMS) which is 10.6 km southwest of Medupi, and the South African Weather Service (SAWS) Lephalale AQMS (Lephalale AQMS) which is 11.3 km east-southeast of Medupi.

Ambient air quality at the three AQMS will be influenced by local (nearby) sources, but ambient concentrations measured at these AQMS will also be influenced by emissions from the two power stations. Local sources of air pollution near the three AQMS include agricultural activities, domestic fuel and waste burning, vehicle emissions, mining and power generation. The Exxarro Grootegeluk Mine and Afrimat Kuipesbult Quarry are significant mining activities.

Pollutant concentrations measured at the three AQMS for 2021 to 2023 are presented here and are referenced against the respective NAAQS (Table 3-3).

5.2.1 Data recovery

Data recovery for the Marapong AQMS was relatively low for all pollutants for all years and below the minimum requirement of 90% as stipulated by the SANAS TR 07-03 (SANAS, 2012). Data recovery for SO_2 (2021), NO_2 (2021 and 2022), PM_{10} (2021) and $PM_{2.5}$ (2021 and 2022) was between 50% and 89.9%. These data are included in this discussion but must be viewed with caution.

Data recovery for the Medupi AQMS was above 90% for SO_2 (2021), NO_2 (2022), PM_{10} (2021) and $PM_{2.5}$ (2021), meeting the minimum requirement of 90% (SANAS, 2012). Data recovery for SO_2 (2022 and 2023), NO_2 (2021 and 2023) and PM_{10} (2022 and 2023) was between 50% and 89.9%, which is below the minimum requirement. These data are included in this discussion but must be viewed with caution.

Data recovery for the Lephalale AQMS was above 90% for SO_2 (2021), however data recovery for SO_2 (2022 and 2023), NO_2 (2021 to 2023), PM_{10} (2021 and 2023) and $PM_{2.5}$ (2023) was between 50% and 89.9%. These data are included in this discussion but must be viewed with caution.

Pollutants with a data recovery below 50% in a single year were not considered in this baseline discussion. These are highlighted in bold in Table 5-1.

Table 5-1: Data recovery at the Marapong, Medupi and Lephalale AQMSs from 2021 to 2023

Year	Data recovery (%)			
	SO_2	NO_2	PM_{10}	$PM_{2.5}$
Marapong AQMS				
2021	59.5	50.4	71.9	67.6
2022	**38.9**	59.4	**43.9**	59.8
2023	**0**	**0**	**0**	**0**
Medupi AQMS				
2021	97.9	86.6	93.2	96.5
2022	75.2	90.4	56.5	**35.4**
2023	71.5	80.1	62.1	**27.8**
Lephalale AQMS				
2021	96.1	64.1	51.4	**48.9**
2022	73.2	71.0	**34.2**	**29.0**
2023	58.0	74.9	59.6	57.7
Note:	Data recovery for the Marapong and Medupi AQMSs are based on 10-minute average data, while the Lephalale AQMS is based on 1-hour average data.			

5.2.2 Sulphur Dioxide (SO_2)

Marapong AQMS

- The 10-min average (Figure 5-4) SO_2 concentrations exceeded the 10-min (500 µg/m³) NAAQS in 2021 (23 times), however remaining compliant as 526 exceedances of 10-min NAAQS are permitted per calendar year.
- The 1-hour average (Figure 5-5) SO_2 concentrations exceeded the 1-hour (350 µg/m³) NAAQS in 2021 (sixteen times), thus compliant with the respective NAAQS as 88 exceedances of the 1-hour NAAQS are permitted per calendar year.
- The 24-hour average (Figure 5-6) SO_2 concentrations exceeded the 24-hour (125 µg/m³) NAAQS in 2021 (one time), thus compliant with the respective NAAQS as four exceedances of the 24-hour NAAQS are permitted per calendar year.
- The annual average SO_2 concentrations for 2021 (13.9 µg/m³) remained below the annual average NAAQS (50 µg/m³), thus compliant with the respective NAAQS.

Medupi AQMS

- The 10-min average (Figure 5-4) SO_2 concentrations exceeded the 10-min (500 µg/m³) NAAQS in 2021 (34 times), 2022 (75 times) and 2023 (53 times), thus compliant with the respective NAAQS as 526 exceedances of 10-min NAAQS are permitted per calendar year.
- The 1-hour average Figure 5-5) SO_2 concentrations exceeded the 1-hour (350 µg/m³) NAAQS in 2021 (eighteen times), 2022 (27 times) and 2023 (21 times), thus compliant

with the respective NAAQS as 88 exceedances of the 1-hour NAAQS are permitted per calendar year.

- The 24-hour average (Figure 5-6) SO_2 concentrations exceeded the 24-hour (125 µg/m³) NAAQS in 2021 (one time), 2022 (one time) and 2023 (one time), thus compliant with the respective NAAQS as four exceedances of the 24-hour NAAQS are permitted per calendar year.
- The annual average SO_2 concentrations for 2021 (16.2 µg/m³), 2022 (27.0 µg/m³) and 2023 (34.6 µg/m³) remained below the annual average NAAQS (50 µg/m³), thus compliant with the respective NAAQS.

Lephalale AQMS

- The 1-hour average (Figure 5-5) SO_2 concentrations exceeded the 1-hour (350 µg/m³) NAAQS in 2023 (two times), thus compliant with the respective NAAQS as 88 exceedances of the 1-hour NAAQS are permitted per calendar year. The 1-hour average SO_2 concentrations remained below the 1-hour (350 µg/m³) NAAQS in 2021 and 2022, with no exceedances recorded, thus compliant with the respective NAAQS.
- The 24-hour average (Figure 5-6) SO_2 concentrations remained below the 24-hour (125 µg/m³) NAAQS between 2021 and 2023, with no exceedances recorded, thus compliant with the respective NAAQS.
- The annual average SO_2 concentrations for 2021 (5.4 µg/m³), 2022 (5.0 µg/m³) and 2023 (7.1 µg/m³) remained below the annual average NAAQS (50 µg/m³), thus compliant with the respective NAAQS.

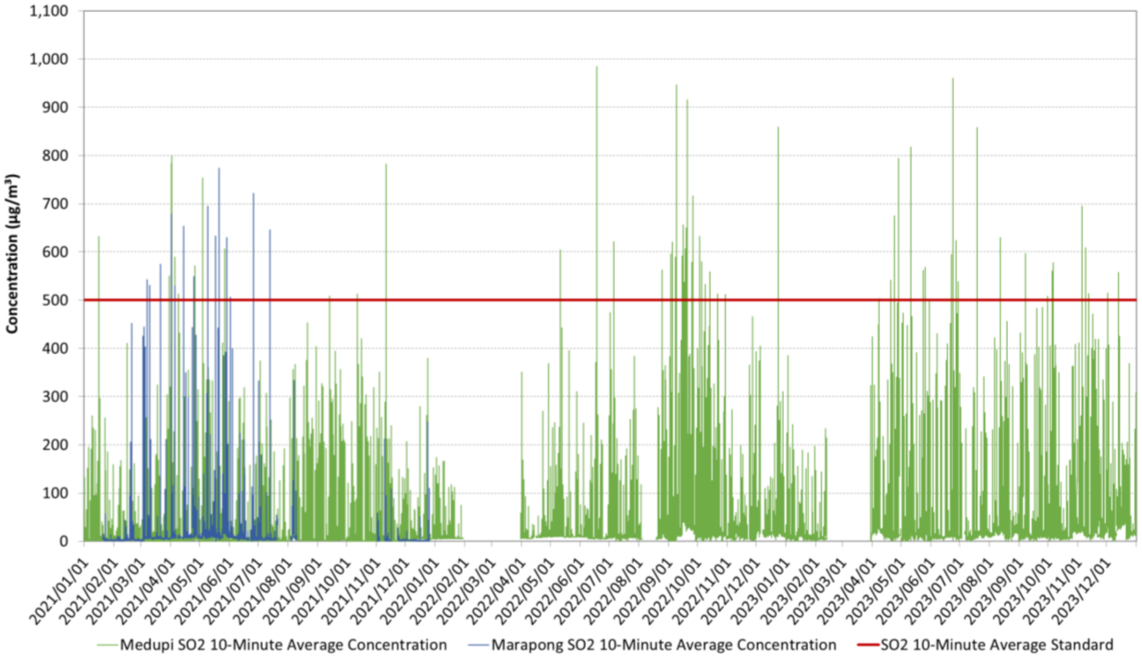


Figure 5-4: 10-minute average SO_2 concentrations at Marapong, Medupi and Lephalale AQMS for 2021 to 2023

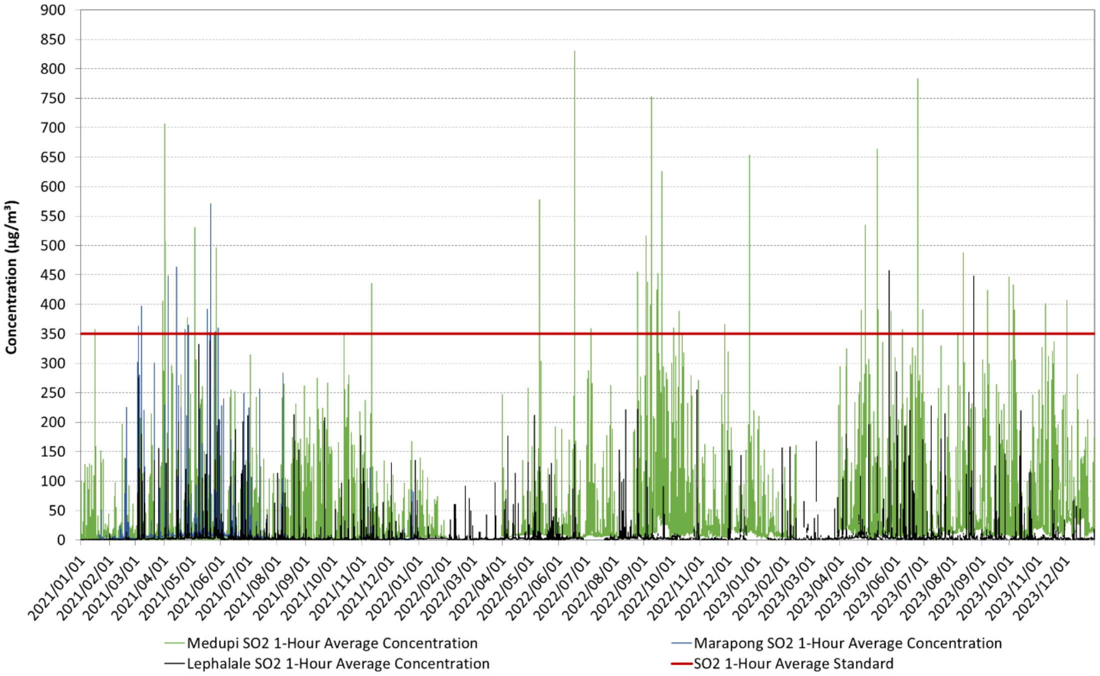


Figure 5-5: 1-hour average SO_2 concentrations at Marapong, Medupi and Lephalale AQMS for 2021 to 2023

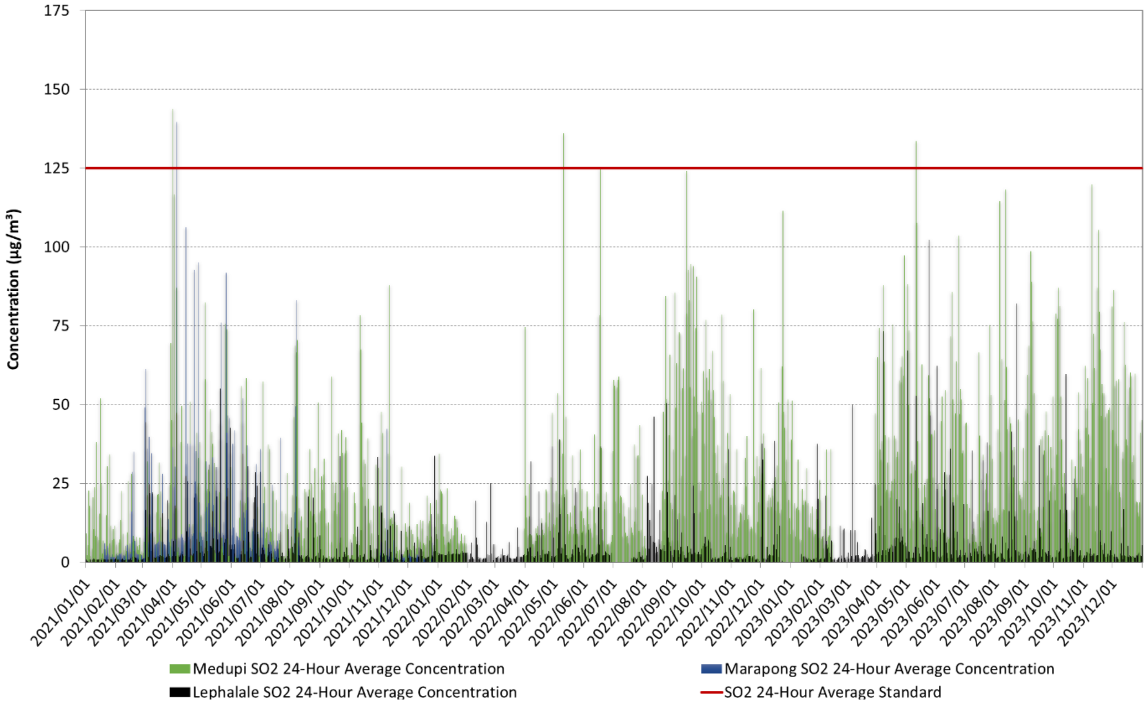


Figure 5-6: 24-hour average SO_2 concentrations at Marapong, Medupi and Lephalale AQMS for 2021 to 2023

5.2.3 Nitrogen Dioxide (NO_2)

Marapong AQMS

- The 1-hour average (Figure 5-7) NO_2 concentrations remained below the 1-hour NAAQS (200 µg/m³) for 2021 and 2022, with no exceedances recorded, thus compliant with the respective NAAQS.
- The annual average NO_2 concentrations for 2021 (16.4 µg/m³) and 2022 (17.3 µg/m³) remained below the annual average NAAQS (40 µg/m³), thus compliant with the respective NAAQS.

Medupi AQMS

- The 1-hour average (Figure 5-7) NO_2 concentrations remained below the 1-hour NAAQS (200 µg/m³) between 2021 and 2023, with no exceedances recorded, thus compliant with the respective NAAQS.
- The annual average NO_2 concentrations for 2021 (5.5 µg/m³), 2022 (10.4 µg/m³) and 2023 (11.3 µg/m³) remained below the annual average NAAQS (40 µg/m³), thus compliant with the respective NAAQS.

Lephalale AQMS

- The 1-hour average Figure 5-7) NO_2 concentrations remained below the 1-hour NAAQS (200 µg/m³) between 2021 and 2023, with no exceedances recorded, thus compliant with the respective NAAQS.
- The annual average NO_2 concentrations for 2021 (10.8 µg/m³), 2022 (12.8 µg/m³) and 2023 (15.7 µg/m³) remained below the annual average NAAQS (40 µg/m³), thus compliant with the respective NAAQS.

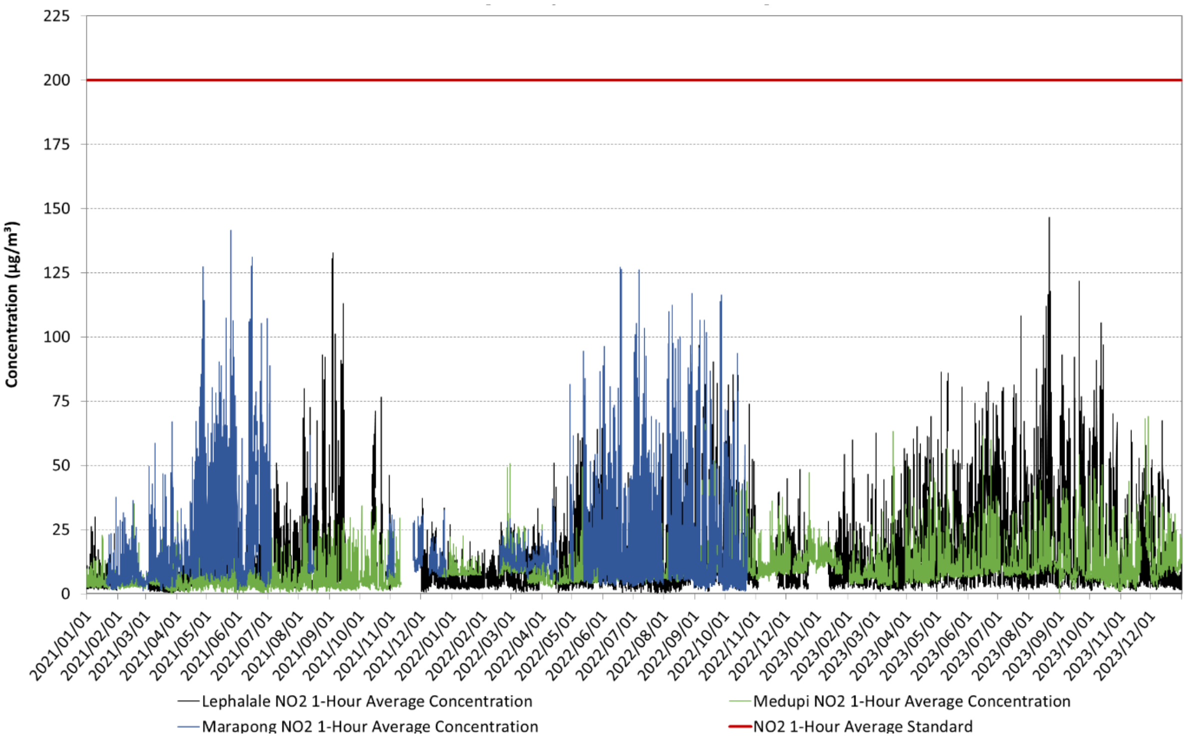


Figure 5-7: 1-hour average NO_2 concentrations at Marapong, Medupi and Lephalale AQMS for 2021 to 2023

5.2.4 Particulates (PM_{10} and $PM_{2.5}$)

Marapong AQMS

- The 24-hour average (Figure 5-8) PM_{10} concentrations exceeded the 24-hour average NAAQS (75 µg/m³) in 2021 (47 times), thus is non-compliant with the respective NAAQS as four exceedances per year are permitted.
- The annual average PM_{10} concentrations for 2021 (47.0 µg/m³) exceeded the annual average NAAQS (40 µg/m³), thus is non-compliant with the respective NAAQS.
- The 24-hour average (Figure 5-9) $PM_{2.5}$ concentrations exceeded the 24-hour average NAAQS (40 µg/m³) in 2021 (43 times) and 2022 (41 times), thus are non-compliant with the respective NAAQS as four exceedances per year are permitted.
- The annual average $PM_{2.5}$ concentrations for 2021 (25.8 µg/m³) and 2022 (30.2 µg/m³) exceeded the annual average NAAQS (20 µg/m³), thus are non-compliant with the respective NAAQS.

Medupi AQMS

- The 24-hour average (Figure 5-8) PM_{10} concentrations exceeded the 24-hour average NAAQS (75 µg/m³) in 2021 (12 times), 2022 (seven times) and 2023 (22 times), thus are non-compliant with the respective NAAQS as four exceedances per year are permitted.
- The annual average PM_{10} concentrations for 2021 (28.9 µg/m³), 2022 (28.4 µg/m³) and 2023 (37.5 µg/m³) remained below the annual average NAAQS (40 µg/m³), thus compliant with the respective NAAQS.
- The 24-hour average (Figure 5-9) $PM_{2.5}$ concentrations exceeded the 24-hour average NAAQS (40 µg/m³) in 2021 (eight times), thus is non-compliant with the respective NAAQS as four exceedances per year are permitted.
- The annual average $PM_{2.5}$ concentrations for 2021 (15.2 µg/m³) below the annual average NAAQS (20 µg/m³), thus compliant with the respective NAAQS.

Lephalale AQMS

- The 24-hour average (Figure 5-8) PM_{10} concentrations exceeded the 24-hour average NAAQS of 75 µg/m³ once in 2021, with no exceedances in 2023, , thus compliant with the respective NAAQS as four exceedances per year are permitted.
- The annual average PM_{10} concentrations for 2021 (37.3 µg/m³) and 2023 (17.4 µg/m³) remained below annual average NAAQS (40 µg/m³), thus compliant with the respective NAAQS.
- The 24-hour average (Figure 5-9) $PM_{2.5}$ concentrations in 2023 remained below the 24-hour average NAAQS (40 µg/m³) with no exceedances recorded, thus compliant with the respective NAAQS.
- The annual average $PM_{2.5}$ concentrations for 2023 (15.2 µg/m³) remained below the annual average NAAQS (20 µg/m³), thus compliant with the respective NAAQS.

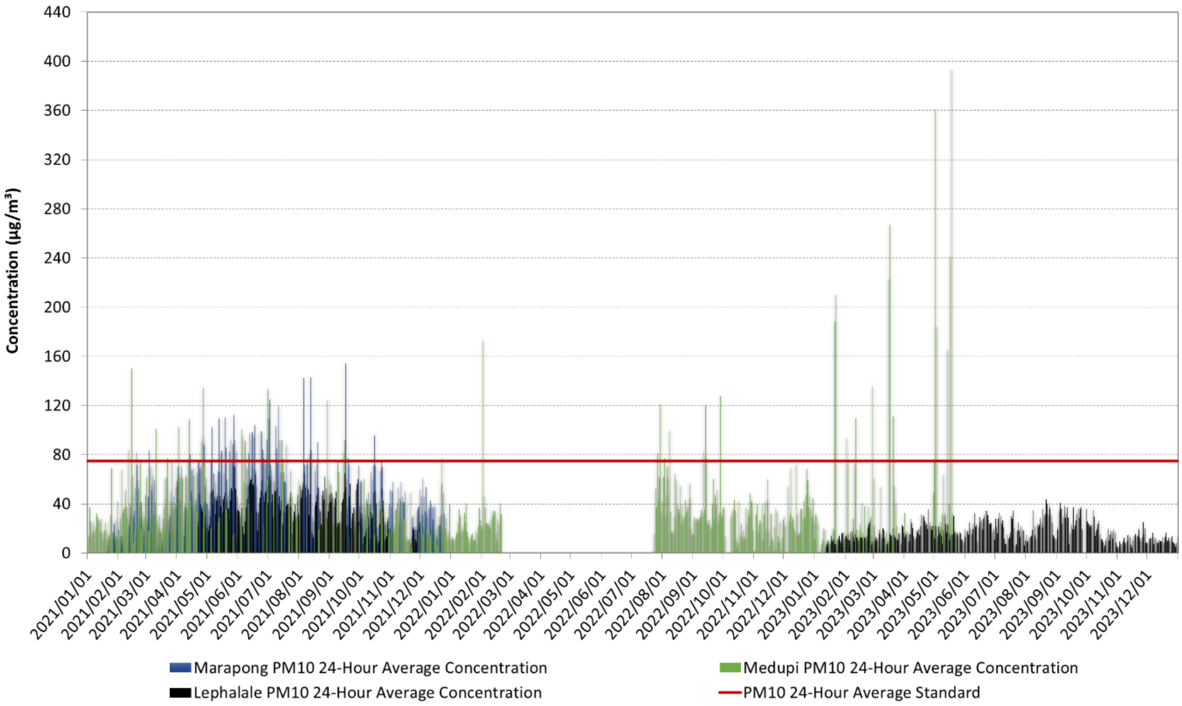


Figure 5-8: 24-hour average PM_{10} concentrations at Marapong, Medupi and Lephalale AQMS for 2021 to 2023

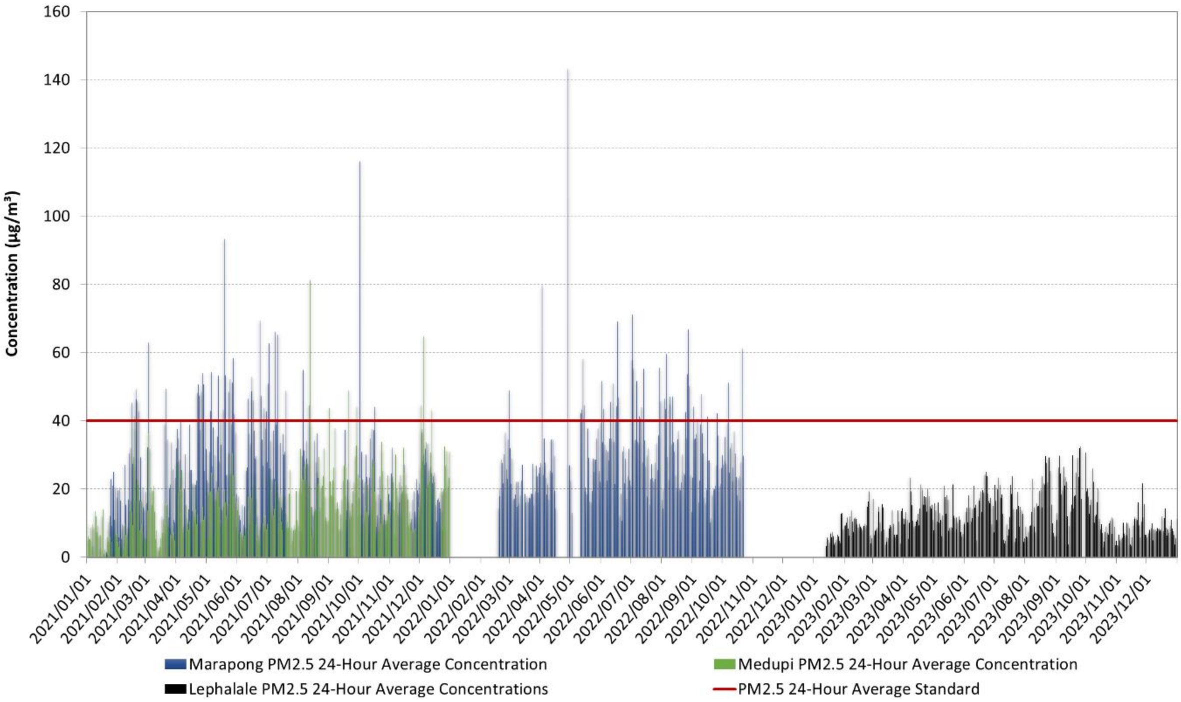


Figure 5-9: 24-hour average $PM_{2.5}$ concentrations at Marapong, Medupi and Lephalale AQMS for 2021 to 2023

5.2.5 Ambient pollutant summary

A summary of exceedances of the limit value of the NAAQS for all pollutants is presented in (Table 5-2).

Despite the proximity of several sources of SO_2 and NO_2 to the three monitoring sites, including Medupi and Matimba Power Station, no exceedances of the NAAQS for SO_2 and NO_2 were recorded during the period 2021 to 2023.

The key pollutants of concern however, are PM_{10} and $PM_{2.5}$. During the period 2021 to 2023 numerous exceedances of the NAAQS limit value for both the 24-hour and annual average for PM_{10} and $PM_{2.5}$ were recorded at the Marapong and Medupi AQMS. The exceedances are attributed to the proximity of sources of particulates to these monitoring sites, such as domestic fuel burning, wind and vehicle entrainment of dust, and mining.

Table 5-2: Pollutant exceedance summary at the Marapong, Medupi and Lephalale AQMS from 2021 to 2023

Pollutant	Averaging Period	Concentration	Permitted Number of Exceedances	2021	2022	2023
Marapong AQMS						
SO_2	10-min	500 $\mu g/m^3$	526	23	- (1)	- (1)
	1-hour	350 $\mu g/m^3$	88	16	- (1)	- (1)
	24-hour	125 $\mu g/m^3$	4	1	- (1)	- (1)
	1-year	50 $\mu g/m^3$	0	0	- (1)	- (1)
NO_2	1-hour	200 $\mu g/m^3$	88	0	0	- (1)
	1-year	40 $\mu g/m^3$	0	0	0	- (1)
PM_{10}	24-hour	75 $\mu g/m^3$	4	47	- (1)	- (1)
	1-year	40 $\mu g/m^3$	0	1	- (1)	- (1)
$PM_{2.5}$	24-hour	40 $\mu g/m^3$	4	43	41	- (1)
	1-year	20 $\mu g/m^3$	0	1	1	- (1)
Medupi AQMS						
SO_2	10-min	500 $\mu g/m^3$	526	34	75	53
	1-hour	350 $\mu g/m^3$	88	18	27	21
	24-hour	125 $\mu g/m^3$	4	1	1	1
	1-year	50 $\mu g/m^3$	0	0	0	0
NO_2	1-hour	200 $\mu g/m^3$	88	0	0	0
	1-year	40 $\mu g/m^3$	0	0	0	0
PM_{10}	24-hour	75 $\mu g/m^3$	4	12	7	22
	1-year	40 $\mu g/m^3$	0	0	0	0
$PM_{2.5}$	24-hour	40 $\mu g/m^3$	4	8	- (1)	- (1)
	1-year	20 $\mu g/m^3$	0	0	- (1)	- (1)
Lephalale AQMS						
SO_2	10-min	500 $\mu g/m^3$	526	- (2)	- (2)	- (2)
	1-hour	350 $\mu g/m^3$	88	0	0	2
	24-hour	125 $\mu g/m^3$	4	0	0	0
	1-year	50 $\mu g/m^3$	0	0	0	0
NO_2	1-hour	200 $\mu g/m^3$	88	0	0	0
	1-year	40 $\mu g/m^3$	0	0	0	0
PM_{10}	24-hour	75 $\mu g/m^3$	4	1	- (1)	0
	1-year	40 $\mu g/m^3$	0	0	- (1)	0
$PM_{2.5}$	24-hour	40 $\mu g/m^3$	4	- (1)	- (1)	0
	1-year	20 $\mu g/m^3$	0	- (1)	- (1)	0
Notes:	(1) Data recovery below 50%; thus, exceedances are not presented. (2) The Lephalale AQMS does not measure data in 10-minute intervals. Values in red indicate non-compliance against the respective standard.					

6. IMPACT OF ENTERPRISE ON THE RECEIVING ENVIRONMENT

6.1 Dispersion Modelling

6.1.1 Models used

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

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

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

6.1.2 TAPM and CALPUFF parameterisation

The TAPM diagnostic meteorological model is used to generate a 3-dimensional temporally and spatially continuous meteorological field for 2021, 2022 and 2023 in hourly increments for the modelling domain.

TAPM is set-up in a nested configuration of two domains, centred between Medupi and Matimba. The outer domain is 480 km by 480 km at a 12 km grid resolution and the inner domain is 120 km by 120 km at a 3 km grid resolution (Figure 6-1). The nesting configuration ensures that topographical effects on meteorology are captured and that meteorology is well resolved and characterised across the boundaries of the inner domain. Twenty-seven vertical levels are modelled in each nest from 10 m to 5 000 m, with a finer resolution in the lowest 1 000 m. The subset of the entire TAPM model output in the form of pre-processed gridded surface meteorological data fields is input into the dispersion model.

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

The CALPUFF modelling domain covers an area of 11 664 km^2, where the domain extends 108 km (west-east) by 108 km (north-south). It consists of a uniformly spaced receptor grid with 1 km spacing, giving 11 664 grid cells (108 x 108 grid cells).

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

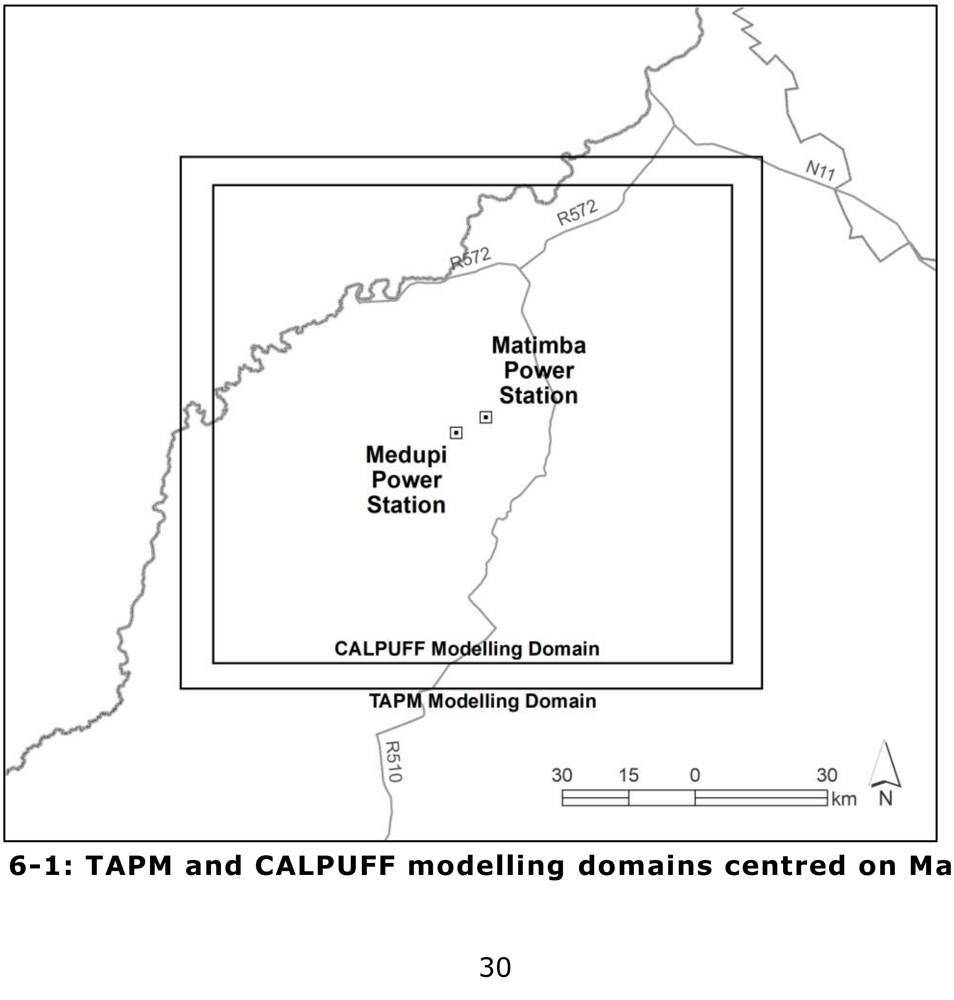


Figure 6-1: TAPM and CALPUFF modelling domains centred on Matimba

The parameterisation of key variables that will apply in CALMET and CALPUFF are indicated in Table 6-1 and Table 6-2 respectively.

Table 6-1: Parameterisation of key variables for CALMET

Parameter	Model value
12 vertical cell face heights (m)	0, 20, 40, 80, 160, 320, 640, 1000, 1500, 2000, 2500, 3000, 4000
Coriolis parameter (per second)	0.0001
Empirical constants for mixing height equation	Neutral, mechanical: 1.41 Convective: 0.15 Stable: 2400 Overwater, mechanical: 0.12
Minimum potential temperature lapse rate (K/m)	0.001
Depth of layer above convective mixing height through which lapse rate is computed (m)	200
Wind field model	Diagnostic wind module
Surface wind extrapolation	Similarity theory
Restrictions on extrapolation of surface data	No extrapolation as modelled upper air data field is applied
Radius of influence of terrain features (km)	5
Radius of influence of surface stations (km)	Not used as continuous surface data field is applied

Table 6-2: Parameterisation of key variables for CALPUFF

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

6.1.3 Model accuracy

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

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

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

6.1.4 Assessment scenarios

Five emission scenarios are assessed for Medupi and Matimba. These scenarios are:

Scenario 1 (Current): The baseline scenario using actual monthly stack emissions for 2021-2023 and fugitive emissions from the coal stockyards and the ash dumps (No FGD installed).

Scenario A (2025): Eskom's planned 2025 stack emissions, representing anticipated station performance between 2025 – 2030, including fugitive emissions from the coal stockyards and the ash dumps (No FGD installed).

Scenario B (2031): Eskom's planned 2031 stack emissions, representing anticipated station performance between 2031 – 2035, including fugitive emissions from the coal stockyards and the ash dumps (No FGD installed but load reduction).

Scenario C (2036): Eskom's planned 2036 stack emissions, representing anticipated station performance from 2036 onwards, including fugitive emissions from the coal stockyards and the ash dumps (FGD installed at Medupi).

Scenario D (MES): Full compliance with the MES, including fugitive emissions from the coal stockyards and the ash dumps (FGD installed at Medupi and Matimba).

6.2 Dispersion Modelling Results

The dispersion modelling results are compared with the NAAQS for SO_2, NO_2, PM_{10} and $PM_{2.5}$ (Table 3-3). It is not possible to apportion the PM_{10} and $PM_{2.5}$ portion of the total PM, so the PM emission is conservatively modelled as PM_{10} and $PM_{2.5}$. The CALPUFF modelling suite provides for the chemical conversion of SO_2 and NO_X to secondary particulates, i.e. sulphate and nitrate in the modelling results. The predicted PM_{10} and $PM_{2.5}$ concentrations presented here include direct emissions of PM plus secondary particulates formed from the power station emissions.

The 99th percentile predicted ambient SO_2, NO_2, PM_{10} and $PM_{2.5}$ concentrations from the dispersion modelling for Medupi and Matimba for the five emission scenarios are presented as isopleth maps over the modelling domain. The DEA (2012c) recommend the 99th percentile concentrations for short-term assessment with the NAAQS since the highest predicted ground-level concentrations can be considered outliers due to complex variability of meteorological processes. In addition, the limit value in the NAAQS is the 99th percentile.

6.2.1 Maximum predicted ambient concentrations

The maximum predicted annual SO_2, NO_2, PM_{10} and $PM_{2.5}$ concentrations and the 99th percentile of the 24-hour and 1-hour predicted concentrations in the modelling domain are discussed here and are listed in Table 6-3 for the 5 scenarios. Exceedances of the limit value of the NAAQS are shown in red font. Exceedance of the limit value does not automatically indicate non-compliance with the NAAQS as the standards provide a tolerance in the form of a permitted number of exceedances. The frequency of exceedances is discussed in Section 6.2.2.

For SO_2, the predicted concentrations are attributed only to the stack emissions. The maximum predicted annual average concentrations for the 5 scenarios are low relative to the limit values of the respective NAAQS. The predicted the 99th percentile of the 24-hour SO_2 concentrations and the predicted 1-hour concentrations exceeded the limit value of the NAAQS in Scenario A (2025) Scenario B (2031) and in Scenario C (2036). The predicted maximum SO_2 concentration occurs between 10 and 15 km southwest of Medupi and Matimba. Noteworthy is the compliance with the NAAQS with actual emissions (Scenario 1 (Current)) and Scenario D (MES).

For NO_2, the predicted concentrations are attributed only to the stack emissions. The predicted maximum and 99th percentile concentrations comply the respective NAAQS for the 5 scenarios. The predicted maximum NO_2 concentration occurs between 10 and 15 km southwest of Medupi and Matimba.

For PM_{10} and $PM_{2.5}$, the predicted concentrations are attributed to stack emissions, the low-level fugitive sources (coal stockyard and ash dump) and the contribution from secondary particulate formation. The total PM emissions are not speciated into PM_{10} or $PM_{2.5}$, rather all PM emitted is assumed to be firstly PM_{10}, and then all PM emitted is assumed to be $PM_{2.5}$.

For PM_{10} and $PM_{2.5}$, the maximum predicted annual average concentrations exceed the limit values of the respective NAAQS in all scenarios. Similarly, the 99th percentile of the

24-hour PM_{10} and $PM_{2.5}$ concentrations exceeds the limit value of the NAAQS. The predicted maximum PM_{10} and $PM_{2.5}$ concentrations occur within 10 km of Medupi and Matimba to the southwest.

Table 6-3: Maximum predicted ambient annual SO_2, NO_2 PM_{10}, and $PM_{2.5}$ concentrations in µg/m³ and the predicted 99th percentile concentrations for 24-hour and 1-hour averaging periods, with the NAAQS

Scenario and Pollutant	**Averaging time**		
Predicted maximum SO_2	**Annual**	**24-hour**	**1-hour**
Scenario 1 (Current)	15.6	123.2	316.9
Scenario A (2025)	24.7	**223.9**	**598.9**
Scenario B (2031)	26.7	**221.6**	**575.8**
Scenario C (2035)	17.9	**211.2**	**451.0**
Scenario D (MES)	6.7	64.9	156.6
NAAQS	50	125	350
Predicted maximum NO_2	**Annual**		**1-hour**
Scenario 1 (Current)	2.0		46.9
Scenario A (2025)	3.9		103.0
Scenario B (2031)	4.3		100.1
Scenario C (2035)	3.2		82.4
Scenario D (MES)	3.2		82.4
NAAQS	40		200
Predicted maximum PM_{10}	**Annual**	**24-hour**	
Scenario 1 (Current)	**77.9**	**277.2**	
Scenario A (2025)	**78.3**	**278.3**	
Scenario B (2031)	**78.2**	**276.2**	
Scenario C (2035)	**77.9**	**272.6**	
Scenario D (MES)	**77.6**	**270.0**	
NAAQS	40	75	
Predicted maximum $PM_{2.5}$	**Annual**	**24-hour**	
Scenario 1 (Current)	**77.9**	**277.2**	
Scenario A (2025)	**78.3**	**278.3**	
Scenario B (2031)	**78.2**	**276.2**	
Scenario C (2035)	**77.9**	**272.6**	
Scenario D (MES)	**77.6**	**270.0**	
NAAQS	**20**	**40**	Up to 31 Dec 2029
NAAQS	**15**	**25**	From 01 Jan 2030

6.2.2 Predicted concentrations at AQMS and sensitive receptors

The predicted annual SO_2, NO_2, PM_{10} and $PM_{2.5}$ concentrations and the 99th percentile of the 24-hour and 1-hour predicted concentrations at AQMS in the Waterberg modelling area are presented in Table 6-4 to Table 6-7. The measured annual averages in 2021, 2022 and 2023 presented with the modelled annual average concentration for Scenario 1: (Current).

For SO_2 and NO_2 the predicted ambient concentrations result from the respective power station stack emissions only. At all the AQMS the modelled concentrations are lower than the monitored concentrations. This is to be expected since AQMS are exposed to all sources of SO_2 and NO_2. The difference between the predicted concentrations and the measured concentrations provides an indication of the contribution of the power station stack emissions at the respective AQMS.

For PM_{10} and $PM_{2.5}$ the predicted ambient concentrations result from the respective power station stack emissions and the fugitive low-level sources, i.e. the coal stockyard and the ash dumps at each power station. At the Marapong and Lephalale AQMS the modelled concentrations are considerably lower than the monitored concentrations. This is to be expected since AQMS are exposed to all sources of PM_{10} and $PM_{2.5}$. The difference between the predicted concentrations and the measured concentrations provides an indication of the contribution of the power station stack emissions at the respective AQMS.

At the Medupi AQMS however the modelled PM_{10} and $PM_{2.5}$ concentrations are generally higher than the monitored concentrations, contrary to expectation as the AQMS is exposed to more sources. Noteworthy is the poor data recover at the Medupi AQMS, especially in 2022 and 2023. In these years for PM_{10} it was only 56% and 62%, and for $PM_{2.5}$ it was 35% and 28%. Data is deemed acceptable if recovery is 90% or more. In this data of 50% or more was used, so the results need to be viewed with caution, otherwise that data was not used in averaging.

Table 6-4: Measured annual average SO_2 concentration at the Waterberg AQMS compared with predicted concentrations in µg/m^3

Receptor	2021	2022	2023	Modelled
Marapong AQMS	13.9	-	-	6.2
Medupi AQMS	16.2	27.0	34.6	10.9
Lephalale AQMS	5.4	5.0	7.1	5.4

Table 6-5: Measured annual average NO_2 concentration at the Waterberg AQMS compared with predicted concentrations in µg/m^3

Receptor	2021	2022	2023	Modelled
Marapong AQMS	16.4	17.3	-	0.7
Medupi AQMS	5.5	10.4	11.3	1.4
Lephalale AQMS	10.8	12.8	15.7	0.5

Table 6-6: Measured annual average PM_{10} concentration at the Waterberg AQMS compared with predicted concentrations in µg/m^3

Receptor	2021	2022	2023	Modelled
Marapong AQMS	47.0	-	-	5.7
Medupi AQMS	28.8	28.4	37.5	36.2
Lephalale AQMS	37.3	-	17.4	2.1

Table 6-7: Measured annual average $PM_{2.5}$ concentration at the Waterberg AQMS compared with predicted concentrations in µg/m^3

Receptor	2021	2022	2023	Modelled
Marapong AQMS	25.8	30.2	-	5.7
Medupi AQMS	15.2	-	-	36.2
Lephalale AQMS	-	-	12.2	2.1

In the Waterberg study area 51 sensitive receptors were identified (Table 2-3). The predicted ambient SO_2 NO_2, PM_{10} and $PM_{2.5}$ concentrations at the sensitive receptors for the five scenarios are presented in Annexure 1 with the limit value of the NAAQS. The predicted concentrations at the sensitive receptors are discussed here. The NAAQS provides for 4 exceedances of the 24-hour limit value per year, implying that 12 or fewer exceedances of the limit value in the 3-year modelling period comply with the NAAQS. The number of exceedances are included in the tables in Appendix 1.

For SO_2, the predicted concentrations result from SO_2 emissions from the power station stacks. At all identified sensitive receptors the predicted annual and 1-hour SO_2 concentrations are below the respective NAAQS for all averaging periods. The highest predicted concentrations occur in Scenario A (2025) when exceedances of the 24-hour limit value of the NAAQS at 10 sensitive receptors are predicted. Exceedances are also predicted at 10 sensitive receptors in Scenario B (2031) and at 9 in Scenario C (2036). Noteworthy is that no exceedances are predicted for Scenario D (MES).

For NO_2, the predicted concentrations result from NO_X emissions from the power station stacks. At all identified sensitive receptors the predicted NO_2 concentrations are low and below the respective NAAQS for all averaging periods. The highest predicted concentration occur for the proposed Scenario A (2025) emissions.

For PM_{10} and $PM_{2.5}$, it must be remembered that the predicted concentrations are attributed to stack emissions and the low-level fugitive sources (coal stockyard and ash dump). Furthermore, the total PM emission is not speciated into PM_{10} and $PM_{2.5}$, but rather all PM emitted is assumed to be PM_{10}, and all PM emitted is assumed to be $PM_{2.5}$. In addition, the predicted PM_{10} and $PM_{2.5}$ concentrations account for the formation of secondary particulates from SO_2 and NO_2 stack emissions. This is a very conservative approach.

For PM_{10} and $PM_{2.5}$, the predicted annual average concentrations are below the limit values of the NAAQS at all sensitive receptor points in all five scenarios. Exceedance of the 24-hour limit value of the NAAQS for PM_{10} and $PM_{2.5}$ are predicted in all five scenarios at several sensitive receptor points (Table 6-8). For $PM_{2.5}$, the limit value of the NAAQS drops from 40 µg/m^3 to 25 µg/m^3 in 2030 resulting in an increase in the number of receptor points where the limit value is exceeded.

Table 6-8: Number of sensitive receptors where the limit value of the 24-hour NAAQS is exceeded

Scenario	Number of sensitive receptors	
	PM_{10}	$PM_{2.5}$
Scenario 1 (Current)	2	17
Scenario A (2025)	5	17
Scenario B (2031)	2	27
Scenario C (3036)	0	25
Scenario D (MES)	0	24

6.2.3 Isopleth maps

Isopleth maps of predicted ambient SO_2, NO_2, PM_{10} and $PM_{2.5}$ concentrations are presented in the following sections. The predicted concentrations are shown as isopleths, lines of equal concentration, in µg/m^3 for the respective NAAQS averaging periods. The isopleths are depicted as coloured lines on the various maps, corresponding to a particular predicted ambient concentration. Areas within red isopleths indicate an area where exceedances of the respective NAAQS limit value are predicted to occur. Sensitive receptors are represented by green squares and AQMS are represented by white dots.

The South African NAAQS permits 4 exceedances of the 24-hour or daily limit value per annum, implying 12 permitted exceedances in a three-year modelling period. For the 24-hour or daily isopleth maps, areas within burgundy isopleths indicate areas where more than 12 exceedances of the limit value are predicted over a 3-year period. The predicted 24-hour concentrations in these areas do not comply with the NAAQS.

The South African NAAQS also permits 88 exceedances of the 1-hour or hourly limit value per annum, implying 264 permitted exceedances in a three-year modelling period. For the 1-hour or hourly isopleth maps, areas within burgundy isopleths indicate areas where more than 264 exceedances of the limit value are predicted over a 3-year period. The predicted 1-hour concentrations in these areas do not comply with the NAAQS.

6.2.3.1 Sulphur dioxide (SO_2)

The isopleth maps showing the predicted annual average SO_2 concentrations clearly demonstrate the effect of the predominant northeasterly winds, with dispersion generally to the southwest of the power plant. In all scenarios the highest predicted annual average concentrations occur between 10 and 20 km of the two power stations and to the southwest. The predicted annual ambient concentrations are relatively low and are below the NAAQS in all scenarios throughout the Waterberg modelling domain.

For the annual, 24-hour and 1-hour predictions, the effect of the increase in SO_2 emissions at Medupi from Scenario 1 (Current) to Scenario A (2025) is shown in the modelled results by an increase in the affected area, and with predicted exceedances of the limit value of the 24-hour and 1-hour NAAQS in an area to the southwest of Medupi and Matimba. There is marginal decrease observed in concentrations from Scenario A (2025) to Scenario B (2031) as the total emission tonnage decreases. The reduction in SO_2 emissions at Medupi in Scenario C (2036) is seen by a marked reduction in the affected area for this scenario. Noteworthy is compliance with the NAAQS in Scenario D (MES).

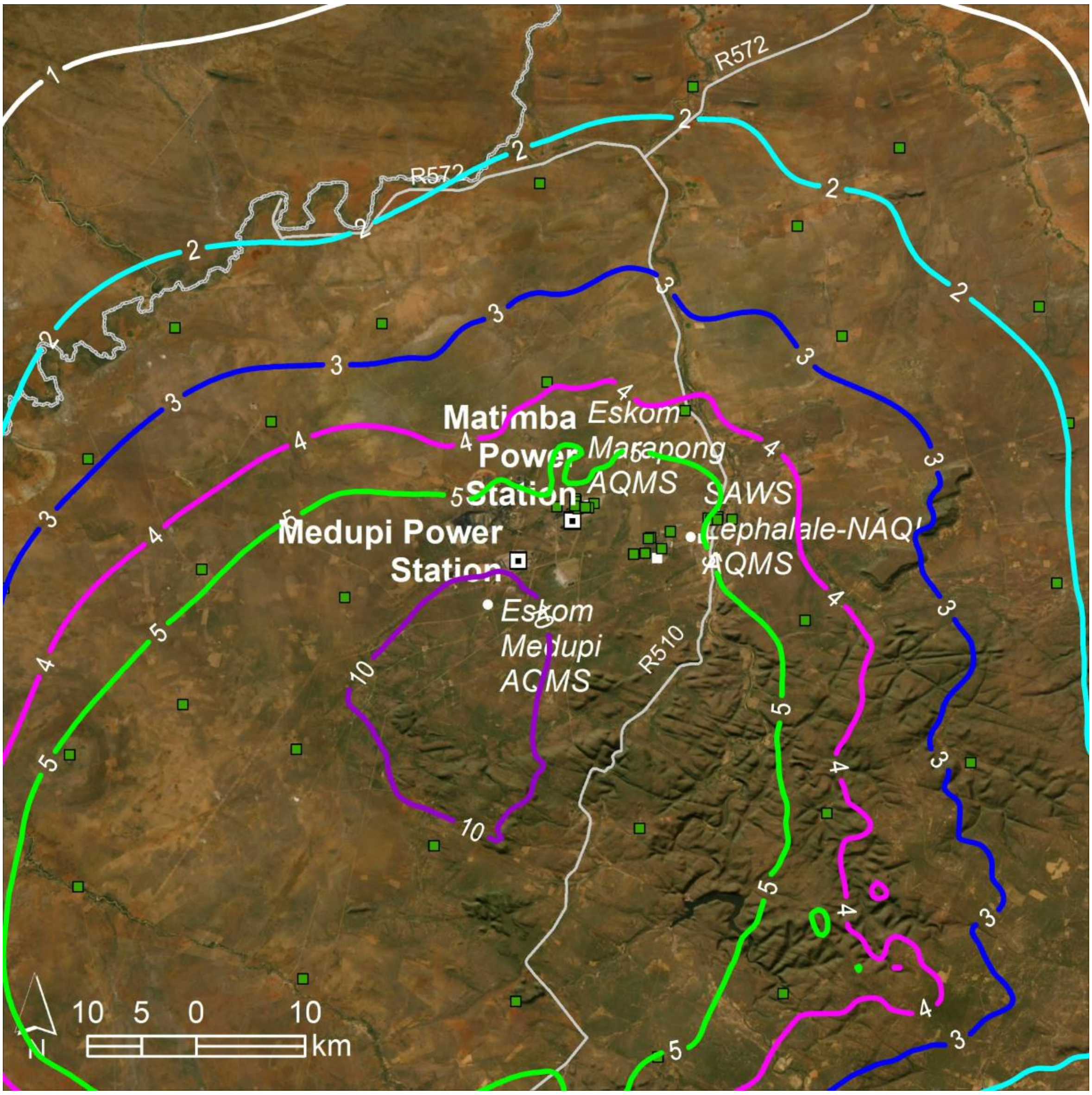


Figure 6-2: Predicted annual average SO_2 concentrations in μg/m³ for Scenario 1 (Current) (NAAQS Limit is 50 μg/m³)

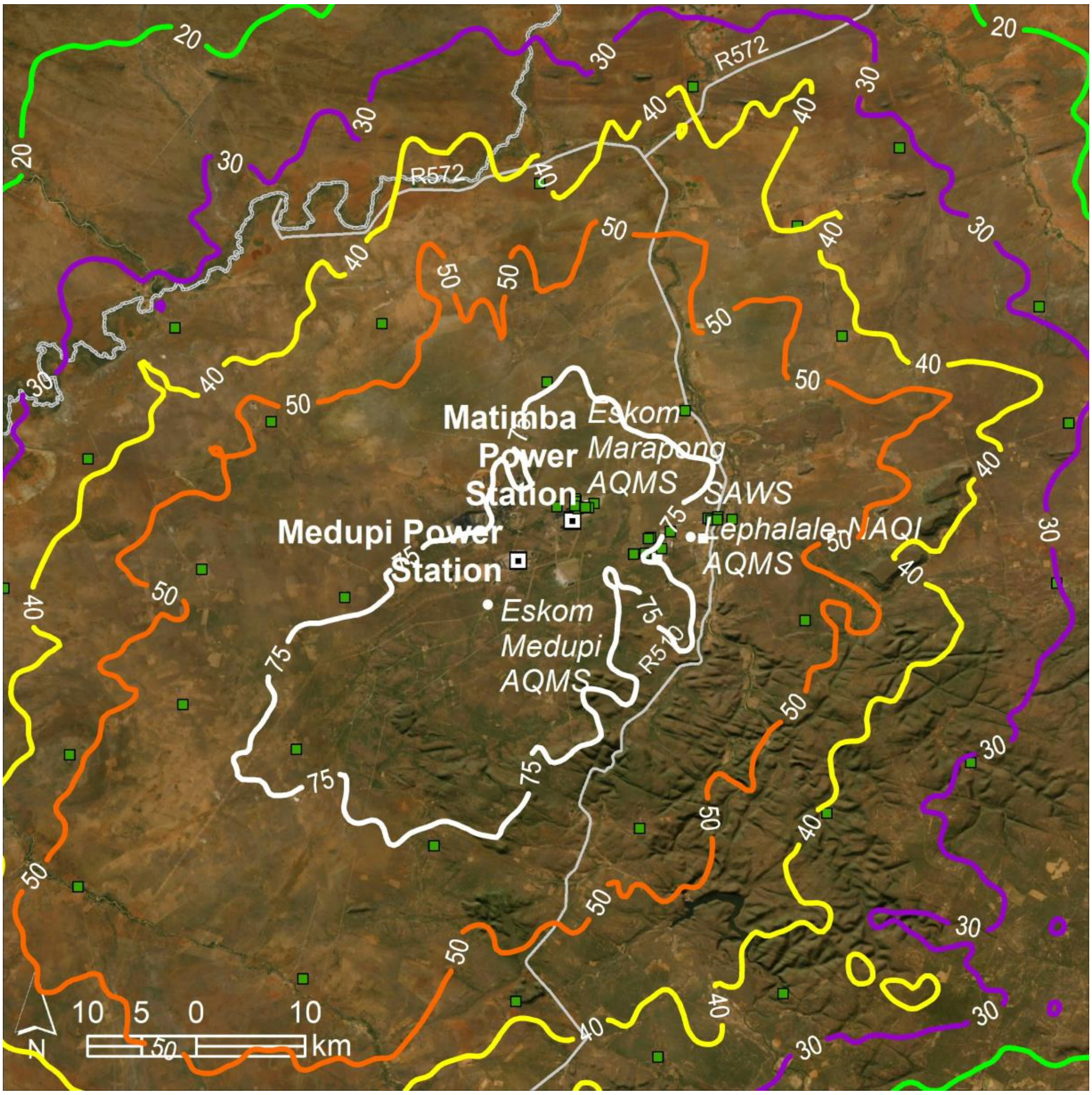


Figure 6-3: Predicted 99th percentile 24-hour SO_2 concentrations in µg/m^3 for Scenario 1 (Current) (NAAQS Limit is 125 µg/m^3)

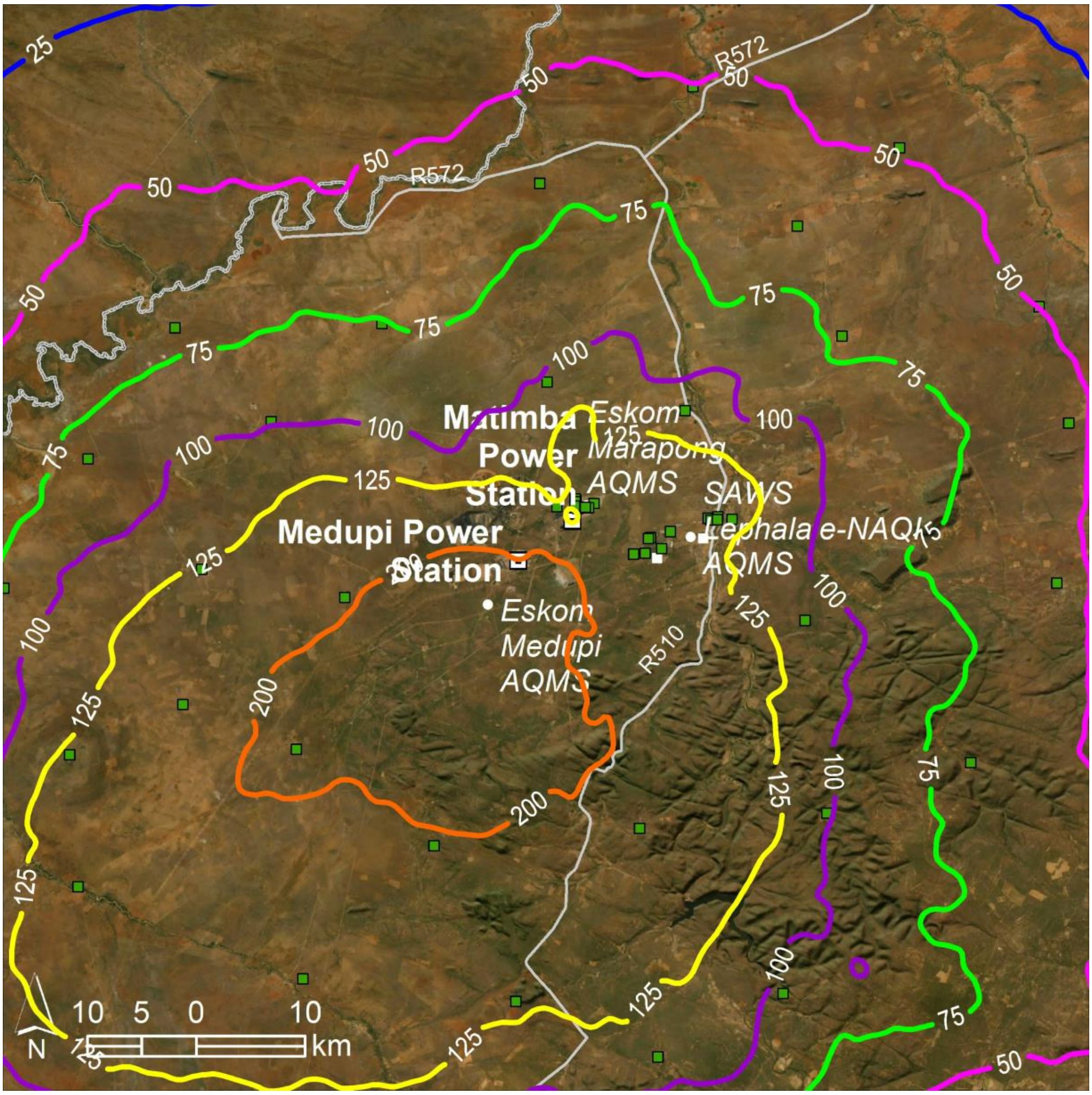


Figure 6-4: Predicted 99th percentile 1-hour SO_2 concentrations in µg/m^3 for Scenario 1 (Current) (NAAQS Limit is 350 µg/m^3)

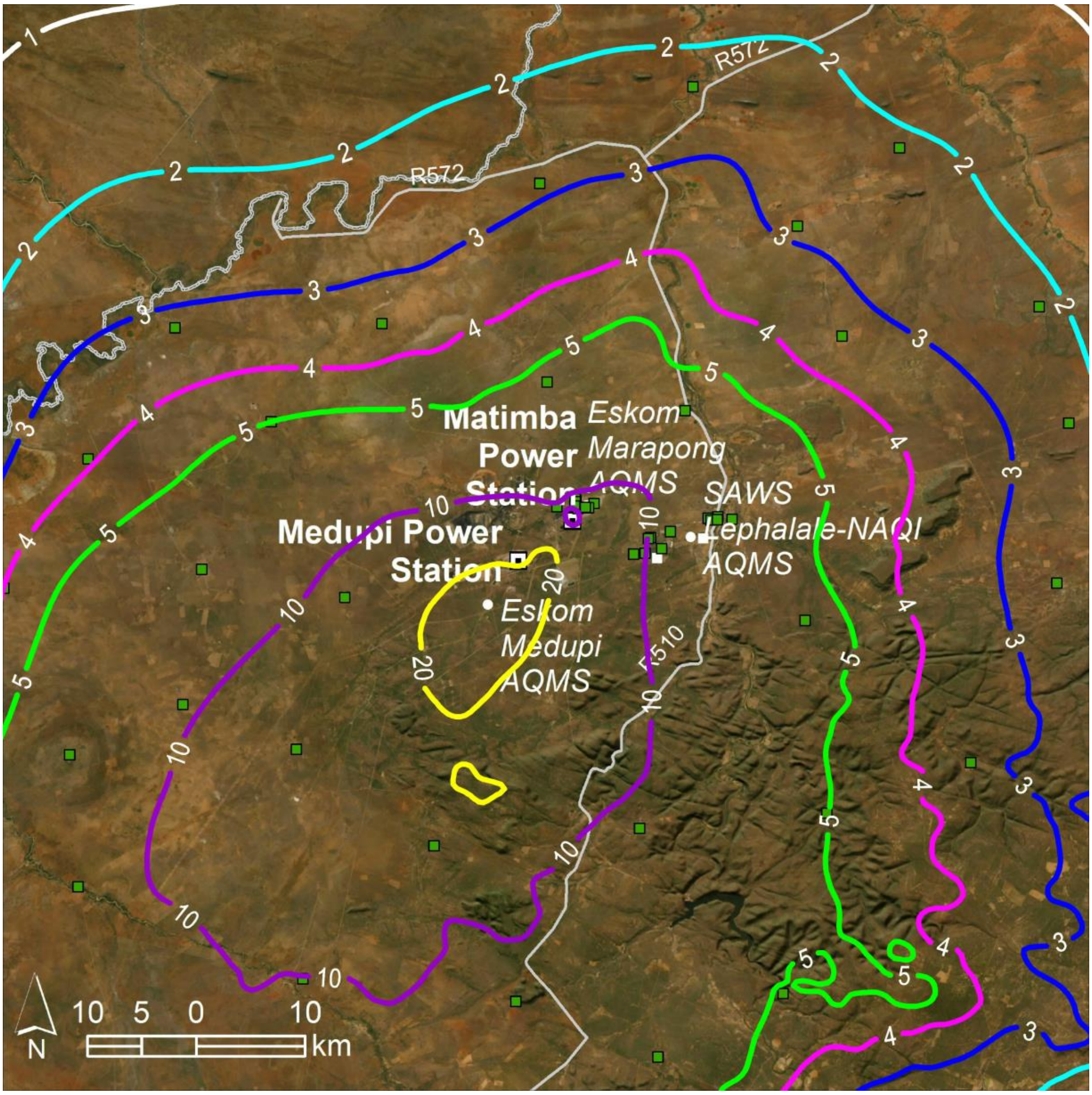


Figure 6-5: Predicted annual average SO_2 concentrations in µg/m^3 for Scenario A (2025) (NAAQS Limit is 50 µg/m^3)

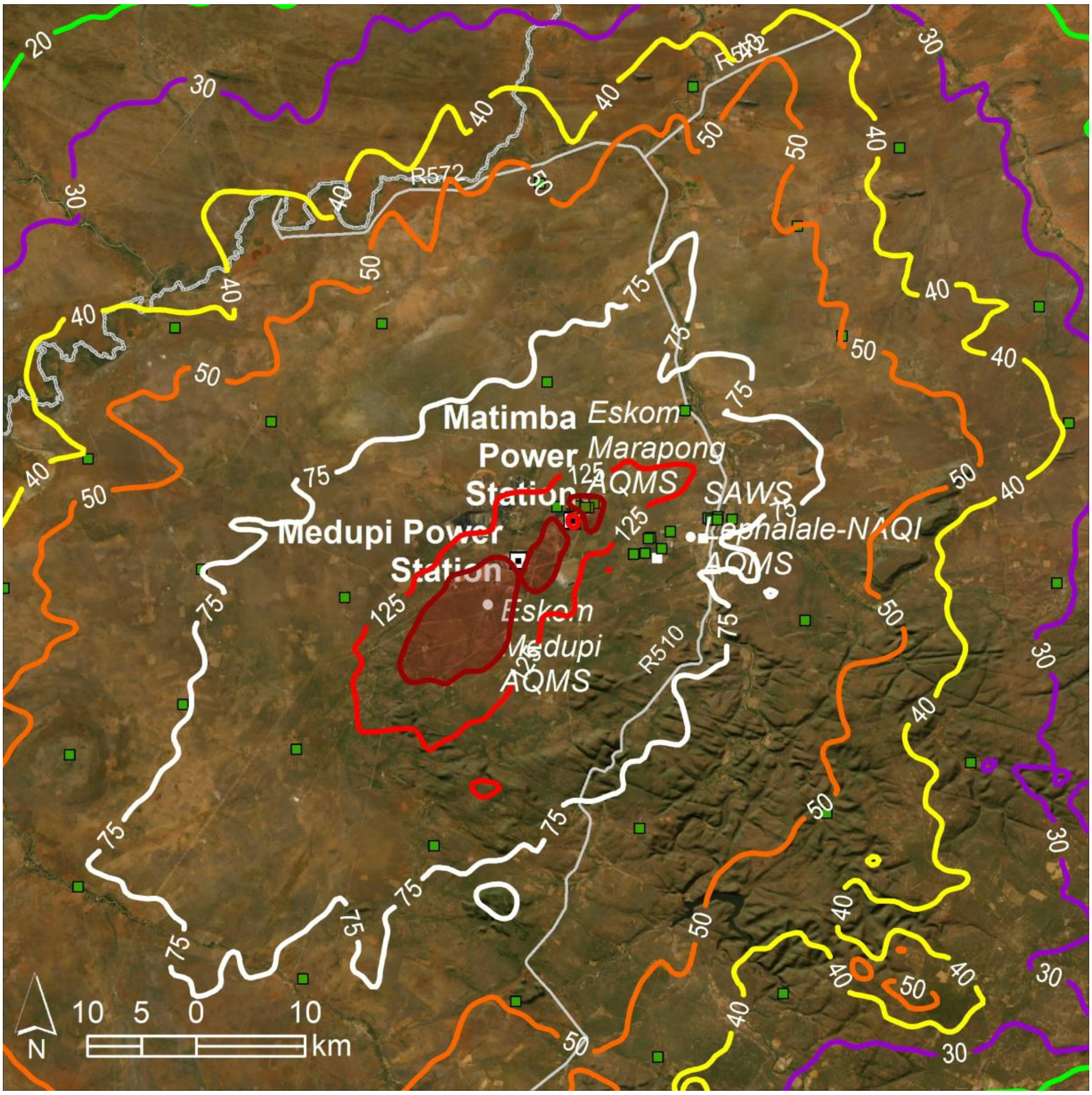


Figure 6-6: Predicted 99th percentile 24-hour SO_2 concentrations in µg/m^3 for Scenario A (2025) (NAAQS Limit is 125 µg/m^3)

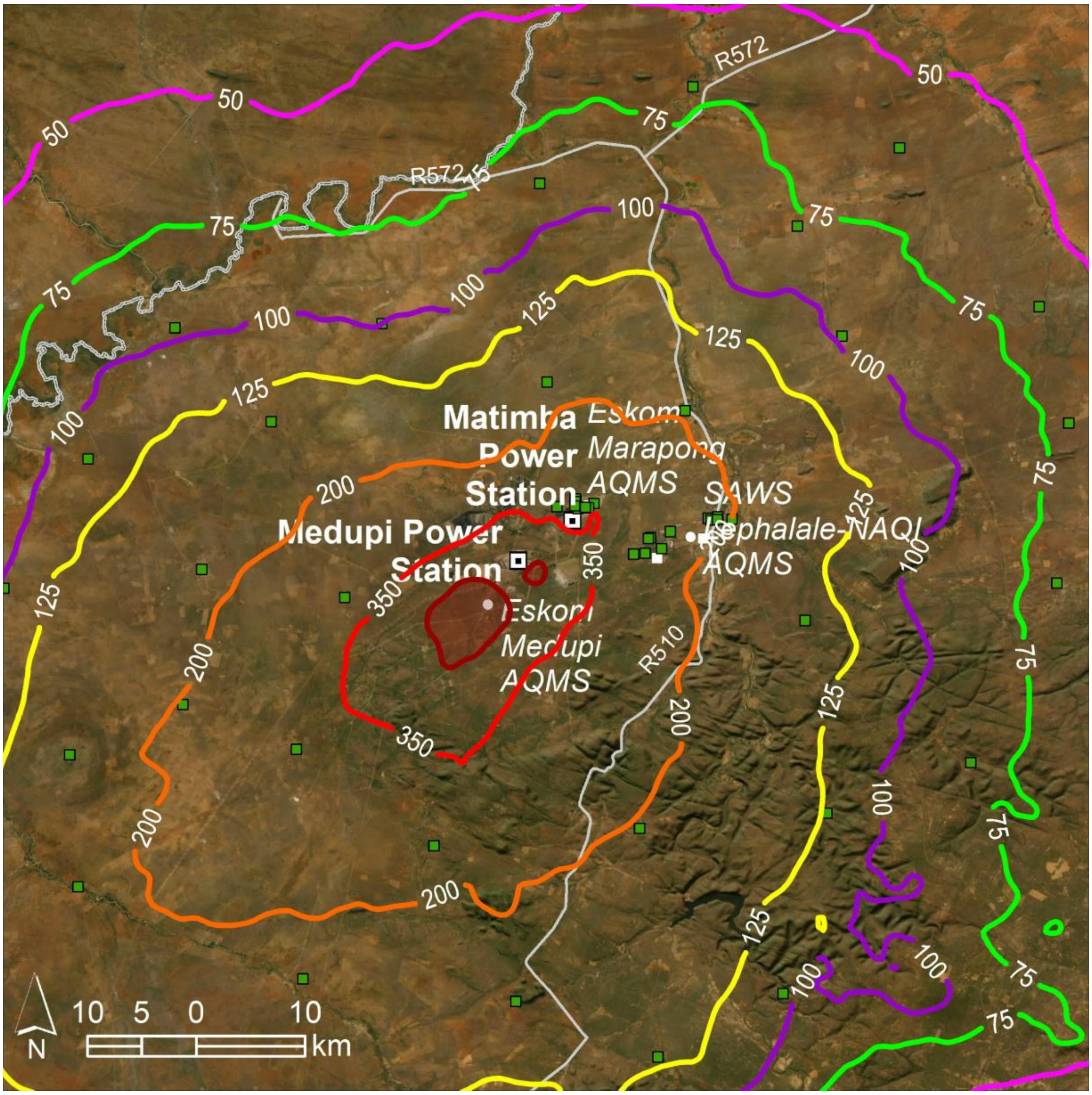


Figure 6-7: Predicted 99th percentile 1-hour SO_2 concentrations in µg/m³ for Scenario A (2025) (NAAQS Limit is 350 µg/m³)

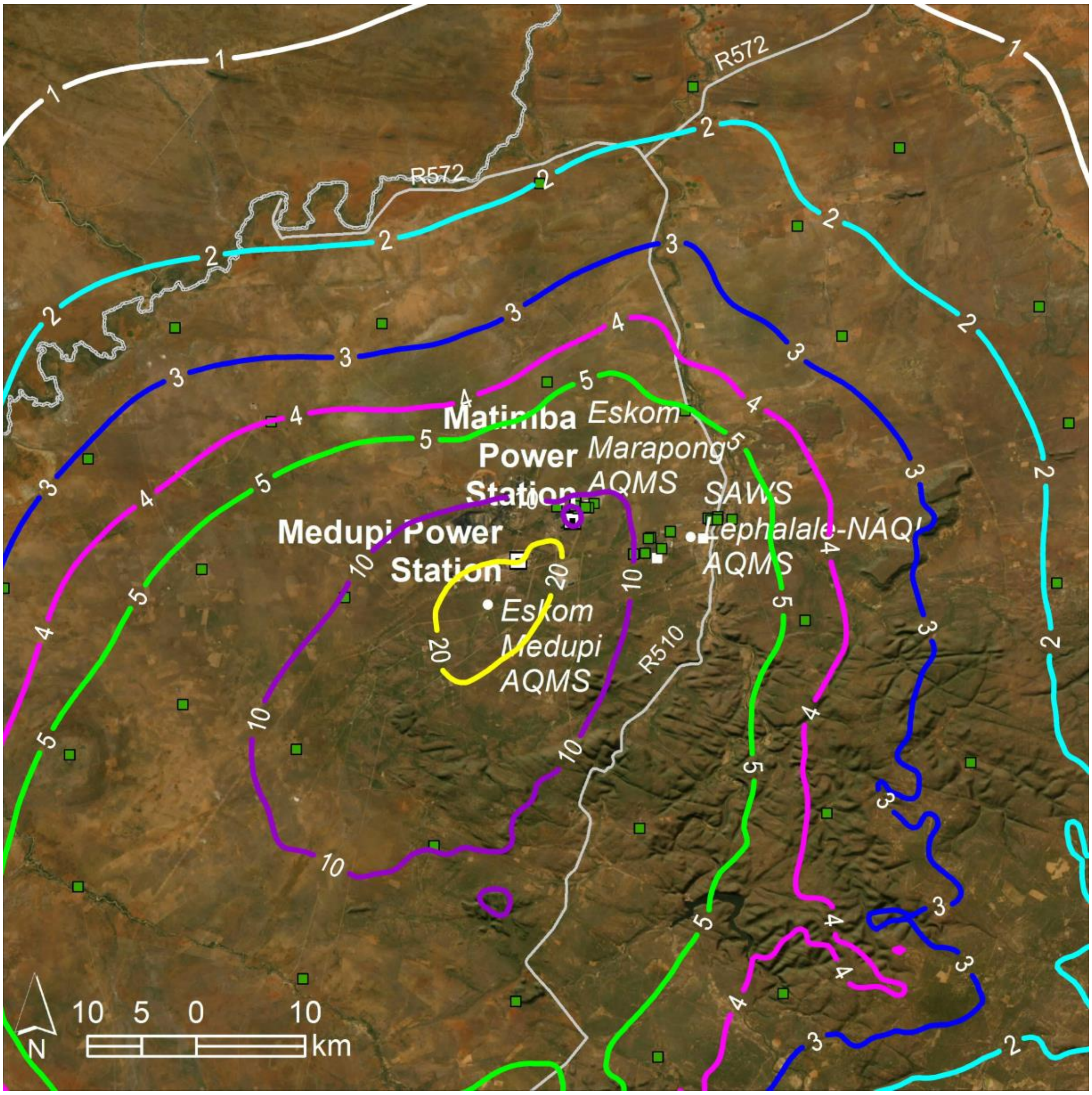


Figure 6-8: Predicted annual average SO_2 concentrations in µg/m^3 for Scenario B (2031) (NAAQS Limit is 50 µg/m^3)

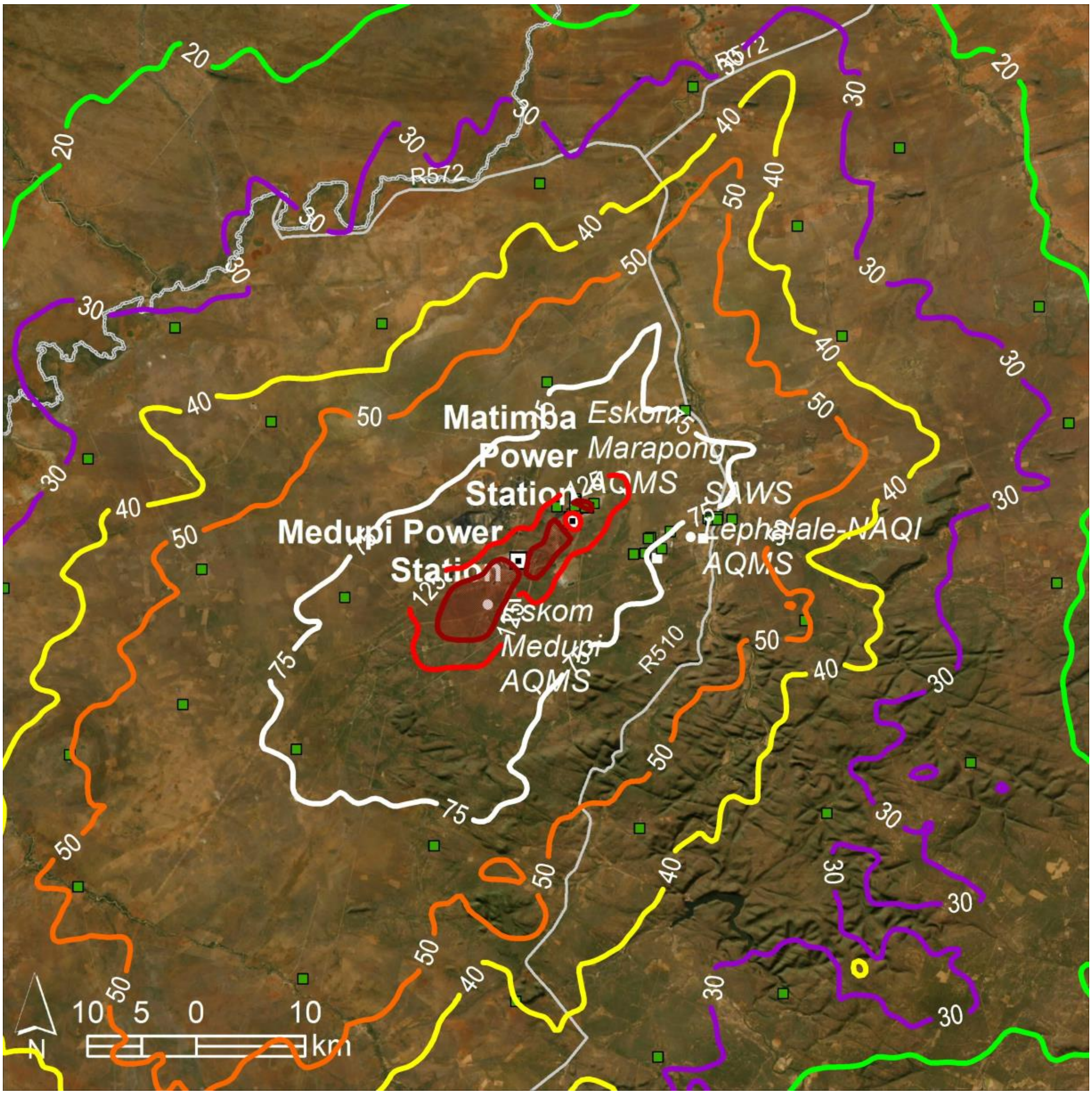


Figure 6-9: Predicted 99th percentile 24-hour SO$_2$ concentrations in µg/m^3 for Scenario B (2031) (NAAQS Limit is 125 µg/m^3)

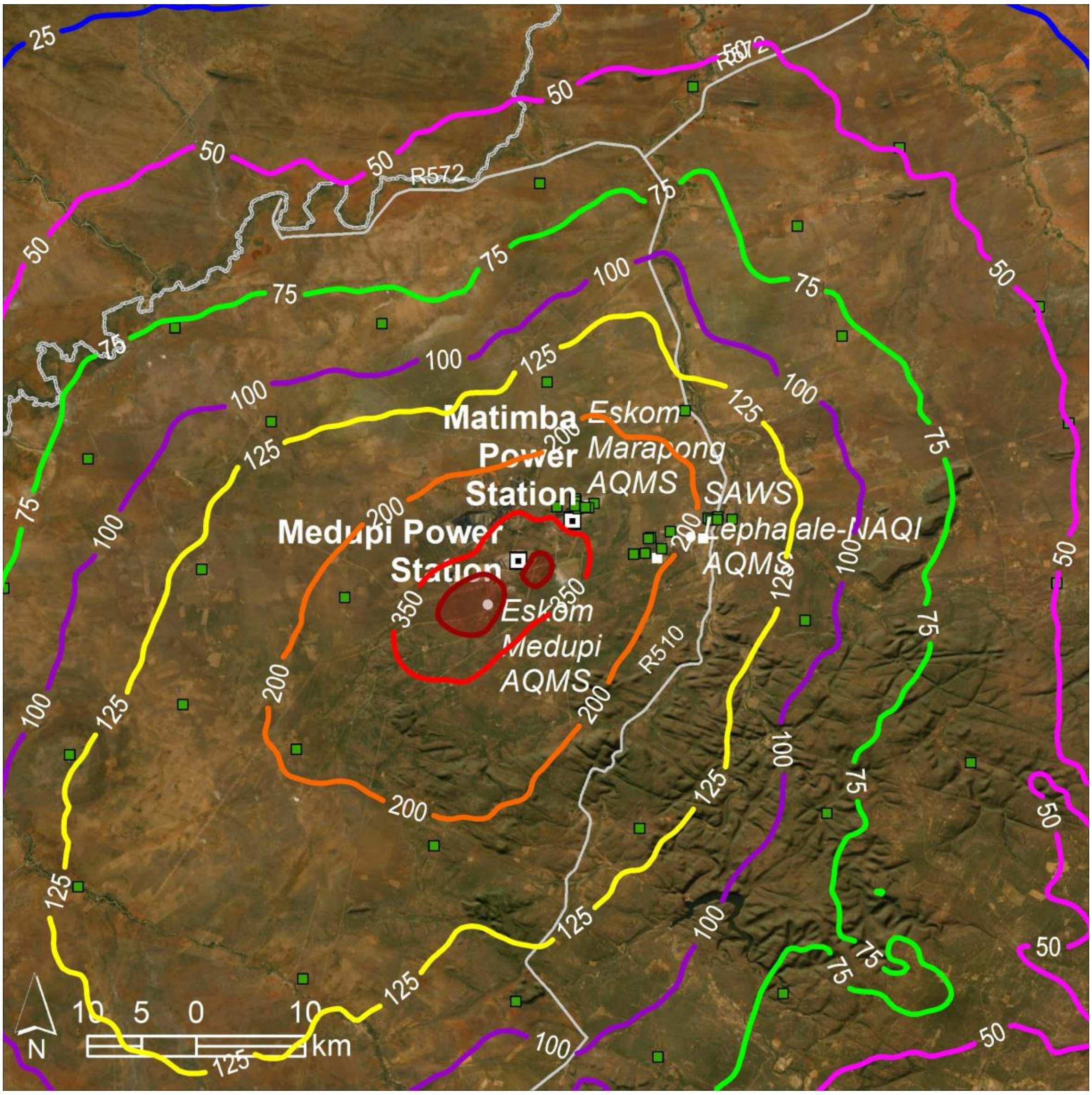


Figure 6-10: Predicted 99th percentile 1-hour SO_2 concentrations in µg/m³ for Scenario B (2031) (NAAQS Limit is 350 µg/m³)

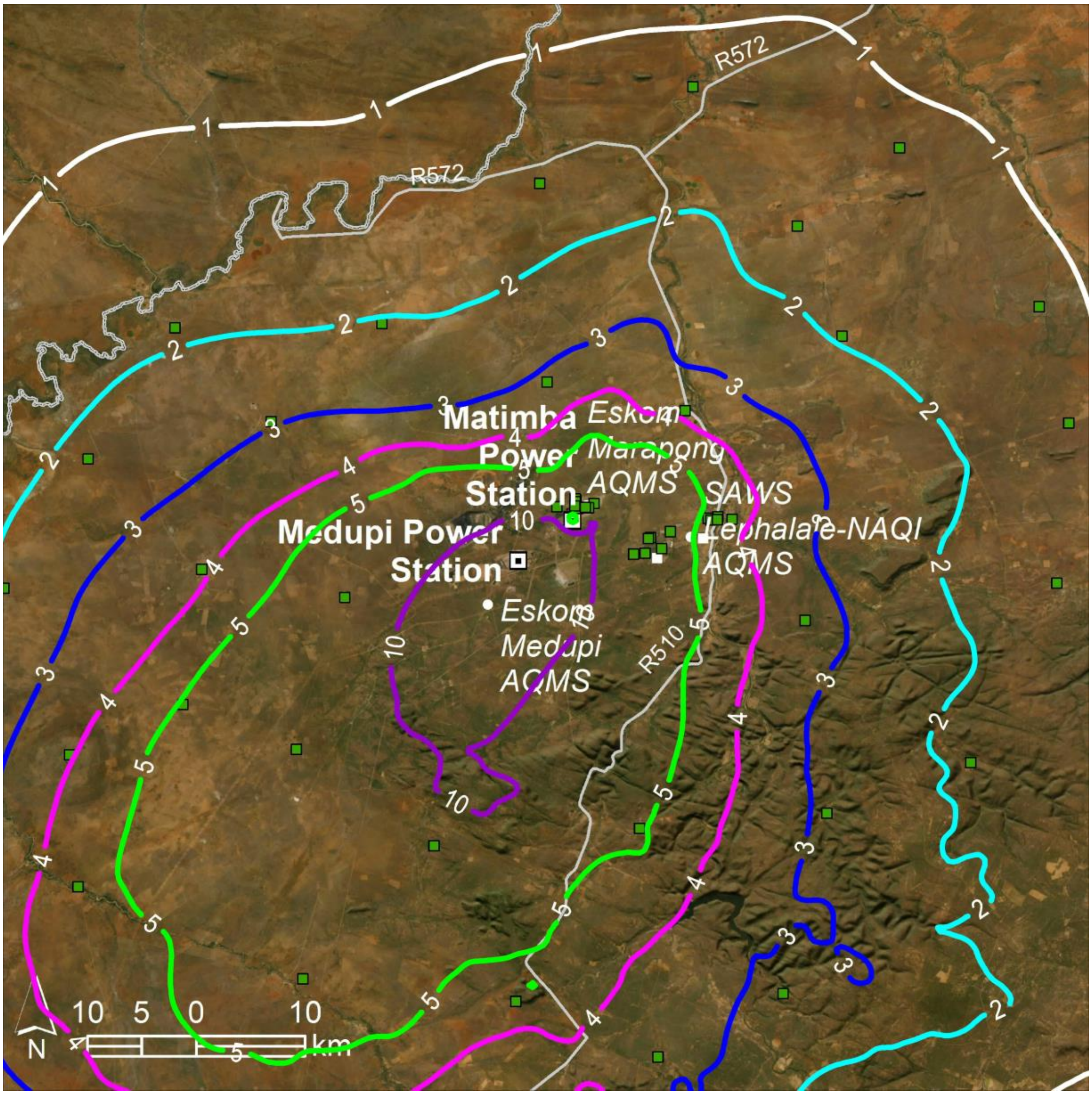


Figure 6-11: Predicted annual average SO_2 concentrations in µg/m³ for Scenario C (2036) (NAAQS Limit is 50 µg/m³)

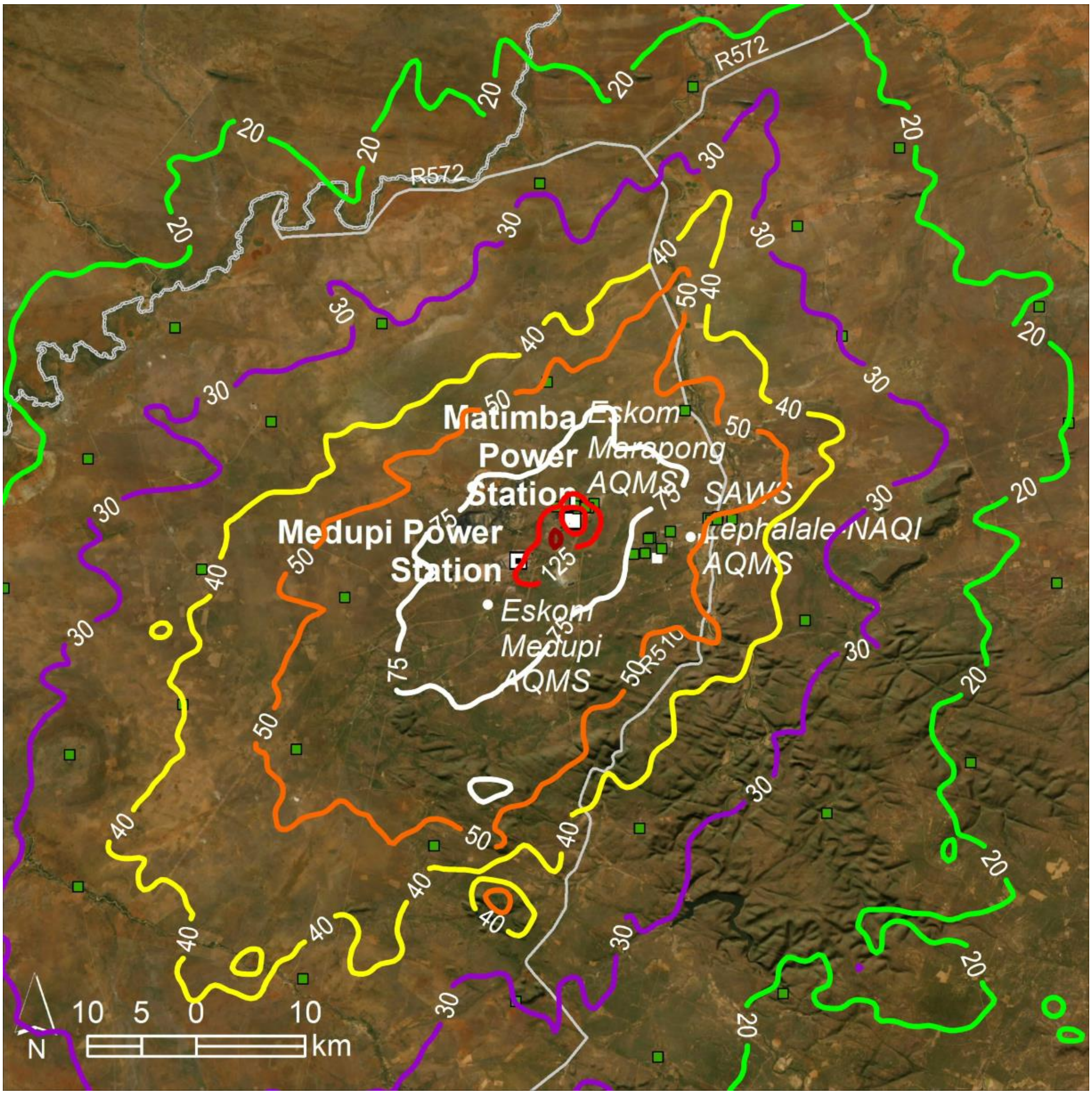


Figure 6-12: Predicted 99th percentile 24-hour SO_2 concentrations in µg/m^3 for Scenario C (2036) (NAAQS Limit is 125 µg/m^3)

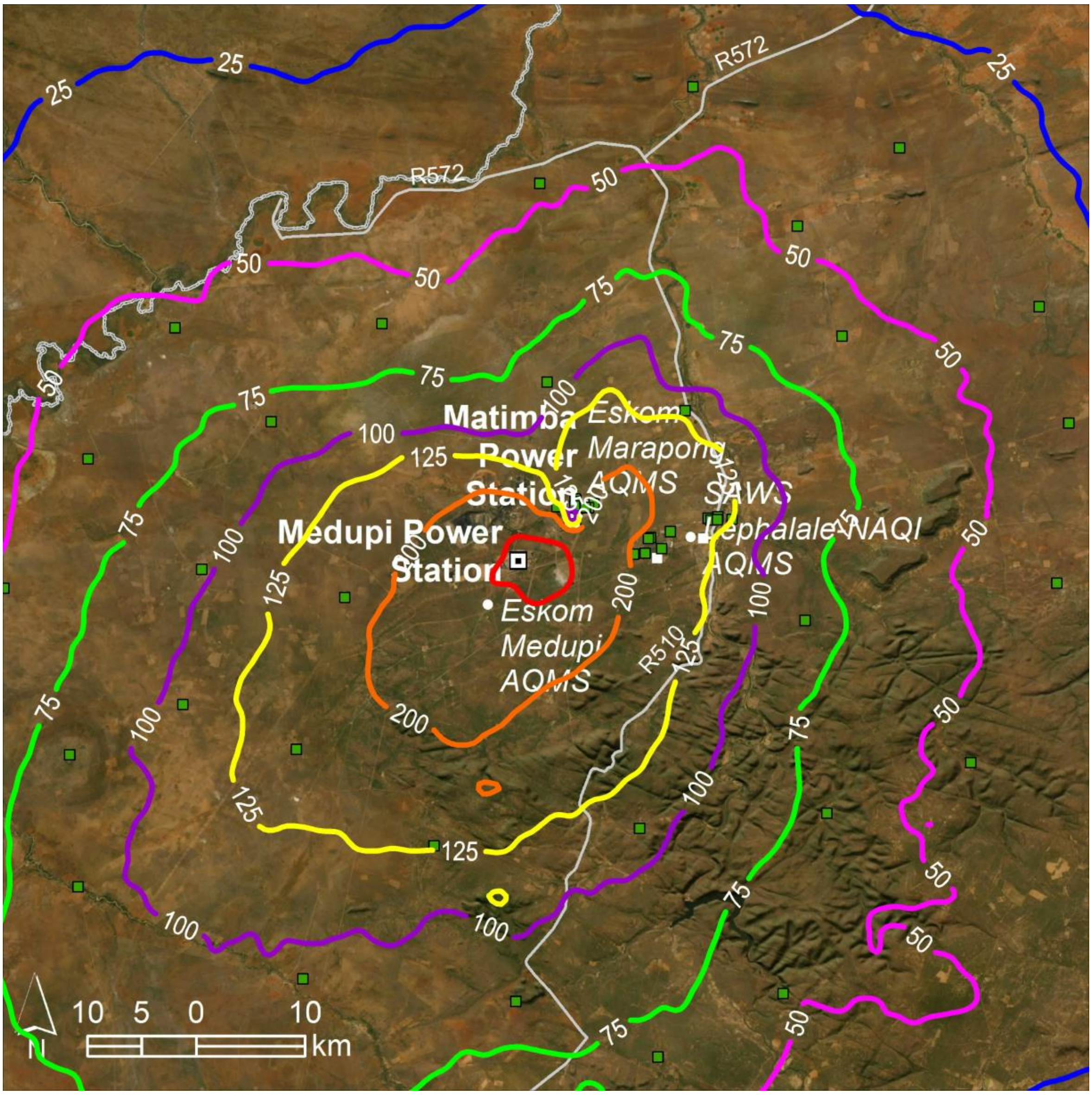


Figure 6-13: Predicted 99th percentile 1-hour SO_2 concentrations in $\mu g/m^3$ for Scenario C (2036) (NAAQS Limit is 350 $\mu g/m^3$)

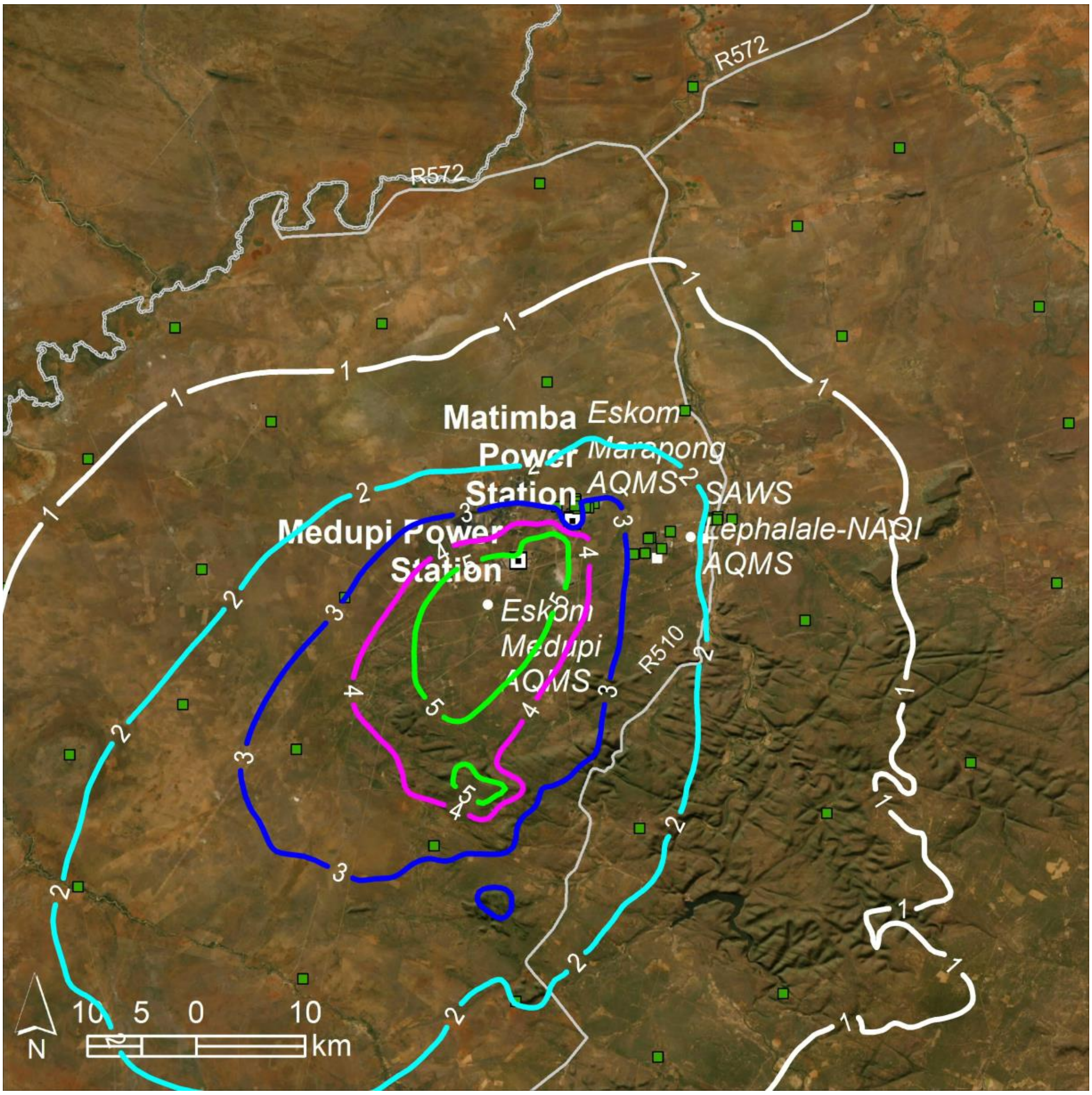


Figure 6-14: Predicted annual average SO_2 concentrations in µg/m^3 for Scenario D (MES) (NAAQS Limit is 50 µg/m^3)

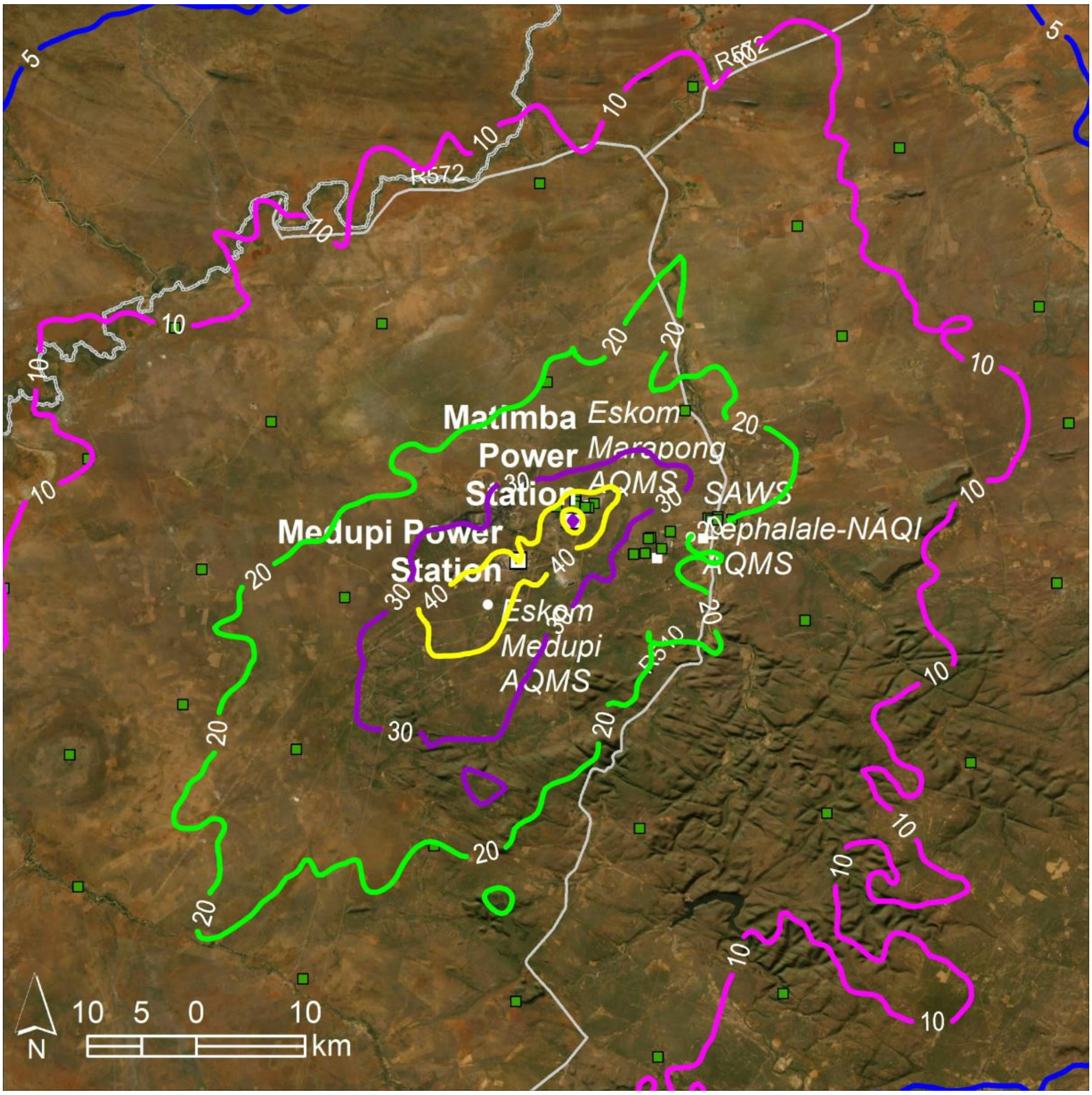


Figure 6-15: Predicted 99th percentile 24-hour SO_2 concentrations in µg/m^3 for Scenario D (MES) (NAAQS Limit is 125 µg/m^3)

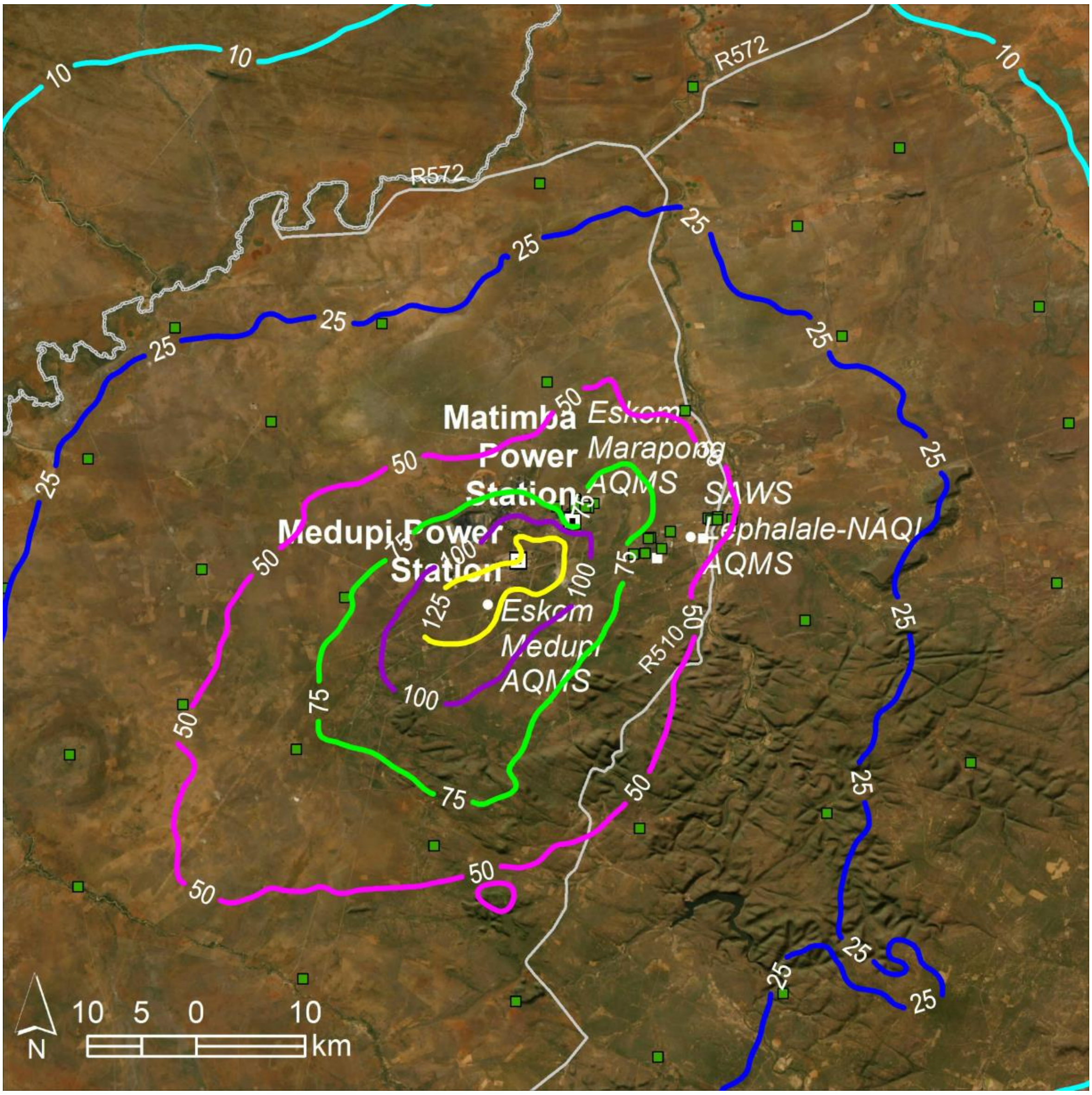


Figure 6-16: Predicted 99th percentile 1-hour SO_2 concentrations in µg/m³ for Scenario D (MES) (NAAQS Limit is 350 µg/m³)

6.2.3.2 Nitrogen dioxide (NO_2)

The isopleth maps showing the predicted annual average NO_2 concentrations clearly demonstrate the effect of the predominant northeasterly winds, with dispersion generally to the southwest of the power plant. In all scenarios the highest predicted annual average concentrations occur between 10 and 20 km to the southwest of the two power stations. The predicted ambient concentrations for all averaging periods are low and well below the NAAQS in all scenarios throughout the modelling domain.

For the annual 24-hour and 1-hour predictions, the effect of the increase in NO_2 emissions from Scenario 1 (Current) to Scenario A (2025) at Medupi is shown in the modelled results by an increase in the affected area. Similarly, the reduction in NO_2 emissions to Scenario B (2031) at both Medupi and Matimba is seen by a reduction in the affected area from the one scenario to the next. A small reduction in the affected is seen from Scenario B (2031) to Scenario C (2036). No further change is seen from Scenario C (2036) to Scenario D (MES).

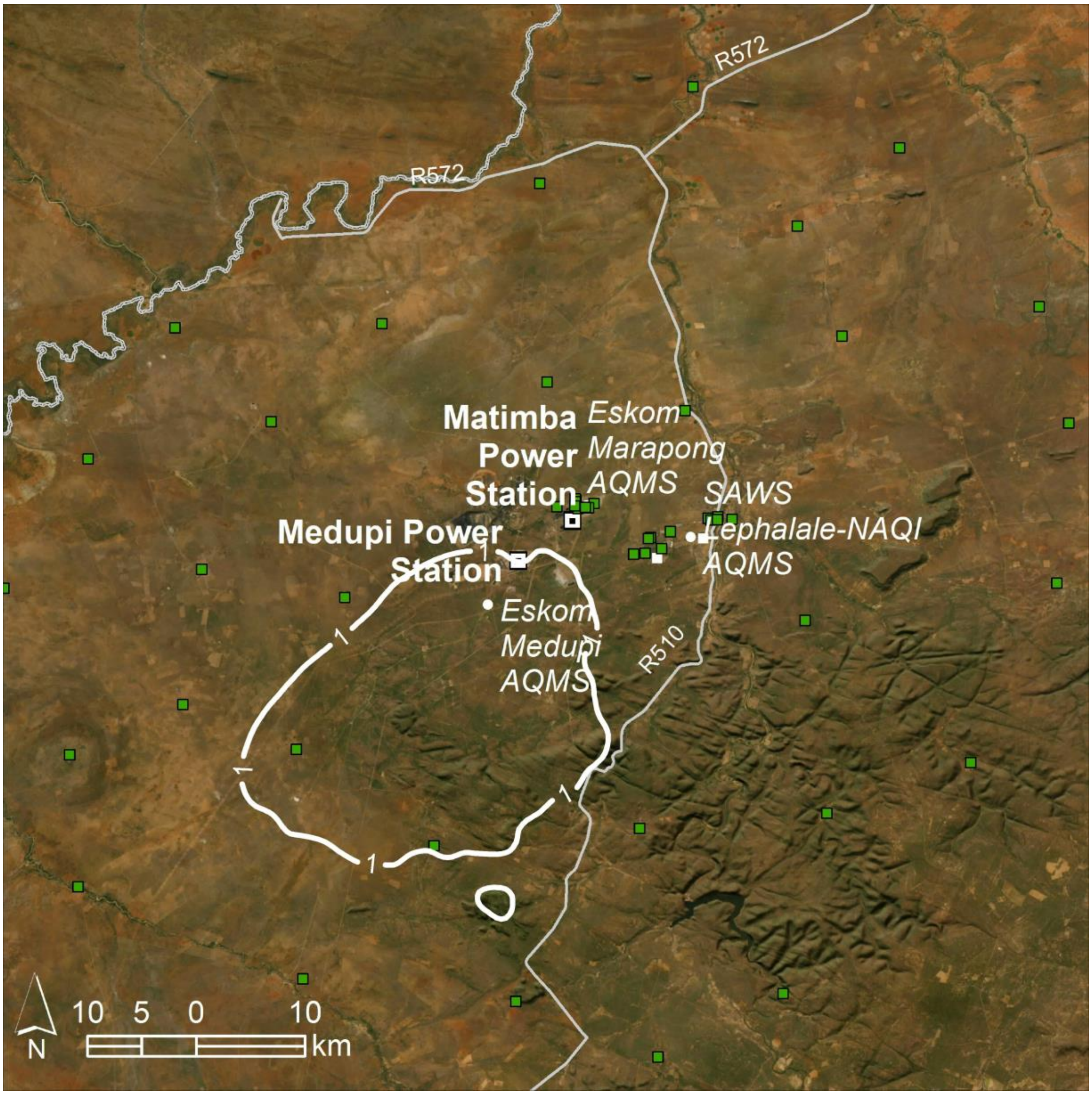


Figure 6-17: Predicted annual average NO_2 concentrations in µg/m^3 for Scenario 1 (Current) (NAAQS Limit is 40 µg/m^3)

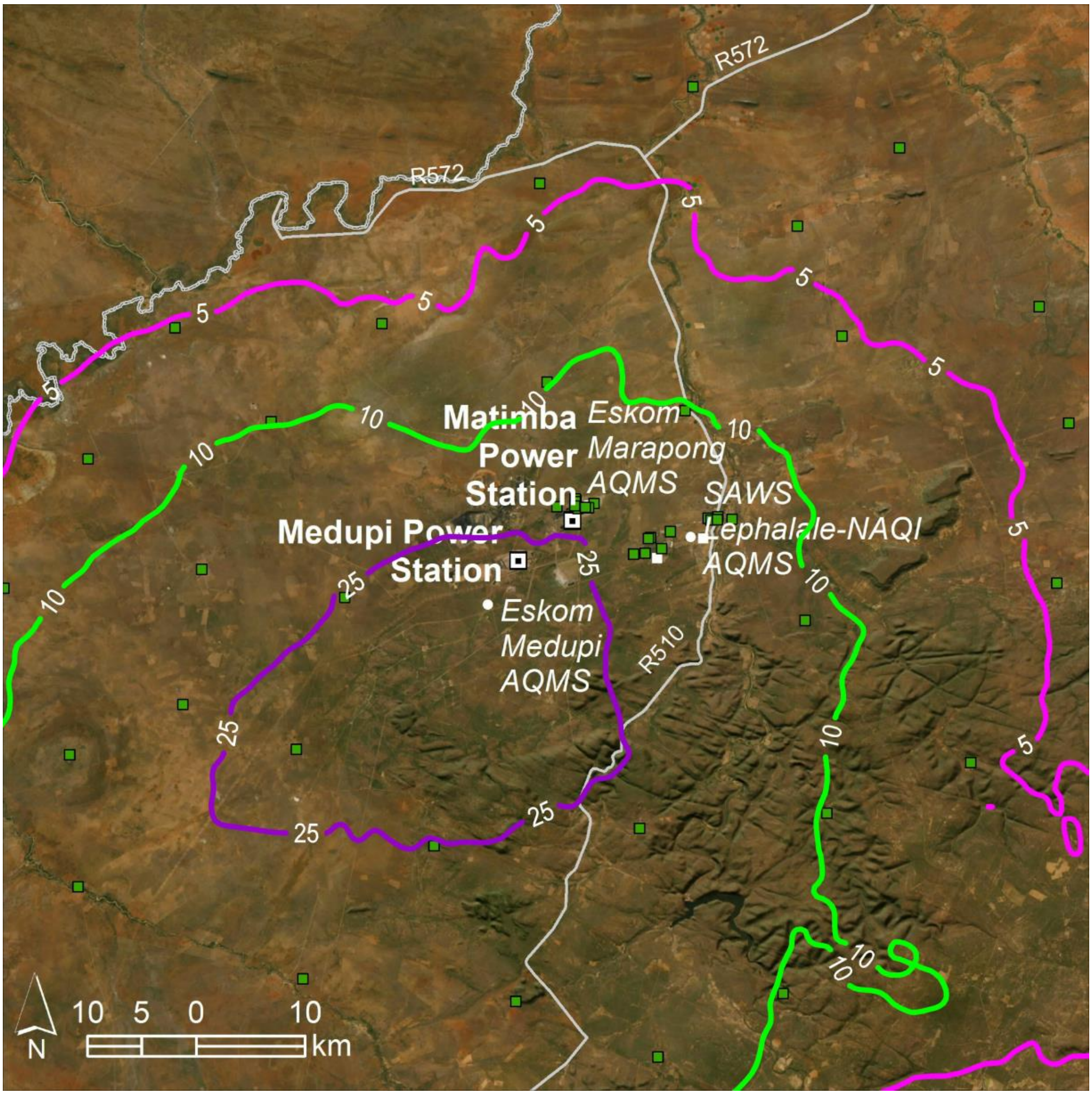


Figure 6-18: Predicted 99th percentile 1-hour NO_2 concentrations in µg/m³ for Scenario 1 (Current) (NAAQS Limit is 200 µg/m³)

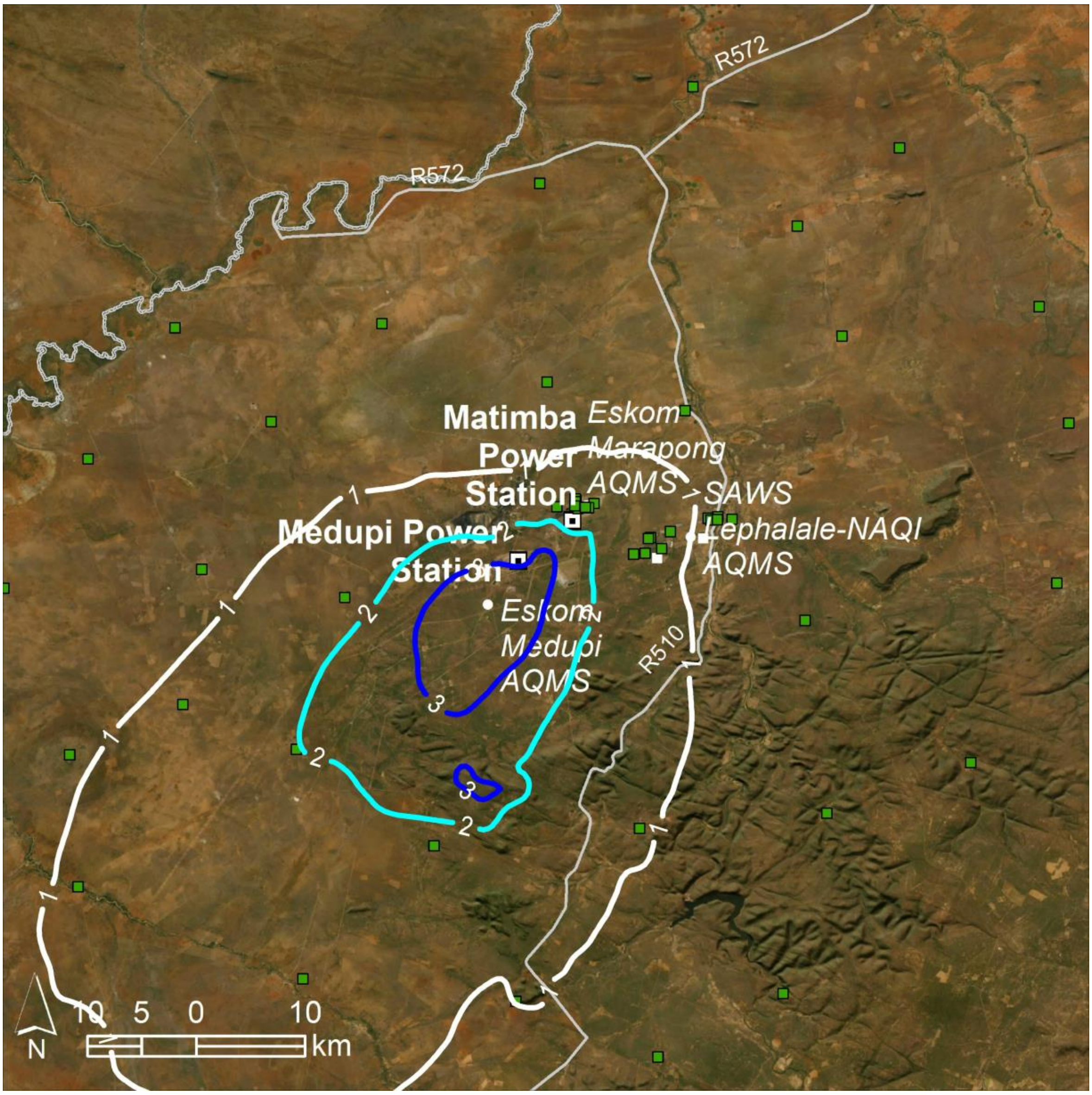


Figure 6-19: Predicted annual average NO_2 concentrations in μg/m^3 for Scenario A (2025) (NAAQS Limit is 40 μg/m^3)

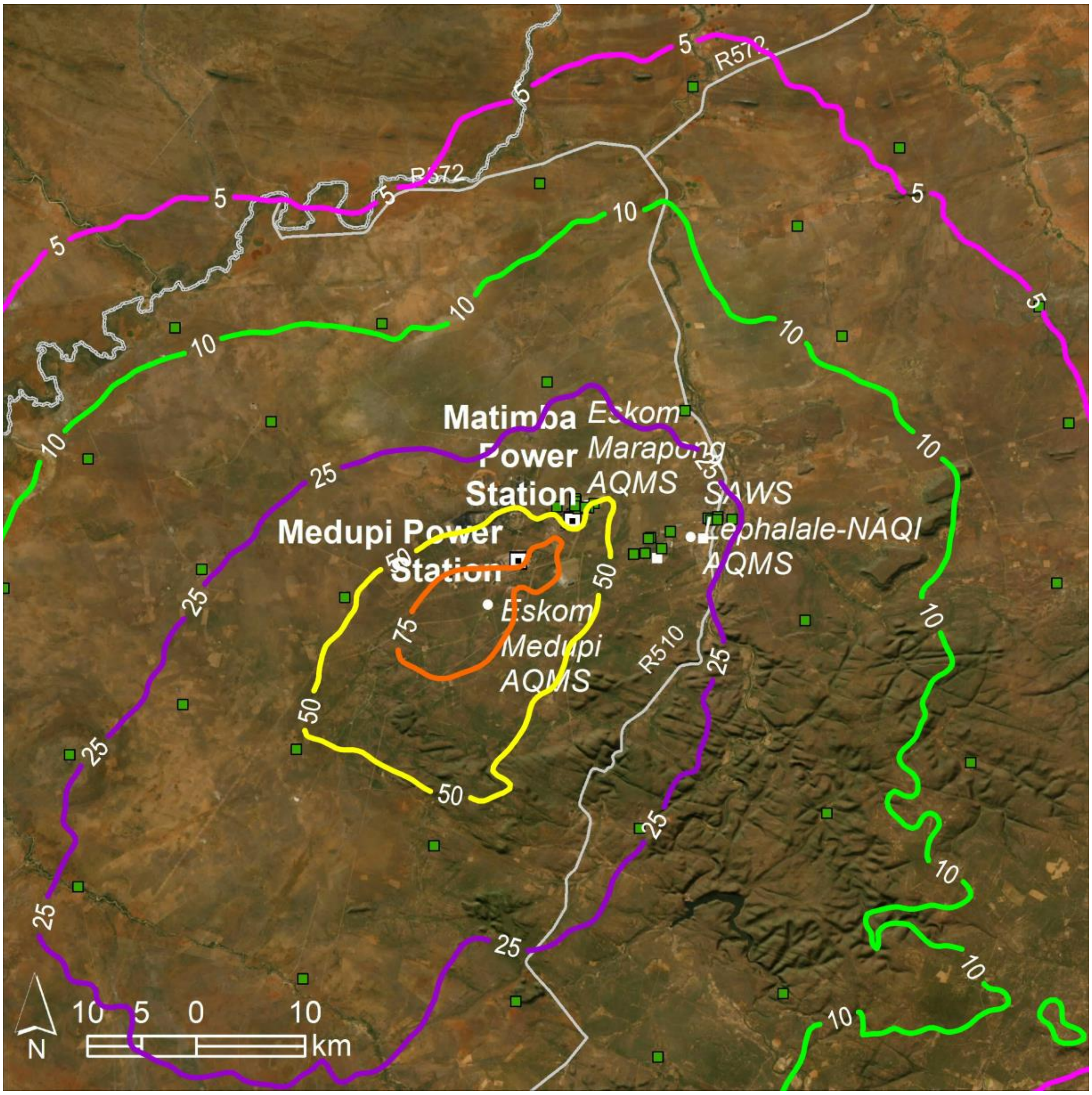


Figure 6-20: Predicted 99th percentile 1-hour NO_2 concentrations in µg/m³ for Scenario A (2025) (NAAQS Limit is 200 µg/m³)

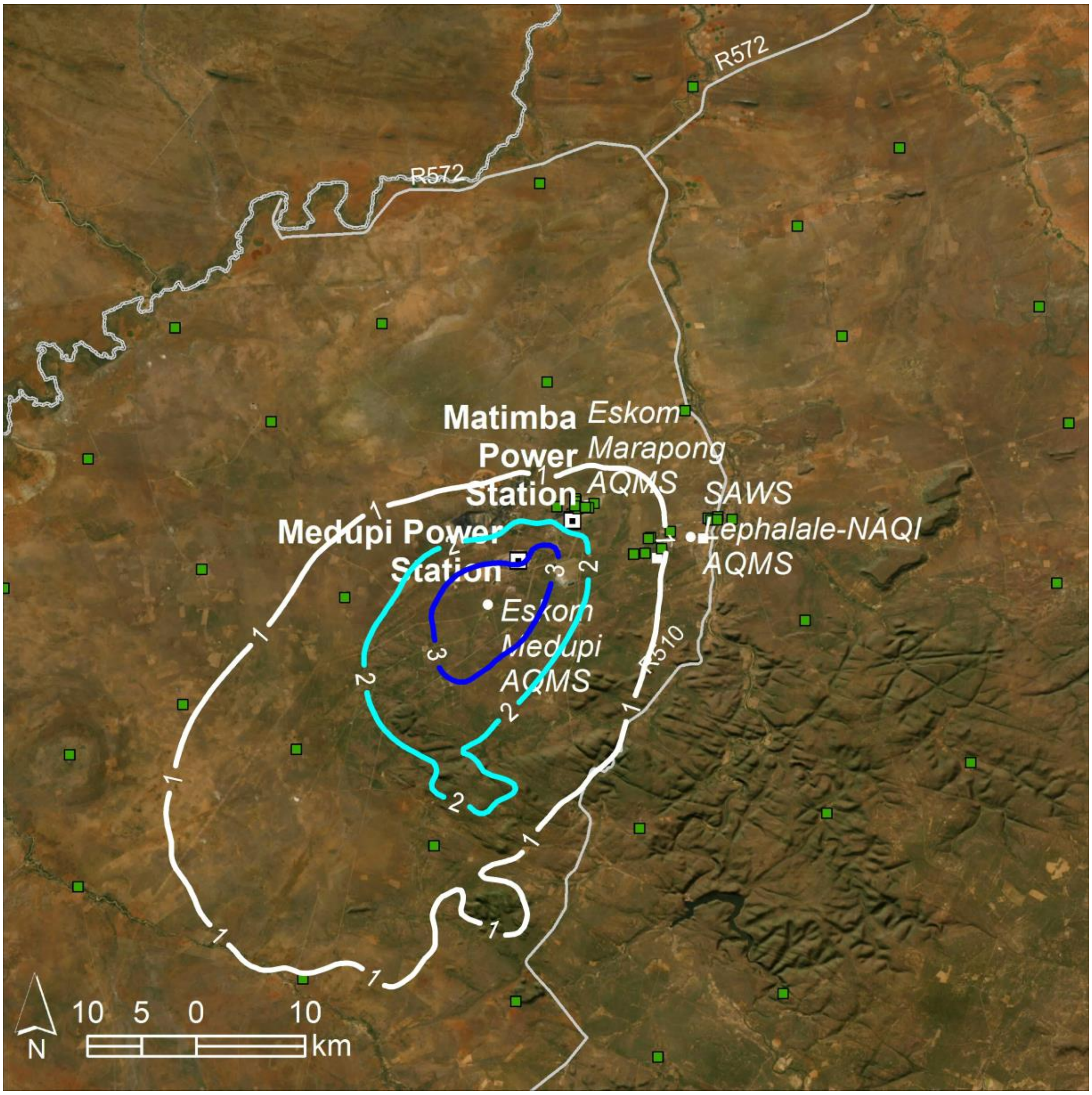


Figure 6-21: Predicted annual average NO_2 concentrations in µg/m³ for Scenario B (2031) (NAAQS Limit is 40 µg/m³)

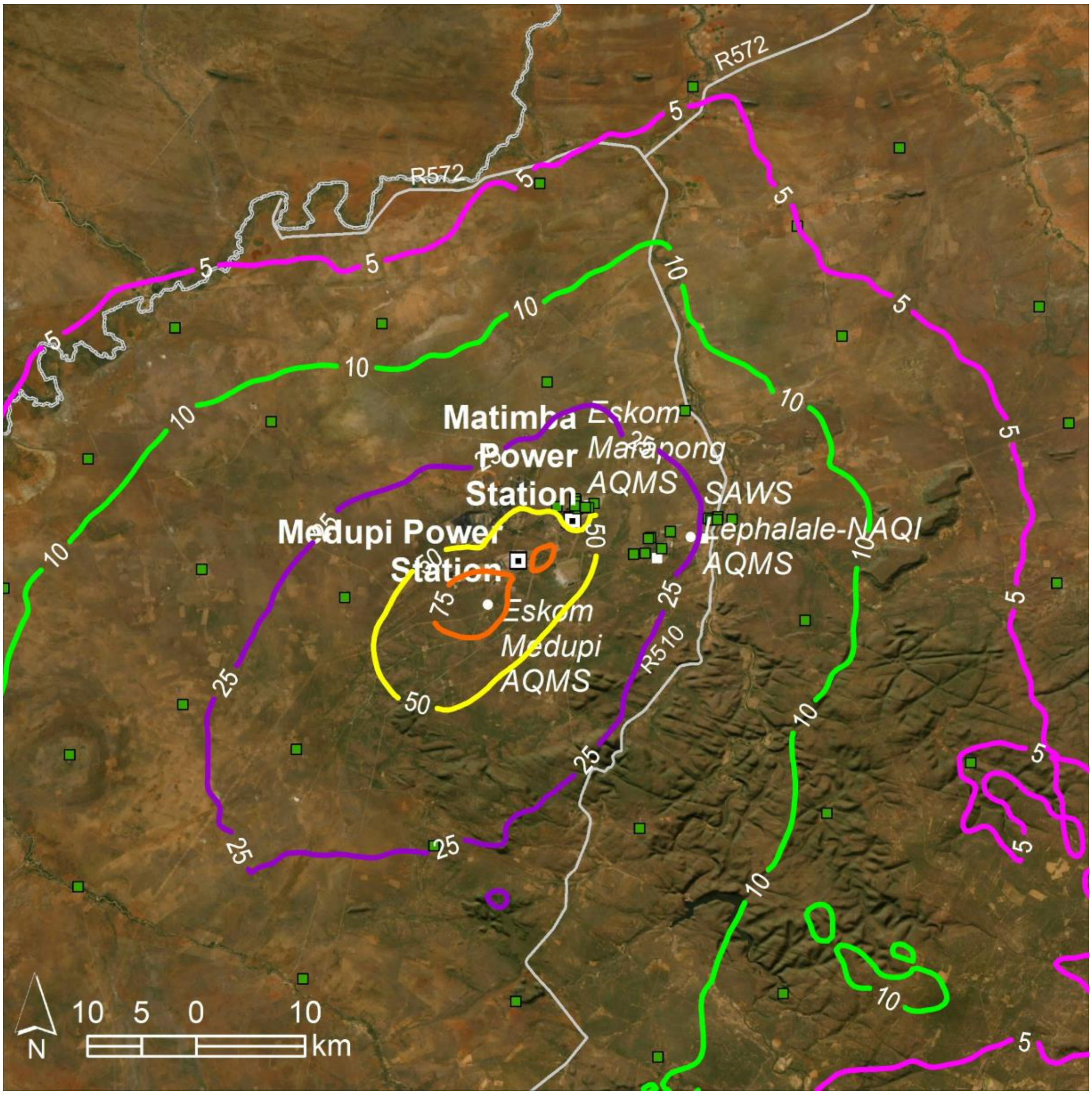


Figure 6-22: Predicted 99th percentile 1-hour NO_2 concentrations in µg/m³ for Scenario B (2031) (NAAQS Limit is 200 µg/m³)

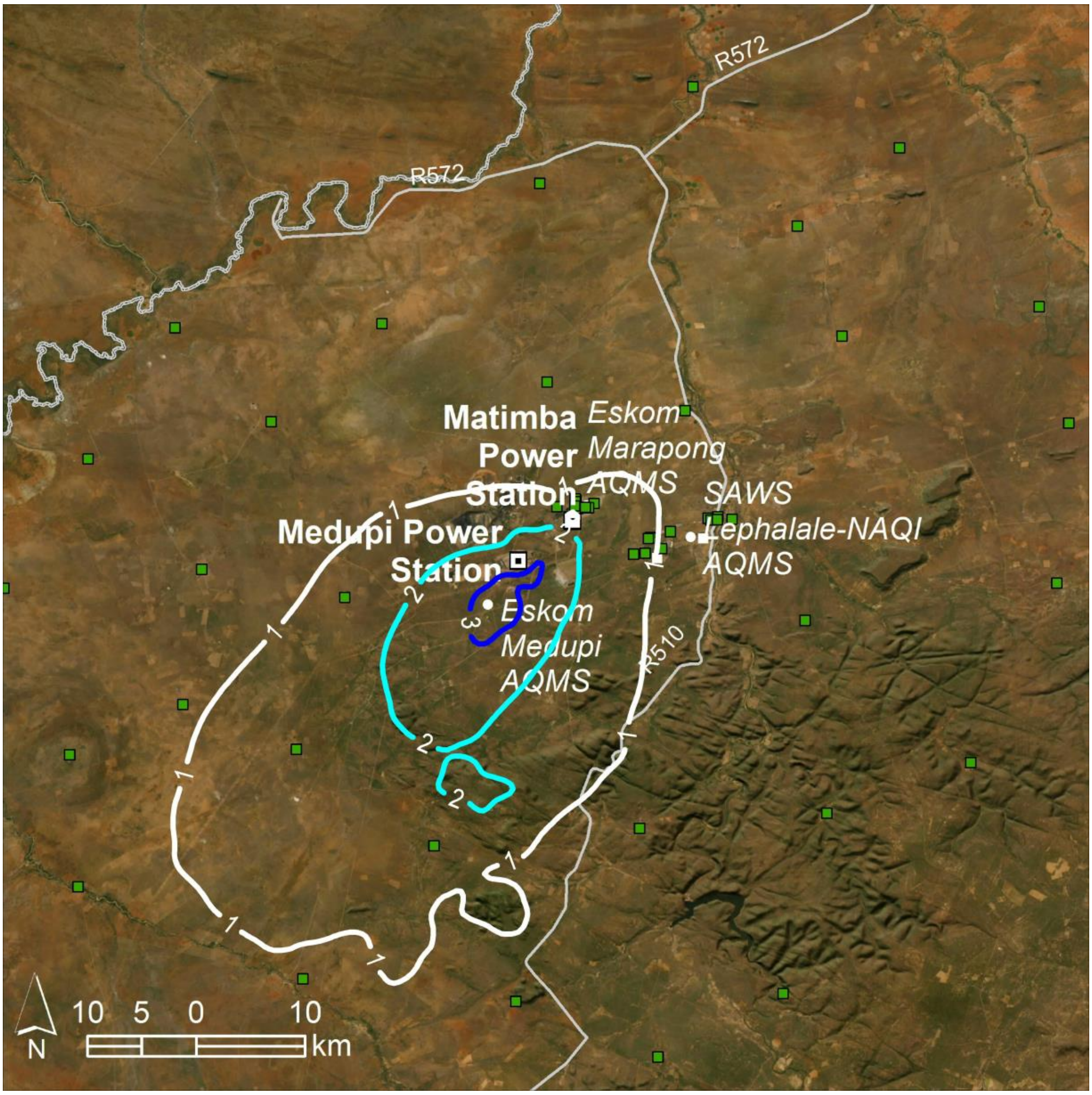


Figure 6-23: Predicted annual average NO_2 concentrations in µg/m³ for Scenario C (2036) (NAAQS Limit is 40 µg/m³)

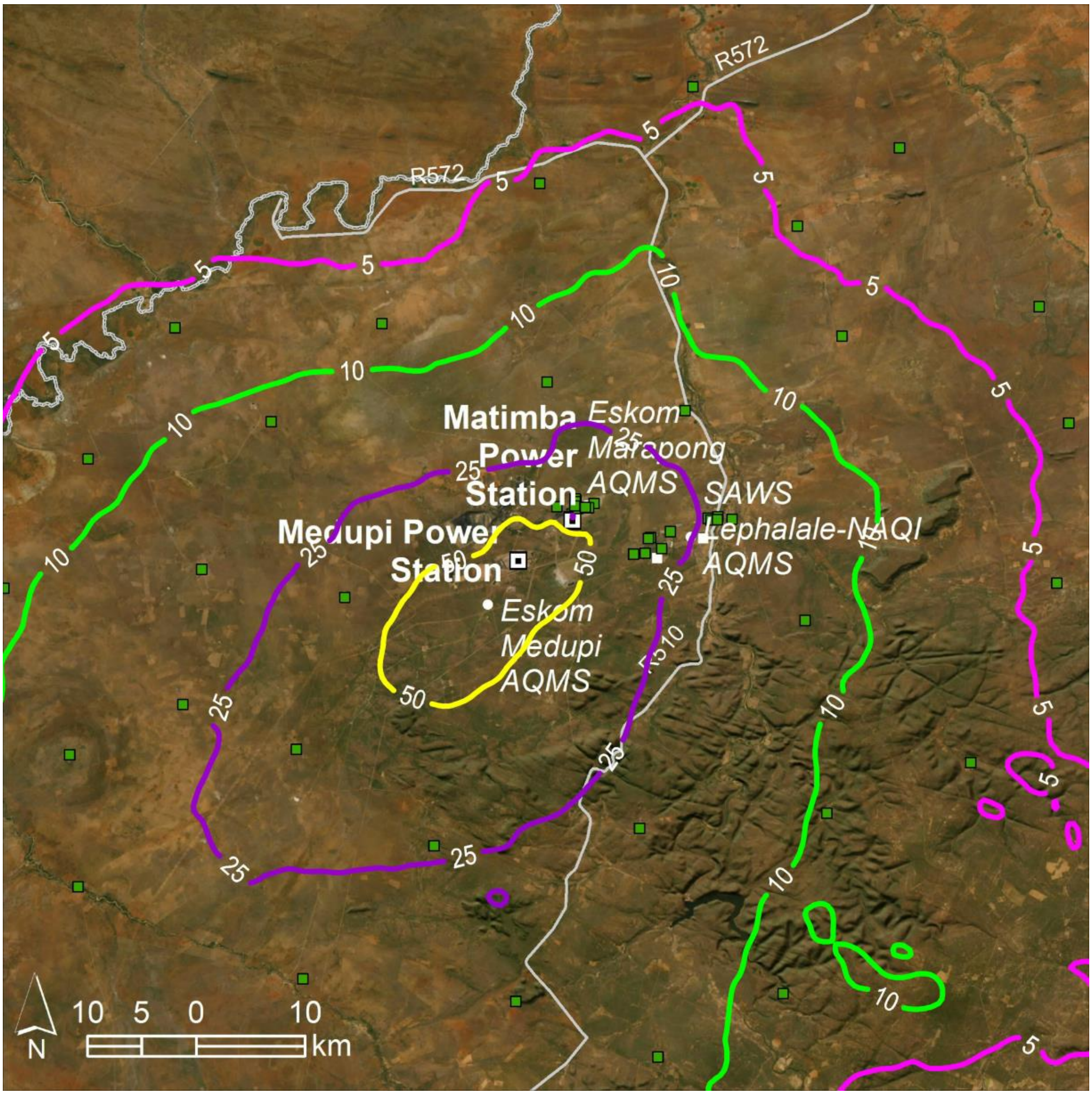


Figure 6-24: Predicted 99th percentile 1-hour NO_2 concentrations in µg/m^3 for Scenario C (2036) (NAAQS Limit is 200 µg/m^3)

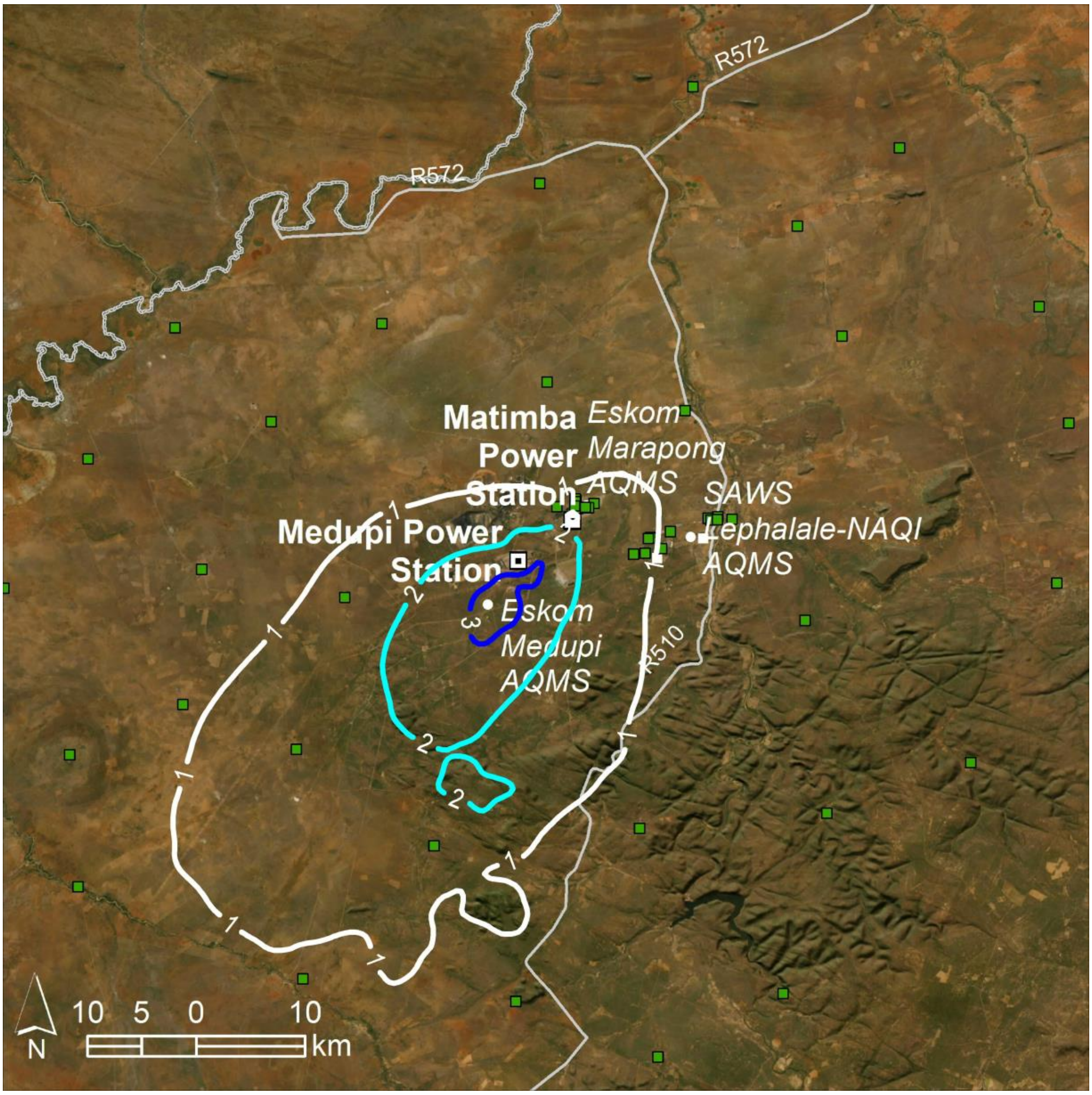


Figure 6-25: Predicted annual average NO_2 concentrations in µg/m³ for Scenario D (MES) (NAAQS Limit is 40 µg/m³)

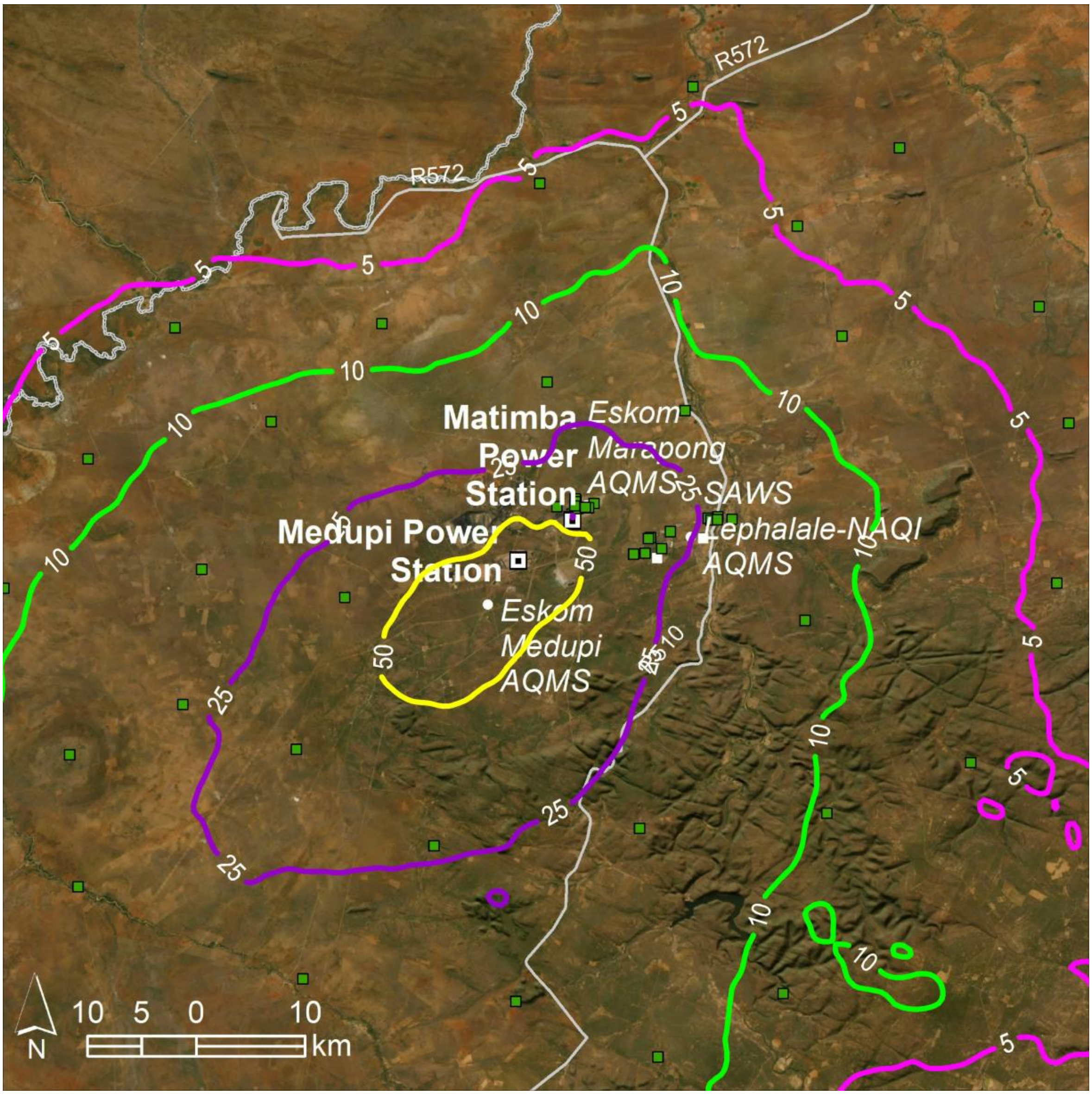


Figure 6-26: Predicted 99th percentile 1-hour NO_2 concentrations in µg/m³ for Scenario D (MES) (NAAQS Limit is 200 µg/m³)

6.2.3.3 Particulates (PM_{10})

The isopleth plots for PM_{10} are similar for all scenarios due to the significant contribution of the low-level fugitive sources to the ambient concentrations. The fugitive emission from the coal stockyard and the ash dump are the same for all scenarios, hence the similarity in the model results for the five scenarios. The effect on ambient PM_{10} concentrations of relatively small changes in the stack PM emissions is masked in the model output by the effect of the fugitive sources.

The predicted annual average concentrations exceed the NAAQS of 40 µg/m^3 in a small area immediately to the southwest of the two power stations. The area where the predicted 24-hour concentrations exceed the limit value of 75 µg/m^3 (shaded area) extends up to 10 km to the southwest of the two power station.

Exceedances of the 24-hour limit value of 75 µg/m^3 is exceeded once in the 3-year modelling period at 2 sensitive receptor points in Scenario 1 (Current) and Scenario B (2031), and once at 5 sensitive receptor points in Scenario A (2025). As 12 exceedances are permitted in the 3-year modelling period these predictions comply with the NAAQS.

It must be remembered that the predictions are conservative given the assumption that TPM = PM_{10} = $PM_{2.5}$. Remembering too that the fugitive emission have the greatest effect on ambient concentrations close to the source, while the effect of the stack emissions is generally further from the power station.

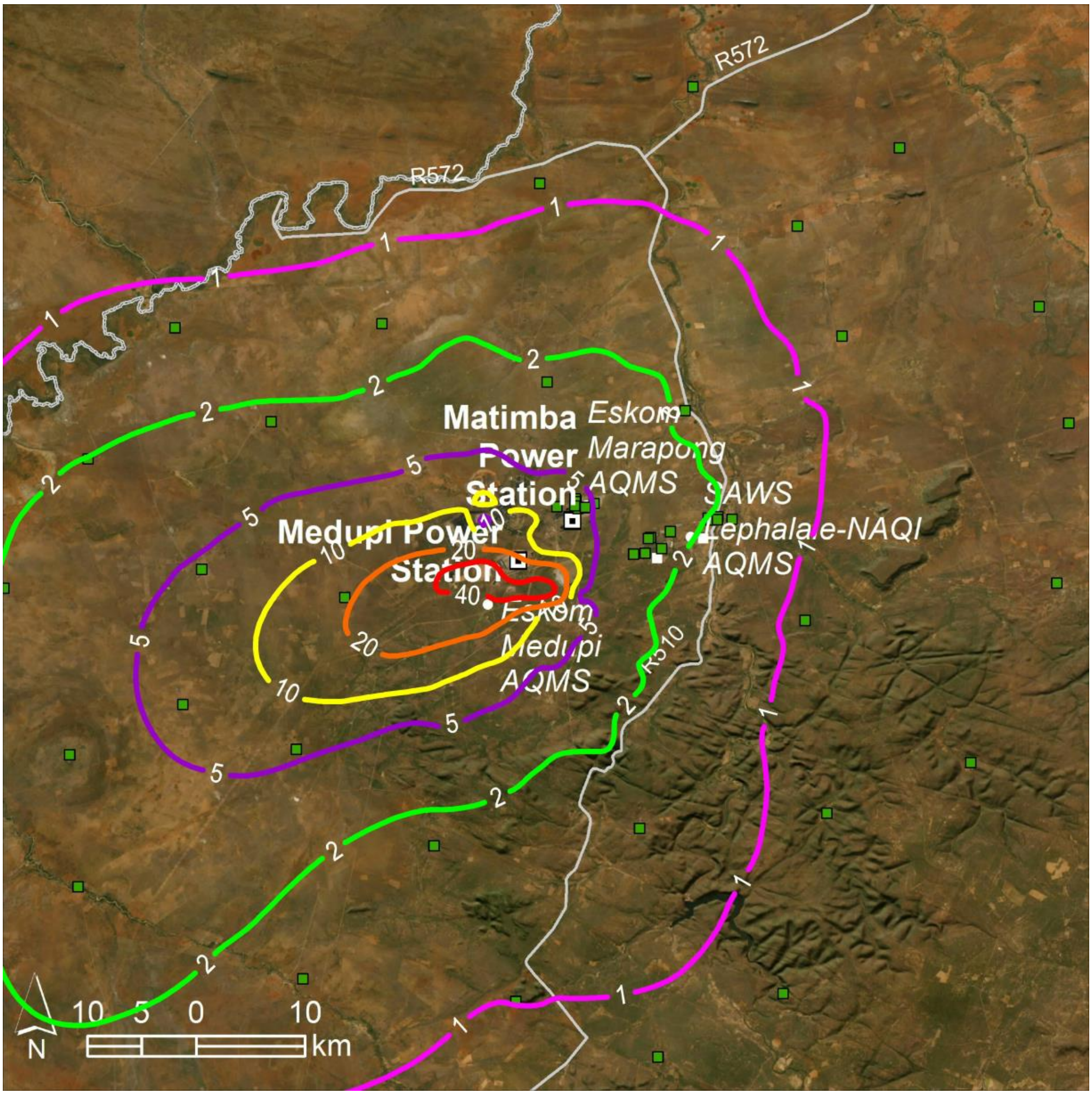


Figure 6-27: Predicted annual average PM_{10} concentrations in µg/m³ for Scenario 1 (Current) (NAAQS Limit is 40 µg/m³)

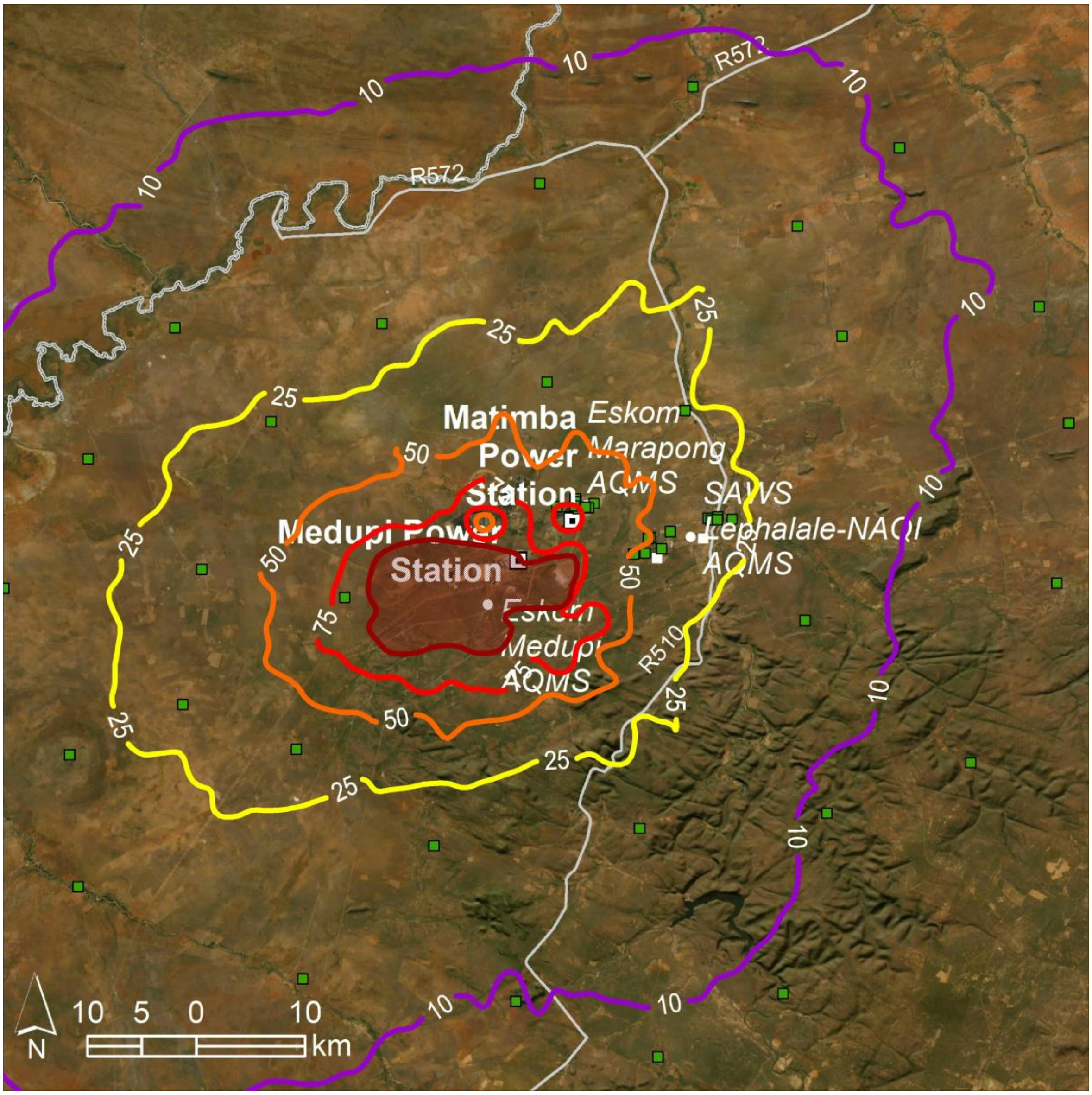


Figure 6-28: Predicted 99th percentile of the 24-hour PM_{10} concentrations in µg/m³ for Scenario 1 (Current) (NAAQS Limit is 75 µg/m³)

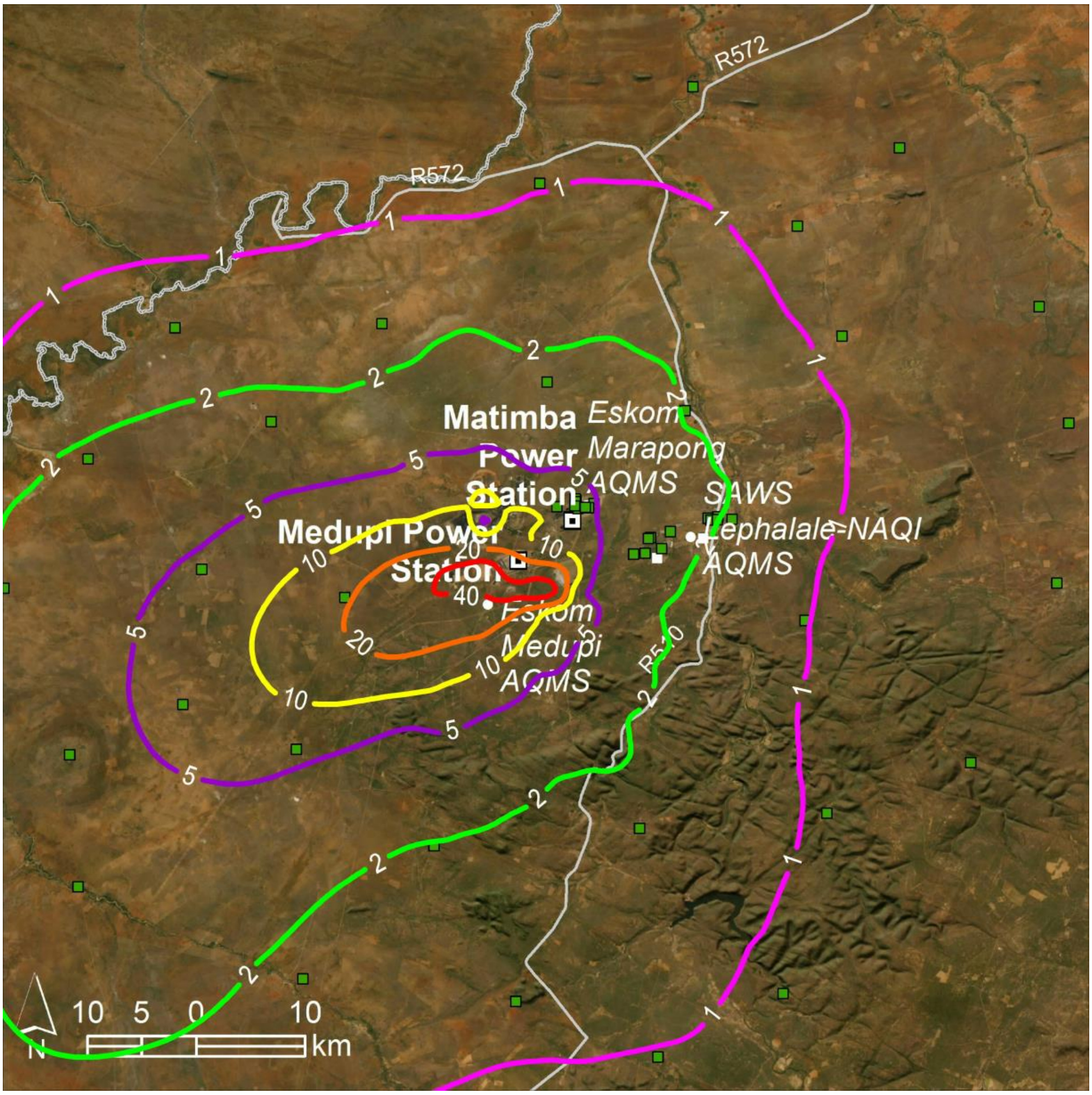


Figure 6-29: Predicted annual average PM_{10} concentrations in µg/m^3 for Scenario A (2025) (NAAQS Limit is 40 µg/m^3)

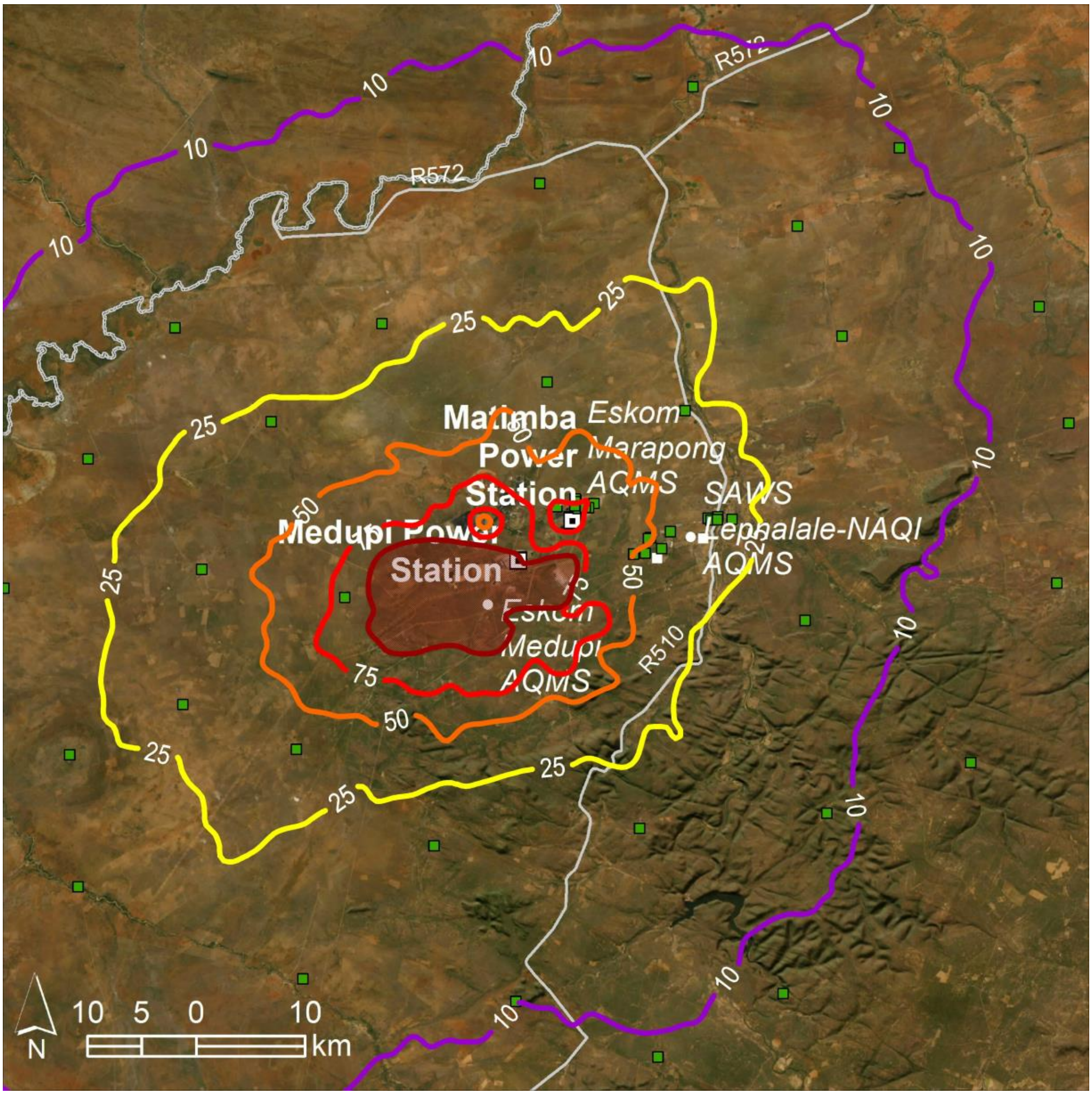


Figure 6-30: Predicted 99th percentile of the 24-hour PM_{10} concentrations in µg/m³ for Scenario A (2025) (NAAQS Limit is 75 µg/m³)

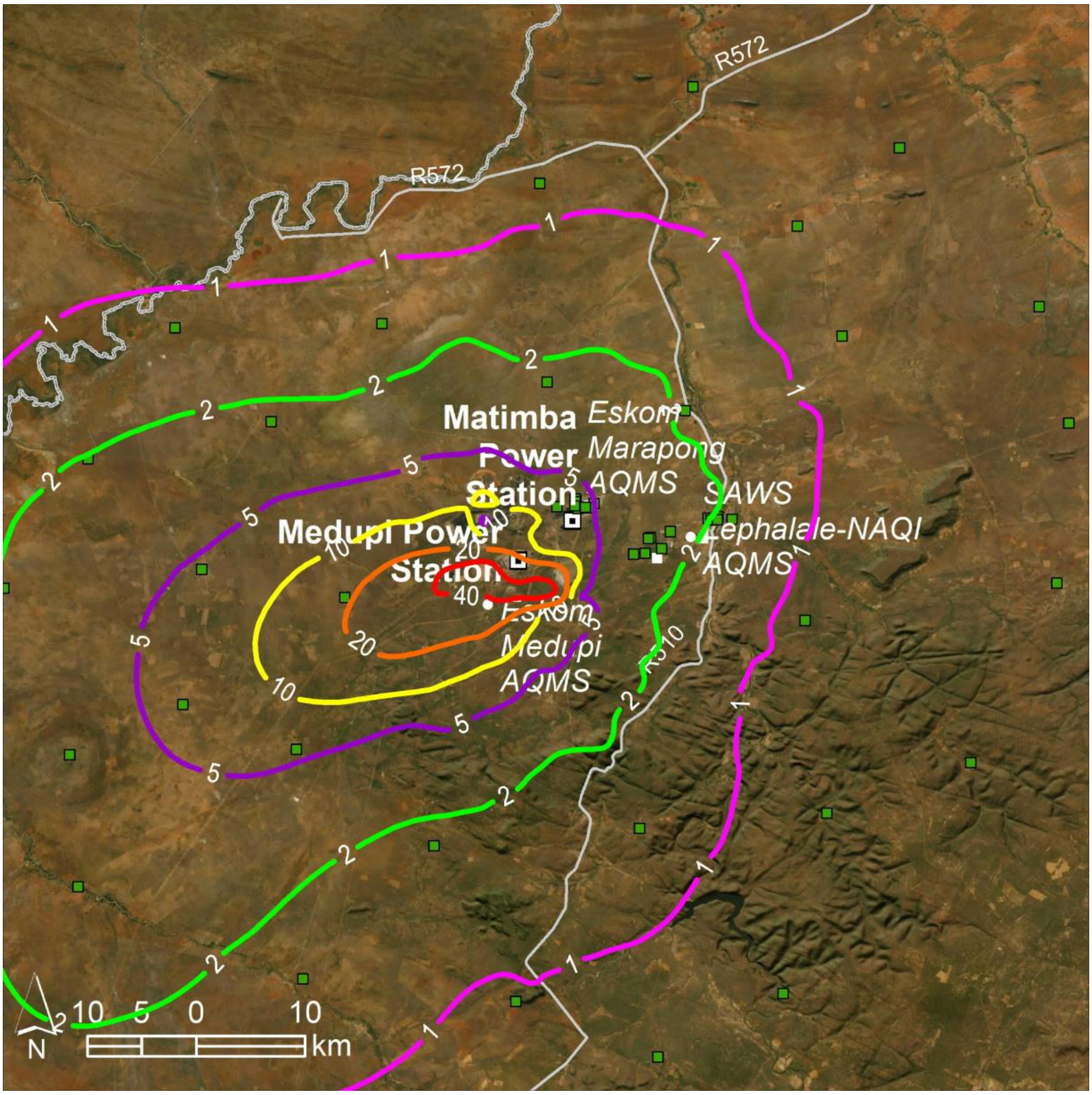


Figure 6-31: Predicted annual average PM$_{10}$ concentrations in µg/m^3 for Scenario B (2031) (NAAQS Limit is 40 µg/m^3)

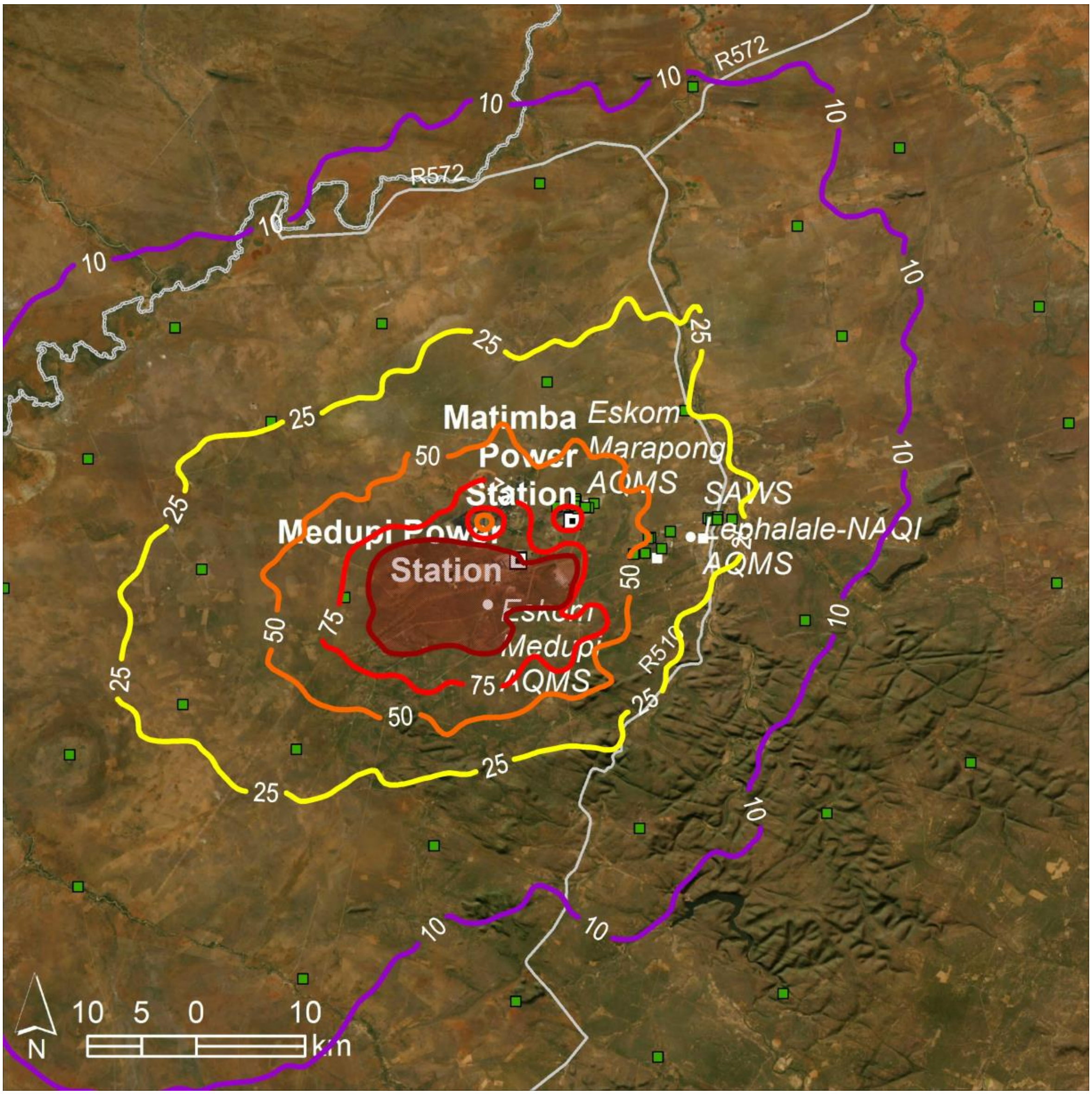


Figure 6-32: Predicted 99th percentile of the 24-hour PM$_{10}$ concentrations in µg/m^3 for Scenario B (2031) (NAAQS Limit is 75 µg/m^3)

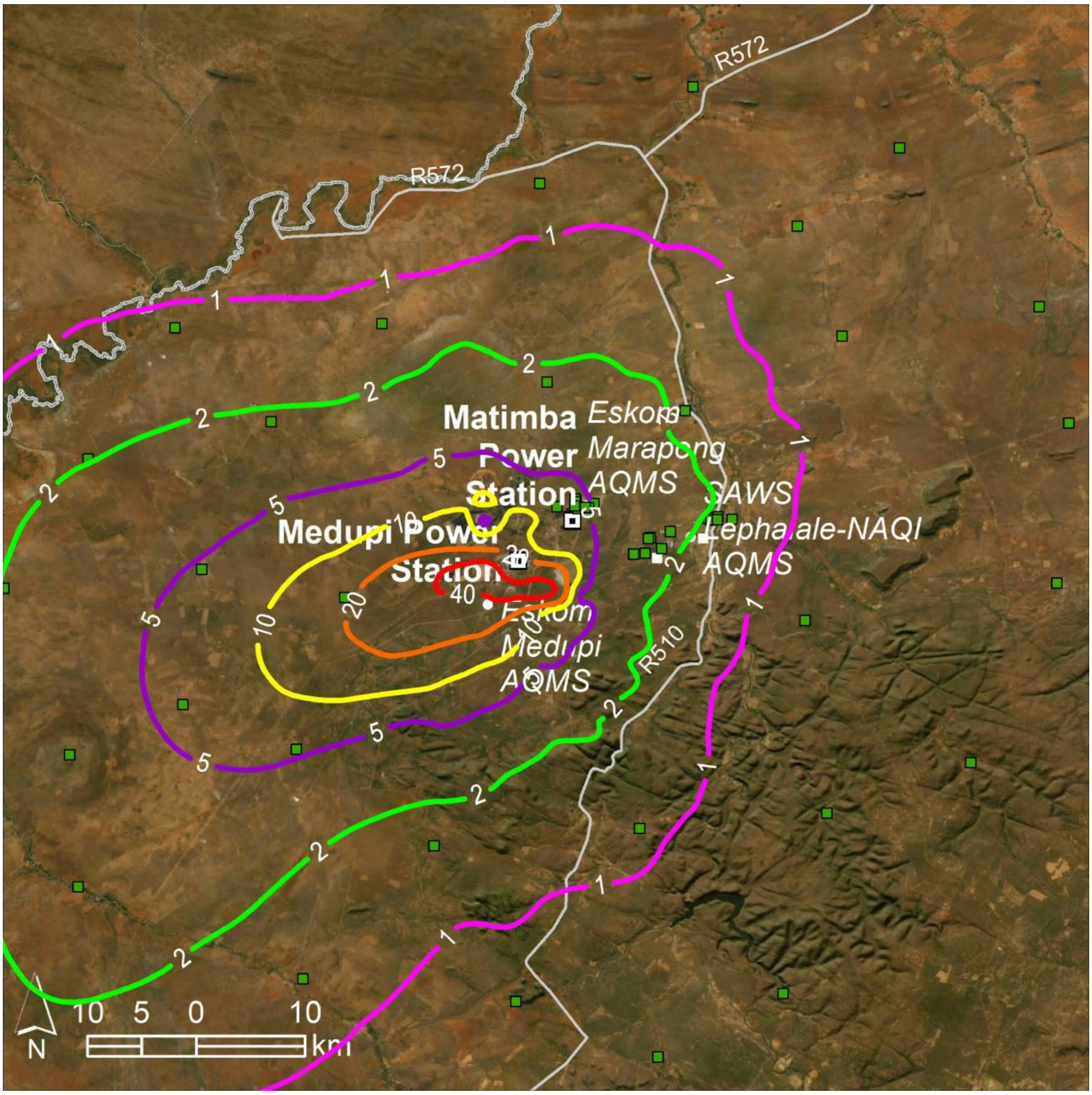


Figure 6-33: Predicted annual average PM$_{10}$ concentrations in µg/m^3 for Scenario C (2036) (NAAQS Limit is 40 µg/m^3)

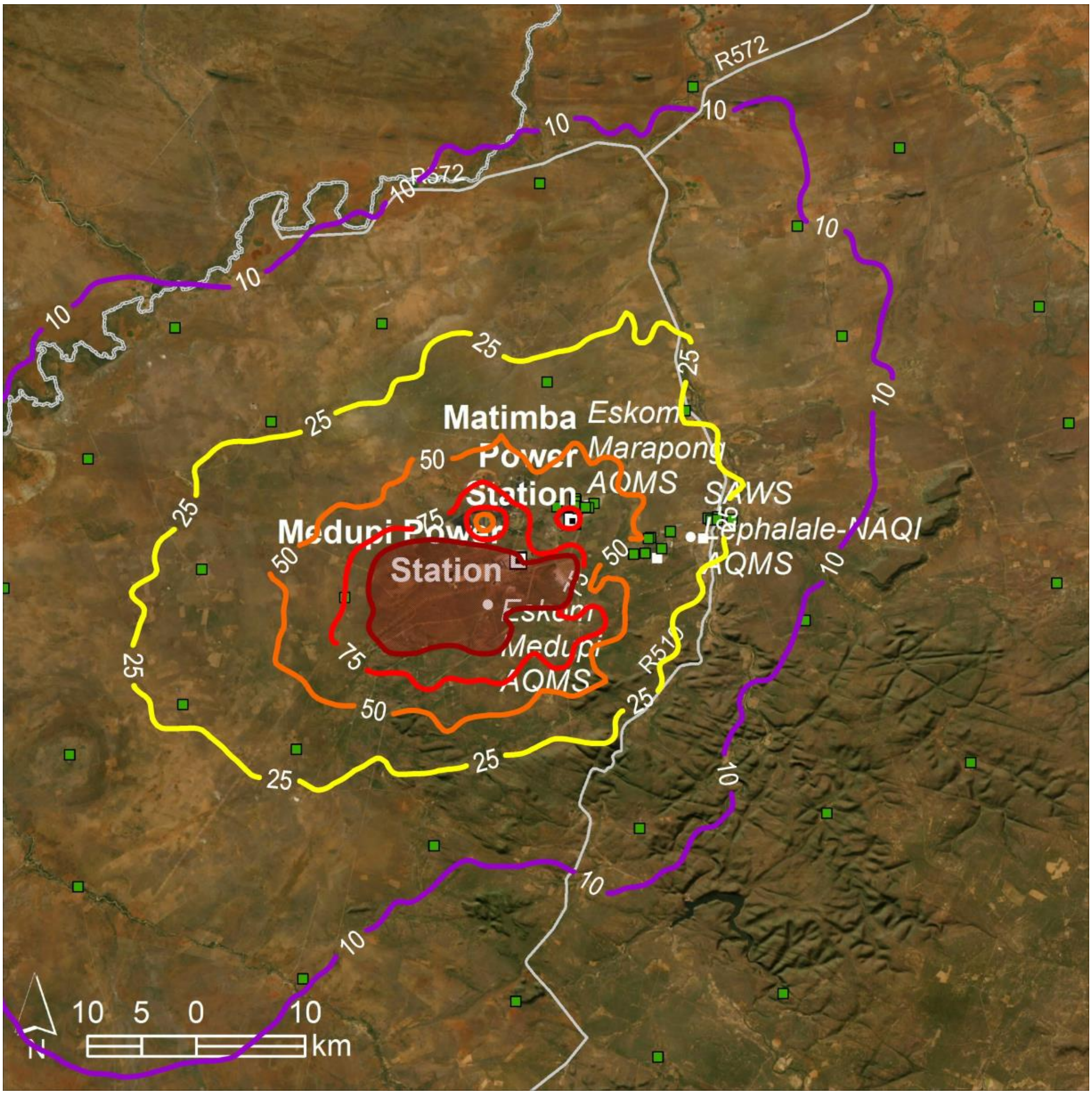


Figure 6-34: Predicted 99th percentile of the 24-hour PM_{10} concentrations in µg/m³ for Scenario C (2036) (NAAQS Limit is 75 µg/m³)

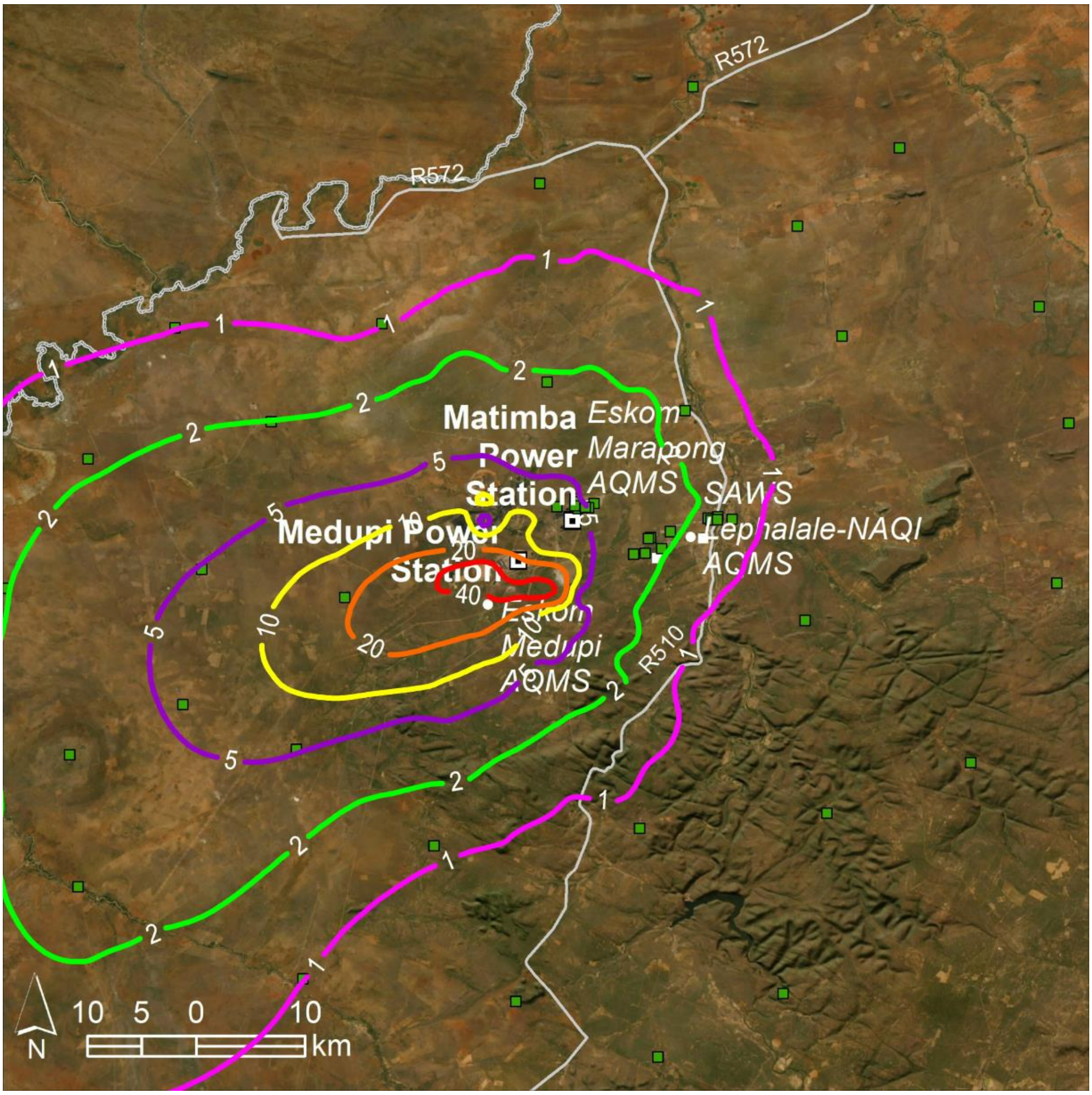


Figure 6-35: Predicted annual average PM_{10} concentrations in µg/m^3 for Scenario D (MES) (NAAQS Limit is 40 µg/m^3)

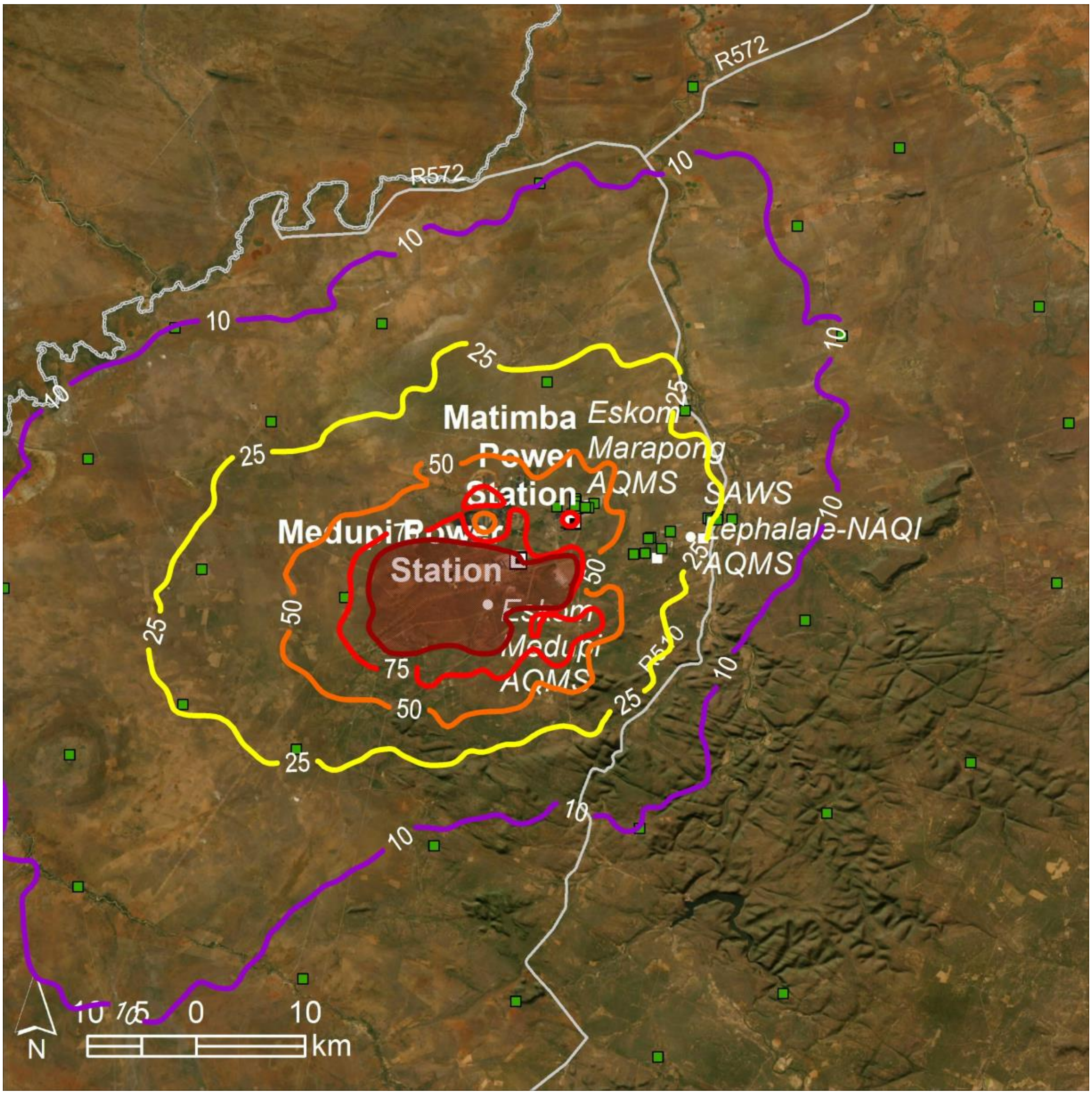


Figure 6-36: Predicted 99th percentile of the 24-hour PM_{10} concentrations in µg/m³ for Scenario D (MES) (NAAQS Limit is 75 µg/m³)

6.2.3.4 Particulates ($PM_{2.5}$)

The isopleth plots for $PM_{2.5}$ are similar for all scenarios due to the significant contribution of the low-level fugitive sources to the ambient concentrations close to the sources. The fugitive emission from the coal yards and the ash dumps at Medupi and Matimba are the same for all scenarios, hence the similarity in the model results for the five scenarios. The effect on ambient $PM_{2.5}$ concentrations of relatively small changes in the stack PM emissions is masked in the model output by the effect of the fugitive sources.

The area where the predicted annual average $PM_{2.5}$ concentrations exceed the NAAQS of 20 µg/m^3 extends approximately 10 km from the power station. The area is larger than for PM_{10} is due the more stringent NAAQS being applied for $PM_{2.5}$. The reader is reminded that the PM has been simulated as $PM_{2.5}$ and compared against the most stringent NAAQS for $PM_{2.5}$.

For Scenario 1 (Current) and Scenario A (2025) the limit value of the 24-hour NAAQS of 40 µg/m^3 is exceeded at 17 sensitive receptors. At 9 of these the limit value is exceeded more than 12 times and are therefore non-compliant with NAAQS. In Scenario B (2031), Scenario C (2036) and Scenario D (MES) the limit value of the NAAQS of 25 µg/m^3 applies, resulting in an increase in the number of receptor points where the limit value is exceeded to 25. At 14 of these the limit value is exceeded more than 12 times and are therefore non-compliant with NAAQS. (See Appendix 1).

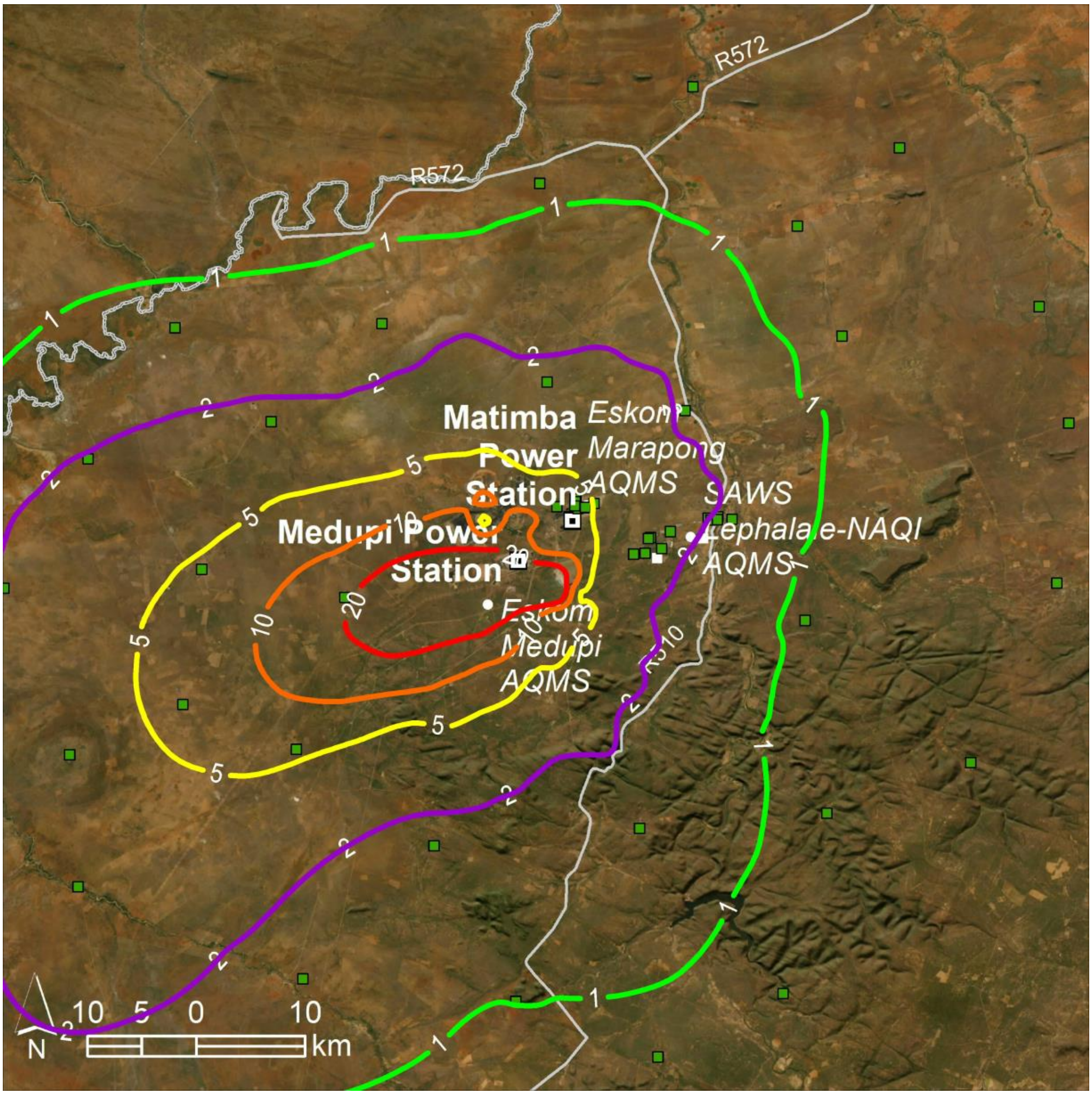


Figure 6-37: Predicted annual average $PM_{2.5}$ concentrations in µg/m^3 for Scenario 1 (Current) (NAAQS Limit is 20 µg/m^3)

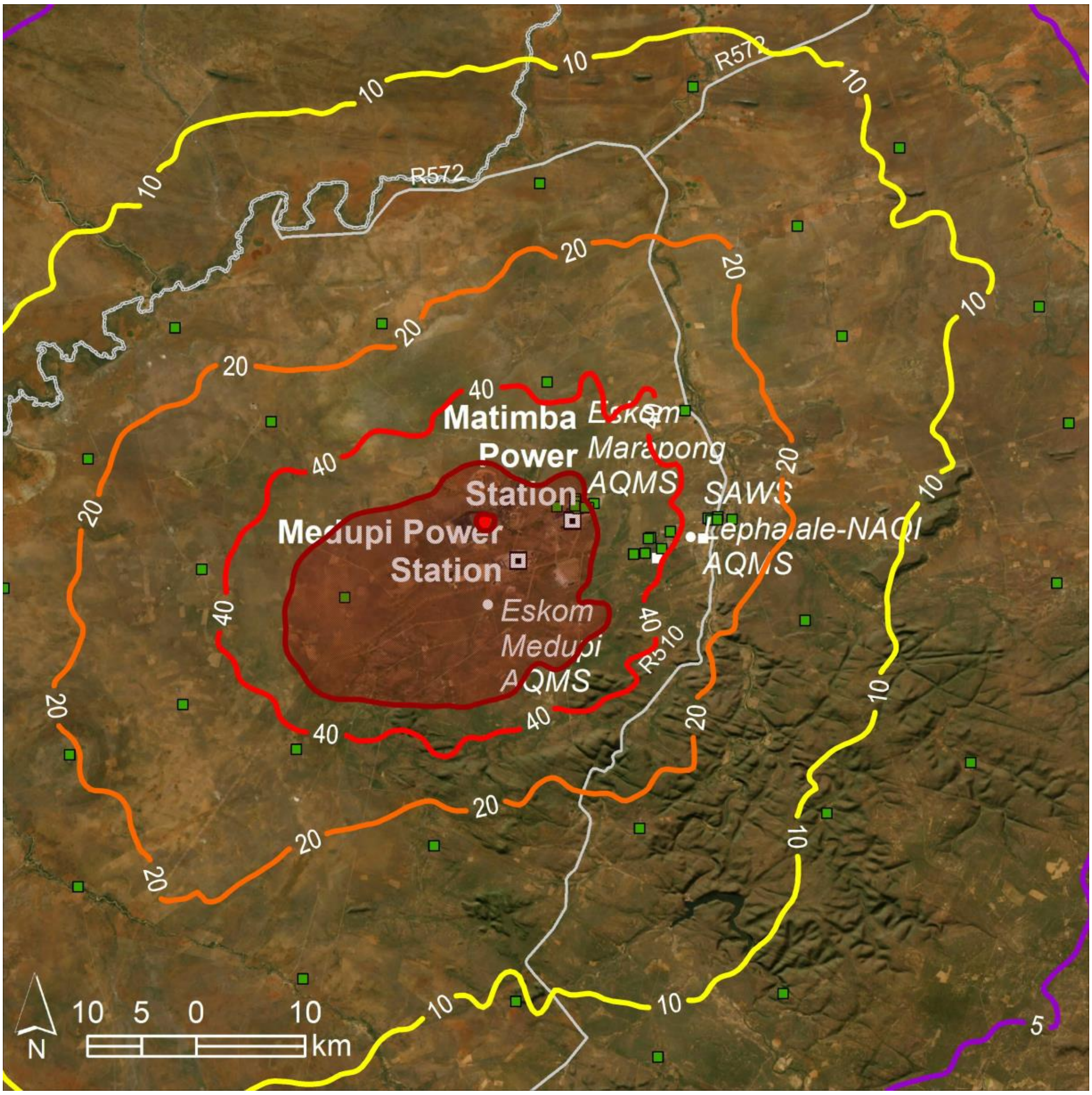


Figure 6-38: Predicted 99th percentile of the 24-hour $PM_{2.5}$ concentrations in µg/m³ for Scenario 1 (Current) (NAAQS Limit is 40 µg/m³)

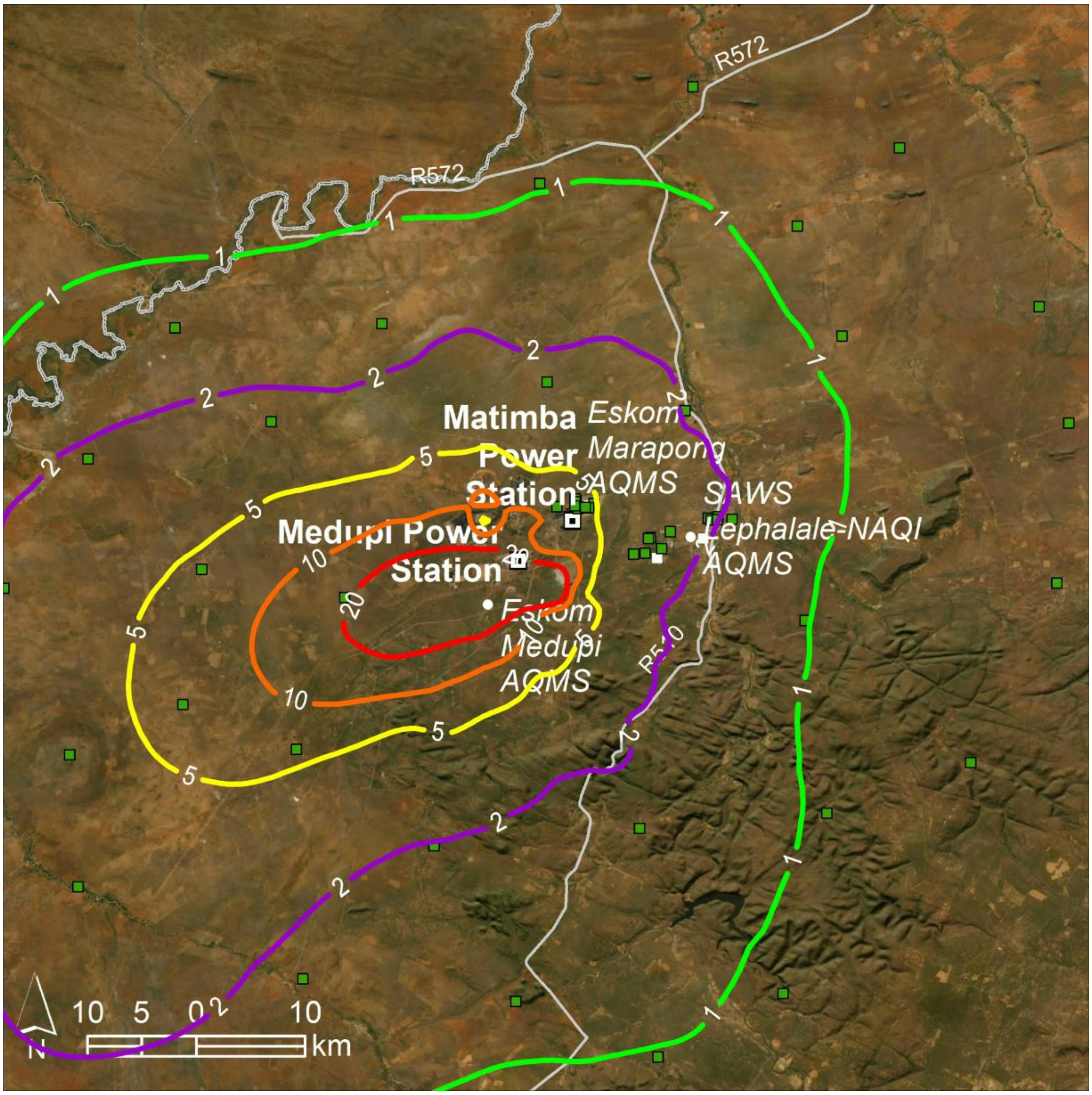


Figure 6-39: Predicted annual average $PM_{2.5}$ concentrations in μg/m^3 for Scenario A (2025) (NAAQS Limit is 20 μg/m^3)

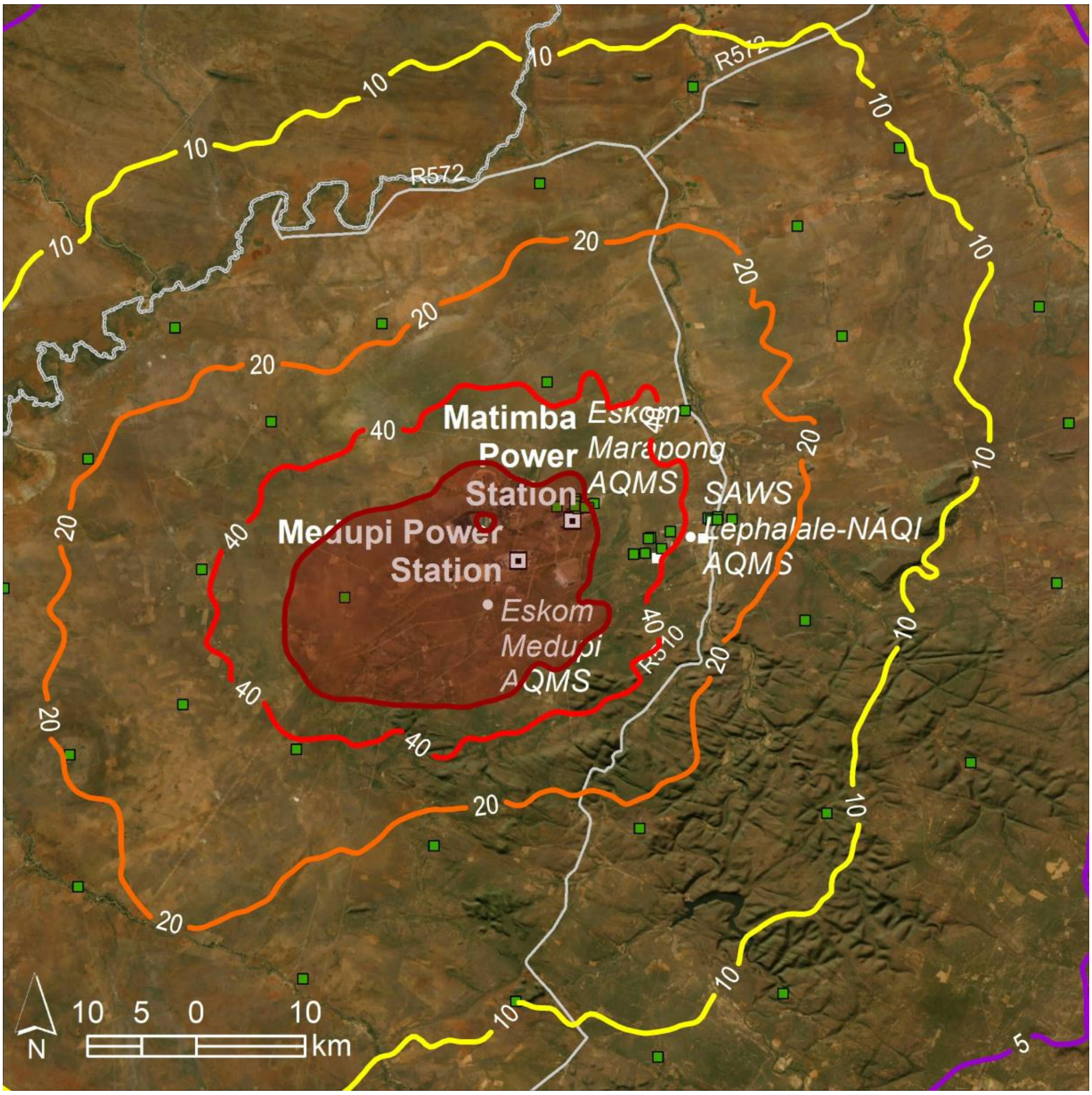


Figure 6-40: Predicted 99th percentile of the 24-hour $PM_{2.5}$ concentrations in µg/m³ for Scenario A (2025) (NAAQS Limit is 40 µg/m³)

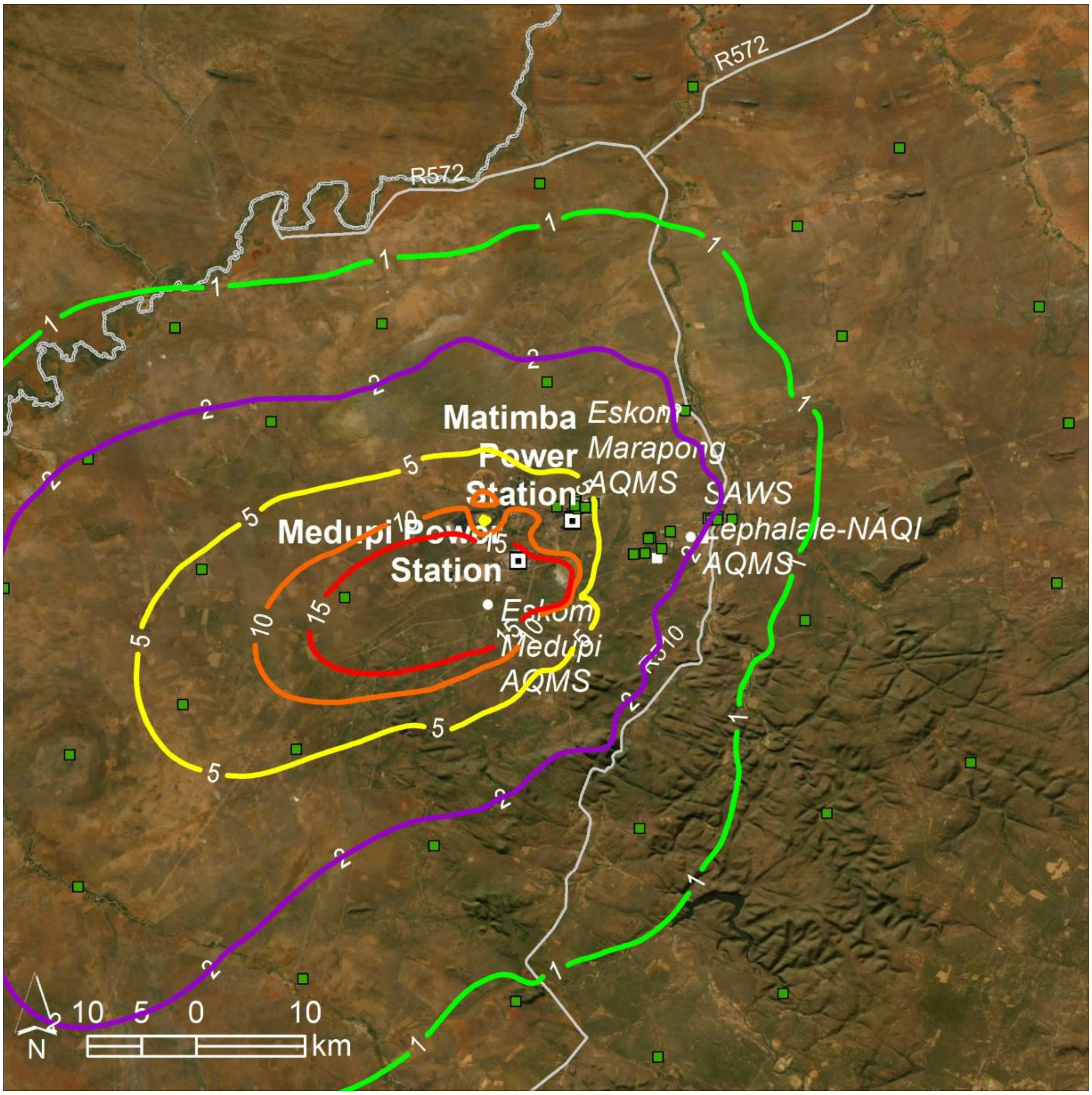


Figure 6-41: Predicted annual average $PM_{2.5}$ concentrations in µg/m^3 for Scenario B (2031) (NAAQS Limit is 15 µg/m^3)

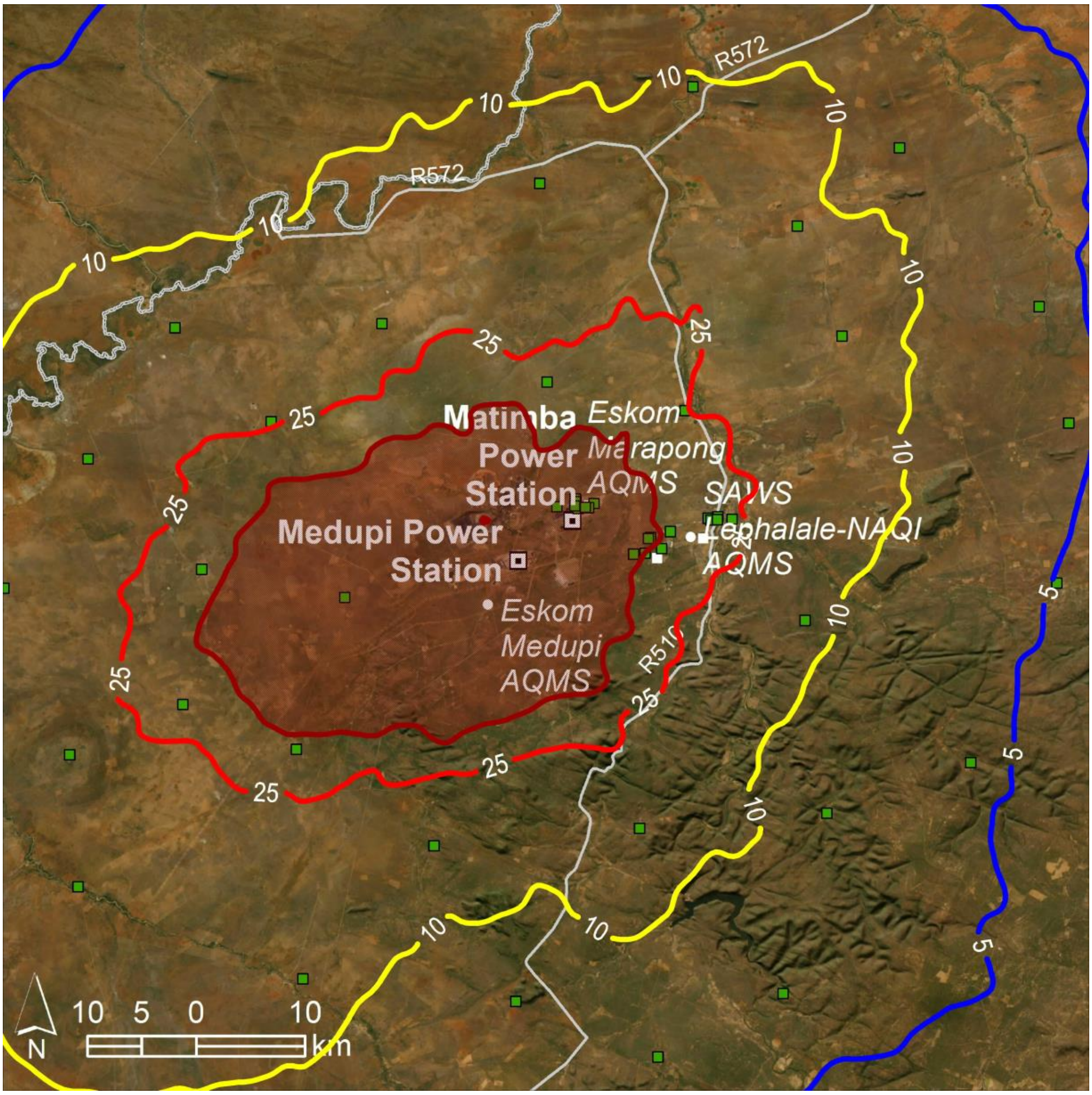


Figure 6-42: Predicted 99th percentile of the 24-hour $PM_{2.5}$ concentrations in µg/m³ for Scenario B (2031) (NAAQS Limit is 25 µg/m³)

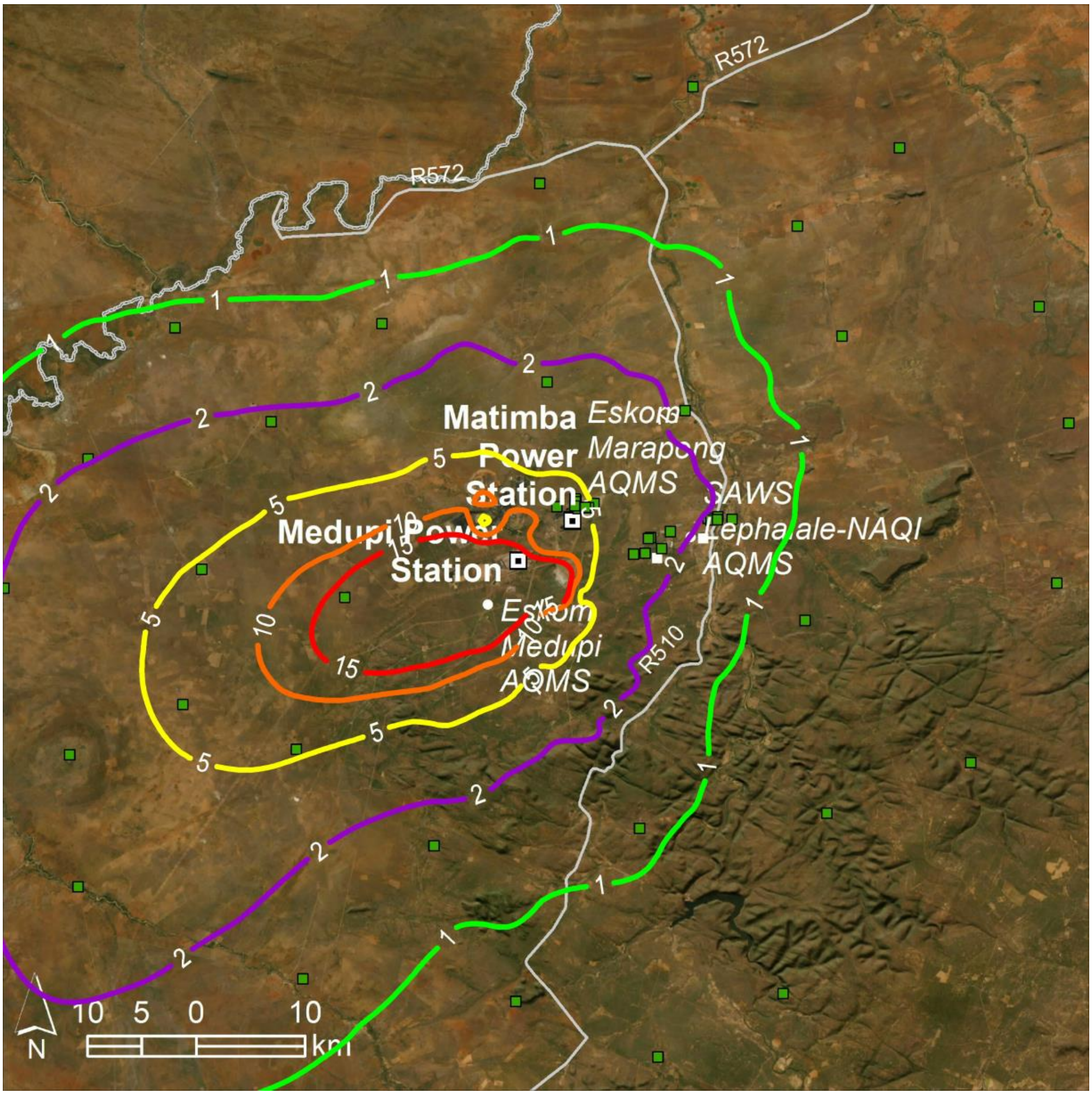


Figure 6-43: Predicted annual average $PM_{2.5}$ concentrations in µg/m^3 for Scenario C (2036) (NAAQS Limit is 15 µg/m^3)

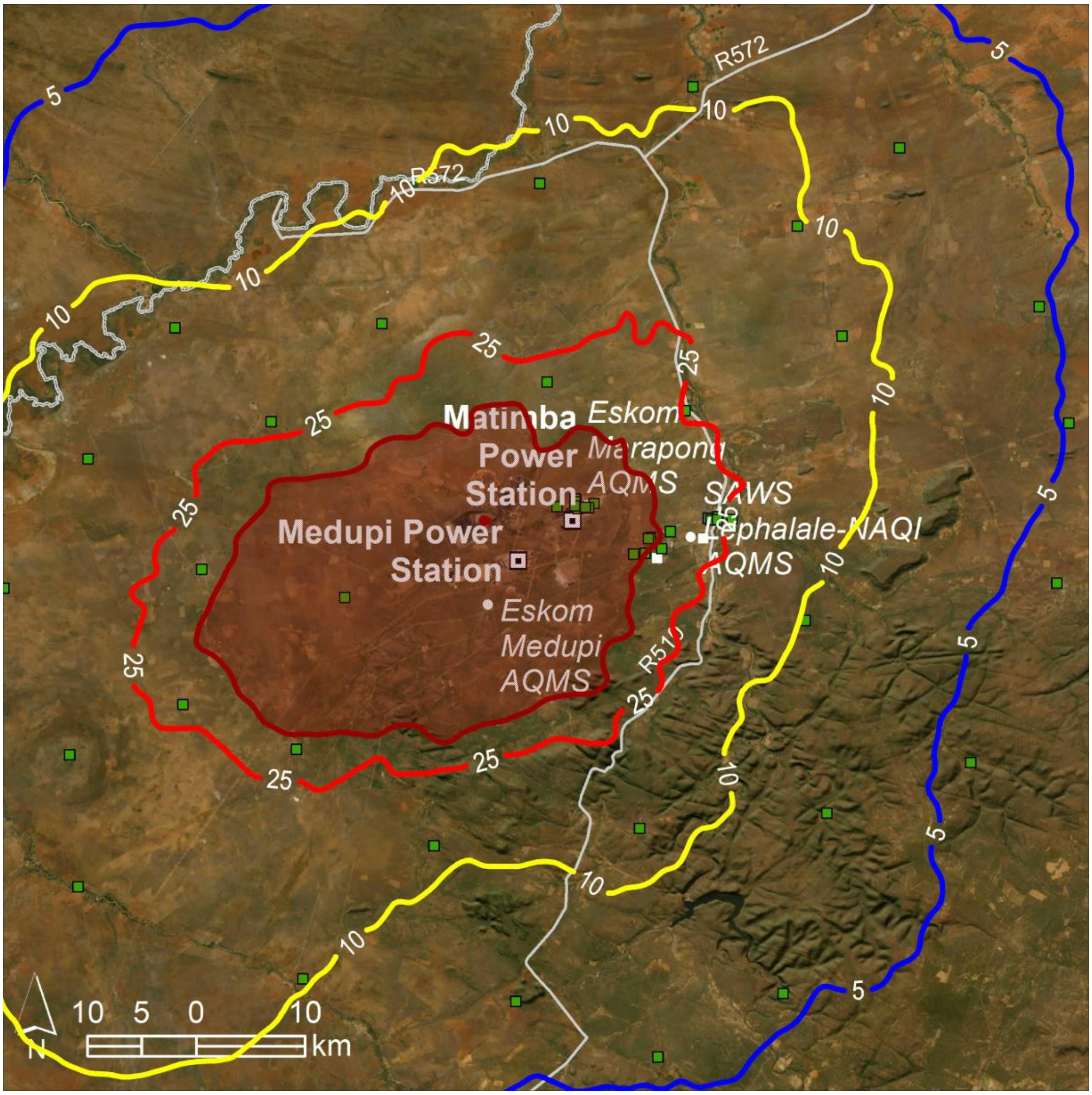


Figure 6-44: Predicted 99th percentile of the 24-hour $PM_{2.5}$ concentrations in $\mu g/m^3$ for Scenario C (2036) (NAAQS Limit is 25 $\mu g/m^3$)

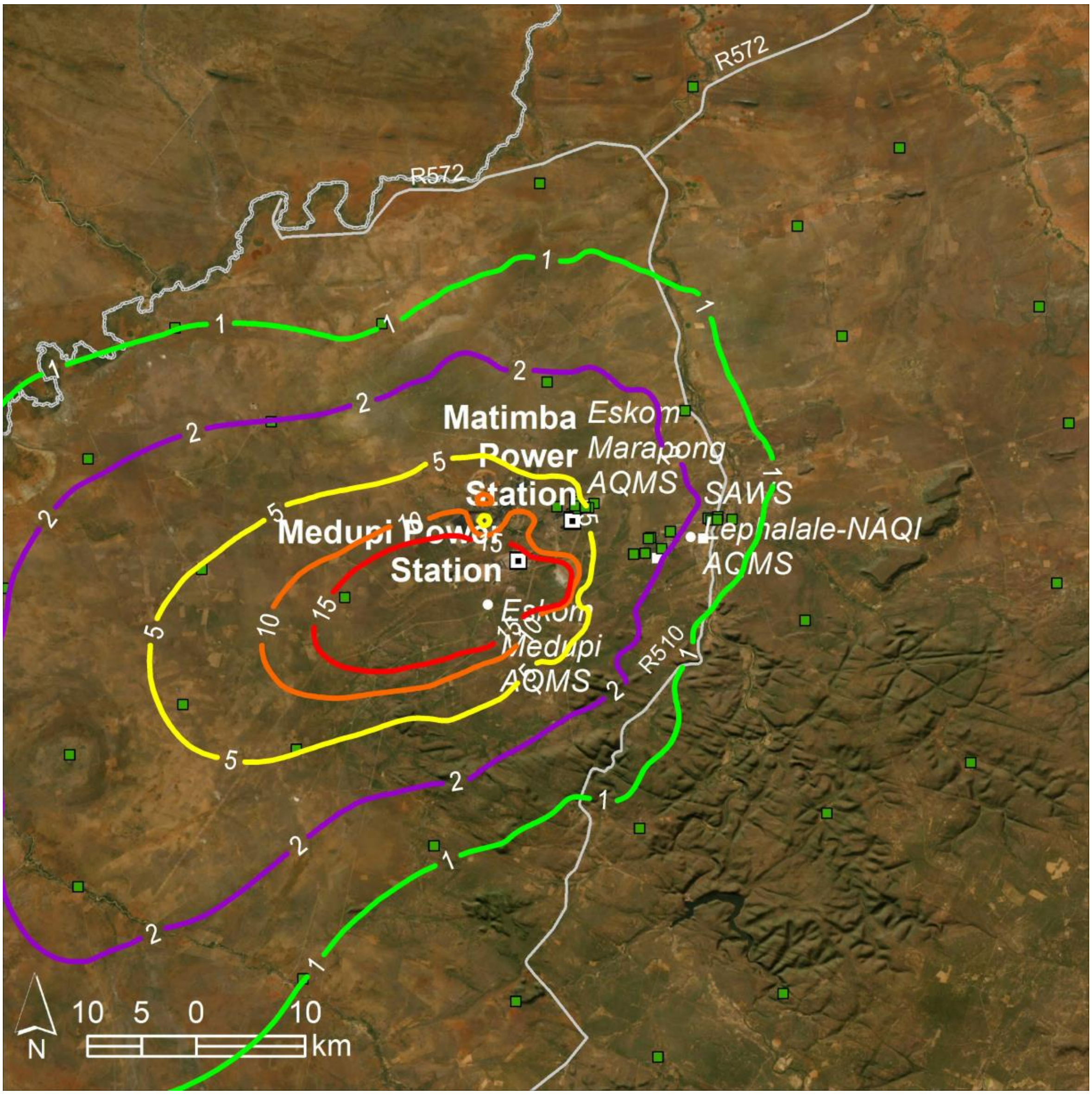


Figure 6-45: Predicted annual average $PM_{2.5}$ concentrations in µg/m^3 for Scenario D (MES) (NAAQS Limit is 15 µg/m^3)

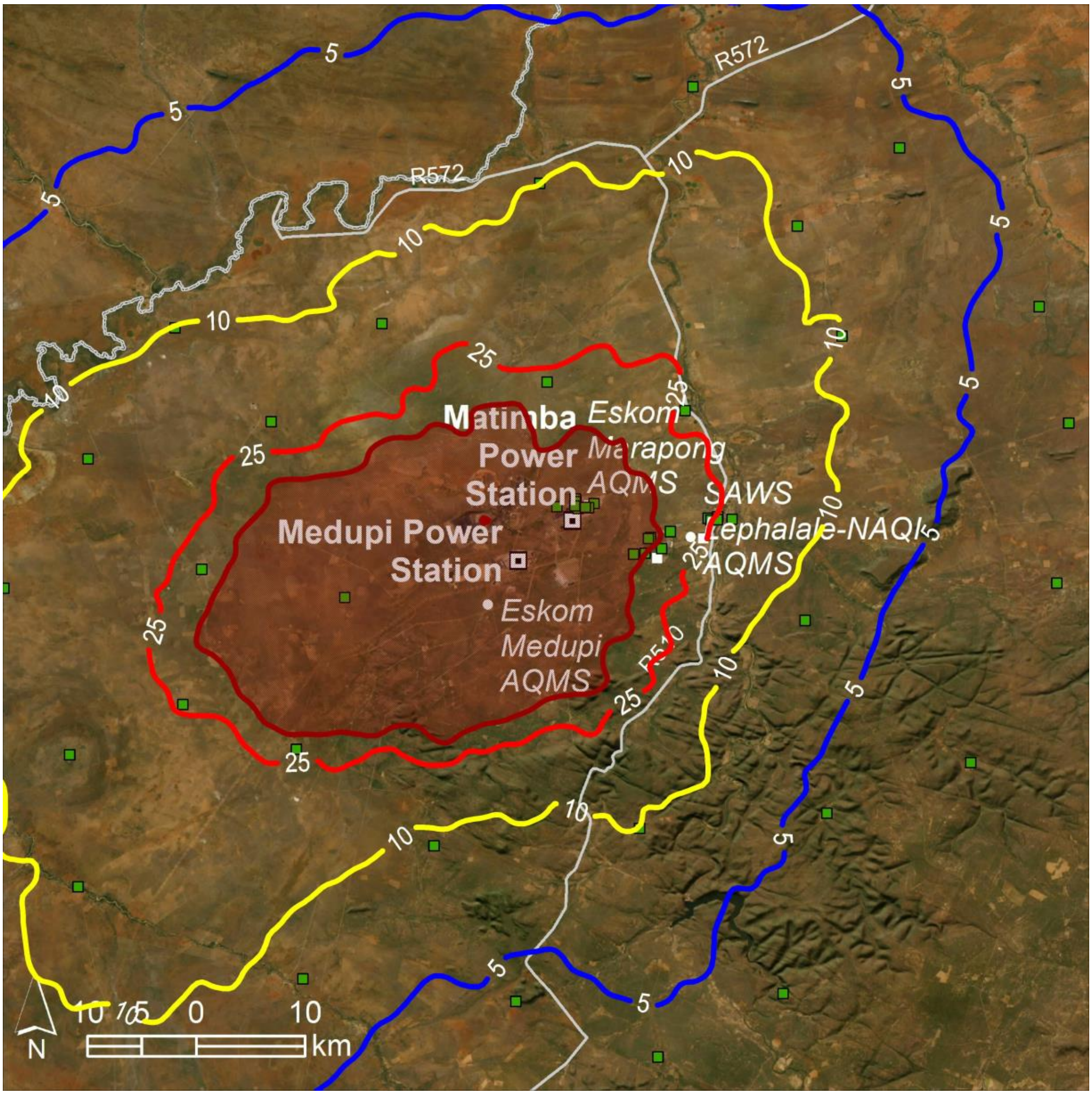


Figure 6-46: Predicted 99th percentile of the 24-hour $PM_{2.5}$ concentrations in µg/m^3 for Scenario D (MES) (NAAQS Limit is 25 µg/m^3)

7. SUMMARY AND CONCLUSION

In this AIR five emission scenarios are assessed collectively for the suite of 2 coal-fired power stations in the Waterberg to support Eskom's application for exemption from the MES for the 2 power stations. AIRs have been produced for the 2 power stations.

Dispersion modelling is used to demonstrate the effect of Eskom's emission reduction strategy by assessing 5 sequential emission scenarios. These are from Scenario 1 using actual emissions from 2021 to 2023, Scenario A using proposed 2025 emissions, Scenario B using proposed 2031 emissions and Scenario C using proposed 2036 emissions. Scenario D uses emissions that comply with the MES to demonstrate the relative effect of compliance.

Noteworthy findings from the modelling results may be summarised as:

i) Ambient SO_2 and NO_2 concentrations are attributed to the stack emissions only, while ambient PM_{10} and $PM_{2.5}$ concentrations are attributed to the stack emissions and the low-level fugitive sources. The stack emissions generally have an effect some distance from the source, while low-level emissions have an effect close to the source.

ii) The predicted ambient concentrations are lower than the monitored concentrations for all pollutants at all AQMS, except at the Medupi AQMS where predicted and measured are higher in general. It is expected that measured concentrations will be higher than modelled since AQMS are exposed to all sources of the pollutants while the modelled concentrations result from power station emission only.

Generally, the difference between the modelled concentrations and the measured concentrations are indicative of the contribution of other sources at the respective AQMS.

The PM_{10} and $PM_{2.5}$ data recovery rate at the Medupi AQMS in 2022 and 2023 was poor so it is likely that the reported averages are unreliable.

iii) For Scenario 1 (Current):
   a. Predicted SO_2 and NO_2 concentrations comply with the NAAQS for all averaging periods throughout the modelling domain.
   b. Predicted PM_{10} and $PM_{2.5}$ concentrations comply with the NAAQS, except close to the power stations where the limit value of the 24-hour NAAQS are exceeded as a result of the fugitive sources. Exceedances of the limit value for PM_{10} are predicted once at 2 sensitive receptor points respectively and thereof compliant with the NAAQS. For $PM_{2.5}$ exceedances of the limit value were predicted at 17 sensitive receptor points, at 10 of which the limit value was exceeded more than 12 times, hence non-compliant with the NAAQS.

iv) For Scenario A (2025):
   a. Predicted annual and 1-hour SO_2 concentrations comply with the NAAQS throughout the modelling domain, but exceedances of the 24-hour limit value are predicted at 10 sensitive receptor points.
   b. Predicted NO_2 concentrations comply with the NAAQS for all averaging periods throughout the modelling domain.
   c. Predicted PM_{10} and $PM_{2.5}$ concentrations comply with the NAAQS, except close to the power stations where the limit value of the 24-hour NAAQS are exceeded as a result of the fugitive sources. Exceedances of the limit value

for PM_{10} are predicted once at 5 sensitive receptor points respectively and thereof compliant with the NAAQS. For $PM_{2.5}$ exceedances of the limit value were predicted at 17 sensitive receptor points, at 10 of which the limit value was exceeded more than 12 times, hence non-compliant with the NAAQS.

v) For Scenario B (2031):
   a. Predicted annual and 1-hour SO_2 concentrations comply with the NAAQS throughout the modelling domain, but exceedances of the 24-hour limit value are predicted at 10 sensitive receptor points.
   b. Predicted NO_2 concentrations comply with the NAAQS for all averaging periods throughout the modelling domain.
   c. Predicted PM_{10} and $PM_{2.5}$ concentrations comply with the NAAQS, except close to the power stations where the limit value of the 24-hour NAAQS are exceeded as a result of the fugitive sources. The number of predicted exceedances for PM_{10} decrease to 2, while the number of exceedances for $PM_{2.5}$ increase to 27 sensitive receptor points. The increase corresponds to the more stringent $PM_{2.5}$ limit value of 25 μg/m^3 which is implemented in 2030. At 14 of these points limit value was exceeded more than 12 times, hence non-compliant with the NAAQS.

vi) For Scenario C: (2036):
   a. Predicted annual and 1-hour SO_2 concentrations comply with the NAAQS throughout the modelling domain, but exceedances of the 24-hour limit value are predicted at 9 sensitive receptor points.
   b. Predicted NO_2 concentrations comply with the NAAQS for all averaging periods throughout the modelling domain.
   c. Predicted PM_{10} and $PM_{2.5}$ concentrations comply with the NAAQS, except close to the power stations where the 24-hour limit value of the NAAQS for $PM_{2.5}$ are exceeded as a result of fugitive sources. Exceedances of the limit value for $PM_{2.5}$ are predicted at 25 sensitive receptor points. At 14 of these points, the limit value was exceeded more than 12 times, hence non-compliant with the NAAQS.

vii) For Scenario D:
   a. Predicted SO_2 and NO_2 concentrations comply with the NAAQS for all averaging periods throughout the modelling domain.
   b. Predicted PM_{10} and $PM_{2.5}$ concentrations comply with the NAAQS, except close to the power stations where the 24-hour limit value of the NAAQS for $PM_{2.5}$ are exceeded as a result of fugitive sources. Exceedances of the limit value for $PM_{2.5}$ are predicted at 25 sensitive receptor points. At 14 of these points, the limit value was exceeded more than 12 times, hence non-compliant with the NAAQS.

Given the conservative approach to the fugitive emission source simulations, and that this has provided an absolute worst-case emission scenario, and based on recommendations received from uMoya-Nilu, Eskom will be undertaking an additional modelling scenario, assessing only PM, SO_2, and NO_X stack emissions. NO_X and SO_2 emissions will be included in this scenario to ensure secondary particulate formation is accounted for. This will provide improved insight to impacts directly related to stack emissions, which are the focus of this exemption application.

8. REFERENCES

Auer, A.H. (1978): Correlation of Land Use and Cover with Meteorological Anomalies, Journal of Applied Meteorology, 17:636-643.

CARB (2024): https://ww2.arb.ca.gov/capp-resource-center/community-assessment/sensitive-receptor-assessment.

CSIRO (2008): TAPM V4. User Manual. Prepared by Peter Hurley, CSIRO Marine and Atmospheric Research Internal Report No. 5, October 2008, ISBN: 978-1-921424-73-1.

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

DEA (2010): Listed Activities and Associated Minimum Emission Standards identified in terms of Section 21 of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004), Government Gazette 33064, Notice No. 248 of 31 March 2010.

DEA (2012): National Ambient Air Quality Standard for Particulate Matter of Aerodynamic Diameter less than 2.5 micrometers, Notice 486, 29 June 2012, Government Gazette, 35463.

DEA (2013a): Regulations Prescribing the Format of the Atmospheric Impact Report, Government Gazette 36904, Notice No. 747 of 11 October 2013.

DEA (2013b): Listed Activities and Associated Minimum Emission Standards identified in terms of Section 21 of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004), Government Gazette 37054, Notice No. 893 of 22 November 2013.

DEA (2014a): Code of Practice for Air Dispersion Modelling in Air Quality Management in South Africa, Government Notice R.533, Government Gazette, no. 37804, 11 July 2014.

DEA (2014b): Environmental Assessment Regulations, 2014 identified in terms of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004), Government Gazette 38282, Notice No. R 982 of 4 December 2014.

DEA (2019): Listed Activities and Associated Minimum Emission Standards identified in terms of Section 21 of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004), Government Gazette 42472, Notice No. 893 of 22 May 2019.

DEA (2020): Listed Activities and Associated Minimum Emission Standards identified in terms of Section 21 of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004), Government Gazette 43174, Notice No. 421 of 27 March 2020.

Hurley, P. (2000): Verification of TAPM meteorological predictions in the Melbourne region for a winter and summer month. Australian Meteorological Magazine, 49, 97-107.

Hurley, P.J., Blockley, A. and Rayner, K. (2001): Verification of a prognostic meteorological and air pollution model for year-long predictions in the Kwinana industrial region of Western Australia. Atmospheric Environment, 35(10), 1871-1880.

Hurley, P.J., Physick, W.L. and Ashok, K.L. (2002): The Air Pollution Model (TAPM) Version 2, Part 21: summary of some verification studies, CSIRO Atmospheric Research Technical Paper No. 57, 46 p.

SANAS (2012): Tr 07-03 Supplementary Requirements for the Accreditation of Continuous Ambient Air Quality Monitoring Stations (pp. 112).

uMoya-NILU (2024a): Atmospheric Impact Report in Support of the Application for Exemption from the Minimum Emission Standards for Medupi Power Station, Report No.: uMN214-24, October 2024.

uMoya-NILU (2024b): Atmospheric Impact Report in Support of the Application for Exemption from the Minimum Emission Standards for Matimba Power Station, Report No.: uMN213-24, October 2024.

USEPA (1995): A user's guide for the CALPUFF dispersion model (version 5). Prepared by Scire, J., Strimaitis, D. and Yamartino, Robert.

USEPA (2005): Revision to the Guideline on Air Quality Models: Adoption of a Preferred General Purpose (Flat and Complex Terrain) Dispersion Model and Other Revisions, 40 CFR Part 51, US Environmental Protection Agency 40 CFR Part 51.

USEPA (2024a): https://www.epa.gov/newenglandhc/environmental-issues-concern-urban- communities-resources.

USEPA (2024b): Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources. Chapter 13: Miscellaneous Sources. http://www.epa.gov/ttn/chief/ap42/ch13/index.html.

9. FORMAL DECLARATIONS

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

DECLARATION OF ACCURACY OF INFORMATION – APPLICANT

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

Declaration of accuracy of information provided:

Atmospheric Impact Report in terms of Section 30 of the Act

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

Signed at Durban on this 4th day of November 2024.

SIGNATURE

Managing Director – uMoya-NILU Consulting
CAPACITY OF SIGNATORY

DECLARATION OF INDEPENDENCE – PRACTITIONER

Name of Practitioner: Mark Zunckel

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

Professional Registration Number: 400449/04

Declaration of independence and accuracy of information provided:

Atmospheric Impact Report in terms of Section 30 of the Act

I, Mark Zunckel declare that I am independent of the applicant. I have the necessary expertise to conduct the assessment required for the report and will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant. I will disclose to the applicant and the air quality officer all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the air quality officer. The information provided in the atmospheric impact report is, to the best of my knowledge, in all respects factually true and correct. I am aware that the supply of false or misleading information to an air quality office is a criminal office in terms of section 51(1)(g) of this Act.

Signed at Durban on this 4th day of November 2024.

SIGNATURE

Managing Director – uMoya-NILU Consulting
CAPACITY OF SIGNATORY

ANNEXURE 1: PREDICTED CONCENTRATIONS AT SENSIIVE RECEPTORS

Predicted concentrations in µg/m^3 at the sensitive receptors for Scenario 1 (Current), together with the limit value of the NAAQS and number of exceedances (NoE)

	SO_2				NO_2		PM_{10} Total			$PM_{2.5}$ Total		
	1-hr	24-hr	NoE	Ann	1-hr	Ann	24-hr	NoE	Ann	24-hr	NoE	Ann
Receptor	350	125	12	50	200	40	75	12	40	40	12	20
Phegelelo Senior Secondary	137.1	118.9		5.7	15.4	0.7	69.9		5.5	**69.9**	**13**	5.5
Contractors Village	127.8	80.7		5.3	14.8	0.6	**76.5**	1	7.8	**76.5**	**24**	7.8
Ditheku Primary School	136.4	112.7		5.6	15.5	0.6	70.7		5.5	**70.7**	**13**	5.5
Ditheko Primary School	149.7	111.5		6.2	17.8	0.7	69.4		5.0	**69.4**	10	5.0
Marapong Training Centre	135.2	104.5		5.9	15.2	0.7	71.3		5.9	**71.3**	**13**	5.9
Marapong Clinic	149.7	120.3		6.4	17.0	0.7	73.6		5.4	**73.6**	**15**	5.4
Tielelo Secondary School	136.1	119.0		5.8	15.2	0.7	71.3		5.6	**71.3**	**13**	5.6
Grootegeluk Medical Centre - Community Center	141.0	99.5		6.0	15.5	0.7	71.6		5.8	**71.6**	**14**	5.8
Lephalale College	161.5	80.8		6.1	20.7	0.7	51.7		3.2	**51.7**	1	3.2
Nelsonskop Primary School	152.0	116.8		6.4	16.7	0.7	73.2		5.5	**73.2**	**13**	5.5
Hansie en Grietjie Pre-Primary School	159.3	82.2		6.2	20.8	0.7	52.6		3.3	**52.6**	2	3.3
Sedibeng Special School for the Deaf and Disabilities	152.1	73.7		6.0	19.3	0.6	44.2		2.6	**44.2**	1	2.6
Kings College	162.7	79.4		6.6	20.6	0.7	51.6		3.4	**51.6**	1	3.4
Bosveld Primary School	157.9	76.2		6.3	20.4	0.7	46.6		3.0	**46.6**	1	3.0
Lephalale Medical Hospital	134.8	108.8		5.8	15.9	0.7	73.8		5.9	**73.8**	**15**	5.9
Ellisras Hospital	158.1	71.9		5.7	19.6	0.6	43.6		2.7	**43.6**	1	2.7
Laerskool Ellisras Primary School	141.0	60.4		4.9	15.9	0.5	31.1		1.9	31.1		1.9
Hoerskool Ellisras Secondary School	148.0	60.6		5.0	16.8	0.5	31.9		2.0	31.9		2.0
Marlothii Learning Academy	145.7	59.5		5.0	16.3	0.5	32.7		2.0	32.7		2.0
Hardekool Akademie vir C.V.O	135.9	63.6		4.8	14.7	0.5	27.0		1.6	27.0		1.6
Lephalale Clinic	141.7	58.5		4.9	15.7	0.5	30.7		1.9	30.7		1.9
Ons Hoop	116.0	66.9		4.3	10.3	0.4	26.8		1.8	26.8		1.8
Woudend	50.0	38.5		1.8	3.5	0.2	12.0		0.6	12.0		0.6
Ramabara's	114.4	53.7		4.5	11.3	0.4	12.9		0.9	12.9		0.9

	SO_2				NO_2		PM_{10} Total			$PM_{2.5}$ Total		
	1-hr	24-hr	NoE	Ann	1-hr	Ann	24-hr	NoE	Ann	24-hr	NoE	Ann
Receptor	350	125	12	50	200	40	75	12	40	40	12	20
Ga-Shongoane	54.9	31.1		2.0	3.8	0.2	6.8		0.4	6.8		0.4
Bulge River	112.7	35.5		5.0	12.8	0.5	8.6		0.8	8.6		0.8
Kaingo Mountain Lodge	95.8	34.6		4.3	9.7	0.4	8.6		0.8	8.6		0.8
Community	131.5	43.1		6.3	15.4	0.7	9.6		1.0	9.6		1.0
Kiesel	146.9	57.1		6.3	18.7	0.7	16.1		2.8	16.1		2.8
Kremetartpan	226.2	80.4		9.4	31.3	1.1	34.6		5.9	34.6		5.9
Mbala Private Camp	182.9	67.0		8.8	24.0	1.0	15.7		1.7	15.7		1.7
Steenbokpan	193.2	70.7		7.1	25.9	0.8	**78.3**	1	17.4	**78.3**	**92**	17.4
Receptor	96.9	52.6		3.7	9.9	0.3	26.7		2.3	26.7		2.3
Sandbult	128.6	59.4		4.7	14.5	0.5	36.5		5.5	36.5		5.5
Hardekraaltjie	68.4	30.2		2.5	5.4	0.2	15.0		1.3	15.0		1.3
Receptor	102.6	71.8		3.9	9.9	0.4	34.9		2.5	34.9		2.5
Receptor	76.2	42.9		2.6	5.6	0.2	18.2		1.3	18.2		1.3
Receptor	65.2	42.5		2.3	4.2	0.2	14.6		0.9	14.6		0.9
Receptor	59.2	39.1		2.2	4.0	0.2	13.6		0.7	13.6		0.7
Receptor	72.3	41.4		2.7	5.4	0.2	14.0		0.8	14.0		0.8
Ditaung	50.0	27.9		1.8	3.1	0.1	7.5		0.4	7.5		0.4
Letlora	48.7	32.1		1.7	3.2	0.1	9.4		0.5	9.4		0.5
Receptor	165.0	60.0		6.5	20.5	0.7	31.7		6.1	31.7		6.1
Glenover	130.5	48.2		5.3	15.9	0.6	19.3		3.5	19.3		3.5
Oxford Safaris	82.2	36.4		3.0	8.0	0.3	14.6		2.2	14.6		2.2
Receptor	83.8	37.5		2.9	7.4	0.2	18.5		2.1	18.5		2.1
Tholo Bush Estate	103.6	39.0		4.2	9.7	0.4	9.2		0.8	9.2		0.8
Receptor	165.0	55.1		7.1	20.3	0.7	17.1		1.4	17.1		1.4
Receptor	66.4	29.3		2.7	5.2	0.2	7.4		0.5	7.4		0.5
Cheetah Safaris	146.7	55.3		7.1	18.4	0.8	13.3		1.5	13.3		1.5
Rhinoland Safaris	57.0	30.3		2.2	4.5	0.2	5.9		0.4	5.9		0.4

Predicted concentrations in $\mu g/m^3$ at the sensitive receptors for Scenario A (2025), together with the limit value of the NAAQS and number of exceedances (NoE)

	SO_2				NO_2		PM_{10} Total			$PM_{2.5}$ Total		
	1-hr	24-hr	NoE	Ann	1-hr	Ann	24-hr	NoE	Ann	24-hr	NoE	Ann
Receptor	350	125	12	50	200	40	75	12	40	40	12	20
Phegelelo Senior Secondary	272.5	**171.2**	**13**	10.8	43.2	1.5	70.5		5.7	**70.5**	**13**	5.7
Contractors Village	259.1	**145.9**	2	10.3	40.2	1.4	**77.7**	1	8.0	**77.7**	**24**	8.0
Ditheku Primary School	274.2	**163.6**	12	10.6	43.8	1.5	71.8		5.7	**71.8**	**13**	5.7
Ditheko Primary School	332.4	**166.2**	**16**	11.9	50.9	1.7	74.2		5.2	**74.2**	10	5.2
Marapong Training Centre	287.9	**195.5**	**14**	11.6	44.2	1.6	74.7		6.1	**74.7**	**13**	6.1
Marapong Clinic	324.4	**184.4**	**22**	12.5	48.9	1.8	**78.5**	1	5.7	**78.5**	**15**	5.7
Tielelo Secondary School	273.9	**178.2**	**18**	11.0	43.9	1.5	72.4		5.8	**72.4**	**13**	5.8
Grootegeluk Medical Centre - Community Center	298.1	**190.2**	**13**	11.9	46.9	1.7	74.9		6.1	**74.9**	**14**	6.1
Lephalale College	264.1	89.9		9.9	40.0	1.3	53.2		3.4	**53.2**	1	3.4
Nelsonskop Primary School	318.0	**172.2**	**24**	12.5	49.8	1.7	**77.5**	1	5.8	**77.5**	**14**	5.8
Hansie en Grietjie Pre-Primary School	263.3	90.5		10.0	40.3	1.3	54.2		3.5	**54.2**	2	3.5
Sedibeng Special School for the Deaf and Disabilities	248.8	78.4		9.3	36.6	1.2	43.3		2.8	**43.3**	1	2.8
Kings College	278.1	93.1		10.8	42.9	1.5	53.2		3.7	**53.2**	1	3.7
Bosveld Primary School	265.7	89.4		10.1	40.4	1.3	46.6		3.2	**46.6**	1	3.2
Lephalale Medical Hospital	273.6	**170.2**	**17**	11.4	43.5	1.6	**75.6**	1	6.1	**75.6**	**15**	6.1
Ellisras Hospital	242.3	93.2		9.0	36.1	1.2	44.7		2.8	**44.7**	1	2.8
Laerskool Ellisras Primary School	218.4	89.8		7.4	28.9	0.9	32.7		2.1	32.7		2.1
Hoerskool Ellisras Secondary School	228.0	81.9		7.7	30.3	0.9	33.8		2.2	33.8		2.2
Marlothii Learning Academy	223.4	83.2		7.6	30.0	0.9	33.8		2.1	33.8		2.1
Hardekool Akademie vir C.V.O	201.1	83.2		7.0	26.8	0.8	27.4		1.8	27.4		1.8
Lephalale Clinic	217.7	84.0		7.4	29.1	0.9	31.7		2.0	31.7		2.0
Ons Hoop	190.2	94.6		6.2	21.1	0.7	27.8		1.9	27.8		1.9
Woudend	67.8	48.0		2.3	6.2	0.2	12.2		0.7	12.2		0.7
Ramabara's	143.7	64.2		5.8	18.1	0.6	14.1		1.0	14.1		1.0
Ga-Shongoane	68.3	38.0		2.4	5.8	0.2	7.7		0.5	7.7		0.5
Bulge River	130.7	43.8		6.2	16.6	0.7	9.0		1.0	9.0		1.0

	SO_2				NO_2		PM_{10} Total			$PM_{2.5}$ Total		
	1-hr	24-hr	NoE	Ann	1-hr	Ann	24-hr	NoE	Ann	24-hr	NoE	Ann
Receptor	350	125	12	50	200	40	75	12	40	40	12	20
Kaingo Mountain Lodge	104.6	35.0		4.9	11.8	0.5	8.5		0.9	8.5		0.9
Community	155.3	52.4		8.4	21.7	1.0	10.2		1.2	10.2		1.2
Kiesel	179.2	73.1		8.6	26.8	1.1	17.2		3.0	17.2		3.0
Kremetartpan	296.2	106.7		14.0	47.9	2.0	36.9		6.2	36.9		6.2
Mbala Private Camp	241.9	81.9		12.9	37.7	1.7	16.9		2.0	16.9		2.0
Steenbokpan	293.2	99.7		11.7	46.7	1.6	**79.7**	1	17.7	**79.7**	**92**	17.7
Receptor	142.8	57.7		5.0	17.3	0.5	26.4		2.5	26.4		2.5
Sandbult	173.3	75.5		6.8	23.4	0.8	38.2		5.7	38.2		5.7
Hardekraaltjie	96.4	42.8		3.2	8.7	0.3	15.6		1.4	15.6		1.4
Receptor	163.3	92.3		5.5	21.5	0.7	35.5		2.7	35.5		2.7
Receptor	100.3	56.2		3.5	9.3	0.3	18.4		1.4	18.4		1.4
Receptor	89.3	50.7		2.8	7.5	0.3	15.1		1.0	15.1		1.0
Receptor	78.0	48.9		2.9	6.4	0.3	14.6		0.8	14.6		0.8
Receptor	100.7	49.8		3.4	8.7	0.3	15.5		0.9	15.5		0.9
Ditaung	66.4	36.2		2.2	5.1	0.2	7.6		0.5	7.6		0.5
Letlora	64.2	36.4		2.1	4.8	0.2	10.3		0.5	10.3		0.5
Receptor	202.2	73.8		9.3	29.7	1.2	33.2		6.3	33.2		6.3
Glenover	159.9	62.9		7.2	23.3	0.9	20.7		3.6	20.7		3.6
Oxford Safaris	103.7	41.9		4.0	12.3	0.4	15.6		2.3	15.6		2.3
Receptor	110.9	40.5		3.9	11.8	0.4	19.4		2.2	19.4		2.2
Tholo Bush Estate	122.4	48.3		5.1	13.8	0.5	10.8		0.9	10.8		0.9
Receptor	196.9	69.3		9.1	25.9	1.1	17.9		1.6	17.9		1.6
Receptor	79.7	32.1		3.2	7.9	0.3	7.5		0.6	7.5		0.6
Cheetah Safaris	186.8	68.1		10.0	27.7	1.3	14.5		1.7	14.5		1.7
Rhinoland Safaris	68.2	32.2		2.5	6.2	0.2	6.3		0.5	6.3		0.5

Predicted concentrations in µg/m³ at the sensitive receptors for Scenario B (2031), together with the limit value of the NAAQS and number of exceedances (NoE)

	SO_2				NO_2		PM_{10} Total			$PM_{2.5}$ Total		
	1-hr	**24-hr**	**NoE**	**Ann**	**1-hr**	**Ann**	**24-hr**	**NoE**	**Ann**	**24-hr**	**NoE**	**Ann**
Receptor	**350**	**125**	**12**	**50**	**200**	**40**	**75**	**12**	**40**	**25**	**12**	**15**
Phegelelo Senior Secondary	255.1	**159.4**	**15**	10.4	40.3	1.4	67.8		5.5	**67.8**	**49**	5.5
Contractors Village	268.4	**139.1**	4	10.5	42.3	1.4	**75.8**	1	7.9	**75.8**	**76**	7.9
Ditheku Primary School	256.7	**149.2**	11	10.2	40.1	1.4	68.7		5.5	**68.7**	**50**	5.5
Ditheko Primary School	307.0	**154.5**	12	11.1	45.4	1.5	68.3		5.1	**68.3**	**50**	5.1
Marapong Training Centre	261.8	**186.1**	**14**	11.2	42.6	1.5	70.5		6.0	**70.5**	**57**	6.0
Marapong Clinic	315.1	**165.9**	12	11.7	47.7	1.6	72.7		5.5	**72.7**	**51**	5.5
Tielelo Secondary School	254.4	**169.5**	**15**	10.6	40.4	1.4	69.7		5.6	**69.7**	**51**	5.6
Grootegeluk Medical Centre - Community Center	271.9	**186.1**	**17**	11.4	42.8	1.6	71.1		5.9	**71.1**	**57**	5.9
Lephalale College	232.9	81.9		9.0	33.1	1.1	51.0		3.3	**51.0**	**18**	3.3
Nelsonskop Primary School	297.1	**163.7**	**18**	11.6	43.9	1.6	72.2		5.6	**72.2**	**55**	5.6
Hansie en Grietjie Pre-Primary School	233.8	82.2		9.2	33.5	1.2	51.8		3.4	**51.8**	**18**	3.4
Sedibeng Special School for the Deaf and Disabilities	217.5	71.1		8.5	30.6	1.0	41.5		2.7	**41.5**	8	2.7
Kings College	250.9	86.1		10.0	35.6	1.3	52.1		3.5	**52.1**	**20**	3.5
Bosveld Primary School	241.7	75.0		9.4	33.4	1.2	45.7		3.1	**45.7**	12	3.1
Lephalale Medical Hospital	262.4	**186.9**	**15**	11.1	41.2	1.5	72.7		5.9	**72.7**	**57**	5.9
Ellisras Hospital	220.0	76.1		7.9	30.2	1.0	43.5		2.7	**43.5**	7	2.7
Laerskool Ellisras Primary School	175.7	65.8		6.3	22.3	0.7	30.9		1.9	**30.9**	1	1.9
Hoerskool Ellisras Secondary School	184.7	68.1		6.6	23.6	0.7	31.8		2.1	**31.8**	1	2.1
Marlothii Learning Academy	182.4	67.2		6.5	23.3	0.7	32.1		2.0	**32.1**	1	2.0
Hardekool Akademie vir C.V.O	165.8	62.8		5.9	20.3	0.6	26.6		1.7	**26.6**	1	1.7
Lephalale Clinic	177.5	65.9		6.3	22.4	0.7	30.1		1.9	**30.1**	1	1.9
Ons Hoop	153.4	71.3		5.1	16.4	0.6	25.8		1.8	**25.8**	1	1.8
Woudend	53.4	30.7		1.7	4.5	0.1	10.2		0.6	10.2		0.6
Ramabara's	111.6	51.0		4.6	12.9	0.5	11.5		0.9	11.5		0.9
Ga-Shongoane	49.7	27.6		1.7	3.9	0.1	5.7		0.4	5.7		0.4
Bulge River	90.1	32.1		4.5	10.9	0.4	7.3		0.8	7.3		0.8
Kaingo Mountain Lodge	70.4	26.4		3.5	7.3	0.3	6.5		0.7	6.5		0.7

	SO_2				NO_2		PM_{10} Total			$PM_{2.5}$ Total		
	1-hr	24-hr	NoE	Ann	1-hr	Ann	24-hr	NoE	Ann	24-hr	NoE	Ann
Receptor	350	125	12	50	200	40	75	12	40	25	12	15
Community	109.3	39.7		6.4	14.8	0.7	7.7		1.0	7.7		1.0
Kiesel	130.0	50.7		6.7	19.1	0.8	14.7		2.7	14.7		2.7
Kremetartpan	211.6	78.8		11.3	33.0	1.5	33.6		5.9	**33.6**	1	5.9
Mbala Private Camp	172.9	60.2		10.2	26.1	1.3	14.0		1.7	14.0		1.7
Steenbokpan	231.4	83.2		10.2	35.6	1.4	**75.5**	1	17.6	**75.5**	**270**	**17.6**
Receptor	112.4	45.8		4.0	12.9	0.4	23.4		2.3	23.4		2.3
Sandbult	135.6	56.6		5.6	17.2	0.6	34.0		5.5	**34.0**	1	5.5
Hardekraaltjie	76.8	32.3		2.5	6.4	0.2	13.7		1.2	13.7		1.2
Receptor	144.8	72.2		4.5	17.8	0.5	32.1		2.5	**32.1**	1	2.5
Receptor	86.5	38.3		2.7	7.4	0.2	15.7		1.2	15.7		1.2
Receptor	65.8	35.8		2.0	5.5	0.2	13.2		0.8	13.2		0.8
Receptor	62.9	35.9		2.1	5.0	0.2	11.4		0.7	11.4		0.7
Receptor	79.3	37.5		2.6	6.6	0.2	12.6		0.8	12.6		0.8
Ditaung	49.7	26.3		1.6	3.3	0.1	6.0		0.4	6.0		0.4
Letlora	50.3	28.1		1.6	3.3	0.1	8.4		0.5	8.4		0.5
Receptor	150.5	62.4		7.4	21.7	0.9	31.4		6.1	**31.4**	1	6.1
Glenover	118.7	49.9		5.6	16.3	0.7	19.1		3.4	19.1		3.4
Oxford Safaris	77.3	30.8		3.2	8.7	0.3	13.7		2.2	13.7		2.2
Receptor	85.7	31.5		3.1	8.3	0.3	16.8		2.1	16.8		2.1
Tholo Bush Estate	83.2	32.0		3.6	8.2	0.3	7.7		0.7	7.7		0.7
Receptor	133.5	44.6		6.7	16.5	0.7	14.0		1.3	14.0		1.3
Receptor	57.5	24.1		2.3	4.9	0.2	5.5		0.4	5.5		0.4
Cheetah Safaris	131.8	53.5		8.1	19.4	1.0	12.4		1.5	12.4		1.5
Rhinoland Safaris	49.7	22.4		1.9	4.1	0.1	4.9		0.4	4.9		0.4

Predicted concentrations in $\mu g/m^3$ at the sensitive receptors for Scenario C (2036), together with the limit value of the NAAQS and number of exceedances (NoE)

	SO$_2$				NO$_2$		PM$_{10}$ Total			PM$_{2.5}$ Total		
	1-hr	**24-hr**	**NoE**	**Ann**	**1-hr**	**Ann**	**24-hr**	**NoE**	**Ann**	**24-hr**	**NoE**	**Ann**
Receptor	**350**	**125**	**12**	**50**	**200**	**40**	**75**	**12**	**40**	**25**	**12**	**15**
Phegelelo Senior Secondary	135.3	**146.2**	2	7.3	32.3	1.2	66.1		5.4	**66.1**	**49**	5.4
Contractors Village	128.7	**129.7**	1	7.3	32.9	1.2	74.0		7.7	**74.0**	**76**	7.7
Ditheku Primary School	129.7	**130.6**	2	7.2	32.4	1.2	66.8		5.4	**66.8**	**50**	5.4
Ditheko Primary School	202.4	115.8		8.0	40.7	1.3	65.8		4.9	**65.8**	**50**	4.9
Marapong Training Centre	134.3	**152.4**	4	8.0	34.9	1.4	68.7		5.8	**68.7**	**57**	5.8
Marapong Clinic	179.5	**131.9**	2	8.5	40.9	1.4	71.1		5.3	**71.1**	**51**	5.3
Tielelo Secondary School	123.3	**148.8**	6	7.5	32.4	1.3	67.9		5.5	**67.9**	**51**	5.5
Grootegeluk Medical Centre - Community Center	141.6	**148.1**	5	8.2	36.0	1.4	68.7		5.7	**68.7**	**57**	5.7
Lephalale College	188.7	66.1		6.4	32.1	1.1	49.0		3.1	**49.0**	**18**	3.1
Nelsonskop Primary School	175.4	**141.7**	5	8.5	39.6	1.4	70.3		5.5	**70.3**	**55**	5.5
Hansie en Grietjie Pre-Primary School	187.2	66.1		6.5	32.5	1.1	49.9		3.2	**49.9**	**18**	3.2
Sedibeng Special School for the Deaf and Disabilities	173.1	57.9		6.0	29.9	1.0	39.8		2.5	**39.8**	8	2.5
Kings College	194.9	65.2		7.2	35.0	1.2	48.6		3.3	**48.6**	**20**	3.3
Bosveld Primary School	189.7	60.4		6.7	33.3	1.1	42.9		2.9	**42.9**	**13**	2.9
Lephalale Medical Hospital	129.8	**146.8**	7	7.8	33.2	1.3	71.3		5.8	**71.3**	**57**	5.8
Ellisras Hospital	164.3	56.4		5.7	28.8	0.9	40.3		2.5	**40.3**	7	2.5
Laerskool Ellisras Primary School	137.4	48.9		4.6	22.2	0.7	28.6		1.7	**28.6**	1	1.7
Hoerskool Ellisras Secondary School	143.3	50.7		4.8	23.5	0.7	29.5		1.9	**29.5**	1	1.9
Marlothii Learning Academy	140.3	50.1		4.7	23.4	0.7	29.5		1.8	**29.5**	1	1.8
Hardekool Akademie vir C.V.O	127.0	47.8		4.3	20.2	0.6	24.3		1.5	24.3		1.5
Lephalale Clinic	137.3	49.1		4.6	22.4	0.7	27.7		1.7	**27.7**	1	1.7
Ons Hoop	117.6	59.3		3.8	16.2	0.5	23.5		1.6	23.5		1.6
Woudend	37.8	25.7		1.3	4.5	0.2	9.5		0.5	9.5		0.5
Ramabara's	87.1	35.5		3.5	13.1	0.5	9.8		0.7	9.8		0.7
Ga-Shongoane	38.9	19.6		1.4	4.1	0.1	4.9		0.3	4.9		0.3
Bulge River	68.9	24.3		3.3	11.8	0.5	6.1		0.6	6.1		0.6

	SO_2				NO_2		PM_{10} Total			$PM_{2.5}$ Total		
	1-hr	**24-hr**	**NoE**	**Ann**	**1-hr**	**Ann**	**24-hr**	**NoE**	**Ann**	**24-hr**	**NoE**	**Ann**
Receptor	**350**	**125**	**12**	**50**	**200**	**40**	**75**	**12**	**40**	**25**	**12**	**15**
Kaingo Mountain Lodge	53.7	19.8		2.6	7.8	0.3	5.5		0.6	5.5		0.6
Community	84.6	30.5		4.7	15.8	0.8	6.8		0.8	6.8		0.8
Kiesel	94.1	37.7		4.6	19.4	0.8	13.2		2.6	13.2		2.6
Kremetartpan	150.2	54.3		7.5	34.3	1.5	31.4		5.7	**31.4**	1	5.7
Mbala Private Camp	127.3	44.5		7.1	27.0	1.3	12.3		1.5	12.3		1.5
Steenbokpan	164.8	53.8		6.8	34.6	1.2	73.6		17.3	**73.6**	**269**	**17.3**
Receptor	85.0	35.4		2.9	12.6	0.4	22.1		2.2	22.1		2.2
Sandbult	96.6	37.6		3.9	17.1	0.6	32.6		5.4	**32.6**	1	5.4
Hardekraaltjie	55.7	25.0		1.9	6.2	0.2	12.5		1.1	12.5		1.1
Receptor	91.6	50.8		3.2	16.5	0.5	30.2		2.4	**30.2**	1	2.4
Receptor	60.8	31.8		2.1	7.3	0.2	13.9		1.1	13.9		1.1
Receptor	49.1	29.0		1.5	5.5	0.2	11.9		0.8	11.9		0.8
Receptor	45.5	27.6		1.6	4.6	0.2	10.8		0.6	10.8		0.6
Receptor	57.5	29.9		1.9	6.3	0.2	11.8		0.7	11.8		0.7
Ditaung	36.6	18.2		1.2	3.4	0.1	5.3		0.3	5.3		0.3
Letlora	36.9	20.7		1.2	3.2	0.1	7.5		0.4	7.5		0.4
Receptor	108.1	39.7		5.1	21.2	0.9	29.2		5.9	**29.2**	1	5.9
Glenover	84.5	32.9		3.9	16.7	0.6	17.4		3.3	17.4		3.3
Oxford Safaris	54.2	21.8		2.2	8.6	0.3	12.9		2.1	12.9		2.1
Receptor	62.2	22.3		2.2	8.5	0.3	15.6		1.9	15.6		1.9
Tholo Bush Estate	65.5	23.4		2.8	9.2	0.3	6.9		0.6	6.9		0.6
Receptor	109.1	35.9		5.0	18.6	0.8	12.6		1.1	12.6		1.1
Receptor	43.0	18.7		1.8	5.3	0.2	4.5		0.4	4.5		0.4
Cheetah Safaris	96.9	38.2		5.4	19.9	1.0	10.3		1.3	10.3		1.3
Rhinoland Safaris	36.8	17.7		1.4	4.3	0.2	4.1		0.3	4.1		0.3

Predicted concentrations in µg/m^3 at the sensitive receptors for Scenario D (MES), together with the limit value of the NAAQS and number of exceedances (NoE)

	SO$_2$				NO$_2$		PM$_{10}$ Total			PM$_{2.5}$ Total		
	1-hr	24-hr	NoE	Ann	1-hr	Ann	24-hr	NoE	Ann	24-hr	NoE	Ann
Receptor	**350**	**125**	**12**	**50**	**200**	**40**	**75**	**12**	**40**	**25**	**12**	**15**
Phegelelo Senior Secondary	68.6	48.2		2.9	32.3	1.2	61.7		5.1	**61.7**	**49**	5.1
Contractors Village	68.9	39.3		2.9	32.9	1.2	70.4		7.5	**70.4**	**76**	7.5
Ditheku Primary School	69.2	46.4		2.8	32.4	1.2	62.7		5.1	**62.7**	**50**	5.1
Ditheko Primary School	90.1	42.7		3.1	40.7	1.3	61.9		4.7	**61.9**	**50**	4.7
Marapong Training Centre	74.1	51.2		3.1	34.9	1.4	64.6		5.6	**64.6**	**57**	5.6
Marapong Clinic	89.8	48.2		3.3	40.9	1.4	67.0		5.1	**67.0**	**51**	5.1
Tielelo Secondary School	69.5	46.7		3.0	32.4	1.3	63.6		5.2	**63.6**	**51**	5.2
Grootegeluk Medical Centre - Community Center	76.5	51.6		3.2	36.0	1.4	65.0		5.5	**65.0**	**57**	5.5
Lephalale College	69.6	24.8		2.6	32.1	1.1	44.8		2.9	**44.8**	**18**	2.9
Nelsonskop Primary School	82.6	49.8		3.3	39.6	1.4	66.0		5.2	**66.0**	**55**	5.2
Hansie en Grietjie Pre-Primary School	70.1	25.3		2.7	32.5	1.1	45.7		2.9	**45.7**	**18**	2.9
Sedibeng Special School for the Deaf and Disabilities	65.6	21.6		2.5	29.9	1.0	35.7		2.2	**35.7**	8	2.2
Kings College	72.3	23.7		2.9	35.0	1.2	44.8		3.1	**44.8**	**20**	3.1
Bosveld Primary School	69.8	22.3		2.7	33.3	1.1	39.1		2.6	**39.1**	**13**	2.6
Lephalale Medical Hospital	70.4	52.4		3.1	33.2	1.3	66.8		5.5	**66.8**	**57**	5.5
Ellisras Hospital	64.3	22.9		2.3	28.8	0.9	36.7		2.3	**36.7**	7	2.3
Laerskool Ellisras Primary School	54.7	20.8		1.9	22.2	0.7	25.2		1.5	**25.2**	1	1.5
Hoerskool Ellisras Secondary School	57.1	21.6		2.0	23.5	0.7	26.0		1.7	**26.0**	1	1.7
Marlothii Learning Academy	55.8	21.2		1.9	23.4	0.7	26.2		1.6	**26.2**	1	1.6
Hardekool Akademie vir C.V.O	50.5	20.0		1.8	20.2	0.6	20.7		1.3	20.7		1.3
Lephalale Clinic	54.6	20.5		1.9	22.4	0.7	24.4		1.5	24.4		1.5
Ons Hoop	47.0	23.4		1.5	16.2	0.5	20.3		1.4	20.3		1.4
Woudend	17.0	10.8		0.6	4.5	0.2	7.6		0.4	7.6		0.4
Ramabara's	35.4	15.3		1.4	13.1	0.5	7.1		0.5	7.1		0.5
Ga-Shongoane	16.2	8.7		0.6	4.1	0.1	3.3		0.2	3.3		0.2
Bulge River	30.8	10.2		1.5	11.8	0.5	4.1		0.4	4.1		0.4

	SO_2				NO_2		PM_{10} Total			$PM_{2.5}$ Total		
	1-hr	24-hr	NoE	Ann	1-hr	Ann	24-hr	NoE	Ann	24-hr	NoE	Ann
Receptor	350	125	12	50	200	40	75	12	40	25	12	15
Kaingo Mountain Lodge	23.9	7.9		1.2	7.8	0.3	3.6		0.4	3.6		0.4
Community	37.0	13.5		2.0	15.8	0.8	4.3		0.6	4.3		0.6
Kiesel	42.9	17.1		2.1	19.4	0.8	11.3		2.3	11.3		2.3
Kremetartpan	69.8	25.8		3.5	34.3	1.5	28.0		5.3	**28.0**	1	5.3
Mbala Private Camp	57.6	19.5		3.2	27.0	1.3	9.1		1.1	9.1		1.1
Steenbokpan	73.1	24.1		3.0	34.6	1.2	70.3		17.1	**70.3**	**269**	**17.1**
Receptor	34.8	14.8		1.2	12.6	0.4	18.9		2.0	18.9		2.0
Sandbult	42.3	17.6		1.7	17.1	0.6	29.5		5.1	**29.5**	1	5.1
Hardekraaltjie	23.6	10.2		0.8	6.3	0.2	10.1		1.0	10.1		1.0
Receptor	42.6	21.8		1.4	16.5	0.5	26.6		2.2	**26.6**	1	2.2
Receptor	25.6	12.7		0.9	7.3	0.2	11.1		1.0	11.1		1.0
Receptor	21.3	12.0		0.7	5.5	0.2	9.8		0.6	9.8		0.6
Receptor	18.9	12.2		0.7	4.6	0.2	8.5		0.5	8.5		0.5
Receptor	23.7	12.9		0.8	6.3	0.2	9.5		0.5	9.5		0.5
Ditaung	15.6	8.4		0.5	3.4	0.1	3.7		0.2	3.7		0.2
Letlora	15.6	8.6		0.5	3.2	0.1	5.7		0.3	5.7		0.3
Receptor	47.7	17.7		2.3	21.2	0.9	26.9		5.6	**26.9**	1	5.6
Glenover	37.5	15.5		1.8	16.7	0.6	15.4		3.1	15.4		3.1
Oxford Safaris	24.5	10.0		1.0	8.6	0.3	11.4		1.9	11.4		1.9
Receptor	27.4	9.7		1.0	8.5	0.3	13.1		1.8	13.1		1.8
Tholo Bush Estate	28.9	11.3		1.2	9.2	0.3	4.6		0.4	4.6		0.4
Receptor	47.2	15.5		2.2	18.6	0.8	9.8		0.8	9.8		0.8
Receptor	18.9	7.3		0.8	5.3	0.2	3.0		0.2	3.0		0.2
Cheetah Safaris	44.0	17.3		2.5	19.9	1.0	7.6		1.0	7.6		1.0
Rhinoland Safaris	16.1	7.6		0.6	4.3	0.2	2.7		0.2	2.7		0.2

ANNEXURE 2: NEMA REGULATION – APPENDIX 6

Specialist Reports as per the NEMA EIA Regulations, 2014 (as amended), must contain the information outlined in According to Appendix 6 (1) of the Regulations. Table A1 indicates where this information is included in the AIR.

Table A1: Prescribed contents of the Specialist Reports (Appendix 6 of the EIA Regulations, 2014)

Relevant section in GNR. 982	Requirement description	Relevant section in this report
(a) details of—	(i) the specialist who prepared the report; and	Section 2.7
	(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	Section 2.7 & Annexure 2
(b)	a declaration that the specialist is independent in a form as may be specified by the competent authority;	Section 12
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	Section 1, 2.1 & 3.2
(cA)	an indication of the quality and age of base data used for the specialist report;	Section 5 & 6
(cB)	a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 6.1
(d)	the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Site investigation not applicable
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 5 & 6.2
(f)	details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 6.3 & 6.4
(g)	an identification of any areas to be avoided, including buffers;	None identified
(h)	a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 6.3.2
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge; Note: Uncertainties should be qualified within the report – there will always be uncertainties due to gaps in knowledge should also be qualified – a gap is to record that not all knowledge can be obtained for a study.	Section 2.9
(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 6.4
(k)	any mitigation measures for inclusion in the EMPr;	Section 9

Relevant section in GNR. 982	Requirement description	Relevant section in this report
	Note: We need to include whether these mitigation measures (excluding ongoing monitoring) can be practically implemented prior to commencement or not.	
(l)	any conditions for inclusion in the environmental authorisation;	Section 9
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 9
(n) a reasoned opinion—	(i) whether the proposed activity, activities or portions thereof should be authorised;	Section 10
	(iA) regarding the acceptability of the proposed activity or activities; and	Section 10
	(ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan; Note: We need to include whether these mitigation measures (excluding ongoing monitoring) can be practically implemented prior to commencement or not.	Section 10
(o)	a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 1
(p)	a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Addressed in April 2021 AIR
(q)	any other information requested by the competent authority.	Addressed in April 2021 AIR
(2)	Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Section 1 & 6.2.1

ANNEXURE 3: CURRICULUM VITAE

MARK ZUNCKEL

Firm : uMoya-NILU (Pty) Ltd
Profession : Air quality consultant
Specialization : Air quality assessment, air quality management planning, air dispersion modelling, boundary layer meteorology, project management
Position in Firm : Managing director and senior consultant
Years with Firm : Since 1 August 2007
Nationality : South African
Year of Birth : 1959
Language Proficiency : English and Afrikaans

EDUCATION AND PROFESSIONAL STATUS

Qualification	Institution	Year
National Diploma (Meteorology)	Technikon Pretoria	1980
BSc (Meteorology)	Univ. of Pretoria	1984
BSc Hons (Meteorology)	Univ. of Pretoria	1988
MSc	Univ. of Natal	1992
PhD	Univ. Witwatersrand	1999

Registered Natural Scientist: South African Society for Natural Scientific Professionals
Ex-Council Member: National Association for Clean Air
Member: National Association for Clean Air

EMPLOYMENT AND EXPERIENCE RECORD

Period	**Organisation details and responsibilities/roles**
1976 – May 1992	South African Weather Bureau : Observer, junior forecaster, senior forecast, researcher, assistant director
June 1992 – July 2007	CSIR: Consultant and researcher, Research group Leader: Atmospheric Impacts
August 2007 to present	uMoya-NILU Consulting: Managing Director and senior air quality consultant

Key and Recent Project Experience:

1996	Project leader & Principal researcher: Atmospheric impact assessment for the proposed Mozal aluminium smelter in Maputo, Mozambique.

1996	Project leader & Principal researcher: Dry sulphur deposition during the Ben MacDhui High Altitude Trace Gas and Transport Experiment (BATTEX) in the Eastern Cape.
1997	Project leader & Principal researcher: Atmospheric impact assessment of the proposed capacity expansion project for Alusaf in Richards Bay.
1997	Project leader & Principal researcher: The Uruguayan ambient air quality project with LATU.
1997	Principal researcher on the Air quality specialist study for the Strategic Environmental Assessment on the industrial and urban hinterland of Richards Bay.
1997	Project leader & Principal researcher: Feasibility study for the implementation of a fog detection system in the Cape Metropolitan area: Meteorological aspects.
2001	Project leader & Principal researcher: Air quality specialist study for the Environmental Impact Assessment for the proposed expansion of the Hillside Aluminium Smelter, Richards Bay.
2001-03	Researcher: The Cross Border air Pollution Impact (CAPIA) project. A 3-year modelling and impacts study in the SADC region.
2002	Project leader & Principal researcher: Air quality assessment specialist study for the proposed Pechiney Smelter at Coega.
2002	Project leader & Principal researcher: Air quality assessment specialist study for the proposed N2 Wild Coast Toll Road.
2002-05	Project leader on the NRF project – development of a dynamic air pollution prediction system
2004	Project leader on the specialist study for expansion at the Natal Portland Cement plant at Simuma, KwaZulu-Natal.
2004-05	Researcher: National Air Quality Management Plan implementation project for Department Environmental Affairs and Tourism.
2005	Researcher in the assessment of air quality impacts associated with the expansion of the Natal Portland Cement plant at Port Shepstone.
2006-07	Project team leader of a multi-national team to develop the National Framework for Air Quality Management for the Department of Environment Affairs and Tourism
2007	Air quality assessment for Mutla Early Production System in Uganda for ERM Southern Africa on behalf of Tullow Oil.
2007-10	Lead consultant on the development of a dust mitigation strategy fro the Bulk Terminal Saldanha and an ambient guideline for Fe_2O_3 dust for Transnet Projects and on-going monitoring.
2008	Lead consultant on the Air quality status quo assessment and scoping for the EIA for the Sonangol Refinery
2008-09	Lead consultant on the development of the air quality management plan for the Western Cape Provincial. Department of Environmental Affairs and Development Planning.
2008-10	Lead consultant on the development of the Highveld Priority Area air quality management plan for the Department of Environmental Affairs and Tourism.
2008	Lead consultant in the development of an odour management and implementation strategy for eThekwini, focussing on Wastewater Treatment Works and odourous industrial sources
2008&10	Lead consultant on the Air Quality Specialist Study for the EIA for the proposed Kalagadi Manganese Smelter at Coega

2008	Lead consultant on the Air Quality Assessment for the Proposed Construction and Operation of a Second Cement Mill at NPC-Cimpor, Simuma near Port Shepstone.
2008	Lead consultant on the Air Quality Specialist Study Report for the New Multi-Purpose Pipeline Project (NMPP) for Transnet Pipelines.
2008	Lead consultant on the Air quality assessment for the proposed UTE Power Plant and RMDZ coal mine at Moatize, Mozambique for Vale.
2008-09	Lead consultant on the Dust source apportionment study for the Coedmore region in Durban for NPC-Cimpor.
2009	Consultant on the Air quality specialist study for the upgrade of the Kwadukuza Landfill, KwaZulu-Natal
2009-10	Lead consultant on the Audit of ambient air quality monitoring programme and air quality training for air quality personnel at PetroSA
2010	Lead consultant on the Qualitative assessment of impact of dust on solar power station at Saldanha Bay
2010	Lead consultant on the Air quality specialist study for the EIA for the Kalagadi Manganese Smelter at Coega
2009-10	Lead consultant on the Air quality specialist study for the Environmental Management Framework for the Port of Richards Bay
2010	Lead consultant on the Air quality status quo assessment and abatement planning at Idwala Carbonates, Port Shepstone
2010	Lead consultant on the Air quality status quo assessment and abatement planning at Sappi Tugela, Mandeni
2010–11	Air quality status quo assessment and revision of the Air Quality Management Plan for City of Johannesburg
2010	Lead consultant on the Air quality status quo assessment and abatement planning at First Quantum Mining’s Bwana Mkubwa and Kansanshi mines, Zambia
2010–11	Lead consultant on the Air quality specialist study for the EIA for the Alternative Fuel and Resources Project at Simuma, Port Shepstone
2010–11	Lead consultant on the Air quality specialist study for the EIA for the Coke Oven re-commissioning at ArcelorMittal Newcastle
2010	Qualitative air quality assessment for the EIA for the Mozpel sugar to ethanol project , Mozambique
2011	Development of the South African Air Quality Information System – Phase II The National Emission Inventory
2011	Ambient baseline monitoring for Riversdale’s Zambezi Coal Project in Tete, Mozambique
2010-11	Ambient quality baseline assessment for the Ncondeze Coal Project, Tete Mozambique
2011-12	Air quality assessment for the mining and processing facilities at Longmin Platinum in Marikana
2012	Air quality assessment for the proposed LNG and OLNG power stations in Mozambique
2012	Modelling study in Abu Dhabi for the transport and deposition of radio nuclides
2012	Air quality assessment for the proposed manganese ore terminal at the Ngqura Port
2012-13	Air quality management plan development for Stellenbosch Municipality
2012-12	Air quality management plan development for the Eastern Cape Province

2013	Air quality specialist for Tullow Oil Waraga-D and Kinsinsi environmental audit in Uganda
2013	Air quality specialist study for the EIA for the Thabametsi IPP station
2013	Air quality management plan for the Ugu District Municipality
2013-14	Air quality specialist study for the application for postponement of the minimum emission standards for 9 Eskom power stations
2014	Air quality specialist study for the application for postponement applications of the minimum emission standards for the Engen Refinery in Merebank, Durban
2014-15	Baseline assessment and AQMP development for the uThungulu District Municipality
2013-15	Baseline assessment, AQMP and Threat Assessment for the Waterberg-Bojanala Priority Area
2014-15	Review of the 2007 AQMP for eThekwini Municipality, including metropolitan emission inventory development for all sectors, i.e. industrial, transport, waste management, biomass burning, residential fuel burning, dispersion modelling and strategy development
2014-14	Dispersion modelling study for Richards Bay Minerals
2015	Air quality assessment for Rainbow Chickens at Hammersdale
2015	Air quality status quo assessment and planning for TNPA ports in South Africa
2016- 7	Lead author of the National State of Air Report for 2005 to 2015, including national emission inventory development for all sectors, i.e. industrial, transport, waste management, biomass burning, residential fuel burning
2016	Air quality assessment for Kanshansi Mine, Solwesi, Zambia
2016	Assessment of air quality impacts associated with activities at the Venetia Mine, Limpopo Province
2016	Assessment of air quality impacts associated with activities at the Komati Anthracite Mine, Mpumalanga Province
2016	Air quality assessment for the proposed Powership Project at the Port of Nacala, Mozambique
2016	Air quality assessment for the proposed Richards Bay Gas to Power Project
2017	Baseline assessment and review of the 2009 AQMP for Gauteng Province, including emission inventory development for all sectors, i.e. industrial, transport, waste management, biomass burning, residential fuel burning, and dispersion modelling
2017	Baseline assessment and air quality management plan for Northern Cape Province
2017	Air quality assessment for the EIA for the Thabametsi Power Station in Limpopo Province
2017	Air quality assessment for the EIA for the proposed Tshivasho Power Station in Limpopo Province
2018	Air quality assessment for the EIA for the proposed Bellmall Thermal Plant in Ekurhuleni
2018	Air quality assessment for the EIA for the proposed Simba Oil mini Refinery in Tororo, Uganda
2018-19	Air dispersion modelling for input to the Atmospheric Reports for the postponement application for 14 Eskom power stations
2019	Air quality impact assessment for the proposed NamPower expansion project in Walvis Bay
2019	Air quality assessment for the mine expansion project at the Akanani Mine

2019	Air quality impact assessment for the proposed power plant at Nacala, Mozambique
2020	AIR for the KarpowershipSA proposal in the Ports of Ngqura, Richards Bay and Saldanha Bay
2020	AIR for the Coega Development Corporation gas-to-power project at 4 sites in the CDC
2020	AIRs for 10 Eskom coal-fired power power stations on the Highveld to support their postponement application
2020	AIR for the proposed Azure Power gas-to-power project in the Western Cape
2021	Air quality assessment for the proposed optimisation project at Beeshoek Iron Ore Mine, Postmasburg, Northern Cape
2021	AIR for the proposed Frontier Power Gas-to-Power project at Saldanha Bay, Western Cape
2021	AIR for the 2021 shutdown and start-up at Engen Refinery in Merebank
2021	AIR for the proposed expansion of the Swartkops Ore handling facility in Port Elizabeth, Eastern Cape
2016-21	AEL compliance monitoring for Joseph Grieveson, Durban, including dust fallout monitoring and reporting
2018-21	Dust fallout and HF monitoring and reporting for Hulamin, Richards Bay
2018-21	Dust fallout and H_2S monitoring and reporting for at KwaDukuza Landfill for Dolphin Coast Landfill Management (DCLM)
2019-21	AEL compliance monitoring for Umgeni Iron and Steel Foundry, including dust fallout monitoring and reporting

PUBLICATIONS

Author and co-author of 34 articles in scientific journals, chapters in books and conference proceedings. Author and co-author of more than 300 technical reports and presented 47 papers at local and international conferences.

ATHAM RAGHUNANDAN

Firm : uMoya-NILU Consulting (Pty) Ltd
Profession : Air Quality Consultant
Specialization : Meteorological and Atmospheric Dispersion Modelling, Air Quality Specialist Studies, Project Management, Data Processing, Emission Inventories
Position in Firm : Senior Air Quality Consultant
Years with Firm : 14 years (appointed in 2008)
Nationality : South African
Year of Birth : 1977
Language Proficiency :English (mother tongue), Afrikaans (fair)

EDUCATION AND PROFESSIONAL STATUS

Qualification	**Institution**	**Year**
M.A. (Atmospheric Sciences)	University of Natal, Durban	2003
B.A. Hons. (Environmental Sciences)	University of Durban–Westville	2001
B.Paed. (Education)	University of Durban–Westville	2000

Memberships:

- National Association for Clean Air (NACA)
- South African Society for Atmospheric Sciences (SASAS)
- South African Council of Educators (SACE)

EMPLOYMENT AND EXPERIENCE RECORD

Period	Organisation details and responsibilities/roles
Jan 2003 – Oct 2008	CSIR: Consultant/Researcher in Air Quality Group, Research Group Leader – Air Quality Research Group
Nov 2008 – present	uMoya-NILU: Senior Air Quality Consultant

Key and Recent Project Experience:

2003	Baseline air dispersion modelling study for Natal Portland Cement (Pty) Ltd – Simuma Plant, Port Shepstone – Modelling and Reporting
2004	Air Quality Screening Study for MOZAL 3 – Modelling and Reporting
2005	Air Quality Specialist Study for the Proposed Kudu Combined Cycle Gas Turbine Power Station at Oranjemund, Namibia (Site D) – Modelling and Reporting
2005	Air Quality Specialist Study for the Proposed Kudu Combined Cycle Gas Turbine Power Plant at Uubvlei, Namibia – Modelling and Reporting
2005	Air Quality Specialist Study for a Proposed Cement Milling, Storage and Packaging Facility and a Second Clinker Kiln at Natal Portland Cement (Pty) Ltd – Simuma Plant, Port Shepstone – Modelling and Reporting
2005	Technology Review: Air quality specialist study for the Coega Aluminium Smelter at Coega, Port Elizabeth – Modelling and Reporting
2005	Assessment of Development Scenarios for Hillside Aluminium using Sulphur Dioxide (SO_2) as an Ambient Air Quality Indicator – Modelling and Reporting
2005	Air Quality Scoping Study for Eskom's Proposed Open Cycle Gas Turbine Power Station at Atlantis – Modelling and Reporting
2005	Air Quality Specialist Study for Eskom's Proposed Open Cycle Gas Turbine Power Station at Atlantis, Western Cape – Modelling and Reporting
2005	Air Quality Specialist Study for the Proposed Tata Steel Ferrochrome Project at Richards Bay – Alton North Site – Modelling and Reporting
2005	Air Quality Audit for the Amathole District Municipality - Compilation of detailed emissions inventory
2006	A Regional Scale Air Dispersion Modelling Study for Northeastern Uruguay – Modelling and Reporting

2006	Air Dispersion Modelling Study for Natal Portland Cement (Pty) Ltd for the Proposed AFR Programme at the Simuma Plant, Port Shepstone – Modelling and Reporting
2007	Development of an air quality management strategy for particulate matter at the Bulk Terminal Saldanha - Project Leader and Reporting
2007	Air Quality and Human Health Specialist Study for the Proposed Coega Integrated LNG to Power Project (CIP) within the Coega Industrial Zone, Port Elizabeth, South Africa - Project Leader, Modelling and Reporting
2008	Dispersion Modelling for the Proposed Coega Aluminium Smelter (CAL) at Port Elizabeth - Project Leader, Modelling and Reporting
2008	Modelled and Measured Vertical Ozone Profiles over Southern Africa (as part of the Young Researcher Establishment Fund (2005-2008)) - Project Leader
2008	Air Quality Specialist Study for the Proposed N2 Wild Coast Toll Highway - Project Leader, Modelling and Reporting
2008	Initial Air Quality Impact Assessment for the Proposed Illovo Ethanol Plant in Mali, West Africa - Project Leader, Modelling and Reporting
2008	Modelling Mercury Stack Emissions from South African Coal-fired Power Power stations – Modelling and Reporting
2009	Air Quality Management Plan for the Western Cape Province – Baseline Assessment – Modelling
2009	Proposed Exxaro AlloyStream^{TM} Manganese Project in the Coega Industrial Development Zone: Air Quality Impact Assessment – Modelling and Reporting
2009	Air Quality Specialist Study for the Kalagadi Manganese Smelter at Coega, Eastern Cape – Modelling and Reporting
2009	Qualitative Air Quality Impact Assessment for the Wearne Platkop Quarry – Modelling and Reporting
2009	Specialist Air Quality Study for the Vopak Terminal Durban Efficiency Project – Modelling
2009	Qualitative Air Quality Impact Assessment for the Proposed ETA STAR Coal Mine at Moatize, Mozambique – Modelling and Reporting
2009	Specialist Air Quality Study for the Kwadukuza Landfill Upgrade Project – Modelling and Reporting
2010	Ambient dust assessment at Saldanha Bay for the period October 2006 to September 2009 for Transnet Bulk Terminal Saldanha – Reporting
2010	Dust Impact Assessment for the Proposed Saldanha Bay Pilot PV plant – Reporting
2010	Modelling Particulate Emission Concentration Scenarios for Eskom's Kriel Power Station – Modelling and Reporting
2010	Air Quality Dispersion Modelling for MOZAL, Mozambique – Modelling and Reporting
2010	Air Quality Management Plan for the Highveld Priority Area – Air Quality Baseline Assessment for the Highveld Priority Area – Modelling
2010	Ambient Air Quality Modelling and Monitoring at Sappi, Mandeni – Modelling and Reporting
2010	Dust Impact Study at Idwala Carbonates – Modelling and Reporting
2010	Air quality specialist study for the EIA for the proposed re-commissioning of an existing coke oven battery at ArcelorMittal South Africa, Newcastle Works – Modelling

2010	Air quality specialist study for the proposed storage and utilisation of alternative fuels and resources at NPC-Cimpor's Simuma facility, Port Shepstone, KwaZulu-Natal – Modelling and Reporting
2010	Air quality status quo assessment and abatement planning at First Quantum Mining's Bwana Mkubwa and Kansanshi mines, Zambia – Modelling
2010	Air quality specialist study for the proposed briquetting plant at the Mafube Colliery – Modelling and Reporting
2011	Air quality modelling study for the Copeland reactor at Sappi Stanger – Modelling and Reporting
2011	Air quality modelling study for the Copeland reactor at Sappi Tugela – Modelling and Reporting
2011	Air quality monitoring and modelling study for the Copeland reactor at Mpact Paper, Piet Retief – Modelling and Reporting
2011	Air Quality Study for the Basic Environmental Assessment for the Proposed Biomass Co-Firing Facility at the Arnot Power Station – Modelling and Reporting
2011	Assessment of Scenarios for Developing and Implementing a Sulphur Dioxide Emissions Licensing Strategy for Hillside Aluminum – Modelling and Reporting
2011-12	Air quality assessment for the mining and processing facilities at Lonmin Platinum in Marikana – Modelling and Reporting
2012	Development of an Air Quality Management Plan for Anglo's Mafube Colliery in Mpumalanga – Modelling and Reporting
2012	Air quality assessment for the proposed manganese ore terminal at the Ngqura Port – Modelling and Reporting
2012	Air Quality Impact Assessment for NPC Cimpor – Modelling and Reporting
2013	Air Quality Impact Assessment for Proposed AfriSam Plant in Coega – Modelling
2013	Air quality assessment for the Orion Engineered Carbons Co-Gen Plant – Modelling
2013	Air quality assessment for the Orion Engineered Carbons - Main Boiler – Modelling
2013	Air quality assessment for the EIA for the Sekoko Coal Mine – Modelling and Reporting
2013	Air quality specialist study for the EIA for the Thabametsi IPP station – Modelling and Reporting
2013	Air quality specialist study for the EIA for the Mamathwane Common User facility – Modelling and Reporting
2013-14	Air quality specialist study for the application for postponement of the minimum emission standards for 16 Eskom power stations: Acacia, Arnot, Camden, Duvha, Grootvlei, Hendrina, Kendal, Komati, Kriel, Lethabo, Majuba, Matimba, Matla, Madupi, Tutuka, Port Rex – Modelling and Reporting
2014	Air quality specialist study for the application for postponement of the minimum emission standards for the Engen Refinery in Merebank, Durban – Modelling and Reporting
2013-14	Baseline assessment and air quality management plan for the Waterberg-Bojanala Priority Area – Modelling

2013	Air Quality Specialist Study for the EIA for the Pandora Platinum Mine Joint Venture – Modelling and Reporting
2013	Air Quality Specialist Study for the EIA for the Proposed New Tailings Storage Facility (TD8) and Associated Infrastructure at Lonmin's Western Platinum Mine and Eastern Platinum Mine – Modelling and Reporting
2015	Waterberg-Bojanala Priority Area Air Quality Management Plan and Threat Assessment – Modelling
2015	Air Quality Management Plan for eThekwini Municipality – Modelling and Reporting
2015	Air Quality Management Plan for the uThungulu District Municipality – Modelling and Reporting
2015	Dispersion Modelling for Richards Bay Minerals – Modelling and Reporting
2015	Atmospheric Impact Report in support of Sancryl Chemicals's application for a verification to the existing AEL as a result of the introduction of Ethyl Acrylate and Vinyl Acetate, Prospecton – Modelling and Reporting
2016	Dispersion Modelling Study for the City of Johannesburg – Modelling and Reporting
2016	Air Quality Specialist Study for the Department of Energy's Emergency Power IPP Project at Richards Bay and Saldanha Bay – Modelling and Reporting
2016	Atmospheric Impact Report in support of the EIA for the Proposed Gas to Power Plant in Zone 1F of the Richards Bay IDZ – Modelling and Reporting
2016	Atmospheric Impact Report for the EIA for the proposed Tshivhaso Coal-fired Power Plant, Lephalale – Modelling and Reporting
2016	TNPA Air Quality Study – Dispersion Modelling for 8 Ports in South Africa: Port of Richards Bay, Durban, East London, Ngqura, Port Elizabeth, Mossel Bay, Cape Town and Saldanha Bay – Modelling and Reporting
2016	Atmospheric Impact Report for Durran's Calcination Plant – Modelling and Reporting
2016	Air Quality Assessment for the EIA for the Floating Power Plant in Nacala, Mozambique – Modelling and Reporting
2016	Ambient Air Quality Assessment for 2016 for Kansanshi Mining Plc – Modelling and Reporting
2016	Air Quality Impact Assessment for the EIA for the Proposed Hilli FLNG Project in Cameroon – Modelling and Reporting
2016	Kansanshi Smelter and TSF1 Modelling Scenarios for Kansanshi Mining Plc – Modelling and Reporting
2016	Air Quality Assessment the Proposed Accommodation Facility at the Venetia Mine in Limpopo – Modelling and Reporting
2016	Atmospheric Impact Report in support of the EIA for the Proposed Optimisation of the Process Plant at Nkomati Anthracite Mine – Modelling and Reporting
2017	Atmospheric Impact Report in support of the DRDAR Atmospheric Emission License (AEL) application for the proposed replacement and use of an incinerator at their State Veterinary Laboratories located in Grahamstown, Middelburg and Queesntown in the Eastern Cape – Modelling and Reporting
2017	Baseline Assessment and Review of the 2009 AQMP for Gauteng Province, including emission inventory development for all sectors, i.e. industrial,

	transport, waste management, biomass burning, residential fuel burning, and dispersion modelling – Modelling and Reporting
2017	Baseline Assessment and Air Quality Management Plan for Northern Cape Province – Modelling and Reporting
2017	Atmospheric Impact Report in support of Maloka Machaba Surfacing's application for an Atmospheric Emission License (AEL) for a proposed asphalt plant located in Polokwane – Modelling and Reporting
2017	Assessment of modelling scenarios involving an increase in the open area of the cone on the Common Stack for the pretreater, reformer and CHD furnaces at Engen Refinery – Modelling and Reporting
2017	Atmospheric Impact Report in support of the Atmospheric Emission License (AEL) application and stack-height assessment for the proposed Thabametsi Power Plant near Lephalale, Limpopo – Modelling and Reporting
2017	Dispersion Modelling Study for the Beeshoek Mine, near Postmasburg, Northern Cape – Modelling and Reporting
2018	Air quality assessment for the EIA for the proposed Bellmall Thermal Plant in Ekurhuleni – Modelling and Reporting
2018	Air quality assessment for the EIA for the proposed Simba Oil mini Refinery in Tororo, Uganda – Modelling and Reporting
2018-19	Air dispersion modelling for input to the Atmospheric Reports for the postponement application for 14 Eskom power stations – Modelling and Reporting
2019	Air quality impact assessment for the proposed NamPower expansion project in Walvis Bay – Modelling and Reporting
2019	Air quality assessment for the mine expansion project at the Akanani Mine – Modelling and Reporting
2019	Air quality impact assessment for the proposed power plant at Nacala, Mozambique – Modelling and Reporting
2019	Atmospheric Impact Report in Support of the Atmospheric Emission License (AEL) Amendment Application and Basic Assessment for Dow Southern Africa - New Germany – Modelling and Reporting
2019	Atmospheric Impact Report in support of Tau-Pele Construction's application for an Atmospheric Emission License (AEL) for a proposed emulsion and asphalt plant located in Indwe, Eastern Cape – Modelling and Reporting
2019	Atmospheric Impact Report in Support of the EIA for the Proposed Material Source and Processing Sites Along the N3 Between Durban and Hilton, KwaZulu-Natal: RCL1, RCL9 and Harrison's Quarry – Modelling and Reporting
2019	Atmospheric Impact Report in Support of the Atmospheric Emission License (AEL) Amendment Application and Basic Assessment for the Vopak Efficiency (Growth 4) Expansion Project, Durban, South Africa – Modelling and Reporting
2020	AIR for the KarpowershipSA proposal in the Ports of Ngqura, Richards Bay and Saldanha Bay – Modelling and Reporting
2020	AIR for the Coega Development Corporation gas-to-power project at 4 sites in the CDC – Modelling and Reporting
2020	AIRs for 10 Eskom coal-fired power power stations on the Highveld to support their postponement application – Modelling and Reporting
2020	AIR for the proposed Azura Power gas-to-power project in the Western Cape – Modelling and Reporting

2020	Atmospheric Impact Report for the proposed 315 MW LPG Power Plant at Saldanha Bay – Modelling and Reporting
2021	Air quality assessment for the proposed optimisation project at Beeshoek Iron Ore Mine, Postmasburg, Northern Cape – Modelling and Reporting
2021	Air quality assessment for the proposed expansion at Akanani Mine in Limpopo – Modelling and Reporting
2021	AIR for the proposed Frontier Power Gas-to-Power project at Saldanha Bay, Western Cape
2021	AIR for the 2021 shutdown and start-up at Engen Refinery in Merebank – Modelling and Reporting
2021	AIR for the proposed expansion of the Swartkops Ore handling facility in Port Elizabeth, Eastern Cape – Modelling and Reporting
2021	Atmospheric Impact Report in support of the Proposed 200 MW Engie CB Hybrid Power Project in the Coega Special Economic Zone (SEZ) – Modelling and Reporting
2021	Air Quality Impact Assessment for the proposed Mining of TSF-1 at the Stibium Mopani Mine near Gravelotte, Limpopo Province – Modelling and Reporting
2021	Addendum to the Atmospheric Impact Report in support of the proposed Mulilo-Total 200 MW Gas-fired Power Station, Coega Special Development Zone, Eastern Cape – Reporting
2021	Air Quality Assessment for the EIA for the Tete 1 400 MW Coal-Fired Power Plant, Tete Province, Mozambique – Modelling and Reporting
2021	Atmospheric Impact Report in support of Tugela Asphalt's application for an Atmospheric Emission License (AEL) for a proposed asphalt plant located in Mandini, KwaZulu-Natal – Modelling
2021	Atmospheric Impact Report for Nkomati Mine – Modelling and Reporting
2022	Emission Inventory for Lanxess for 2021 – Reporting
2022	Annual Report for Puregas: Atmospheric Emission License - Submission to the City of Ekurhuleni in compliance with the Atmospheric Emission Licence of the facility for the Reporting Period Year 2021 – Reporting
2022	Emission Inventory for Puregas for 2021 – Reporting
2022	Emission Inventory for Dow Advanced Materials for 2020 – Reporting
2022	Atmospheric Impact Report for the Engen Cape Town Terminal – Modelling and Reporting

PUBLICATIONS

Author and co-author of 5 articles in scientific journals and conference proceedings. Author and co-author of more than 200 technical reports for external contract clients. Presented 4 papers at local conferences. A full list of publications, conference papers and contract reports is available on request.

NOPASIKA XULU

Firm	:	uMoya-NILU (Pty) Ltd
Profession	:	Senior Air Quality Consultant
Specialization	:	Air Quality Assessment, Air Dispersion Modelling; Project Management; Data Analysis; Report Writing and Reviews
Position in Firm	:	Senior Air Quality Consultant
Years with Firm	:	Since 27 March 2023
Nationality	:	South African
Year of Birth	:	1985
Language Proficiency	:	English and IsiZulu (read, write. Speak)

EDUCATION AND PROFESSIONAL STATUS

Qualification	**Institution**	**Year**
BSc. Environmental Studies	Univ. of Witwatersrand	2011
BSc Hons (Env. Studies)	Univ. of Witwatersrand	2012
BSc MSc (Env Sciences)	NWU Potchefstroom	2017

EMPLOYMENT AND EXPERIENCE RECORD

Period	**Organisation details and responsibilities/roles**
Oct 2016 – Dec 2018	Gondwana Environmental Solutions (Pty) Ltd: Air Quality Management Plans; Report Writing; Business Development and Marketing, Researcher,
July 2019 – March 2023	Rayten Engineering Solutions (Pty) Ltd: Air Quality Consultant, Project Management; Report Writing and Review; Data Analysis; Dispersion Modelling and Air Quality Impact Assessment; Research; Compiling Atmospheric Emission License (AEL) Applications; Populating National Atmospheric Emissions Inventory System; AEL Compliance Auditing; Dust Emission Reduction Plans; Greenhouse Gas Emissions Inventory Reporting; Facilitating/ Attending meetings; Liaising with Clients and Suppliers.

March 2023 – Present: uMoya – Nilu Consulting (Pty) Ltd Senior Air Quality Consultant, Dispersion Modelling and Air Quality Impact Assessments; Project Management

Key Project Experience:

2019 – 2023: Project Leader: Air Quality Impact Assessment projects (Harmony Moab Khotsong; EzeeTile Bloemfontein, EzeeTile Mokopane; Transvaal Galvanizers; Duho Drying; Lingaro Drying; Nama Copper Pty Ltd) Project Leader: AEL Applications and Reporting (Harmony Kopanang Operations; Harmony Mponeng Operations; Sibanye Gold Mines; Sibanye Platinum

Mines; TotalEnergies Marketing; Matt Cast Supplies CC; Independent Crematorium SA; City of Tshwane Crematorium; Buffalo City Municipality Crematorium; Wahl Industries; Transvaal Galvanizers)

2014 – 2017: Researcher: Air Quality Assessment in low-income residential areas in the Highveld

---

Publications: Author: Xulu, N.A., Piketh, S.J. Feig,G.T., Lack, D.A and Garland,R.M., (2020).Characterizing Light Absorbing Aerosols in a Low –Income Settlement in South Africa. Aerosol Air Quality Aerosol Air Quality Research. https://doi.org/10.4209/aaqr.2019.09.004

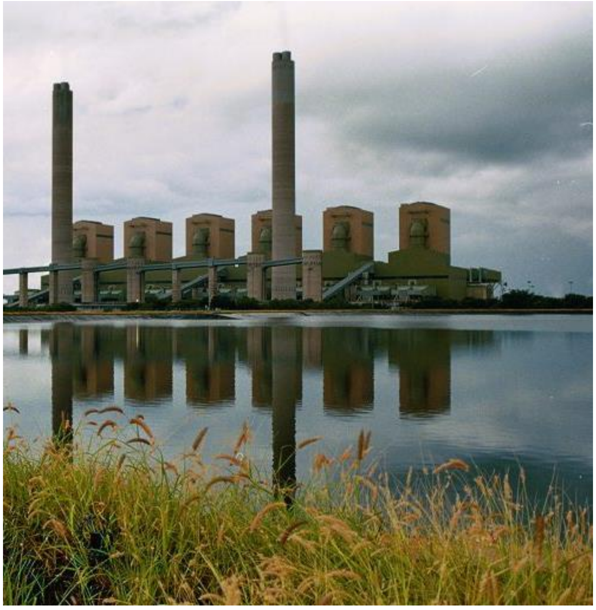
CONTACT INFORMATION:

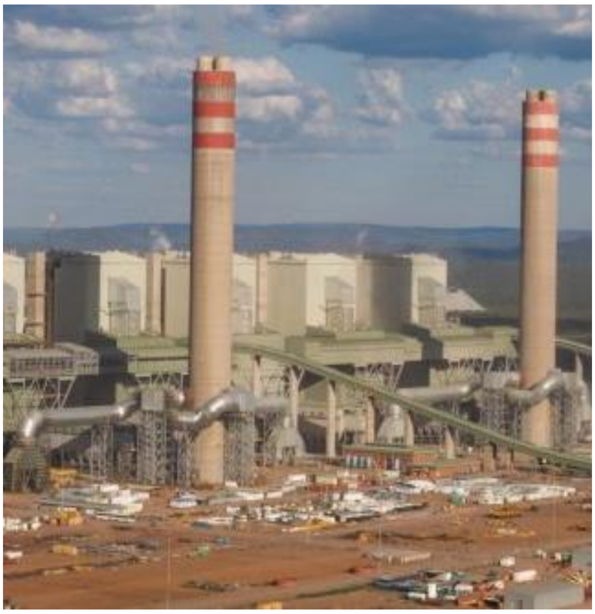
Email: nopasika@umoya-nilu.co.za
Phone: +27 63 1289 447

Appendix C

CUMULATIVE STACK ONLY EMISSIONS DISPERSION MODELLING

ADDENDUM TO: ATMOSPHERIC IMPACT REPORT IN SUPPORT OF THE APPLICATION FOR EXEMPTION FROM THE MINIMUM EMISSION STANDARDS FOR ESKOM's COAL-FIRED POWER STATIONS IN THE WATERBERG (A CUMULATIVE ASSESSMENT)





9 December 2024

Report issued by:

uMoya-NILU Consulting (Pty) Ltd
P O Box 20622
Durban North, 4016
South Africa

Report issued to:

WSP Group Africa (Pty) Ltd
Building 1, Maxwell Office Park
Magwa Crescent West, Waterfall City
Midrand, 1685
South Africa

Report Details

Client:	WSP Group Africa (Pty) Ltd
Report title:	Addendum to: Atmospheric Impact Report in Support of the Application for Exemption from the Minimum Emission Standards for Eskom’s Coal-Fired Power Stations in the Waterberg (A Cumulative Assessment)
Project:	uMN920-24
Report number:	uMN296-24
Version:	9 December 2024
Prepared by:	uMoya-NILU Consulting (Pty) Ltd, P O Box 20622, Durban North 4016, South Africa
Authors:	Mark Zunckel, Atham Raghunandan and Nopasika Xulu

When used in a reference this document should be cited as follows:
uMoya-NILU (2024): Addendum to: Atmospheric Impact Report in Support of the Application for Exemption from the Minimum Emission Standards for Eskom’s Coal-Fired Power Stations in the Waterberg (A Cumulative Assessment), Report No.: uMN296-24, December 2024.

Front page picture credit: https://www.eskom.co.za/eskom-divisions/gx/coal-fired-power-stations/

GLOSSARY OF TERMS AND ACRONYMS

AEL	Atmospheric Emission Licence
AIR	Atmospheric Impact Report
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
DSI	Dry Sorbent Injection
EIA	Environmental Impact Assessment
FGD	Flue-gas desulfurisation
g/s	Grams per second
kPa	Kilo Pascal
LNB	Low NO_X burner
MES	Minimum Emission Standards
mg/Nm^3	Milligrams per normal cubic meter refers to emission concentration, i.e. mass per volume at normal temperature and pressure, defined as air at 20^oC (293.15 K) and 1 atm (101.325 kPa)
NAAQS	National Ambient Air Quality Standards
NAQO	National Air Quality Officer
NECA	National Environmental Consultative and Advisory
NEM-AQA	National Environment Management: Air Quality Act, 2004 (Act No. 39 of 2004)
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
USEPA	United States Environmental Protection Agency
µm	1 µm = Micro meter 1 µm = 10^{-6} m

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

On 22 May 2024, the Minister directed Eskom to submit an application in terms of Section 59 of the National Environmental Management: Air Quality Act for exemption of the MES for eight (8) power stations that will continue to operate post 2030. These are Duvha, Kendal, Majuba, Matla and Tutuka in the Highveld Priority Area; Lethabo in the Vaal Triangle Airshed Priority Area; and Medupi and Matimba in the Waterberg-Bojanala Priority Area.

In terms the Minister's ruling Eskom Holdings SOC Ltd appointed WSP Group Africa (Pty) Ltd to prepare the necessary applications. WSP Group Africa (Pty) Ltd sub-contracted uMoya-NILU Consulting (Pty) Ltd to prepare the associated Atmospheric Impact Reports (AIRs) to support the applications. AIRs were duly prepared to support the respective exemption applications for the individual power stations. Furthermore, two cumulative AIRs were prepared, for the suite of power stations on the Highveld and the Vaal Triangle, and for the two coal-fired power stations in the Waterberg-Bojanala Priority Area, i.e. Medupi and Matimba (uMoya-NILU, 2024). In so doing, 5 emission scenarios were assessed, which included SO_2, NO_X and PM emissions from the stacks as well as fugitive PM emissions from the coal stockyard and ash dumps. The intention was to provide an understanding of the power stations total contribution to ambient concentrations.

The stack emission data were provided by Eskom for the five scenarios based firstly on actual emissions, followed by emissions representing anticipated station performance in different years. Fugitive emissions were estimated based on a worst-case scenario, with little dust control implemented on the ash dumps. Specifically, 60-80% of the entire area of the ash dumps was assumed to be exposed and available for entrainment of particulates. It was assumed that the sides of the ash dumps are in fact partially vegetated, and the tops are partially wet.

To provide an absolute worst-case, it was assumed that the total PM emission from the stacks into the respective PM_{10} and $PM_{2.5}$ fractions. Therefore, the total PM emission was firstly assumed to be PM_{10}, then was assumed to be $PM_{2.5}$. For consistency in the modelling, the total PM emission from the fugitive sources was also assumed to be PM_{10}, then $PM_{2.5}$. The modelled outputs were then compared against the respective National Ambient Air Quality Standards (NAAQS).

The modelled PM_{10} and $PM_{2.5}$ concentrations were high close to the respective power stations and exceeded the NAAQS. Further away from the power stations, the predicted concentrations were relatively low and complied with the NAAQS. From the results it was however impossible to distinguish between the contribution of the fugitive sources and the stack emissions to ambient concentrations, although the results indicated that the high concentrations were due to the fugitive sources rather than the stack emissions themselves.

As Eskom's request to the Minister concerns stack emissions, it was decided to prepare an addendum to the cumulative assessment for the Waterberg power stations and to assess the contribution of stack PM emissions only to the ambient PM_{10} and $PM_{2.5}$ concentrations. The same dispersion model, stack parameterisation and model setup are used. In this

Addendum to the AIR (uMoya-NILU, 2024), the focus is specifically on stack emissions for PM and the modelled results for PM_{10} and $PM_{2.5}$.

2. STACK EMISSIONS

In this Addendum to the AIR (uMoya-NILU, 2024), the cumulative effect of stack emissions from 2 coal-fired power stations comprising the Waterberg fleet are assessed, i.e. Medupi and Matimba.

2.1 Operational Scenarios

The five operational scenarios anticipated by Eskom for the Waterberg power station fleet in the coming years are:

Scenario 1 (Current): The baseline scenario using actual monthly stack emissions for 2021-2023 (No FGD installed).

Scenario A (2025): Eskom's planned 2025 stack emissions, representing anticipated station performance between 2025 – 2030 (No FGD installed).

Scenario B (2031): Eskom's planned 2031 stack emissions, representing anticipated station performance between 2031 – 2035 (No FGD installed but load reduction).

Scenario C (2036): Eskom's planned 2036 stack emissions, representing anticipated station performance from 2036 onwards (FGD installed at Medupi).

Scenario D (MES): Full compliance with the MES (FGD installed at Medupi and Matimba).

The estimated emission rates for SO_2, NO_X and PM_{10} and equivalent emission concentrations that are used in the dispersion modelling for the power stations are shown in **Error! Reference source not found.**. A reminder that the total PM emission is assumed to be PM_{10}. The estimated emission rates and equivalent emission concentrations that are used in the dispersion modelling for the two power stations are shown in Table 2-1. The maximum anticipated emissions during each period are used for simulation in the model. The boiler units are assumed to operate continuously, i.e. 24 hours a day. Since each future scenario is a snapshot of the period of operation (e.g. Scenario A = 2025 to 2030), the maximum anticipated emissions during that period, in a single year was selected for simulation in the model.

Table 2-1: Annual emissions from the Medupi and Matimba Power Stations and the corresponding emission concentrations

Scenario	Stack	Emission rate (tonnes/annum)			Emission concentration @ 10% O_2 and average load (mg/Nm^3)		
		NO_X	SO_2	PM	NO_x	SO_2	PM
		Medupi Power Station					
1[a]	Stack 1	25 577	123 502	1 314	257	1 343	13
	Stack 2	25 577	123 502	1 314	257	1 343	13
A	Stack 1	34 716	134 340	1 663	522	2 020	25
	Stack 2	34 716	134 340	1 663	522	2 020	25
B	Stack 1	20 770	80 374	1 273	522	2 020	32
	Stack 2	20 770	80 374	1 273	522	2 020	32
C	Stack 1	23 447	31 263	1 438	375	500	23
	Stack 2	23 447	31 263	1 438	375	500	23
D	Stack 1	23 447	31 263	1 438	375	500	23
	Stack 2	23 447	31 263	1 438	375	500	23
		Matimba Power Station					
1[a]	Stack 1	28 921	150 457	2 648	291	1 514	27
	Stack 2	28 921	150 457	2 648	291	1 514	27
A	Stack 1	28 346	150 830	1 820	545	2 900	35
	Stack 2	28 346	150 830	1 820	545	2 900	35
B	Stack 1	18 118	103 026	1 243	510	2 900	35
	Stack 2	18 118	103 026	1 243	510	2 900	35
C	Stack 1	20 872	112 752	1 432	510	2 755	35
	Stack 2	20 872	112 752	1 432	510	2 755	35
D	Stack 1	20 872	33 825	1 432	510	827	35
	Stack 2	20 872	33 825	1 432	510	827	35
MES					**750**	**1000**	**50**

(a): Average from actual monthly emissions

2.2 Methodology for determining $PM_{2.5}$ emissions

In terms of the determination of fine particulate matter emissions ($PM_{2.5}$), it is noted that Eskom utilises the dry bottom boiler emission factors from the United States Environmental Protection Agency (US EPA AP42) (US EPA, 1995) to determine the fine particulate matter emissions ($PM_{2.5}$). The ratio of the $PM_{2.5}$ to PM_{10} is used to calculate $PM_{2.5}$ from the total PM measured from the Continuous Emission Monitoring System (CEMS) equipment at the respective stacks. The utilisation of CEMS equipment is a more accurate representation of site-specific PM and therefore constitutes a Tier 3 method of reporting.

The US EPA defines dry bottom boilers as those burning coals with high fusion temperatures resulting in dry ash. In wet bottom boilers, coal with low fusion temperatures is used, resulting in molten ash or slag. Eskom coal fired power stations are therefore considered to have dry bottom boilers. Eskom has either Electrostatic Precipitators (ESPs) or Fabric Filter Plants (FFPs) installed as air pollution control devices in all its coal fired units. The following ratios determined from dry bottom emission factors in the US EPA AP42 are used:

- ESP controlled - 0.024 lb/ton for $PM_{2.5}$ and 0.054 lb/ton for PM_{10} [ratio = 0.44]
- FFP controlled - 0.01 lb/ton for $PM_{2.5}$ and 0.02 lb/ton for PM_{10} [ratio = 0.5]

The above ratios for PM_{10}:$PM_{2.5}$ have been applied accordingly at the power stations as follows:

- Medupi has FFPs installed on both stacks, hence the PM_{10}:$PM_{2.5}$ ratio is 1:0.50
- Matimba has ESPs installed on both stacks, hence the PM_{10}:$PM_{2.5}$ ratio is 1:0.44

3. DISPERSION MODELLING RESULTS

The CALPUFF modelling suite provides for the chemical conversion of SO_2 and NO_X to secondary particulates, i.e. sulphates and nitrates in the modelling results. For PM_{10} and $PM_{2.5}$, the predicted concentrations presented are therefore attributed to stack emissions and the contribution from secondary particulate formation.

The DEA (2014) recommends the 99th percentile concentrations for short-term assessment with the NAAQS since the highest predicted ground-level concentrations can be considered outliers due to complex variability of meteorological processes. In addition, the limit value in the NAAQS is the 99th percentile. The impact assessment therefore compares the predicted 99th percentile concentrations with the respective NAAQS limit values and the permitted frequency of exceedance for the five scenarios.

3.1 Maximum predicted ambient concentrations

The maximum predicted annual PM_{10} and $PM_{2.5}$ concentrations and the 99th percentile of the 24-hour predicted concentrations are discussed here and are listed in Table 3-1 for the 5 scenarios.

Changes in the predicted annual average and 24-hour PM_{10} and $PM_{2.5}$ concentrations from one scenario to the next are strongly influenced by changes in PM_{10} and $PM_{2.5}$ emissions, the contribution from secondary particulate formation and stack exit velocity.

In all scenarios, the maximum predicted annual average PM_{10} and $PM_{2.5}$ concentrations are well below the limit values of the respective NAAQS. In all scenarios, the maximum predicted 99th percentile of the 24-hour PM_{10} and $PM_{2.5}$ concentrations are in general, relatively low compared to the limit value of the NAAQS. In other words, here are no predicted exceedances of the 24-hour limit value of the respective NAAQS for PM_{10} and for $PM_{2.5}$.

The increase in SO_2, NO_X, PM_{10} and $PM_{2.5}$ emissions at Medupi and a reduction in stack exit velocity from Scenario 1 (Current) to Scenario A (2025) is seen by an increase in the predicted PM_{10} and $PM_{2.5}$ ambient concentrations. Although there is a decrease in PM_{10} and $PM_{2.5}$ emissions at Matimba, the reduced exit velocity in the stacks reduces the dispersion potential.

The maximum predicted PM_{10} and $PM_{2.5}$ ambient concentrations decrease significantly from Scenario A (2025) to Scenario B (2031) due to the substantial decrease in SO_2, NO_X, PM_{10} and $PM_{2.5}$ emissions at Medupi and Matimba.

Although there is an increase in NO_X, PM_{10} and $PM_{2.5}$ emissions, and a reduction in exit velocity in the stacks at Medupi and Matimba from Scenario B (2031) to Scenario C (2036), the substantial decrease in SO_2 emissions at Medupi is responsible for a slight decrease in PM_{10} and $PM_{2.5}$ ambient concentrations, as this reduces the formation of secondary particulates.

Although NO_X, PM_{10} and $PM_{2.5}$ emissions remain the same for Scenario C (2036) and Scenario D (MES), it is noted that the maximum predicted PM_{10} and $PM_{2.5}$ ambient concentrations show a fairly large decrease between the two scenarios. This decrease is mainly attributed to the reduced formation of secondary particulates brought about by a substantial decrease in SO_2 emissions at Matimba.

Table 3-1: Maximum predicted ambient annual PM_{10}, and $PM_{2.5}$ concentrations in µg/m³ and the predicted 99th percentile concentrations for 24-hour averaging periods, with the South African NAAQS

Scenario and Pollutant	Averaging time	
Predicted maximum PM_{10}	**Annual**	**24-hour**
Scenario 1 (Current)	1.2	15.4
Scenario A (2025)	1.7	17.9
Scenario B (2031)	1.3	13.8
Scenario C (2035)	1.0	10.8
Scenario D (MES)	0.6	6.0
NAAQS	**40**	**75**
Predicted maximum $PM_{2.5}$	**Annual**	**24-hour**
Scenario 1 (Current)	1.1	14.3
Scenario A (2025)	1.5	16.8
Scenario B (2031)	1.2	12.8
Scenario C (2035)	0.9	10.0
Scenario D (MES)	0.5	4.9
NAAQS (up to 31 Dec 2029)	**20**	**40**
NAAQS (from 01 Jan 2030)	**15**	**25**

3.2 Predicted concentrations at the AQMSs

The predicted annual PM_{10} and $PM_{2.5}$ concentrations are compared with the measured annual averages in 2021, 2022 and 2023 at three Air Quality Monitoring Stations (AQMS) in the Waterberg modelling domain for Scenario 1 (Current) in Table 3-2 and Table 3-3, respectively.

For PM_{10} and $PM_{2.5}$ the predicted ambient concentrations result from the respective power station stack emissions. At all AQMSs, the modelled concentrations are considerably lower than the monitored concentrations. This is to be expected since the here are exposed to all sources of PM_{10} and $PM_{2.5}$. The difference between the predicted concentrations and the measured concentrations provides an indication of the contribution of the power station stack emissions at the respective AQMSs.

Table 3-2: Measured annual average PM_{10} concentration at the Waterberg AQMSs compared with predicted concentrations in µg/m³ for Scenario 1 (Current)

Receptor	2021	2022	2023	Modelled
Marapong AQMS	47.0	-	-	**0.7**
Medupi AQMS	28.8	28.4	37.5	**0.8**
Lephalale AQMS	37.3	-	17.4	**0.7**

Table 3-3: Measured annual average $PM_{2.5}$ concentration at the Waterberg AQMSs compared with predicted concentrations in µg/m^3 for Scenario 1 (Current)

Receptor	2021	2022	2023	Modelled
Marapong AQMS	25.8	30.2	-	**0.6**
Medupi AQMS	15.2	-	-	**0.7**
Lephalale AQMS	-	-	12.2	**0.6**

3.3 Predicted concentrations at sensitive receptors

In the Waterberg study area, 51 sensitive receptors were identified. These are listed in Annexure 1. Predicted ambient concentrations for PM_{10} and $PM_{2.5}$ for the five scenarios are presented in Annexure 2.

At all identified sensitive receptors, the predicted PM_{10} and $PM_{2.5}$ concentrations are low and well below the limit value of the respective NAAQS for all five scenarios. The highest predicted concentrations occur for Scenario A (2025) and the lowest predicted concentrations occur for Scenario D (MES).

Noteworthy is the systematic decrease in predicted PM_{10} and $PM_{2.5}$ concentrations from 2025 to 2036 at all sensitive receptors.

3.4 Isopleth maps

Isopleth maps of predicted ambient PM_{10} and $PM_{2.5}$ concentrations are presented in the following sections. The predicted concentrations are shown as isopleths, lines of equal concentration, in µg/m^3 for the respective NAAQS averaging periods. The isopleths are depicted as coloured lines on the various maps, corresponding to a particular predicted ambient concentration. Sensitive receptors are represented by green squares and AQMSs are represented by white dots.

The South African NAAQS permits 4 exceedances of the 24-hour or daily limit value per annum, implying 12 permitted exceedances in a three-year modelling period. In all scenarios, the maximum predicted annual average PM_{10} and $PM_{2.5}$ concentrations are well below the limit values of the respective NAAQS. In all scenarios, the maximum predicted 99th percentile of the 24-hour PM_{10} and $PM_{2.5}$ concentrations are in general, relatively low compared to the limit value of the NAAQS. The predicted 24-hour PM_{10} and $PM_{2.5}$ concentrations therefore comply with the NAAQS for all five scenarios. As discussed above, changes in the predicted concentrations are strongly influenced by changes in emissions, the contribution from secondary particulate formation and stack exit velocity.

3.4.1 Particulates (PM_{10})

In Scenario 1 (Current), the highest predicted annual concentrations occur approximately 20 km to the south-southwest of the Medupi Power Station. The highest predicted 24-hour concentrations occur up to 20 km around the Medupi and Matimba Power Stations.

The increase in SO_2, NO_X, PM_{10} and $PM_{2.5}$ emissions at Medupi and a reduction in stack exit velocity from Scenario 1 (Current) to Scenario A (2025) is seen by an increase in the predicted concentrations. In Scenario A (2025), the highest predicted annual concentrations occur approximately 20 km to the south-southwest of the Medupi Power Station. The highest predicted 24-hour concentrations occur approximately 20 km to the southwest of the Medupi Power Station, and approximately 10 km to the east of the Matimba Power Station.

Noticeable is the dramatic decrease in ambient concentrations on the isopleths for Scenario B (2031), where the biggest reductions are seen, due to the substantial decrease in SO_2, NO_X, PM_{10} and $PM_{2.5}$ emissions at Medupi and Matimba. In Scenario B (2031), the highest predicted annual concentrations occur approximately 20 km to the south-southwest of the Medupi Power Station. The highest predicted 24-hour concentrations occur up to 20 km around the Medupi and Matimba Power Stations.

The effect of the reduced formation of secondary particulates brought about by the substantial decrease in SO_2 emissions at Medupi are also noticeable on the isopleths for Scenario C (2036). In Scenario C (2036), the highest predicted annual concentrations occur approximately 20 km to the south-southwest of the Medupi Power Station. The highest predicted 24-hour concentrations occur approximately 10 km to the west of the Medupi Power Station, and approximately 5 km to the east of the Matimba Power Station.

Although PM_{10} emissions remain the same for Scenario C (2036) and Scenario D (MES), the predicted PM_{10} concentrations show a fairly large decrease on the isopleths for Scenario D (MES) (as discussed previously, this decrease is mainly attributed to the reduced formation of secondary particulates brought about by a substantial decrease in SO_2 emissions between these scenarios at Matimba). In Scenario D (MES), the highest predicted annual concentrations occur approximately 20 km to the south-southwest of the Medupi Power Station. The highest predicted 24-hour concentrations occur approximately 20 km to the southwest of the Medupi Power Station, and approximately 10 km to the west of the Matimba Power Station.

Isopleth maps of the predicted annual average and 99th percentile of the 24-hour PM_{10} concentrations are presented in Figure 3-1 to Figure 3-10.

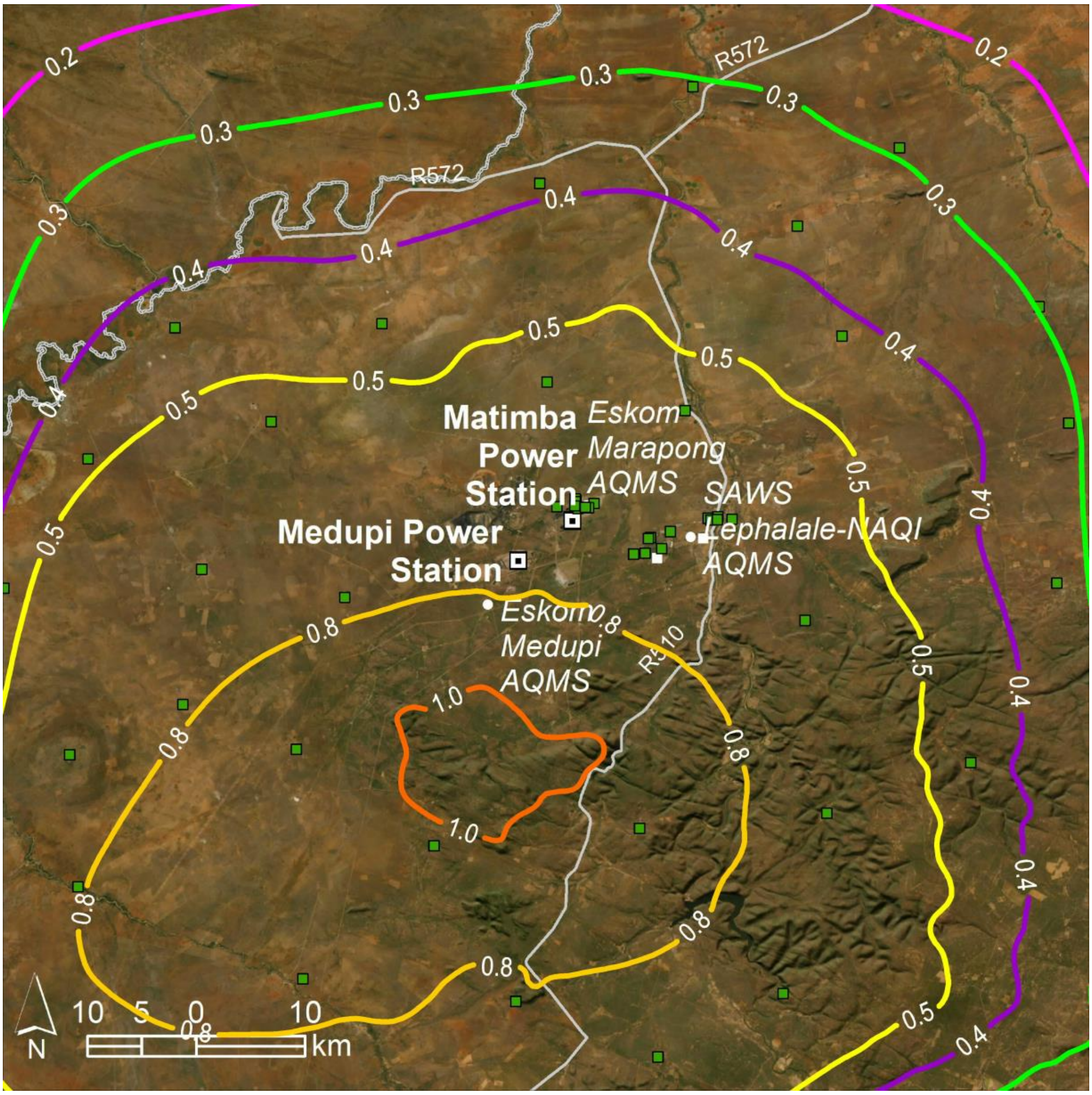


Figure 3-1: Predicted annual average PM_{10} concentrations in µg/m^3 for Scenario 1 (Current) (NAAQS Limit is 40 µg/m^3)

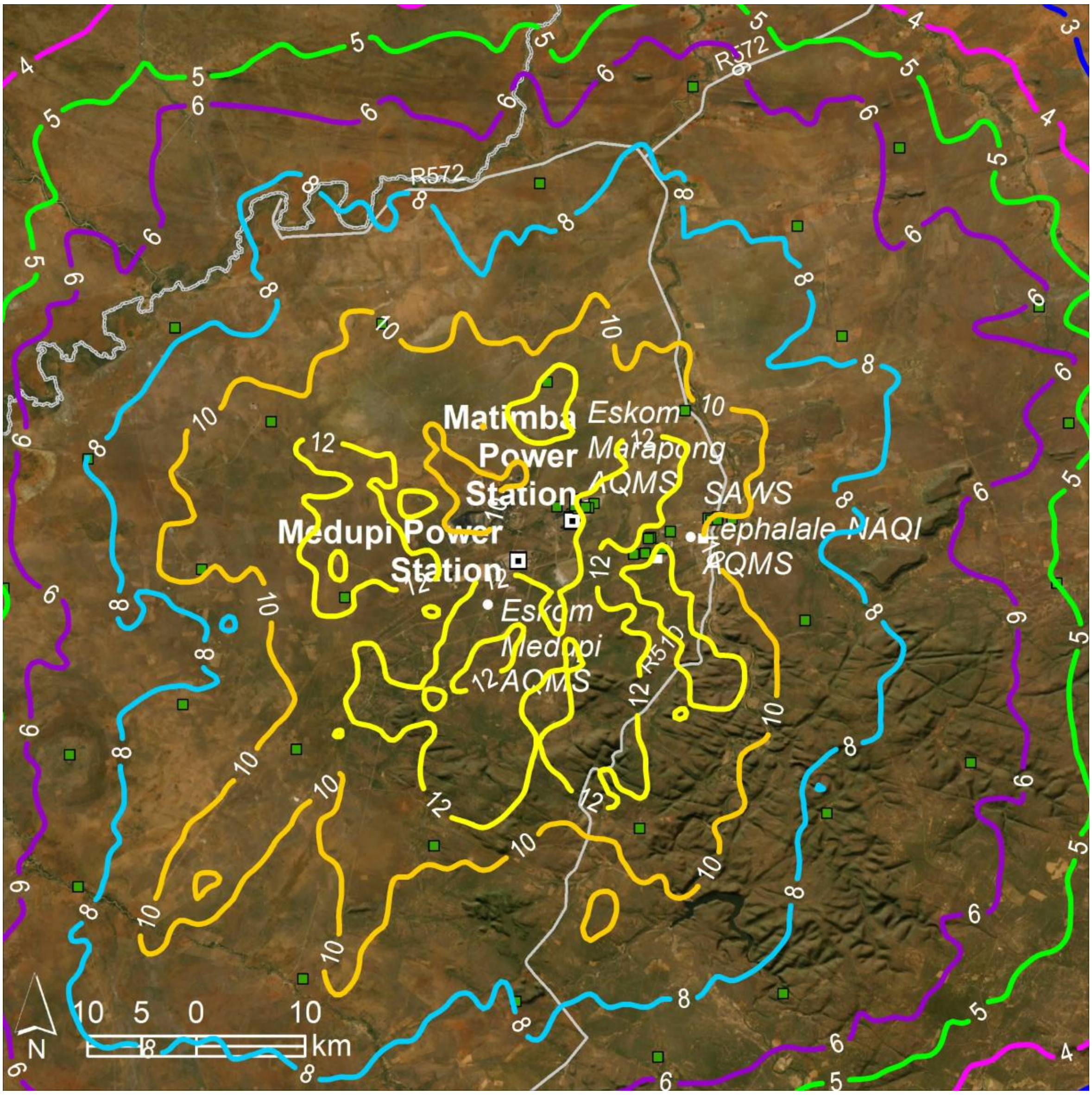


Figure 3-2: Predicted 99th percentile of the 24-hour PM$_{10}$ concentrations in µg/m^3 for Scenario 1 (Current) (NAAQS Limit is 75 µg/m^3)

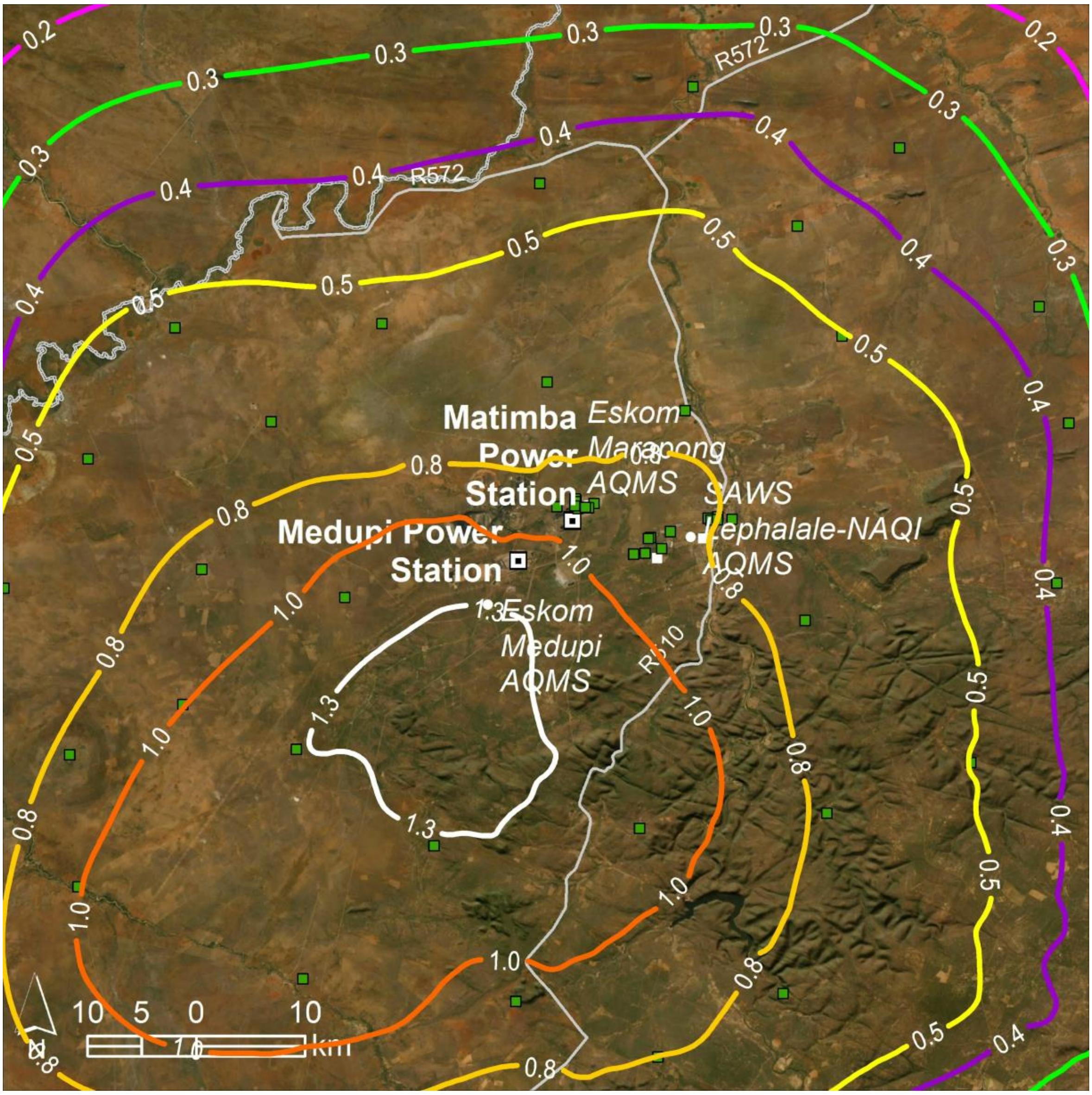


Figure 3-3: Predicted annual average PM_{10} concentrations in µg/m³ for Scenario A (2025) (NAAQS Limit is 40 µg/m³)

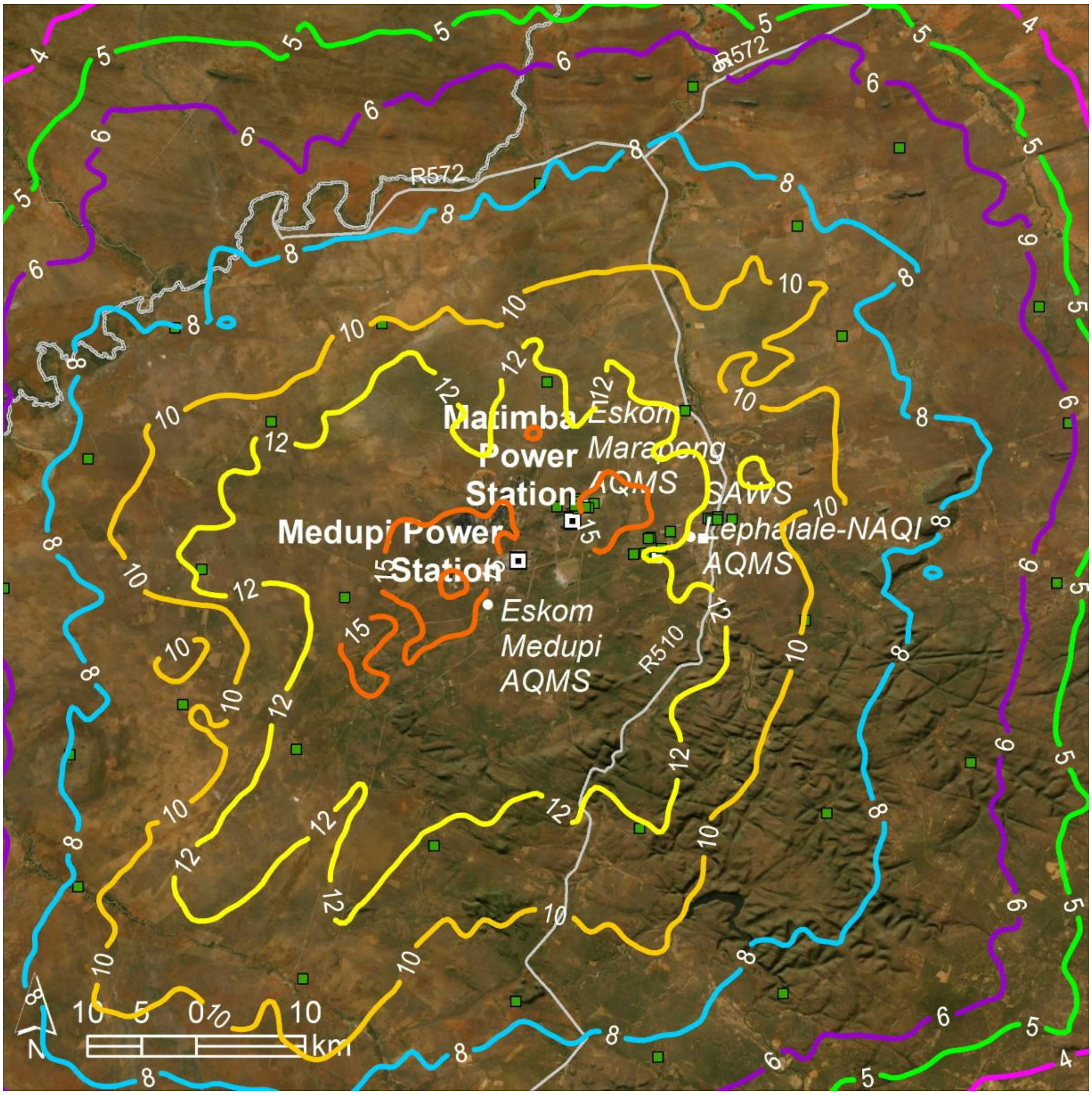


Figure 3-4: Predicted 99th percentile of the 24-hour PM_{10} concentrations in µg/m^3 for Scenario A (2025) (NAAQS Limit is 75 µg/m^3)

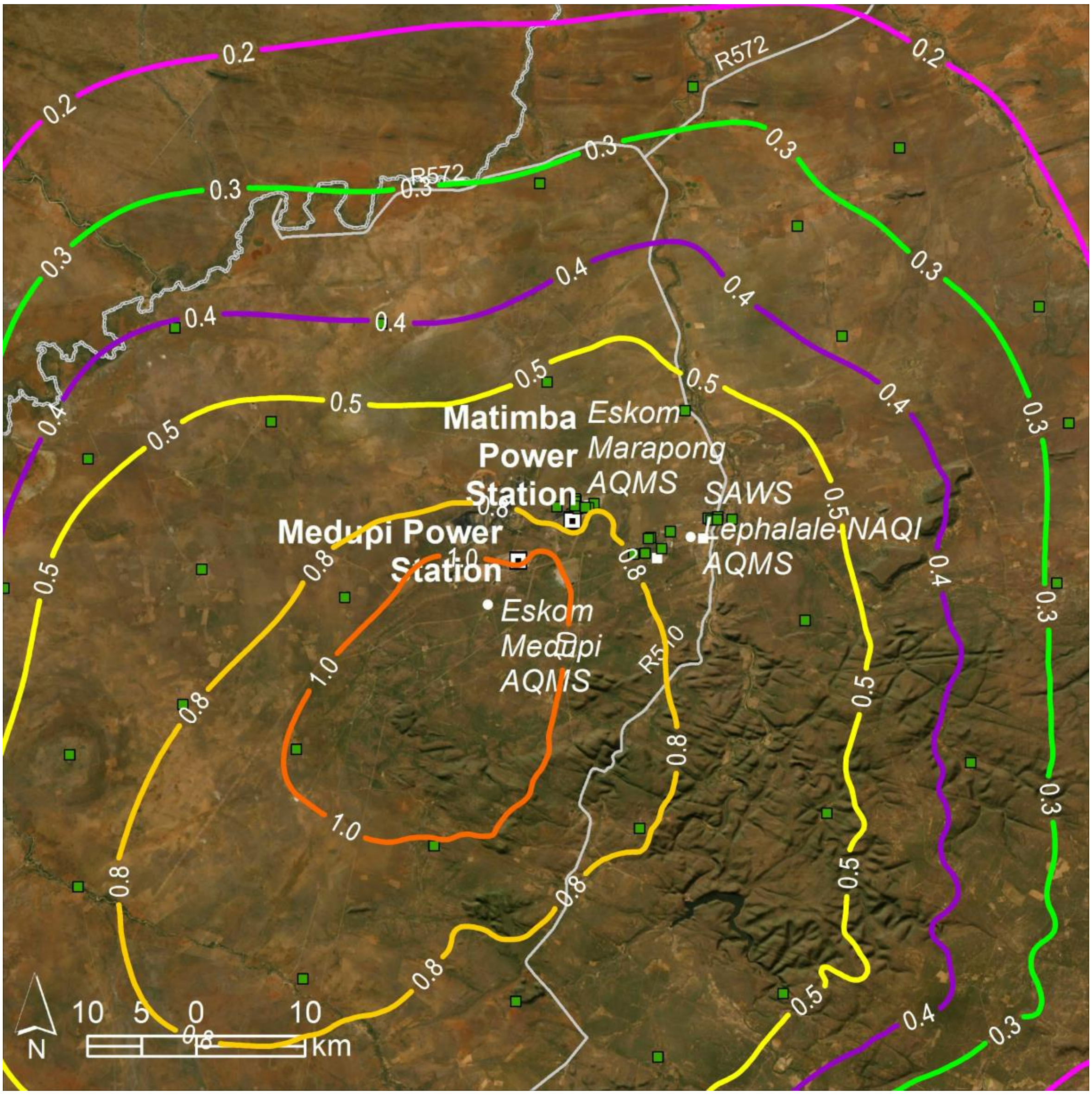


Figure 3-5: Predicted annual average PM_{10} concentrations in µg/m³ for Scenario B (2031) (NAAQS Limit is 40 µg/m³)

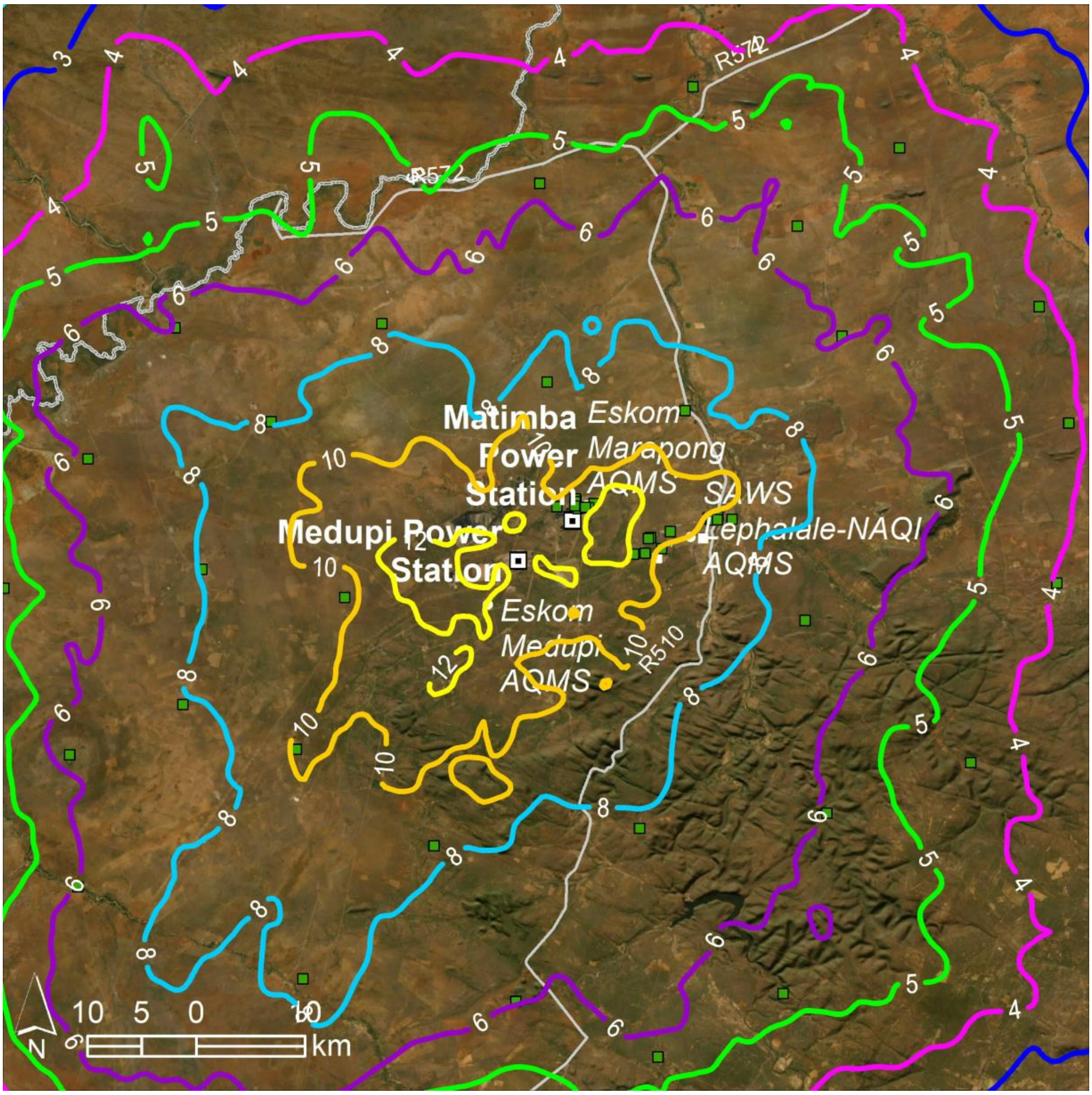


Figure 3-6: Predicted 99th percentile of the 24-hour PM_{10} concentrations in µg/m³ for Scenario B (2031) (NAAQS Limit is 75 µg/m³)

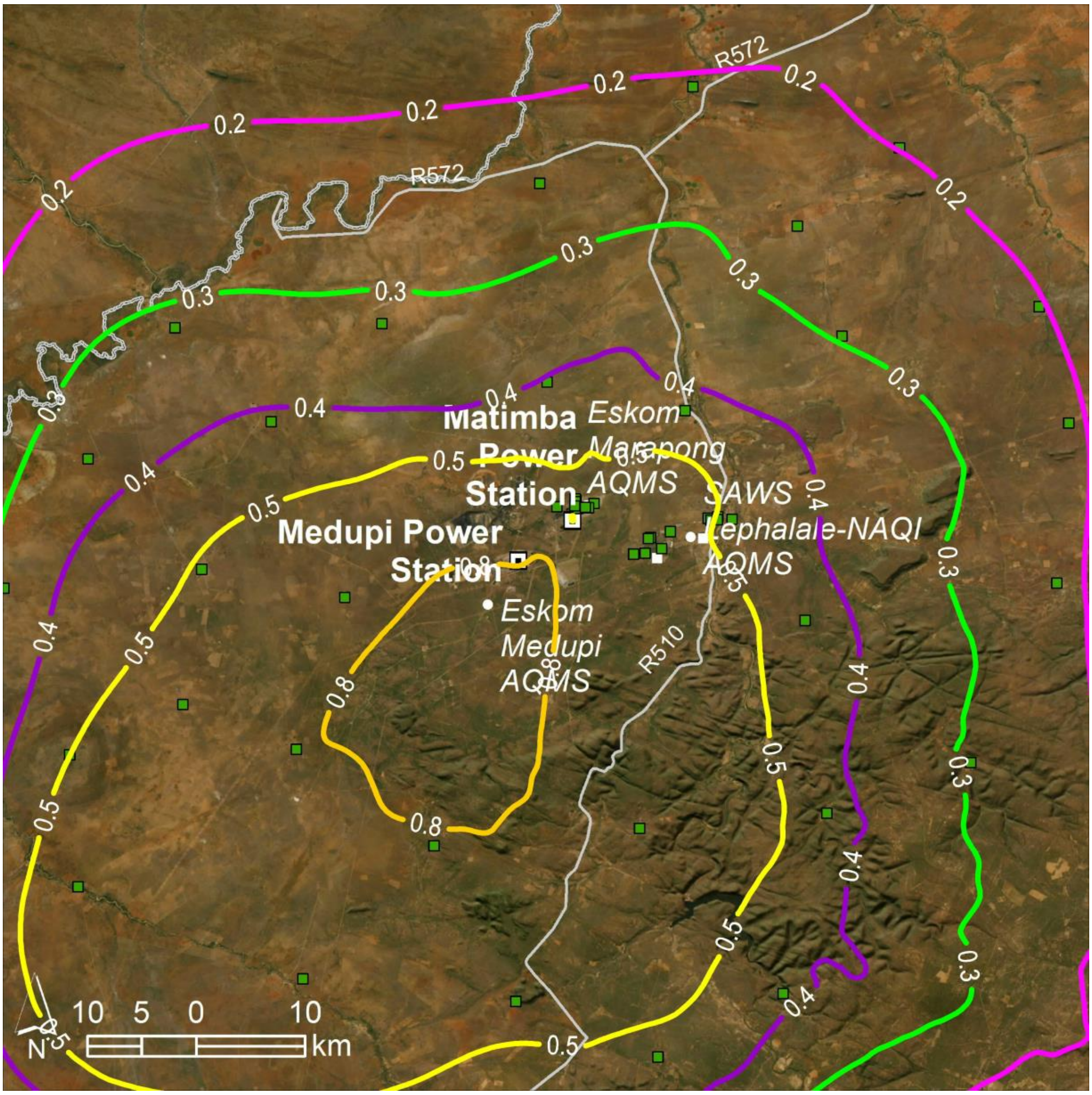


Figure 3-7: Predicted annual average PM_{10} concentrations in µg/m^3 for Scenario C (2036) (NAAQS Limit is 40 µg/m^3)

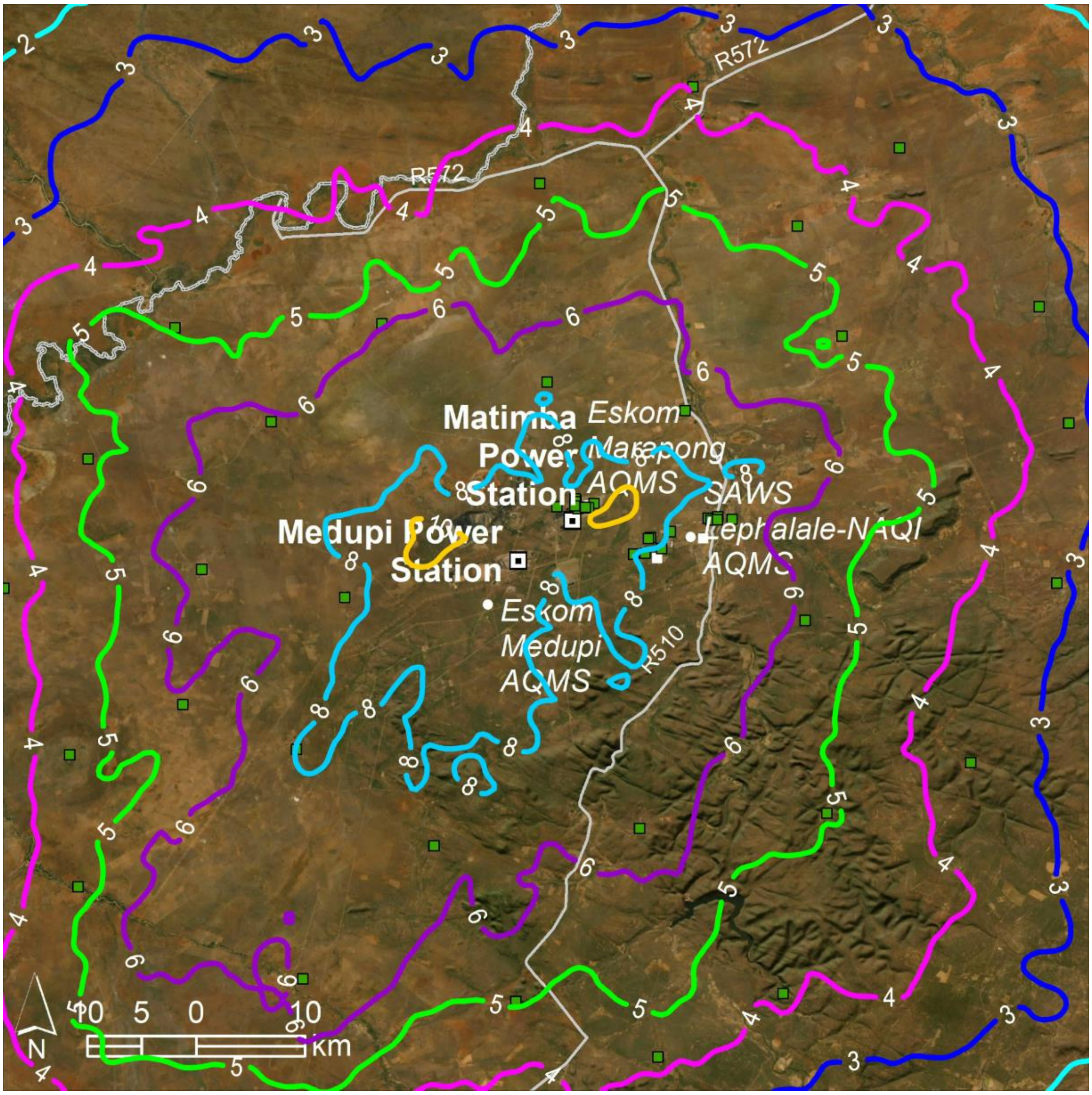


Figure 3-8: Predicted 99th percentile of the 24-hour PM_{10} concentrations in µg/m³ for Scenario C (2036) (NAAQS Limit is 75 µg/m³)

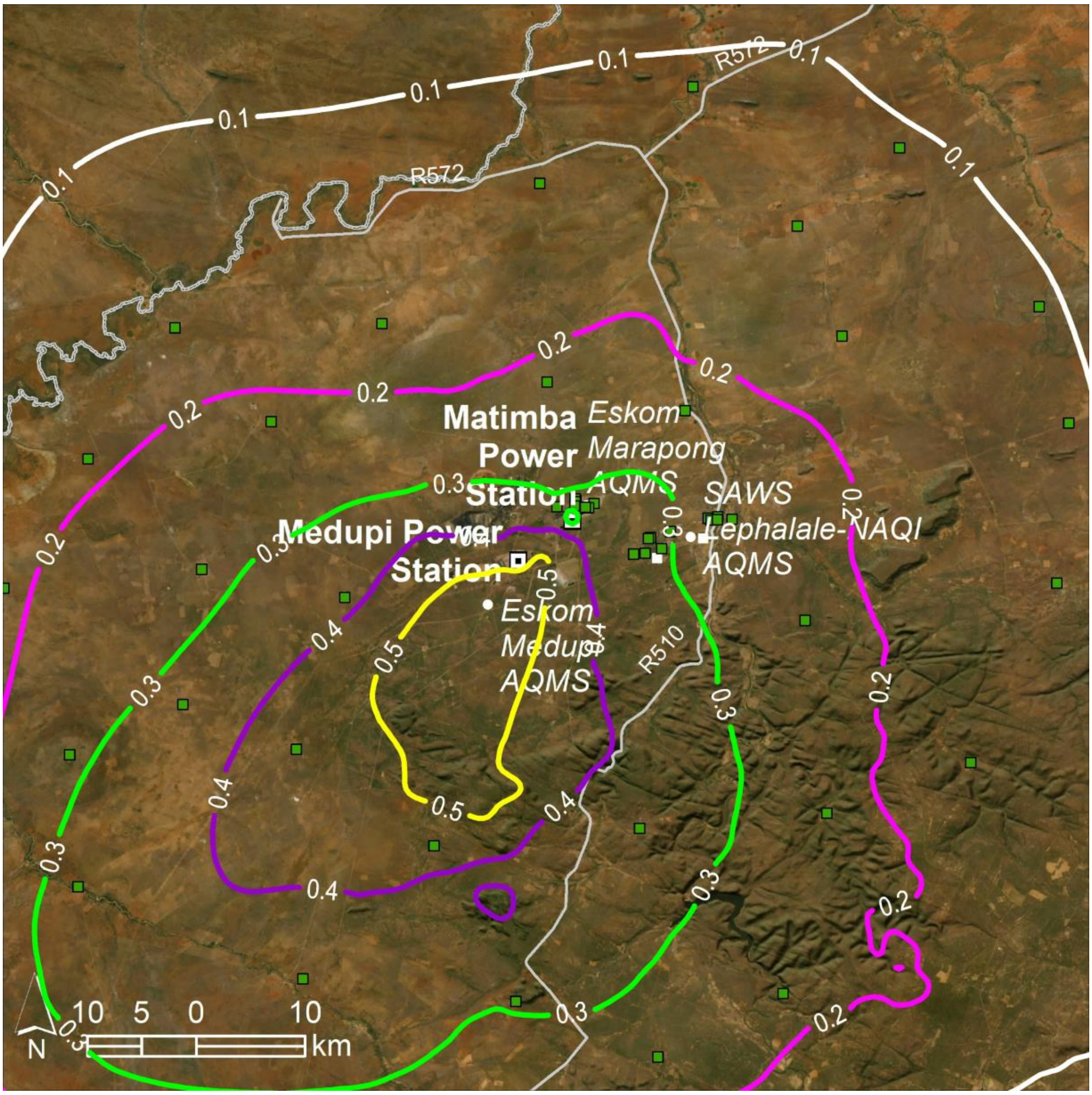


Figure 3-9: Predicted annual average PM_{10} concentrations in µg/m^3 for Scenario D (MES) (NAAQS Limit is 40 µg/m^3)

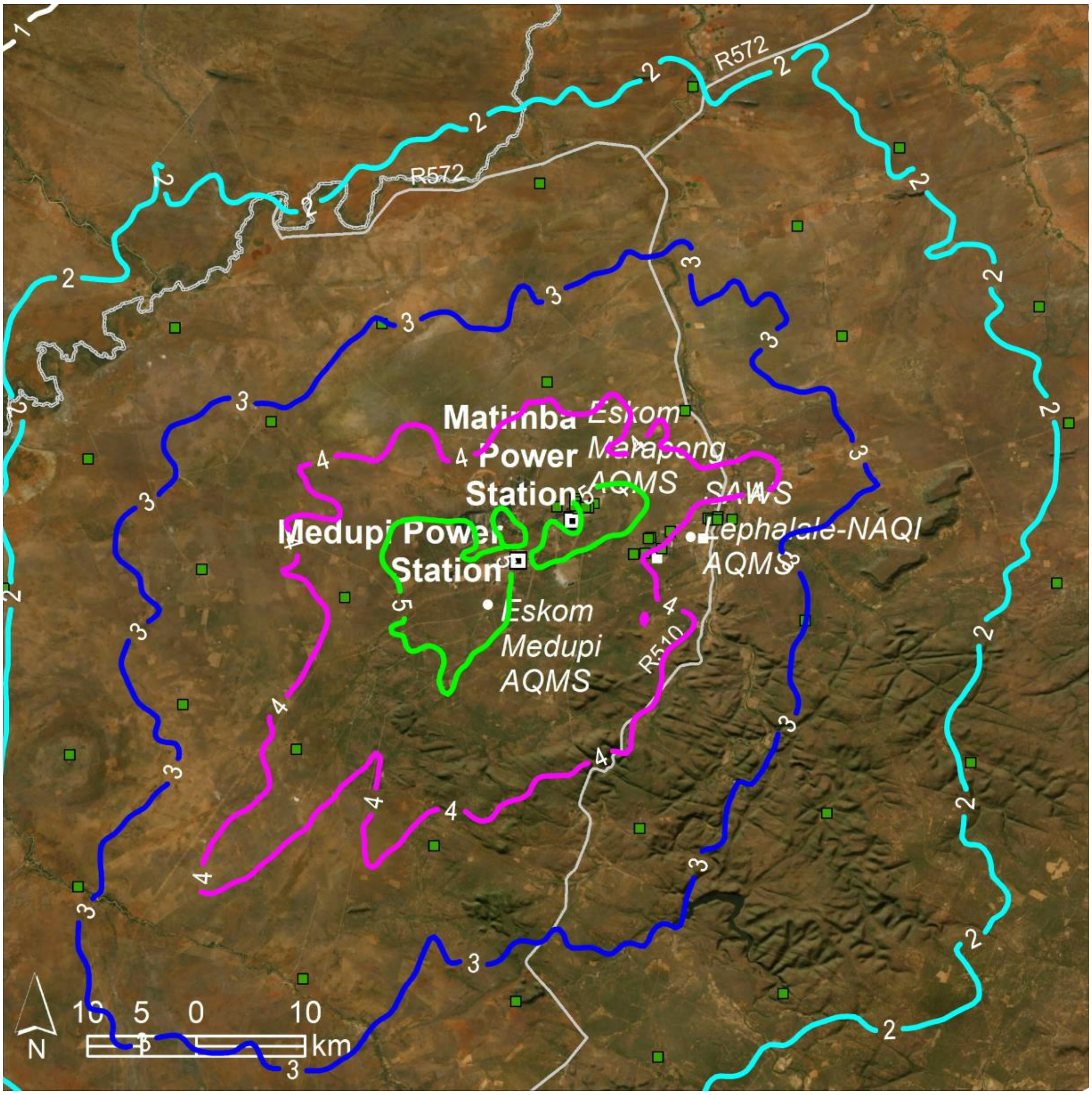


Figure 3-10: Predicted 99th percentile of the 24-hour PM_{10} concentrations in µg/m^3 for Scenario D (MES) (NAAQS Limit is 75 µg/m^3)

3.4.2 Particulates ($PM_{2.5}$)

In Scenario 1 (Current), the highest predicted annual concentrations occur approximately 20 km to the south-southwest of the Medupi Power Station. The highest predicted 24-hour concentrations occur up to 20 km around the Medupi and Matimba Power Stations.

The increase in SO_2, NO_X, PM_{10} and $PM_{2.5}$ emissions at Medupi and a reduction in stack exit velocity from Scenario 1 (Current) to Scenario A (2025) is seen by an increase in the predicted concentrations. In Scenario A (2025), the highest predicted annual concentrations occur approximately 20 km to the south-southwest of the Medupi Power Station. The highest predicted 24-hour concentrations occur approximately 20 km to the southwest of the Medupi Power Station, and approximately 10 km to the east of the Matimba Power Station.

Noticeable is the dramatic decrease in ambient concentrations on the isopleths for Scenario B (2031), where the biggest reductions are seen, due to the substantial decrease in SO_2, NO_X, PM_{10} and $PM_{2.5}$ emissions at Medupi and Matimba. In Scenario B (2031), the highest predicted annual concentrations occur approximately 20 km to the south-southwest of the Medupi Power Station. The highest predicted 24-hour concentrations occur up to 20 km around the Medupi and Matimba Power Stations.

The effect of the reduced formation of secondary particulates brought about by the substantial decrease in SO_2 emissions at Medupi are also noticeable on the isopleths for Scenario C (2036). In Scenario C (2036), the highest predicted annual concentrations occur approximately 20 km to the south-southwest of the Medupi Power Station. The highest predicted 24-hour concentrations occur approximately 10 km to the west of the Medupi Power Station, and approximately 5 km to the east of the Matimba Power Station.

Although $PM_{2.5}$ emissions remain the same for Scenario C (2036) and Scenario D (MES), the predicted $PM_{2.5}$ concentrations show a fairly large decrease on the isopleths for Scenario D (MES) (as discussed previously, this decrease is mainly attributed to the reduced formation of secondary particulates brought about by a substantial decrease in SO_2 emissions between these scenarios at Matimba). In Scenario D (MES), the highest predicted annual concentrations occur approximately 20 km to the south-southwest of the Medupi Power Station. The highest predicted 24-hour concentrations occur approximately 20 km to the southwest of the Medupi Power Station, and approximately 10 km to the west of the Matimba Power Station.

Isopleth maps of the predicted annual average and 99th percentile of the 24-hour $PM_{2.5}$ concentrations are presented in Figure 3-11 to Figure 3-20.

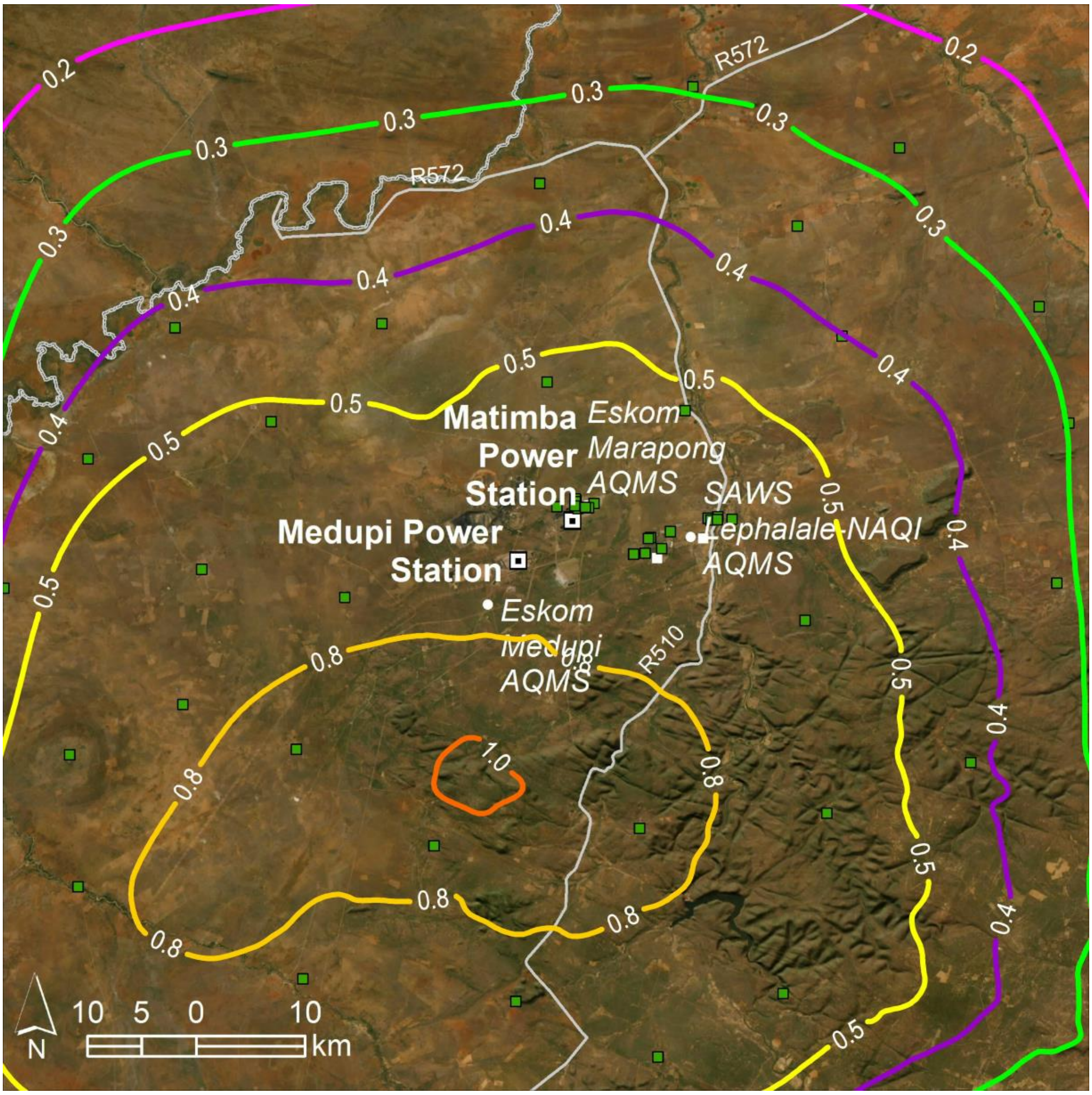


Figure 3-11: Predicted annual average $PM_{2.5}$ concentrations in µg/m^3 for Scenario 1 (Current) (NAAQS Limit is 20 µg/m^3)

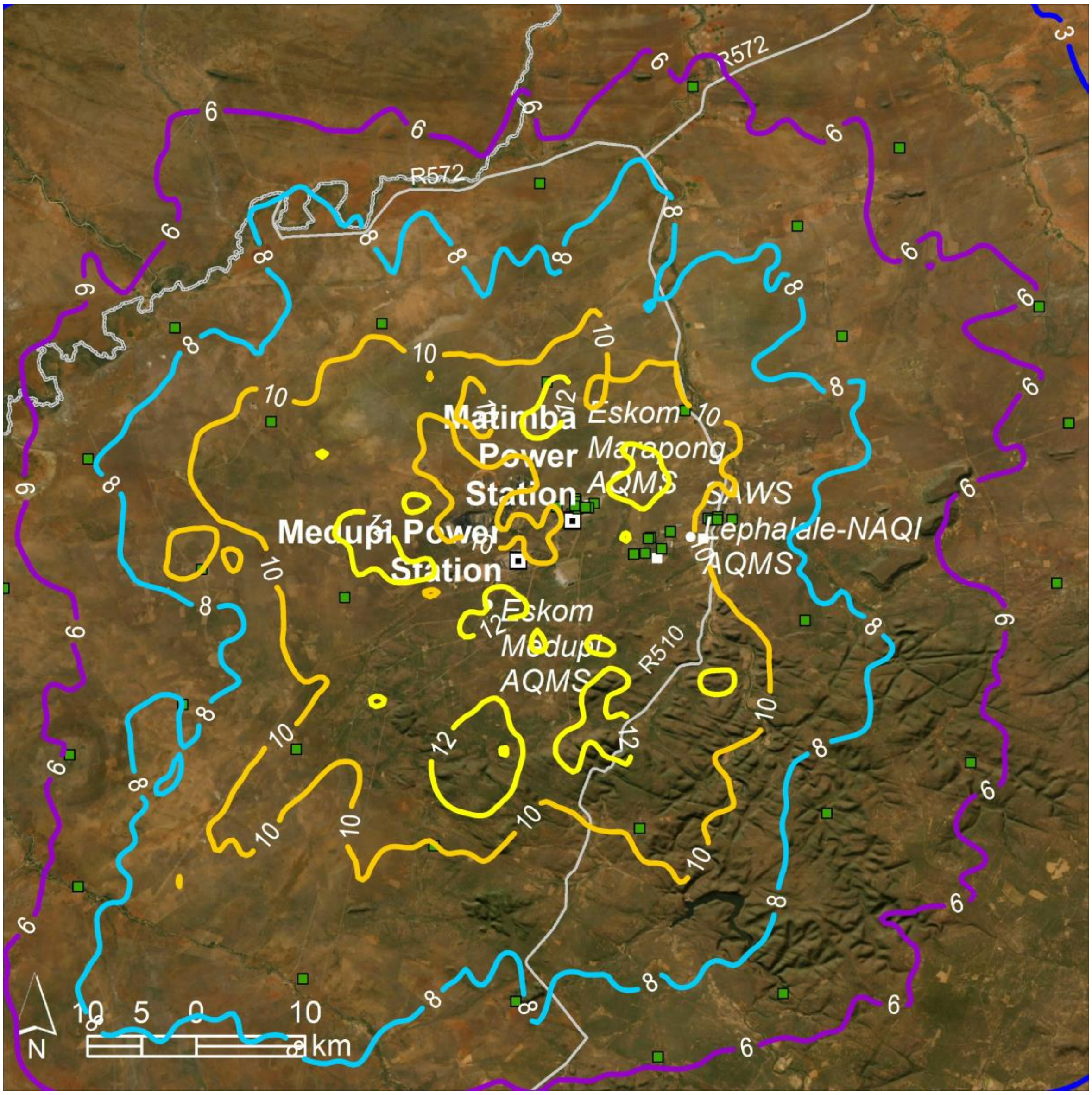


Figure 3-12: Predicted 99th percentile of the 24-hour $PM_{2.5}$ concentrations in µg/m^3 for Scenario 1 (Current) (NAAQS Limit is 40 µg/m^3)

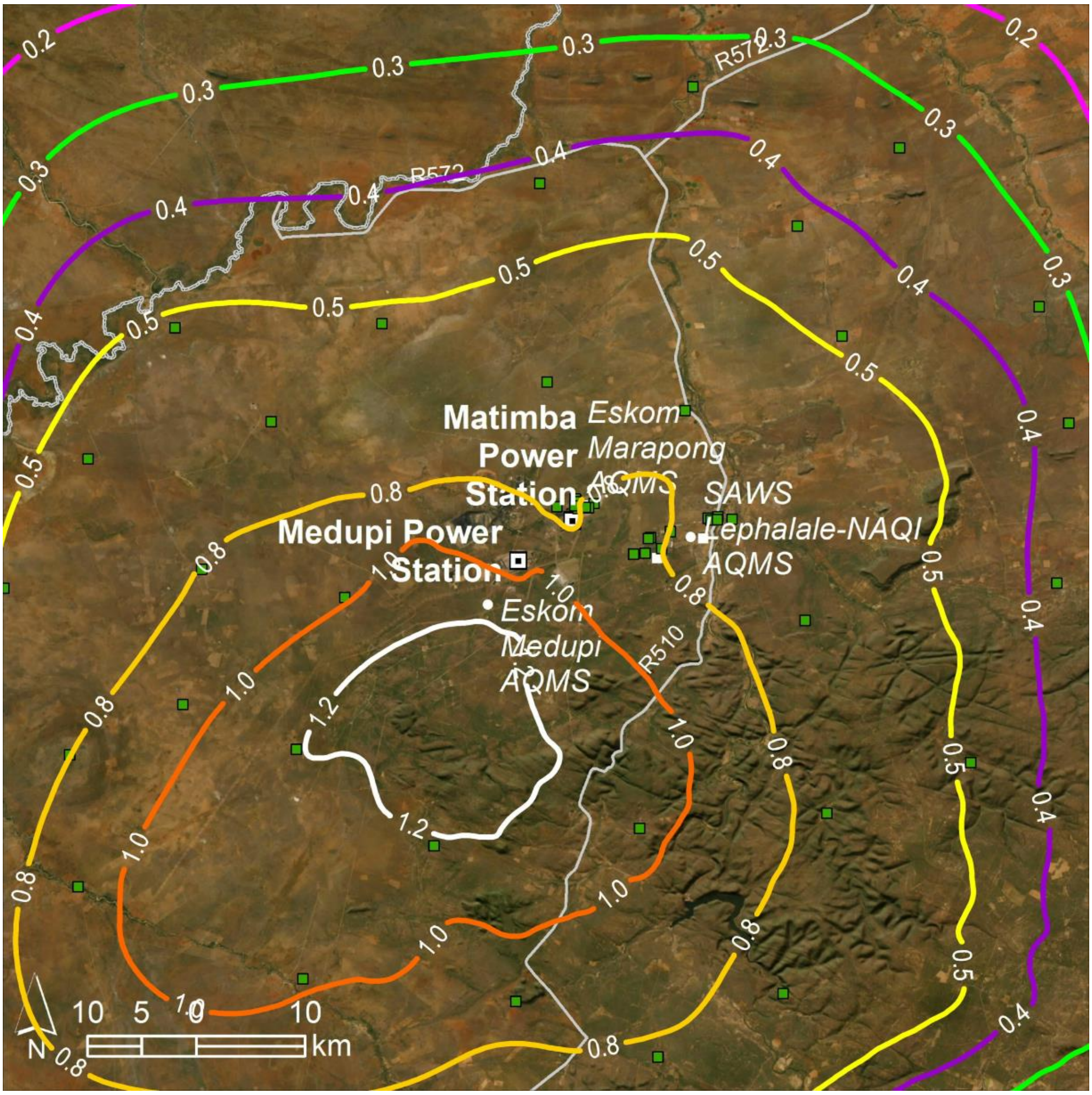


Figure 3-13: Predicted annual average $PM_{2.5}$ concentrations in µg/m^3 for Scenario A (2025) (NAAQS Limit is 20 µg/m^3)

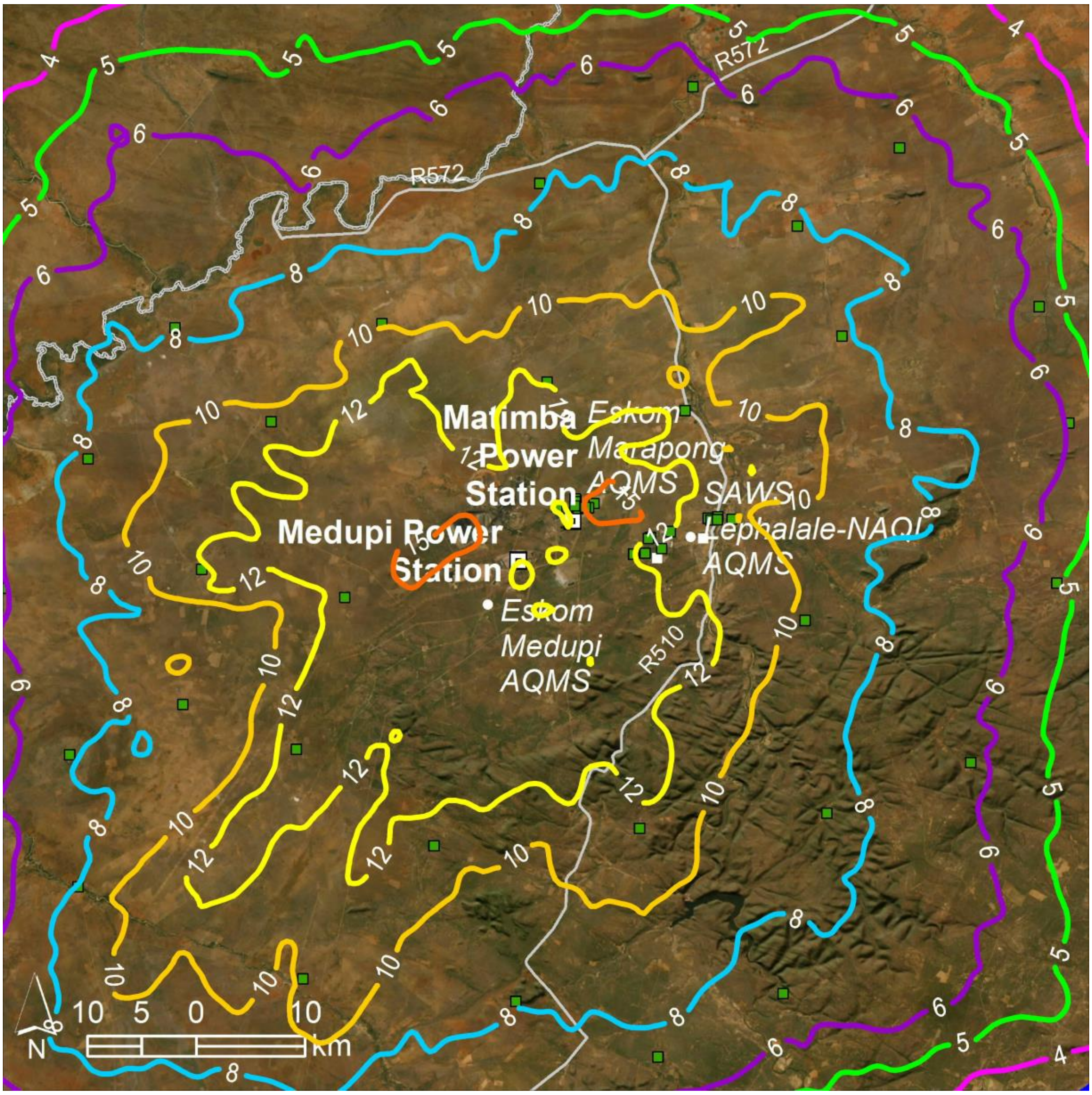


Figure 3-14: Predicted 99th percentile of the 24-hour $PM_{2.5}$ concentrations in µg/m^3 for Scenario A (2025) (NAAQS Limit is 40 µg/m^3)

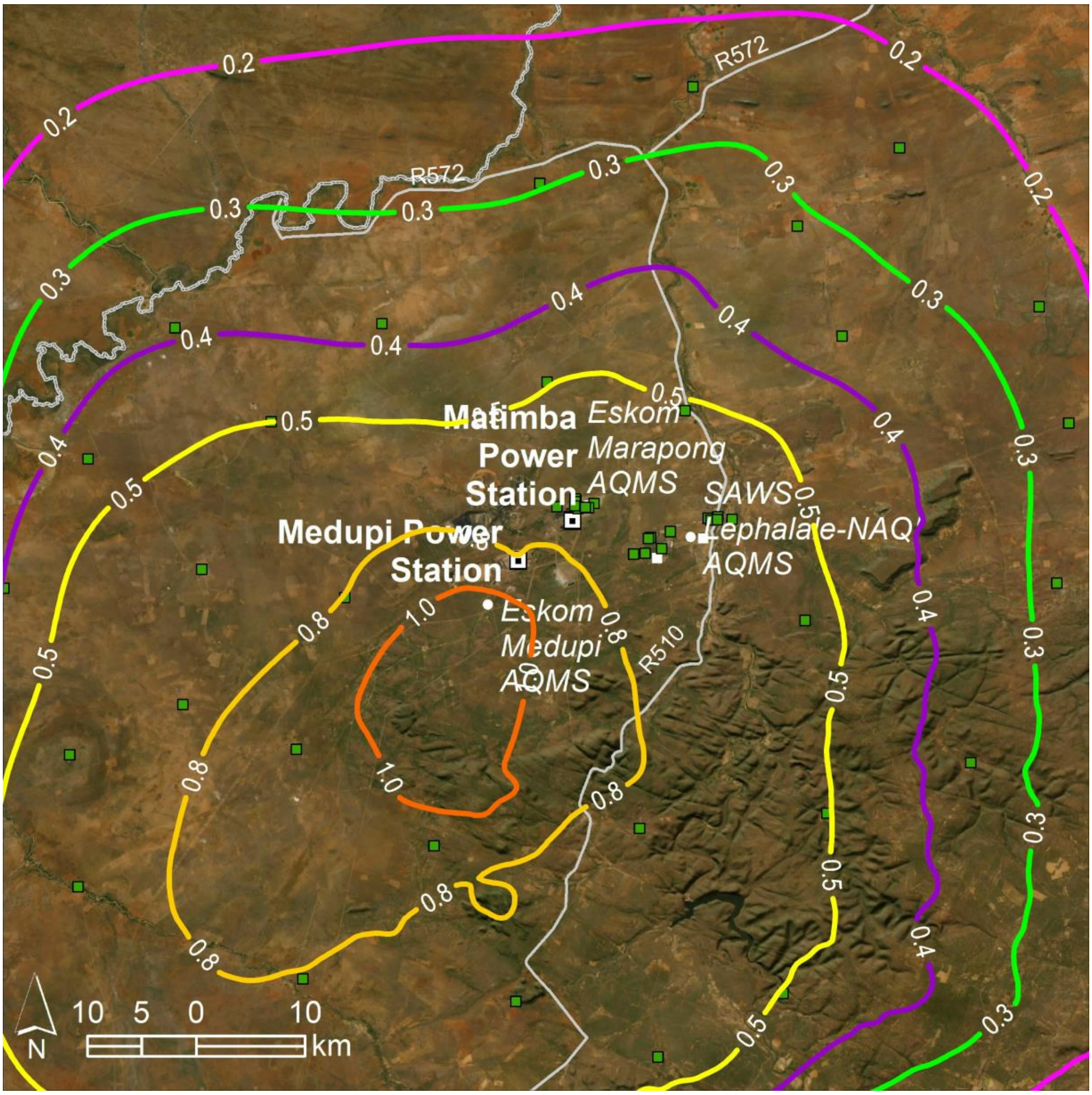


Figure 3-15: Predicted annual average $PM_{2.5}$ concentrations in µg/m^3 for Scenario B (2031) (NAAQS Limit is 15 µg/m^3)

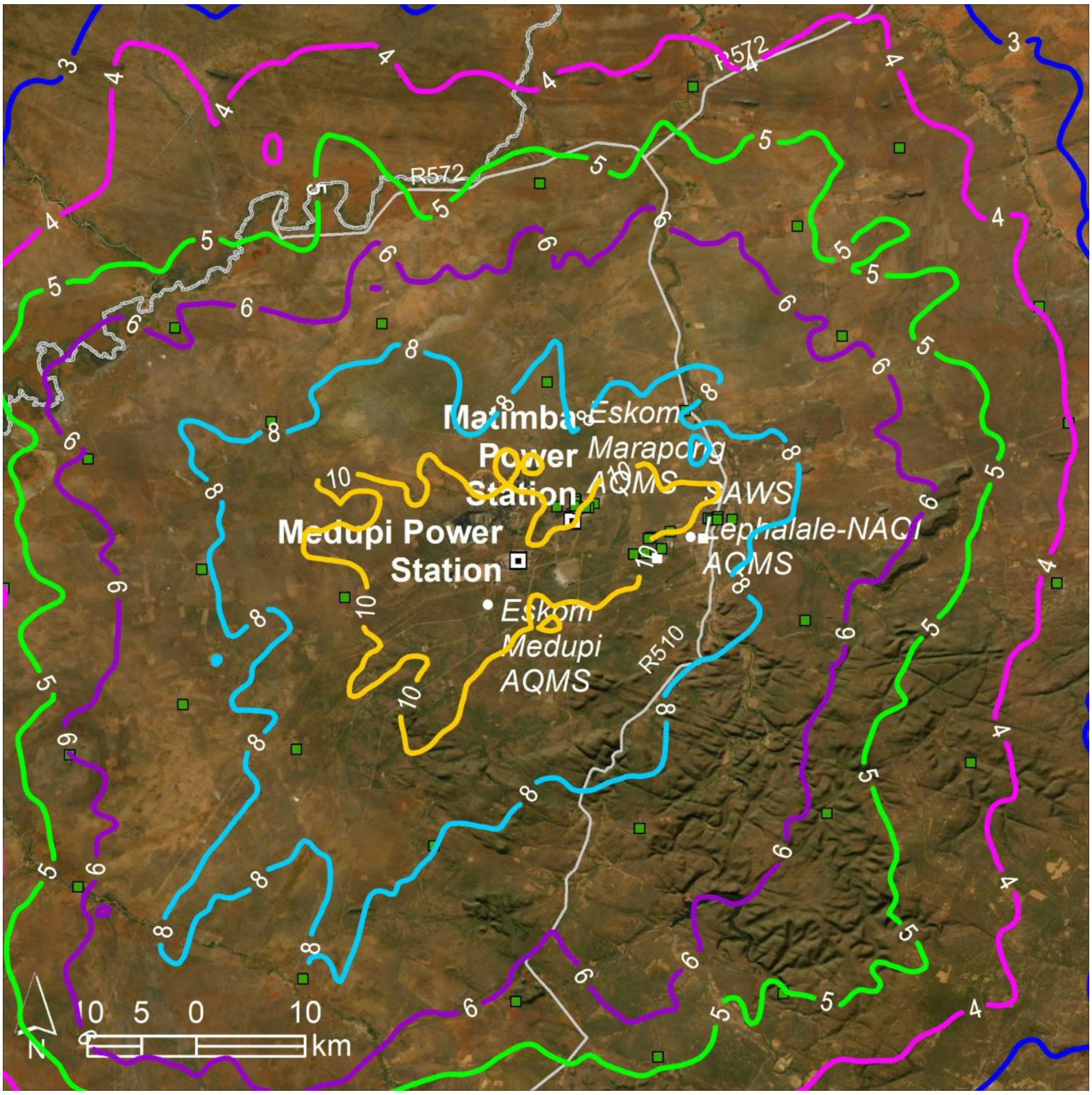


Figure 3-16: Predicted 99th percentile of the 24-hour PM2.5 concentrations in µg/m³ for Scenario B (2031) (NAAQS Limit is 25 µg/m³)

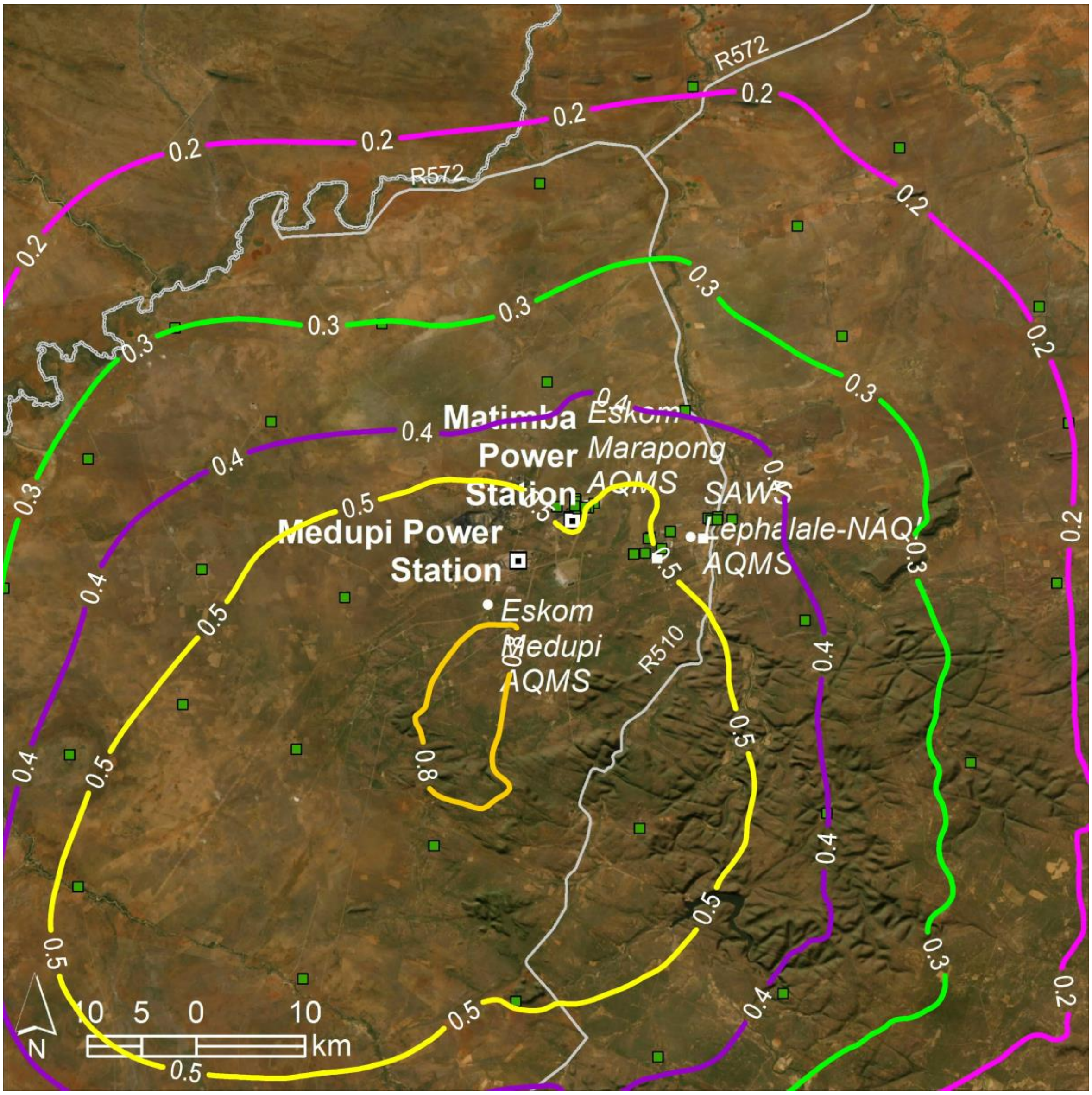


Figure 3-17: Predicted annual average $PM_{2.5}$ concentrations in µg/m^3 for Scenario C (2036) (NAAQS Limit is 15 µg/m^3)

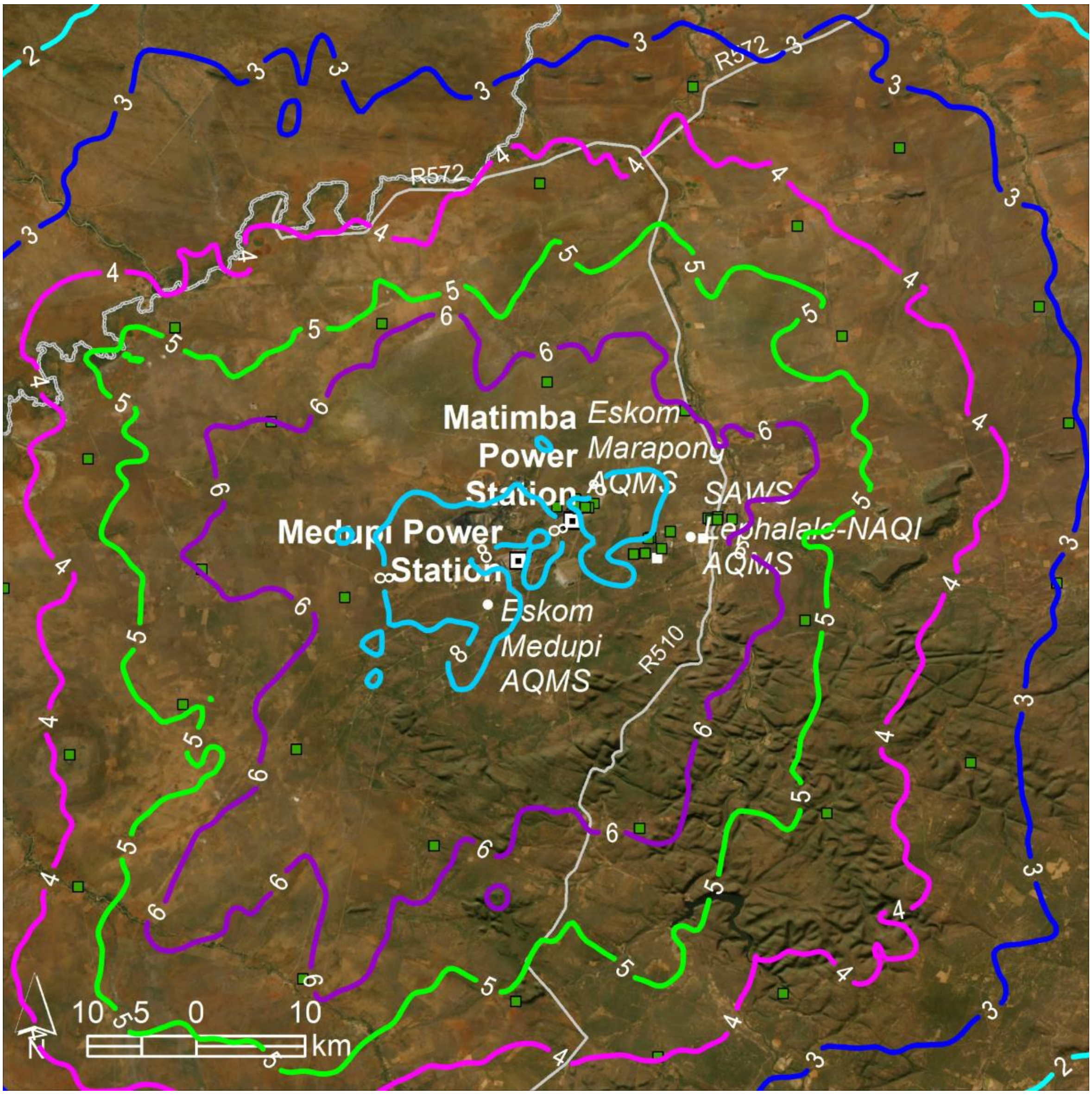


Figure 3-18: Predicted 99th percentile of the 24-hour $PM_{2.5}$ concentrations in µg/m³ for Scenario C (2036) (NAAQS Limit is 25 µg/m³)

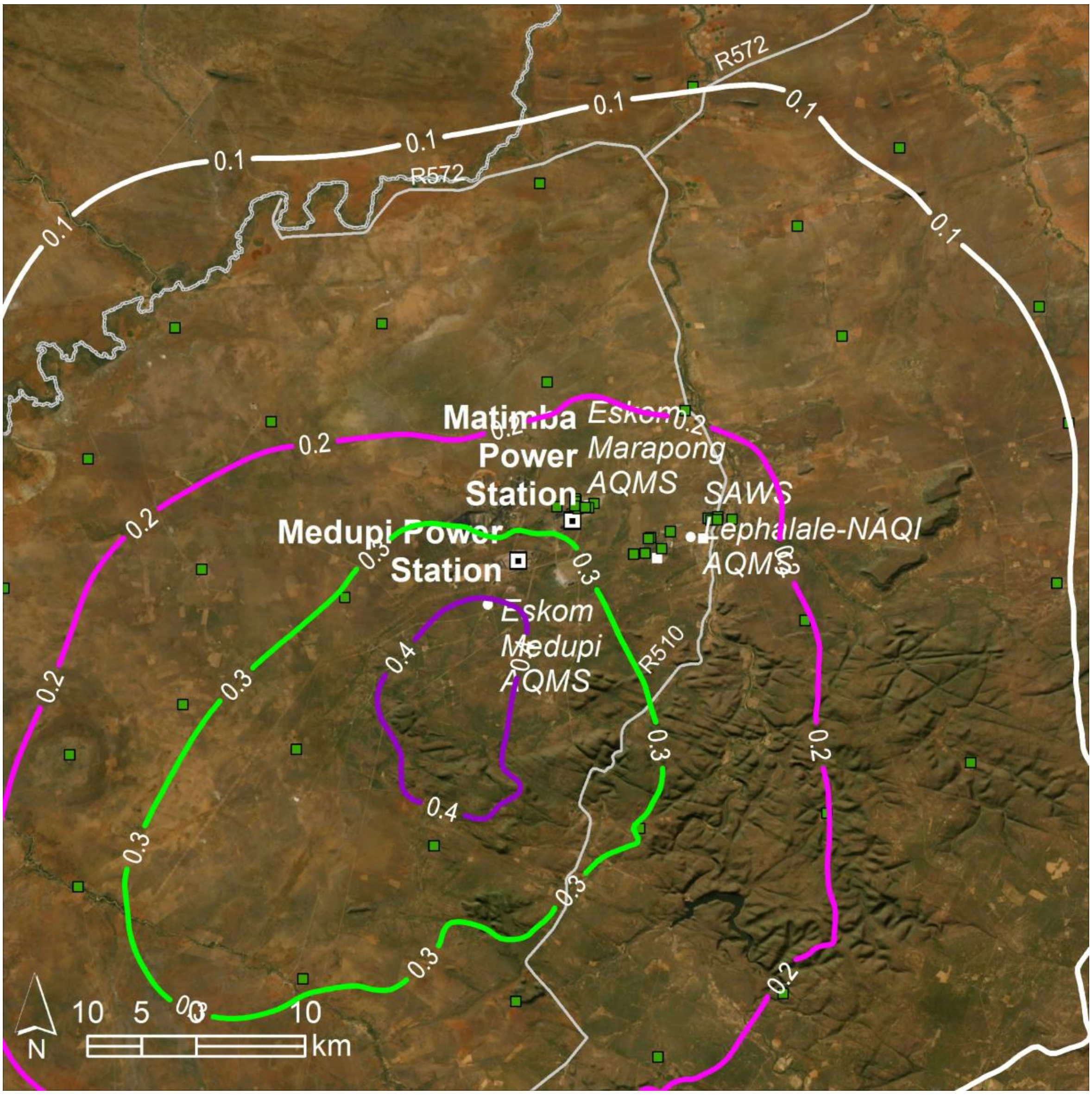


Figure 3-19: Predicted annual average $PM_{2.5}$ concentrations in µg/m^3 for Scenario D (MES) (NAAQS Limit is 15 µg/m^3)

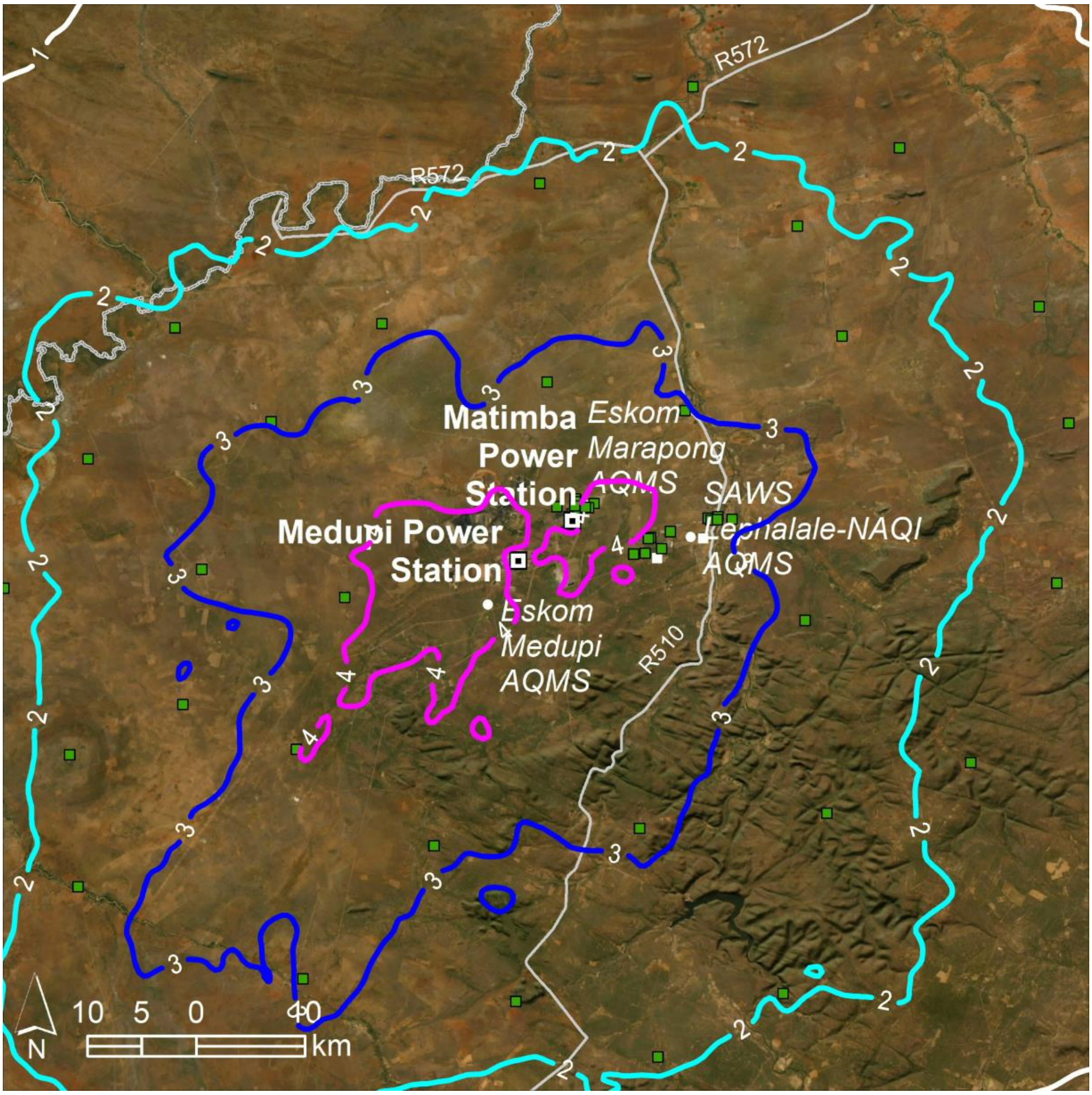


Figure 3-20: Predicted 99th percentile of the 24-hour $PM_{2.5}$ concentrations in µg/m^3 for Scenario D (MES) (NAAQS Limit is 25 µg/m^3)

4. SUMMARY AND CONCLUSION

In this Addendum to the AIR (uMoya-NILU, 2024), the focus is specifically on stack emissions for PM and the modelled results for PM_{10} and $PM_{2.5}$. In this Addendum, the cumulative effect of stack emissions from the 2 coal-fired power stations comprising the Waterberg power station fleet are assessed, i.e. Medupi and Matimba in the Waterberg-Bojanala Priority Area.

Dispersion modelling is used to demonstrate the effect of Eskom's emission reduction strategy by assessing 5 sequential emission scenarios. These are from Scenario 1 using actual emissions from 2021 to 2023, Scenario A using proposed 2025 emissions, Scenario B using proposed 2031 emissions and Scenario C using proposed 2036 emissions. Scenario D uses emissions that comply with the MES to demonstrate the relative effect of compliance.

Noteworthy findings from the modelling results may be summarised as follows:

i) Changes in the predicted annual average and 24-hour PM_{10} and $PM_{2.5}$ concentrations from one scenario to the next are strongly influenced by changes in PM_{10} and $PM_{2.5}$ emissions, the contribution from secondary particulate formation and stack exit velocity.

ii) In all scenarios, the maximum predicted annual average PM_{10} and $PM_{2.5}$ concentrations are well below the limit values of the respective NAAQS. In all scenarios, the maximum predicted 99th percentile of the 24-hour PM_{10} and $PM_{2.5}$ concentrations are in general, relatively low compared to the limit value of the NAAQS.

iii) The increase in SO_2, NO_X, PM_{10} and $PM_{2.5}$ emissions at Medupi and a reduction in stack exit velocity from Scenario 1 (Current) to Scenario A (2025) is seen by an increase in the predicted PM_{10} and $PM_{2.5}$ ambient concentrations. Although there is a decrease in PM_{10} and $PM_{2.5}$ emissions at Matimba, the reduced exit velocity in the stacks reduces the dispersion potential.

iv) The maximum predicted PM_{10} and $PM_{2.5}$ ambient concentrations decrease significantly from Scenario A (2025) to Scenario B (2031) due to the substantial decrease in SO_2, NO_X, PM_{10} and $PM_{2.5}$ emissions at Medupi and Matimba.

v) Although there is an increase in NO_X, PM_{10} and $PM_{2.5}$ emissions, and a reduction in exit velocity in the stacks at Medupi and Matimba from Scenario B (2031) to Scenario C (2036), the substantial decrease in SO_2 emissions at Medupi is responsible for a slight decrease in PM_{10} and $PM_{2.5}$ ambient concentrations, as this reduces the formation of secondary particulates.

vi) Although NO_X, PM_{10} and $PM_{2.5}$ emissions remain the same for Scenario C (2036) and Scenario D (MES), it is noted that the maximum predicted PM_{10} and $PM_{2.5}$ ambient concentrations show a fairly large decrease between the two scenarios. This decrease is mainly attributed to the reduced formation of secondary particulates brought about by a substantial decrease in SO_2 emissions at Matimba.

vii) At all AQMSs, the modelled PM_{10} and $PM_{2.5}$ concentrations are considerably lower than the monitored concentrations. This is to be expected since the AQMSs are exposed to all sources of PM_{10} and $PM_{2.5}$. The difference between the predicted concentrations and the measured concentrations provides an indication of the contribution of the power station stack emissions at the respective AQMSs.

viii) At all identified sensitive receptors, the predicted PM_{10} and $PM_{2.5}$ concentrations are low and well below the limit value of the respective NAAQS for all five scenarios. Noteworthy is the systematic decrease in predicted PM_{10} and $PM_{2.5}$ concentrations from 2025 to 2036 at all sensitive receptors.

5. REFERENCES

DEA (2014): Code of Practice for Air Dispersion Modelling in Air Quality Management in South Africa, Government Notice R.533, Government Gazette, no. 37804, 11 July 2014.

uMoya-NILU (2024): Atmospheric Impact Report in Support of the Application for Exemption from the Minimum Emission Standards for Eskom’s Coal-Fired Power Stations in the Waterberg (A Cumulative Assessment), Report No.: uMN219-24, November 2024.

USEPA (1995): Compilation of air pollutant emission factors. Volume 1: Stationary point and area sources. AP-42 fifth edition January 1995. US EPA

6. FORMAL DECLARATIONS

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

DECLARATION OF ACCURACY OF INFORMATION – APPLICANT

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

Declaration of accuracy of information provided:

Atmospheric Impact Report in terms of Section 30 of the Act

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

Signed at Durban on this 9th day of December 2024.

SIGNATURE

Managing Director – uMoya-NILU Consulting
CAPACITY OF SIGNATORY

DECLARATION OF INDEPENDENCE – PRACTITIONER

Name of Practitioner: Mark Zunckel

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

Professional Registration Number: 400449/04

Declaration of independence and accuracy of information provided:

Atmospheric Impact Report in terms of Section 30 of the Act

I, Mark Zunckel declare that I am independent of the applicant. I have the necessary expertise to conduct the assessment required for the report and will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant. I will disclose to the applicant and the air quality officer all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the air quality officer. The information provided in the atmospheric impact report is, to the best of my knowledge, in all respects factually true and correct. I am aware that the supply of false or misleading information to an air quality office is a criminal office in terms of section 51(1)(g) of this Act.

Signed at Durban on this 9th day of December 2024.

SIGNATURE

Managing Director – uMoya-NILU Consulting
CAPACITY OF SIGNATORY

ANNEXURE 1: WATERBERG SENSITIVE RECEPTORS

Area	Sensitive Receptors	Latitude	Longitude
Marapong	Phegelelo Senior Secondary	-23.651888°	27.618334°
	Contractors Village	-23.657320°	27.601031°
	Ditheku Primary School	-23.651003°	27.617502°
	Ditheko pramary School	-23.654704°	27.634336°
	Marapong Training Centre	-23.658318°	27.618626°
	Marapong Clinic	-23.658287°	27.629470°
	Tielelo Secondary School	-23.653177°	27.617447°
	Grootegeluk Medical Centre - Community center	-23.658717°	27.619834°
Lephalale	Lephalale College	-23.682740°	27.685668°
	Nelsonskop Primary School	-23.657586°	27.626724°
	Hansie En Grietjie Pre-Primary School	-23.683331°	27.683339°
	Sedibeng Special School for the Deaf and Disabilities	-23.691657°	27.695709°
	Kings College	-23.696561°	27.670262°
	Bosveld Primary School	-23.695608°	27.680724°
	Lephalale Medical Hospital	-23.656805°	27.617153°
	Ellisras Hospital	-23.677758°	27.703310°
	Laerskool Ellisras Primary School	-23.665398°	27.745938°
	Hoerskool Ellisras Secondary School	-23.666541°	27.737342°
	Marlothii Learning Academy	-23.667777°	27.739952°
	Hardekool Akademie vir C.V.O	-23.667215°	27.758752°
	Lephalale Clinic	-23.667615°	27.745728°
Ons Hoop	Ons Hoop	-23.577123°	27.716123°
Woudend	Woudend	-23.308433°	27.721479°
Ramabara's	Ramabara's	-23.750848°	27.825234°
Shongoane	Ga-Shongoane	-23.585319°	28.061576°
Bulge River	Bulge River	-24.113815°	27.694438°
	Kaingo Mountain Lodge	-24.060357°	27.807197°
	Community	-24.067953°	27.565793°
Kiesel	Kiesel	-23.974023°	27.169620°
	Kremetartpan	-23.859326°	27.366887°
	Mbala Private Camp	-23.939199°	27.491076°
Steenbokpan	Steenbokpan	-23.733401°	27.409802°
	Receptor	-23.587405°	27.343032°
Sandbult	Sandbult	-23.710158°	27.280718°
Hardekraaltjie	Hardekraaltjie	-23.509997°	27.256399°
	Receptor	-23.554188°	27.591804°
	Receptor	-23.506063°	27.442803°
	Receptor	-23.388962°	27.584125°
	Receptor	-23.423577°	27.816176°
	Receptor	-23.514728°	27.856760°
Ditaung	Ditaung	-23.489060°	28.034173°
Letlora	Letlora	-23.358262°	27.907715°
	Receptor	-23.822555°	27.264099°
	Glenover	-23.864360°	27.162054°

Area	**Sensitive Receptors**	**Latitude**	**Longitude**
	Oxford Safaris	-23.726164°	27.102742°
	Receptor	-23.618685°	27.178320°
Tholo Bush Estate	Tholo Bush Estate	-23.910668°	27.845646°
	Receptor	-23.924018°	27.676686°
	Receptor	-23.867661°	27.975574°
Thabazimbi	Cheetah Safaris	-24.049921°	27.373278°
	Rhinoland Safaris	-23.718286°	28.051922°

ANNEXURE 2: PREDICTED CONCENTRATIONS AT SENSIIVE RECEPTORS

Predicted concentrations in µg/m^3 at the sensitive receptors for Scenario 1 (Current), together with the limit value of the NAAQS

Scenario 1 (Current)	**PM_{10} Total**		**$PM_{2.5}$ Total**	
	24-hr	**Ann**	**24-hr**	**Ann**
Receptor	**75**	**40**	**40**	**20**
Phegelelo Senior Secondary	12.6	0.6	11.9	0.6
Contractors Village	10.5	0.6	9.9	0.6
Ditheku Primary School	12.5	0.6	11.8	0.6
Ditheko Primary School	12.6	0.7	11.8	0.6
Marapong Training Centre	11.7	0.6	10.9	0.6
Marapong Clinic	12.4	0.7	11.6	0.6
Tielelo Secondary School	12.1	0.6	11.4	0.6
Grootegeluk Medical Centre - Community Center	11.7	0.7	10.9	0.6
Lephalale College	11.4	0.7	10.8	0.6
Nelsonskop Primary School	12.1	0.7	11.3	0.6
Hansie en Grietjie Pre-Primary School	11.5	0.7	10.9	0.6
Sedibeng Special School for the Deaf and Disabilities	12.4	0.7	11.9	0.6
Kings College	11.0	0.7	10.4	0.7
Bosveld Primary School	11.6	0.7	11.0	0.7
Lephalale Medical Hospital	11.6	0.6	10.8	0.6
Ellisras Hospital	10.9	0.7	10.4	0.6
Laerskool Ellisras Primary School	9.9	0.6	9.4	0.6
Hoerskool Ellisras Secondary School	10.2	0.6	9.8	0.6
Marlothii Learning Academy	10.1	0.6	9.6	0.6
Hardekool Akademie vir C.V.O	9.9	0.6	9.4	0.6
Lephalale Clinic	9.9	0.6	9.4	0.6
Ons Hoop	10.7	0.6	10.2	0.5
Woudend	6.6	0.3	6.3	0.3
Ramabara's	9.1	0.6	8.6	0.6
Ga-Shongoane	5.3	0.3	5.1	0.3
Bulge River	7.1	0.7	6.7	0.6
Kaingo Mountain Lodge	7.4	0.6	7.1	0.6
Community	8.1	0.8	7.7	0.7
Kiesel	7.6	0.8	7.2	0.7
Kremetartpan	11.2	1.0	10.5	0.9
Mbala Private Camp	10.6	0.9	10.0	0.9
Steenbokpan	12.2	0.8	11.6	0.7
Receptor	11.1	0.5	10.7	0.5
Sandbult	10.4	0.7	10.0	0.6
Hardekraaltjie	7.4	0.4	7.1	0.4
Receptor	12.0	0.6	11.5	0.5
Receptor	10.2	0.4	9.8	0.4
Receptor	7.2	0.4	6.9	0.4
Receptor	7.6	0.4	7.3	0.4
Receptor	7.2	0.4	6.9	0.4
Ditaung	5.7	0.3	5.5	0.3
Letlora	5.6	0.3	5.4	0.3
Receptor	8.3	0.8	7.9	0.7
Glenover	6.5	0.7	6.1	0.6
Oxford Safaris	5.1	0.5	4.8	0.4
Receptor	8.0	0.5	7.7	0.5
Tholo Bush Estate	7.7	0.6	7.3	0.6

Scenario 1 (Current)	PM_{10} Total		$PM_{2.5}$ Total	
	24-hr	**Ann**	**24-hr**	**Ann**
Receptor	**75**	**40**	**40**	**20**
Receptor	11.1	0.9	10.6	0.9
Receptor	6.5	0.4	6.2	0.4
Cheetah Safaris	9.3	0.8	8.9	0.8
Rhinoland Safaris	5.0	0.3	4.7	0.3

Predicted concentrations in μg/m^3 at the sensitive receptors for Scenario A (2025), together with the limit value of the NAAQS

Scenario A (2025)	**PM$_{10}$ Total**		**PM$_{2.5}$ Total**	
	24-hr	**Ann**	**24-hr**	**Ann**
Receptor	**75**	**40**	**40**	**20**
Phegelelo Senior Secondary	13.9	0.9	12.7	0.8
Contractors Village	12.3	0.8	11.3	0.8
Ditheku Primary School	14.1	0.9	13.0	0.8
Ditheko Primary School	17.9	0.9	16.8	0.8
Marapong Training Centre	15.6	0.9	14.3	0.8
Marapong Clinic	17.3	0.9	16.1	0.8
Tielelo Secondary School	14.0	0.9	12.8	0.8
Grootegeluk Medical Centre - Community Center	15.5	0.9	14.3	0.8
Lephalale College	12.9	0.9	12.3	0.8
Nelsonskop Primary School	17.1	0.9	15.9	0.8
Hansie en Grietjie Pre-Primary School	12.8	0.9	12.2	0.8
Sedibeng Special School for the Deaf and Disabilities	11.6	0.9	11.0	0.8
Kings College	12.6	0.9	12.0	0.8
Bosveld Primary School	11.7	0.9	11.1	0.8
Lephalale Medical Hospital	13.9	0.9	12.8	0.8
Ellisras Hospital	12.3	0.9	11.7	0.8
Laerskool Ellisras Primary School	11.1	0.8	10.5	0.8
Hoerskool Ellisras Secondary School	11.6	0.8	11.0	0.8
Marlothii Learning Academy	11.4	0.8	10.8	0.8
Hardekool Akademie vir C.V.O	10.5	0.8	9.9	0.7
Lephalale Clinic	11.0	0.8	10.5	0.8
Ons Hoop	11.4	0.7	10.8	0.7
Woudend	6.7	0.4	6.4	0.4
Ramabara's	10.0	0.7	9.5	0.7
Ga-Shongoane	6.2	0.4	6.0	0.4
Bulge River	7.4	0.8	7.1	0.8
Kaingo Mountain Lodge	7.0	0.7	6.8	0.7
Community	8.6	0.9	8.2	0.9
Kiesel	8.8	1.0	8.3	0.9
Kremetartpan	13.6	1.3	12.9	1.2
Mbala Private Camp	11.6	1.3	11.0	1.2
Steenbokpan	13.9	1.1	13.2	1.0
Receptor	10.8	0.7	10.4	0.6
Sandbult	12.5	0.9	11.9	0.8
Hardekraaltjie	8.0	0.5	7.7	0.5
Receptor	12.9	0.7	12.2	0.6
Receptor	10.5	0.5	10.1	0.5
Receptor	7.7	0.4	7.4	0.4
Receptor	8.7	0.4	8.4	0.4
Receptor	8.7	0.5	8.3	0.5
Ditaung	5.7	0.4	5.4	0.3
Letlora	6.6	0.3	6.4	0.3
Receptor	9.6	1.0	9.1	0.9
Glenover	8.0	0.8	7.6	0.8
Oxford Safaris	6.2	0.6	5.9	0.5
Receptor	8.8	0.6	8.5	0.6
Tholo Bush Estate	9.0	0.8	8.7	0.7

Scenario A (2025)	**PM_{10} Total**		**$PM_{2.5}$ Total**	
	24-hr	**Ann**	**24-hr**	**Ann**
Receptor	**75**	**40**	**40**	**20**
Receptor	11.9	1.1	11.4	1.0
Receptor	6.4	0.5	6.2	0.5
Cheetah Safaris	10.5	1.1	10.1	1.0
Rhinoland Safaris	5.4	0.4	5.2	0.4

Predicted concentrations in μg/m^3 at the sensitive receptors for Scenario B (2031), together with the limit value of the NAAQS

Scenario B (2031)	**PM_{10} Total**		**$PM_{2.5}$ Total**	
	24-hr	**Ann**	**24-hr**	**Ann**
Receptor	**75**	**40**	**25**	**15**
Phegelelo Senior Secondary	10.8	0.7	9.7	0.6
Contractors Village	10.4	0.7	9.4	0.7
Ditheku Primary School	10.7	0.7	9.6	0.6
Ditheko Primary School	11.4	0.8	10.3	0.7
Marapong Training Centre	11.3	0.7	10.0	0.7
Marapong Clinic	11.5	0.8	10.3	0.7
Tielelo Secondary School	10.9	0.7	9.8	0.7
Grootegeluk Medical Centre - Community Center	11.6	0.8	10.3	0.7
Lephalale College	10.7	0.8	10.1	0.7
Nelsonskop Primary School	11.4	0.8	10.2	0.7
Hansie en Grietjie Pre-Primary School	10.7	0.8	10.0	0.7
Sedibeng Special School for the Deaf and Disabilities	9.7	0.7	9.1	0.7
Kings College	11.6	0.8	10.9	0.7
Bosveld Primary School	10.7	0.8	10.1	0.7
Lephalale Medical Hospital	11.1	0.7	9.8	0.7
Ellisras Hospital	10.9	0.7	10.4	0.7
Laerskool Ellisras Primary School	9.4	0.7	8.8	0.6
Hoerskool Ellisras Secondary School	9.7	0.7	9.2	0.6
Marlothii Learning Academy	9.6	0.7	9.1	0.6
Hardekool Akademie vir C.V.O	9.5	0.6	9.0	0.6
Lephalale Clinic	9.4	0.7	8.8	0.6
Ons Hoop	8.7	0.6	8.2	0.5
Woudend	4.7	0.3	4.4	0.3
Ramabara's	7.2	0.6	6.8	0.5
Ga-Shongoane	4.3	0.3	4.0	0.3
Bulge River	5.6	0.6	5.3	0.6
Kaingo Mountain Lodge	5.1	0.5	4.9	0.5
Community	6.1	0.7	5.8	0.7
Kiesel	6.1	0.8	5.7	0.7
Kremetartpan	10.1	1.0	9.5	0.9
Mbala Private Camp	8.5	1.0	8.1	0.9
Steenbokpan	9.5	0.9	8.9	0.8
Receptor	7.7	0.5	7.3	0.5
Sandbult	8.1	0.7	7.7	0.6
Hardekraaltjie	6.0	0.4	5.8	0.4
Receptor	9.4	0.5	8.8	0.5
Receptor	7.5	0.4	7.2	0.4
Receptor	5.8	0.3	5.5	0.3
Receptor	5.4	0.3	5.1	0.3
Receptor	5.8	0.4	5.5	0.4
Ditaung	4.2	0.3	4.0	0.2
Letlora	4.6	0.3	4.4	0.2
Receptor	7.9	0.8	7.4	0.7
Glenover	6.4	0.6	6.0	0.6
Oxford Safaris	4.3	0.4	4.0	0.4
Receptor	6.2	0.5	5.9	0.4
Tholo Bush Estate	5.9	0.5	5.6	0.5

Scenario B (2031)	**PM_{10} Total**		**$PM_{2.5}$ Total**	
	24-hr	**Ann**	**24-hr**	**Ann**
Receptor	**75**	**40**	**25**	**15**
Receptor	7.8	0.8	7.4	0.8
Receptor	4.5	0.4	4.3	0.3
Cheetah Safaris	8.3	0.9	7.9	0.8
Rhinoland Safaris	4.0	0.3	3.8	0.3

Predicted concentrations in µg/m^3 at the sensitive receptors for Scenario C (2036), together with the limit value of the NAAQS

Scenario C (2036)	**PM_{10} Total**		**$PM_{2.5}$ Total**	
	24-hr	**Ann**	**24-hr**	**Ann**
Receptor	**75**	**40**	**25**	**15**
Phegelelo Senior Secondary	9.4	0.5	8.2	0.5
Contractors Village	8.6	0.5	7.6	0.5
Ditheku Primary School	9.1	0.5	8.0	0.5
Ditheko Primary School	9.1	0.6	8.1	0.5
Marapong Training Centre	9.5	0.6	8.3	0.5
Marapong Clinic	9.8	0.6	8.6	0.5
Tielelo Secondary School	9.4	0.5	8.2	0.5
Grootegeluk Medical Centre - Community Center	9.2	0.6	8.1	0.5
Lephalale College	8.6	0.6	8.0	0.5
Nelsonskop Primary School	9.8	0.6	8.6	0.5
Hansie en Grietjie Pre-Primary School	8.6	0.6	8.0	0.5
Sedibeng Special School for the Deaf and Disabilities	8.0	0.6	7.5	0.5
Kings College	8.0	0.6	7.4	0.5
Bosveld Primary School	7.9	0.6	7.4	0.5
Lephalale Medical Hospital	9.7	0.6	8.4	0.5
Ellisras Hospital	7.8	0.5	7.2	0.5
Laerskool Ellisras Primary School	7.0	0.5	6.5	0.5
Hoerskool Ellisras Secondary School	7.3	0.5	6.8	0.5
Marlothii Learning Academy	7.0	0.5	6.5	0.5
Hardekool Akademie vir C.V.O	7.2	0.5	6.7	0.4
Lephalale Clinic	6.9	0.5	6.4	0.5
Ons Hoop	6.7	0.4	6.2	0.4
Woudend	3.9	0.2	3.7	0.2
Ramabara's	5.6	0.4	5.2	0.4
Ga-Shongoane	3.4	0.2	3.2	0.2
Bulge River	4.4	0.5	4.1	0.4
Kaingo Mountain Lodge	4.1	0.4	3.8	0.4
Community	5.2	0.6	4.8	0.5
Kiesel	4.7	0.6	4.3	0.5
Kremetartpan	7.9	0.8	7.3	0.7
Mbala Private Camp	6.9	0.8	6.4	0.7
Steenbokpan	7.5	0.7	6.9	0.6
Receptor	6.4	0.4	6.0	0.4
Sandbult	6.7	0.5	6.3	0.5
Hardekraaltjie	4.7	0.3	4.5	0.3
Receptor	7.4	0.4	6.9	0.4
Receptor	5.9	0.3	5.5	0.3
Receptor	4.5	0.2	4.3	0.2
Receptor	4.8	0.3	4.5	0.2
Receptor	5.0	0.3	4.7	0.3
Ditaung	3.4	0.2	3.2	0.2
Letlora	3.7	0.2	3.5	0.2
Receptor	5.6	0.6	5.2	0.5
Glenover	4.6	0.5	4.2	0.5
Oxford Safaris	3.4	0.3	3.2	0.3
Receptor	4.9	0.4	4.7	0.3
Tholo Bush Estate	5.1	0.4	4.8	0.4

Scenario C (2036)	**PM_{10} Total**		**$PM_{2.5}$ Total**	
	24-hr	**Ann**	**24-hr**	**Ann**
Receptor	**75**	**40**	**25**	**15**
Receptor	6.5	0.6	6.1	0.6
Receptor	3.5	0.3	3.3	0.3
Cheetah Safaris	6.2	0.6	5.8	0.6
Rhinoland Safaris	3.2	0.2	3.0	0.2

Predicted concentrations in µg/m³ at the sensitive receptors for Scenario D (MES), together with the limit value of the NAAQS

Scenario D (MES)	**PM_{10} Total**		**$PM_{2.5}$ Total**	
	24-hr	**Ann**	**24-hr**	**Ann**
Receptor	**75**	**40**	**25**	**15**
Phegelelo Senior Secondary	4.9	0.3	3.8	0.2
Contractors Village	4.9	0.3	4.0	0.2
Ditheku Primary School	5.0	0.3	3.9	0.2
Ditheko Primary School	5.2	0.3	4.2	0.3
Marapong Training Centre	5.3	0.3	4.1	0.3
Marapong Clinic	5.6	0.3	4.5	0.3
Tielelo Secondary School	5.0	0.3	3.8	0.2
Grootegeluk Medical Centre - Community Center	5.5	0.3	4.3	0.3
Lephalale College	4.5	0.3	3.9	0.3
Nelsonskop Primary School	5.5	0.3	4.3	0.3
Hansie en Grietjie Pre-Primary School	4.4	0.3	3.8	0.3
Sedibeng Special School for the Deaf and Disabilities	3.9	0.3	3.4	0.2
Kings College	4.2	0.3	3.6	0.3
Bosveld Primary School	4.0	0.3	3.5	0.3
Lephalale Medical Hospital	5.2	0.3	4.0	0.3
Ellisras Hospital	4.1	0.3	3.6	0.2
Laerskool Ellisras Primary School	3.6	0.3	3.1	0.2
Hoerskool Ellisras Secondary School	3.8	0.3	3.3	0.2
Marlothii Learning Academy	3.7	0.3	3.2	0.2
Hardekool Akademie vir C.V.O	3.7	0.3	3.2	0.2
Lephalale Clinic	3.6	0.3	3.1	0.2
Ons Hoop	3.6	0.2	3.0	0.2
Woudend	2.1	0.1	1.8	0.1
Ramabara's	3.0	0.2	2.6	0.2
Ga-Shongoane	1.9	0.1	1.7	0.1
Bulge River	2.4	0.3	2.2	0.2
Kaingo Mountain Lodge	2.2	0.2	2.0	0.2
Community	2.7	0.3	2.4	0.3
Kiesel	2.8	0.3	2.4	0.3
Kremetartpan	4.5	0.5	3.9	0.4
Mbala Private Camp	3.7	0.4	3.2	0.4
Steenbokpan	4.2	0.4	3.7	0.3
Receptor	3.2	0.2	2.9	0.2
Sandbult	3.7	0.3	3.2	0.2
Hardekraaltjie	2.4	0.2	2.2	0.1
Receptor	3.8	0.2	3.3	0.2
Receptor	3.1	0.2	2.7	0.1
Receptor	2.4	0.1	2.1	0.1
Receptor	2.5	0.1	2.2	0.1
Receptor	2.7	0.2	2.4	0.1
Ditaung	1.8	0.1	1.6	0.1
Letlora	2.0	0.1	1.8	0.1
Receptor	3.3	0.3	2.9	0.3
Glenover	2.7	0.3	2.3	0.2
Oxford Safaris	1.9	0.2	1.7	0.2
Receptor	2.5	0.2	2.2	0.2
Tholo Bush Estate	2.7	0.2	2.5	0.2

Scenario D (MES)	**PM_{10} Total**		**$PM_{2.5}$ Total**	
	24-hr	**Ann**	**24-hr**	**Ann**
Receptor	**75**	**40**	**25**	**15**
Receptor	3.6	0.4	3.2	0.3
Receptor	1.9	0.2	1.7	0.1
Cheetah Safaris	3.5	0.4	3.1	0.3
Rhinoland Safaris	1.7	0.1	1.5	0.1

Appendix D

HEALTH COST BENEFIT ANALYSIS

Health impact focused cost benefit analyses for Medupi and Matimba Power Stations in the Waterberg-Bojanala Priority Area

For input into the Minimum Emission Standards Exemption Report Chapter 8

21 October 2024

Prepared For:

WSP Group Africa (Pty) Ltd
Building 1, Maxwell Office Park,
Magwa Crescent West,
Waterfall City, Midrand, 1685
South Africa

Prepared By:

Prime Africa Consult
The Factory, 274 Brander Street,
Jan Niemand Park, 0186 Pretoria,
South Africa
Email: info@primeafrica.net

Authors: Dr Karen Eatwell, Dr Jackie Crafford, and Valmak Mathebula

PREAMBLE

This study forms part of the project entitled, “Eskom MES Exemption Applications & Decommissioning AIRs” for WSP Group Africa (Pty) Ltd appointed by Eskom SOC Limited for the preparation of the Minimum Emission Standards (MES) exemption application report.

The study investigates the health benefits and implementation costs of mitigating air pollution emissions from Eskom coal-fired power stations, Matimba and Medupi, in the Waterberg-Bojanala Priority Area. The two stations may be retrofitted with air emission abatement technologies. Matimba is scheduled for closure by 2043 and Medupi is scheduled for closure by 2071.

The methodology used in this study is based on World Health Organisation guidelines.

In addition to the authors, the contributors to this analysis include:

- Dr Mark Zunckel and Atham Raghunandan from uMoya-NILU Consulting (Pty) Ltd who were responsible for CALPUFF modelling.
- Ms Rietha Oosthuizen (independent consultant) and Dr Caradee Wright (SA Medical Research Council) who provided advice for the epidemiological evidence used in the study.
- Mr Bryan McCourt and Mr Ebrahim Patel from Eskom provided important details on scenarios and abatement technology costs.

EXECUTIVE SUMMARY

The combustion of fossil fuels results in the emission of numerous atmospheric pollutants, that include but are not limited to sulphur dioxide (SO_2), particulate matter (PM), and nitrogen dioxide (NO_2). Atmospheric pollutants have numerous negative effects on human health and increase the risk of premature mortality.

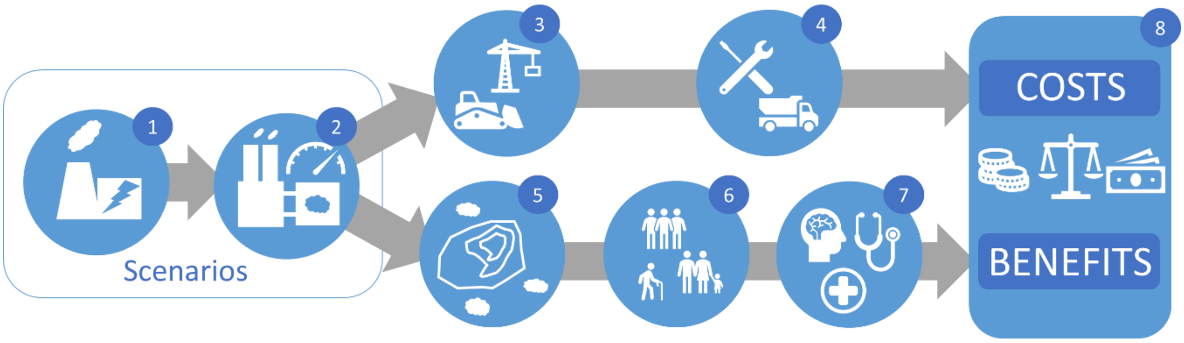
Technologies exist to reduce these emissions and therefore also their negative health effects. Abatement technologies for the power stations include wet and semi-dry Flue Gas Desulphurisation (FGD) for SO_2 reduction and installation of high-frequency power supply (HFPS) to improve Electrostatic Precipitator (ESP) efficiency and reduce PM emissions.

A benefit-cost analysis (BCA) allows for trade-offs between different scenarios to be compared to support decision making.

The aim of this study was to estimate the incremental health benefits associated with abatement technology options, to achieve or move towards compliance with the new Minimum Emission Standards (MES) of the Department of Forestry Fisheries and the Environment (DFFE).

Methodology

An integrated Air Pollution Health Risk Benefit Cost Analysis APHR-BCA model was developed to model the impacts of three different abatement scenarios as developed by Eskom. The APHR-BCA was developed following the General Principles of the World Health Organisation, WHO (WHO, 2016a), for performing air pollution health risk assessments (AP-HRA). The detailed methodology and assumptions are set out in section 2 below. In summary, the methodology proceeded through several steps, as set out in the schematic:



Health benefits resulting from air pollution abatement

The WHO (2016a) recommends that the health risk in a population, associated with air pollution, is to be estimated using exposure-response functions (ERFs). ERFs are based on Relative Risk (RR) estimates derived from primary epidemiological studies. These RR functions estimate the likelihood of health outcomes occurring in a population exposed to a higher level of air pollution relative to that in a population with a lower exposure level. RR is usually expressed as the proportional increase in the assessed health outcome risk incidence associated with a given increase in pollutant concentrations, measured in $\mu g/m^3$. The WHO (2016a) notes that "*the RR estimate cannot be assigned to a specific person; it describes risk in a defined population, not individual risk.*"

Ideally, ERF studies and their RRs should be determined based on primary epidemiological studies focussing on the exposed population. In the absence of such studies, as in the case of South Africa, the WHO (2016a) recommends using ERFs from other countries.

The health outcomes were selected based on the latest WHO systematic reviews from 2020 and 2021 that were conducted for the update of the WHO Global Air Quality guidelines. The health outcome that was considered in this study is all-cause mortality. Morbidity was not considered in this study as comprehensive data on morbidity studies is not widely available. Additionally, there are issues relating the transferability of data from one population to another in terms of country and culture as populations have different sensitivities to pollutant exposure (WHO 2000).

Pollution levels, chemical composition and health care systems are typically very different in other settings, and this would affect the accuracy of the ERFs. It is important to understand at what level interval the ERFs would result in significant differences in health outcome incidences. As a result, the WHO (2016a) advises performing an assessment of the uncertainty of the analysis; in this case therefore this requires an assessment related to a lack of knowledge about one or more components of the integrated Health BCA Model. Section 2.5 discusses each source of uncertainty and related limitations. Variation in the health outcome ERFs was dealt with through performing sensitivity analysis in the BCA (refer to section 2.4).

Interpretation of the risk of premature mortality has to be done with care. It is to be noted firstly that these numbers are indicators of health risk at a population level. The relative risk estimate inherent in the ERF is a metric of the likelihood of an adverse health outcome, and it cannot be attributed to an individual person. It can thus be used to quantify risk to a defined population (and not to an individual), (WHO 2016a) and how this risk would vary between various mitigation scenarios.

In this study, the ERFs obtained from the latest WHO systematic reviews, focused exclusively on mortality and thus a monetary measure of mortality was required in order to perform benefit-cost analyses. In air pollution benefit-cost analyses, the concept of value of a statistical life (VSL) is commonly used to monetise mortality related benefits of air pollution reduction. The concept of a VSL is frequently misunderstood. It does not measure the intrinsic value of a human life, and neither does it value the economic productivity of a human. Rather, VSL is estimated by dividing an individual's willingness to pay (WTP) to reduce health risk, by the likelihood of risk reduction. Robinson and Hammitt (2009) defines VSL to represent the rate at which an individual is willing to exchange their own income for a small reduction in their own mortality risk over a particular time period. VSL is not the value that a person, society or the government would place on reducing mortality rates with certainty, but it is rather a representation of the rate at which a person views a change in the money available for spending as equivalent to a small change in their own mortality risk (Robinson et al., 2018).

Primary WTP studies for mortality risk reductions have not been done in South Africa. The VSL for South Africa in the BCA was determined by using the methodology as advised by Viscusi and Masterman (2017) and Robinson et al. (2018) with a base VSL from the U.S, GNI per capita for income measures and adjusted by income elasticity. As advised by Robinson et al. (2018), a sensitivity analysis is conducted to explore various VSL estimates.

Scenario assessment

The three scenarios evaluated in the BCA study, against a baseline included:

- Scenario ERP 2024 A (PM reduction, generating load capped, air quality offsets and SO_2 reduction at Medupi)
- Scenario ERP 2024 B (As per ERP 2024 B)
- Scenario ERP 2024 C (Full compliance with MES for PM, NOx and SO_2 for both Medupi and Matimba)

The detailed emission abatement measures relevant to the scenarios are set out in Table 2-3 in Section 2.3.3. A key difference in the scenarios is the number of stations which are installed with SO_2 reduction technology in the form of wet-Flue Gas Desulphurisation (FGD) or semi-dry FGD. The focus on SO_2 reduction is important given the extent to which it is anticipated to impact on air quality and public health and the very significant cost of SO_2 reduction.

Health benefits associated with each scenario were calculated against the baseline (FY 25) that took into account the anticipated increase in loads in the coming years from 2025 and assumed no additional abatement technologies installed and both stations would continue to emit air pollution at their current rates until shutdown, repowering and repurposing.

- The health benefits of ERP 2024 A deliver immediate impact from 2024. At Medupi Wet FGD is commissioned from 2028 to 2032. Both stations already operate at NOx = 750 mg/Nm^3. Medupi already has Fabric Filter Plant (FFP) for PM reduction. Matimba station is equipped with ESP + HPPS for optimisation of PM reduction. These increase the associated health benefits until 2039. Hereafter the associated health benefits reduce as Matimba shutdown, repowering and repurposing is between 2039 and 2043. Medupi station shutdown, repowering and repurposing is much later from 2065 and the health benefits from the Wet FGD continue until final closure of the station.
- The health benefits of ERP 2024 B include those as discussed for ERP 2024 A above. In addition, efficiency and coal improvement projects reduce total sulphur and carbon emissions by 5% for Medupi and Matimba from 2024 onwards.
- The health benefits of ERP 2024 C include those as discussed for ERP 2024 A and B above. Semi-dry FGD is installed at Matimba by 2035, however the associated health benefits are effectively negated as Matimba starts to shut down in 2039.

With respect to the **abatement costs** associated with each scenario:

- The total Capex and Opex costs of abatement are identical to 2024.
- ERP 2024 A implementation starts in 2025 with Matimba ESP + HFPS technology and in 2028 with Medupi, Wet FGD installation. After 2032 only operational costs continue at Medupi.
- ERP 2024 B is the same as ERP 2024 A discussed above.

- ERP 2024 C is the same as described for ERP 2024 A and B. In addition, implementation starts in 2031 with Matimba semi-dry FGD. The Capex costs decrease after 2032 as Medupi Wet FGD is fully installed and only the Capex of the Matimba semi-dry FGD remains until 2035 whereafter only operational costs remain. After closure of Matimba in 2043 only Medupi continues to operate.

The BCA ratios need to be interpreted with care. They are meant only to provide a perspective on and inform the decision-making process underlying the scenarios. They are not meant to be interpreted as a definitive answer to making abatement decisions. Decisions involving human health have to be informed by non-economic criteria as well. In addition, with uncertainty inherent in the analysis, the cost benefit ratio should thus not be viewed as absolute, but rather as a relative value from which to compare scenarios.

The **BCA results** are provided in Table 0-1. In the upper estimates the lower costs and higher VSL are used and in the lower estimates the higher costs and lower VSL are used as recommended by Robinson et al. 2018.

- The BCA central ratio of ERP 2024 A is significantly less than 1, indicating that costs of abatement far exceed the health benefits. This ratio remains below 1 even in the most optimistic (upper) parameters of the sensitivity analysis. The reasons for this include the implementation of FGDs at Medupi in conjunction with the small population that benefits. This scenario has a total nominal cost of R58,660 million and is likely to increase electricity tariffs by 0.6% - 0.9% in ERP 2024 A.
- The BCA ratio of ERP 2024 B is also significantly less than 1, indicating that costs of abatement far exceed the health benefits. This ratio remains below 1 even in the most optimistic (upper) parameters of the sensitivity analysis. The same reasons apply as for ERP 2024 A above. This scenario has a total nominal cost of R58,660 million and is likely to increase electricity tariffs by 0.6% - 0.9% as in ERP 2024 A.
- The BCA ratio of ERP 2024 C is also significantly less than 1, indicating that costs of abatement far exceed the health benefits. This ratio remains below 1 even in the most optimistic (upper) parameters of the sensitivity analysis. This scenario has a larger discrepancy in NPV of health benefits and NPV of costs due to implementation of FGDs at both Medupi and Matimba and the small population that benefits. This scenario has a total nominal cost of R101,670 million and is likely to increase electricity tariffs by 0.9% - 1.2% in ERP 2024 C.
- Evaluation of the BCA ratios at a social discount rate of 2% delivers similar results, with all three scenarios ratios remaining less than 1.

Table 0-1: BCA ratios (lower and upper ranges) for each scenario (discounted at Eskom WACC)

	ERP 2024 A		**ERP 2024 B**		**ERP 2024 C**	
Million Rands	*Lower*	*Upper*	*Lower*	*Upper*	*Lower*	*Upper*
NPV of Costs	-18,970	-13,437	-18,970	-13,437	-27,716	-19,632
NPV of Benefits	3	17	8	39	16	83
NPV of Benefits minus Costs	-18,967	-13,420	-18,962	-13,398	-27,700	-19,549
Benefit:Cost Ratio (*range*)	0.0002	0.0012	0.0004	0.0029	0.0006	0.0042
Benefit:Cost Ratio (*central*)	0.0007		0.0017		0.0024	

ACRONYMS AND ABBREVIATIONS

AP-HRA	Air Pollution Health Risk Assessment
AQA	Air Quality Act
AQMS	Air Quality Monitoring Station
BCA	Benefit-Cost Analysis
CFOI	Census of Fatal Occupational Injuries (USA)
COI	Cost of Illness
DEA	Department of Environmental Affairs (now DFFE)
DFFE	Department of Forestry Fisheries & Environmental Affairs
DSI	Dry Sorbent Injection
ERF	Exposure Response Function
ESP	Electrostatic Precipitators
FFP	Fabric Filter Plants
FGD	Flue Gas Desulphurisation
GNI	Gross National Income
ICD	International Classification of Diseases
kW	Kilowatt
kWh	Kilowatt Hour
MES	Minimum Emissions Standards
NAAQS	National Ambient Air Quality Standard
NAQI	National Air Quality Index
NEMA	National Environmental Management Act
NO_2	Nitrogen Oxide
NPV	Net Present Value
PM	Particulate Matter
RR	Relative Risk
SAMRC	South African Medical Research Council
SO_2	Sulphur Dioxide
USA	United States of America
VSL	Value of a Statistical Life

WBPA	Waterberg-Bojanala Priority Area
WHO	World Health Organisation
WACC	Weighted Average Cost of Capital
WTP	Willingness to Pay

TABLE OF CONTENTS

1 INTRODUCTION

The Earth Summit[1] in Rio de Janeiro in 1991 raised the awareness of the linkages between environmental health and human wellbeing to a global agenda. In the three and half decades since the Summit, significant effort has gone into methods for quantifying these linkages, in all environmental spheres, and informing policy development. During the same period, we have seen an information technology revolution, which has radically improved our ability to collect and analyse large data sets. In the field of air quality health risk assessment specifically, there has been a rapid and continuously improving set of methodologies through which to analyse the linkages between air pollution and health risk.

The World Health Organisation (WHO) has been leading the development of health risk assessment methodology. Formally, air pollution health risk assessments (AP-HRA) are performed to provide quantifiable information for informing public policy decisions. The general principles for AP-HRAs have been published by the WHO (WHO, 2016a). An AP-HRA proceeds through three steps.

Firstly, it assesses the exposure of the target population to specific air pollutants. This requires a quantification of constituents in the atmosphere that are associated with human health risks. The atmosphere we breathe contains various such constituents, both from natural sources (e.g. sea salt and bio-aerosols) and anthropogenic sources (e.g. fuel combustion, suspension of fine particles, and industrial emissions) (refer to FRIDGE (2004) for a comprehensive discussion of pollution sources). When a particular policy option is analysed, specific indicator constituents need to be selected, and the incremental effect of the policy option needs to be estimated in terms of population exposure. In this study, incremental population exposure resulting from Eskom's coal-fired power plant emissions (from two stations in the Waterberg), was estimated through the use of dispersion modelling (uMoya-Nilu, 2024).

Secondly, the AP-HRA estimates the resultant incremental change in health risk. This requires the application of exposure-response functions (ERFs). ERFs quantify the incremental change in health outcomes (compared to the baseline incidence), based on changes in exposure to pollutants. ERFs are derived from epidemiological studies, which are large scale population health studies that compare health outcome incidence between populations exposed to different concentrations of pollution. In this study, ERFs from the latest systematic reviews from 2020 and 2021 that were conducted for the update of the WHO Global Air Quality guidelines were used (WHO 2020, 2021). AP-HRA results can be reported in terms of morbidity indicators (e.g. cost of medical treatment and lost economic productivity) or mortality indicators (e.g. premature mortality). These indicators can be converted to monetary impacts by applying cost of illness (COI) methodologies. In this study, premature mortality was evaluated, using a value of a statistical life (VSL) COI methodology.

Thirdly, the AP-HRA process requires the quantification and expression of the uncertainty of the estimated health effects. The WHO states that this step is "*an important and integral component of the results, and … vital to ensure both that the main message is not lost and that the results*

---

[1] http://www.un.org/geninfo/bp/enviro.html

produced are understandable by policy-makers and others who do not necessarily have a technical background or expertise in AP-HRA." This step requires "*the use of expert judgement (consensus) on the level of confidence of the results*".

This study investigates the health effects of air pollution resulting from two coal-fired power stations in the Waterberg-Bojanala Priority area and applies the AP-HRA methodology described above.

The indicator pollutants used included sulphur dioxide (SO_2), particulate matter (PM), and nitrogen dioxide (NO_2). These pollutants have several negative impacts on public health (WHO, 2016b).

The Department of Forestry, Fisheries and the Environment (DFFE) under the National Environmental Management Act (NEMA: AQA, 2004) sets ambient air quality standards. Where ambient air quality standards are exceeded, specific air quality mitigation actions would be required. Power generation is a Listed Activity in terms of Section 21 of the NEMA: AQA and Minimum Emission Standards (MES) are prescribed for existing and new stations. In 2018 amendments were made to the list of activities and associated minimum emission standards in terms of section 21 (4)(a). Eskom was granted MES postponements for SO_2 at Medupi and Matimba to 2025 (DEA, 2018 a & b). The May 2024 ruling by the Minister of the Department of Forestry, Fisheries and the Environment requires that Eskom submit application in terms of Section 59 of the National Environmental Management: Air Quality Act (NEMA: AQA), for the exemption of the MES for eight power stations that will continue to operate beyond 2030. Matimba and Medupi are included in these eight stations.

Technologies exist for the reduction of emissions and therefore the health effects. These abatement technologies include Flue Gas Desulphurisation (FGD) and Dry Sorbent Injection (DSI) to reduce SO_2, Electrostatic Precipitators (ESP) and high-frequency power supplies (HFPS) to improve Electrostatic Precipitators (ESP) efficiency to reduce PM, Low NO_X Burners (LNB) to reduce NO_2 and Fabric Filter Plants (FFP) to reduce PM.

The current study investigated three air pollution mitigation scenarios for Eskom, through a benefit-cost analysis (BCA). The BCA uses the AP-HRA methodology to estimate the likely changes in health costs resulting from each scenario. The BCA compares these benefits against the capital costs and operational costs of the mitigation options for each scenario (refer to section 2.3).

1.1 Other studies

Other studies have previously been conducted to estimate the health impacts of either fossil fuel power stations, air pollution in general or specific sources in South Africa. They estimated morbidity and mortality, and in some instances attributed costs to these health impacts. Studies of this nature can take either bottom up (deterministic) approaches or top down (stochastic) approaches to modelling pollution exposure with the latter usually preferable in data poor environments or large spatial domains (Dios et al., 2012). These studies also varied in geographic scale, ranging from selected areas to the national scale. Some of the most recent and relevant include:

The World Health Organisation estimated that, in South Africa, in 2009, the relative risk of premature mortality attributed to poor outdoor air quality was approximately 1,100 cases per year (WHO, 2009).

- Scale: National (All Air Pollution)
- Resolution: Course
- Health Outcomes: Mortality
- Modelling Approach: Top-down

The Centre for Research on Energy and Clean Air estimated that full Minimum Emissions Standard (MES) compliance at Eskom power stations remaining in operation until 2030 would reduce the relative risk of premature mortality from air pollution by 2,300 cases per year and economic costs of R42 billion per year (Myllyvirta & Kelly, 2023). The impacts of mercury were also estimated in the study.

- Scale: National (Power Station Air Pollution)
- Resolution: Medium
- Health Outcomes: Morbidity and Mortality
- Modelling Approach: Bottom-up

The Institute for Health Metrics and Evaluation listed air pollution as the 9th largest risk factor driving death and disability combined in 2016 in South Africa (IHME, 2016).

- Scale: National (All Air Pollution)
- Resolution: Medium
- Health Outcomes: Morbidity and Mortality
- Modelling Approach: Bottom-up

A study commissioned by Greenpeace in 2014 estimated air pollution emissions from Eskom's coal-fired power stations could increase the relative risk of premature mortality from air pollution by as much as 2,200 cases per year (Myllyvirta, 2014). The study also estimated the impacts of mercury pollution.

- Scale: National (Air Pollution from Coal-fired Power Stations)
- Resolution: Medium
- Health Outcomes: Morbidity and Mortality
- Modelling Approach: Bottom-up

A 2017 study commissioned by Groundwork, estimated the total impact of air pollution resulting from the coal-fired power stations at $2.4 billion of health costs annually in South Africa (Holland, 2017).

- Scale: National (Air Pollution from Coal-fired Power Stations)
- Resolution: Medium
- Health Outcomes: Morbidity and Mortality
- Modelling Approach: Bottom-up

Van Horen (1996) evaluated the health costs associated with Eskom's power stations as part of understanding the true costs of electricity generation. The valuation of morbidity outcomes was found to be small in terms of costs per kWh generated.

- Scale: National (Air Pollution from Coal-fired Power Stations)
- Resolution: Medium
- Health Outcomes: Morbidity and Mortality
- Modelling Approach: Bottom-up

The Fund for Research into Industrial Development Growth and Equity, in 2004, assessed the economic impact of air pollution in selected areas in South Africa. The study found that power generation was responsible for 51% of the 8,700 respiratory cases in Mpumalanga (FRIDGE, 2004).

- Scale: Selected Areas (All Air Pollution and Air Pollution from Power Stations)
- Resolution: Medium
- Health Outcomes: Morbidity and Mortality
- Modelling Approach: Bottom-up

A review by Spalding-Fecher and Matibe in 2003 aimed to calculate the external costs of electric power generation in South Africa. They estimated the health costs to be R1.1 billion per year (Spalding-Fecher and Matibe, 2003).

- Scale: National (Air Pollution from Power Stations)
- Resolution: Low
- Health Outcomes: Morbidity and Mortality
- Modelling Approach: Top-down.

The methodology used in this investigation is discussed in detail in Section 2 below.

2 METHODOLOGY AND INPUTS

2.1 Overview

An integrated Health BCA Model was developed that combined an AP-HRA with a BCA to assess three air pollution mitigation scenarios for two Eskom coal-fired power stations in the Waterberg region.

Figure 2-1 below provides an overview of the methodology, and Sections 2.2 - 2.5 provide a more detailed discussion of each component.

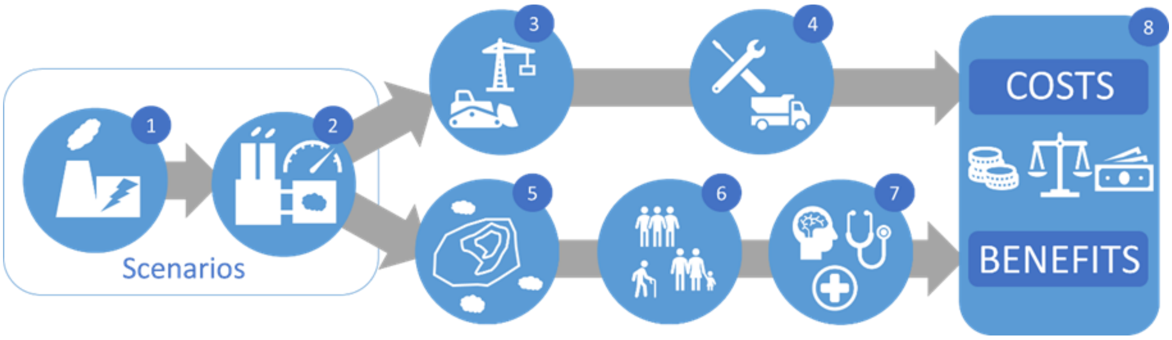


Figure 2-1: Overview of methodology and model architecture

With reference to Figure 2-1, the integrated Health BCA Model includes the following components:

1. Station lifetimes were described for two coal-fired power stations, Medupi and Matimba, and included commissioning and shutdown, repowering and repurposing dates (provided by Eskom).
2. Abatement technologies required for the two power-stations as required in each scenario were defined, by type and likely implementation schedule (refer to section 2.3.3).
3. Capital expenditure required for abatement in each scenario and was obtained from Eskom and attributed per station and per year (refer to section 2.3.4).
4. Operational expenditure required for abatement in each scenario was and was obtained from Eskom and attributed per station and per year (refer to section 2.3.4).
5. Dispersion modelling was done by uMoya-NILU Consulting (Pty) Ltd. This data was then segregated spatially, by municipal ward boundaries to align with population data. Two types of dispersion modelling were performed, one modelling the individual power station predicted ambient concentrations of SO_2, PM, and NO_2 per scenario and the other the cumulative predicted ambient concentrations of SO_2, PM, and NO_2 from both power stations per scenario. Note that for PM, the dispersion modelling predicted primary PM and secondary PM effects, resulting from NO_2 and SO_2 reactions in the atmosphere, as well as fugitive emissions (refer to Section 2.2).
6. Population exposure was estimated at a spatial resolution of municipal wards. At each municipal ward, the number of people exposed to different concentration

ranges were determined per scenario per year, based on Stats SA population estimates and United Nations population growth forecasts (refer to Section 2.2).

7. Health impacts were determined by using the AP-HRA methodology. Epidemiological evidence, in the form of Exposure-response functions (ERFs) and baseline incidence rates were obtained from the World Health Organization (WHO) systematic reviews (2020 & 2021) conducted by various researchers for the WHO as part of the WHO update to the Global Air Quality Guidelines (released in late of September 2021) (refer to Section 2.3). The ERFs were limited to mortality incidence. The Cost of Illness (COI) methodology used was the value of a statistical life (VSL). This method estimates the willingness to pay (WTP) of an individual for reducing their health risk. The VSL should not be interpreted as the intrinsic value of a life. Refer to Section 2.3.2 for a more detailed discussion.
8. The BCA compares the overall scenario health benefits achieved through abatement to the costs of implementation. The outputs of the AP-HRA, i.e. the health cost savings of each scenario, was used as the benefit. The analysis timeline spans 2024 – 2045. (refer to Section 2.4). Finally, an assessment of uncertainty of the results was done (refer to Section 2.5).

2.2 Exposure of the target population to specific air pollutants

2.2.1 Overview

This section comprises the first step of the AP-HRA and assesses the exposure of the target population to specific air pollutants.

This requires an incremental effects quantification of constituents in the atmosphere that are associated with human health risks. These pollutants include SO_2, PM, and NO_2 emitted by the two coal-fired power stations investigated. The emissions from these stations impact the Waterberg-Bojanala Priority area in the Limpopo province of South Africa.

Dispersion modelling combined with population distribution provided an estimate of the exposed population.

2.2.2 Pollutants analysed

The Waterberg-Bojanala Priority Area (WBPA) has three ambient Air Quality Monitoring Stations, Marapong, Medupi and Lephalale stations equipped for continuous monitoring of air quality and meteorological parameters. Marapong AQMS and Medupi AQMS were established by Eskom in 2006 and 2014 respectively and Lephalale is SAWS-DEA owned NAQI (National Air Quality Index) station that was established by DEA (now DFFE) in 2012.

The sections that follow provide a summary of the ambient concentrations of SO_2, NO_2 and PM in the period of 2021 to 2023 at the AQMS at Matimba and Medupi power stations. In the WBPA the main sources of air pollution include agriculture activities, domestic fuel and waste burning, vehicle emissions, mining activities and power generation.

2.2.2.1 Sulphur dioxide (SO_2)

Industrial processes and power generation are the main source of SO_2 in the atmosphere through the combustion or refining of sulphur containing fuels.

During the analysis period from 2021 to 2023, the hourly, daily and annual SO_2 ambient concentrations at Medupi and Lephalale monitoring stations were within the National Ambient Air Quality Standards (NAAQS). There were no exceedances recorded for this time period at Medupi and Lephalale monitoring stations. At Marapong AQMS the hourly, daily and annual SO_2 ambient concentrations were below the NAAQS for 2021 with no exceedances recorded. At this station data recovery for 2022 and 2023 was below 50% and thus not reflected in the analyses.

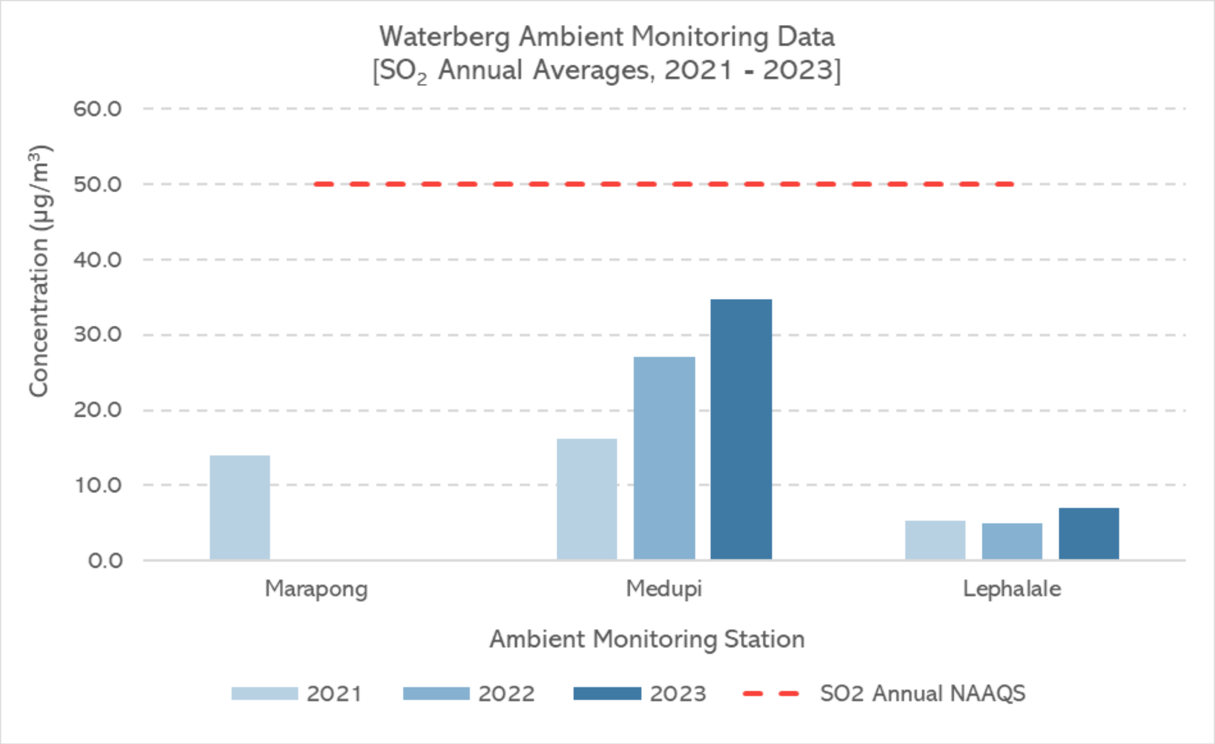


Figure 2-2: Annual average SO_2 concentrations at the Marapong, Medupi and Lephalale AQMS

2.2.2.2 Nitrogen dioxide (NO_2)

Industrial processes and power generation are the main source of NO_2 in the atmosphere through the combustion or refining of fossil fuels, with some contribution from motor vehicle emissions, residential fuel burning and biomass burning.

At Marapong the hourly concentrations for 2021 and 2022 were below NAAQS and no exceedances were recorded and the annual average concentrations were below the average NAAQS for 2021. The hourly concentrations and the annual average concentration for 2021 to 2023 at Medupi and Lephalale monitoring stations were below the average NAAQS with no hourly exceedances recorded.

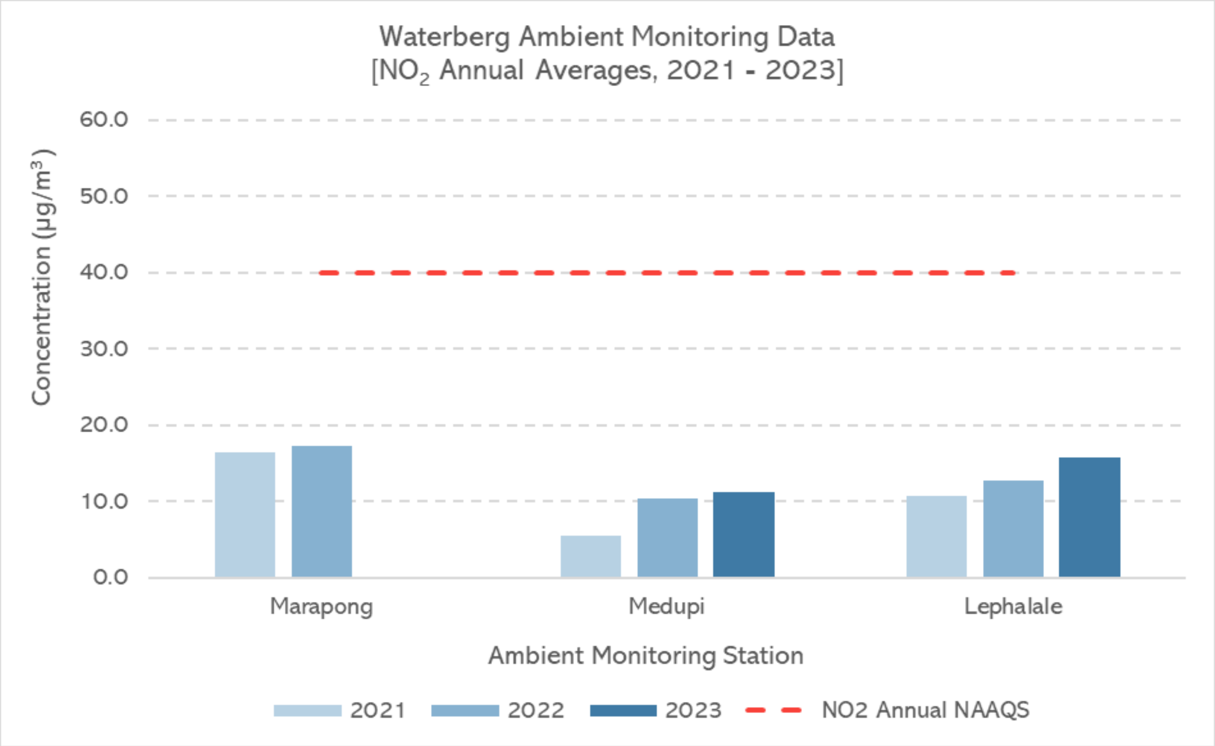


Figure 2-3: Annual average NO_2 concentrations at the Marapong, Medupi and Lephalale AQMS

2.2.2.3 Particulate matter (PM)

There are numerous sources of primary particulate matter, including power generation, industry, mining, biomass burning and agricultural activities, as well as natural sources such as wind entrainment. In addition, secondary PM is produced by NO_2 and SO_2 reactions in the atmosphere.

At the Marapong and Medupi monitoring stations the daily $PM_{2.5}$ and PM_{10} concentrations in 2021 and 2022 were non-compliant with the NAAQS with multiple exceedances reported. The annual average concentrations at Marapong station for PM_{10} in 2021 exceeded the NAAQS average and the annual average concentrations of $PM_{2.5}$ in 2021 and 2022 respectively exceeded NAAQS average and remain non-compliant. At Medupi station annual average concentrations of PM_{10} for 2021 to 2023 exceeded the average NAAQS and the 2021 concentrations for $PM_{2.5}$ also exceeded the average and is thus non-compliant for PM.

The daily and annual average PM_{10} concentrations at the Lephalale station remained below the NAAQS in 2021 and 2023 with one daily exceedance recorded in 2021 and no exceedances recorded in 2023, thus remaining compliant. The daily $PM_{2.5}$ concentrations in 2023 remained below the NAAQS with no exceedances recorded and in 2021 the annual average $PM_{2.5}$ concentrations remained below NAAQS and thus remains compliant. (WSP, 2024)

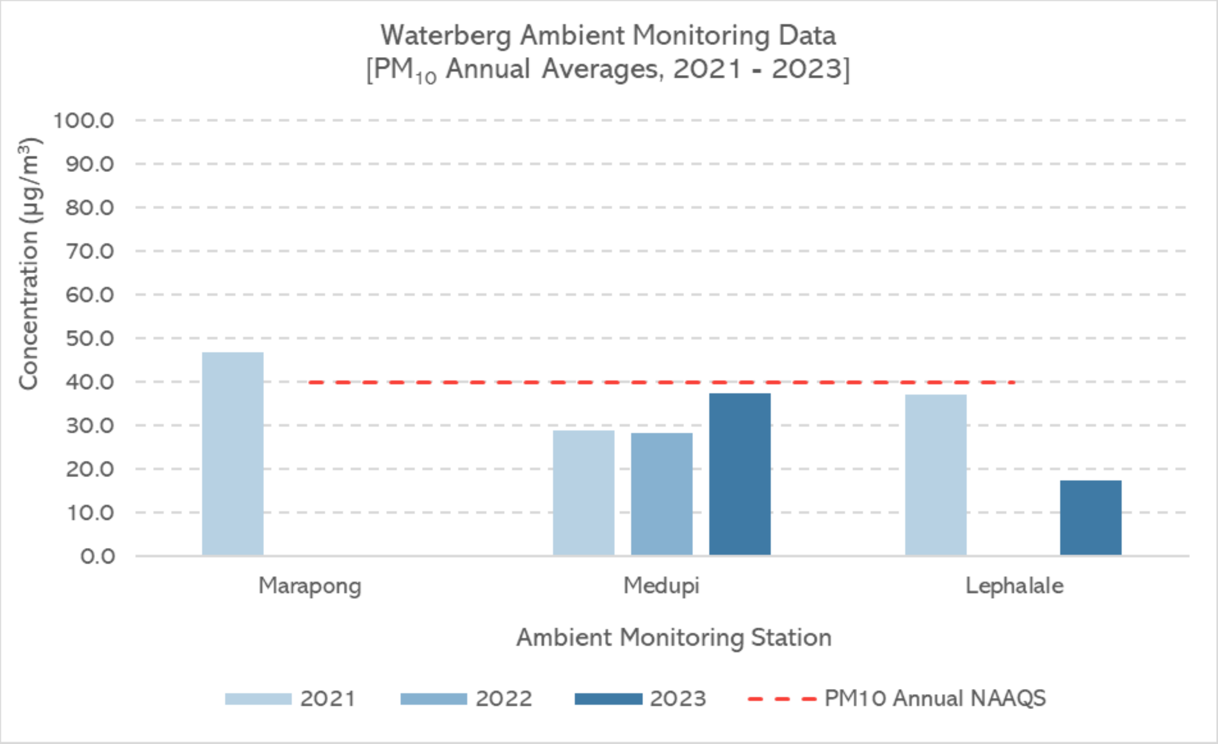


Figure 2-4: Annual average PM_{10} concentrations at the Marapong, Medupi and Lephalale AQMS in $\mu g.m^3$

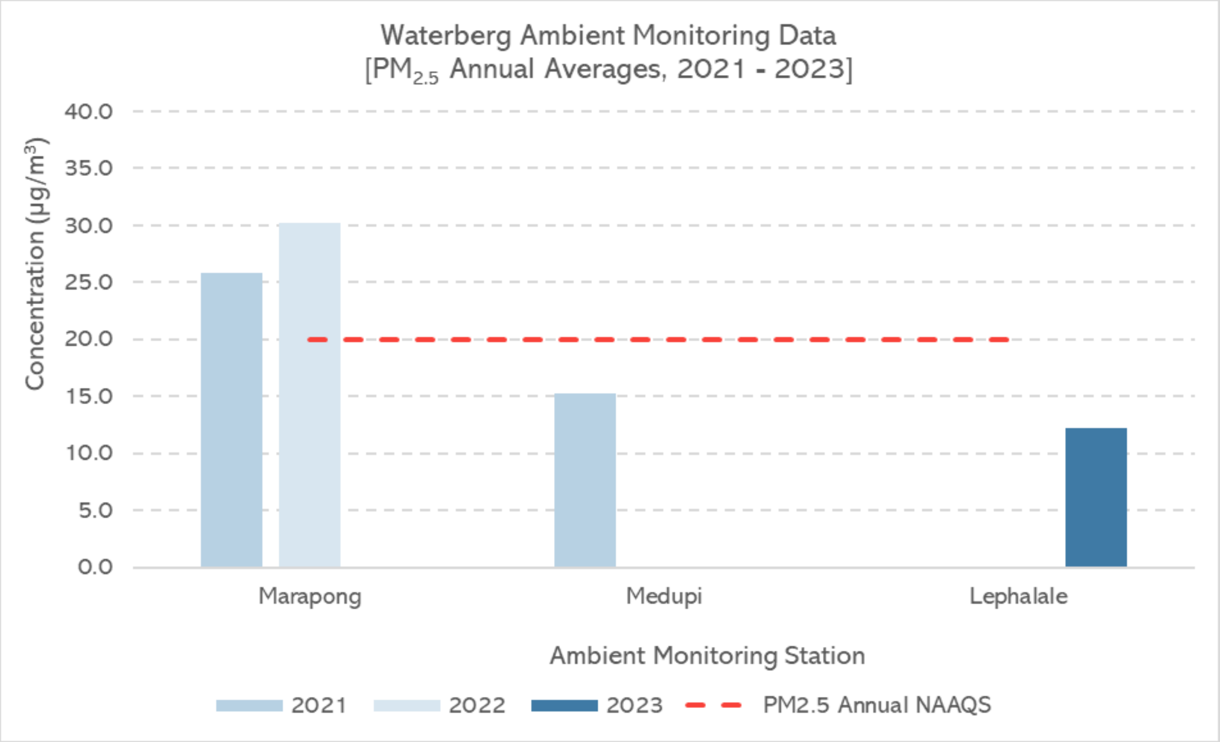


Figure 2-5: Annual average $PM_{2.5}$ concentrations at the Marapong, Medupi and Lephalale AQMS in $\mu g.m^3$

2.2.3 Description of power stations

The Eskom power stations forming part of this study in the Waterberg-Bojanala Priority Area are Matimba and Medupi. These power stations will have a combined installed capacity of 8,754 MW and are listed in Table 2-1.

Table 2-1: Eskom coal-fired power stations, used in this study, and their installed capacity (Eskom, 2023)

Power Station	Province	Installed capacity (MW)
Matimba	Limpopo	3,990
Medupi	Limpopo	4,760

2.2.4 Dispersion modelling

Dispersion modelling is required to estimate the effects of stack emissions on ambient concentrations of pollutants and describe them spatially.

Dispersion modelling for this study was conducted by uMoya-NILU Consulting (Pty) Ltd and followed the requirements of the Code of Practice for Air Dispersion Modelling, DEA guideline (DEA, 2014).

The work modelled the dispersion of sulphur dioxide (SO_2), primary and secondary particulate matter (PM), fugitive emissions and nitrogen dioxide (NO_2) for the Matimba and the Medupi power stations. Dispersion modelling was performed using the CALPUFF suite of models. CALPUFF is a multi-layer, multi-species non-steady-state puff dispersion model that simulates the effects of time and space-varying meteorological conditions on pollution transport, transformation and removal. It includes algorithms for sub-grid scale effects, such as terrain effect, as well as longer range effects, such as pollutant removal due to wet scavenging and dry deposition, chemical transformation, and the formation of secondary particulate matter. The Air Pollution Model (TAPM) was used to model surface and upper air meteorological data for the study domain.

Two types of analysis were performed, individual and cumulative models. Individual station dispersion modelling results had a modelling domain covering 4,356 km^2 where the domain extends 66 km (west-east) by 66 km (north-south) and consists of a uniformly spaced receptor grid with 0.5 km spacing, giving 17,424 grid cells (132 x 132 grid cells). The cumulative station dispersion modelling results had a modelling domain that covers an area of 11,664 km^2, where the domain extends 108 km (west-east) by 108 km (north-south) and consists of a uniformly spaced receptor grid with 1 km spacing, giving 11,664 grid cells (108 x 108 grid cells).

There were two baseline scenarios modelled in CALPUFF that are used in the study. The first one (Scenario 1) represents the current performance of stations based on data over the three year period of 2021 to 2023. The second baseline (Scenario A baseline) took into account the anticipated increase in loads (due to several aspects such as economy requirements, possible delays in IPP projects coming online etc.) in the coming years from 2025 to 2030 and is a better representation of what will be happening in the next five years. Scenario A baseline was used for comparison with the different scenarios in the BCA.

Individual power station models: Five emissions scenarios have been modelled for Matimba and Medupi Power Stations individually. These are (1) Scenario 21-23 Actual (Current Scenario 1 Current actual emissions), (2) Scenario FY25 (Baseline Scenario - Emission based on anticipated loads), (3) ERP 2024 A (Scenario B - 2031 planned stack emissions), and (4) ERP 2024 B (Scenario C - 2036 planned stack emissions), (5) Scenario D (Emissions in Full MES compliance 2036) Emissions sources at Matimba included stacks, coal stockpile and ash dump, while those at Medupi included stacks, coal stockpile, excess coal stockyard and ash dump.

Cumulative impact: The same five emissions scenarios listed above have been modelled for Matimba and Medupi Power Stations to assess the combined effect of these power stations on the ambient air quality.

Isopleth maps of predicted ambient SO_2, NO_2, PM_{10} and $PM_{2.5}$ concentrations are presented in Figure 2-6 to Figure 2-9. The predicted concentrations are shown as isopleths, lines of equal concentration, in µg/m^3 for the respective NAAQS averaging periods. The isopleths are depicted as coloured lines on the maps, corresponding to a particular predicted ambient concentration. Areas within red isopleths indicate an area where exceedances of the respective NAAQS limit value are predicted to occur. Exceedance is only seen for PM_{10} and $PM_{2.5}$ close to the stations. Sensitive receptors are represented by green squares and AQMS are represented by white dots on the maps. (uMoya-NILU, 2024).

National Ambient Air Quality Standards (NAAQS) (DEA, 2009, 2012) apply to the pollutants emitted by stations. The NAAQS consists of a 'limit' value and a permitted frequency of exceedance. The limit value is the fixed concentration level aimed at reducing the harmful effects of a pollutant and the permitted frequency of exceedance represents the acceptable number of exceedances of the limit value expressed as the 99th percentile. Compliance with the ambient standard implies that the frequency of exceedance of the limit value does not exceed the permitted tolerance. The NAAQS limits for the averaging period of 1 year for SO_2 is 50 µg/m^3, for NO_2 is 40 µg/m^3, for PM_{10} is 40 µg/m^3 and for $PM_{2.5}$ is 20 µg/m^3 (from 2030 is 15 µg/m^3).

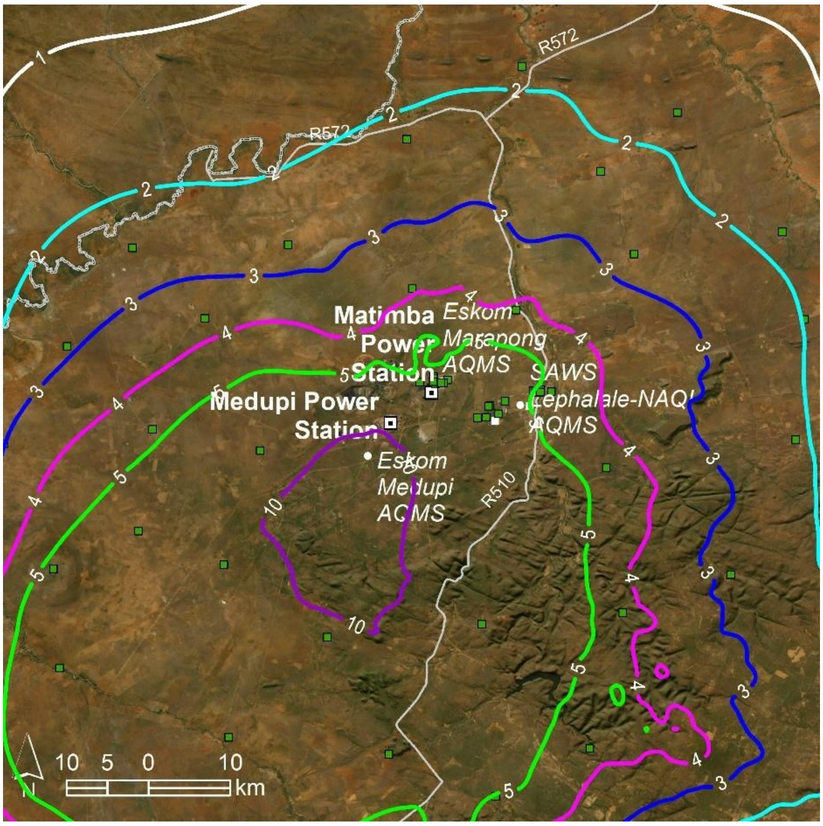


Figure 2-6: Cumulative predicted annual average SO_2 concentrations (µg/m^3) for Matimba and Medupi Power Stations.

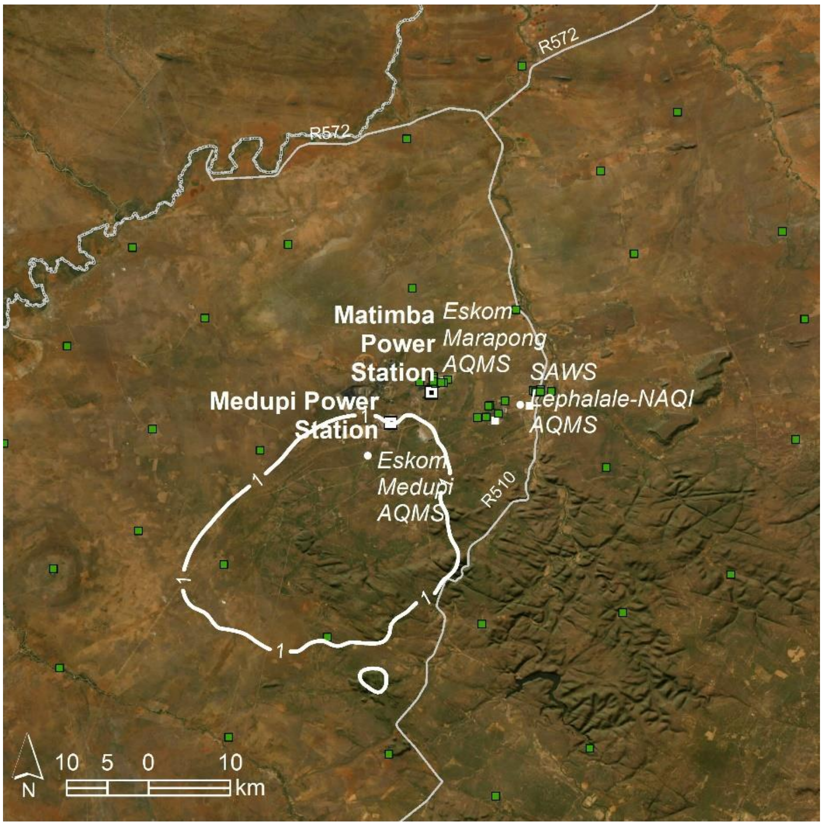


Figure 2-7: Cumulative predicted annual average NO_2 concentrations (µg/m^3) for Matimba and Medupi Power Stations.

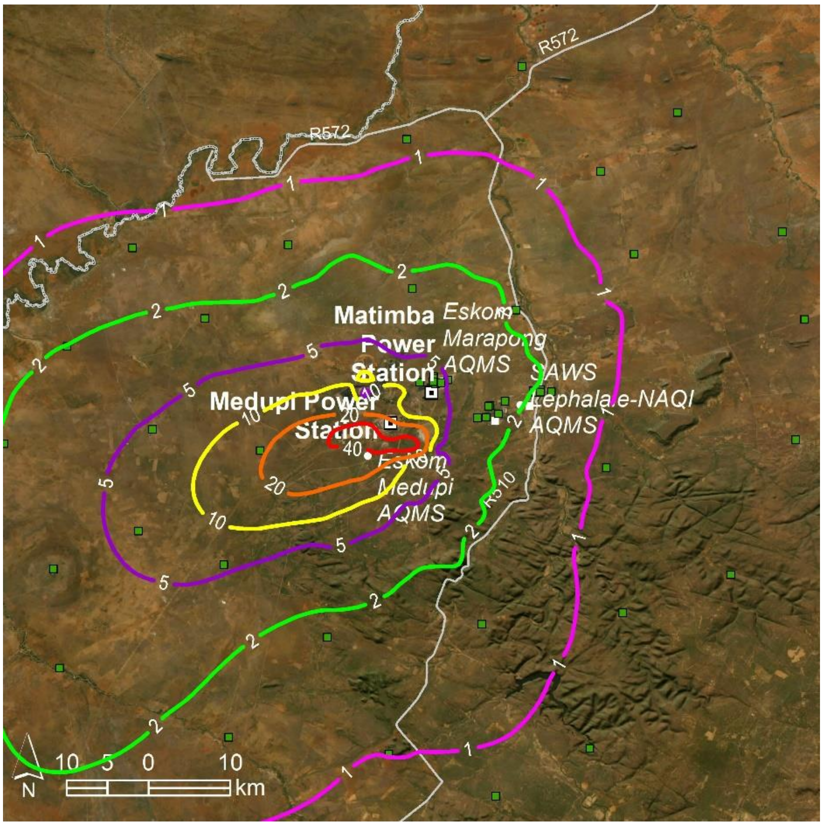


Figure 2-8: Cumulative predicted annual average PM$_{10}$ concentrations (µg/m^3) for Matimba and Medupi Power Stations.

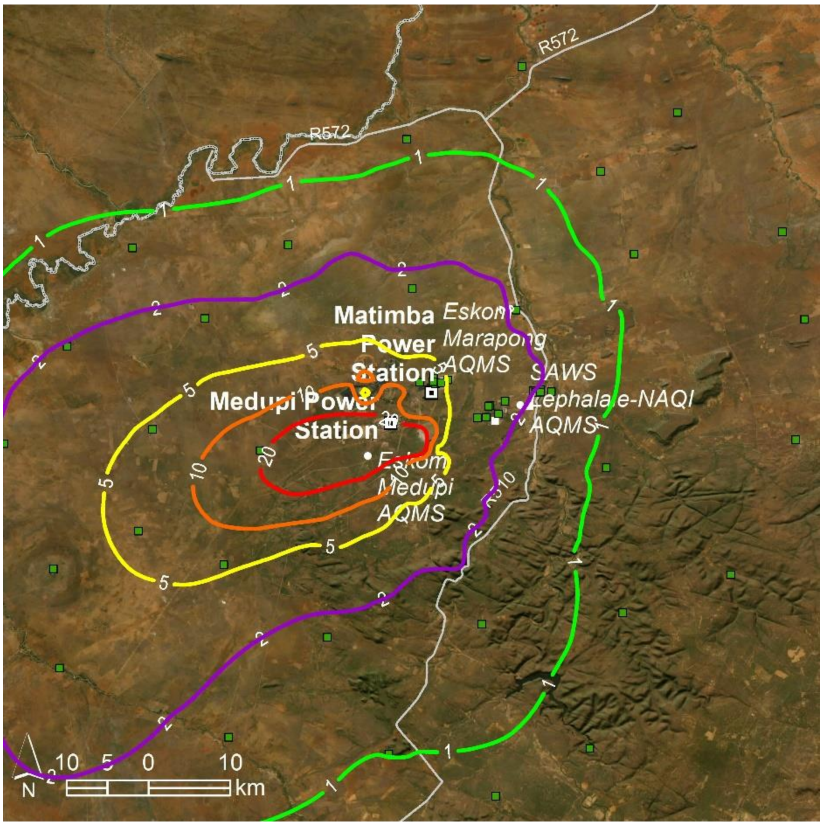


Figure 2-9: Cumulative predicted ambient PM$_{10}$ concentrations (µg/m^3) for Matimba and Medupi Power Stations.

2.2.5 Population exposure

Population exposure was estimated at a spatial resolution of municipality and municipal wards. At each municipality or ward, the number of people exposed to different concentration ranges were determined based on Stats SA population estimates (Stats SA, 2012; Stats SA, 2024a,b) and United Nations population prospects growth forecasts (United Nations, 2024).

Population exposure was estimated at a spatial resolution of municipal wards for the data from the dispersion model runs. At each ward, the number of people exposed to different concentration ranges for each pollutant were determined per scenario per year. A small area of the model falls within Botswana and the number of people exposed within this area was also estimated and included in the model runs. Particulate matter (PM) in the model took the primary and secondary particulate matter into account.

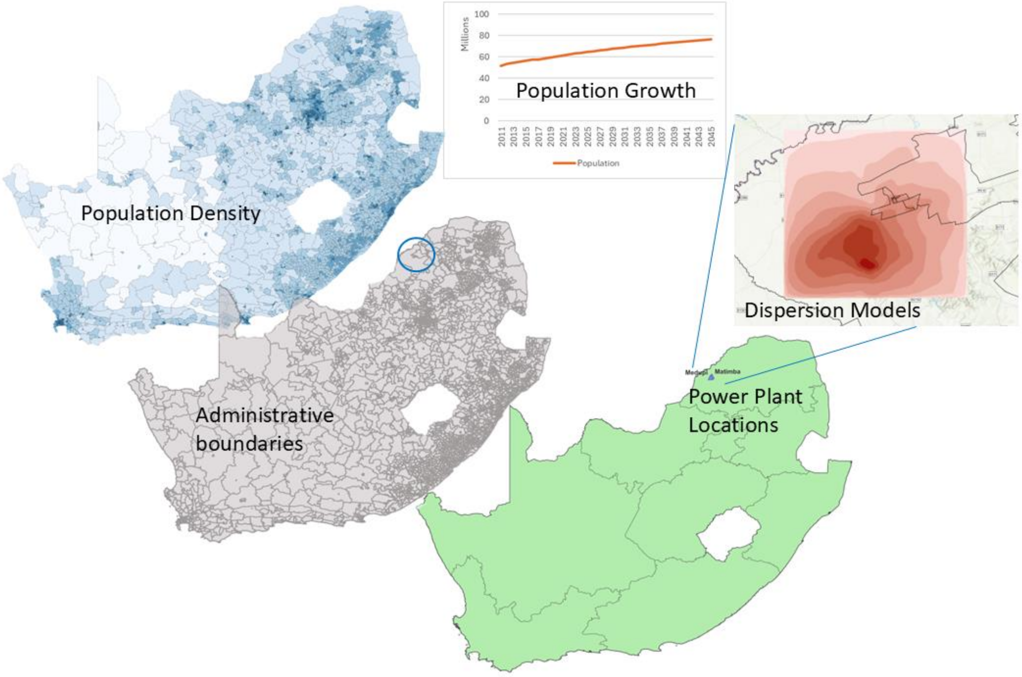


Figure 2-10: Overview of population exposure calculation

The integrated Health BCA model calculated pollution exposure as follows:

- Dispersion Model outputs were used to spatially apportion pollution concentrations. The co-ordinates (x;y) of receptors from the output files were attributed to specific administrative boundaries.
- Administrative boundaries used were municipalities and municipal wards. The predicted ambient concentrations for each pollutant were averaged for the entire spatial unit.
- Population density (population per ward) was obtained from the Census 2011 (Stats SA, 2012), given that the latest Census 2022 metadata which includes ward level numbers has not been released.
- Total population was obtained from the latest available mid-year population estimates (Stats SA, 2024a,b). Population data for Botswana was obtained from

Census/projection-disaggregated gridded Botswana population datasets (Bondarenko et al. 2020).

- Population growth forecasts were used to determine the growth in population exposure over time (United Nations, 2024). This was used to grow the population numbers in each year following 2024 to the end of the modelled timeframe year of 2045.
- Power station locations were used to determine the wards which were affected by each station, to estimate relative impacts of each power station to the cumulative impact modelled.

If one considers current emissions from Matimba and Medupi over the period 2021 to 2023, approximately 125,000 people in the population were exposed to concentration ranges above 1 µg/m^3 (mean annual average) of SO_2 due to the two power stations. Similarly, 81,000 people were exposed to more than an additional 1 µg/m^3 of PM. During this period there were no ambient concentrations of NO_2 exceeding 1 µg/m^3 from the power stations.

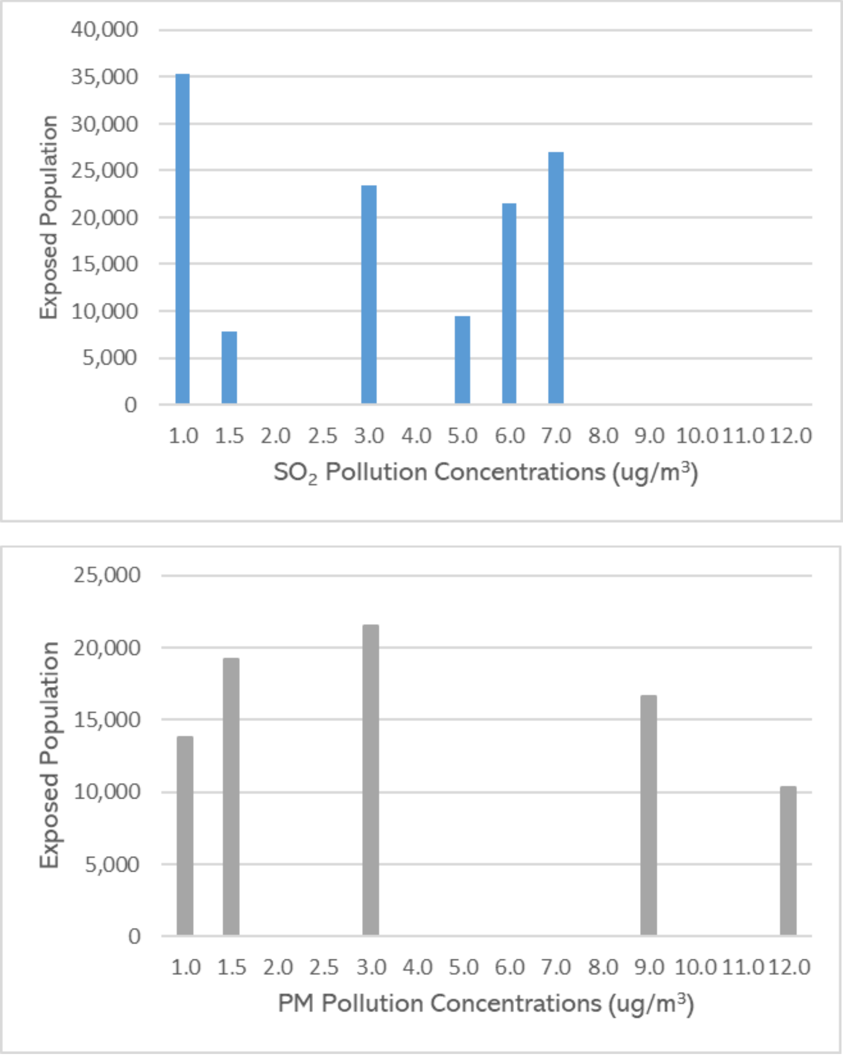


Figure 2-11: Population exposure to SO_2 and PM mean annual average concentration ranges above 1µg/m^3.

2.3 Incremental change in health risk

2.3.1 Health impacts

The WHO (2016a) recommends that the health risk in a population, associated with air pollution, is to be estimated using exposure-response functions (ERFs). ERFs are based on Relative Risk (RR) estimates derived from primary epidemiological studies.

These RR functions estimate the likelihood of health outcomes occurring in a population exposed to a higher level of air pollution relative to that in a population with a lower exposure level (WHO, 2016a). RR is usually expressed as the proportional increase in the assessed health outcome associated with a given increase in pollutant concentrations, measured in µg/m^3. The WHO (2016) notes that "*the RR estimate cannot be assigned to a specific person; it describes risk in a defined population, not individual risk.*"

Epidemiological studies are mostly based on evidence from population health studies that compare health outcome incidences of populations exposed to higher levels of air pollution to populations exposed to lower levels of air pollution. Most of these studies have been done in Europe and North America.

Ideally, ERF studies and their RRs should be determined based on primary epidemiological studies focussing on the exposed population. In the absence of such studies, as in the case of South Africa, the WHO (2016a) recommends using ERFs from other countries.

It is to be noted that there are inherently significant limitations in transferring ERF studies from other countries. Pollution levels, chemical composition and health care systems are typically very different in other settings, and this would affect the accuracy of the ERFs.

The health outcomes were selected based on the latest WHO systematic reviews from 2020 and 2021 that were conducted for the update of the WHO Global Air Quality guidelines. The health outcome considered in this study is all-cause mortality. Morbidity was not considered in this study as comprehensive data on morbidity studies is not widely available. Additionally, there are issues relating the transferability of data from one population to another in terms of country and culture as populations have different sensitivities to pollutant exposure (WHO 2000).

All-cause Mortality: This provides a measure of all the deaths that occur within the population from any natural causes. It includes natural deaths from all causes of death as provided in the WHO (2016b) International statistical classification of diseases and related health problems (ICD-10). In South Africa all-cause mortality makes up 88% of total deaths in South Africa (Stats SA, 2023).

In the AP-HRA, a health outcome must be attributed to an individual indicator pollutant. While health outcomes can be attributed to many different indicator pollutants, using all would result in double counting mixture effects in health impacts as these pollutants are associated with each other (WHO, 2016a, Malmqvist et al., 2018).

Table 2-2: Indicator pollutants, baseline incidence, and relative risks, of each health outcome (Source: WHO systematic reviews by various researchers & baseline incidence – Stats SA 2021)

Indicator Pollutant	Health Outcome	Baseline data	Relative Risk or Hazard Ratio per 10 μg/m³	Reference
$PM_{2.5}$	All-cause Mortality	0.687%	1.08	Chen & Hoek, 2020
PM_{10}	All-cause Mortality	0.687%	1.04	Chen & Hoek, 2020
SO_2	All-cause Mortality	0.687%	1.0059	Orellano et al., 2021
NO_2	All-cause Mortality	0.687%	1.02	Huangfu & Atkinson, 2020

The baseline incidence rates of these health outcomes were determined based on published data from the year 2019 from Stats SA (Stats SA, 2023). The ERFs describing the change in incidence in relation to changes in exposure (RRs) were obtained from the WHO latest systematic reviews for the update of the WHO Global Air Quality guidelines (WHO, 2020, 2021).

2.3.2 Health costs

The detrimental effects of air pollution on human health are borne in the economy by households, insurance companies, employers and public health programs (Romley et al., 2010).

The fundamental goal of health cost or cost of illness (COI) studies is to evaluate the economic burden that illness imposes on society as a whole (Jo, 2014). Rice (1967) and Rice et al. (1985), were instrumental in standardising methodologies for estimating COI, and these methodologies continue to be used internationally, and periodically updated (Rice, 1996; Rice, 2000).

COI studies contextualise adverse diseases effects into monetary terms, with the purpose of informing decision-making. Such decisions could include (a) to simply present the magnitude of disease in monetary terms; (b) to comparatively evaluate intervention programs; (c) to assist in the allocation of research funding on specific diseases; (d) to provide a basis for policy and planning relative to mitigation initiatives; and (e) to provide an economic framework for program evaluation (Rice, 2000).

The COI studies traditionally stratify costs into two categories: direct costs and indirect costs. Direct costs relate to the cost of medical treatment. This would include costs of visiting health care facilities, medicine and hospitalisation. Indirect costs comprise morbidity costs (the cost of lost economic productivity due to absenteeism or temporary or permanent disability) and mortality costs. With respect to mortality costs, valuing human life is contentious, as it can be seen as a judgement on the intrinsic value of life and involves complex ethical considerations. Often, cost-effectiveness analysis is used as an alternative (Muchapondwa, 2009). This side-steps the complexity of life valuation and uses disease or fatality incidence indicators to compare effectiveness of different policy or spending options.

[insert par on direct costs]

The health impact or health risk, associated with air pollution, is estimated using ERFs as described in section 2.3.1 above. In this study, the ERFs obtained from the latest WHO systematic reviews, focussed exclusively on mortality and thus a monetary measure of mortality was required in order to perform benefit-cost analyses. In air pollution benefit-cost analyses, the concept of value per statistical life (VSL) is commonly used to monetise mortality related benefits of air pollution reduction. The concept of a VSL is frequently misunderstood. It does not measure the intrinsic value of a human life, and neither does it value the economic productivity of a human. Rather, VSL is estimated by dividing an individual's willingness to pay (WTP) to reduce health risk, by the likelihood of risk reduction. Robinson and Hammitt (2009) defines VSL to represent the rate at which an individual is willing to exchange their own income for a small reduction in their own mortality risk over a particular time period. VSL is not the value that a person, society or the government would place on reducing the relative risk of mortality with certainty, but it is rather a representation of the rate at which a person views a change in the money available for spending as equivalent to a small change in their own mortality risk (Robinson et al., 2018).

Primary WTP studies for mortality risk reductions have not been done in South Africa. Most countries do not have reliable revealed preference or stated preference estimates of the VSL according to Viscusi and Masterman (2017) and primary research studies require considerable time and expense (Robinson et al., 2018). In these cases a "benefit transfer" method is used to transfer values from other studies. Both the above authors recommend using a United States of America (USA) base VSL (calculated using labour market estimates from their Census of Fatal Occupational Injuries, CFOI, data) and then further adjust it for differences in income between the USA and the country of interest.

The VSL estimate in this study is determined by the following equation ((from Viscusi and Masterman (2017) and Robinson et al. 2018):

$$VSL_{target} = VSL_{base} \times \left(\frac{Income_{target}}{Income_{base}}\right)^{\text{elasticity}}$$

In the above equation the base country is the United States. The VSL is transferred using the income measure of GNI (Gross National Income) per capita from the World Bank which uses the Atlas method which is based on exchange rates and inflation rates.

Data for the US base VSL was obtained from the US Economic Research service and the federal register, the GNI value per capita was sourced from the World Bank. Exchange rates to convert the dollar value of the South African VSL into rands was taken from the annual average exchange rates from the South African Reserve Bank.

A sensitivity analysis was conducted in the BCA based on the recommendations of Robinson et al. 2018. The default values include:

VSL = 160 * GNI per capita of the target country

VSL = 100 * GNI per capita of the target country

VSL extrapolated from USA estimate to target country using an elasticity of 1.5.

Additionally, the sensitivity analysis uses the Masterman and Viscusi (2017) income elasticity of 1.0.

2.3.3 Pollution abatement options

2.3.3.1 Summary

Table 2-3 sets out the detailed abatement options per scenario assessed.

Abatement options include the installation of technologies to reduce emissions. Technologies include Flue Gas Desulphurisation (FGD), Dry Sorbent Injection (DSI), Electrostatic Precipitators (ESP), Low NOx Burners (LNB) and Fabric Filter Plants (FFP). FGD and DSI are used to reduce sulphur dioxide (SO_2) emissions. ESP and FFP are used to reduce particulate matter (PM) emissions, and LNB to reduce nitrogen dioxide (NO_2) emissions. The abatement technologies investigated in the scenarios for this current study in the Waterberg included FGD and Installation of high-frequency power supply (HFPS) to improve ESP efficiency.

The BCA model was setup to compare three different scenarios in terms of abatement technology implementation for the Matimba and Medupi power stations. The dispersion modelling was done for each of these scenarios and the results were used in the BCA model. The model was constructed to allow for a gradual change in pollutant emission concentrations over several years based on the capital and operational expenditure timeframe. This was done to reflect that not all retrofitted units will be operational at the same time. When the abatement technology of all units at a station is operational the model then reflects the compliance emission concentration values related to the specific scenario.

2.3.3.2 Eskom load curtailment strategy

With the proliferation of the alternate energy sources on to the national grid due to the IRP, the existing coal fired power stations are expected to move into a load following mode of operation. This essentially results in lower running load factors for these stations as the renewable energy sources will be given priority over the fossil fuelled stations. This equates to average load factors of 40-45% for stations operating in 2031 and between 40 to 55% for stations operating beyond 2035, i.e. after Matla and Duvha shutdown. The nett effect of this is that less coal will be burnt in the generation of South Africa's electricity which results in direct emissions reduction at no additional cost impact. This is the basis of Eskom's load based alternate emissions limits.

2.3.3.3 Station shutdown

Station lifetimes were described for the two power stations that were modelled. The shutdown, repowering and repurposing dates affect the emissions per year (reduces) in the years that the station units are being shutdown. Only Matimba power station has shutdown, repowering and repurposing dates that fall within the modelling timeframe. The shutdown period for Matimba power station is 2039 to 2043. Medupi will shut down from 2065 to 2071.

Shutdown dates are based on Eskom's present planning and technical requirements, dates are subject to review based on national energy requirements. Eskom will follow all necessary regulator and stakeholder engagement process prior to station shutdown.

2.3.3.4 PM reduction

Abatement technologies considered in the scenarios for PM reduction included Electrostatic Precipitators (ESP) and High Frequency Power Supplies (HFPS) to improve the efficiency of the ESP. An ESP removes particulate matter, from the flue gas using the force of an induced electrostatic charge. ESP upgrades or refurbishments can reduce particulate matter between 95-97%.

2.3.3.5 Flue Gas Desulphurisation (FGD) for SO_2 reduction

FGD is a set of technologies used to reduce SO_2 emissions. FGD systems typically include a fly ash removal and SO_2 removal. SO_2 (an acid gas) removal is facilitated by alkaline sorbents such as limestone to react with the gas. FGDs are typically separated into two types, semi-dry and wet, dependent on their water requirements, and can reduce SO_2 emissions by 90%. Based on coal qualities and station characteristics Eskom considers wet FGD suitable for Medupi and semi-dry FGD suitable for Matimba.

Table 2-3: Detail Summary Table of Scenarios (Source: Eskom)

Scenario	Abatement and additional information
Eskom plan - ERP 2024 A (Scenario B)	Predicted monthly tonnage emitted per stack in 2031 assuming: a. All planned PM emission reduction projects completed. Matimba PM upgrade ensures station continues to operate at PM=50 mg/Nm^3. b. NOx projects completed with Matimba, and Medupi at 750 mg/Nm^3. c. Medupi FGD constructed between 2028 and 2032. Medupi operates at SO_2 = 500 mg/Nm^3 to reduce total SO_2 load. AEL limit is 1,000 mg/Nm^3. d. Efficiency and coal improvement projects reduce total emissions by 5% at Matimba and Medupi. e. Load factor restricted to an average value per station per year (see Appendix A) h. This scenario is similar to the existing Eskom Emission Reduction Plan 2022.
Eskom plan - ERP 2024 B (Scenario C)	Predicted monthly tonnage emitted per stack in 2036 assuming: a. Efficiency and coal improvement projects reduce total sulphur and carbon emissions by 5% for Matimba and Medupi, b. Medupi FGD completed in 2032 Medupi operates at SO_2 = 500 mg/Nm^3 to reduce total SO_2 load. AEL limit is 1,000 mg/Nm^3 c. Load factor restricted to an average value per station per year (see Appendix A)
Full MES compliance – ERP 2024 C (Scenario D)	Predicted monthly tonnage emitted per stack in 2036 assuming: a. Both Matimba and Medupi as per the CDS (Rev 4) shut down schedule. b. All planned PM emission reduction projects completed (by 2028), and stations operate at PM=50 mg/Nm^3. c. Matimba FGD constructed between 2031 and 2036. d. Load factor restricted to an average value per station per year (see Appendix A)

2.3.4 Costs of implementation

Table 2-4: Summary of costs of implementation of abatement for the Waterberg power stations: costs of CAPEX and OPEX and estimated impacts on electricity tariffs

	Scenario	CAPEX and OPEX (Rand million Nominal)	Impact on Electricity Tariff (c/kWh)		Impact on Electricity Tariff (%)	
		-15% +20%	Lower	Upper	Lower	Upper
	ERP 2024 A - Other	1,400	0.036	0.051	0.02	0.03
+	ERP 2024 A – Medupi FGD	57,260	1.07	1.52	0.58	0.82
Sub-total	ERP 2024 A (WRP Sc B)	58,660	1.11	1.57	0.60	0.85
	ERP 2024 B	0	0.00	0.00	0.00	0.00
Sub-total	ERP 2024 B	58,660	1.11	1.57	0.60	0.85
+	ERP 2024 C – Matimba FGD	43,010	0.52	0.73	0.28	0.40
Total	ERP 2024 C	101,670	1.63	2.30	0.88	1.24

The total nominal cost of all Eskom abatement scenarios has been estimated by Eskom at a Class 2 accuracy implying a variance between -15% and +20%:

- ERP 2024 A = R58,660 million
- ERP 2024 B = R58,660 million
- ERP 2024 C = R101,670 million.
- Source: Eskom

We estimated the effect of these additional costs on electricity tariffs. This was based on a cashflow waterfall model set up for each scenario, solving for a tariff that would pay back the cost of abatement technology over the assessment period. This tariff margin may be thought of as an air emissions abatement levy:

- ERP 2024 A = 0.6% - 0.9%
- ERP 2024 B = 0.6% - 0.9%
- ERP 2024 C = 0.9% - 1.2%.
- Note: It is to be noted that these electricity impact tariffs were not sourced by Eskom but were estimated using the method described above.

2.4 Benefit-cost Analysis

A BCA is a widely used approach employed for decision-making support. This approach was formalized in the United States in 1958 with the purpose of justifying public expenditures on alternative investment options competing public funds such as water, roads, and other public utilities' networks construction projects. BCA methodology broadly advises on the treatment of income benefits and costs; externality costs; how to measure them conceptually; how future prices should be treated; the importance of using a discount rate; the proper period of analysis; and cost allocation procedures for projects.

The World Bank[2] defines a Social BCA as an extension of a financial analysis. Ideally, in extending the financial analysis, all relevant economic costs and benefits are quantified and analysed. The BCA pulls together the component analyses of the study to assess the overall impact for a set of scenario options (emission reduction measures).

The objective of the BCA is to comparatively analyse investments or scenarios (in this case interventions in air quality management). The BCA achieves this end by identifying and monetizing the costs and benefits and predicting the timing thereof over the same horizon as the projects' economic lifetime (National Treasury, 2017).

A BCA allows scenarios to be objectively compared according to the benefit:cost relationship to analyse the relative efficiency of various interventions and the magnitude of the benefits to identify the interventions that will have the largest impacts.

In this analysis, the BCA compares the scenario health benefits to capital and operational costs of abatement. This BCA does not capture all potential costs and benefits, both direct and indirect. (Refer to section 2.5.1 below for a discussion of BCA limitations.)

The analysis timeline spans 2024 – 2045. The base year was 2024, due to dispersion modelling timeframe. The BCA was performed in an Excel spreadsheet, which consolidated all data sources, which contains all calculations, to run the large spatial exposure estimates for each scenario for the review period. The benefit-cost analysis apportioned costs (capital and operation expenditure on abatement technologies) and benefits (health benefits) to the years in which they would be realised. Because costs and benefits are accrued in different years according to the intervention schedules, the net present values of costs and benefits, using Eskom's weighted average cost of capital (WACC) rate of 10.8% (Eskom, 2024) as the discount rate allows an objective comparison of scenarios.

The health cost benefits were estimated based on the outputs of the AP-HRA and followed the steps below (Section 3.2 provides the BCA results).

1. Each of the assessed Scenarios implemented an abatement schedule at the two power stations (refer to section 3 for details)
2. The dispersion effects modelled by uMoya-NILU (Pty) Ltd were used to estimate the change in population exposure over the timeline.

---

[2] http://documents.worldbank.org/curated/en/445971468767366310/pdf/multi-page.pdf

3. The change in population exposure resulting from step 2 above was applied to the ERFs identified in section 2.3.1 to estimate health impact outcomes (sensitivity analysis was performed in the BCA to develop a view on the uncertainty inherent in the ERFs, also refer to section 2.5.1)
4. The VSL (refer to section 2.3.2) was applied to the health impact outcomes for each scenario, to estimate change in health cost benefits.
5. Capital and operational cost estimates were used as the costs in the BCA (refer to section 2.3.4).
6. Sensitivity analysis was performed on the VSL, the health benefit and abatement cost estimates.

2.5 Uncertainty of the estimated health effects

2.5.1 Sources of uncertainty and limitations

The WHO (2016a) advises performing an assessment of the uncertainty of the analysis; in this case therefore this requires an assessment related to a lack of knowledge about one or more components of the integrated Health BCA Model. The sections below discuss each source of uncertainty and related limitations.

Air pollutants exist as a complex mixture: Despite improvements in the science underlying AP-HRAs, it is still not possible to estimate with complete certainty the effects of air pollution on health (WHO Regional Office for Europe, 2014 cited in WHO, 2016a). The observed adverse effects attributed to an individual air pollutant may well be (partly) attributable to other pollutants in the mixture which are correlated with the assessed pollutant (WHO Regional Office for Europe, 2013 cited in WHO 2016a). It is not possible to assess the uncertainty relating to this (WHO, 2016a).

Pollutants modelled: The analysis was limited to SO_2, $PM_{2.5}$ and NO_2 pollutants, , these are the criteria pollutants managed in terms of South African air quality legislation and of most recognised significance in the Priority Area. Other pollutants may also contribute to health risk and these were not modelled in the dispersion modelling. This may under-estimate health risks and thus benefits of health risk mitigation. However, no data or other information exists through which to assess this limitation.

Exposure response functions: ERFs are derived from epidemiological studies, in which the parameters of the epidemiological experiment and assumptions made during the experiment introduce some uncertainty into the results. More significantly, because primary epidemiological evidence on air pollution is not available for South Africa. This is a key limitation. As a result, inference has to be drawn from studies in other parts of the world. It is to be noted that health response per unit change in air pollution in environments with high ambient levels (such as the HPA) may differ from that observed in countries with lower pollution levels. In summary, the WHO (2016a) notes that extrapolated ERF information may not accurately describe the exposure-response relationship in the region to be assessed, leading to uncertainties in the results. In order to deal with these uncertainties, we used variances in ERF outcomes as a measure of BCA ratio variation.

Dispersion model accuracy (uMoya-Nilu, 2024): “Air quality models attempt to predict ambient concentrations based on “known” or measured parameters, such as wind speed, temperature profiles, solar radiation and emissions. There are, however, variations in the parameters that are not measured, the so-called “unknown” parameters as well as unresolved details of atmospheric turbulent flow. Variations in these “unknown” parameters can result in deviations of the predicted concentrations of the same event, even though the “known” parameters are fixed. In the present dispersion modelling conservative assumptions in terms of surface area of ashing facilities giving rise to fugitive emissions were made that have resulted in an over prediction of PM emissions in shorter time periods. Furthermore, for $PM_{2.5}$ and PM_{10} the predicted concentrations are attributed to stack emissions and low-level fugitive sources (ash dump). The inclusion of the fugitive sources was done assuming the entire area is exposed and available for entrainment, while in reality only a small portion of the modelled area would be exposed to entrainment due to the vegetated sides and wet areas of the dump. This approach is extremely conservative. The PM emissions from stacks and fugitive sources are not speciated into PM_{10} and $PM_{2.5}$, rather all PM emitted is assumed to be PM_{10}, and all PM emitted is assumed to be $PM_{2.5}$.

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

Baseline disease burden: The baseline cases of mortality used were for 2019, based on latest available Stats SA data. The data for this year is therefore accurate. Stats SA data for 2020 was not used as these numbers may be skewed by the effects of COVID. Uncertainty arises however because projections are made of population size growth in future, under the assumption that the relative ratio of mortality in the future remain constant.

Morbidity effects were not assessed: The costs of medical treatment (including visiting health care facilities, and costs of medicine and hospitalisation) and the loss of economic production due to sick-leave absenteeism or temporary or permanent disability, were not assessed. This is because of an absence of official data on health care visits and associated direct costs within both the public and private health care sectors; linked to suitable ERFs. As a result, the BCA underestimates the health benefits of the various scenarios. As before, within the BCA, this uncertainty remains constant across all scenarios and thus enables inter-scenario evaluation.

Value of a statistical life: VSLs are accurate when estimated based on primary data collected through willingness to pay studies specific to the exposed population. All VSL estimates for South Africa are derived and transferred from studies done in the United States of America. This introduces uncertainty in the BCA results. As before, within the BCA, this uncertainty remains constant across all scenarios and thus enables inter-scenario evaluation.

Timeline of dispersion modelling predicted concentrations: The data from the dispersion modelling in CALPUFF is from a specific point in time and is then interpolated for the timeline values that are required to run a benefit:cost analysis. Ideally the BCA model should have a CALPUFF run for each year used in the model timeline, however, to do this is not practical. This causes uncertainties in the results.

Cost uncertainty: Eskom uses a cost estimate classification matrix which has different estimate classes associated with different expected accuracy ranges for making project cost estimations (Eskom, 2020). Based on these classes the sensitivity analysis for costs estimates varied by +20% or -15% (Class 2). Eskom is constantly working to refine the accuracy of the emission reduction costing and this may result in internal updates of costing. Anticipated changes in cost are anticipated to fall within the range of variance (-15% and +20%).

The BCA does not capture economic externalities. These include both benefits and costs. The benefits of reduced health risk on households, employers and the health care and insurance industries were not assessed. The costs of implementation of abatement technologies would put additional pressure on Eskom capital (and debt) requirements, and further on electricity price escalations. These would result in additional economic costs, and these were not assessed. Furthermore, the economic benefits and costs of transitioning from coal to alternatives were not assessed. A full electricity system modelling exercise was not completed as part of the Eskom exemption application process given time constraints. Capacity assessments undertaken indicate that attempting to install SO_2 reduction technologies simultaneously on Eskom stations will result in significant electricity supply shortfalls. These capacity shortfalls would need to be addressed by other generation sources, if these are available, which may have additional cost implications. If the capacity is not available then the country would be forced to endure further periods of load shedding with resultant economic, social and environmental impacts.

As above, within the BCA, this uncertainty remains constant across all scenarios and thus enables inter-scenario evaluation

Level of acceptable risk not quantified: The health benefits assessed are the total health benefits associated with all reductions in modelled ambient air quality as a result of abatement technology. It is to be noted however that the MES implies a level of acceptable health risk, and the quantum of the health costs associated with this level of acceptable risk were not assessed in the BCA.

2.5.2 Dealing with the uncertainties and limitations in the assessment of results

Several important considerations exist when interpreting the results of the integrated Health BCA.

Interpretation of premature mortality has to be done with care. It is to be noted firstly that these numbers are indicators of health risk at a population level. The relative risk estimate inherent in the ERF is a metric of the likelihood of an adverse health outcome, and it cannot be attributed to an individual person. It can thus be used to quantify risk to a defined population (and not to an individual), (WHO 2016) and how this risk would vary between various policy options of scenarios.

The various sources of uncertainty discussed above, affect the accuracy of the absolute values of the assessments. In the absence of primary ERF studies, it is not possible to judge the accuracy of the absolute values of the assessment with a high level of confidence. However, this report uses ranges to reflect uncertainty.

In spite of the various sources of uncertainty discussed above, the analysis still provides valuable insights into the comparison of scenarios tested in the BCA. This is because the uncertainty inherent in the analysis remains constant across all scenarios.

The description of uncertainty sources also serves as a basis for further work to be prioritised in improving future integrated Health BCAs.

3 RESULTS AND DICUSSION

3.1 Scenarios

Three scenarios were evaluated in this study (against a baseline of anticipated emissions 2025 - 2030). A brief description is provided in the sub-sections below and the detailed summary table (see Table 2-3).

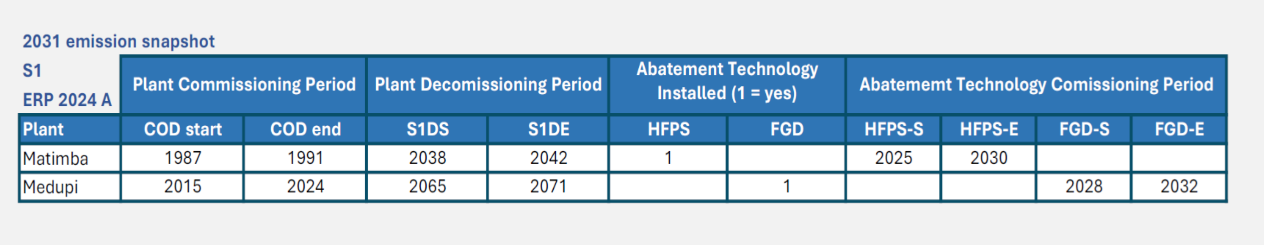
3.1.1 ERP 2024 A

This scenario represents the Eskom ERP 2024 A plan. The scenario is similar to the existing Eskom Emission Reduction Plan (ERP) 2022. Abatement projects for emission reduction included in this scenario comprised of PM projects at Matimba and SO_2 projects at Medupi (see Table 2-3 for detailed information).

In this scenario it is additionally assumed:

- Medupi will operate at SO_2 500 mg/Nm^3 instead of the AEL limit of 1000 mg/Nm^3 to reduce total SO_2 emission load into the atmosphere
- Total emissions are reduced by 5% at Matimba and Medupi through efficiency and coal improvement projects.
- See Appendix A for load factors at the stations.

The commissioning and shutdown periods, and abatement technology installation schedules used in the BCA for this scenario are shown in Figure 3-1.



2031 emission snapshot

S1 ERP 2024 A	Plant Commissioning Period		Plant Decomissioning Period		Abatement Technology Installed (1 = yes)		Abatememt Technology Comissioning Period			
Plant	COD start	COD end	S1DS	S1DE	HFPS	FGD	HFPS-S	HFPS-E	FGD-S	FGD-E
Matimba	1987	1991	2038	2042	1		2025	2030		
Medupi	2015	2024	2065	2071		1			2028	2032

Figure 3-1: ERP 2024 A power plant commissioning and shutdown periods, and abatement technology installation schedules. An S-suffix denotes the start of an activity, and the E-suffix denotes the end of the activity. Abatement technologies are assumed to run as units are retrofitted from commissioning date to continue until the shutdown, repowering and repurposing date of the power plant.

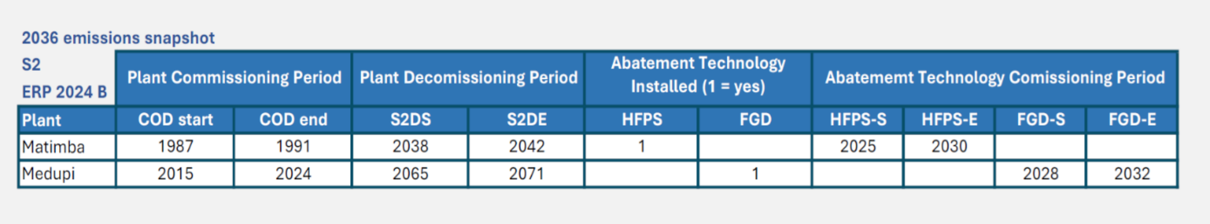
3.1.2 ERP 2024 B

This scenario represents the Eskom ERP 2024 B plan. Abatement projects for emission reduction included in this scenario comprised of PM projects at Matimba and SO_2 projects at Medupi (see Table 2-3 for detailed information).

In this scenario it is additionally assumed:

- Efficiency and coal improvement projects reduce total sulphur and carbon emissions by 5% for Matimba and Medupi.

The commissioning and shutdown periods, and abatement technology installation schedules used in the BCA for this scenario are shown in Figure 3-2.



2036 emissions snapshot

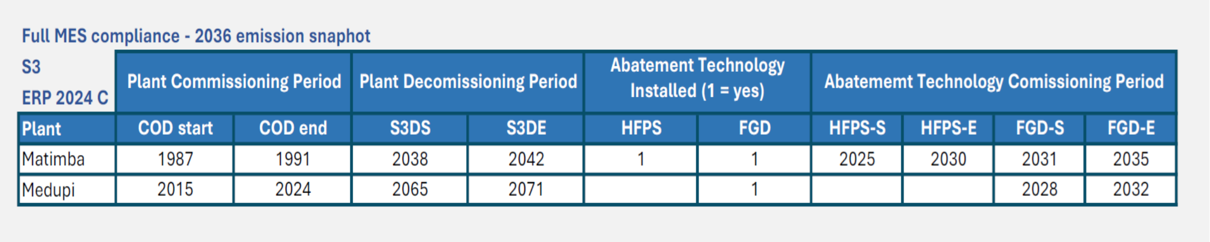
S2 ERP 2024 B	Plant Commissioning Period		Plant Decomissioning Period		Abatement Technology Installed (1 = yes)		Abatememt Technology Comissioning Period			
Plant	**COD start**	**COD end**	**S2DS**	**S2DE**	**HFPS**	**FGD**	**HFPS-S**	**HFPS-E**	**FGD-S**	**FGD-E**
Matimba	1987	1991	2038	2042	1		2025	2030		
Medupi	2015	2024	2065	2071		1			2028	2032

Figure 3-2: ERP 2024 B power plant commissioning and shutdown periods, and abatement technology installation schedules. An S-suffix denotes the start of an activity, and the E-suffix denotes the end of the activity. Abatement technologies are assumed to run as units are retrofitted from commissioning date to continue until the shutdown, repowering and repurposing date of the power plant.

3.1.3 ERP 2024 C

This scenario represents the Eskom ERP 2024 C plan. In 2036 the operating stations will operate according to the Consistent Data Set (CDS) (Rev4) shut down schedule. Matimba will shut down in the period from 2039 to 2043. Abatement projects for emission reduction included in this scenario are comprised of PM projects and SO_2 projects (completed by 2035) (see Table 2-3 for detailed information).

The commissioning and shutdown periods, and abatement technology installation schedules used in the BCA for this scenario are shown in Figure 3-3.



Full MES compliance - 2036 emission snaphot

S3 ERP 2024 C	Plant Commissioning Period		Plant Decomissioning Period		Abatement Technology Installed (1 = yes)		Abatememt Technology Comissioning Period			
Plant	**COD start**	**COD end**	**S3DS**	**S3DE**	**HFPS**	**FGD**	**HFPS-S**	**HFPS-E**	**FGD-S**	**FGD-E**
Matimba	1987	1991	2038	2042	1	1	2025	2030	2031	2035
Medupi	2015	2024	2065	2071		1			2028	2032

Figure 3-3: ERP 2024 C power station commissioning and shutdown periods, and abatement technology installation schedules. An S-suffix denotes the start of an activity, and the E-suffix denotes the end of the activity. Abatement technologies are assumed to run as units are retrofitted from commissioning date to continue until the shutdown, repowering and repurposing date of the power station.

3.2 Summary

In 2024, approximately 157,000 people are exposed to air pollution from the two power stations modelled, that fall within the modelling domain. The mean additional annual average exposure to air pollution of the population within this domain, resulting from coal-fired power station emissions, was estimated by averaging dispersion modelling results over municipal boundaries. Approximately 145,000 people were exposed to more than an additional 1 µg.m^3 (mean annual average) of SO_2.in the modelled area. Similarly, 81,000 and 48,000 people, were exposed to more than an additional 1 µg.m^3 of PM and NO_2 and respectively.

Health benefits associated with each scenario were calculated against the baseline that took into account the anticipated increase in loads in the coming years from 2025 to 2030 and assumed no abatement technologies installed and both stations would continue to emit air pollution at their current rates until shutdown, repowering and repurposing.

The health benefits over time are summarised in Figure 3-4:

- The health benefits of ERP 2024 A deliver immediate impact from 2024. At Medupi Wet FGD is commissioned from 2028 to 2032. Both stations already operate at NOx = 750 mg/Nm^3. Medupi already has Fabric Filter Plant (FFP) for PM reduction. Matimba station is equipped with ESP + HPPS for optimisation of PM reduction. These increase the associated health benefits until 2039. Hereafter the associated health benefits reduce as Matimba shutdown, repowering and repurposing is between 2039 and 2043. Medupi station shutdown, repowering and repurposing is much later from 2065 and the health benefits from the Wet FGD continue until final closure of the station.
- The health benefits of ERP 2024 B include those as discussed for ERP 2024 A above. In addition, efficiency and coal improvement projects reduce total sulphur and carbon emissions by 5% for Medupi and Matimba from 2024 onwards.
- The health benefits of ERP 2024 C include those as discussed for ERP 2024 A and B above. Semi-dry FGD is installed at Matimba by 2035, however the associated health benefits are effectively negated as Matimba starts to shut down in 2039.

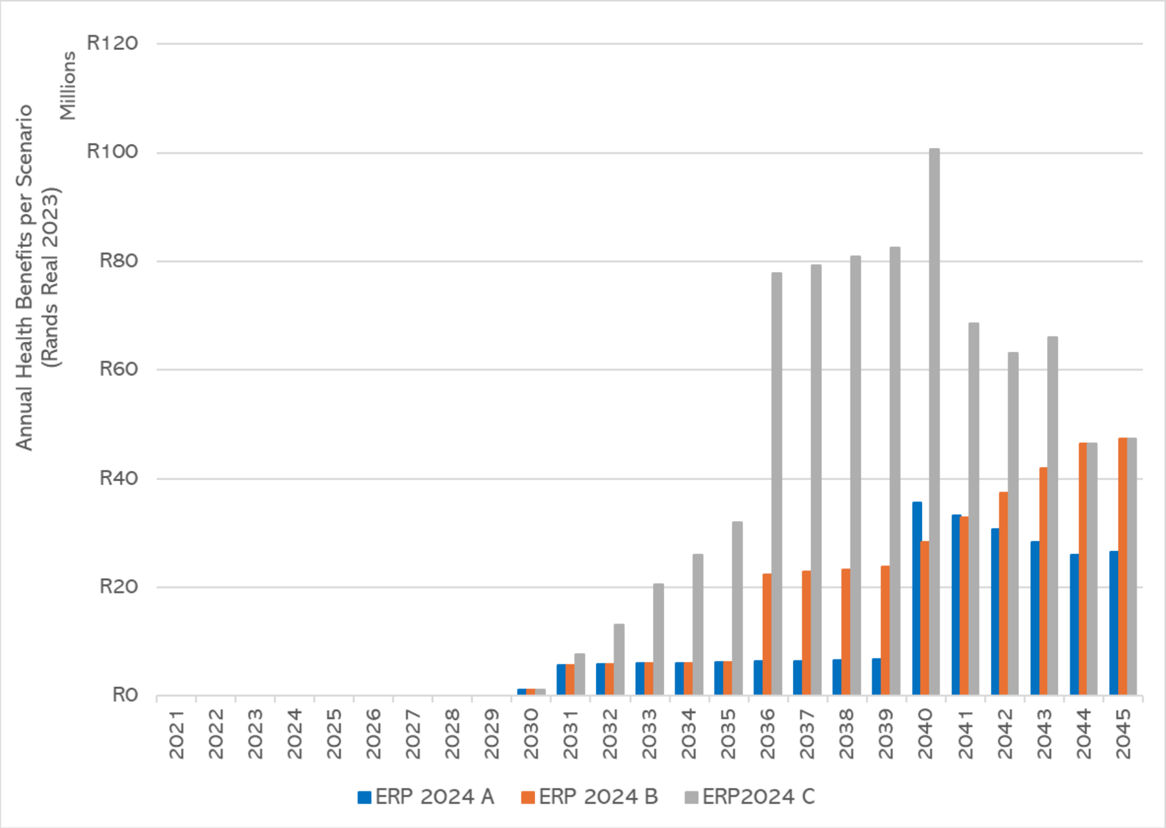


Figure 3-4: Annual health benefits per scenario illustrating the timeline of cumulative health benefits

The **abatement costs** associated with each scenario are set out in Figure 3-5 below:

- The total Capex and Opex costs of abatement are identical to 2024.
- ERP 2024 A implementation starts in 2025 with Matimba ESP + HFPS and in 2028 with Medupi, Wet FGD installation. After 2032 only operational costs continue at Medupi.
- ERP 2024 B is the same as ERP 2024 A discussed above.
- ERP 2024 C is the same as described for ERP 2024 A and B. In addition, implementation starts in 2031 with Matimba semi-dry FGD. The Capex costs decrease after 2032 as Medupi Wet FGD is fully installed and only the Capex of the Matimba semi-dry FGD remains until 2035 whereafter only operational costs remain. After closure of Matimba in 2043 only Medupi continues to operate.

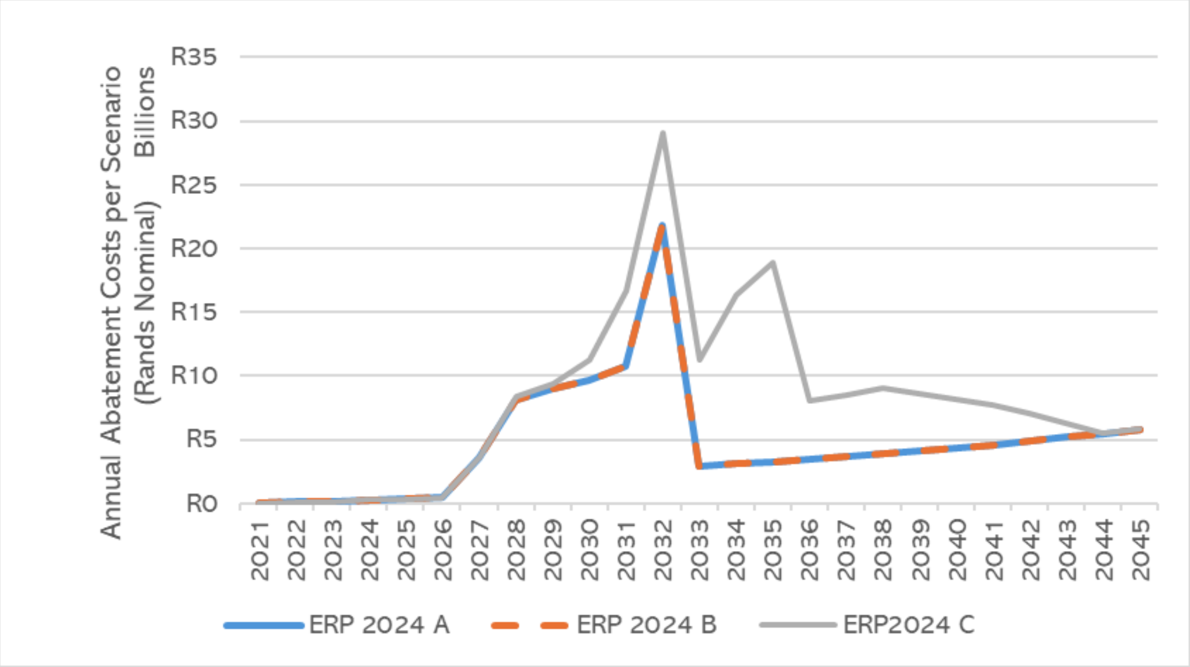


Figure 3-5: Total abatement costs (CAPEX and OPEX) associated with each scenario's abatement retrofits

Scenarios were compared in a benefit-cost analysis. The benefit-cost analysis apportioned costs (capital and operation expenditure on abatement technologies) and benefits (health benefits) to the years in which they would be realised. Because costs and benefits are accrued in different years according to the intervention schedules, the net present values of costs and benefits, used Eskom's weighted average cost of capital (WACC) rate of 10.8% as the discount rate (Eskom, 2024), and additional sensitivity analysis testing using a social discount rate of 2% (Stern, 2006) allowing for an objective comparison of scenarios.

The BCA ratios need to be interpreted with care. They are meant only to provide a perspective on and to inform the decision-making process underlying the scenarios. They are not meant to be interpreted as a definitive answer to making abatement decisions. Decisions involving human health must be informed by non-economic criteria as well. In addition, with uncertainty inherent in the analysis, the cost benefit ratio should thus not be viewed as absolute, but rather as a relative value from which to compare scenarios.

The **BCA results** are provided in Table 3-1. In the upper estimates the lower costs and higher VSL are used and in the lower estimates the higher costs and lower VSL are used as recommended by Robinson et al. 2018.

- The BCA central ratio of ERP 2024 A is significantly less than 1, indicating that costs of abatement far exceed the health benefits. This ratio remains below 1 even in the most optimistic (upper) parameters of the sensitivity analysis. The reasons for this include the implementation of FGDs at Medupi in conjunction with the small population that benefits. This scenario has a total nominal cost of R58,660 million and is likely to increase electricity tariffs by 0.6% - 0.9% in ERP 2024 A.

- The BCA ratio of ERP 2024 B is also significantly less than 1, indicating that costs of abatement far exceed the health benefits. This ratio remains below 1 even in the most optimistic (upper) parameters of the sensitivity analysis. The same reasons apply as for ERP 2024 A above. This scenario has a total nominal cost of R58,660 million and is likely to increase electricity tariffs by 0.6% - 0.9% as in ERP 2024 A.
- The BCA ratio of ERP 2024 C is also significantly less than 1, indicating that costs of abatement far exceed the health benefits. This ratio remains below 1 even in the most optimistic (upper) parameters of the sensitivity analysis. This scenario has a larger discrepancy in NPV of health benefits and NPV of costs due to implementation of FGDs at both Medupi and Matimba and the small population that benefits. This scenario has a total nominal cost of R101,670 million and is likely to increase electricity tariffs by 0.9% - 1.2% in ERP 2024 C.
- Evaluation of the BCA ratios at a social discount rate of 2% delivers similar results, with all three scenarios ratios remaining less than 1.

Table 3-1: BCA ratios (lower and upper ranges) for each scenario (discounted at Eskom WACC)

	ERP 2024 A		**ERP 2024 B**		**ERP 2024 C**	
Million Rands	*Lower*	*Upper*	*Lower*	*Upper*	*Lower*	*Upper*
NPV of Costs	-18,970	-13,437	-18,970	-13,437	-27,716	-19,632
NPV of Benefits	3	17	8	39	16	83
NPV of Benefits minus Costs	-18,967	-13,420	-18,962	-13,398	-27,700	-19,549
Benefit:Cost Ratio (*range*)	0.0002	0.0012	0.0004	0.0029	0.0006	0.0042
Benefit:Cost Ratio (*central*)	0.0007		0.0017		0.0024	

In the analyses above the benefits from closure form part of the baseline.

The cumulative health benefits over time of the baseline:

- The power stations planned shutdown schedule (Section 2.3.3 for the years in which this occurs) results in health benefits without associated abatement costs. These benefits are dependent on timing of the shutdown schedule.
- In order to contextualize the three scenarios that were analysed with respect to the baseline Figure 3-7, Figure 3-8 and Figure 3-9 show how each scenario contributes to cumulative health benefits over time. The green area in the figures illustrates the health benefit of Matimba shutdown compared to the baseline, as the station shuts down the population exposed to pollution decreases and the health benefits increase. The blue, orange and grey areas indicating the health benefits of the ERP scenarios described above. The figures illustrate that effectiveness of station shutdown in decreasing health impact and increasing health benefits.

- The health benefits from the respective scenarios contribute an additional 1.5 – 7.6 times the health benefits of the baseline (estimated on a net present value basis).
- The Figures below are shown in Real 2023 Rand terms to better demonstrate in 2023 terms, the relative benefit for scenarios ERP 2024 A, B and C and Matimba closure.

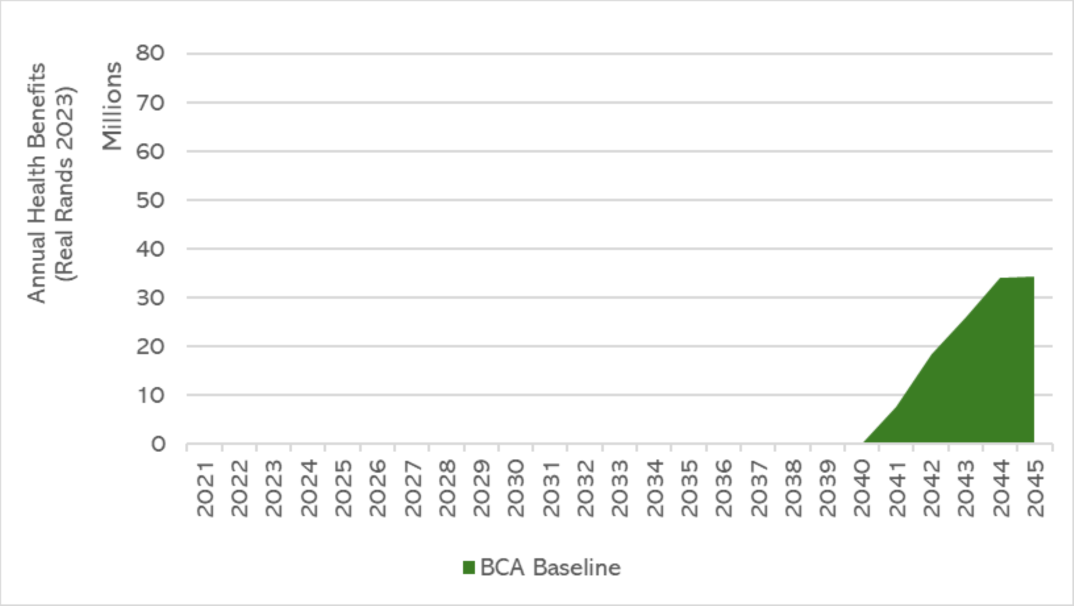


Figure 3-6: Cumulative annual health benefits in the baseline with planned power station shutdown of Matimba

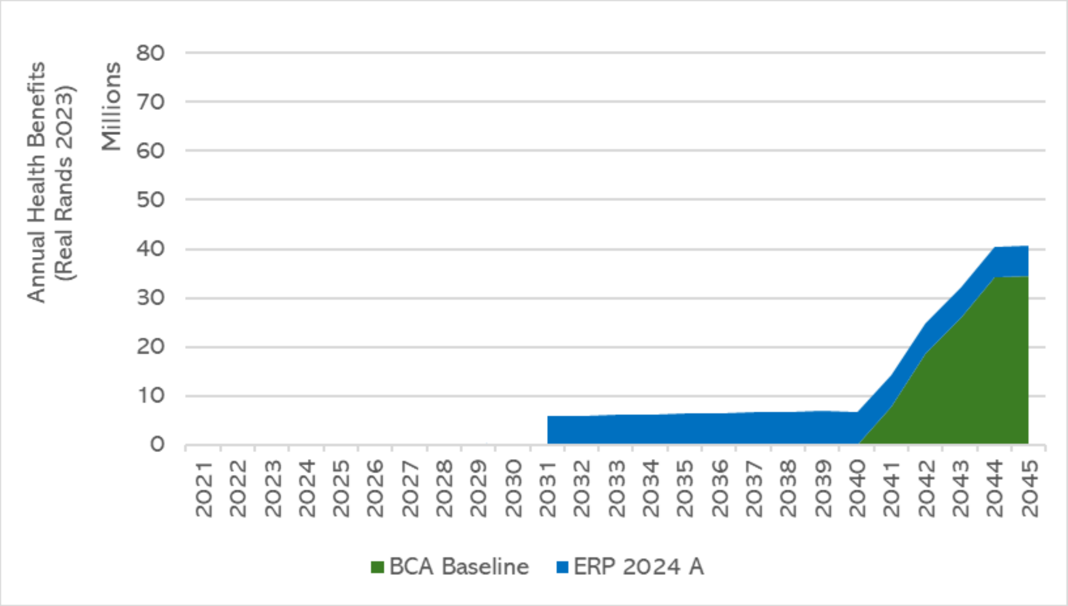


Figure 3-7: Cumulative health benefits of ERP 2024 A over the baseline

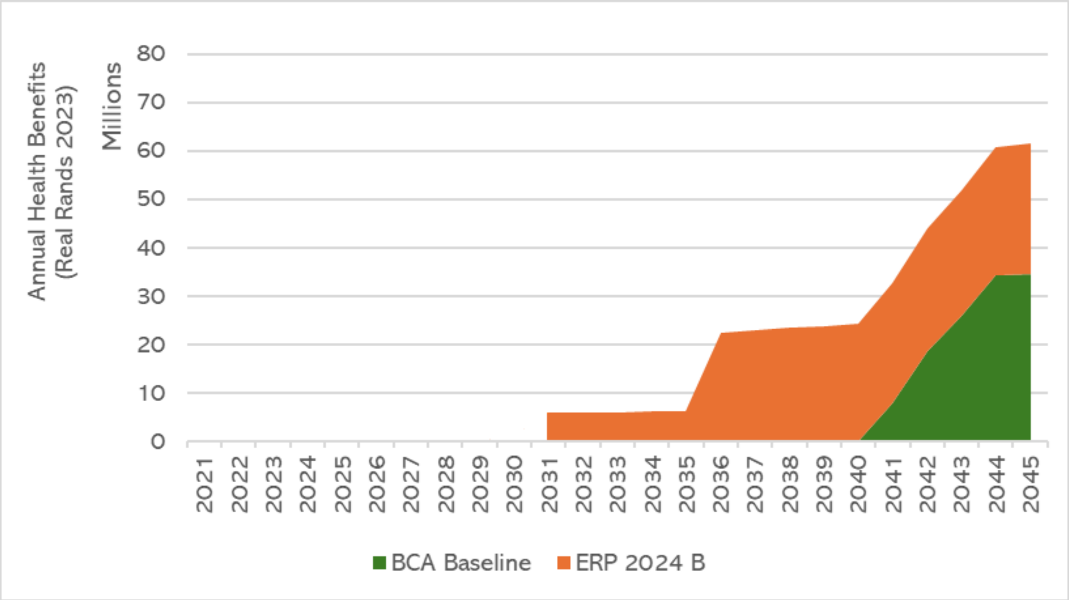


Figure 3-8: Cumulative health benefits of ERP 2024 B over the baseline

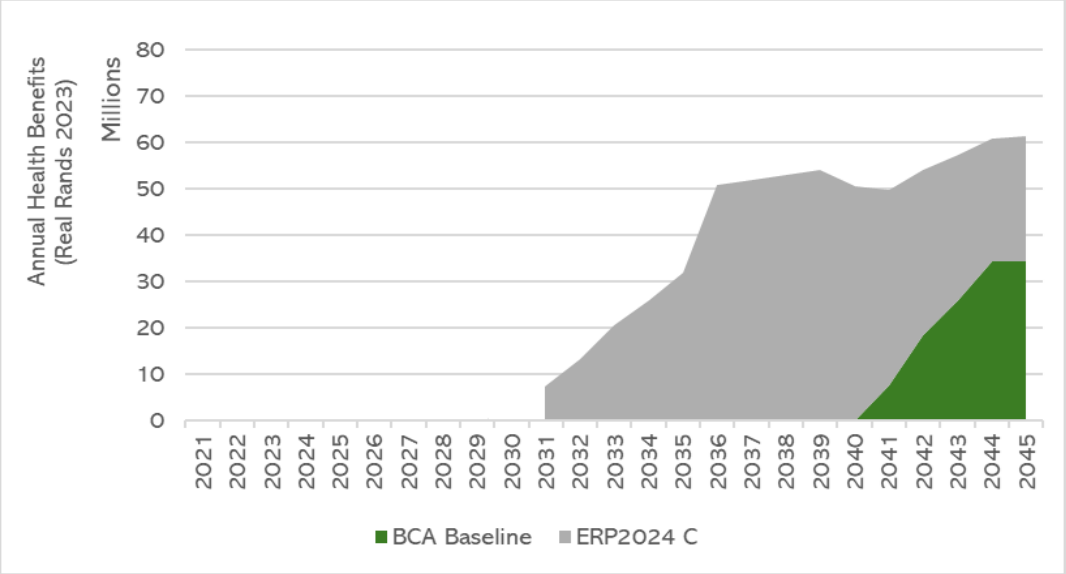


Figure 3-9: Cumulative health benefits of ERP 2024 C over the baseline

4 REFERENCES

Bondarenko M., Kerr D., Sorichetta A., and Tatem, A.J. (2020): Census/projection-disaggregated gridded population datasets, adjusted to match the corresponding UNPD 2020 estimates, for 51 countries across sub-Saharan Africa using building footprints. WorldPop, University of Southampton, UK. doi:10.5258/SOTON/WP00683.

Chen, J. and Hoek, G. (2020): Long-term exposure to PM and all-cause and cause-specific mortality: A systematic review and meta-analysis. *Environmental International*, 143 (2020) 105974.

DEA, Department of Environmental Affairs (2009): National Ambient Air Quality Standards, Government Gazette, 32861, Vol. 1210, 24 December 2009.

DEA, Department of Environmental Affairs (2012): National Ambient Air Quality Standard for Particulate Matter of Aerodynamic Diameter less than 2.5 micron metres, Notice 486, 29 June 2012, Government Gazette, 35463.

DEA, Department of Environmental Affairs (2014): Code of Practice for Air Dispersion Modelling in Air Quality Management in South Africa, Government Notice R.533, Government Gazette, no. 37804, 11 July 2014.

DEA, Department of Environmental Affairs (2018)a: DEA Matimba MES Postponement Decision, Reference LP/ES-MT/WDM/20170825, 10 September 2018.

DEA, Department of Environmental Affairs (2018)b: DEA Medupi MES Postponement Decision, Reference LP/ES-ME/WDM/20170825, 10 September 2018.

Dios, M.; Souto, J.A.; Casares, J.J.; Gallego, N.; Sáez, A.; Macho, M.L.; Cartelle, D.; Vellón, J.M. (2012): A mixed top-down and bottom-up methodology in spatial segregation of emissions based on GIS tools. 20th International Conference on Modelling, Monitoring and Management of Air Pollution, 16–18 May 2012, A Coruña, Spain.

Eskom (2023): Eskom Integrated Report 31 March (2023): https://www.eskom.co.za/wp-content/uploads/2023/10/Eskom_integrated_report_2023.pdf.

Eskom (2024): Eskom Multi-Year Price Determination (MYPD) 6 Revenue Application for FY2026 – FY2028 Submission to NERSA. https://www.eskom.co.za/wp-content/uploads/2024/09/1-MYPD6-Summary_NERSA-Submission_20240807.pdf.

FIRS, Forum of International Respiratory Societies (2017): The Global Impact of Respiratory Disease – Second Edition. Sheffield, European Respiratory Society. http://www.who.int/gard/publications/The_Global_Impact_of_Respiratory_Disease.pdf.

FRIDGE, Fund for Research into Industrial Development Growth and Equity (2004): Study to examine the potential socio-economic impact of measures to reduce air pollution from combustion. http://www.idc.co.za/FRIDGE.asp.

Holland, M. (2017): Health impacts of coal fired power plants in South Africa. Centre for Environmental Rights. https://cer.org.za/wp-content/uploads/2017/04/Annexure-Health-impacts-of-coal-fired-generation-in-South-Africa-310317.pdf.

Huangfu, P. and Atkinson, R. (2020): Long-term exposure to NO_2 and O_3 and all-cause and respiratory mortality: A systematic review and meta-analysis. *Environmental International*, 144 (2020) 105998.

Integrated Environmental Health Impact Assessment System. (2015): Guidance System: Exposure-Response Functions. http://www.integrated-assessment.eu/guidebook/exposure_response_functions.

Jo, C. (2014): Cost-of-illness studies: concepts, scopes, and methods*. Clinical Molecular Hepatology*, 20(4): 327–337.

Malmqvist, E., Oudin, A., Pascal, M. and Medina, S. (2018): Choices Behind Numbers: A Review of the Major Air Pollution Health Impact Assessments in Europe. *Curr Environ Health Rep* 5(1):34-43.

Muchapondwa, A. (2009): A cost-effectiveness analysis of options for reducing pollution in Khayelitsha township, South Africa. North West University. https://repository.nwu.ac.za/bitstream/handle/10394/6900/transd_v6_n2_a4.pdf?sequence=1

Myllyvirta, L. (2014): Health impacts and social costs of Eskom's proposed non-compliance with South Africa's air emission standards. Greenpeace. www.greenpeace.org/africa/Global/africa/publications/Health%20impacts%20of%20Eskom%20applications%202014%20_final.pdf.

Myllyvirta, L. and Kelly, J. (2023): Health impacts of Eskom's non-compliance with minimum emissions standards. https://dx.doi.org/10.1021/acs.est.7b01148.

National Treasury (2017): Guideline on budget submissions for large strategic infrastructure proposals. Budget Facility for Infrastructure: 2018 Budget Cycle.

Orellano, P., Reynoso, J. and Quaranta, N. (2021): Short-term exposure to sulphur dioxide (SO_2) and all-cause and respiratory mortality: A systematic review and meta-analysis. *Environmental International*, 150 (2021) 106434.

Rice, D.P. (1967): Estimating the cost of illness. *American Journal of Public Health Nations Health*, 57(3): 424–440.

Rice, D. P.; Hodgson, T. A.; Kopstein, A. N. (1985): The Economic Cost of Illness: A Replication and Update. *Health Care Financing Review*, 6: 61-80.

Rice, D.P. (1996): Health Economics Series No 6. Washington: U. S. Government Printing Office; Estimating the Cost of Illness. PHS Pub. No. 947-6.

Rice, D.P. (2000): Cost of illness studies: what is good about them? *Injury Prevention*,6:177–179.

Robinson, L.A. and Hammitt J.K. (2009): The Value of Reducing Air Pollution Risks in Sub-Saharan Africa. The World Bank Sub-Saharan Africa Refinery Study Contract Number: 7147247. http://www.regulatory-analysis.com/robinson-hammitt-air-pollution-africa.pdf.

Robinson, L.A.; Hammitt, J.K.; O'Keeffe, L. (2018): Valuing Mortality Risk Reductions in Global Benefit-Cost Analysis. Guidelines for Benefit-Cost Analysis Project Working Paper No. 7, Harvard.

https://cdn2.sph.harvard.edu/wp-content/uploads/sites/94/2017/01/Robinson-Hammitt-OKeeffe-VSL.2018.03.23.pdf.

Romley, J.A.; Hackbarth, A; Goldman, D.P. (2010): The impact of air quality on hospital spending. RAND Health. ISBN 978-0-8330-4929-2

Sahu, R. (2013): Technical Report on Dry Sorbent Injection (DSI) and Its Applicability to TVA's Shawnee Fossil Plant (SHF). Commissioned by the Southern Alliance for Clean Energy. https://cleanenergy.org/wp-content/uploads/Final_Sahu_DSI_Report.pdf.

Sahu, R. (2019): Comments on the series of Applications for Suspension of the Minimum Emissions Standards (MES) Compliance Timeframes for Various Eskom Coal-Fired Power Plants. https://cer.org.za/wp-content/uploads/2019/02/Annexure-1.pdf.

Spalding-Fecher, R. and Matibe, D. K. (2003): Electricity and externalities in South Africa. *Energy Policy*, 31 (8): 721-734.

Stats SA. (2012): Census 2011 Statistical release – P0301.4 / Statistics South Africa. Pretoria: Statistics South Africa. https://www.Stats SA.gov.za/publications/P03014/P030142011.pdf.

Stats SA. (2023): Mortality and causes of death in South Africa: Findings from death notification 2019. Release P0309.3 https://www.statssa.gov.za/publications/P03093/P030932019.pdf.

Stats SA. (2024a): Mid-year population estimates 2024 – P0302/ Statistics South Africa. Pretoria: Statistics South Africa. https://www.statssa.gov.za/publications/P03093/P030932020.pdf.

Stats SA. (2024b): Country projection by population group, sex and age (2020-2024). https://www.statssa.gov.za/?page_id=1854&PPN=P0302&SCH=73952.

Stern, N. (2006): The Stern Review on the Economics of Climate Change. HM Treasury, UK. https://assets.cambridge.org/97805217/00801/frontmatter/9780521700801_frontmatter.pdf

United Nations (UN) (2024): World Population Prospects: The 2024 Revision. UN Department of Economic and Social Affairs, Population Division. Online: https://population.un.org/wpp/DataQuery/.

uMoya-NILU (2024): Atmospheric Impact Report in Support of the Application for Exemption from the Minimum Emission Standards for Lethabo Power Station, Report No.: uMN215-24, October 2024.

Van Horen, C. (1996): Counting the social costs: electricity and externalities in South Africa. University of Cape Town Press, 1996.

Viscusi, W.K and Masterman, J. (2017): Income Elasticities and Global Values of a Statistical Life. J. Benefit Cost Anal. 2017; 8(2):226–250.

World Health Organisation (2000): Quantification of the Health Effects of Exposure to Air Pollution Report of a WHO Working Group. https://www.euro.who.int/__data/assets/pdf_file/0011/112160/E74256.pdf

World Health Organisation (2009): Environmental Burden of Disease. South Africa. https://cdn.who.int/media/docs/default-source/environmental-health-impacts/gbd-country-profiles/south-africa.pdf http://www.who.int/quantifying_ehimpacts/national/countryprofile/en/.

World Health Organisation. (2014): WHO Expert Meeting: Methods and tools for assessing the health risks of air pollution at local, national and international level. Meeting report Bonn, Germany, 12-13 May 2014. Available: http://www.euro.who.int/pubrequest.

World Health Organisation (2016a): Health risk assessment of air pollution – general principles. Copenhagen: WHO Regional Office for Europe; 2016.

World Health Organisation (2016b): International Statistical Classification of Diseases and Related Health Problems 10th Revision. http://apps.who.int/classifications/icd10/browse/2016/en.

World Health Organisation (2021): WHO global air quality guidelines. Particulate matter ($PM_{2.5}$ and PM_{10}), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide. Geneva: World Health Organization; 2021. License: CC BY-NC-SA 3.0 IGO.

5 APPENDIX A

The estimated calculated load factors for each station in the Waterberg:

Station	Medupi	Matimba
2025	81%	74%
2026	69%	57%
2027	60%	54%
2028	59%	55%
2029	54%	50%
2030	53%	49%
2031	64%	48%
2032	65%	49%
2033	68%	52%
2034	71%	51%
2035	70%	53%
2036	73%	55%
2037	76%	57%
2038	84%	61%
2039	88%	59%
2040	90%	39%
2041	95%	30%
2042	92%	17%
2043	93%	0%
2044	92%	0%
2045	94%	0%
2046	99%	0%
2047	97%	0%
2048	96%	0%
2049	97%	0%
2050	95%	0%

Building 1, Maxwell Office Park
Magwa Crescent West, Waterfall City
Midrand, 1685
South Africa

wsp.com