BUFFALO CITY METROPOLITAN MUNICIPALITY

AIR QUALITY MANAGEMENT PLAN

DRAFT

30 JULY 2018

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DRAFT

PROJECT NO.: 41100595
DATE: JULY 2018

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QUALITY MANAGEMENT

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1 INTRODUCTION

Section 24 of the Constitution states that 'Everyone has the right to an environment that is not harmful to their health and well-being' and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.' The Constitution further places an obligation in terms of section 152(1)(b) and (d) on the part of Local Government as stipulated in sections 4(2)(d) and 4(2)(i), 73(1) and (2) of the Municipal Systems Act 32 of 2000 to ensure that the right to a clean and health environment is fulfilled.

The National Environmental Management: Air Quality Act 39 of 2004 (AQA) requires Municipalities to introduce Air Quality Management Plans (AQMP) that set out what will be done to achieve the prescribed air quality standards. After five years, the AQMP must be reviewed, the goals realigned and a revised AQMP should be developed. As part of their legal obligation, Buffalo City Metropolitan Municipality (BCMM) have appointed WSP Environmental (Pty) Ltd to review and update their existing AQMP which was first developed in 2012. An AQMP describes the current state of air quality in an area, how it is changing over time and what can be done to ensure clean air is achieved and maintained. An AQMP provides objectives and sets a course of action to attain air quality management goals. It identifies and addresses significant sources of impact using appropriate solutions to ensure that health effects and environmental impacts are minimised.

The BCMM is situated on the east coast of the Eastern Cape Province. It includes the towns of East London, Bisho and King William's Town, as well as the large townships of Mdantsane and Zweltisha. The area has a well-developed manufacturing base, with the auto industry playing a major role. Mercedes-Benz SA, based in East London, is one of the largest foreign investors in South Africa. Although Buffalo City's economy is relatively small, it is the second largest metropolitan municipality in the Eastern Cape, contributing 1.6% to the South African economy and 20.9% to the Eastern Cape's economy. The prominent economic sectors are community services, finance, manufacturing, trade and transport. Agriculture, mining and quarrying are insignificant in the Metro's economy.

1.1 PURPOSE

Chapter 3 of the National Environmental Management: Air Quality Act 39 of 2004 (NEM:AQA) tasks all South African Municipalities with the development and implementation of an AQMP as part their Integrated Development Plan (IDP). Where applicable, the AQMP must:

- Improve air quality;
- Identify and reduce the negative impact on human health and the environment of poor air quality;
- Address the effects of emissions from the use of fossil fuels in residential applications;
- Address the effects of emissions from industrial sources;
- Address the effects of emissions from any point or non-point source of air pollution
- Implement the Republic's obligations in respect of international agreements;
- Give effect to best practice in air quality management; and
- Describe how the relevant National Department, Province or Municipality will give effect to its Air Quality Management Plan.

The National Framework for Air Quality Management in the Republic of South Africa in terms of section 7(5) of AQA provides guidance to meet the objectives of the AQA (DEA, 2013). The National Framework provides norms and standards for all technical aspects of air quality management. Air Quality Management Plans are outlined in Chapter 5 of the National Framework with guidance for the development and implementation of AQMP's provided in the Manual for Air Quality Management Planning (DEA, 2012).

The main objective of the project is to review the Air Quality Management Plan developed for the BCMM as per the requirements of the Air Quality Act of 2004. The development of the AQMP for the BCMM follows the approach as outlined in the Manual for Air Quality Management Planning (DEA, 2012). The development and implementation of the AQMP is a dynamic process involving the following steps (**Figure 1-1**):

— Establish stakeholder groups and the baseline air quality;
— Undertake a gap and problem analysis;
— Develop air quality vision and goals;
— Develop an implementation plan (intervention strategies)
— Implementation of the intervention strategies;
— Monitoring, reporting and evaluation.

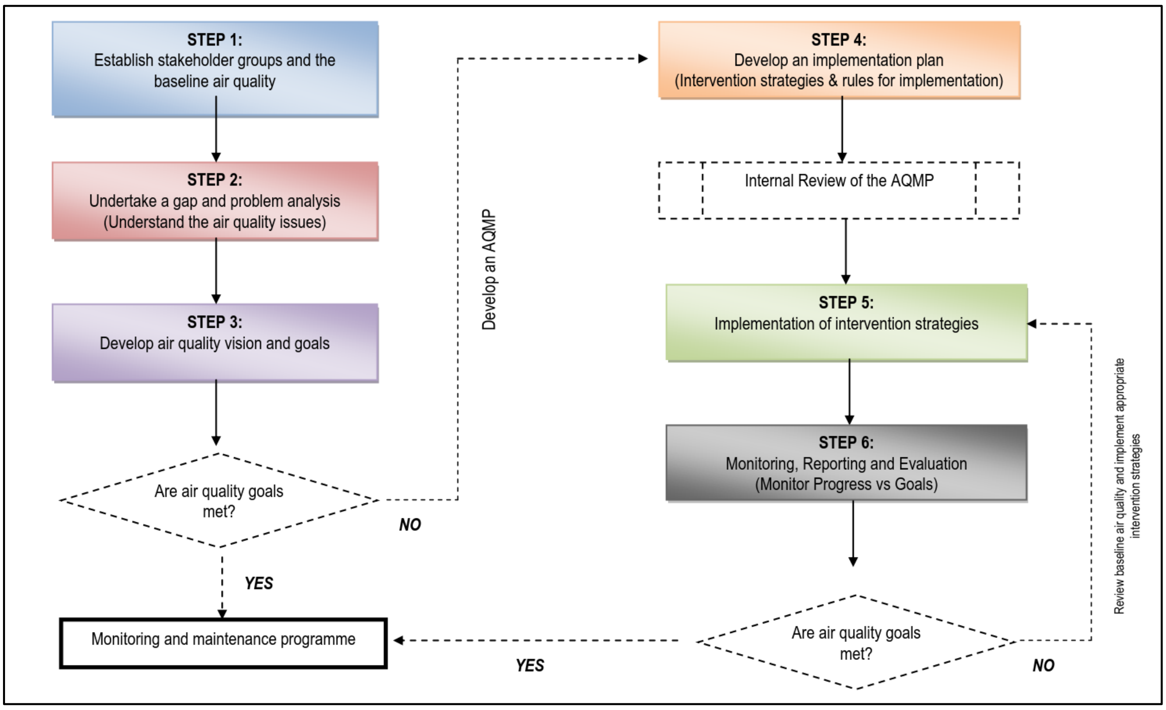

Figure 1-1: Generic process flow for the development of an Air Quality Management Plan (DEA, 2012b).

The review of the BCMM AQMP will be undertaken in the following phases:

— A *Baseline Assessment and Status Quo Assessment* to determine the prevailing meteorological conditions, existing ambient air quality situation and contributing air pollution sources. The current capacity for air quality management;
— A *Gap Analysis* which will identify information gaps, capacity issues and air quality problems requiring intervention;
— Review of the existing *Air Quality Vision and Goals*;
— Recommendations for practical and implementable *Implementation Strategies* to address emissions from identified air pollution sources; and
— Development of an *Air Quality Management Plan* for the Buffalo City Metropolitan Municipality following input and consultation with stakeholder groups.

2 REGULATORY FRAMEWORK

2.1 NATIONAL ENVIRONMENTAL MANAGEMENT: AIR QUALITY ACT 39 OF 2004

The National Environmental Management: Air Quality Act 39 of 2004 (NEM:AQA), which repeals the Atmospheric Pollution Prevention Act (APP) of 1965, came into effect on 11 September 2005, with the promulgation of regulations in terms of certain sections resulting in the APPA being repealed entirely on 1 April 2010. The Air Quality Act has shifted the approach of air quality management from source-based control to receptor-based control. The main objectives of the Act are to:

1. Give effect to everyone's right 'to an environment that is not harmful to their health and well-being'
2. Protect the environment by providing reasonable legislative and other measures that:
   - Prevent pollution and ecological degradation;
   - Promote conservation; and
   - Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

Significant functions detailed in NEM:AQA include:

3. The National Framework for Air Quality Management;
4. Institutional planning matters, including:
   - The establishment of a National Air Quality Advisory Committee;
   - The appointment of Air Quality Officers (AQOs) at each level of government; and
   - The development, implementation and reporting of AQMPs at national, provincial and municipal levels;

and;

5. Air quality management measures including:
   - The declaration of Priority Areas where ambient air quality standards are being, or may be, exceeded;
   - The listing of activities that result in atmospheric emissions and which have the potential to impact negatively on the environment and the licensing thereof through an Atmospheric Emissions License (AEL);
   - The declaration of Controlled Emitters;
   - The declaration of Controlled Fuels;
   - Procedures to enforce Pollution Prevention Plans or Atmospheric Impact Reporting for the control and inventory of atmospheric pollutants of concern; and
   - Requirements for addressing dust and offensive odours.

A summary of the functions and responsibilities of National, Provincial and Local Government, as informed by the Air Quality Act and the National Framework for Air Quality Management in the Republic of South Africa, are given in **Table 2-1**.

Table 2-1: Air quality responsibilities and functions of National, Provincial and Local Government.

National Government	Provincial Government	Local Government
Establish and review National Framework	None	None
Identify National priority pollutants	Identify Provincial priority pollutants	Identify priority pollutants (in terms of its by-laws)
Establish National air quality standards	Establish Provincial air quality standards	Establish Local air quality standards (more stringent)
Establish National emission standards	Establish Provincial emission standards	Establish Local emission standards
Appoint National Air Quality Officer	Appoint Provincial Air Quality Officer	Appoint Air Quality Officer
Prepare a National AQMP as a component of their EIP	Prepare a Provincial AQMP as a component of their EIP	Develop an AQMP as part of their IDPs
Execute overarching auditing function to ensure that adequate air quality monitoring occurs	Ambient air quality monitoring	Ambient air quality monitoring
Declare National priority areas	Declare Provincial priority areas	None
Prepare National priority areas AQMP	Prepare Provincial priority areas AQMP	None
Prepare an annual report regarding the implementation of the AQMP	Prepare an annual report regarding the implementation of the AQMP	Prepare an annual report regarding the implementation of the AQMP
Prescribe regulations for implementing and enforcing the priority area AQMP	Prescribe regulations for implementing and enforcing the priority area AQMP	None
List activities	List activities	None
None	Perform emission licensing authority functions	Perform emission licensing authority functions
Declare controlled emitters	Declare controlled emitters	None
Declare and set requirements for controlled fuels	Declare and set requirements for controlled fuels	None
Set requirements for pollution prevention plans	Establish a programme of public recognition of significant achievement in air pollution prevention	None
Prescribe measures for the control of dust, noise and odours	Prescribe measures for the control of dust, noise and odours	None
Investigate and regulate transboundary pollution	None	None
Investigate potential international agreement contraventions	None	None

2.2 LEGISLATION FOR LOCAL GOVERNMENT

The Local Government: Municipal Systems Act 32 of 2000, together with the Municipal Structures Act, establish local government as an autonomous sphere of government with specific powers and functions as defined by the Constitution. Section 155 of the Constitution provides for the establishment of Category A, B and C municipalities which each has different levels of municipal executive and legislative authorities. According to Section 156(1) of the Constitution, a municipality has the executive authority in respect of, and has the right to, administer the local government matters (listed in Part B of Schedule 4 and Part B of Schedule 5) that deal with air pollution. Section 156(2) makes provision for a Municipality to make and administer by-laws for the effective administration of any matters which it has the right to administer as long as it does not conflict with National or Provincial legislation.

The Municipal Systems Act as read with the Municipal Financial Management Act requires Municipalities to budget for and provide proper atmospheric environmental services. In terms of the National Health Act 61 of 2003, Municipalities are expected to appoint a health officer who is required to investigate any state of affairs that may lead to a contravention of Section 24(a) of the Constitution. Section 42(a) states that each person has the right to an environment that is not harmful to their health or well-being.

The Promotion of Access to Information Act 2 of 2000, in conjunction with Section 32 of the Constitution, entitles everyone to the right of access to any information held by government and private individuals. The relevance of the right to information is that government, industry and private individuals can be compelled, through court proceedings if required, to make information available regarding the state of the atmosphere and pollution. The Promotion of Administrative Justice Act 3 of 2000 which was introduced by the State to give effect to Section 33 of the Constitution provides everyone with the right to administrative action that is lawful, reasonable and procedurally fair and the right to be given written reasons when rights have been adversely affected by administrative action.

2.2.1 LOCAL AIR QUALITY BY-LAWS

Section 156(2) of the Constitution of the Republic of South Africa makes provision for a Local Municipality to make and administer by-laws for the effective administration of the matters which it has the right to administer so long as such by-laws do not conflict with National or Provincial legislation. The Buffalo City Metropolitan Municipality has a published Noise and Environmental Health By-Law (2010). However, this by-law does not address air pollution within the BCMM.

2.3 NATIONAL AMBIENT AIR QUALITY STANDARDS

Ambient air quality standards are defined as those *"targets for air quality management which establish the permissible concentration of a particular substance in, or property of, discharges to air, based on what a particular receiving environment can tolerate without significant deterioration"*[1]. The aim of ambient air quality standards is to provide a benchmark for air quality management and governance. South Africa's National Ambient Air Quality Standards (NAAQS), as shown in **Table 2-2**, are used to:

— Define whether ambient air is harmful to health and wellbeing;
— Inform decisions on appropriate development specific to an area;
— Measure air quality management performance; and
— Provide a basis for initiating government intervention.

[1] Department of Environmental Affairs (2000): *Integrated Pollution and Waste Management Policy for South Africa.* Government Gazette (No. R 227 of 2000), 17 March 2000 (No. 20978)

Table 2-2: National Ambient Air Quality Standards.

Pollutant	Averaging Period	Concentration (µg/m^3)	Frequency of Exceedence	Compliance Date
Particulate Matter (PM_{10})	24 hours	120	4	Immediate – 31 Dec 2014
		75	4	01 Jan 2015
	1 year	50	0	Immediate – 31 Dec 2014
		40	0	01 Jan 2015
Particulate Matter ($PM_{2.5}$)	24 hours	65	4	Immediate – 31 Dec 2015
		40	4	01 Jan 2016 – 31 Dec 2029
		25	4	01 Jan 2030
	1 year	25	0	Immediate – 31 Dec 2015
		20	0	01 Jan 2016 – 31 Dec 2029
		15	0	01 Jan 2030
Benzene (C_6H_6)	1 year	10	0	Immediate – 31 Dec 2014
		5	0	01 Jan 2015
Sulphur Dioxide (SO_2)	10 minutes	500	526	Immediate
	1 hour	350	88	Immediate
	24 hours	125	4	Immediate
	1 year	50	0	Immediate
Nitrogen Dioxide (NO_2)	1 hour	200	88	Immediate
	1 year	40	0	Immediate
Carbon Monoxide (CO)	1 hour	30000	88	Immediate
	8 hour	10000	11	Immediate

2.4 CRITERIA POLLUTANTS AND ASSOCIATED HEALTH IMPACTS

The composition of air pollutant mixtures, pollutant concentrations, duration of exposure and other susceptibility factors (e.g.: age, nutritional status and predisposing conditions) can lead to diverse impacts on human health. Health effects can range from nausea and skin irritation to cancer and mortality[2]. Health implications associated with various pollutants of concern are summarised in **Table 2-3**. High risk individuals include the elderly, people with pre-existing heart or lung disease, pregnant women, asthmatics and children.

[2] Kampa, M., and Castanas, E. (2007): *Human health effects of air pollution,* Environmental Pollution 151 (2008) 362-367, Elsevier

Table 2-3: Priority air pollutants and associated human health impacts

Pollutant	Description	Health effects
Sulphur Dioxide (SO_2)	SO_2 originates from the combustion of sulphur-rich fuels (principally coal and heavy oils) and the smelting of sulphur containing ores[3]. Health effects associated with exposure to SO_2 are associated with the respiratory system[4].	— Nose and throat irritation; — Bronchoconstriction and dyspnoea; and — Reduced lung function in sensitive individuals.
Nitrogen Dioxide (NO_2)	Nitric Oxide is a primary pollutant emitted from combustion processes including stationary sources (e.g.: heating, power generation, etc.) and from motor vehicles. Nitrogen dioxide (NO_2) is formed through the oxidation of nitric oxide. Oxidation of NO by O_3 occurs rapidly, even at low levels of reactants present in the atmosphere. NO_x contributes to the formation of tropospheric ozone, an important atmospheric oxidant, a respiratory irritant and a greenhouse gas[5.]	— Nose and throat irritation; — Bronchoconstriction and dyspnoea; — Asthma; — Bronchitis; — Reduced lung function and tissue damage in sensitive individuals; — Emphysema; and — Premature death
Ozone (O_3)	Ozone in the atmosphere is a secondary pollutant formed through a complex series of photochemical reactions between NO_2 and VOCs in the presence of sunlight. Sources of these precursor pollutants include motor vehicles and industries. Atmospheric background concentrations are derived from both natural and anthropogenic sources. Natural concentrations of O_3 vary with altitude and seasonal variations (i.e. summer conditions favour O_3 formation due to increased insolation). Ozone is a powerful oxidant and can react with a wide range of cellular components and biological materials[6].	— Reduced lung function; — Inflammation of the lungs; — Pulmonary function decrements; — Asthma; and — Exacerbated pre-existing lung conditions
Particulate Matter (PM_{10} & $PM_{2.5}$)	Particles can be classified by their aerodynamic properties into coarse particles, PM_{10} (particulate matter with an aerodynamic diameter of less than 10 µm) and fine particles, $PM_{2.5}$ (particulate matter with an aerodynamic diameter of less than 2.5 µm)[7]. Particulate air pollution is associated with effects of the respiratory system[8]. Particle size is important for health because it controls how far into the respiratory system particles are able to permeate. Fine particles have been found to be more damaging to human health than coarse particles as larger particles are less respirable in that they do not penetrate deep into the lungs compared to smaller particles[9].	— Increase in lower respiratory symptoms; — Reduced lung function; — Inflammation of the lungs; — Angina; — Myocardial infraction; — Bronchitis; and — Mortality

[3] Ibid.[2]

[4] Maroni, M., Seifert, B., Lindvall, T., (1995): *Indoor air quality – a comprehensive reference book*, Elsevier, Amsterdam.

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

[6] Ibid.[5]

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

[8] Ibid.[5]

[9] Manahan, E. (1991): *Environmental Chemistry.*

Carbon monoxide (CO)	CO is one of the most common and widely distributed air pollutants. CO is a tasteless, odourless and colourless gas which has a low solubility in water. In the human body, after reaching the lungs it diffuses rapidly across the alveolar and capillary membranes and binds reversibly with haemoglobin, reducing the oxygen carrying capacity of the blood leading to hypoxia as vital organs (particularly the brain and heart) are starved of oxygen. High risk individuals include persons with pre-existing cardiovascular diseases, pregnant women and infants[10]. Anthropogenic emissions of CO originate from the incomplete combustion of carbonaceous materials. The largest proportion of these emissions is produced from exhausts of internal combustion engines, in particular petrol vehicles. Other sources include industrial processes, coal power plants and waste incinerators. Ambient CO concentrations in urban areas depend on the density of vehicles and are influenced by topography and weather conditions[11].	— Headaches; — Nausea and vomiting; — Muscle weakness; — Shortness of breath; — Impaired cognitive ability; — Impaired coordination and reflex responses; — Haematological problems; — Unconsciousness; and — Mortality.
Lead (Pb)	Lead is a naturally occurring heavy metal that is found in the Earth's crust. Lead can be released into the atmosphere through volcanic eruptions, sea spray and bushfires. Ore mining and metal processing are the largest anthropogenic sources of lead emissions[12]. Leaded petrol used to be a source of high levels of lead in urban areas however as a result of national legislation lead has since been removed from petrol and significant reductions in air-borne lead has been achieved.	— Muscle pain; — Abdominal pain; — Headaches; — Nausea and Vomiting; — Seizures; — Coma; — Learning disabilities; — Impaired coordination; — Increased blood pressure; — Anaemia; — Neuropathies: – Memory disturbances; – Sleep disorders; – Anger; – Fatigue; – Tremors; – Blurred vision; — Miscarriage; and — Premature delivery or stillbirth.
Benzene (C_6H_6)	Benzene in its purest form is a colourless liquid with an aromatic odour. Crude oil is the largest natural source of benzene, with benzene being used in many products, including plastics, synthetic rubber, glues, paints, furniture wax, lubricants, dyes, detergents, pesticides and some pharmaceuticals.	— Drowsiness; — Dizziness; — Headaches; — Irritation of the eyes, skin and respiratory tract; — Visual disorders;

[10] Ibid.[2]

[11] Rudolf, W. (1994): *Concentration of air pollutants inside cars driving on highways and in downtown areas*. Science of the Total Environment, 146, pp 433-444.

[12] The Australian Government (date unknown): *Lead* (www.environment.gov.au)

	Benzene is emitted from industrial sources as well as from combustion sources such as motor engines, wood combustion and stationary fossil fuel combustion. The major source is exhaust emissions and evaporation losses from motor vehicles, and evaporation losses during the handling, distribution and storage of petrol[13].	— Fatigue; — Impaired coordination; — Haematological problems; — Adverse foetal development; — Cancer; and — Mortality

[13] US EPA (2012): *Health effects of Hazardous Air Pollutants – Benzene* (www.epa.gov/airtoxics)

2.5 GREENHOUSE GASES AND CLIMATE CHANGE

South Africa has ratified several international co-operative agreements relating to air quality and as such, is obligated to align National Policy to meet the conditions of these commitments.

2.5.1 GREENHOUSE GASES

The United Nations Framework on Climate Change (UNFCCC) recognises that climate change is a global problem requiring cohesive commitment from the international community. The level of responsibility varies between developed (Annex 1) and developing (Non-Annex 1) countries. The framework convention is expanded on through protocols and agreements, of which the Kyoto Protocol and Paris Agreement are the most recent and well recognised.

In terms of the provisions made under UNFCCC, South Africa has prepared and periodically updates a National inventory of greenhouse gas (GHG) emissions and has published a National Climate Change Response White Paper (October 2011)[14]. South Africa's approach to climate change is to implement mitigation and adaption measures that contribute to a fair and effective global solution while simultaneously building and maintaining South Africa's international competitiveness and achieving sustainable development goals.

Although the UNFCCC has categorised South Africa as a Non-Annex 1 party and therefore not bound by a commitment to cap or reduce GHG emissions, Government has proceeded to develop strategic policy with the aim of peaking National GHG emissions between 2020 and 2025 with the intention to reduce GHG emissions from 2036 onwards. In support of this goal, GHGs were declared as priority air pollutants in July 2017[15]. The following GHGs are categorised as priority pollutants:

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

Polluters emitting GHGs in excess of 0.1 Megatonnes per annum (measured as $CO_{2\text{-eq}}$) are required to submit a pollution prevention plan. On 22 May 2018, in 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 is now due on or before 21 June 2018.

In addition, the National Greenhouse Gas Emission Reporting Regulations[16] which were gazetted on 3 April 2017 have the purpose of introducing a single national GHG reporting system. This will be used to inform policy development and to maintain the national GHG inventory as part of South Africa's obligations under the UNFCCC.

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[14] Department of Environmental Affairs (2001): *National Climate Change Response White Paper*. www.environment.gov.za

[15] Department of Environmental Affairs (2017): *Declaration of Greenhouse Gases as Priority Air Pollutants* (No. R. 710 of 2017) Government Gazette, 21 July (No. 40996).

[16] Department of Environmental Affairs (2017): *National Greenhouse Gas Emission Reporting Regulations* (No. R. 275 of 2017) Government Gazette, 03 April 2017 (No. 40762).

2.5.2 STRATOSPHERIC OZONE DEPLETION

In 1990, South Africa acceded to the Vienna Convention and the Montreal Protocol with the purpose of protecting human health and the environment from adverse effects resulting from anthropogenic influences on ozone depletion. Member countries are required to reduce or eliminate the production and consumption of ozone depleting substances (ODS) including chlorofluorocarbons, halons, methyl bromide, hydrochlorofluorocarbons and methyl chloroform. Measures to eliminate production and consumption of ODS include licensing systems, trade bans and annual reporting to the Secretariat of the Protocol. South Africa is currently in full compliance with the conditions of the Protocol.

3 BASELINE ASSESSMENT

3.1 GEOGRAPHIC OVERVIEW

The BCMM covers an area of approximately 2,536 km^2 within the Eastern Cape Province (**Figure 3-2**). The BCMM is bounded to the south-east by the long coastline along the Indian Ocean. Buffalo City is the key urban centre of the eastern part of the Eastern Cape and consists of a corridor of urban areas, stretching from the port city of East London to the east, through Mdantsane to Dimbaza in the west. East London is the primary node whilst the King William's Town is the secondary node.

The Municipality was established as a Local Municipality in 2000 after South Africa's reorganisation of municipal areas, and is named after the Buffalo River, at whose mouth lies the only river port in South Africa. On 18 May 2011, it was separate from the Amathole District Municipality and converted into a Metropolitan Municipality.

Although the economy of the Buffalo City Metropolitan Municipality is relatively small, it is the second largest metropolitan municipality in the Eastern Cape (Eastern Cape Socio Economic Consultative Council (ECSECC), 2012). It contributes 1.57% to the South African economy and 20.08% to the Eastern Cape's economy (ECSECC, 2017a). **Figure 3-1** indicates the Gross Value Added (GVA) by broad economic sector within the BCMM. Community services account for the highest GVA (27 %), while agriculture accounts for the lowest (1 %) (ECSECC, 2017a).

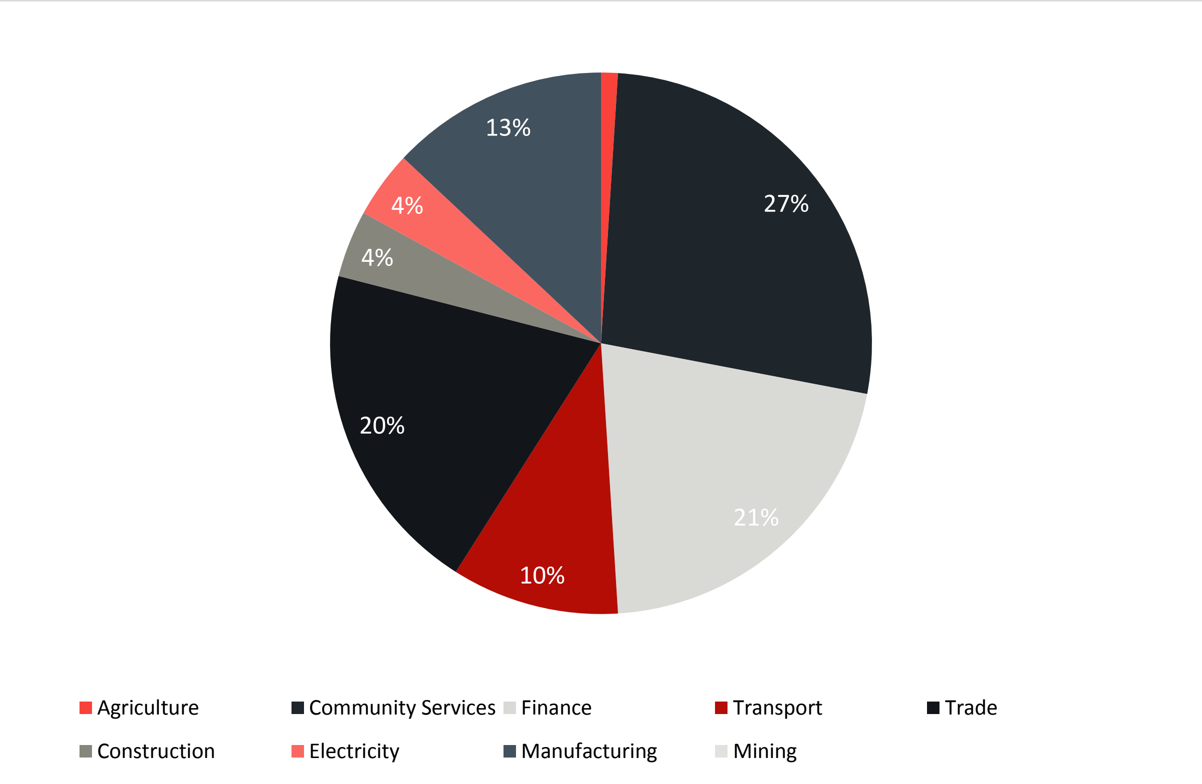

Figure 3-1: GVA by broad economic sector within the Buffalo City Metropolitan Municipality.

3.2 DEMOGRAPHICS

According to the *Buffalo City Metro Municipality Socio-Economic Outlook, 2017*, the BCMM has a total population of approximately 848,328 (**Table 3-1**). For the period 2006 – 2016, the BCMM experienced an average population growth rate of 1.01 % per annum. Compared to the average population growth rate of the Eastern Cape (0.83 % per annum), the BCMM population growth rate at 1.01 % was greater than that of the province (ECSECC, 2017a). When compared to other regions within the Eastern Cape, the BCMM accounts for 12.1% of the province, making it the most populous Metropolitan Municipality for 2016 (ECSECC, 2017a). The East London sub-metro region and the Mdantsane, Chalumna sub-metro region recorded the highest and second highest annual average population growth rates of 1.09 and 1.08 %, respectively. Macleantown, Sandisiwe sub-metro region recorded the lowest annual average population growth rate of 0.70 % (ECSECC, 2017a). The spatial distribution of the population in the BCMM is given in **Figure 3-3**.

Table 3-1: Total population and growth rates (%) for each sub-metro region within the Buffalo City Metropolitan Municipality.

Sub-Metro Region	2006	2011	2016	Annual Average Growth (%)
Macleantown, Sandisiwe	53,200	54,200	57,100	0.70
King William's Town, Bisho	208,000	215,000	227,000	0.91
Mdantsane, Chalumna	235,000	246,000	262,000	1.08
East London	271,000	283,000	302,000	1.09
BCMM	**766,899**	**798,215**	**848,328**	**1.01**

3.3 TOPOGRAPHY

The topography of the BCMM extends from sea level along the coastal belt, rising to the north-west and forming a plateau with an elevation between 450 and 850 m above sea level (ECSECC, 2017b) (**Figure 3-4**). The plateau extends from Maclean Town and Berlin, through to Dimbaza. The most north-westerly portion of the BCMM reaches 2100 m above sea level falling in the Amatole Mountains. The region is characterized by several incised river valleys, such as the Buffalo, Nahoon and Gonubi Rivers, running parallel in a south-easterly direction through the municipality. This terrain, which lacks large tracts of flat land, significantly influences settlement patterns and the cost of service provision within the region. The land-use includes the urbanised centres of East London, Mdantsane, Zwelitsha and King Williams Town, and large areas of cultivated crops, natural vegetation and vacant land (uMoya-NILU, 2013) (**Figure 3-5**).

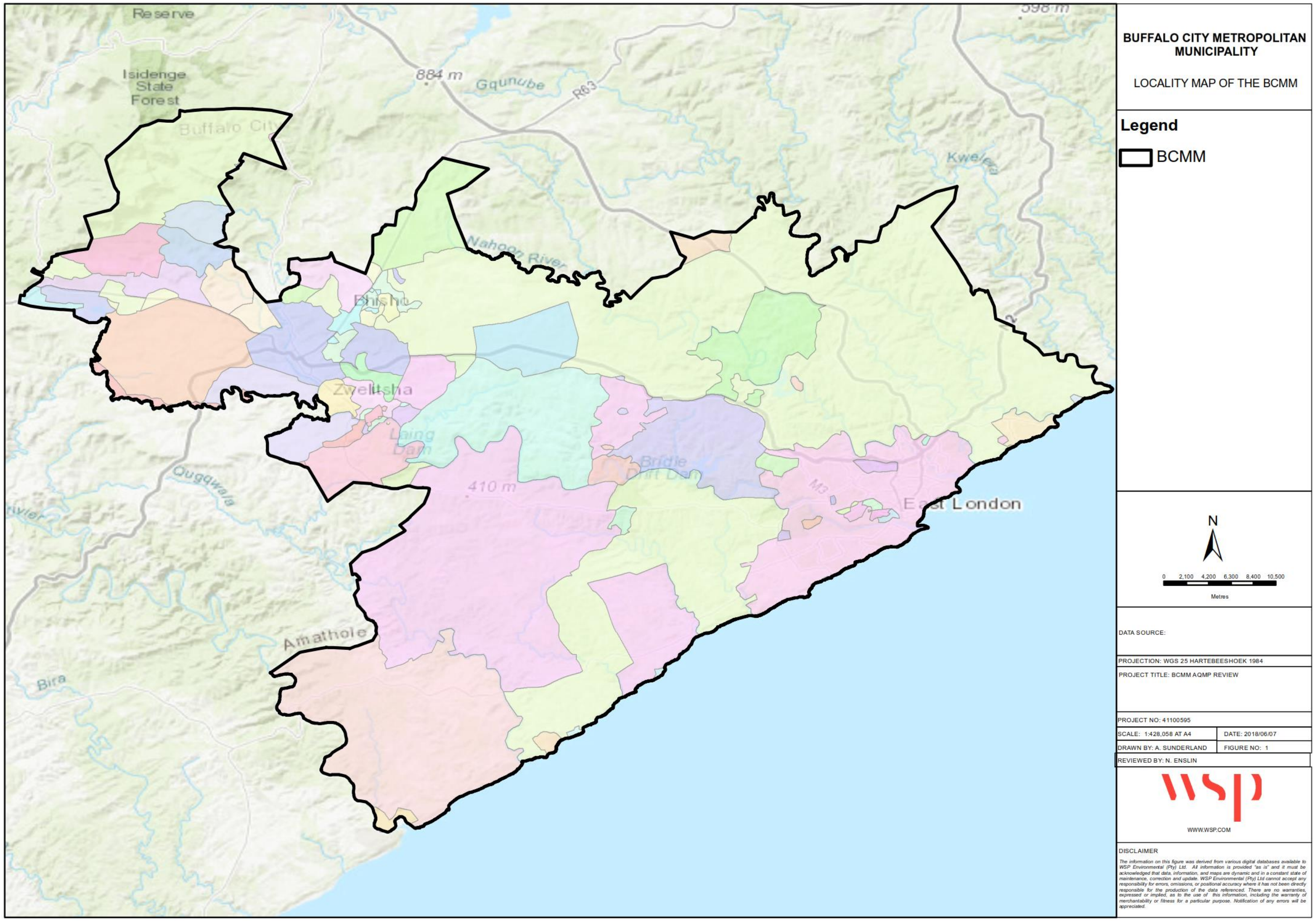

Figure 3-2: Locality map of the Buffalo City Metropolitan Municipality.

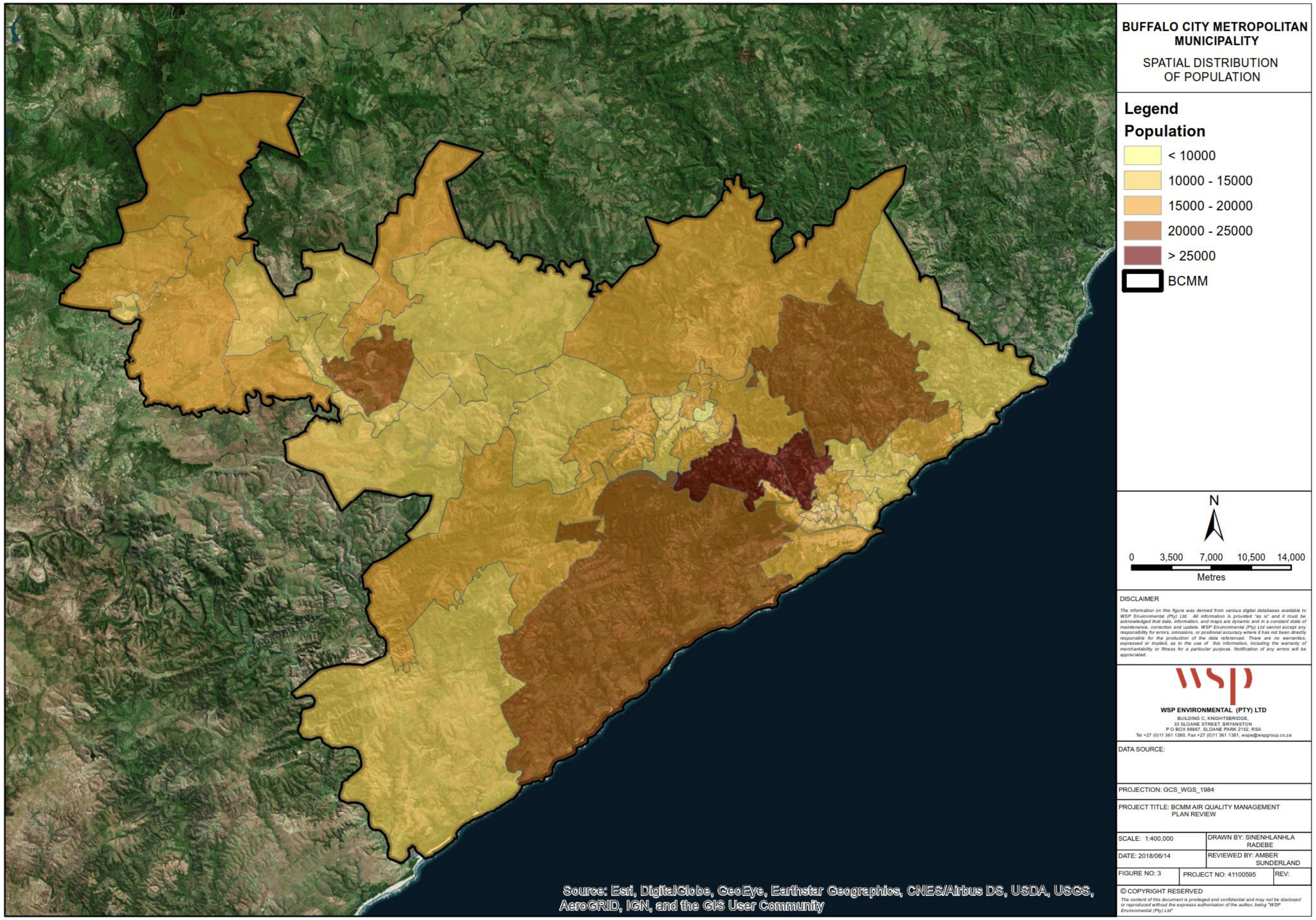

Figure 3-3: Population distribution within the Buffalo City Metropolitan Municipality.

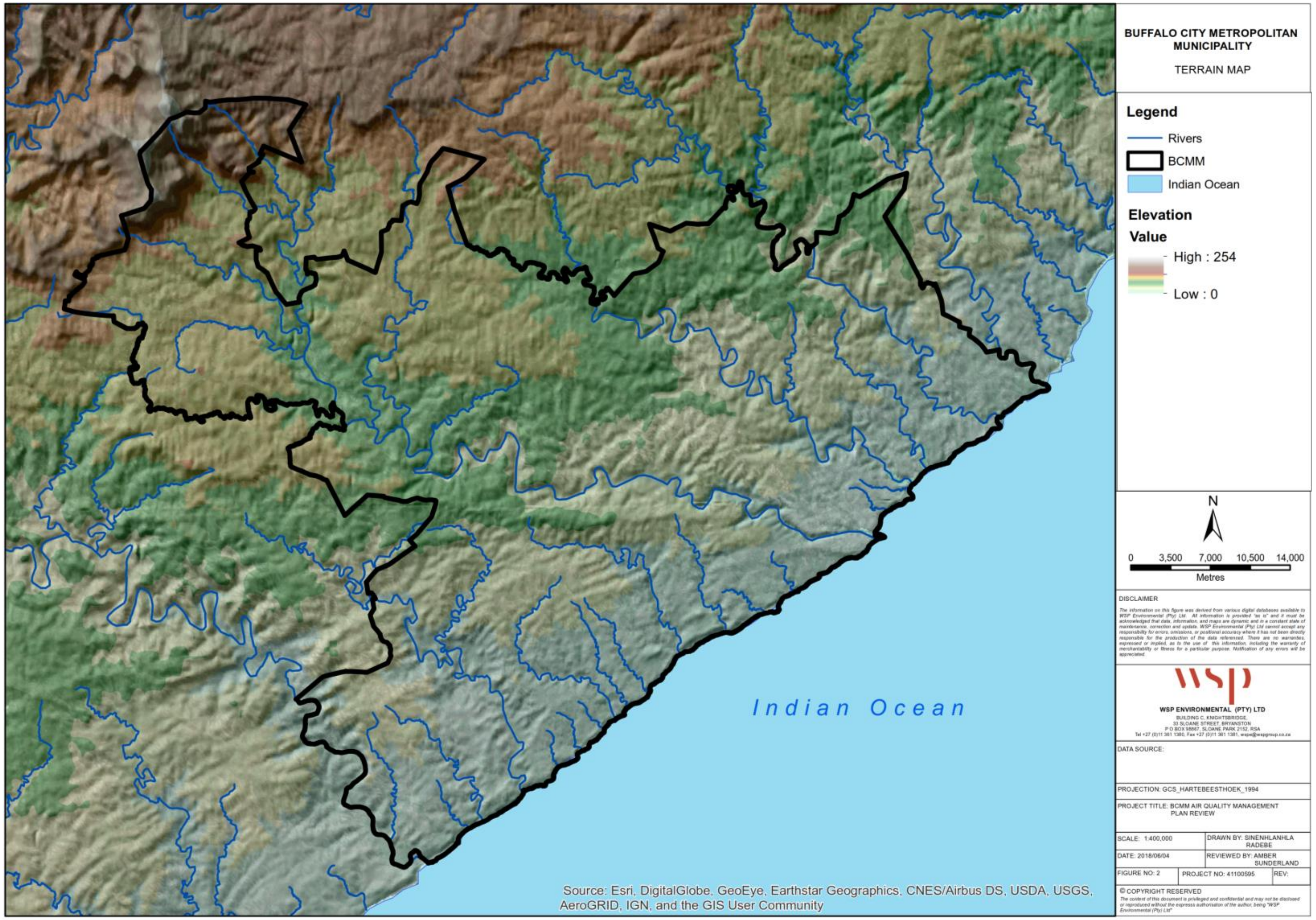

Figure 3-4: Topography of the Buffalo City Metropolitan Municipality.

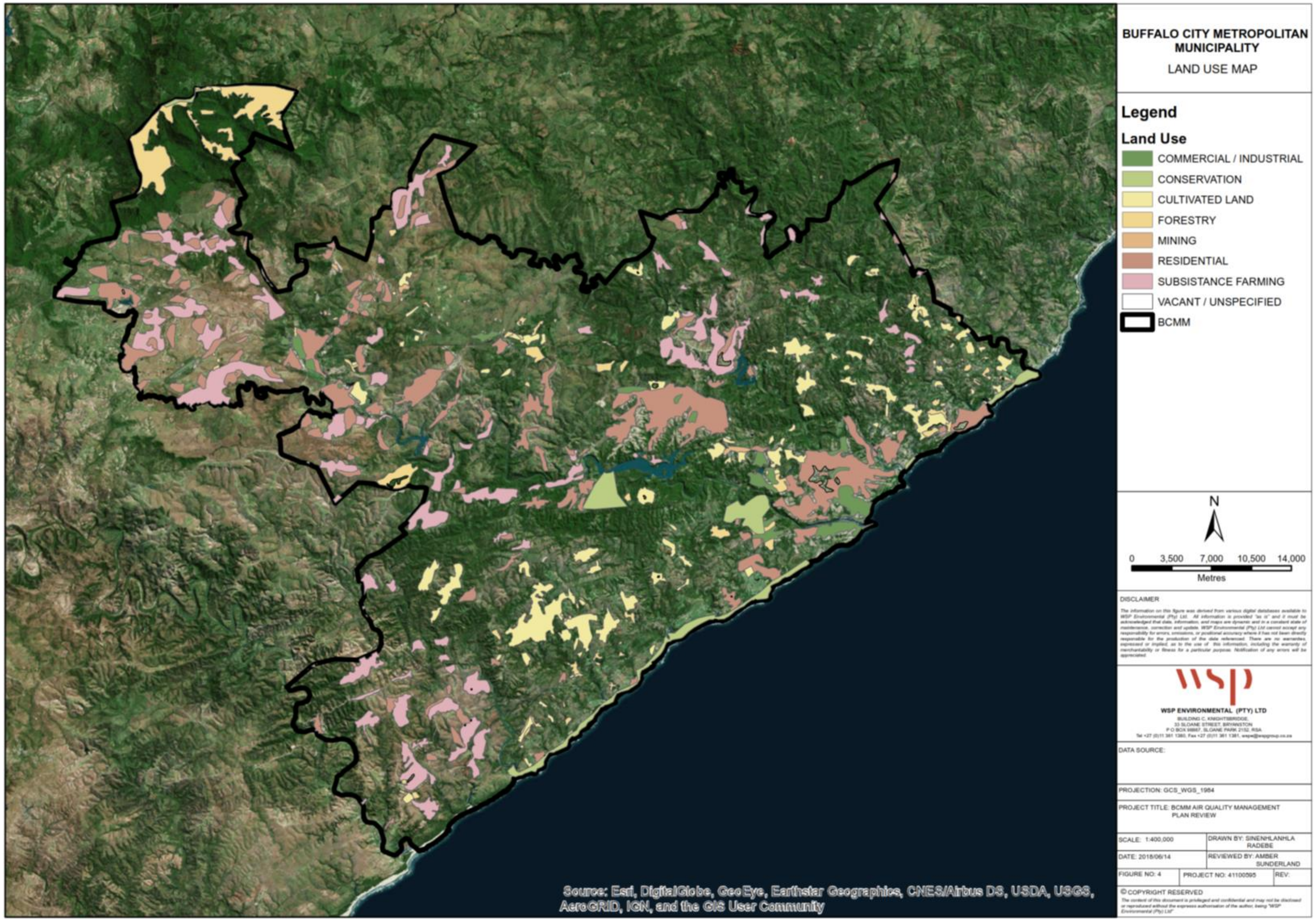

Figure 3-5: Land-use within the Buffalo City Metropolitan Municipality.

3.4 CLIMATE AND METEOROLOGY

Seasonal and diurnal pollutant concentration levels fluctuate in response to the changing state of atmospheric stability, to concurrent variations in mixing depth and to the influence of mesoscale and macroscale wind systems on the transport of atmospheric contaminants. The solution to an air pollution problem therefore requires an understanding of local weather conditions and the manner in which these conditions combine to produce air pollution episodes.

This section provides an overview of the atmospheric circulations influencing airflow and the subsequent dispersion and dilution of pollutant concentrations in the region while local meteorological conditions in the Municipality are analysed using surface meteorological data from weather stations operated in the Municipality.

Surface meteorological data was obtained from the South African Weather Service (SAWS) stations in Bisho and East London for the period January 2015 – December 2017. The Agricultural Research Council (ARC) also operates a network of monitoring stations in the Municipality as part of a larger National Meteorological Monitoring Network. Meteorological parameters were obtained from the Bisho and Berlin weather stations for the same period. A summary of the meteorological stations operated in the BCMM is provided in **Table 3-2** and **Figure 3-6** while the data recovery for meteorological variables is given in **Table 3-3**.

Table 3-2: Meteorological stations located within the Buffalo City Metropolitan Municipality.

Monitoring Agency	Station Name	Latitude (ºS)	Longitude (ºE)	Height (m)
SAWS	Bisho	-32.900000	27.280000	593
	East London	-33.035000	27.816111	134
ARC	Berlin	-32.93588	27.59773	391
	Bisho	-32.86252	27.42741	548

Table 3-3: Data recovery for meteorological variables from each station.

Monitoring Agency	Station Name	Data Recovery (%)		
		Temperature	Humidity	Wind Speed
SAWS	Bisho	98	98	98
	East London	100	100	100
ARC	Berlin	100	100	100
	Bisho	100	100	100

3.4.1 LOCAL WIND FIELD

Wind roses summarize the occurrence of winds at a location, representing their strength, direction and frequency. Calm conditions are defined as wind speeds less than 1 m/s. Each directional branch on a wind rose represents wind originating from that direction. Each directional branch is divided into segments of different colours, which are representative of different wind speeds. Wind speed classes are represented as 1 – 2 m/s (slow), 2 – 4 m/s (moderate), 4 – 6 m/s (strong) and > 8 m/s (fast).

Typical wind fields are analysed for the full period (January 2015 – December 2017); diurnally for early morning (00h00–06h00), morning (06h00–12h00), afternoon (12h00–18h00) and evening (18h00–24h00); and seasonally for summer (December, January and February), autumn (March, April and May), winter (June, July and August) and Spring (September, October and November).

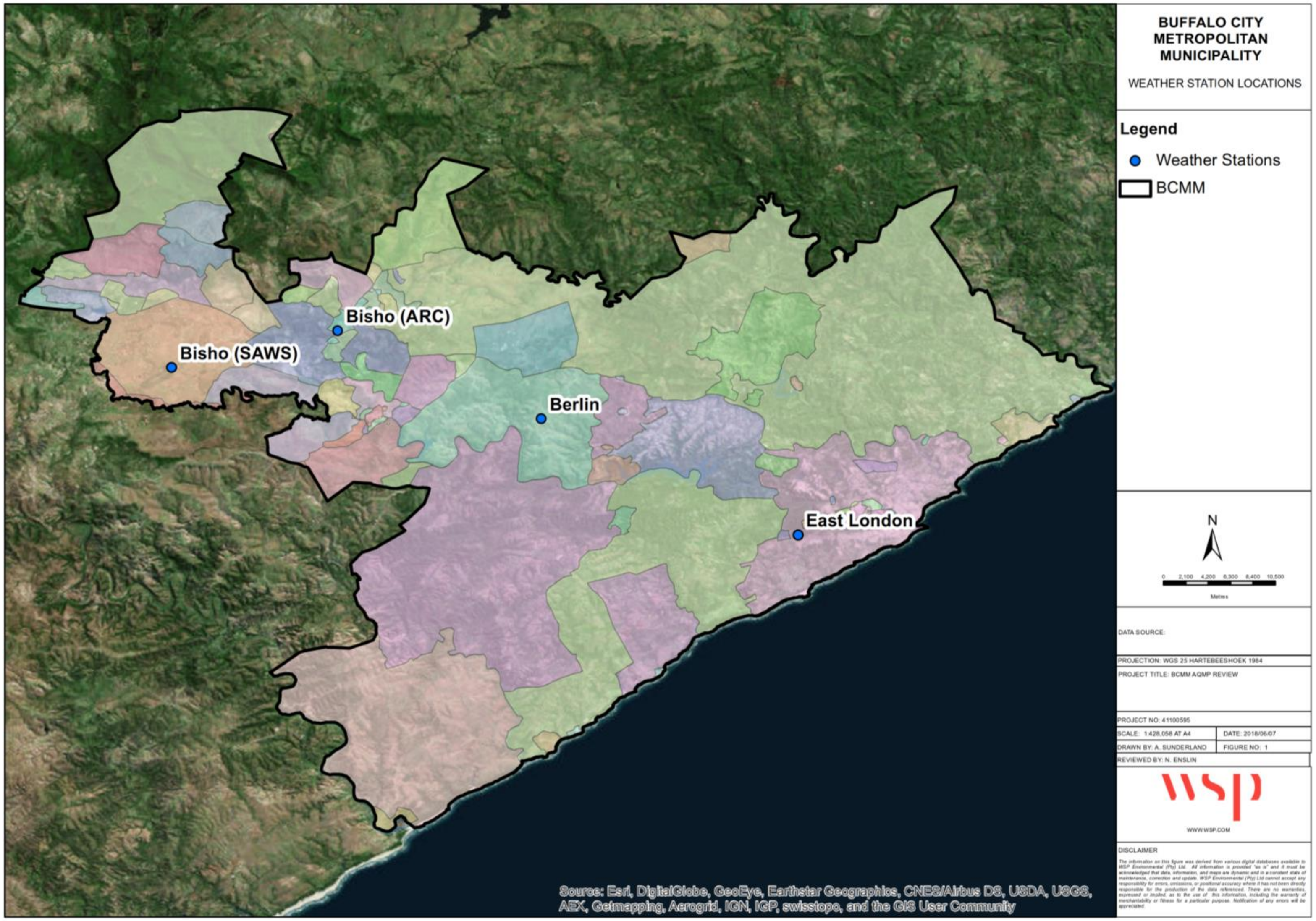

Figure 3-6: Location of meteorological monitoring stations within the Buffalo City Metropolitan Municipality.

BISHO (SAWS)

- The period wind rose (January 2015 – December 2017) presents dominant westerly winds with frequent easterly winds also observed. Wind speeds are generally fast, with calm conditions occurring infrequently (1.36 % of the time).
- Diurnal wind flow patterns show prevailing winds from the west during morning (00:00 – 12:00), with a shift to dominant easterly winds in the afternoon (12:00 – 18:00). Dominant east-north-easterly winds are noted during the evening hours (18:00 – 24:00).
- Seasonal conditions show dominant east-north-easterly and easterly winds during spring and summer, respectively, while westerly winds prevail during the autumn and winter months.
- Wind roses for this meteorological station are shown in **Figure 3-7**.

EAST LONDON

- The period wind rose (January 2015 – December 2017) presents dominant westerly winds with frequent easterly winds also observed. Wind speeds are generally moderate to fast, with calm conditions occurring infrequently (1.74 % of the time).
- Diurnal wind flow patterns show prevailing westerly winds throughout the evening to morning hours (18:00 – 12:00), with a shift to dominant easterly winds in the afternoon (12:00 – 18:00).
- Seasonal conditions show dominant westerly winds in autumn and spring, while easterly and northerly winds prevail during summer and winter, respectively.
- Wind roses for this meteorological station are shown in **Figure 3-8**.

BERLIN

- The period wind rose (January 2015 – December 2017) presents dominant north-westerly winds with frequent west-north-westerly winds also observed. Wind speeds are generally moderate to fast, with calm conditions occurring frequently (14.37 % of the time).
- Diurnal wind flow patterns show prevailing north-westerly winds throughout the morning (00:00 – 12:00), with a shift to dominant south-easterly and east-south-easterly winds in the afternoon (12:00 – 18:00) and evening (18:00 – 24:00), respectively.
- Seasonal conditions show dominant north-westerly winds during autumn and winter, with a shift to dominant west-north-westerly and south-easterly winds during spring and summer, respectively.
- Wind roses for this meteorological station are shown in **Figure 3-9**.

BISHO (ARC)

- The period wind rose (January 2015 – December 2017) presents dominant easterly winds. Wind speeds are generally slow to moderate, with calm conditions occurring frequently (13.05 % of the time).
- Diurnal wind flow patterns show prevailing easterly winds during the evening and early morning hours (18:00 – 06:00), with a shift to dominant north-westerly and south-easterly winds in the morning (06:00 – 12:00) and afternoon (12:00 – 18:00), respectively.
- Seasonal conditions show prevailing easterly winds throughout spring, summer and autumn, with a shift to dominant north-westerly winds in winter.
- Wind roses for this meteorological station are shown in **Figure 3-10**.

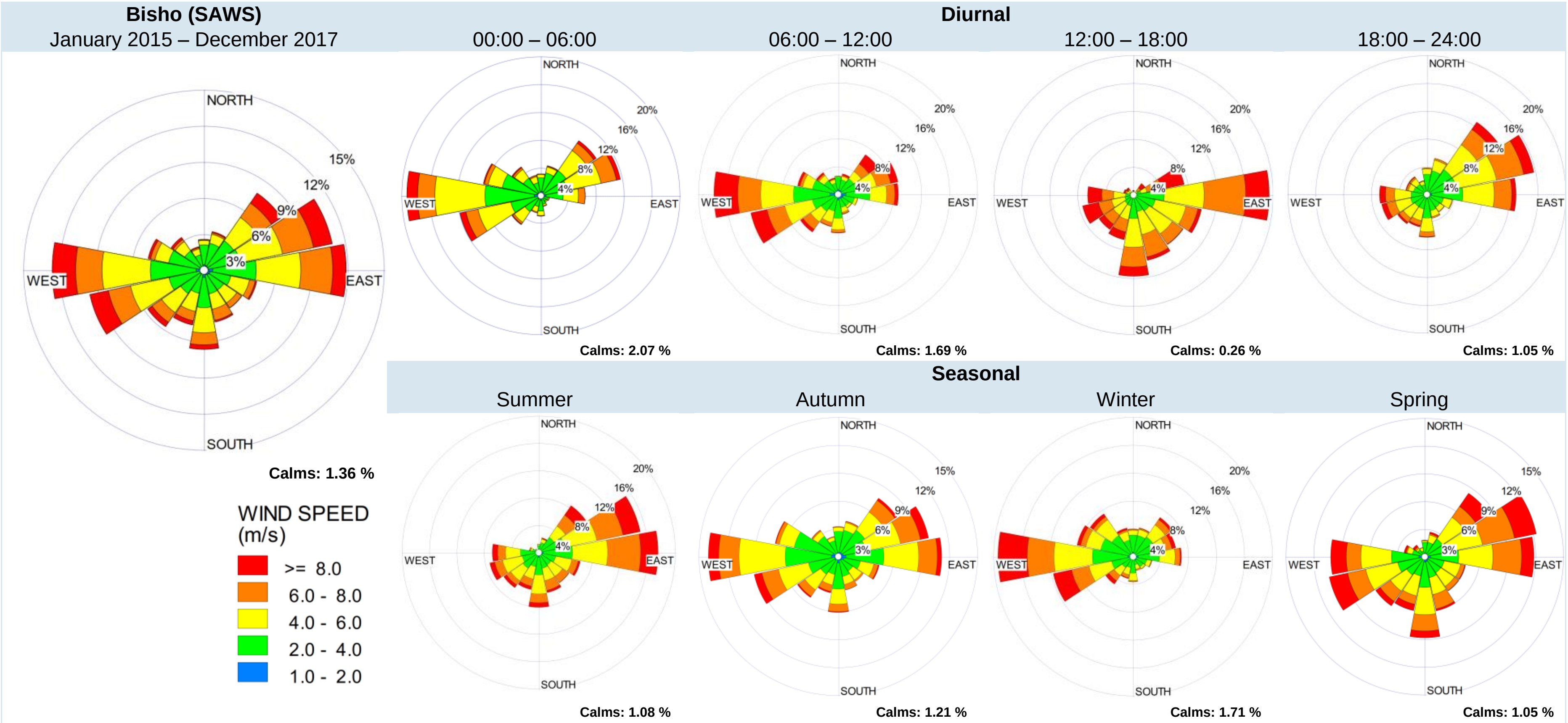

Figure 3-7: Local wind conditions at Bisho (SAWS) for the period January 2015 – December 2017.

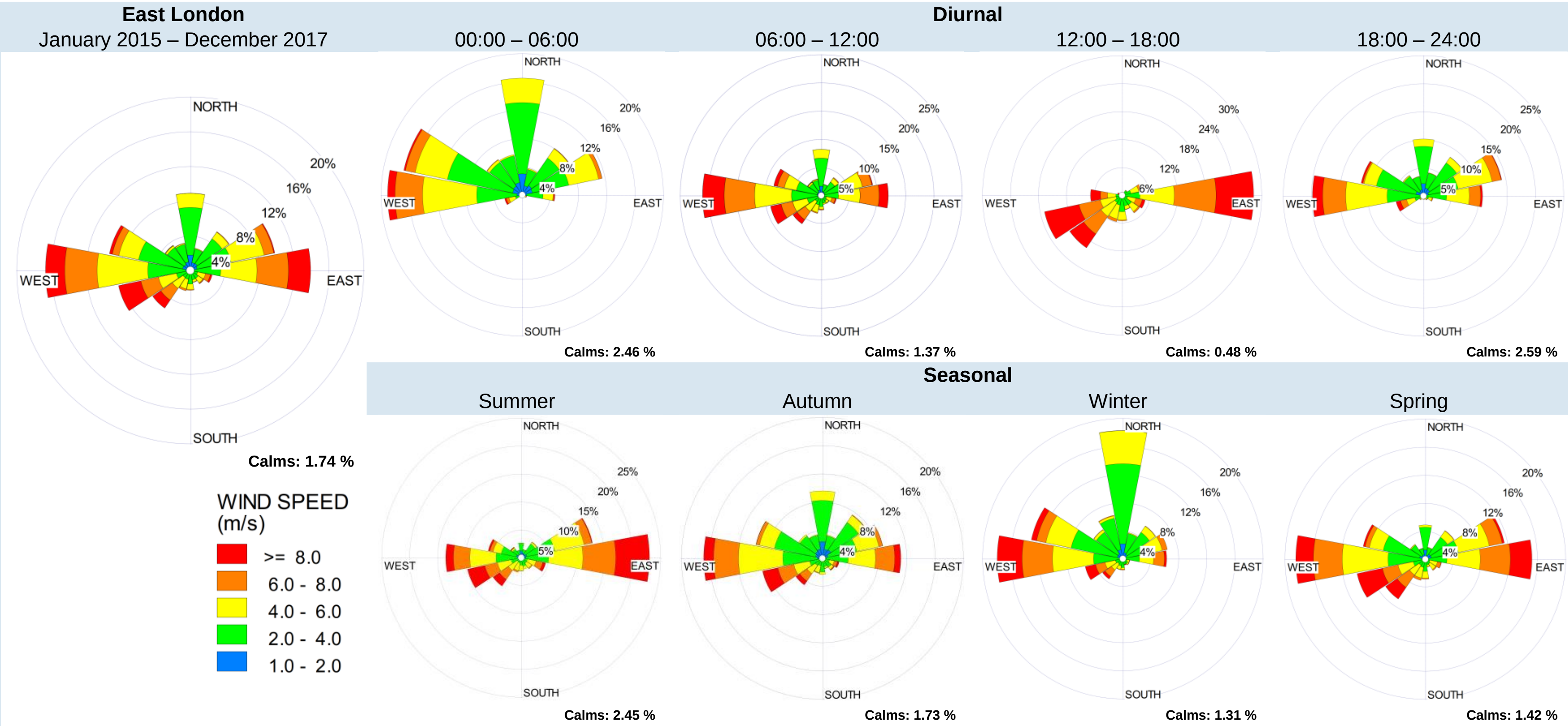

Figure 3-8: Local wind conditions at East London for the period January 2015 – December 2017.

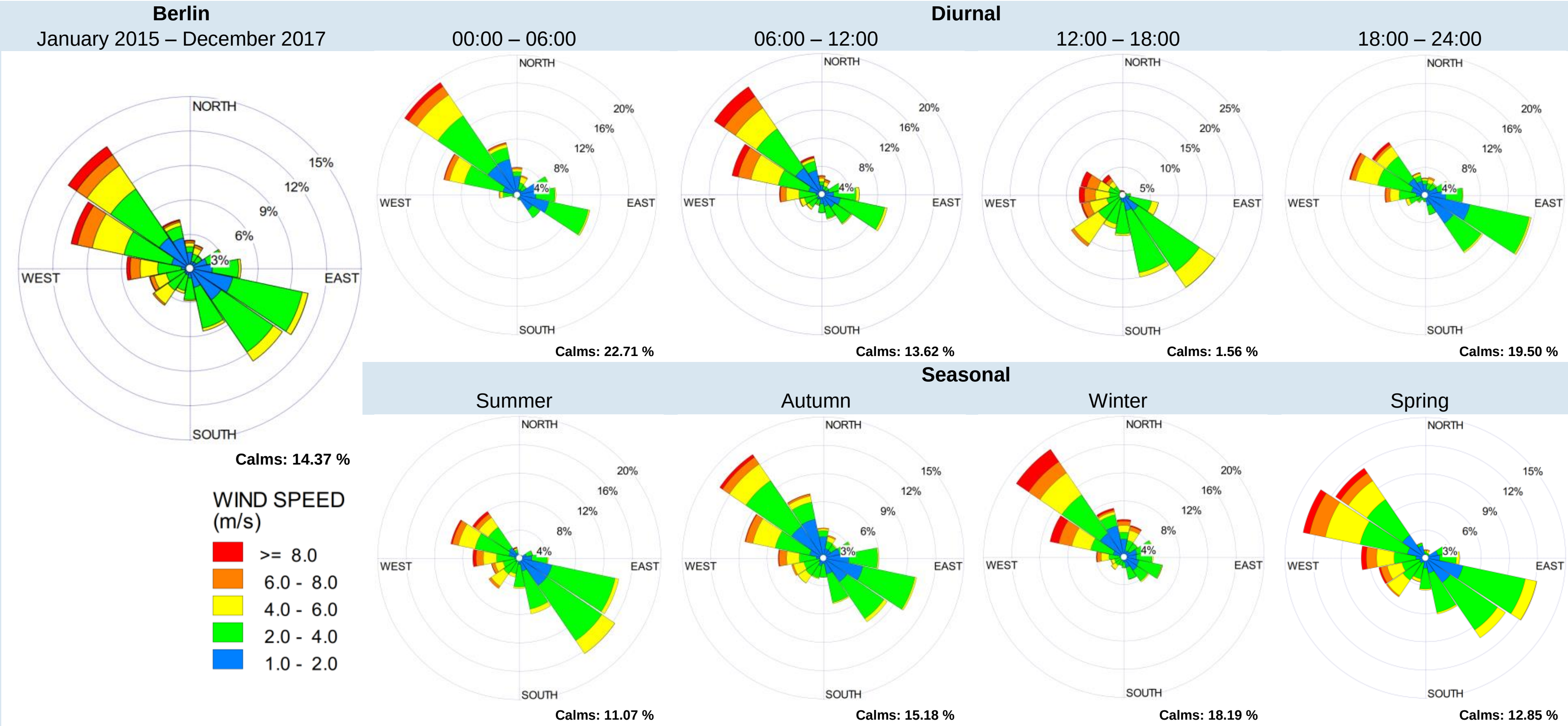

Figure 3-9: Local wind conditions at Berlin for the period January 2015 – December 2017.

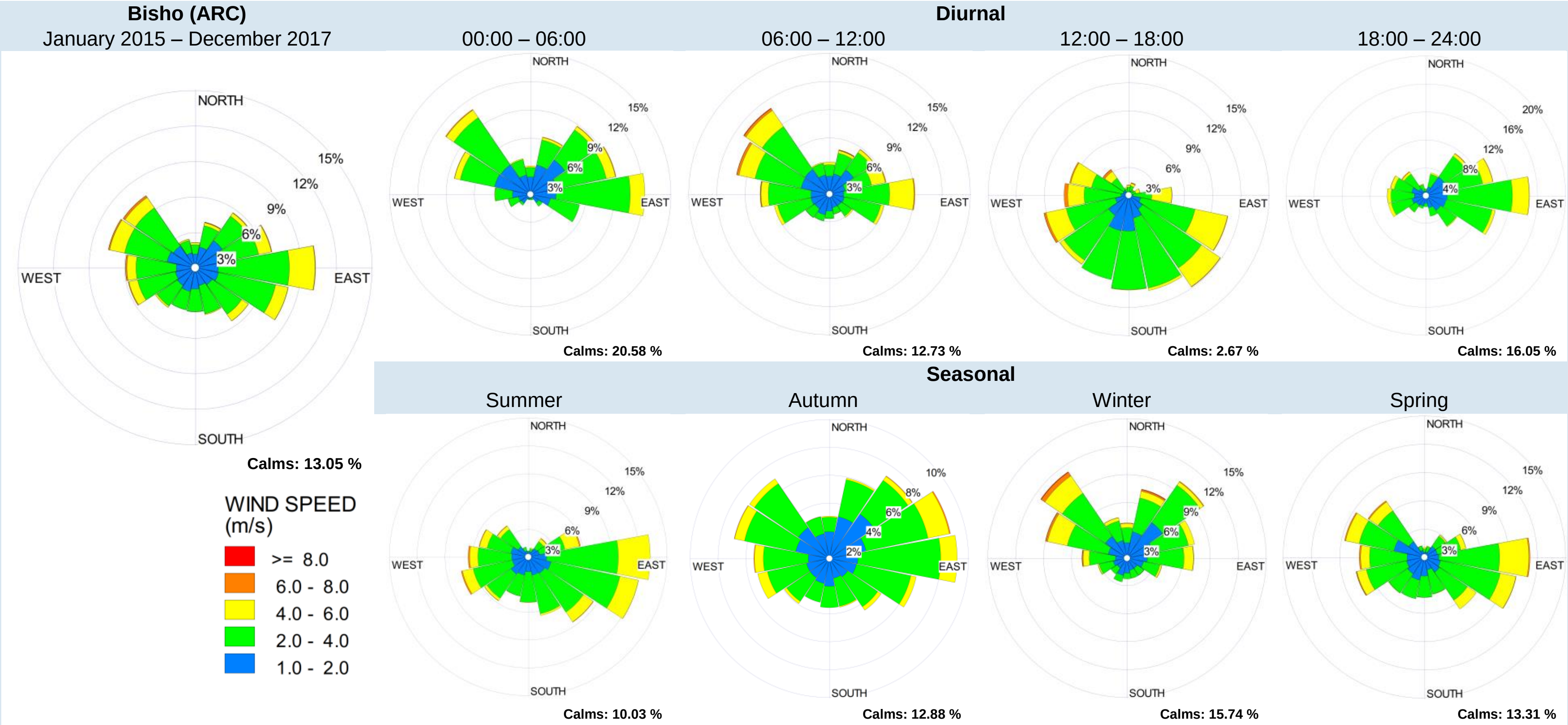

Figure 3-10: Local wind conditions at Bisho (ARC) for the period January 2015 – December 2017.

3.4.2 LOCAL TEMPERATURE AND RAINFALL

TEMPERATURE

Ambient air temperature is important, both for determining the effect of plume buoyancy (the higher the plume temperature is above the ambient temperature, the higher the plume is able to rise), and determining the development of the mixing and inversion layers. **Figure 3-11** illustrates the average, maximum and minimum monthly temperatures at various locations within the BCMM. All stations follow a very similar trend, with mild fluctuations. Temperatures at each station are relatively stable over the period, with average summer and winter temperatures (across all stations) being 21 and 15 ^{o}C, respectively.

RAINFALL

Rainfall requires consideration as it represents an effective removal mechanism of atmospheric pollutants, thereby improving the air quality situation in high rainfall areas. Total monthly rainfall for the BCMM is presented in **Figure 3-12**. All stations represent summer rainfall patterns, although East London appears to maintain moderate to high rainfall throughout the year. High rainfall is likely to have a positive effect on ambient air quality within the area. East London had the highest annual average rainfall of 786 mm, while Berlin had the lowest annual average rainfall of 473 mm. Average humidity follows a similar pattern, with the BCMM experiencing higher humidity levels during the summer months, and lower humidity levels in the winter months.

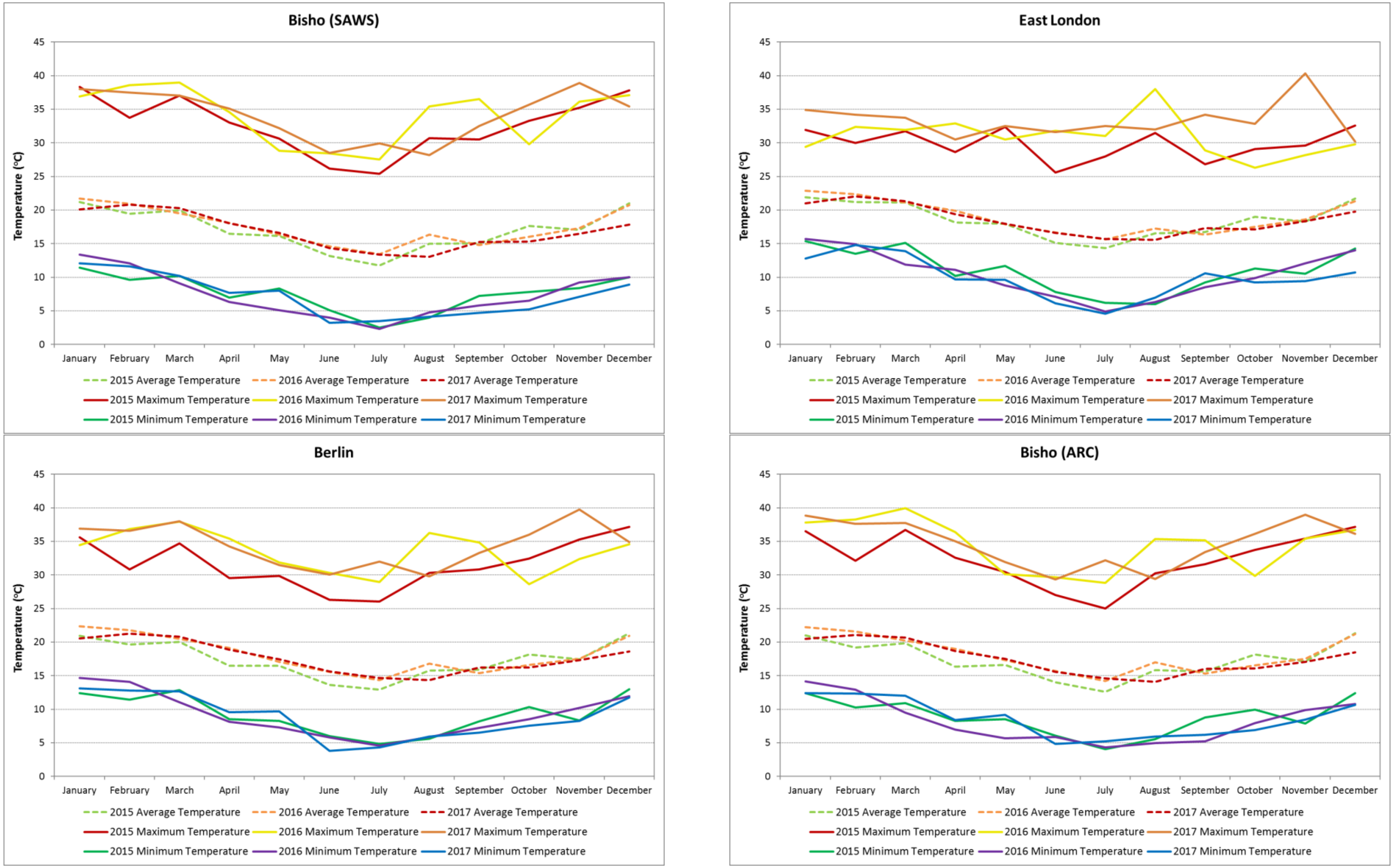

Figure 3-11: Monthly average, maximum and minimum temperatures for Buffalo City Metropolitan Municipality for the period January 2015 – December 2017.

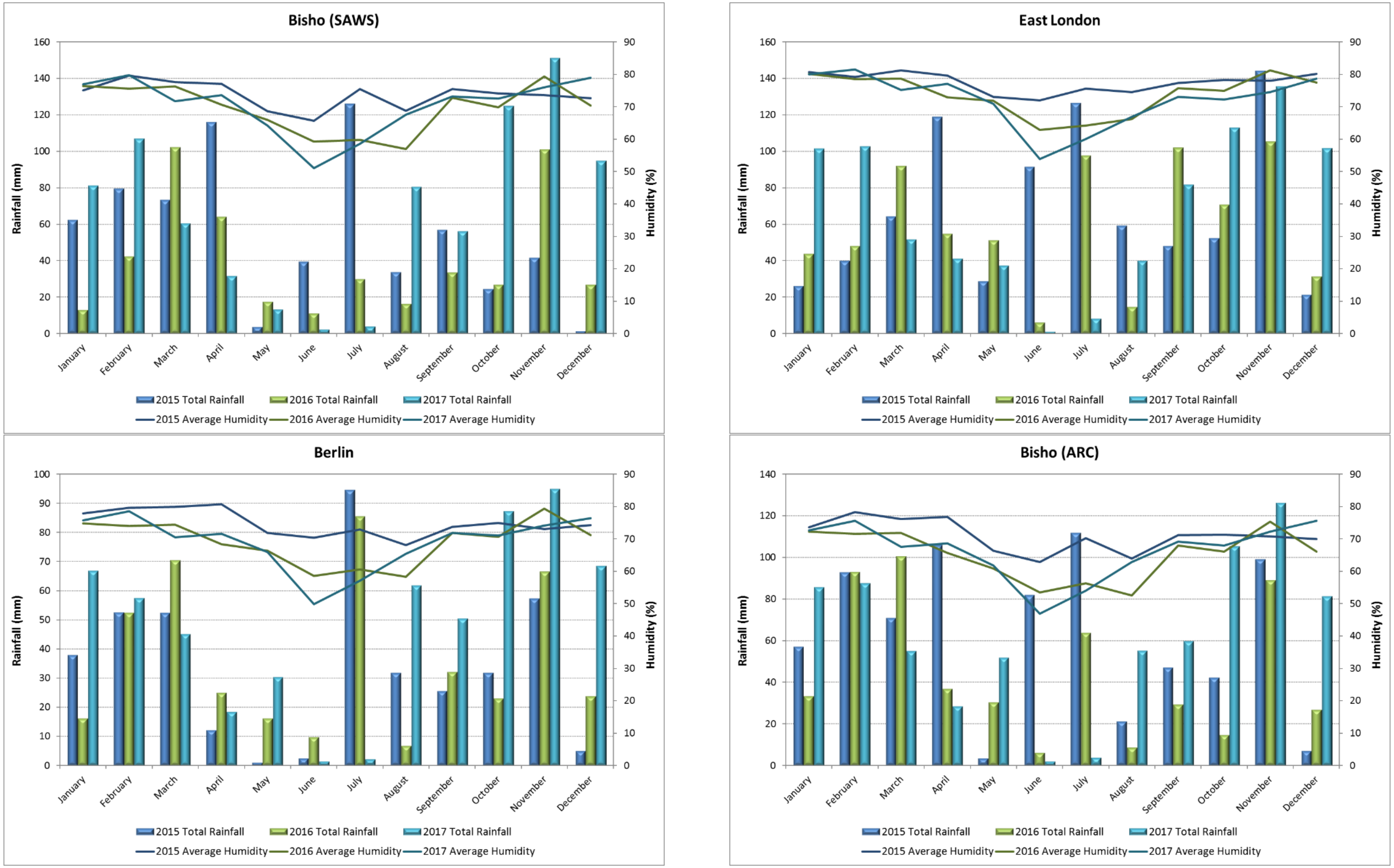

Figure 3-12: Total monthly rainfall and average monthly humidity for Buffalo City Metropolitan Municipality for the period January 2015 – December 2017.

3.5 AMBIENT AIR QUALITY

An evaluation of the existing air pollution situation provides an understanding of the potential risk for health impacts. The baseline characterisation provides the foundation for the development of the AQMP to formulate detailed strategies and procedures required to meet clean air objectives and goals.

The BCMM operates a network of three continuous monitoring stations (two permanent and one mobile). One permanent monitoring station is located in King William's Town, while the other permanent station and mobile station are located in East London (CBD) and Gompo (a suburb within East London), respectively (**Figure 3-13**).

Due to technical difficulties and maintenance challenges, data is currently inaccessible from the stations. The permanent station located in King William's Town is currently unable to report to the South African Air Quality Information System (SAAQIS), as the modem is not operational.. A new modem has since been purchased and is to be installed at the King William's Town station in the near future.

The permanent and mobile stations located in East London are indicated to be operating and reporting to SAAQIS, however, there have been several challenges when trying to download the data. Discussions with the relevant personnel are on-going while the reasons for data inaccessibility are investigated.

Historic ambient SO_2 and PM_{10} data was provided for the East London monitoring station for the period January 2007 – December 2015. However, the data was not considered representative due to the low data recovery experienced for the period (**Table 3-4**). The South African National Accreditation System (SANAS, 2012) TR 07-03 standards stipulate a minimum data recovery of 90% for the dataset to be deemed representative of conditions during a particular reporting period.

Table 3-4: Data recovery at the East London monitoring station for the period January 2007 - December 2015.

Year	Data Recovery (%)	
	PM_{10}	SO_2
2007	0.7	14.3
2008	5.3	62.2
2009	7.8	54.4
2010	4.9	30.5
2011	1.6	51.8
2012	4.2	31.9
2013	5.8	25.6
2014	0.1	11.0
2015	50.8	10.0

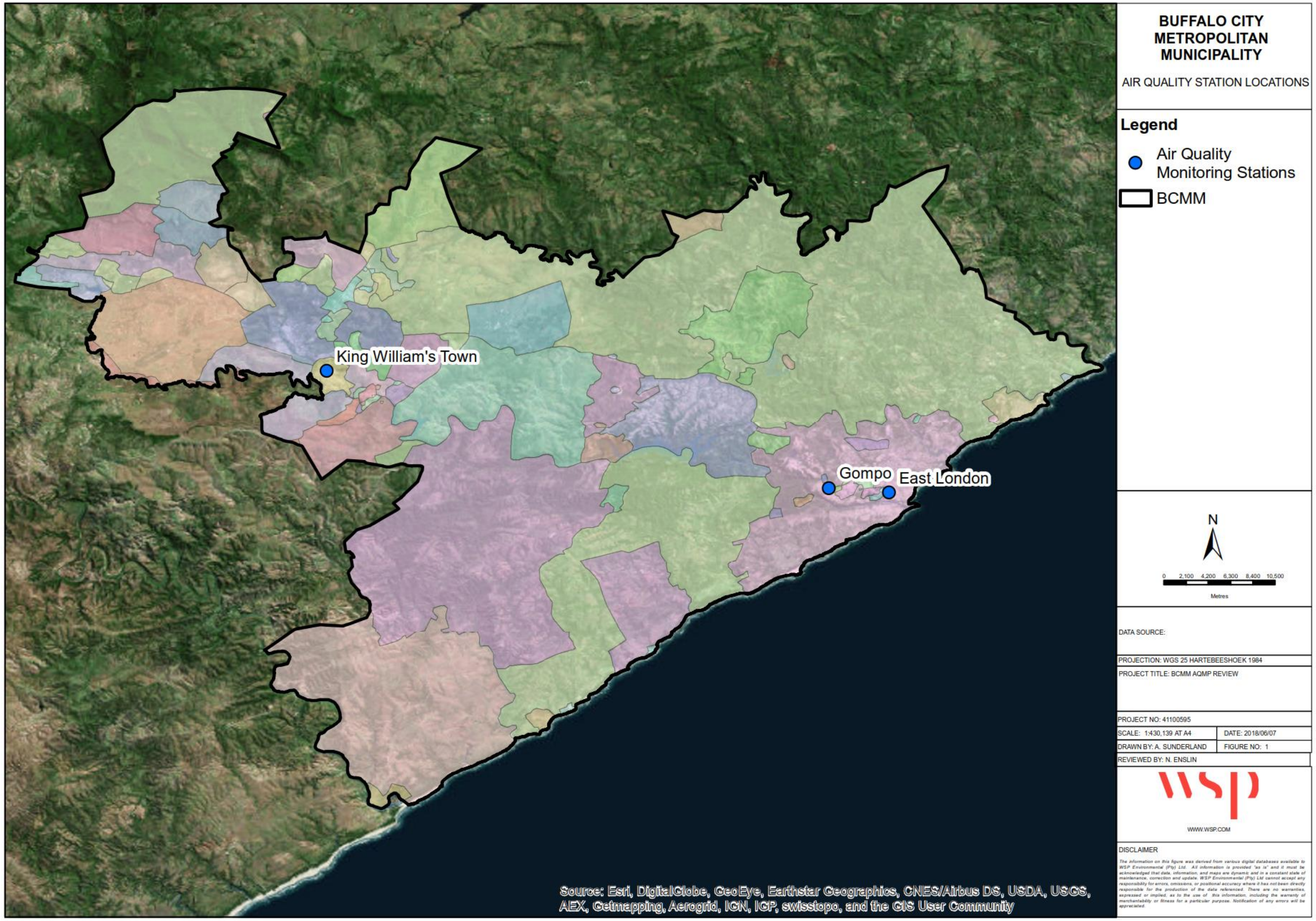

Figure 3-13: Location of ambient air quality monitoring stations within the Buffalo City Metropolitan Municipality

4 STATUS QUO ASSESSMENT

4.1 EMISSIONS INVENTORY

An emissions inventory for air pollution sources in the BCMM has been compiled, building on what was completed as part of the first AQMP (C&M Consulting Engineers, 2011) and the emissions inventory database (C&M Consulting Engineers, 2012). Potential air pollution sources in the BCMM have been identified as:

— Industrial operations;
— Domestic fuel burning;
— Vehicle emissions;
— Airport and Harbour;
— Agricultural activities;
— Biomass burning;
— Waste treatment and disposal; and
— Fugitive dust sources.

Particulate and gaseous emissions from industrial operations, domestic fuel burning and vehicle tailpipe emissions were quantified due to the availability of information for these sources. Emissions were calculated using available international and local emission factors including the United States Environmental Protection Agency (USEPA) AP-42 emission factors. The emission calculations and resultant emission rates for the above mentioned sources are discussed in the section below.

An emission factor is a value representing the relationship between an activity and the rate of emissions of a specified pollutant. Emission factors are always expressed as a function of the weight, volume, distance or duration of the activity emitting the pollutant. The general equation used for the estimation of emissions is:

$$E = A \times EF \times \left(1 - \frac{ER}{100}\right)$$

Where:

E = emission rate
A = activity rate
EF = emission factor
ER = overall emission reduction efficiency (%)

4.1.1 INDUSTRIAL OPERATIONS

The majority of industrial and manufacturing activities in the Eastern Cape Province are found in the Nelson Mandela Bay Metropolitan Municipality and the BCMM, located in close proximity to the three harbours. The main economic sectors within the BCMM that are likely to contribute to industrial emissions are power generation and manufacturing activities. A number of the industrial processes in the BCMM are listed activities and as such, require an Atmospheric Emission Licence to operate. In terms of the recent National Atmospheric Emission Reporting Regulations (2015), listed activities are required to register on NAEIS and report their emissions into NAEIS on an annual basis. For industries not reporting to NAEIS, questionnaires were delivered requesting the required emissions data. A list of the industrial activities identified within the BCMM and their associated source parameters, are given in **Table 4-1** and **Table 4-2**, respectively, while **Figure 4-1** illustrates their locality and spatial distribution.

Table 4-1: List of industries identified within the Buffalo City Metropolitan Municipality.

Area	Source	Process Description	Latitude (°S)	Longitude (°E)
Berlin	Compass Medical Waste	Medical waste removal	-32.978	27.904
	Epol	Pet food manufacturer	-32.875	27.568
	Samil (Pty) Ltd	Textiles	-32.881	27.582
Bisho	Clean Tech Agrochem (Pty) Ltd	Diesel and chemical manufacturing	-32.882	27.582
East London	Summerpride Foods (Pty) Ltd	Food processing	-33.027	27.887
	Aspen Pharmacare	Pharmaceutical	-32.983	27.834
	Atlas Laundromat	Dry cleaning	-32.984	27.902
	Blueberry Hill Farm	Food Processing	-33.054	27.814
	BP Southern Africa	Refinery	-33.031	27.899
	Chevron (Pty) Ltd - East London	Bulk storage	-33.033	27.896
	Clariter ZA (Pty) Ltd	-	-33.055	27.835
	Collateral Trading 27 (Pty) Ltd	Hot asphalt batcher	-30.535	27.447
	DLP Manufacturers	Foundry	-32.987	27.835
	East London Bricks	Brick Manufacturing	-32.921	27.989
	East London Quarry	Quarry	-32.903	27.754
	Elton Quarries	Quarry	-	-
	Elvin Group	Food manufacturer	-33.033	27.875
	Engen Petroleum LTD	Refinery	-33.032	27.897
	Eskom Port Rex Power Station	Power station	-33.028	27.881
	First National Battery (Pty) Ltd - Buffalo View Plant	Battery manufacturing	-33.032	27.872
	First National Battery (Pty) Ltd - Settlersway Plant	Battery manufacturing	-33.033	27.931
	Foam Factory	Foam manufacturer	-33.036	27.875
	Fort Glamorgan Correctional Facility	Prison	-33.030	27.906
	Foxtec-Ikhwezi	Aluminium smelter	-33.038	27.887
	Glenmore	Soap manufacturer	-33.033	27.875
	Inca Concrete Products	Brick manufacturer	-32.993	27.832
	Independent Group Concrete Plant	Concrete batcher	-32.976	27.806
	Independent Group St Lukes Quarry	Quarry	-32.908	27.767
	Johnson and Johnson	Manufacturer	-32.963	27.835
	Lafarge Aggregates	Quarry	-32.852	27.412
	Mercedes Benz South Africa	Motor vehicle manufacturing	-33.029	27.587
	Much Asphalt - East Coast Asphalt	Asphalt production	-32.977	27.824
	Nestle	Sweet manufacturer	-33.009	27.900
	Paramount Mills	Food processing	-33.030	27.889
	Parmalat	Food processing	-32.989	27.890
	Prism Products	DLP manufacturer	-32.989	27.837
	Rec-Oil	Oil Recycling	-33.014	27.910
	Service Products	Furniture manufacturer	-33.030	27.888
	Speciality Dry Cleaners	Dry cleaners	-33.017	27.906
	St Dominic's Hospital	Hospital	-32.998	27.903
	T F M Manufacturing (Pty) Ltd	Autobody manufacturer	-33.037	27.872

	Total South Africa (Pty) Ltd	Bulk storage	-33.034	27.894
King William's Town	Fast and Smart Dry Cleaners CC	Dry cleaner	-32.880	27.390
	Stutt Quarries	Quarry	-32.921	27.989
Mdantsane	La Farge Blue Rock	Quarry	-32.676	27.472
	Mdantsane Correctional Facility	Prison	-32.924	27.705
	Morhot Galvanizers	Galvaniser	-32.852	27.415
Zwelitsha	Stutt Brick Company (Pty) Ltd	Brick manufacturing	-32.916	27.417

Table 4-2: Source parameters of industrial sources within the Buffalo City Metropolitan Municipality.

Area	Source	Emission Source	Stack Height (m)	Stack Diameter (m)	Gas Temperature (ºC)	Gas Exit Velocity (m/s)	Volume Flux (m^3/s)	Abatement Equipment
Berlin	Compass Medical Waste	Boiler	18	0.35	150	-	-	None
	Epol	Boiler	-	-	-	-	-	-
	Samil	Boiler	-	-	-	-	-	-
Bisho	Clean Tech Agrochem	Incinerator	-	-	-	-	-	-
		Boiler	-	-	-	-	-	-
		Tanks	-	-	-	-	-	-
East London	Summerpride Foods	Boiler	23	1.31	180	6.7	9.0	Cyclone
	Aspen Pharmacare	Boiler	-	-	-	-	-	-
	Atlas Laundromat	Autoclade	-	-	-	-	-	-
	Blueberry Hill Farm	Boiler	-	-	-	-	-	-
	BP Southern Africa	Vapour Recovery Unit (VRU) Vent	2.5	0.1524	5	0.1	0.002	VRU
	Chevron	Vapour Recovery Unit (VRU) Vent	3	0.15	296	2	2.73E-05	VRU
	Collateral Trading 27	Stack	18	0.75	167	28	12	Bag filter
	DLP Manufacturers	Electric furnace extraction stack	7	4	23.2	2.2	28.1	-
	East London Bricks	Kiln stack	10	0.5	91	48.4	7.7	-
	Elvin Group	Boiler	-	-	-	-	-	-
	Engen Petroleum LTD	Tanks	-	-	-	-	-	-
	Eskom Port Rex Power Station	Turbine stack 1a	14	4	540	8.4	105.2	-
		Turbine stack 1b	14	4	540	8.4	105.2	-
		Turbine stack 2a	14	4	540	8.4	105.2	-
		Turbine stack 2b	14	4	540	8.4	105.2	-
		Turbine stack 3a	14	4	540	8.4	105.2	-
		Turbine stack 3b	14	4	540	8.4	105.2	-
		Stack 1	13.5	1.52	19	8.1	14.7	Scrubber
		Stack 2	8.8	0.35	19	7.9	0.8	Scrubber

	First National Battery (Pty) Ltd - Buffalo View Plant	Stack 3	11.4	0.8	22	15.2	7.7	Scrubber
		Stack 4	15.3	1.04	19	17.9	15.2	Scrubber
		Stack 5	15.5	1.3	24	19.3	25.6	Scrubber
	First National Battery (Pty) Ltd - Settlersway Plant	Stack 1	15.5	1.1	22	12.0	11.4	Scrubber
		Stack 2	8.8	1.1	21	13.0	12.4	Scrubber
		Stack 3	11.4	1	21	13.0	10.2	Scrubber
		Stack 4	15.3	1.3	26	3.9	5.2	Scrubber
		Stack 5	9.8	0.7	21	4.4	1.7	Scrubber
		Stack 6	9.8	0.7	21	4.4	1.7	Scrubber
		Stack 7	6.7	0.6	21	7.8	2.2	Scrubber
		Stack 8	6.7	0.3	87	11.3	0.8	Scrubber
	Foam Factory	-	-	-	-	-	-	-
	Fort Glamorgan Correctional Facility	Boiler	-	-	-	-	-	-
	Foxtech-Ikhwezi	Electrostatic Precipitator	-	-	-	-	-	-
		Furnace	-	-	-	-	-	-
	Glenmore	Boiler	-	-	-	-	-	-
	Inca Concrete Products	-	-	-	-	-	-	-
	Independent Group Concrete Plant	-	-	-	-	-	-	-
	Independent Group St Lukes Quarry	-	-	-	-	-	-	-
	Johnson and Johnson	Boiler	-	-	-	-	-	-
	Lafarge Aggregates	-	-	-	-	-	-	-
	Medal Paints	-	-	-	-	-	-	-
	Mercedes Benz South Africa	Oven stack 1	17.7	1	209	330940	259920	-
		Oven stack 2	19.7	0.6	220	640864	181200	-
		Oven stack 3	17.2	0.6	135	376490	106450	-
		Oven stack 4	18.3	1.2	255	17241.8	19500	-
		Oven stack 5	22	0.6	249	437853	123800	-
		Oven stack 6	19.6	0.6	217	546644	154560	-

	Much Asphalt - East Coast Asphalt	Rotary drum stack	11.6	0.8	116	12.9	6.2	Baghouse
	Nestle'	Boiler 1	15	1.5	150	-	-	None
		Boiler 2	15	1.5	165		--	None
	Paramount Mills	Oven	-	-	-	-	-	-
	Parmalat	Boiler	-	-	-	-	-	-
	Rec-Oil	Boiler	15	-	-	-	-	-
	Service Products	Boiler	-	-	-	-	-	-
	Speciality Dry Cleaners	Boiler	-	-	-	-	-	-
	St Dominic's Hospital	Boiler	-	-	-	-	-	-
	T F M Manufacturing (Pty) Ltd	-	-	-	-	-	-	-
	Total South Africa (Pty) Ltd	Tanks	-	-	-	-	-	-
King William's Town	Fast and Smart Dry Cleaners	Boiler	-	-	-	-	-	-
	Stutt Quarries	-	-	-	-	-	-	-
Mdantsane	Mdantsane Correctional Facility	Boiler	-	-	-	-	-	-
	Morhot Galvanizers	Fume extraction	11	1	25	10.9	8.6	Filter
Zwelitsha	Stutt Brick Company (Pty) Ltd	Kiln	-	-	-	-	-	-

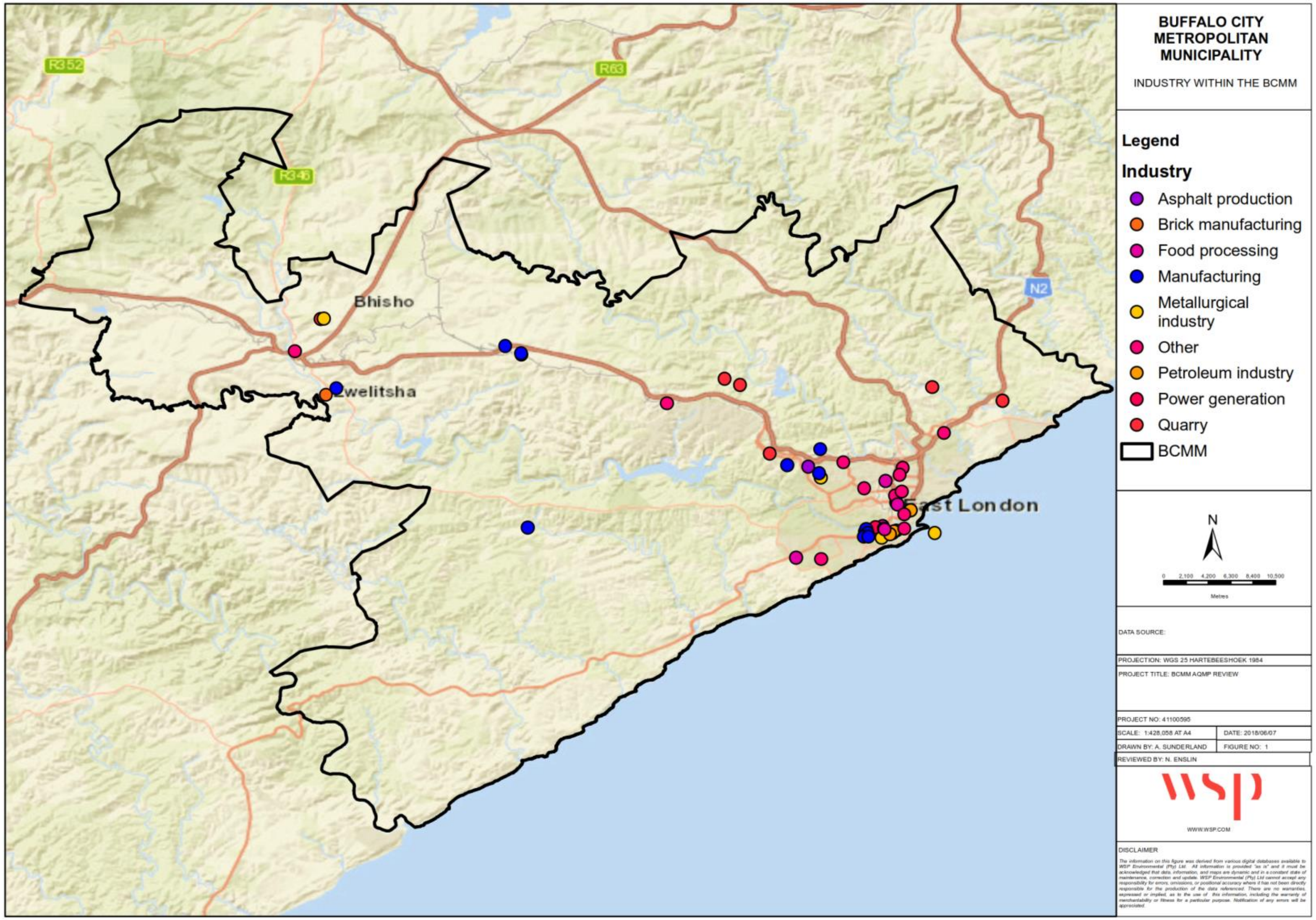

Figure 4-1: Location of industries Identified within the Buffalo City Metropolitan Municipality.

Industrial activities release gaseous and particulate emissions into the atmosphere. The main pollutants released from combustion processes include SO_2, CO, CO_2, NO_x and PM. Emission rates for most listed and non-listed industries were obtained from the recent NAEIS submissions, AELs as well as from completed questionnaires. Where emission rates were not available, emission rates were calculated for sources based on known source characteristics provided by the respective industries. Emissions were quantified using the emission factors from the Australian National Pollution Inventory (NPI) / USEPA and the known fuel consumption for each source (**Table 4-3 - Table 4-4**).

Table 4-3: Emission factors for combustion in boilers (NPI, 2011).

Fuel	Emission Factor (kg/ton)					
	NO_x	SO_2	CO	PM_{10}	$PM_{2.5}$	TVOCs
Coal	5.5	15.2	2.5	6.6	2.3	0.03
Diesel	2.72	0.0193	0.68	0.14	0.03	0.0272
Heavy fuel oil	7.32	0.02	0.67	0.19	0.12	0.04
Wood/Bark	1.49	0.17	4.08	3.24	2.74	0.12

Table 4-4: Emission factors for hot mix asphalt plants (USEPA, 2004).

Fuel	Emission Factor (kg/ton)						
	NO_x	SO_2	CO	CO_2	CH_4	PM_{10}	$PM_{2.5}$	VOCs
Diesel	0.06	0.04	0.20	18.50	0.004	0.01	0.001	0.004

East London is the main contributor to industrial emissions within the BCMM (**Table 4-5**). This is as expected due to the high concentration of industrial activities within East London. The second highest annual emissions are found in Berlin, while industries within Mdantsane and Zwelitsha were found to be of least impact. The majority of industrial emissions were found to comprise SO_2 (43%), NO_x (24%) and PM_{10} (19%) emissions. This is typical of industrial activities, particularly involving the combustion of coal and petroleum distillates (**Figure 4-2**). Coal is the most predominantly used fuel (37%) within the BCMM, with heavy fuel oil being the next most predominant (27%). Other fuels such as diesel, jet fuel, paraffin and waste are also used (**Figure 4-3**).

Table 4-5: Estimated industrial emissions per area in the Buffalo City Metropolitan Municipality.

Area	Emissions (tons per annum)						
	NO_x	SO_2	CO	PM_{10}	$PM_{2.5}$	TVOCs	Pb
Berlin	141	0.5	16	4	2	1	-
East London	17,474	31,615	5,812	13,897	4,872	104	3
Mdantsane	-	-	-	0.4	0.3	-	-
Zwelitsha	-	2.9E-10	-	-	-	-	-
TOTAL	**17,616**	**31,615**	**5,828**	**13,902**	**4,875**	**105**	**3**

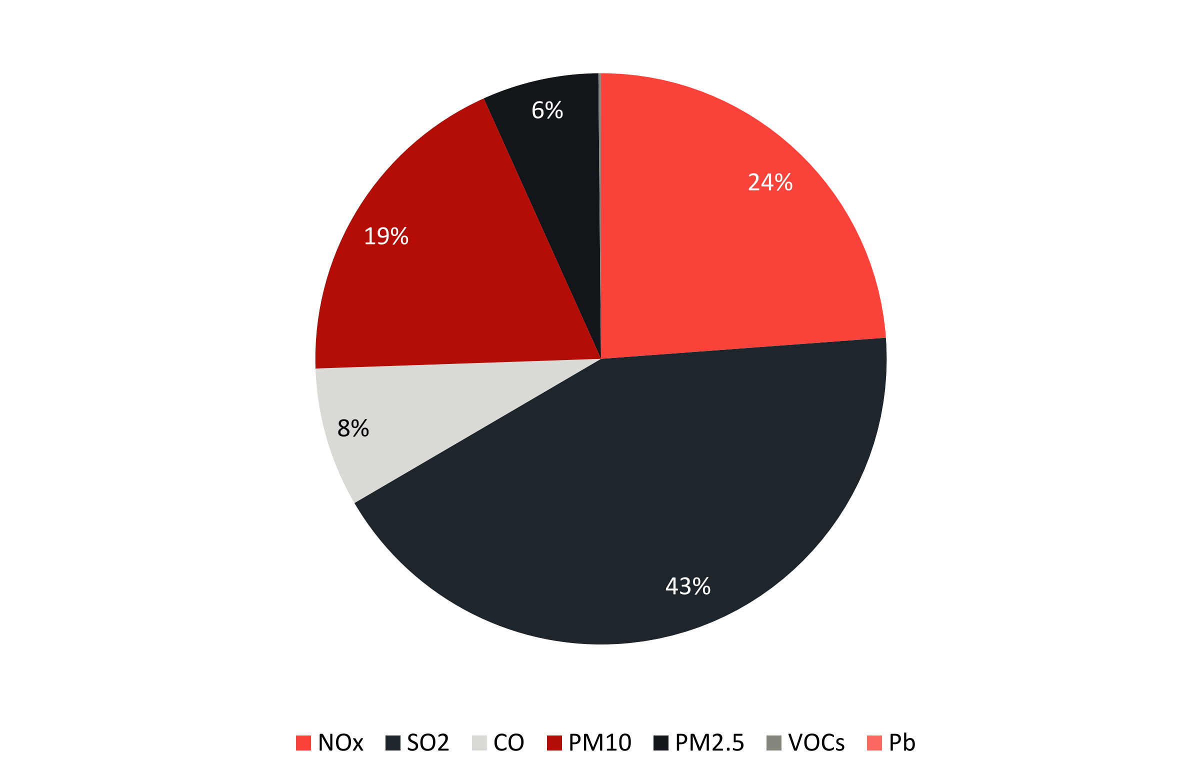

Figure 4-2: Total annual emissions from industries within the Buffalo City Metropolitan Municipality.

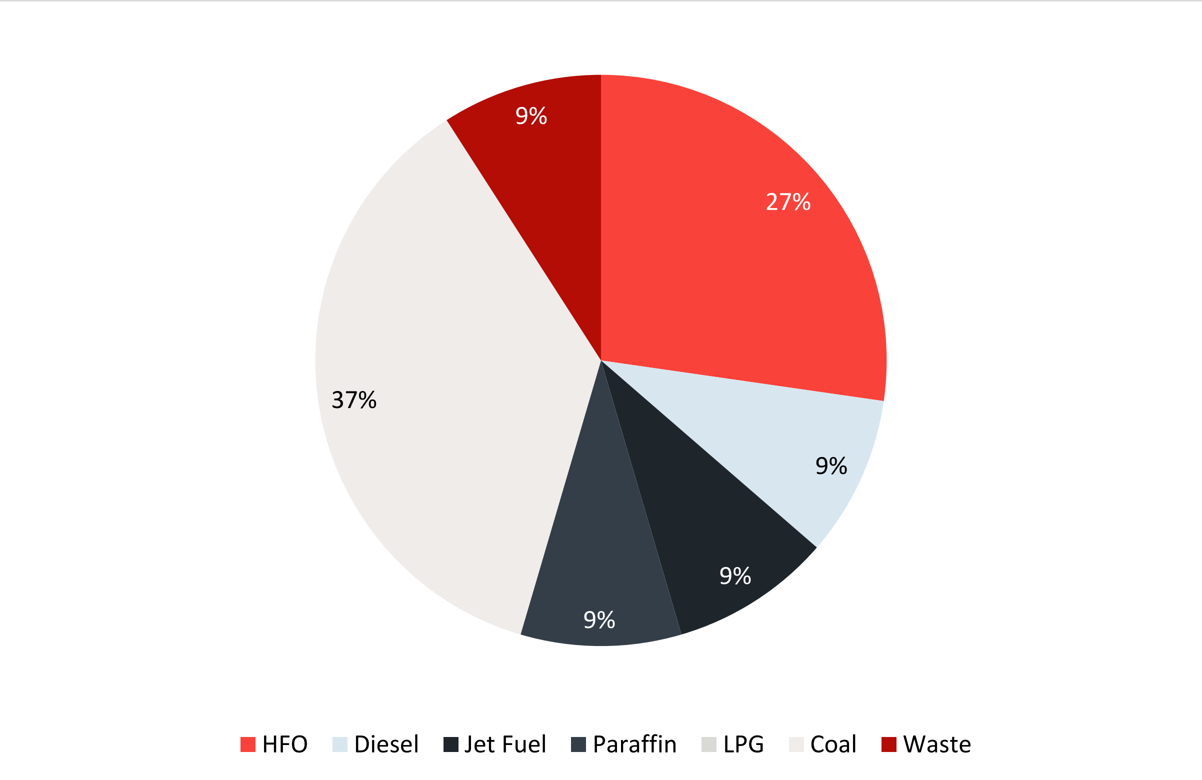

Figure 4-3: Fuels utilised by industries within the Buffalo City Metropolitan Municipality.

4.1.2 DOMESTIC FUEL BURNING

According to the 2016 Community Survey, approximately 82 and 87 % of households use electricity for cooking and lighting, respectively, within the Buffalo City Metropolitan Municipality. However, some households still continue to use fuels such as gas, wood and paraffin for cooking and space heating purposes (**Table 4-6** and **Figure 4-4**). Domestic fuel use was quantified for the BCMM using monthly fuel consumption figures for low-income households (Afrane-Okese, 1995), together with the numbers of households using the different fuel types (Census, 2011). Statistics and household numbers from the Census 2011 show that households continue to make use of domestic fuels due to high electricity costs and the traditional use of such fuels. **Figure 4-4** presents the percent household fuel usage within residential areas. While electricity is predominantly used, a significant portion of households still make use of coal, gas, paraffin and wood as a fuel source.

Pollutants released from these fuels include CO, NO_2, SO_2, inhalable particulates and polycyclic aromatic hydrocarbons. Particulates are the dominant pollutant emitted from the burning of wood. Smoke from wood burning contains respirable particles that are small enough in diameter to enter and deposit in the lungs. These particles comprise a mixture of inorganic and organic substances including aromatic hydrocarbon compounds, trace metals, nitrates and sulphates. Polycyclic aromatic hydrocarbons are produced as a result of incomplete combustion and are potentially carcinogenic in wood smoke (Maroni *et al.*, 1995).

The FRIDGE (Scorgie *et al.*, 2004) emission factors can be used, together with the total quantities of fuel consumed, to calculate domestic fuel burning emissions from coal, wood and paraffin burning (**Table 4-7**).

Table 4-6: Household fuel usage in the Buffalo City Metropolitan Municipality.

Fuel	Cooking (%)	Heating (%)	Lighting (%)
Electricity	74.6	49.6	81.1
Gas	3.8	2.7	0.4
Paraffin	18.6	40.7	16.7
Wood	2.5	5.8	-
Coal	0.1	0.7	-
Animal Dung	0.1	0.1	-
Solar	0.2	0.4	0.2
Other	0.2	0.0	1.5

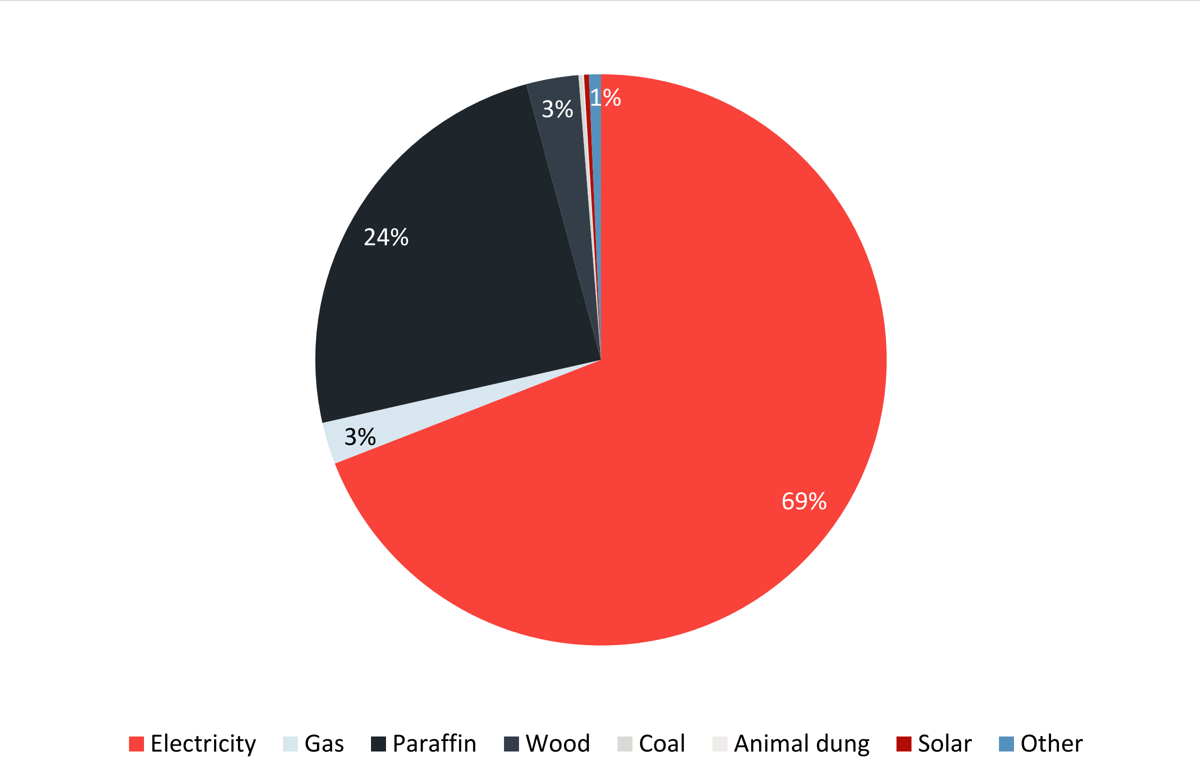

Figure 4-4: Household fuel usage in the Buffalo City Metropolitan Municipality.

Table 4-7: Emission factors for domestic fuel burning (Scorgie *et al.*, 2004).

Fuel	Emission Factor			
	SO_2	NO_x	PM_{10}	CO
Coal (g/kg)	19.00	1.50	4.10	187.40
Paraffin (g/l)	8.50	1.50	0.20	44.90
Wood (g/kg)	0.18	5.00	15.70	114.60
Gas (g/kg)	0.01	1.40	0.07	13.60

Estimated total SO_2, NO_x, PM_{10} and CO emissions from domestic fuel burning in key areas, and the BCMM as a whole, are given in **Table 4-8** and **Figure 4-5**. Chris Hani Township (near Mdantsane) is the largest contributor to domestic fuel burning emissions within the BCMM. Other areas with high contributions include Eluxolweni (near Mdantsane), Ententeni, Mzamonhle (near East London), Potsdam East and Potsdam South.

Table 4-8: Estimated domestic fuel burning emissions (tons per annum) in the Buffalo City Metropolitan Municipality.

Area	Emissions (tons per annum)			
	SO_2	NO_x	PM_{10}	CO
Chris Hani	1,819	44,950	300	13,070,507
Eluxolweni	110	2,705	23	786,193
Ententeni	250	6,151	43	1,788,435
Mzamonhle	627	15,484	103	4,502,378
Potsdam East	94	2,315	16	673,153
Potsdam South	51	1,263	17	366,546
BCMM	3,027	74,510	952	21,627,306

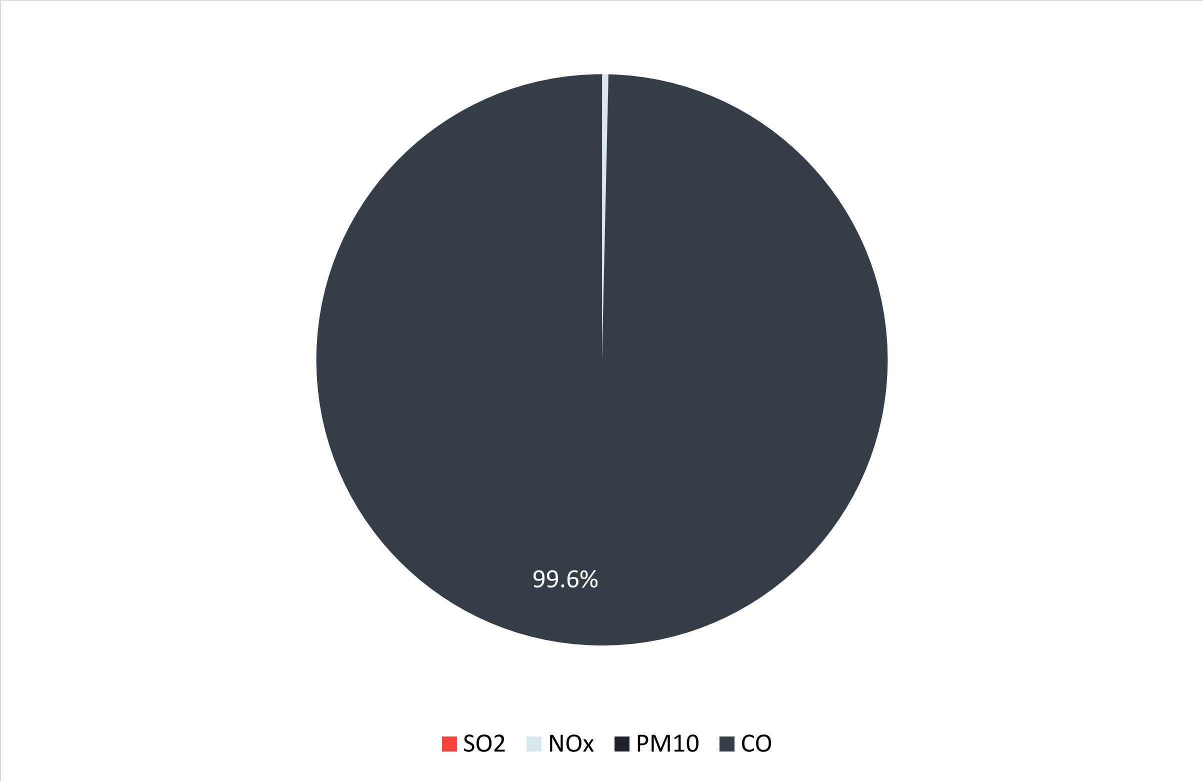

Figure 4-5: Estimated total SO_2, NO_x, PM_{10} and CO emissions (%) from domestic fuel burning in the Buffalo City Metropolitan Municipality.

4.1.3 TRANSPORT EMISSIONS

VEHICLE EMISSIONS

One of the major contributors to urban air pollution is vehicular emissions. Atmospheric pollutants emitted from motor vehicles include hydrocarbons, CO, NO_x, SO_2 and particulates. Hydrocarbon emissions, such as benzene, result from the incomplete combustion of fuel molecules in the engine. CO is a product of incomplete combustion and occurs when carbon in the fuel is only partially oxidized to carbon dioxide. NO_x are formed by the reaction of nitrogen and oxygen under high pressure and temperature conditions in the engine. SO_2 is emitted due to the high sulphur content of the fuel. Particulates such as lead originate from the combustion process as well as from brake and clutch linings wear. With the introduction of unleaded fuel, lead emissions have been reduced. Diesel engines are a significant source of particulate emissions. Vehicle emission rates are affected by specific vehicle-related factors such as vehicle class, model, fuel-delivery system, vehicle speed and maintenance history; fuel-related factors such as fuel type, oxygen, sulphur, benzene and lead content and environmental factors such as altitude, humidity and temperature (Samaras and Sorensen, 1999).

Emissions from vehicles in all Municipalities in South Africa were estimated in the Integrated Strategy for the Control of Motor Vehicle Emissions: Motor Vehicle Emission Inventory (DEA, 2013). Vehicle categories assessed included passenger cars, light duty vehicles (< 3.5 ton), heavy duty vehicles (> 3.5 ton) and buses and motorcycles. Emissions were estimated using emission factors for diesel (500 and 50 ppm) and gasoline, and fuel sales data for 2016 from the Department of Energy. Estimated vehicle emissions for the BCMM are given in **Figure 4-6**. Vehicle emissions are low compared to other Municipalities in South Africa, with annual average NO_x, CO and VOC emissions estimated to be 5878, 29 573 and 3 976 tons, respectively. SO_2 and PM_{10} emissions were 121 and 224 tons per annum, respectively (DEA, 2013).

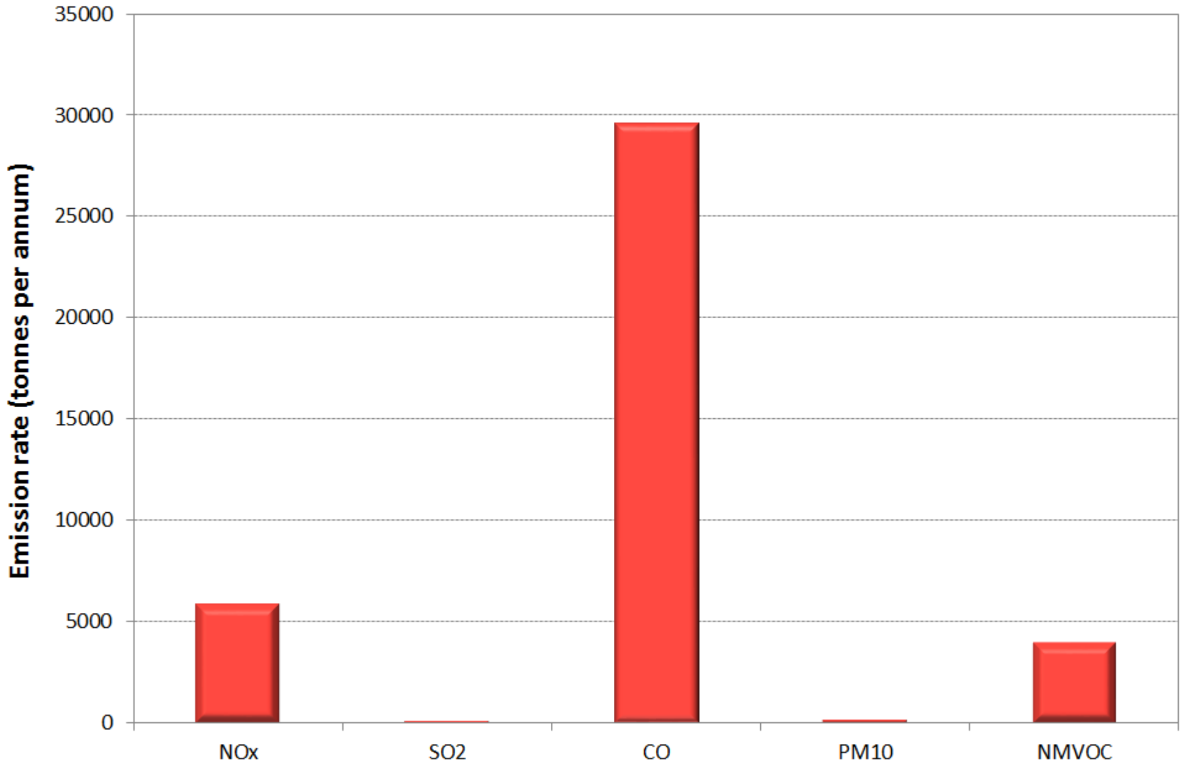

Figure 4-6: Vehicle emissions in the Buffalo City Metropolitan Municipality (after DEA, 2013).

For the estimation of more recent PM_{10} SO_2, NO_x, CO and VOC emissions from vehicles, fuel sales per magisterial district for 2016 were obtained from the Department of Energy. Diesel and petrol are the main fuels sold in the Municipality with negligible sales of furnace oil, LPG and paraffin (**Figure 4-7** and **Table 4-9**). Traffic count data was obtained from the South African National Roads Agency SOC Ltd (SANRAL) database (2017) recorded by several stations operating within the BCMM (**Figure 4-8**). However, this data is limited to a few main roads and highways, and as such, was not used to quantify vehicle emissions. For a more conservative estimate, information on the vehicle population in within the Municipality was obtained from eNATIS, which provides vehicle volumes for the following categories (**Table 4-10**).

- Unknown
- Special Vehicles
- Motorcycles/Motortricycle/Quadrucycle
- Minibus
- Light passenger motor vehicles (less than 12 persons)
- Heavy passenger motor vehicles (12 or more persons)
- Light load vehicles (GVM 3500 kg or less)
- Heavy load vehicles (GVM>3500 kg, equip to draw)
- Heavy load vehicles (GVM>3500 kg, not to draw)

Sulphur content of diesel in South Africa is regulated under the Petroleum Product Act (No. 120 of 1977) at 50 mg/kg[17] for low grade and 500 mg/kg[18] for standard grade diesel. A breakdown of the sulphur content of the diesel (diesel 50 and diesel 500) was not available. The average fuel consumption figures for different vehicle categories were used to apportion the fuels sales to the different vehicle categories.

[17] Department of Minerals and Energy (2006): Regulations regarding petroleum products specifications and standards. Government Gazette (No. R. 627) 23 June 2006 (No. 208958)
[18] Ibid.17

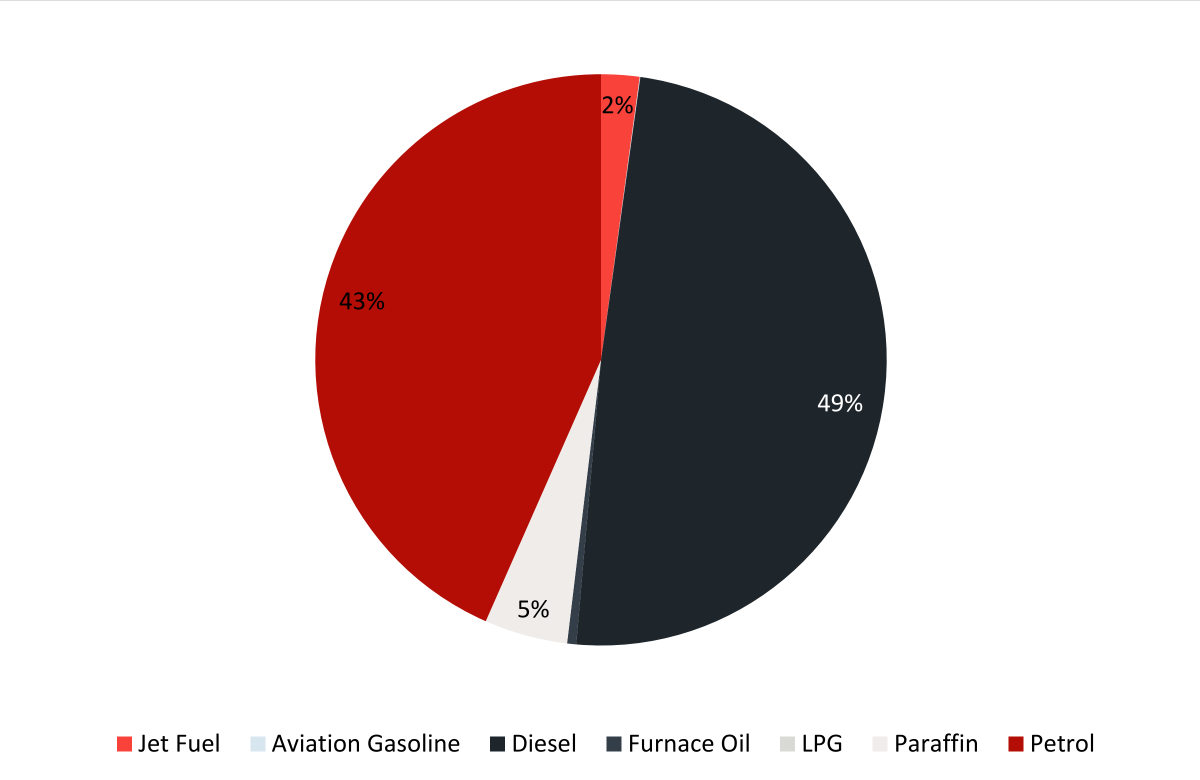

Figure 4-7: Fuel sales within the Buffalo City Metropolitan Municipality.

Table 4-9: Fuel sales (litres) per magisterial district (2016) in the Buffalo City Metropolitan Municipality.

Fuel	East London	King William's Town	Mdantsane	Zwelitsha
Jet fuel	13,887,642	-	-	-
Aviation	239,423	-	-	-
Diesel	298,303,085	12,007,905	5,286,637	-
Furnace oil	2,341,074	938,988	-	-
Paraffin	-	-	-	-
Petrol	28,462,410	1,389,180	391,802	-

Table 4-10: Number of licensed and unlicensed vehicles within the Buffalo City Metropolitan Municipality.

Vehicle Type	Buffalo City Metropolitan Municipality			
	East London	Gonubie	King William's Town	Mdantsane
HVL (GVM>3500Kg equip to draw)	1647	1617	325	0
HVL GVM>3500Kg, not to draw)	1631	1668	216	0
Heavy passenger mv (12 or more persons)	2461	296	1266	0
Light load vehicle (GVM 3500Kg or less)	27529	13281	9990	0
Light passenger mv(less than 12 persons)	73103	17662	21067	2
Motorcycle / Motortricycle / Quadrucycle	2442	1534	268	0
Special Vehicle	1159	1535	244	0
Unknown	207	82	81	0

Notes:
(1) GVM>3500kg, not to draw
(2) GVM>3500 kg, equip to draw
(3) GVM 3500 kg or less
(4) 12 or more persons
(5) Less than 12 persons

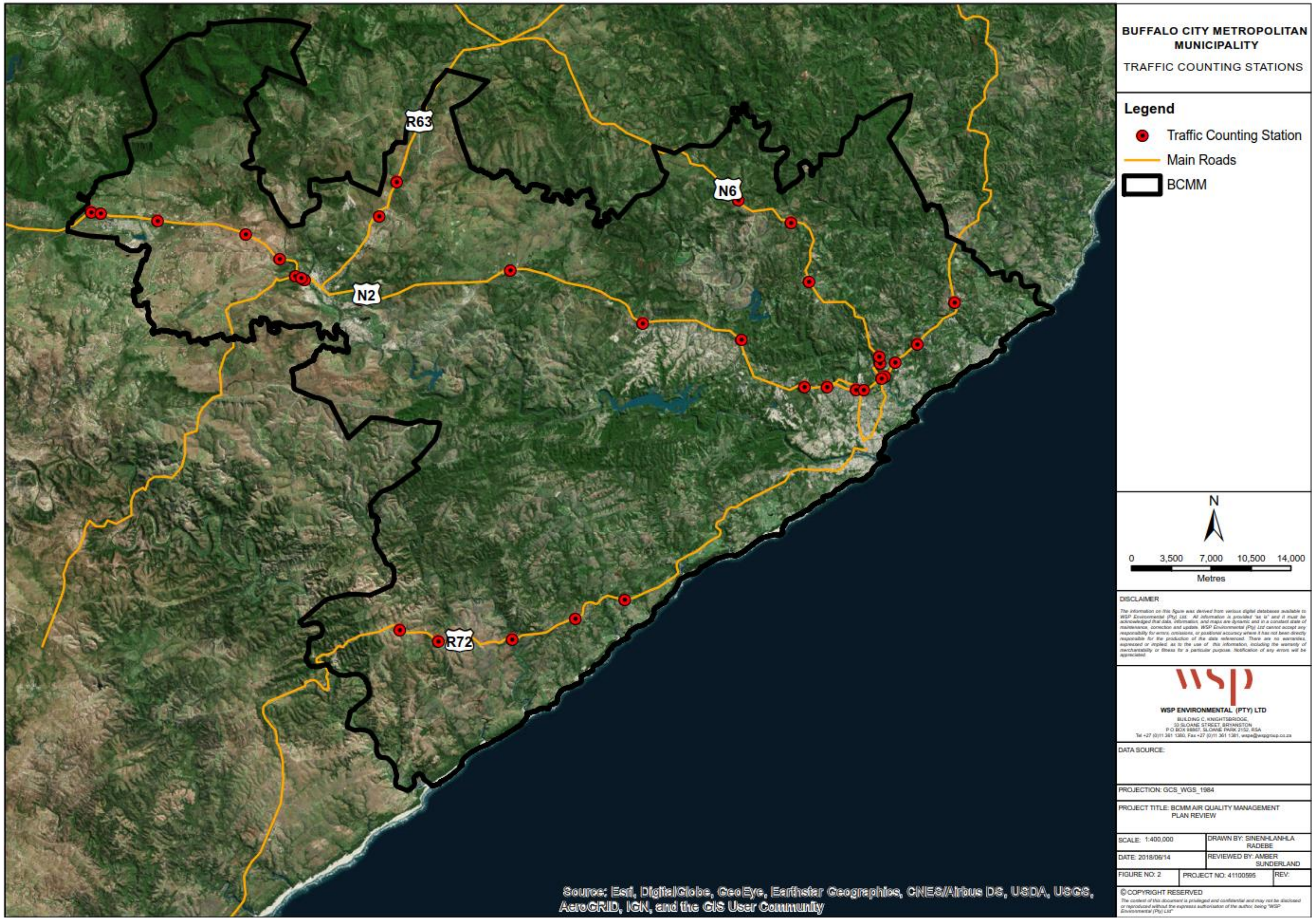

Figure 4-8: Location of SANRAL traffic counting stations along main roads within the Buffalo City Metropolitan Municipality.

Local emission factors have been developed for tailpipe exhaust emissions from petrol (Wong and Dutkiewicz, 1998) and diesel driven vehicles (Stone, 2000) at the coast (Cape Town) and Highveld (Johannesburg). However, the European Environment Agency (EEA) emission factors will be used to ensure alignment with the methodology followed in the Eastern Cape Air Quality Management Plan. The EEA have developed emission factors for combustion from motor vehicles (**Table 4-11**), tyre and brake wear, and road surface wear (**Table 4-12**) and evaporation from motor vehicles (**Table 4-13**). In the absence of detailed information on vehicle kilometres travelled, it was assumed that each vehicle travels 25 000 km per annum (DEA, 2013).

Table 4-11: Emission factors for combustion from motor vehicles (EEA, 2012).

Category	Fuel	Emission Factor (g/kg)					
		NO_x	SO_2	CO	$PM_{2.5}$	NMVOC	Lead
Motorcycles	Gasoline	6.64	-	497.70	2.20	131.4	0.000033
Passenger cars	Gasoline	8.73	-	84.70	0.03	10.05	0.000033
	Diesel 50	12.96	0.10	3.33	1.10	0.70	0.000052
Light-duty vehicles	Gasoline	13.22	-	152.30	0.02	14.59	0.000033
	Diesel 500	14.91	1.00	7.40	1.52	1.54	0.000052
Heavy-duty vehicles and buses	Diesel 500	33.37	1.00	7.58	0.94	1.92	0.000052

Table 4-12: Emission factors for tyre and brake wear and road surface wear (EEA, 2013).

Category	Emission Factor (g/km/vehicle)	
	PM_{10}	$PM_{2.5}$
Motorcycles	0.0094	0.0050
Passenger cars	0.0213	0.0115
Light-duty vehicles	0.0291	0.0158
Heavy-duty vehicles and buses	0.0970	0.0521

Table 4-13: Emission factors for evaporation from motor vehicles (EEA, 2013).

Category	Fuel	Emission Factor (g/vehicle/day)
		NMVOC
Motorcycles	Gasoline	7.50
Passenger cars	Gasoline	14.60
	Diesel 50	-
Light-duty vehicles	Gasoline	22.20
	Diesel 500	-
Heavy-duty vehicles and buses	Diesel 500	-

The total estimated PM_{10} SO_2, NO_x, CO and VOC emissions are given in **Figure 4-9**. Annual average NO_x, CO and VOC emissions for 2016 were estimated to be 9 251, 41 141 and 7 330 tons, respectively. SO_2 and PM emissions were 230 and 566 tons per annum, respectively.

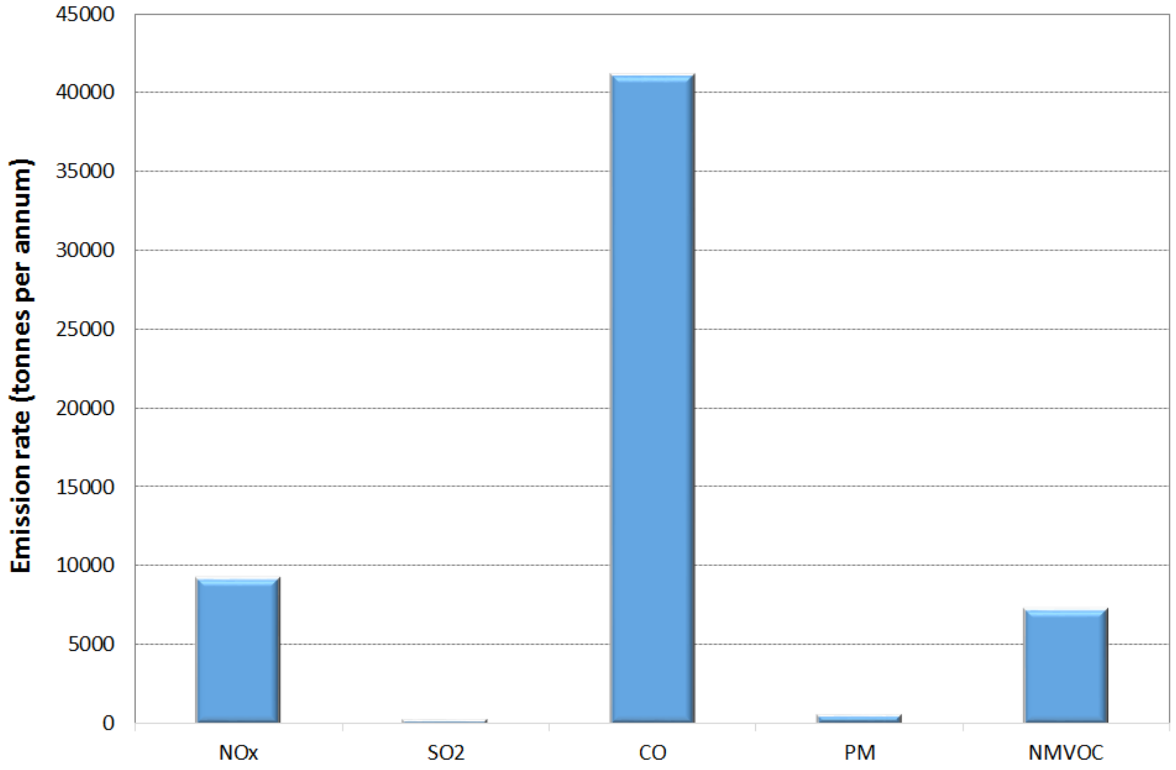

Figure 4-9: Estimated vehicle emissions (tons/annum) in the Buffalo City Metropolitan Municipality

AIRPORT

Airports can be significant sources of atmospheric pollution due to jet fuel storage facilities and aircraft operations. In addition, due to the mobile nature of aircraft in terms of distance and altitude, aircraft exhaust fumes have the potential to impact local, regional and international air quality. It is estimated that 10% of aircraft emissions are produced while grounded and during take-off and landing. The remaining occur at higher altitudes. Associated emissions include, CO_2, PM, NO_x, CO, SO_2 and VOCs. Emissions associated with airports are a function of the jet fuel composition and the number of take-off and landing cycles (including take-off, climb out, approach, landing and idle functions).

East London Airport is one of the fastest growing airports in South Africa, receiving approximately 20 and 30 flights per day and approximately 620 000 people per annum. The airport is a crucial link in the cargo chain, playing an important role in the growing economy of the Eastern Cape. Planes carrying a variety of cargo head for domestic and international destinations, including France and Holland.

Available information on aircraft arrivals and departures was obtained from ACSA's website (**Figure 4-10**). Current information on the type of aircraft and number of flights at East London Airport was requested from Airports Company South Africa (ACSA) but comprehensive information was not received.

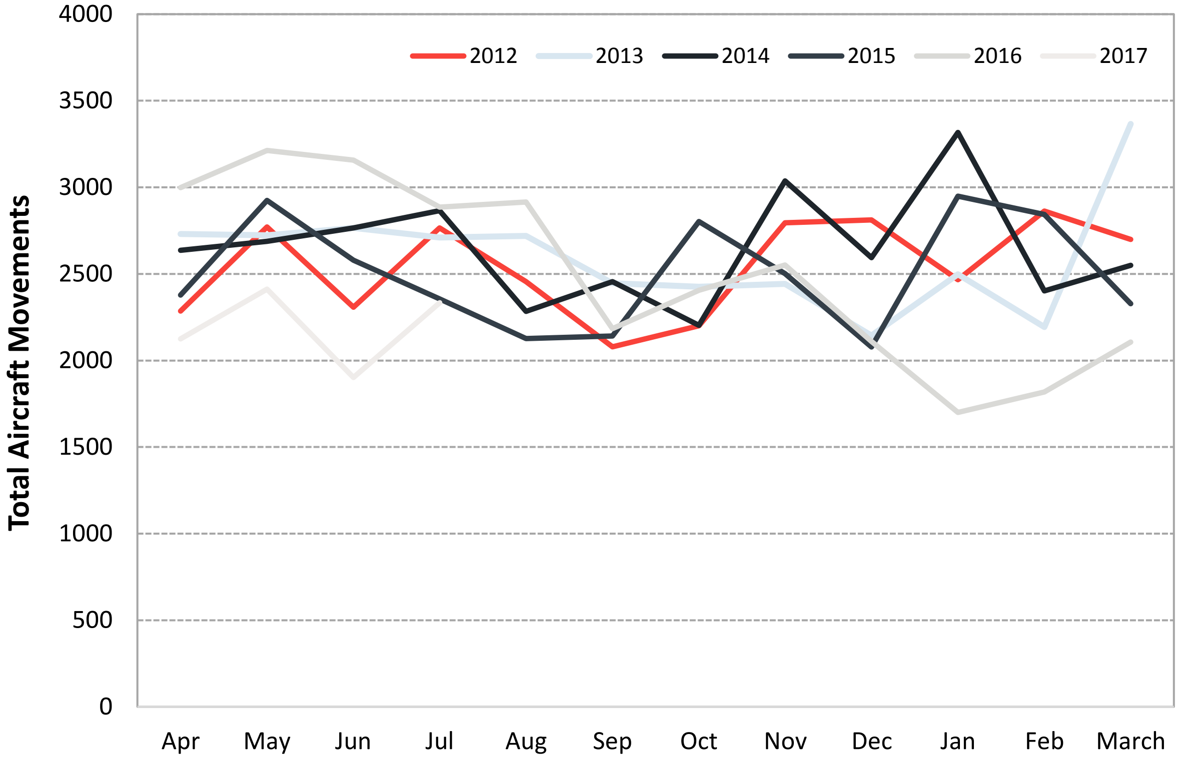

Figure 4-10: Aircraft arrivals and departures at East London Airport for the period April 2012 – July 2017.

HARBOUR

Mobile source, port emissions are generated by marine vessels and by land-based sources at ports. Marine emissions come primarily from diesel engines operating on oceangoing vessels (OGVs), tugs and tows, dredges and other vessels operating within a port area. Land-based emission sources include cargo-handling equipment (CHE) such as terminal tractors, cranes, container handlers, forklifts as well as heavy-duty trucks and locomotives operating within a port area. These land-based sources are also likely to have diesel engines. Diesel emissions of concern include NO_x, SO_x, PM and air toxics (Browning, 2006).

The largest part of emissions in ports is generally from shipping activities. Emissions from seagoing vessels can be separated into emissions 1) on international waters, 2) on national waters and 3) while in berth. Ships in berth are the main source of shipping emissions in ports because the ships typically spend one or more days there, while manoeuvring only takes about two hours (Denier van der Gon and Hulskotte, 2010). An detailed understanding of port traffic (including each vessel type arriving at and departing from the port, time spent manoeuvring in and out of the quay and time spent stationary at the quay), is required in order to develop an emissions inventory. This data was requested from the Port of East London, though has not yet been received. **Figure 4-11** provides a typical break-down of the types of vessels accessing the Port of East London over a period of 30 days (sourced from marine traffic.com (2007-2018)). The predominant vessel type is tug boats (64%), as these are required to assist larger vessels with manoeuvring in and out of the quay. Cargo ships (21%) and tankers (10%) are the second and third most predominant vessels recorded arriving at the Port of East London.

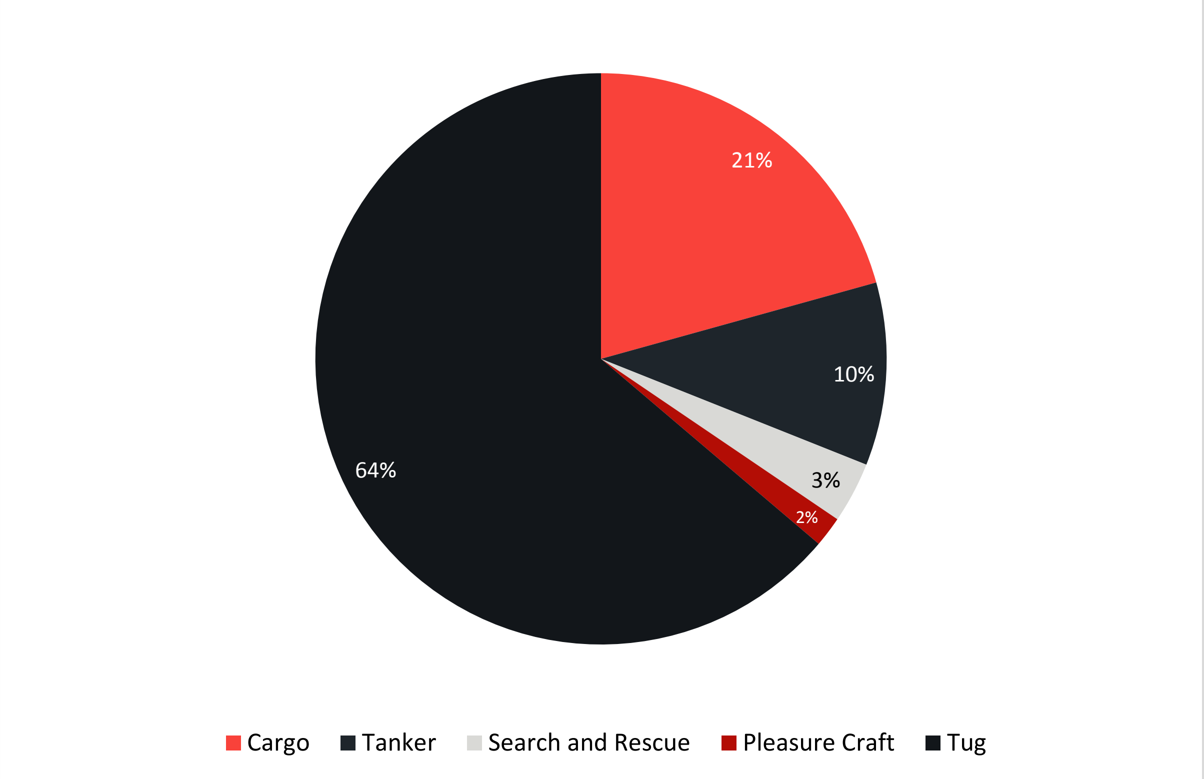

Figure 4-11: Vessel arrival by type over a 30 day period (Marinetraffic.com, 2018).

4.1.4 AGRICULTURE

Emissions from agricultural activities are difficult to control due to the seasonality of emissions and the large surface area producing emissions (USEPA, 1995). Expected emission resulting from agricultural activities include particulates associated with wind erosion and burning of crop residue, chemicals associated with crop spraying and odiferous emissions resulting from manure, fertilizer and crop residue.

Dust associated with agricultural practices may contain seeds, pollen and plant tissue, as well as agrochemicals, such as pesticides. The application of pesticides during temperature inversions increases the drift of the spray and the area of impact. Dust entrainment from vehicles travelling on gravel roads may also cause increased particulates in an area. Dust from traffic on gravel roads increases with higher vehicle speeds, more vehicles and lower moisture conditions.

Air emissions from pesticides arise because of the volatile nature of many active ingredients, solvents, and other additives used in formulations, and of the dusty nature of some formulations. Most modern pesticides are organic compounds. Emissions can result directly during application or as the active ingredient or solvent volatilizes over time from soil and vegetation. Organic compounds and particulate matter are the main air emissions from pesticide application. The active ingredients of most types of synthetic pesticides used in agriculture have some degree of volatility, ranging from non-volatile, semi-volatile to volatile organic compounds (e.g. fumigants). Many pesticide formulations are liquids or emulsifiable concentrations which contain volatile organic solvents such as xylene, emulsifiers, diluents and other organics.

Agriculture is a common land-use within many areas of the BCMM, however, contributes less than 1% of all value added by broad economic sector within the BCMM. This is likely due to subsistence farming being the dominant agricultural practice within the area. As such, atmospheric emissions resulting from agricultural activities are likely to be negligible and were not assessed further.

4.1.5 BIOMASS BURNING

As a significant source of gaseous and particulate matter emissions to the atmosphere, biomass burning is a persistent problem in South Africa. Fires are usually anthropogenically induced for the purposes of land management (i.e.: crop land management, preventing bush encroachment, firebreaks, etc.). Pollutants associated with biomass burning include GHGs (CO_2, CH_4 and NO_x), O_3, CO, and VOCs). Emission properties are a function of the burning process and fuel type. The combustion process for smouldering fires is less efficient resulting in an increase in the release of CO, whereas more complete combustion occurs with intense, flaming fires, releasing CO_2.

Veld fire risk for the Municipalities of South Africa has been determined based on the prevailing vegetation type by Kruger *et al* (2006). Biomes categorised as high to extreme risk include savannah, grassland and fynbos (**Figure 4-12**).

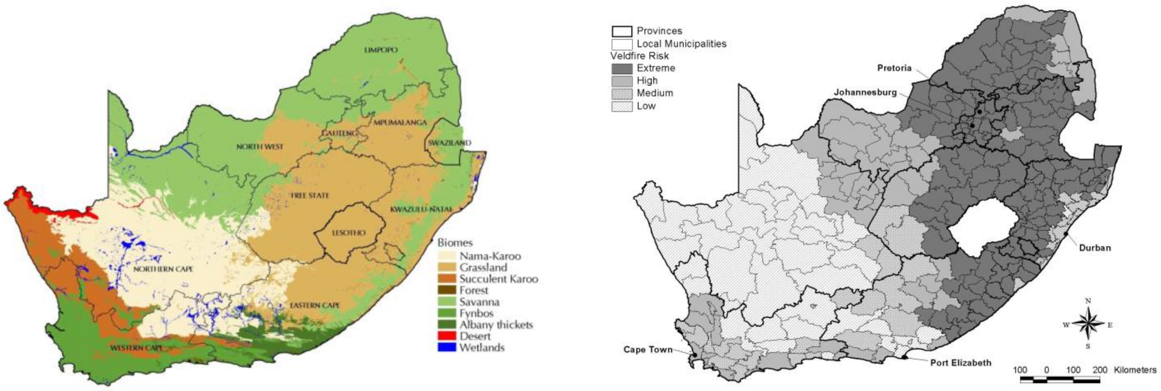

Figure 4-12: Biomes of South Africa (left) and fire risk for South African Municipalities (right) (South African National Biodiversity Institute, 2004).

Emissions released from biomass burning can be quantified by using active fire detection systems and applying an emissions factor for the relevant vegetation type. The Council for Scientific and Industrial Research (CSIR) Satellite Applications Centre (SAC) in conjunction with Eskom and the Department of Agriculture has developed a fire monitoring system, the Advanced Fire Information System (AFIS). The AFIS product has been developed with the assistance of the NASA and the University of Maryland and uses MODIS and MSG data, and applies the Wild Fire Automated Biomass Burning Algorithm (WF_ABBA) to the satellite data. This near-real time monitoring system provides fire information to disaster management centres, fire protection agencies, Eskom's national control centre and researchers, in an attempt to document and monitor the frequency and distribution of natural and man-made fires and allow for early fire detection. The products generated are displayed as regional maps and are accessible on the internet.

As would be expected, given the characteristically low fire risk of the biomes within the BCMM, biomass burning data obtained from the AFIS indicated no record of fires (burnt areas) within the Municipality for the period January – December 2017. Biomass burning emissions also occur as a result of agricultural practices. Given the negligible occurrence of commercial farming, it is expected that biomass burning would be an unlikely occurrence within the BCMM. As such, potential emissions associated with biomass burning within the BCMM were not assessed further.

4.1.6 WASTE TREATMENT AND DISPOSAL

Waste treatment includes the disposal of waste materials ranging from general domestic waste to hazardous industrial and liquid effluent at landfill, incineration or wastewater treatment facilities.

LANDFILLS

Landfills are a major source of GHGs including CO_2 and CH_4. Odorous, toxic and carcinogenic trace gases such as C_6H_6 are also cause for concern particularly with regards to the associated odour nuisance and human health implications[19]. These gases are emitted as a result of waste decomposition. Emission concentrations depend on the composition, storage and handling of the waste as well as mitigation measures implemented by the landfill to manage these atmospheric emissions. In terms of the National Environmental Management: Waste Act (No 59 of 2008), all landfill sites are required to obtain a waste management license from the Department of Environmental Affairs, before being established and commencing operations. However, there are many unpermitted landfills operating around the country and within the BCMM. These range from well managed facilities to situations where uncontrolled dumping has occurred. According to the US EPA (1998)[20], Landfill gas (LFG) consists of CO_2 (40%), CH_4 (55%) and trace amounts of non-methane organic compounds (NMOC) and VOCs. Although CO_2 and CH_4 were recently identified as priority pollutants in South Africa, the quantification of GHGs within the BCMM is beyond the scope of this AQMP review and therefore LFG emissions have not been quantified as part of this emissions inventory.

Information on waste disposal sites was obtained from the BCMM (**Table 4-14**). The BCMM only has two operational waste disposal sites, namely the East London Regional Waste Disposal Site (also known as Roundhill), located to the south-east of Berlin, and King Williams Town landfill, located north of the town.

Table 4-14: Waste disposal sites within the Buffalo City Metropolitan Municipality.

Site	Status	Latitude (ºS)	Longitude (ºE)
Beacon Bay	Closed	32˚ 57’ 16” S	27˚ 57’ 00” E
Berlin Battery	Closed	32˚ 53’ 37” S	27˚ 35’ 52” E
Dimbaza	Closed	32˚ 50’ 35” S	27˚ 12’ 45” E
Ducats	Rehabilitated	32˚ 55’ 45” S	27˚ 54’ 30” E
Kayser’s Beach	Communal	33˚ 12’ 20” S	27˚ 35’ 56” E
Kidd’s Beach	Communal	33˚ 08’ 22” S	27˚ 41’ 08” E
KWT (Tannery Site)	Closed	32˚ 53’ 20” S	27˚ 24’ 10” E
Macleantown	Closed	32˚ 46’ 28” S	27˚ 45’ 21” E
NU12	Closed	32˚ 55’ 21” S	27˚ 42’ 27” E
NU2	Closed	32˚ 57’ 31” S	27˚ 45’ 20” E
Old Everite	Closed	32˚ 53’ 23” S	27˚ 24’ 18” E
Old Selbornian	Closed	32˚ 59’ 42” S	27˚ 55’ 15” E
Port Rex	Closed	32˚ 59’ 14” S	27˚ 54’ 46” E
Second Creek	Closed	33˚ 01’ 15” S	27˚ 53’ 18” E
Westbank	Closed	33˚ 02’ 26” S	27˚ 52’ 36” E
East London Regional Waste Disposal Site	Operational	32˚ 53’ 30” S	27˚ 37’ 33” E
King William’s Town	Operational	32˚ 51’ 06” S	27˚ 23’ 27” E

INCINERATORS

‘Incineration’ is defined as any method, technique or process to convert waste to flue gases and residues by means of oxidation. ‘Thermal treatment’ means incineration, co-processing and other high temperature treatment of hazardous and general waste. Pollutants released from waste incineration include sulphur dioxide, heavy metals, acid gases, dioxins and furans, which represent a considerable air quality and human health risk. Particulate emissions from incinerators may also contain heavy metals such as chromium and cadmium, which are suspected human carcinogens.

In 2009, the Department of Environmental Affairs published the National Policy on Thermal Treatment of General and Hazardous Waste. The policy provides the framework within which the following thermal treatment technologies shall be implemented in the country:

[19] Ibid.32

[20] United States Environmental Protection Agency (1998): *AP42 5th ed Vol 1 – Chapter 2: Solid Waste Disposal* (www3.epa.gov) Last updated: 05/07/2016

i. The incineration of general and hazardous waste in dedicated incinerators or other high temperature thermal treatment technologies, including but not limited to pyrolysis and gasification and;

ii. The co-processing of selected general and hazardous wastes as alternative fuels and/or raw materials (AFR) in cement production.

The policy proposed air emission standards for waste incineration and AFR co-processing (prior to the publishing of the Listed Activities and Minimum Emission Standards) as well as outlining the monitoring requirements for waste incineration and AFR co-processing activities. An approved Environmental Authorisation is also required in terms of the National Environmental Management Act, No. 107 of 1998. Compliance with the conditions as listed in the policy is also required.

With the introduction of the Listed Activities and Minimum Emission Standards, incineration is classified as a listed activity in terms of Category 8: Thermal Treatment of Hazardous and General Waste.

Waste incineration processes involve the destruction of various waste types through the application of heat. Pollutants released from incinerators include PM, CO, SO_2, NO_x, Pb, hydrogen chloride, hydrogen fluoride, mercury, cadmium, thallium, organic compounds, NH_3 and dioxins and furans. Emissions from such facilities pose a significant health risk and are also associated with nuisance impacts from odours.

Within the BCMM, four incinerators were identified at the SPCA, Clean Tech Agrochem, East London abattoir and East London Crematorium, respectively, with only the East London Crematorium incinerator found to be currently operational. Hazardous waste is collected and either transported to Port Elizabeth or to Gauteng for treatment or disposal. The development of a Health Care Risk Waste thermal treatment plant has been proposed within East London's Industrial Development Zone (IDZ).

WASTEWATER TREATMENT WORKS

Pollutants released during wastewater treatment include a range of VOCs. Species measured at local waste water treatment works include hydrogen sulphide, mercaptans, ammonia, formaldehyde, acetone, toluene, ethyl benzene, xylenes, perchloroethylene, butyric acid, propionic acid, valeric acid and acetic acid.

Wastewater treatment works also have the potential to generate unpleasant odours, which can result in annoyance and consequently have a detrimental effect on a local population. Species associated with odours include hydrogen sulphide and ammonia as well as a variety of organic sulphides and organic nitrogen based compounds along with some oxygenated organic compounds and organic acids.

FUGITIVE DUST SOURCES

Sources of fugitive dust within the BCMM are quarries, cement batching and product plantsand crushing facilities. These sources have been identified mainly within East London and King William's Town. Given the nature of fugitive emissions, the above mentioned sources are likely to impact on local dust levels with close proximity to the dust generating activities. Fugitive dust concentrations typically dissipate rapidly with distance from the source, having a low impact on regional concentrations.

4.2 EMISSIONS SUMMARY

Emission concentrations for pollutants of concern have been quantified where possible. Total estimated emissions have been apportioned between the contributing sources within the BCMM (**Table 4-15** and **Figure 4-13**). Industrial sources are the main contributor to SO_2 (90%) and PM_{10} (93%) emissions within the BCMM. Domestic fuel burning is the second highest contributor to SO_2 (9%) and PM_{10} (6%), while vehicle emissions contribute approximately 1% to SO_2 and PM_{10} respectively. Domestic fuel burning is the main contributor to NO_2 (74%) and CO (100%) emissions. While industrial and vehicle emissions account for approximately 17 and 9 % if NO_2 emissions, respectively, these sources contribute less than 1% toward total CO emissions within the BCMM.

Table 4-15: Total estimated emissions by source for the Buffalo City Metropolitan Municipality.

Pollutant	Emission Rate (Tons/annum			
	Industry	Domestic fuel burning	Vehicle Tailpipe and Entrainment	Total
SO_2	31,615	3,027	230	34,872
NO_2	17,616	74,510	9251	101,377
CO	5,828	21,627,306	41,140	21,674,274
PM_{10}	13,902	952	124	14,978
$PM_{2.5}$	4,875	Not quantified	441	5,316
Pb	3	Not quantified	0.02	3
VOCs	105	Not quantified	7,330	7,435

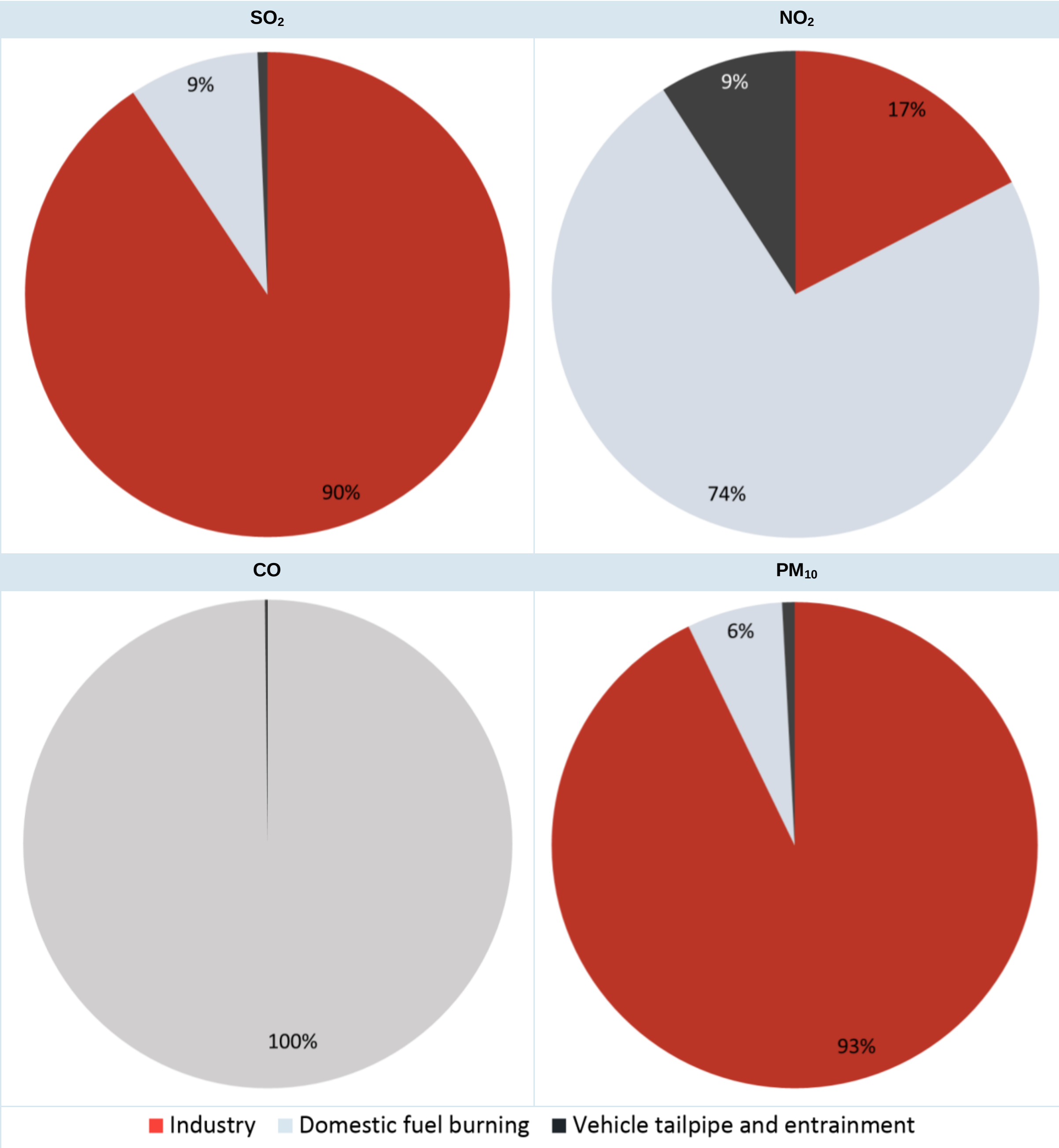

Figure 4-13: Source contributions to emissions within the Buffalo City Metropolitan Municipality.

5 OPERATIONAL CAPACITY

5.1 GOVERNMENT STRUCTURE AND FUNCTIONS

The capacity for air quality management and control within the BCMM is assessed within the various spheres of Government. The current capacity at Provincial and Metropolitan levels is evaluated in terms of available personnel, functions and resources.

5.1.1 PROVINCIAL LEVEL

In-line with NEM:AQA, each provincial member of the executive committee (MEC) with environmental responsibilities has exclusive authority over several aspects of air quality management. As such, the MEC facilitate the following tasks:

- Designate an AQO responsible for coordinating all air quality affairs within the province;
- Develop a provincial AQMP in fulfilment of the Environmental Management Plan;
- Develop an annual report detailing the implementation progress of the AQMP and compliance with the provincial implementation plan;
- Process AEL applications for municipalities within the province (if delegated by a metropolitan or district municipality to fulfil this function); and
- Review all AQMPs received from municipalities within the province.

Furthermore, the MEC has the discretional authority to establish provincial emission and ambient air quality standards, declare priority areas within the province and establish management plans for such areas.

5.1.2 METROPOLITAN LEVEL

Within provinces, district and local municipalities have governance responsibilities and exclusive authority regarding air quality management. In fulfilment of such responsibilities, municipalities must conduct the following:

- Designate an AQO within the municipal administration;
- Develop an AQMP as part of their IDP; and
- Develop an annual report detailing implementation progress of the AQMP and compliance with the implementation plan.

5.2 CURRENT CAPACITY

The air quality management responsibilities for each governmental tier are clearly defined within the National Framework for Air Quality Management[21]. The development of the organisational capacity required to implement these functions is at the discretion of each department or municipality. Organisational capacity can be defined as the structures (including sustainable funding), systems, skills, strategies, incentives and interrelationships necessary to efficiently and effectively implement air quality management functions. How each sphere intends to capacitate themselves must be defined within their AQMP.

The BCMM empowers the office of Municipal Health Services, which umbrellas four departments, namely; Special Programmes, Municipal Health Services: Coastal Region, Municipal Health Services: Inland Region, Municipal Health Services: Midland Region. The department of Municipal Health Services: Coastal Region manages Special Programmes, which further controls three Divisions, including Environmental Health Support, Integrated Environmental Strategic Management, and Community Development and Projects. Air quality management is a responsibility of the Integrated Environmental Strategic Management, together with Vector Control Surveillance and Pollution Control. Departmental hierarchy is shown in **Figure 5-1**.

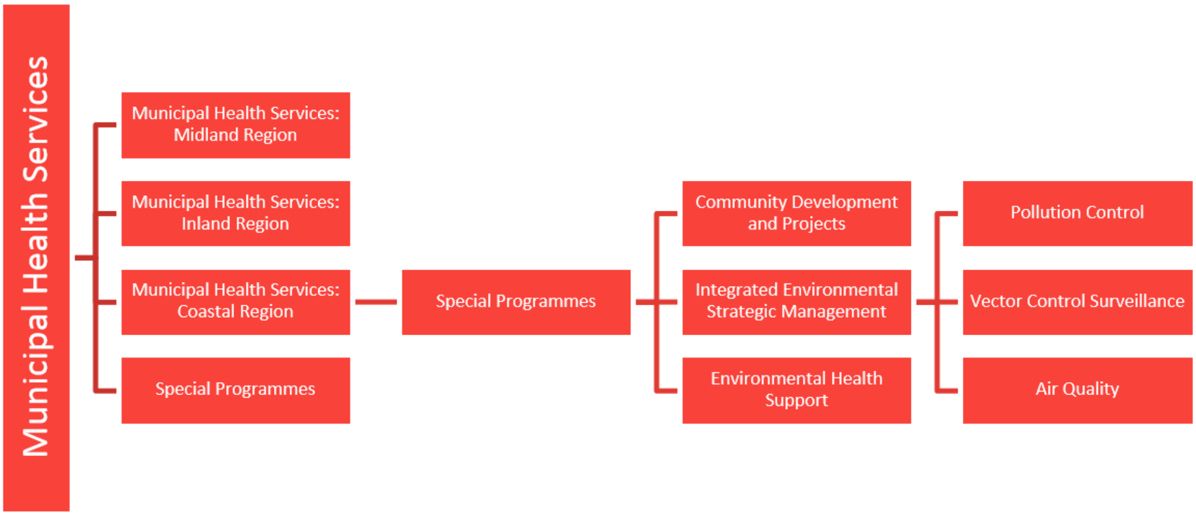

Figure 5-1: Departmental organogram for Buffalo City Metropolitan Municipality.

The BCMM has assigned two posts to the Air Quality division including that of a Chief Air Quality officer and a Senior Air Quality Officer. The Pollution Control Officer acts as an assistant to the Chief Air Quality Officer, however, a Senior Air Quality officer has not yet been appointed.

GOVERNANCE

For the BCMM AQMP to be effective, co-operative governance across all spheres of government is required, as well as the capacity to enforce compliance with air quality legislation. Air quality management and control in the Municipality is currently a function of the BCMM. For the BCMM to continue fulfilling its regulatory role in terms of air quality, the AQO needs to have a good understanding of air quality issues within each area of the Metropolitan Municipality. Current duties and functions of the BCMM AQO include:

- Implementing the requirements of the NEM:AQA including:
  - Setting ambient air quality standards;
  - Setting local emission standards;
  - Development of air quality by-laws;
  - Emission licencing of listed activities and permitting of controlled emitters;
  - Design and implementation of an air quality monitoring programme;
  - Development and upkeep of an emissions inventory;
  - Enforcement and compliance;
  - AQMP review at least every 10 years;
  - Developing reporting mechanisms to inform national, provincial and local authorities on a monthly basis; and
  - Develop an annual "State of the Air" report, including the Municipality's progress towards the implementation of its AQMP, for submission to the provincial AQO.
- Manage the review and implementation of the BCMM AQMP;
- Request Atmospheric Impact Reports and Pollution Prevention Plans based on Best Available Technology (BAT) or the Best Practicable Environmental Option from emitters;
- Advise on the establishment of priority areas in the Municipality if deemed necessary; and
- Develop air quality and climate change policies, instruments and tools to support environmental policy and promote the air quality and climate change function.

AMBIENT AIR QUALITY MONITORING AND DATA REPORTING

Ambient air quality monitoring is an integral part of effective air quality management. Monitoring will enable the Municipality to assess the extent of the air pollution situation to develop appropriate air quality goals and evaluate the effectiveness of emissions control strategies. Consideration needs to be given to the intended data use, financial feasibility (installation and maintenance costs), system reliability and current skill capacity when choosing appropriate monitoring methods and installations. Most air quality monitoring networks are designed to support human health objectives and therefore monitoring networks are normally established in population centres. Data systems for data verification, storage and analysis are an essential component of ambient air quality monitoring.

The monitoring network currently managed by the BCMM is somewhat limited (in terms of record keeping, dataset length, data accessibility and reporting reliability) to provide sufficient information to support adequate air quality management for the greater region.

COMPLAINTS REGISTER

Air pollution complaints received from the public need to be recorded in a database, investigated and addressed within each level of Government. Pollution complaints need to be logged into a centralised electronic pollution complaints database to ensure the effective co-ordination and management of complaints received for the region.

EMISSIONS INVENTORY DATABASE

The development and regular maintenance of a comprehensive emissions inventory database is an important component of any air quality management system. Such a database contains information regarding pollution sources (point, line, volume and area), source parameters (stack height and diameter, gas exit velocity and gas exit temperature) and emission rates.

An emissions inventory was last compiled for the BCMM in 2012. Current information is limited to that submitted by listed activities and controlled emitters to the NAEIS. A comprehensive emissions inventory is being developed as part of the 2018 AQMP review process and considers all types of emission sources (e.g.: domestic fuel burning, vehicle tailpipe emissions, etc.).

DISPERSION MODELLING

NEM:AQA[22] recommends a suite of dispersion models to be applied for regulatory practices. These include the application of Level 1 (SCREEN3, AERSCREEN), Level 2 (AERMOD) and Level 3 (CALPUFF) dispersion models. The application of each of these models is dependent on the level of assessment required and a number of technical factors such as the geophysical, emissions and meteorological conditions. The use of such modelling software is critical to the understanding of the temporal and spatial distribution of pollutants in the atmosphere.

Operational capacity in terms of personnel and availability of management tools within each sphere of government is summarised in **Table 5-1** and **Table 5-2**.

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[22] Department of Environmental Affairs (2014): *Regulations regarding air dispersion modelling (No. R. 533)* Government Gazette (No. 37804) 11 July 2014.

Table 5-1: Current capacity for air quality management within Department of Economic Development, Environment, Agriculture and Tourism.

Department of Economic Development, Environment, Agriculture and Tourism			
Requirement		**Status**	**Comment**
Appointment of AQO		Yes	— An AQO has been designated (Mr Lyndon Mardon) and the department has adequate capacity to perform the function. — The development of the provincial AQMP was completed in 2013. — DEDEAT do not conduct ambient monitoring in the BCMM.
Air Quality Management Plan		Yes	
Capacity	Human Resources	Yes	
	Equipment	Yes	
	Skills	Yes	
AEL Capacity		Yes	
Cooperative Governance		Yes	
AQM factored into EIP		Yes	
Management Tools	Ambient Air Quality Monitoring and Data reporting	Limited	
	Complaints Register	Unknown	
	Emissions Inventory	Yes	
	Dispersion Modelling	Unknown	

Table 5-2: Current capacity for air quality management within the Buffalo City Metropolitan Municipality.

Buffalo City Metropolitan Municipality			
Requirement		**Status**	**Comment**
Appointment of AQO		Yes	— An AQO has been designated (Mr Lukhanyo Mgadle) and the department has adequate capacity to perform the function. — The 2012 AQMP is currently being reviewed. — Ambient air quality monitoring is undertaken at three locations although significant repairs and regular maintenance of the stations is required. The available monitoring data is also not reported in SAAQIS.
Air Quality Management Plan		Yes	
Capacity	Human Resources	Yes	
	Equipment	Limited	
	Skills	Limited	
AEL Capacity		Yes	
Cooperative Governance		Yes	
AQM factored into IDP		Yes	
Management Tools	Ambient Air Quality Monitoring and Data reporting	Limited	
	Complaints Register	Yes	
	Emissions Inventory	Limited	
	Dispersion Modelling	Limited	

5.3 CAPACITY BUILDING

Capacity development is a cross-cutting issue that underpins every element of environmental governance. The scarcity of skills in South Africa is a key constraint to service delivery in general however within the field of air quality management this shortage is critical. Capacity development is often seen as simply the provision of extra financial or staff resources or the provision of extra skills through training and education, however capacity development must be seen as an attempt to build an organisation's capacity to fulfil its role efficiently and effectively through a diverse range of strategies at all levels of governance. As defined by the national framework[23], strategies for capacity development are categorised as follows:

- Applying additional financial and physical resources;
- Improving organisational and technical capabilities;
- Definition of a clear strategic direction;
- Protecting innovation and providing opportunity for learning;
- Strengthening the organisational system;
- Shape an enabling environment; and
- Creating performance incentives and pressures.

A summary of the air quality responsibilities of the BCMM as per the National requirements are given in **Table 5-3**.

Table 5-3: Air quality functions and capacity to meet these functions within the Buffalo City Metropolitan Municipality as per National Requirements

Air Quality Functions	National Requirements	Current Regulations / Resources	Required Resources
Identify priority pollutants	Municipalities may in terms of a by-law identify substances or mixtures of substances which represent a threat to health, well-being or the environment in the Municipality. As per the generic air pollution control by-law, a Municipality must compile a list of substances (using set criteria) which must be submitted to the Standards South Africa to develop local emission standards	— GNR 1210 on 24 December 2009 (Government Gazette 32816) National Ambient Air Quality Standards. — GNR 486 on 29 June 2012 (Government Gazette 35463) National Ambient Air Quality Standard for Particulate Matter with Aerodynamic Diameter Less than 2.5 Micron Metres.	— Such measures are currently not required for any additional priority pollutants in the BCMM.
Establish local emission standards and by-laws	Municipalities may in terms of a by-law establish local standards from point, non-point and mobile sources. If National or Provincial standards have been established, a Municipality may not alter such standards except by establishing stricter standards.	— GNR 248 on 31 June 2010 (Government Gazette 33064) List of Activities Which Result in Atmospheric Emissions Which Have or May Have a Significant Detrimental Effect on the Environment, Including Health, Social Conditions, Economic Conditions, Ecological Conditions or Cultural Heritage.	— More stringent local emission standards are currently not required for pollution sources in the BCMM. — By-laws to assist in air quality management and cooperation with local industries are recommended. — The NMBMM has Air Pollution By-laws that may be relevant to the BCMM.
Establish local air quality standards	No provision is made for the setting of standards by local authorities, however, Local Government may establish more stringent local air quality guidelines for the purpose of air quality management	— GNR 1210 on 24 December 2009 (Government Gazette 32816) National Ambient Air Quality Standards. — GNR 486 on 29 June 2012 (Government Gazette 35463) National Ambient Air Quality Standard for Particulate Matter with Aerodynamic Diameter Less than 2.5 Micron Metres.	— More stringent local air quality guidelines are not required in the BCMM.
Appoint Air Quality Officer	The Municipality must designate an AQO from its administration to be responsible for air quality management.	— A Chief AQO has been appointed.	— A dedicated Senior AQO to be appointed. — AQOs to attend air quality courses including monitoring, licensing and permitting management, at a minimum.
Develop and implement an Air Quality Management Plan	The Municipality must include an AQMP in its IDP. An annual report must be submitted on the implementation of its AQMP.	— The BCMM has initiated the review of its 2012 AQMP.	— The AQO must implement the AQMP, including the submission of annual progress reports to the provincial AQO.
Ambient air quality monitoring	The National Framework establishes national norms and standards for Municipalities to monitor ambient air quality	— Continuous ambient air quality monitoring is undertaken at three fixed stations located in	— Access to data needs to be improved, and datasets recorded need to be managed and reported for effective interpretation and

Air Quality Functions	National Requirements	Current Regulations / Resources	Required Resources
		East London, Gompo and Zwelitsha. Also one mobile monitoring station available.	information sharing purposes. Stations need to be maintained and repaired where necessary.
Perform emission licensing authority functions	Metropolitan and District Municipalities must implement the atmospheric licencing system and perform the functions of a licencing authority. Such functions include the processing of atmospheric emission licences of applicants and the issuing of the licence fee. Local municipalities must implement the controlled emitter permitting and emissions enforcement function of a permitting authority.	— GNR 250 on 11 March 2016 (Government Gazette 39805) Regulations Prescribing the Atmospheric Emission Licencing Fee — BCMM currently functions as the licencing and permitting authority.	— The BCMM is to continue as the licensing authority for AEL applications, enforcement of AEL conditions and the issuing of licensing fees.

6 OUTCOME ANALYSIS

Air quality management gaps and issues in the BCMM have been determined based on the findings of the baseline assessment and capacity assessment.

6.1 GOVERNANCE

- The appointed AQO should undergo training (including periodic refresher training and networking to keep abreast of evolving legislation, monitoring solutions, international best practise techniques, etc.) on sources of air pollution, meteorology, emissions inventories, dispersion modelling and air quality monitoring. Short air quality courses are offered by various universities as well as the National Association for Clean Air (NACA) which also conducts regional seminars and an annual National air quality conference;
- Additional air quality personnel should be appointed to support the AQO. BCMM is the second largest metropolitan municipality in the Eastern Cape with East London the second largest industrial centre in the Province. As such, a team of dedicated air quality personnel is required to manage air quality within the BCMM;
- Capacity building assistance and guidance (if and when required) needs to be provided by DEDEAT.

6.2 AMBIENT AIR QUALITY MONITORING DATA AND REPORTING

- Continuous ambient air quality monitoring is undertaken in East London, Gompo and Zwelitsha. The East London station has recently been repaired and has been operational since May 2018 while it is understood that the Gompo and Zwelitsha stations are also both operational although the monitoring data for all stations is not accessible or being reported into the South African Air Quality Information System (SAAQIS);
- The co-ordinated transfer of data from the monitoring stations to a centralised database is a critical component to ensure the effective and efficient management and verification of the monitoring data. As part of the SAAQIS, a centralised database has been developed at SAWS to which all ambient monitoring data can be transferred and databased;
- In the absence of available ambient air quality monitoring data, the existing baseline air quality situation in the BCMM could not be evaluated;
- The functionality of the current ambient air quality monitoring network needs significant improvement, specifically in terms of maintenance (including calibrations), database management, verification and reporting. It is recommended that an external supplier be appointed to assist with the maintenance and calibration of the stations.

6.3 EMISSIONS INVENTORY

- An emissions inventory was compiled for the BCMM in 2012. Information contained in this emissions inventory was reviewed and where possible, updated. Since the development of the emissions inventory, listed activities are now required to report into NAEIS on an annual basis, making this information more accessible and current. However, despite this requirement, not all industries are reporting timeously into NAEIS, with incomplete and missing information contained in those that have been submitted;
- A comprehensive database of controlled emitters in the BCMM is not available. While some controlled emitters are known, it is expected that a significant number remain unidentified and unregistered;
- Domestic fuel burning emissions were estimated from Census 2011 statistics. Population growth in the Municipality since 2011 combined with changes in domestic fuel usage are likely to result in emissions being either underestimated/overestimated;
- Detailed traffic count data is not available to estimate emissions from vehicles in the BCMM. While available traffic count data was obtained from SANRAL, this data was limited to the national and regional roads in the BCMM and does not include congested areas such as East London;

6.4 DISPERSION MODELLING

- A comprehensive, updated emissions inventory is required for input into a dispersion model. Poor and incomplete emissions data results in a limited dispersion model, inhibiting the identification of priority emission sources and recognising the extent of impact that priority pollutants may be having on human health;
- A complete, representative and reliable ambient air quality monitoring database is required for dispersion modelling practices in terms of:
  - Sustainable development planning, taking into consideration the cumulative impact within the area;
  - Identification of non-compliance areas; and
  - Model verification for more effective management practices.
- Dispersion modelling software, as recommended in *The Regulations Regarding Air Dispersion Modelling* (the Modelling Regulations) (Government Gazette 37804) should be purchased and used (as and when required);
- Recommended training courses in atmospheric dispersion modelling include:
  - Lakes Environmental AERMOD Course
  - Lakes Environmental CALPUFF Course
  - NACA: Introduction to Air Dispersion Modelling
  - NACA: Air Quality Management Course
  - Centre for Environmental Management (CEM): Essential Air Quality Management

7 VISION, MISSION AND GOALS

An AQMP vision statement is defined as "*a broad overarching statement that reflects the constitutional right to an environment that is not harmful to one's health or well-being.*" Ideally the vision is a statement of intent with values embedded in NEM:AQA and the constitution. The vision and mission statement developed as part of the 2012 AQMP is considered to still be relevant and has therefore remained as the adopted vision and mission statement for this AQMP review. Ambient air quality goals were not established in the 2012 AQMP and as such, air quality goals have been recommended as part of this review. These goals will need to be reviewed and updated during the next AQMP review cycle.

7.1 VISION

A safe and healthy living environment driven by clean air for all

7.2 MISSION

The mission statement developed for the BCMM as part of the 2012 AQMP is as follows:

— BCMM will strive to create and maintain ambient air quality of such a standard that it is not harmful to human health, well-being and the natural environment of the region;

— In pursuing its mission, BCMM takes cognisance of the need for poverty relief through human upliftment and job creation and will strive to manage such developments in a sustainable manner that is not detrimental to air quality.

7.3 GOALS

Ambient air quality goals recommended for adoption by the BCMM include the following:

Goal 1: Implement the Air Quality Management Plan within the BCMM;

Goal 2: Ensure that a team of dedicated personnel are appointed/assigned to oversee air quality responsibilities in the BCMM, ensuring that these responsibilities are either carried out effectively;

Goal 3: Ensure that the existing ambient monitoring network is managed effectively and information is available to public and private sectors; and

Goal 4: Enforce air quality standards to create a clean atmospheric environment for all residents of the Metropolitan.

8 INTERVENTION STRATEGIES

8.1 AIR QUALITY GOVERNANCE

The National Framework[24] describes efficient and effective air quality governance as a cycle to achieve continuous improvement over time (**Figure 8-1**).

Figure 8-1: The environmental governance cycle for continued improvements in environmental quality

Air quality governance priorities for the BCMM have been identified as follows:

- Capacity building (appointment and training of personnel);
- Defining individual responsibilities and regional functions;
- Ambient air quality monitoring;
- Information management; and
- Authorising and enforcement through licensing and permitting functions.

The proposed objectives, actions and timeframes for achieving the air quality management goals in **Section 7.3** are detailed in **Table 8-1**.

[24] Ibid.4

Table 8-1: Proposed intervention strategies and implementation plan for air quality governance.

Strategic Goal	Strategy / Target	Objective	Action	Responsible Party	Timeframe
Goal 1: Implement the Air Quality Management Plan in the Metropolitan	The effective implementation of the Air Quality Management Plan	Build air quality management capacity in the BCMM	Appoint or designate an adequate number of staff within the BCMM to effectively implement and oversee the implementation of the AQMP. Develop a service level agreement with the NMBMM for support and guidance until capacity is reached and skills transfer has taken place	BCMM	Short-term
			Provide adequate funding for the implementation of the AQMP	BCMM	Short-term
		Develop knowledge and specialised skills related to air quality management	Train all designated AQO's (and associated personnel) within the BCMM	BCMM	Short-term
			Collaborate with NMBMM	BCMM	Ongoing
		Compliance with legislative requirements	Include the AQMP in the BCMM's Integrated Development Plan	BCMM	Short-term
			Establish a forum including representatives from Government, industries and other stakeholders to monitor the progress of the implementation of the AQMP	BCMM	Ongoing
			Submission of annual progress reports detailing the progress of the implementation of the AQMP to the Provincial AQO	BCMM	Ongoing
Goal 2: Ensure that a team of dedicated personnel are assigned air quality responsibilities and that these are carried out effectively	Achieve effective air quality management capacity in the BCMM	Develop and build the personnel resources including knowledge and specialised skills for air quality management	Appointment of a sufficient number of staff within the BCMM to oversee air quality management functions	BCMM	Short-medium term
			Provision of adequate funding for air quality management in the BCMM	BCMM	Short-term
			Train all designated AQO's (and associated personnel) within the BCMM on air quality management matters by attending relevant air quality courses and seminars	BCMM	Short-term
			Implement a systematic and standardised information management structure to effectively record and verify air quality related information	BCMM	Short-term
		BCMM fulfil their air quality responsibilities as outlined in NEM:AQA	Identification, permitting and regulation of controlled emitters	BCMM	Short-medium term
			Registration of emission sources and data providers onto NAEIS and annual auditing of NAEIS submissions	BCMM	Ongoing
			Receipt and review of dustfall monitoring reports and fugitive dust management plans in cases where the NDCR are exceeded	BCMM	Ongoing
			Maintain an air quality complaints register	BCMM	Short-term

Short term = 1 – 2 years
Medium term = 3 – 5 years
Long term = 5 – 10 years

Human resources are the driving force behind a successfully implemented AQMP. A sufficient number of personnel should be appointed and/or designated in order to undertake air quality management responsibilities. Municipalities are legally required to appoint an AQO to be responsible for air quality functions within their jurisdiction. At a minimum the following appointments are recommended:

Position	Responsibilities
1 x Chief BCMM Air Quality Officer	— Coordinating the implementation of the AQMP — Compilation and submission of the Metro's annual air quality report to the provincial AQO — Training of air quality personnel within the BCMM — Identify and investigate industry that potentially qualify as listed activities requiring licensing — Process AEL Applications for authorisation — Registration of listed activities on NAEIS — Regulate and enforce AEL conditions — Issue non-compliance notices — Develop and maintain a comprehensive emission inventory — Integration of inventory, monitoring and meteorological data into one database — Dispersion modelling for compliance assessment and review of ambient monitoring points — Development and maintenance of a systematic database to record air quality related complaints
1 x Senior BCMM Air Quality Officer	— Assist the Chief AQO in carrying out the above responsibilities — Perform a variety of professional and technical work in connection with: — inspection, investigation, evaluation, control, and assessment of air quality standards — assessment of air quality conditions, plans, and strategies to ensure compliance with applicable laws, rules and regulations — other related duties as required
1 x BCMM Monitoring Technician	— Maintenance and calibration of ambient air quality monitoring network — Coordination and implementation of dust fallout and passive sampling campaigns — This position could be subcontracted out to a service provider with the knowledge and specialised skills to maintain the air quality monitoring network

8.2 AMBIENT AIR QUALITY MONITORING

In order to ensure integrity, quality and comparativeness of ambient air quality monitoring data, monitoring needs to be conducted according to accepted norms and standards. These norms and standards include:

- Procedures on ambient monitoring programme design, pollutants to monitor, siting conditions and station classification;
- Best practice procedures on how data is recorded, analysed, processed, reported and archived;
- Best practice guidance on monitoring station operation, maintenance and calibrations;
- Quality control and quality assurance procedures;
- Guidance concerning air quality monitoring via passive sampling techniques; and
- A National Air Quality Index for reporting daily air quality data to the general public in a simplified manner.

According to the National Framework[25], sampling points for the purpose of monitoring the impacts of air pollution on human health need to be sited to provide data on areas where the highest concentrations of pollutants occur in relation to the highest density of the population that is likely to be exposed for a significant period (in relation to averaging periods associated with the limits derived for pollutants of concern). General logistical factors also need to be considered (i.e.: access to electricity, security, interfering sources affecting airflow, etc.)

According to SANS 1929:2011[26] the recommended minimum number of sampling points for fixed measurements to assess compliance with National ambient SO_2, NO_2, PM_{10}, $PM_{2.5}$, O_3, CO, C_6H_6 and Pb standards is determined by the population density and intensity of air quality problems in that area.

[25] Ibid.4

[26] South African National Standards 1929 (2011): *Ambient air quality – Limits for common pollutants (2nd ed.)*

Table 8-2: Recommended minimum number of sampling points for fixed measurements to assess compliance with NAAQS[27]

Population density in agglomeration or zone (thousands)	Recommended minimum number of sampling points		
	Class 4 or 5 AQ areas	Class 3 AQ areas	Class 1 or 2 AQ areas
0 – 249	1	1	-
250 – 499	2	1	1
500 – 749	2	1	1
750 – 999	3	1	1
1000 – 1499	4	2	1

The BCMM currently operates two air quality monitoring stations in East London and one in King William's Town (**Figure 3-13**). Assuming all areas within the BCMM are at least Class 1 or 2 Air Quality areas, there should be a minimum of one station operational in Mdantsane and East London, respectively (**Table 8-3**). As such, it is recommended that the mobile monitoring station is moved to Mdantsane to assess baseline concentrations in the area. Low income areas were found to be main contributors to domestic fuel burning emissions, particularly those located in and around Mdantsane.

Table 8-3: Current air quality monitoring situation for each sub-metro region within the Buffalo City Metropolitan Municipality.

Sub-Metro Region	Population Density in 2016	Minimum Recommended Number of AQ Stations*	Current Number of AQ Monitoring Stations
Macleantown, Sandisiwe	57,100	-	0
King William's Town, Bisho	227,000	-	1
Mdantsane, Chalumna	262,000	1	0
East London	302,000	1	2
BCMM	**848,328**	**2**	**3**

Note:
*Assuming all areas are at least Class 1 or 2 AQ areas.

8.2.1 PROPOSED INTERVENTIONS

- It is recommended that SO_2, NO_2, CO, PM_{10}, $PM_{2.5}$ and benzene concentrations are measured at all monitoring stations for compliance purposes. Domestic fuel burning contributes significantly to annual CO and NO_2 emissions, while industry is the main contributor to total SO_2 and particulate emissions. Furthermore, the above mentioned pollutants are criteria pollutants and measurements are required for compliance assessment;
- Ambient air quality data should be made available within the public domain:
  - Data obtained must be easily converted into appropriate information for management planning;
  - Monthly/annual reports should be compiled and made available to the public (this can be loaded onto SAAQIS);
  - The community should be informed and aware of the air quality situation by means of the above mentioned information. Community involvement and stakeholder engagement is a key indicator of the successful implementation of the AQMP. This should be maintained as far as possible for key insight and performance indicators of air quality management.

[27] Ibid.4

Table 8-4: Proposed intervention strategies and implementation plan for air quality monitoring.

Strategic Goal	Strategy / Target	Objective	Action	Responsible Party	Timeframe
Goal 3: Ensure that ambient monitoring networks are managed effectively and information is available to the public and private sectors	Established monitoring network that provides adequate coverage of the BCMM	Maximise monitoring data coverage by placing the monitoring stations in suitable locations	BCMM to take advantage of the mobile station to assess the air quality situation in other area such as, Mdantsane, Mzamonhle, Eluxolweni, Ententeni, Kwetyana, Potsdam East, Potsdam South, etc	BCMM	Medium-term
	Ambient pollutant concentrations / priority areas are quantified and understood	A complete and accurate dataset of pollutant concentrations in the Metro is available	Appointment of a service provider to manage the continuous ambient air quality monitoring network	BCMM	Short-term
			Appointment on a technician to manage the ambient air quality monitoring network (continuous / passives etc.) when required.	BCMM	Medium-term
	Ambient air quality information is readily available to the public and private sectors	Air quality monitoring data is available on SAAQIS	BCMM to submit verified ambient air quality monitoring data from all three stations onto SAAQIS	BCMM	Short - Medium-term

Short term = 1 – 2 years
Medium term = 3 – 5 years
Long term = 5 – 10 years

8.3 AIR POLLUTION SOURCES

Atmospheric emission source priorities for the BCMM have been identified as follows:

- Industry;
- Transport (Vehicle tailpipe and entrainment / airport and harbour);
- Domestic fuel burning; and
- Waste disposal and treatment facilities.

8.3.1 INDUSTRY

NATIONAL GOVERNMENT INTERVENTIONS

Atmospheric Emission Licensing (AEL) legislation applicable to Listed Activities was promulgated in March 2010 (and subsequently revised in November 2012, November 2013 and in June 2015[28]). The Department of Environmental Affairs has recently in May 2018 issued a notice of intention to amend the Listed Activities. National Government has also declared the following industrial activities as controlled emitters and assigned emission standards for each:

- Small boilers (2013)[29];
- Temporary asphalt plants (2014)[30]; and
- Small-scale char and small-scale charcoal plants (2015)[31].

Draft controlled emitter regulations pertaining to certain printing industry activities were gazetted in November 2016[32]. Such regulations will be applicable to facilities with organic solvent consumption threshold equal to or more than 25 tonnes per year. The regulations for controlled emitters stipulate compliance timeframes, methods for emission measurement and reporting requirements for each. It is the Air Quality Officer's responsibility to coordinate matters pertaining to this legislation.

In March 2016 the DEA released their Air Quality Offsets Guidelines[33]. Environmental offsets are generally defined as measures that counteract or compensate for adverse impacts of an activity on the environment. Within the air quality context, an offset is an intervention specifically implemented to counterbalance the residual and adverse impact of atmospheric emissions in order to deliver a net ambient air quality benefit. The purpose of this air quality management tool is to achieve long-term environmental protection. Offsets should not be seen as a substitute for emission reduction from a facility. Air quality offset programmes are intended to be applied during the implementation of an AEL in accordance with section 39(i) of NEM:AQA and are recommended in the following circumstances:

- During an application for postponement of compliance timeframes under section 21 of NEM:AQA, wherein the application is positively considered;
- During an application for a variation of a license; and
- During an application of an AEL in areas where the NAAQS are being or are likely to be exceeded.

[28] Department of Environmental Affairs (2015): Amendments to the List of activities which result in atmospheric emissions which have or may have significant detrimental effect on the environment, including health, social conditions, economic conditions, ecological conditions or cultural heritage (Notice 551 of 2015) Government Gazette, 12 June 2015 (No. 38863).

[29] Department of Environmental Affairs (2013): Declaration of a small boiler as a controlled emitter and establishment of emission standards (Notice 831 of 2013) Government Gazette, 1 November 2013 (No. 36973).

[30] Department of Environmental Affairs (2014): Declaration of temporary asphalt plants as a controlled emitter and establishment of emission standards (Notice 201 of 2014) Government Gazette, 28 March 2014 (No. 37461).

[31] Department of Environmental Affairs (2015): Declaration of small-scale char and small-scale charcoal plants as a controlled emitter and establishment of emission standards (Notice 602 of 2015) Government Gazette, 18 September 2015 (No. 39220).

[32] Department of Environmental Affairs (2016): Declaration of certain printing industry activities as controlled emitters and establishment of emission standards (Notice 1373 of 2016) Government Gazette, 4 November 2016 (No. 40402).

[33] Department of Environmental Affairs (2016): Air Quality Offsets Guidelines (Notice 333 of 2016) Government Gazette, 18 March 2016 (No. 39833).

In summary, the need for an air quality offset programme is to be guided by the conditions depicted in **Figure 8-2** and shall be a condition that must be implemented and will be subject to compliance enforcement.

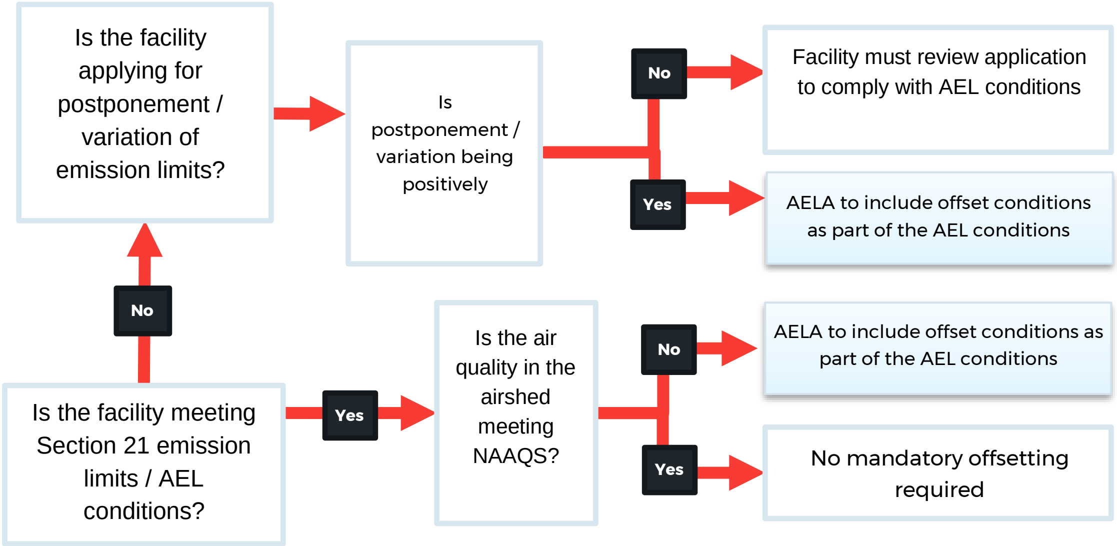

Figure 8-2: Conditions requiring the application of air quality offsets (Source: DEA, 2016)

The Draft Carbon Tax Bill[34] was released for public comment in November 2015 which intends to impose a tax on the CO_2 equivalent of GHG emissions resulting from the combustion of fossil fuels, fugitive emissions and industrial process and product usage. This policy is scheduled to come into effect mid-2018. The policy makes allowances for reductions in tax liability based on the type of activity, performance of implemented reduction strategies and utilising carbon offsets. This policy is applicable to all sectors and activities contributing to GHG emissions except AFOLU and Waste Disposal which are exempt during the first implementation phase (2017 – 2020) due to methodological challenges.

PROPOSED INTERVENTIONS

As a whole, the BCMM is not considered to be significantly industrialised area. East London has the highest level of industrial activity including asphalt production, brick manufacturing, petroleum refineries and bulk storage, textiles, power generation, pharmaceutical industry, etc. While limited information is available on a number of listed activities in the Metro (either through their AELs or the recent report of emissions on NAEIS), information on smaller industries (controlled emitters and non-regulated emission sources) was not readily available. The emissions inventory compiled as part of this study is an important step in attempting to identify and collate all available information on industries in the BCMM. However, it is recognised that some sources may have been excluded from the emissions inventory and as such, the BCMM must ensure that the emissions inventory compiled as part of this study is reviewed and updated on an annual basis. The emissions inventory must include information on:

— Company name and contact details;
— Type of fuel burning appliance (e.g. boiler, incinerator, furnace);
— Make and model of fuel burning appliance;
— Type of fuel;
— Quantity of fuel used;
— Stack parameters (height, diameter, gas exit temperature and gas exit velocity);
— Sulphur and ash content of fuel (where applicable);
— Periods of operation;
— Control equipment (e.g. grit collectors).

[34] The National Treasury of South Africa (2015): Draft Carbon Tax Bill

It is recommended that collaboration with the two local universities; Walter Sisulu University and the University Of Fort Hare, is undertaken for air quality research within the BCMM. Since the declaration of small boilers, temporary asphalt plants and small-scale char and charcoal plants as controlled emitters, there are a number of industries operating in the BCMM that require registration onto NAEIS. These facilities need to be investigated to ensure they do not qualify as a listed activity and subsequently require an AEL. Once all controlled emitters (and listed activities) are identified and registered onto NAEIS, the BCMM must uphold the compliance timeframes and reporting requirements stipulated for controlled emitters (and listed activities) operating within the Metropolitan.

As per NEM:AQA, Metropolitan and District Municipalities are responsible for implementing the Atmospheric Emission Licencing system and must perform the functions of the licencing authority. The BCMM is the responsible licencing authority and is currently fulfilling this function. However, the permitting and regulating of controlled emitters is not being adequately achieved. It is recommended that a Service Level Agreement is established with the Nelson Mandela Bay Metropolitan Municipality for support and guidance until capacity is available within the BCMM and skills transfer has occurred.

The BCMM should also take cognizance of the upcoming Carbon Tax policy to be rolled out in 2017/8 and support both the relevant authority and taxable activities (where possible) with this transition.

8.3.2 VEHICLE TAILPIPE AND ENTRAINMENT

NATIONAL GOVERNMENT INTERVENTIONS

In 2003, DEA, in collaboration with DME, developed the *Joint Implementation Strategy for the Control of Exhaust Emissions from Road-going Vehicles in the Republic of South Africa.* The objective of the strategy is to *'ensure an environment that is not harmful...by controlling emissions from road-going motor vehicles".* The strategy sets out a road map for Government, the oil industry and the vehicle manufacturing industry to achieve improved air quality through the control of vehicle emissions. This includes the implementation of European standards for vehicle exhaust emissions and appropriate fuel specifications.

The strategy embarked on a phased approach for vehicle emissions in urban areas:

- Introduction of Euro vehicle emission regulations for passenger vehicles, light delivery vehicles and heavy vehicles (GVM > 3500 kg);
- Reduction in the maximum sulphur content of unleaded petrol to 500 ppm from January 2004 and to 50 ppm from January 2010;
- A maximum benzene content in petrol of 3% from January 2006 and 1% from a future date;
- A maximum aromatic content in petrol of 42% from January 2006 and 35% and less from a future date;
- Prohibition of lead based additives to petrol from January 2006. Use of heavy metal based additives in unleaded petrol will only be allowed in Lead Replacement Petrol; and
- Reduction in the maximum sulphur content of diesel to 500 ppm from January 2006 and 50 ppm from January 2010

More recently, in 2013, the DEA developed the *Integrated Strategy for the Control of Motor Vehicle Emissions*[35], which outlines:

- A reduction in the sulphur content from 500 ppm to 10 ppm;
- A reduction in the maximum benzene content in petrol from 5% to 1%;
- A reduction in the maximum aromatic content in petrol from 50% to 35% by 2017;
- Emission standards for new vehicles were come into effect from 2017, when Clean Fuels 2 specification fuels are available. The emission limits for 2017 were equivalent to Euro 5 (light-duty vehicles) and Euro V (heavy-duty vehicles); and
- An inspection and maintenance programme for in-use vehicles to be implemented to minimise emissions. Euro 1, 2 and 3 standards will be applicable to vehicles manufactured in 1992, 1996 and 2000, respectively. Vehicles manufactured before 1992 will be exempt.

[35] Ibid.39

PROPOSED INTERVENTIONS

In the absence of detailed vehicle traffic count data for roads in the BCMM, use was made of fuel sales data for 2016 to estimate emissions. It is recommended that more recent fuel sales data is obtained for a more current estimate of vehicle emissions. In addition, a database of traffic count data should be populated for all major and minor roads in the Metro for a more accurate estimate of vehicle emissions.

8.3.3 DOMESTIC FUEL BURNING

NATIONAL GOVERNMENT INTERVENTIONS

In 2003, the DME developed the Integrated Clean Household Energy Strategy. This strategy identified three phases; (1) REFINE current combustion methods and appliances, (2) REPLACE coal with electricity, Low Smoke Fuels, other alternative fuels and solar power and (3) REDUCE energy requirements of homes through the introduction of energy efficient methods (insulation and solar power). The DME subsequently published the Energy Efficiency Strategy of the Republic of South Africa in 2005 which was later revised in 2008. This strategy set out intentions to implement a variety of regulatory and awareness raising measures by Government with the goal of reducing environmental pollution and CO_2 emissions amongst other goals pertaining to energy poverty and energy security. Energy Efficiency programmes designed for the residential sector includes appliance labelling, awareness campaigns and establishing standards for housing and appliances. Targets set out in the strategy are voluntary, and therefore, with no penalties for failure to achieve the desired improvements, the majority of the proposed measures have yet to be implemented[36].

One of the responses by Government to address indoor and ambient air pollution problems experienced in low-income settlements is the launch of the *Basa njengo Magogo* (BnM) campaign. This top down fire lighting method for mbawulas and stoves is considered a short – medium term solution to address domestic fuel burning. In the conventional bottom-up fire ignition approach, the order of preparing a fire is paper, wood then coal, however with the BnM method the order is reversed with a few pieces of coal placed on the top. The idea is that the fire burns from the top down, improving the combustion of the coal through increased oxygen flow created by an updraft through the fire, requiring less coal to reach cooking temperature and resulting in up to 50% less smoke emissions. Significant reductions in particulates (87%) and CO emissions have been noted, with little to no effect on CO_2 emissions[37].

More recently, The Draft Strategy for Addressing Air Pollution in Dense, Low-income Settlements[38] was released for public comment in June 2016 which seeks to:

- Coordinate and prioritise efforts to address air pollution through the formation of a National Coordination Committee (NCC);
- Facilitate the implementation of interventions aimed at reducing emissions by:
  - Providing affordable or subsidized clean energy alternatives;
  - Ensuring low-income housing is energy efficient;
  - Influencing development planning initiatives to take into account residential air quality issues;
  - Encouraging social upliftment programmes with air quality benefits; and
  - Creating public awareness.
- Ensure continued monitoring, evaluation and reporting on the successes and challenges of proposed interventions and on air quality improvements.

The intended role of local government within this strategy is to:

- Implement interventions through alignment with service delivery by refocusing existing resources;

[36] Covary, T. and Averesch, U. (2012): Overview and Assessment of the Energy Efficiency and Energy Conservation Policies and Initiatives of the Republic of South Africa.
[37] Ibid. 39
[38] Department of Environmental Affairs (2016): Draft Strategy for Addressing Air Pollution in Dense, Low-income Settlements (Notice 356 of 2016) 24 June 2016 (No. 40088)

- Encourage offset projects during Atmospheric Emissions Licensing; and
- Report on progress with regards to strategy implementation within the municipality.

On 27 July 2016, the Department of Trade and Industry (DTI) launched the Safe Paraffin Appliance Campaign, which is supported by DEA. This campaign aims to raise awareness about illegal manufacturing and distribution of unsafe paraffin burners with the intention of protecting disadvantaged communities from house fires. This campaign is in line with the Draft Strategy for Addressing Air Pollution in Dense, Low-income Settlements as part of a coordinated Government approach to reducing air pollution.

PROPOSED INTERVENTIONS

Emissions from domestic fuel burning need to be correctly determined to ensure that the contribution to the overall ambient air quality in the Metro is accurately quantified. As part of the risk assessment, a first step in the quantification of domestic fuel burning was undertaken. However, emissions from domestic fuel burning are potentially overestimated as population and household fuel usage statistics were used from the 2011 census database. This initial domestic fuel burning emissions inventory needs to be updated as population statistics become available. The next National population census has been planned for 2021.

Given the challenges that have been experienced in controlling domestic fuel burning emissions on a National basis, it is recommended that the BCMM align its approaches with National strategies such as the Draft Strategy for Addressing Air Pollution in Dense, Low-income Settlements.

8.3.4 WASTE TREATMENT AND DISPOSAL

PROPOSED INTERVENTIONS

Emissions from waste management facilities were not quantified as part of this AQMP due to a lack of access to information and the vast variability of emissions from these sources. As a first step to address emissions from waste facilities in the region, a comprehensive emissions inventory should be compiled. This should include information on both permitted and unpermitted landfill sites, incinerators, sewage and waste water treatment works. It is recommended that the AQO follow up with the responsible departments to understand how many permitted and unpermitted landfills are operating within the BCMM. This information should be captured into the BCMM's integrated waste management plan.

Only one operational incineration facility has been identified within the BCMM. The Metro should initiate an investigation into the legal status of other incinerators operating in the BCMM and ensure that all incinerators are licensed and in compliance with Minimum Emission Standards (MES).

Two operational and permitted landfill sites have been identified within the BCMM however it is suspected that illegal dumping and domestic waste burning activities also occur within informal and low-income settlements. Proper and reliable refuse collection in all areas within the Metro will assist to minimise illegal waste dumping and domestic waste burning.

Awareness campaigns around the environmental benefits of recycling should be promoted. Recycling bins should be placed at key collection points such as schools, clinics, hospitals and petrol stations to promote recycling initiatives. For waste types that cannot be reused or recycled, there are various options for energy recovery. These include biogas projects and methane gas from landfills. The National Waste Management Strategy should be taken into consideration for alignment of emission reduction measures.

The proposed objectives, actions and timeframes for achieving air pollution source goals in **Section 7.3** are detailed in **Table 8-5**.

Table 8-5: Proposed emission reduction strategies for air pollution sources within the BCMM.

Strategic Goal	Strategy / Target	Objective	Action	Responsible Party	Timeframe
Goal 4: Enforce air quality standards to create a clean atmospheric environment for all residents of the Metropolitan	Reduce emissions from industries	A comprehensive emissions inventory database of all industrial emission sources in the BCMM	Undertake an annual review / update of the emissions inventory compiled for the Metropolitan	BCMM	Ongoing
			Ensure all listed activities have an Atmospheric Emission Licence	BCMM	Short-term
			Ensure all listed activities are registered and reporting to NAEIS	BCMM	Short-term
			Ensure all controlled emitters are identified and registered in NAEIS	BCMM	Short-term
		Compliance and enforcement	Uphold reporting and compliance timeframes for identified controlled emitters	BCMM	Short-medium term
			Implement by-laws to assist with compliance and enforcement	BCMM	Medium term
			Ensure compliance with conditions of AELs for listed activities	BCMM	Ongoing
			Assign air quality offset programmes as part of AEL conditions for qualifying facilities	BCMM	Medium-long term
			Offer support to DME and carbon taxpayers to encourage efficient policy implementation	DEDEAT / BCMM	Long-term
	Reduce emissions from domestic fuel burning	A comprehensive emissions inventory for domestic fuel burning sources	Review domestic fuel burning emissions inventory with updated population statistics as these become available	BCMM	Medium-term
		Develop and implement strategies to address domestic fuel burning emissions	Encourage use of cleaner fuels and stoves	DEDEAT / BCMM	Short-term - ongoing
			Ensure strategies implemented in the Metropolitan are aligned with National strategies	BCMM	Medium-long term
			Align and refocus resources in support of interventions such as the Safe Paraffin Campaign with the Department of Trade and Industry (DTI)	DEDEAT / BCMM / DTI	Medium-term
			Assign air quality offset programmes as part of AEL conditions for qualifying facilities	DEDEAT / BCMM	Medium-long term
	Reduce emissions from vehicles	A comprehensive emissions inventory for vehicles	Obtain updated fuel sales data from the Department of Energy	BCMM	Short-term
			Obtain traffic count data for main roads in the Metropolitan	BCMM	Short-term
			Review vehicle emissions inventory with traffic count data	BCMM	Short-term - ongoing

9 IMPLEMENTATION AND REPORTING

9.1 REVIEW

According to the Manual for Air Quality Management Planning[39] the final AQMP is required to undergo internal review with the PSC using evaluation criteria to determine whether air quality problems have been correctly identified and that the design of the AQMP is appropriate. The evaluation criteria ensure consistency with the AQMP 6-step process outlined in **Figure 1-1**, compare the AQMP with international best practice and highlight areas of possible improvement.

Once complete the final AQMP will be submitted for municipal resolution and adoption as well as inclusion in the Municipality's IDP. The final document should also be distributed to all key stakeholders including national, provincial and local authorities.

9.2 IMPLEMENTATION

The implementation of the AQMP will then be initiated in the systematic manner based on rules and strategies defined within this AQMP. This will require formal structure and transparency. It is recommended that an implementation task team consisting of representatives from government and other stakeholder groups be established to oversee this task.

9.3 EVALUATION

Evaluation of the effectiveness of the AQMP is important to establish whether air quality goals are being achieved. This will occur on an annual basis, ideally in conjunction with the submission of the AQO's annual air quality report to the Provincial AQO. Key questions to ask when revising or updating the AQMP include:

- Has air quality improved?
- Is there a need to update information or include new information in the AQMP?
- Is there a need to revise the mission statement of the AQMP?
- What are the challenged experienced in implementing the plan and how should these be addressed?
- Are the region's capacity requirements met?
- Is air quality managed in a manner that encourages co-operative governance?
- Are priority air quality issues being addressed?

After five years, the AQMP should be reviewed, the goals realigned and a revised AQMP should be developed.

9.4 REPORTING

The annual report on the progress of the AQMP must contain information on:

- Implementation of the AQMP, including information on air quality management initiatives undertaken during the reporting period;
- Air quality monitoring activities within the BCMM; and
- Compliance monitoring and reporting.

[39] Ibid.4

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APPENDIX

A TITLE

APPENDIX

A-1 TITLE