A critical evaluation of local government air quality management: The Gauteng experience

K Mohlala

orcid.org 0000-0001-6799-9806

Dissertation accepted in partial fulfilment of the requirements for the degree *Master in Environmental Management* at the North-West University

Supervisor: Prof FP Retief

Co-Supervisor: Mr. P Mukwevhu

Graduation December 2020

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DECLARATION

"I, Keorapetse Mohlala, hereby declare that this study, titled "**A critical evaluation of local government air quality management: The Gauteng experience"** and submitted to the North West University, Potchefstroom Campus is my own original work and I have not previously in its entirety or in part submitted it at any other university for a degree. I further declare that all sources cited or quoted are indicated and acknowledged by means of a comprehensive list of references".

K Mohlala .....

KEORAPETSE MOHLALA

This 27th Day of October 2020

DEDICATION

This work is dedicated to my son Oarabile Bogatsu for his support in making this study a success. May God bless him abundantly.

ACKNOWLEDGEMENTS

First and foremost, I would like to thank God the almighty for being with me always and for guiding me through to the success of this research. ***"For God is not the author of confusion, but of peace, as in all churches of the saints". 1 Corinthians: 14:33.***

I am grateful to my supervisor Prof F.P Retief for his invaluable support; guidance and encouragement throughout this work. You always made time to assist me and for that, I am more than grateful. Your advice made me who I am today. Indeed, I have learnt greatly from you.

To my family, I want to extend my gratitude to you. Thank you for your unconditional love, support, encouragement, and guidance throughout my studies.

I would also like to appreciate North West University for affording me the opportunity to do my master's degree with them and for the Financial Aid provided for my studies.

Very special thanks to the City of Tshwane, City of Johannesburg, South African Weather Services and Gauteng Department of Agriculture and Rural Development for providing me with information and allowing me to conduct interviews and questionnaires with the staff members. This dissertation would not have been possible without providing the rich data which added significant value to the study.

To the following individuals, Prof I Rampedi, Beverley Vertue, Tshianeo Nenzhelele, Rudzani Nemukula, Luncedo Xelelo, Yengeshi Moodley, and T.T Rikhotso, words cannot describe how much I appreciate your contribution. Thank you for all the efforts you took to assist me.

Lastly, I would like to express gratitude to the South African Society for Atmospheric Sciences for affording me the opportunity to present my work during their 35th annual conference held in Vanderbijlpark from 8th -9th October 2019.

ABSTRACT

Environmental governance is complex in South Africa and is subject to a fragmented and ever-changing legislative framework. The National Environmental Management Air Quality Act, No. 39 of 2004 (NEMAQA) was promulgated in 2005 and replaced the 1965 Atmospheric Pollution Prevention Act, No.45 of 1965 (APPA). The NEMAQA's management framework promotes a collaborative and integrated approach (between polluters, the public and government) and assigns a strong mandate for air quality management to municipalities as the local sphere of government. The aim of this research was to determine the extent to which local authority is the appropriate sphere of government for air quality management in South Africa. This research focused on two Gauteng metropolitan municipalities namely, City of Tshwane (CoT) and City of Johannesburg (CoJ). According to the 2016 World Health Organisation (WHO) report on air pollution, Tshwane and Johannesburg were ranked amongst the highest air-polluted cities in South Africa. Out of 3000 locations which were monitored for air pollution by the WHO in 2016, Tshwane and Johannesburg were ranked positions 63 and 85 respectively. The methodology for this research was based on questionnaires, interviews, document and literature review. A questionnaire was administered to key local government officials involved in air quality management within these two municipalities and at provincial level. A total of 14 respondents took part in the questionnaire and interviews. The overall outcome of this study suggests that the two municipalities are struggling to fully implement NEMAQA due to financial constraints, capacity issues, political interference, lack of communication amongst and within departments and conflicting policies in various departments that are also contributors to air pollution.

Keywords*: Air quality; Air Quality Act; Air pollution; municipalities; Local government; NEMAQA*

OUTPUT EMANATING FROM THIS WORK

Mohlala, K., & Retief, F. P. (2019). A critical evaluation of air quality management at a local sphere of government: The case of Gauteng metropolitan municipalities. 35th Annual Conference of the South African Society for Atmospheric Sciences (SASAS). Vanderbijlpark, Gauteng, 8-9 October 2019. **Oral Presentation.**

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ABBREVIATIONS /ACRONYMS

AEL	Atmospheric Emission Licence
AIR	Atmospheric Impact Report
APPA	Atmospheric Pollution Prevention Act, 1965
AQCR	Air Quality Control Regions
AQM	Air quality management
AQMP	Air Quality Management Plan
AQO	Air Quality Officer
BATNEEC	Best Available Technology Not Entailing Excessive Costs
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CoJ	City of Johannesburg
CoT	City of Tshwane
DEA	Department of Environmental Affairs
DEAT	Department of Environmental Affairs and Tourism
DEFF	Department of Environment, Forestry and Fisheries
ECE	Economic Commission for Europe
EIP	Environmental Implementation Plan
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
EU	European Union
FOE	Frequency of Exceedance
GDARD	Gauteng Department of Agriculture and Rural Development

GEMS	Global Environment Monitoring System
GBD	Global Burden Diseases
GP	Gauteng Province
I&APs	Interested and Affected Parties
IDP	Integrated development plan
IPWMP	Integrated Pollution and Waste Management Policy
NAAQS	National Ambient Air Quality Standards
NAEIS	National Atmospheric Emission Inventory System
NAQS	National Air Quality Strategy
NEMA	National Environmental Management Act, 1998
NEMAQA	National Environmental Management: Air Quality Act, 2004
NEMF	National Environmental Management Framework
NF	National Framework
NHA	National Health Act
NO_2	Nitrogen dioxide
OECD	Organisation for Economic Co-operation and Development
O_3	Ozone
PAIA	Promotion of Access to Information Act, 2000
PAJA	Promotion of Administrative Justice Act, 2000
PM	Particulate Matter
PSD	Prevention of Significant Deterioration
RSA	Republic of South Africa
SAAQIS	South African Air Quality Information System
SANAS	South African National Accreditation System

SAWS	South African Weather Services
SIP	State Implementation Plan
SO_2	Sulfur dioxide
UK	United Kingdom
UN	United Nations
UNEP	United Nations Environmental Programme
USA	United States of America
WHO	World Health Organisation

Chapter 1 : Introduction

1.1 Chapter summary

This chapter presents the introduction to the study in section 1.2, problem statement and substantiation as well as the study area in section 1.3, after which the research aim and research questions are introduced in section 1.4. Lastly, section 1.5 gives an outline of the mini dissertation to help the reader navigate through the content.

1.2 Introduction

Access to a clean environment (including air) is a fundamental right of every South African according to section 24 of the Constitution of the Republic of South Africa (RSA) (RSA, 1996). Section155 (7) of the RSA Constitution gives the local government an executive authority and mandate to manage air pollution (Akpan & Ekanem, 2013; Naiker, 2012; RSA, 1996). The National department (Department of Environmental Affairs) and the provincial authorities have legislative and executive authority to ensure the effective performance by the local government of their functions, by regulating the exercise of their executive authority (RSA, 2018:13-15).

Air quality management responsibility shifted from national government to local government, i.e. municipalities under the democratic dispensation and with the promulgation of the NEMAQA in 2004 (Naiker, 2012). Despite this, section 41 of the RSA constitution still encourages the three spheres to collaborate in mutual trust; and to promote effective intergovernmental relations; to ensure efficient communication and coordination; to respect the constitutional status, structures as well as powers and functions of government; and to avoid bringing their conflicts before the courts (Edwards, 2008). Municipalities are therefore required to work co-operatively with national and provincial governments for air quality management matters, as guided by Chapter 3 (section 41) of the RSA constitution and the National Environmental Management Act (NEMA) as amended.

South Africa ranks amongst the countries in the world with the high levels of air pollution. Air pollution is particularly acute in Mpumalanga (CER, 2017:5), Kwazulu-Natal and Gauteng province (WHO, 2017). Major cities like Tshwane and Johannesburg in Gauteng were listed as highly polluted cities in the 2016 WHO

report on air pollution (WHO, 2017). A total of about 3000 locations were monitored for air pollution by the WHO in 2016. Tshwane and Johannesburg were ranked positions 63 and 85 respectively (WHO, 2017).

In CoT, various sources of emissions include "*industrial sources and power generation, vehicle exhaust emissions, household fuel burning appliances, waste disposal activities, sand and dolomite quarries, biomass burning and fugitive dust emissions from exposed areas, materials handling and agricultural activities*"(CoT, 2006:6; SAWS, 2018:1). Furthermore, the influence of trans - boundary sources is evident in the regional aerosol components, despite the fact that such sources are not located within the region (SAWS, 2018:1). In CoJ, air quality is affected by pollution from anthropogenic activities and natural sources of gaseous and particulate contaminants as well as emissions of volatile organic compounds from vegetation. Transportation and domestic fuel burning are the CoJ's largest air pollutant sources, with listed and unlisted contributions from industrial and commercial activities, open fires and dust from sources such as mine dumps. (GDARD, 2018).

The RSA is a developing country that is struggling with air pollution triggered by industrialization and other issues caused by uneven development and access to resources (Naiker, 2007). Nevertheless, it is among the countries currently taking very serious steps to ensure effective and efficient air quality management, which "*involves the management and identification of all aspects that contribute to ambient air pollution and the mitigation of the pollutant levels that are conducive to the health and well-being of general public and for the sustainability of ecosystems*" (Naiker, 2007). This is an internationally favoured approach, with the United Kingdom (UK) (Kuklinska *et al.*, 2015) and the United States of America (USA) having adopted it to control air pollution. The RSA has also adopted this approach to help manage and control air pollution.

Air quality management originated from the Integrated Pollution and Waste Management policy (IPWM), published in the year 2000 (DEAT, 2000). The IPWM was introduced with the intention to integrate the governance and management of waste with pollution management by addressing gaps in legislation and to give clarity and devote responsibilities to the three different spheres of the RSA government

(DEAT, 2000). In addition, it focused on pollution prevention, minimization of pollutants at sources, pollution and waste impacts management on the receiving environment and remediating the damaged environment (DEAT, 2000).

A reading of RSA's air quality legislation shows that the approach to air quality management in the country was previously driven and informed by the Atmospheric Pollution Prevention Act, No. 45 of 1965 (APPA). The APPA was built on the UK's legislation on air quality. It focused specifically on individual source emissions and gave little consideration of ambient air quality. Consequently, the act was considered unconstitutional, as according to the Constitution of South Africa, "*people have the right to a clean environment*" (DEAT, 2005; RSA, 1996). Furthermore, the Act did not conform to the National Environmental Management Act, No. 107 of 1998 (NEMA), Promotion of Administrative Justice Act, No. 3 of 2000 (PAJA) and the Promotion of Access to Information Act, No. 2 of 2000 (PAIA). The APPA was considered ineffective as it did not protect the country's air quality from the emergence of diverse air pollution "Hotspots" within the country. This in turn led to the promulgation of the NEMAQA in September 2005. NEMAQA brought the approach to ambient air quality management into the realm of air pollution control in South Africa, by introducing health-based ambient air quality standards as well as the air quality management tools to achieve these (Scott, 2005). All three spheres of government are empowered through NEMAQA, however, a substantial mandate and responsibility for air pollution control implementation is delegated to local government.

1.3 Problem statement and substantiation

Air is one of the most important natural resources available to sustain human life, the environment, and developmental activities, and therefore, should be protected for the benefit of current and future generations. The world is overwhelmed by a growing tide of air pollution caused by many industrial processes and urbanisation. This trend is most likely to increase overtime in South Africa and other developing countries, due to ongoing infrastructural developments to tackle socio-economic problems such as inequality, unemployment, deprivation and related social ills (Osseiran & Chriscaden, 2016). Air pollutants must be controlled and monitored as they pose

danger to the environment and the population. As already highlighted in the previous section, APPA was the main legislation in South Africa to control and manage air pollution from 1965 until 2004, when NEMAQA was introduced in 2005 and officially replaced it (RSA, 2005). NEMAQA gave municipalities the mandate and responsibility to control and manage air pollution within their jurisdictions. Despite municipalities having been given this executive and legislative mandate and authority, the Global Burden of Diseases (GBD) reported that about 1800 deaths in RSA in 2012 were attributed to fine particulate matter (Altieri & Keen, 2016), which is one of the most dangerous and lethal air pollutants. In addition to this, the 2016 WHO report on air pollution indicated that Johannesburg and Tshwane are amongst some of the most air-polluted cities in South Africa (WHO, 2017). Air pollution is of great concern to the public due to the health impacts and haze episodes related to it. Municipalities are given an executive authority and mandate to manage air pollution in South Africa. Research on the extent of NEMAQA implementation in municipalities and the reasons for such an extent is therefore, necessary. This will help to critically evaluate the extent to which these municipalities are the appropriate sphere of government for NEMAQA implementation. This research focuses only on two metropolitan municipalities, i.e. CoT and CoJ.

The (CoT) and (CoJ).municipalities are both located in Gauteng Province. The geographical location of the metropolitan municipalities is shown in **Figure 1-1.** The CoT is situated directly north of Johannesburg, with a land size of 6,298 km^2 and a population of over 3.5 million, making it the largest municipality in Gauteng (CoGTA, 2020). The CoJ is centred in the inner city and covering more than 1,600 km^2, stretching approximately 60 km from north to south and 30 km from west to east. The city has an increasing economic growth and a population approaching 4.5 million inhabitants. Air quality monitoring is an additional management area for the municipality, in line with high levels of urbanization and immigration, especially in the lower income levels (GDARD, 2018).

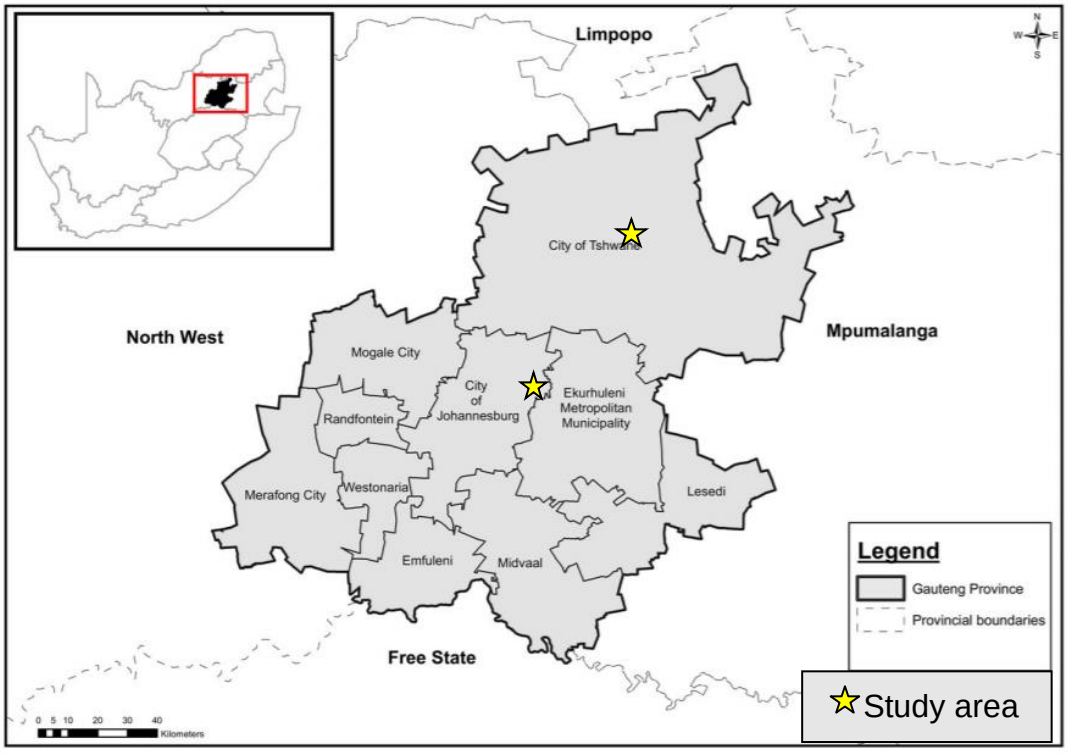

Figure 1-1: Map of Gauteng province. Source: GCRO Maps/GIS

1.4 Research aim and research questions

In line with the problem statement described in section 1.3, the aim of this research was to investigate the extent to which municipalities are the appropriate sphere of government for air quality management in South Africa, with specific focus to CoT and CoJ in Gauteng Province.

In order to achieve the overall aim of this research, the following research questions were identified:

1. What is the extent of the implementation of NEMAQA by Gauteng municipalities?

2. What are the reasons for the extent of NEMAQA implementation?

By answering the research questions, the aim of the research will be elucidated with the understanding that success or failure of municipalities to implement NEMAQA reflects on the appropriateness of mandating them as the preferred sphere of government for air quality management in South Africa. The term appropriateness therefore relates to the ability of municipalities to implement their mandate.

1.5 Structure of the dissertation

The dissertation is structured according to five chapters, as follows:

- **Chapter 1**: Introduction – Introduce the research by providing the problem statement and research aim and questions.
- **Chapter 2**: Methodology – Describe the research methods applied to address the research aim and questions.
- **Chapter 3**: Literature Review: Air quality management literature (Internationally and in South Africa, from legislative and governance perspective and other regulatory approaches by WHO, EU, USA, and UN) is discussed.
- **Chapter 4**: Results and discussion – Interpret and analyse data obtained.
- **Chapter 5**: Conclusion and Recommendations - Make conclusions based on data obtained and provide recommendations for future research. This chapter addressed the research aim and answers the research questions introduced in chapter 1. A summary of the structure of the mini dissertation is illustrated in **Figure 1-2** below:

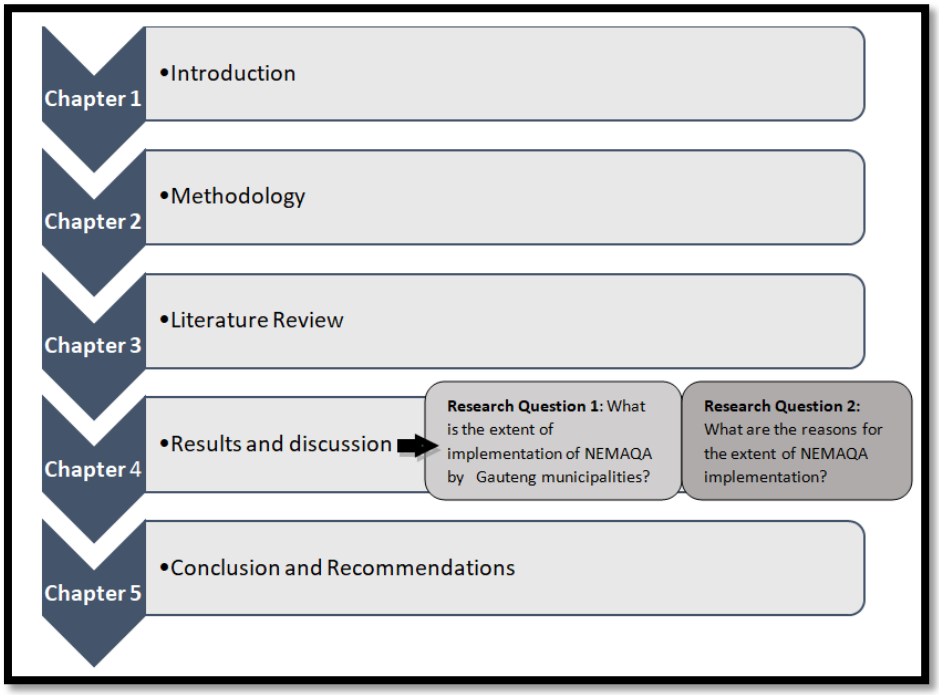

Figure 1-2: The structure of the dissertation.

Chapter 2： Methodology

2.1 Chapter summary

This chapter explains the methodology used to address the research aim and research questions introduced in Chapter 1. The chapter starts by explaining the research design and then discusses the population, sampling, recruitment of participants, the process for obtaining permission, research methods (data collection), data collection tools (and how they were developed) as well as data analysis.

2.2 Introduction

Sampling, data collection and data analysis are the most important factors in research. It is therefore imperative to ensure that the research design as well as proper sampling methods is employed in order to collect data relevant to the study. Purposeful sampling is typically used in qualitative research for identification and selection of information-rich cases related to the study of interest (Palinkas *et al.*, 2015; Patton, 2002). In order to conclude on the extent of NEMAQA implementation in two metropolitan municipalities in Gauteng province, the researcher used non-probability purposive sampling.

2.3 Research design

Labaree (2013) and Leedy *et al.* (1997) define research design as an overall strategy for the integration of various components of a study logically and consistently, and thereby providing the overall framework for collecting, measuring and analysing data. It is basically a procedural plan that is taken up to address a research aim or answer research questions in a valid, unambiguous and logical way (De Vaus, 2001; Labaree, 2013). The research design dictates what data is required, what data collection methods will be used and what data analysis method will be used, and how the research question will be answered by all this (Babbie & Mouton, 2001).McMillan and Schumacher (2001) describe research design as a plan for

selecting a subject matter, the research location, as well as data collection methods to address the research aim, objectives and questions.

2.4 Research Methodology

Methodology is defined as 'the study of methods and justifies a process and methods for collecting, organising, analysing and interpreting data for the purpose of achieving the research aim (Babbie & Mouton, 2001:647). Methods chosen might differ depending on the nature of the research aim and questions (Polit & Hungler, 2004:233). In this study, methodology refers to how the research was conducted to address the research aim and answer the research questions described in Chapter 1. The focus of this study was to determine the extent to which municipalities are the appropriate sphere of government for air quality management, with specific focus on the CoT and CoJ municipalities. The research approach was, therefore, qualitative. Qualitative techniques used for data collection were interviews, questionnaires and document review from municipal employees, air quality officers and experts in the air quality management field.

2.5 Population and Sampling

2.5.1 Population

Polit and Hungler (1999:37) and Rahi (2017:3)describes population as a set of people, items or objects having special similar characteristics as defined by the sampling criteria determined by the researcher. This means the population must satisfy all requirements in order to be included in the study (Burns & Grove, 2003:43; Majid, 2018). For the purpose of this study, the population consisted of only two Gauteng metropolitan municipalities namely, CoT and CoJ.

2.5.2 Sampling

Sampling is defined as a process of selecting segments of the population for investigation (Rahi, 2017). Blankenship (2010) defines a sample as a group of individuals or organizations selected to participate in a study through the sampling process. The sample for this study was the key personnel involved in air quality management duties in the selected municipalities and in other organisations.

2.5.2.1 Sampling Approach

The sampling approach for this study was non-probability purposive sampling. It is described as a method of selecting particular individuals, populations or cases based on a specific purpose or certain characteristics such as accessibility (Teddlie & Yu, 2007). This sampling technique enabled the researcher to survey and interview key personnel tasked with air quality management functions. The participants who met the eligibility/inclusion criteria as described in 2.5.2.3 were contacted by sending a letter of request, and only upon agreeing, the purpose of the study was clarified and consent to participate in the study obtained. The researcher then continued with submitting a questionnaire and/or with interviewing.

2.5.2.2 Sample size

Sample size is defined as the number of participants selected from the population to make up a sample (Kadam & Bhalerao, 2010).There was no specific number of participants in this study. The size of the sample was determined by saturation of information and/or the number of individuals who agreed to take part in the study. In terms of information saturation, this means sufficient sample size was the point at which data collected previously was confirmed to be repeating (Streuber Speziale & Carpenter, 2003:25), and the aims and objectives of the study were met (Charmaz, 2006:114). Reid and Mash (2014) recommends a sample size of between five and 15 individuals to be adequate to obtain data needed to meet the objectives of the study. For research such as this where a very specific group of participants (i.e. air

quality specialists in specific municipalities) are targeted to evaluate performance through questionnaires and interviews, a sample size of between 10 and 25 individuals is typically considered sufficient (Cape *et al.*, 2018; Swanepoel *et al.*, 2019).

2.5.2.3 Inclusion criteria

The participants were chosen based on their accessibility, expertise and involvement in air quality management. The participants were required to meet one of the eligibility criteria to take part in the study. The eligibility criteria were that the participant must be:

- Employed to carry out air quality functions within municipalities (to obtain the opinions of those who do the work).
- Air Quality Officer (to get a good perception of NEMAQA, and experiences of the challenges and opportunities brought by NEMAQA implementation).
- Air Quality Expert (to get opinions about how challenges experienced in municipalities with regard to NEMAQA implementation could be addressed).

2.5.2.4 Exclusion criteria

Employees of the municipality not involved in air quality management or pollution control duties were excluded from the study. Future research might also consider including the views of those not directly involved in air quality management in the municipalities, but who are affected by the outcome of air quality management efforts such as the health departments, town planning department, engineering department, etc.

2.6 Data Collection

Data collection is defined as a process of collecting relevant information from different sources to address the research questions of a particular study (Burns & Grove, 2003:373). Different methods of collecting data exist for qualitative research. In this study, literature review, questionnaires and/or interviews and document review were used to collect data.

2.6.1 Literature Review

The literature review was conducted using relevant scholarly articles, library records, books, air quality management legislation and policy documents. Reviewing both international and local literature provided an overview of the responsibilities or duties that municipalities perform in air quality management, as well as the challenges they face in performing these duties. Basic literature was perused in terms of the legislative and policy context, international agreements, roles, and responsibilities of various spheres of government and sectors in air quality management in RSA, air quality governance, AQM implementation tools, and AQMPs.

2.6.2 Questionnaire

A questionnaire can be defined a document containing standardised questions used to solicit information for analysis, on a particular topic from selected respondents (Babbie, 2013; Parfitt, 2005). In this study, the questionnaire was developed as guided by the literature review on air quality management and the Air Quality Management Framework for RSA. Questionnaires were distributed to relevant people as indicated in 2.5.3.2.

De Vos *et al.* (2011) propose different types of questionnaires that are suitable for a qualitative study. These are mailed, telephonic, hand-delivered, self- administered, group-administered and electronic questionnaires. For the purpose of this study,

mailed and self-administered questionnaires supplemented with interviews were utilised.

2.6.2.1 Design and structure of the questionnaires

Structured questionnaires were used as research tools for this study. The literature was used to construct different questions that are in line with the research aim and questions. Three sets of questionnaires were developed, for municipal employees **(Annexure F),** AQOs **(Annexure G)** and Air Quality Experts **(Annexure H).**Questions that determine whether municipalities understand their requirements and legal obligations in terms of NEMAQA were included in the questionnaire. Additionally, other areas that were given attention while designing the questions were: resources available for performing duties as outlined in the NEMAQA and the Air Quality Framework, challenges and opportunities encountered during implementation and technical requirements such as monitoring and enforcement. The questionnaire was then divided into four parts. The first part of the questionnaire was biographical information, which was used to collect information about the respondents in terms of qualifications, experience, and occupation. The second part was focused on operations within the municipalities, mainly on how the municipalities apply the NEMAQA in general. The third part was about resources, which aimed to find out the efficiency and effectiveness of resources for air quality management; and the last part was on communication. This part aimed to determine the communication strategies in place, both within the municipalities and with other government departments as far as it relates to air quality management. For the AQOs, the questionnaire contained only biographical information, operational and communication parts. The questionnaire for experts consisted only of two parts, i.e. biographical information and open-ended questions.

Different types of questions such as closed questions (which offer for a set of responses from which the respondent has to select), as well as dichotomous questions (which provide the respondent with YES/NO answers) (De Vos *et al.*, 2011), and open-ended questions (which require the person to give his/her opinion (Singer & Couper, 2017) or answer according to their knowledge) were used in this

study. Open-ended questions also assisted the researcher in validating information received from other types of data collection methods (Singer & Couper, 2017). Follow up questions were used in instances where the researcher was not satisfied with the responses from selected individuals. The questionnaires were distributed to about 48 individuals using email. **Figure2-1** and **Figure 2-2** below indicates the questionnaire design:

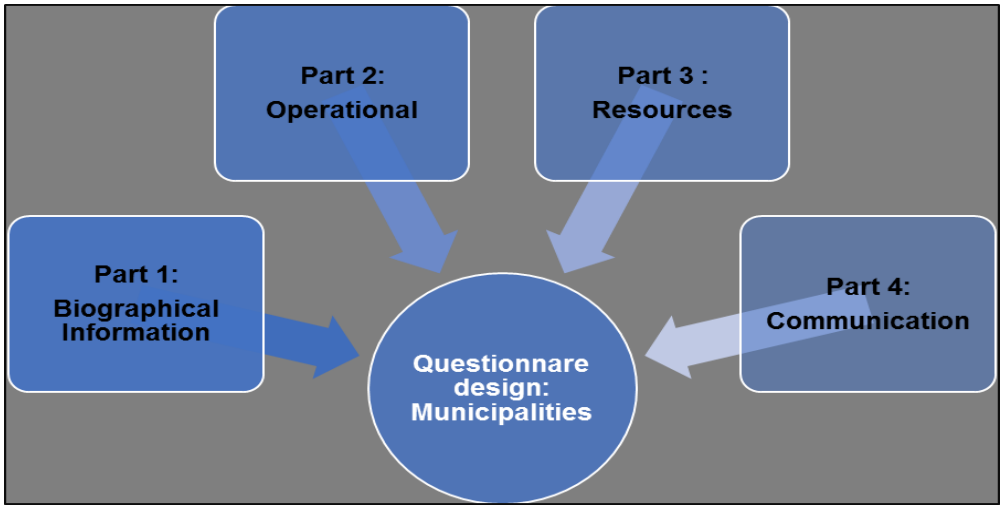

Figure 2-1: Questionnaire design for municipalities

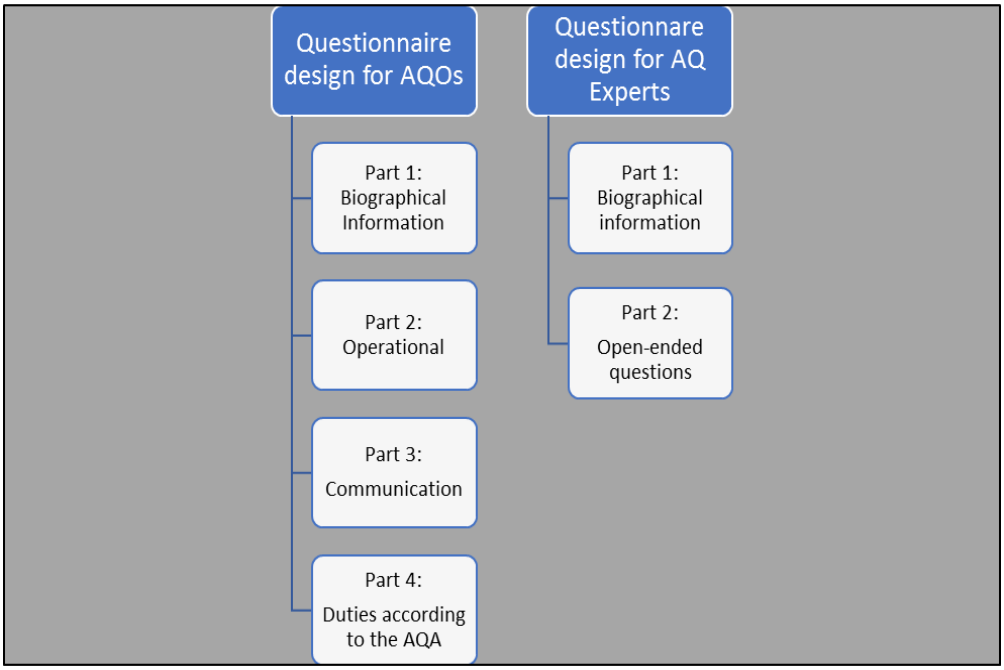

Figure 2-2: Questionnaire design for AQOs and Experts.

2.6.3 Interviews

Interviews are described as a method of qualitative data collection (Babbie, 2013) in which the interviewer coordinates the conversation process by posing questions, and the respondent answers those questions (Sturges & Hanrahan, 2004). In this conversation, only information related to the study is collected. Interviews are regarded as the best data collection tools in qualitative research (Greeff, 2005). For this study, semi-structured interviews were conducted face-to-face. The researcher used same questions that are in the questionnaire and recorded the answers on the questionnaire document.

The participants in this study were afforded anonymity. This ensured that they answered questions freely and truthfully. Both questionnaire and interview methods are suitable to give sufficient information that can be used effectively to answer the research questions for this study.

2.6.4 Document Review

Document review is described as a systematic method for analyzing and evaluating existing documents or records (electronic or printed) and the data they possess (Bowen, 2009:1). In this study document review was aimed at collecting data on air quality management within municipalities. Documents such as air quality monitoring reports; air quality officer's annual reports; IDPs, and AQMPs were reviewed to extract information relevant to this study. Air quality monitoring reports for CoT were obtained from South African Weather Services (SAWS) and GDARD whereas for CoJ the reports were obtained from the city itself and from GDARD. The AQMPs, as well as the IDPs for both cities, were sourced from the internet. **Table 2-1**and **Table 2-2** below indicates monitoring reports which were obtained for CoT and CoJ respectively. N/A indicates that the report could not be accessed.

Table 2-1: Air Quality reports collected for CoT

Air Quality Monitoring Reports for CoT (No data for the period 2015-2016)						
Month	**2013 (SAWS)**	**2014 (SAWS)**	**2017 (SAWS)**	**2017 (GDARD)**	**2018 (SAWS)**	**2018 (GDARD)**
January	✓	n/a	n/a	n/a	✓	✓
February	✓	✓	n/a	n/a	✓	✓
March	✓	✓	n/a	n/a	✓	✓
April	✓	✓	✓	✓	✓	✓
May	✓	✓	✓	✓	✓	✓
June	✓	✓	✓	✓	✓	✓
July	✓	✓	✓	✓	✓	✓
August	✓	✓	✓	n/a	✓	✓
September	✓	n/a	✓	✓	✓	✓
October	n/a	✓	✓	n/a	✓	✓
November	✓	✓	✓	✓	✓	✓
December	✓	n/a	✓	n/a	n/a	✓

Table 2-2: Air Quality reports collected for CoJ.

Air Quality Monitoring Reports for CoJ (No data for the period 2013-2016)		
Month	**2017 (GDARD)**	**2018 (GDARD)**
January	n/a	✓
February	n/a	✓
March	n/a	✓
April	✓	✓
May	✓	✓
June	✓	✓
July	✓	✓
August	n/a	✓
September	✓	✓
October	n/a	✓
November	✓	✓
December	n/a	✓

2.7 Data analysis and interpretation

Data analysis is a process of reducing and organising research data (Burns & Grove, 2003:479), thus bringing order, structure and context to the data collected (Marshall & Rossman, 1999) and enabling the researcher to draw conclusions and recommendations. Analysis of data consists of analysing, classifying, organising or then recombining the facts to answer the research questions proposed in a study (Yin, 1994a).

According to Patton (2002:432), qualitative data analysis converts research data into findings. This includes reducing the amount of raw data, separating context from information, defining important patterns and establishing a structure for communicating the fundamental character of what the data shows. Interpretation is a process of identifying and explaining the actual meaning of the data. It involves organizing and connecting and integrating data from various sources and making a conclusion about what this data means.

Two sources of primary data for this study are questionnaire and interviews, as well as two sources of secondary data, which are literature review and document review. Data obtained from municipalities was inputted into **OriginPro 8** software, then analysed. The analysed data was then presented in graphs, followed by a discussion of each graph for explanatory or clarification purposes. Data obtained from experts and AQOs was discussed individually.

2.8 Ethical considerations

The ethical codes of standards as required by the North West University (NWU) were strictly adhered to. The study was approved by the NWU Faculty of Natural and Agricultural Sciences Ethics Committee (FNASREC) and given ethics number **NWU-01342-20-A9** (**Annexure A**). When dealing with human beings as the objects of the research, distinctive ethical problems and moral dilemmas may arise (De Vos *et al.*, 2011). These must be defined and discussed before the study is carried out to ensure that participants are safe from harm in any way. The ethical considerations

applicable strictly to this project were permission and informed consent, anonymity, and confidentiality.

The CoT required the researcher to sign a confidentiality agreement in order to ensure the confidentiality and privacy of the research data obtained from the municipality. This study only commenced once the confidentiality agreement was signed and submitted to the municipalities. For the CoJ, the study commenced once the permission letter was granted to the researcher.

2.9 Research Permission

2.9.1 City of Tshwane

A letter requesting permission to carry out the research was sent to the CoT municipality. The letter was directed to the Director of the Knowledge Management Section **(Annexure B).** The approved research proposal, the letter from the university and proof of registration were sent as supporting documents for the request. Permission was granted and given reference: **Research Permission/Mohlala** and the researcher was required to sign a confidentiality form before the commencement of the study **(Annexure D).** Permission to access the participants was requested from the manager of the Air Quality Management section. Once all permission requests were granted, a letter of invitation was distributed to all air quality section staff members that met the requirements as stipulated in the inclusion criteria, inviting them to participate in the study **(Annexure C).** The invitation letter included, *inter alia,* aims and objectives of the study, a brief description of what the participation entails and the rights of the participants.

2.9.2 City of Johannesburg

The CoJ has a policy that requires the researcher to apply on the National Health Research Database prior to getting a permission letter from either the Executive Director: Health (City of Joburg) or the Chief Director Health (Johannesburg District).

The Researcher applied on www.nhrd.hst.org.za and attached the letter requesting permission to carry out the study **(Annexure B),** the approved proposal and the letter from the University as proof of registration. The study was approved and given a reference number **GP_201903_017 (Annexure E).** An invitation letter was then sent to all participants meeting the inclusion criteria **(Annexure C).**

2.9.3 AQOs and Experts

Experts and AQOs were identified through LinkedIn, word of mouth and internet. They were requested to take part in the study via email. The respondents included consultants, academics and environmental officers.

2.10 Anonymity

The invitation letter sent to the municipalities, AQOs and experts addressed the issue of anonymity. Affording anonymity of the collected information from the participants means that this study did not collect individual information such as name, address, email address, telephone numbers, etc. However, participants who do not want to remain anonymous were allowed to submit individual information.

2.11 Confidentiality

Confidentiality of information collected from research participants will be maintained by keeping it in a very secure environment. The responses of individual subjects can only be identified by the researcher and individual members of the research team. Researchers shall make every effort to prevent anybody who is not part of the project team from linking individuals to their responses.

2.12 Limitations

The limitation for this study is that it only focused on two metropolitan municipalities in Gauteng Province and not on any other stakeholders who were given the same responsibility of implementing the AQA such as district municipalities and industries. Therefore, follow-up research should aim to cover other categories of municipalities and thereby gain a more generalised understanding.

2.13 Validity & reliability

Validity and reliability of results are very important for any type of research (Golafshani, 2003). Validity indicates that the findings of the study represents the phenomenon being measured, wherein, reliability indicates that a research study produces same and consistent results when carried out by different persons (Litwin & Fink, 1995). The structured and systematic research design aimed to ensure the validity and reliability of results.

2.13.1 Validity

All reasonable measures were taken by the researcher to ensure the internal validity of this study. Leading questions were avoided, and the questions were drafted in a simple and unambiguous language. The design of the questionnaire was in such a way that it can be easily and accurately completed by the respondents. In addition, there were control questions included to assist the researcher to detect any contradiction in responses by each respondent.

2.13.2 Reliability

Reliability is a statistical measure of how reproducible the questionnaire data is (Litwin & Fink, 1995). To test the reliability, the questionnaire, was sent to competent individuals (n=5) who were not part of the sample population for evaluation.

Comments received were integrated, where possible, into the questionnaires. The questionnaire was proofread and any questions that are unclear were removed. The researcher ensured that the instructions are standardized for all respondents. The questions were all the same and were rechecked before handed over to respondents.

2.13.3 Triangulation

Kulkarni (2013) describe triangulation as the use of more than one data collection method on the same research topic. In this study, four methods of data collection were used. In this way, the validity of the research was strengthened.

2.14 Summary of research methodology and methods

Table 2-3 below indicates the data sources and methods used for achieving the two research questions mentioned in Chapter 1.

Table 2-3: Data sources and methodology for research questions 1 and 2.

Research questions	**Data sources**	**Methods**	**Justification**
1. What is the extent of implementation of NEMAQA by Gauteng municipalities?	Municipality employees, AQOs and Experts:	Interviews and questionnaires	Interviews will provide the researcher with information about how municipalities conduct air quality duties, based on their own experiences
	Journals, legislation documents,	Literature review	A review of literature will give the researcher

	books, and any other internet sources AQMPs, AQ monitoring reports	 Document review	background on how the AQM duties were conducted previously and what has improved till now Document review gives information about the duties currently performed, how they are performed and how challenges are dealt/were dealt with.
2. What are the reasons for the extent of NEMAQA implementation?	Municipality employees, AQOs and Experts	Interviews	Based on the information obtained, the interviews will give an overview of why the municipality performed the way they did.

2.15 Challenges for the study

Research by its nature, is challenging and therefore, challenges in any research are inevitable. For this study as well, the researcher was faced with several challenges. **Table 2-4** provides the main challenges encountered when undertaking this study and how these were resolved.

Table 2-4: Challenges encountered while conducting research.

Challenge	**Resolution**
Unavailability of personnel for interviews due to the busy schedule or lack of interest. This made the research difficult as	This was resolved by sending questionnaires and allowing people enough time to answer them. A

there are few individuals working in the air quality sections in the municipalities. This, therefore, affected the sample size.	follow-up telephonic interview was used where possible. However, other employees still did not take any of the two offers.
The challenge emanating from e-mailing the questionnaire was that the participants did not reply immediately, and some did not reply at all, even after telephonic follow up	No resolution for municipalities. For experts, the researcher continued to look for other interested experts through LinkedIn and the internet.
Obtaining information (e.g. reports) from municipal officials was highly challenging.	This challenge could not be addressed successfully as, after numerous follow-ups, the researcher still did not receive any information.

2.16 Conclusion

This section addressed the research design and methodology underpinning this study. Detailed information on how the research was conducted, what data collection methods were employed, how sampling was done and how results are interpreted are presented in this section. In addition to this, challenges faced, and the resolutions were also presented. Ethical consideration, validity as well as reliability, were also clearly indicated.

Chapter 3： Literature Review

3.1 Chapter summary

This chapter explores air quality management literature in South Africa, from legislative and governance perspective and other regulatory approaches. The chapter also covers air quality management at international level, with specific focus on the World Health Organisation (WHO), the European Union (EU), the United States of America (USA) as well as the United Nations (UN).

3.2 Introduction

Previously before urban sprawl and industrial growth became major issues, the main contributors to the pollution of the atmosphere were mainly due to fires, smoke (being the by-product combustion) and natural sources such as volcanoes and sea. As a result of urbanisation and industrialisation in the last 200 years, a range of toxins are constantly being released into the environment (Chen *et al.*, 2017; Thevenon *et al.*, 2011). In most parts of the world, levels of air pollution remain very high. Data released by the WHO in 2018 indicates that nine in ten people are breathing polluted air (CCAC, 2018). Sources of air pollution include mines, agricultural sector, domestic premises, industrial areas, and roads. Air pollutants can have detrimental health impacts on human beings if they are not managed (DEAT, 2000). The excessive pollution in turn results in human-health deterioration as well as detrimental impacts on natural vegetation, animals, land, buildings and the entire environment, including atmospheric conditions. Furthermore, it has put pressure on the natural resources which are essential for the development of the economy in the long term (Elsom, 1987). The health effects associated with air pollution includes upper respiratory tract infections, asthma, emphysema, chronic bronchitis and the exacerbation of more serious illness such as lung cancer (Barnwell, 2009). Property damage on the other hand is generally caused by the effects of gaseous emissions on metals and coatings and by airborne acid which is responsible for steel corrosion (Barnwell, 2009).

Air pollution control and monitoring should be prioritised. New models and advanced techniques together with strong management systems and effective monitoring strategies are needed for curbing air pollution and assisting in the improvement of the environmental quality (NILU, 2007). Various countries, both developed and developing, have attempted different approaches to control air pollution for the benefit of current and future generations, including for the country's sustainability. Though some of the approaches worked extremely well, some of them had serious shortcomings.

In 1972, the UN conference on the environment was held in Stockholm and resulted in the collaboration of United Nations Environmental Programme (UNEP) with the WHO to focus on dealing with problems associated with air quality, which was exemplified by the 1952 London Smog episode. UNEP and WHO have since 1974 worked together in launching an urban air pollution monitoring network Global Environment Monitoring System (GEMS), (GEMS/Air) (UNEP/WHO, 1993). The GEMS programme emerged from the recommendations of the 1972 UN conference. The Organisation for Economic Co-operation and Development (OECD) has also been reporting annually on the concentrations and trends of air pollutants in certain selected countries. Ever since these initiatives came into existence, several networks have been established globally to monitor and measure air pollutants in various regions.

In the USA, local governments have proven to be key players in improving the local air quality (Fowler, 2016:175). The local governments have no official role under Clean Air Act (CAA); however, studies by Fowler (2016) indicate that the local government plays a major role in implementing air quality legislation and policies and in the improvement and maintenance of air quality in various local communities (Fowler, 2016:175). When the air quality monitoring sites are analysed, it was apparent that that air quality management at local level has the potential for success provided that the local government is fully capacitated to effect change across all areas.

In the UK, Part IV of the Environment Act of 1995 sets out responsibilities for central and local government with regards to air quality. The Act places air quality management responsibilities under local authorities while retaining a crucial role at

national level in the planning and execution of local acts and the implementation of these duties most efficiently carried out at the national level. The Local Air Quality Management (LAQM) legislation recommends that local authorities have the air quality review responsibility. In fact, local authorities have a key role to play in air quality improvement; public awareness and engagement with the people they represent and make them acquainted with the problems on the ground (DEFRA, 2016). Air quality in the UK has greatly improved over the last decades (DEFRA, 2016; DEFRA, 2017a; DEFRA, 2017b) due to cooperative actions at all government levels (DEFRA, 2017a).

In RSA as well, air quality management is the responsibility of local government. Municipalities are expected to ensure that an AQO is designated, annual progress reports on air quality performance is given, Atmospheric emission licenses (AELs) are processed and an AQMP is prepared and implemented (Naiker, 2012). However, for municipalities to succeed there should be an understanding and knowledge about the air quality within the area of interest (NILU, 2007). The goals outlined in the AQMP must be practicable and implementable. The outcomes of the plans developed by municipalities are to successfully achieve the air quality objectives and to make certain that the ambient air media is favourable for the wellbeing of individuals.

The AELs are issued by the provincial authorities and metropolitan municipalities (Naiker, 2012). Licensing of emitters is a very important tool in AQM. Previously, this was done by the national government. AELs are considered bearing in mind the best practicable environmental alternatives and emission standards (RSA, 2005). These licenses clearly indicate the operating conditions such as the compulsory monitoring procedures, procedures and periods for review as well as penalties for non-compliance (Naiker, 2012).

3.3 Legislation and policy for Air Quality Management in South Africa

In RSA, air quality management is informed by international, national, provincial and municipal level policies and legislation. Internationally, RSA has obligations and commitments under multilateral environmental agreements (RSA, 2018). There are

three main air quality concerns that are addressed in the international arena, namely, stratospheric ozone depletion, greenhouse gases and associated climate change, and persistent organic pollutants (RSA, 2018:7).

The national policy provides the essential point of reference for air quality whereas the provincial legislation is an expansion of the national policy, focused on addressing particular air quality issues. Municipalities on the other hand influence air quality governance by introducing by-laws (RSA, 2018:7).

After the democratisation of RSA in 1994, several environmental acts were promulgated. The intention of these acts was to bring the country's laws and principles of environmental management in line with international best practices (Naiker, 2007), with the Constitution of South Africa being the main yardstick for all the other legislation relating to the environment. **Figure 3-1** below summarises the time frame for air quality legislation South Africa since 1965. While there are other pieces of legislation (regulations and notices) that play a role in air quality management, Figure 3-1 shows only the backbone of air quality management.

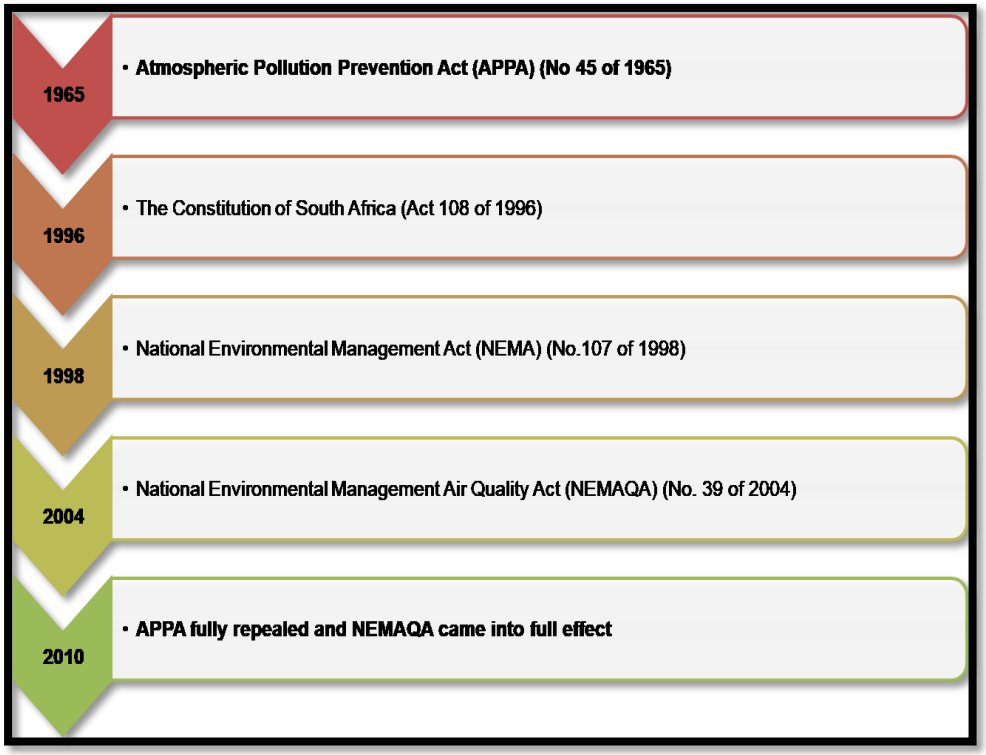

Figure 3-1: South African Air Quality Management legislation timeframe

3.3.1 The Atmospheric Pollution Prevention Act (APPA) (Act No.45 of 1965)

The APPA was a piece of legislation for air pollution control in RSA from 1965 till 2005 (Naiker, 2012). The APPA emission standards which were used "*as part of the best practicable approach to pollution control*", did not achieve the desired outcomes (Scott, 2005). APPA emphasised point source control (Engelbrecht & Van der Walt, 2012:407), used the command and control approach, and guideline principle rather than proactive or reactive protection of the receiving environment. APPA utilized notices and fines as a means of achieving compliance; and in instances of violation of the Scheduled process, termination of operation could be requested (RSA, 1965). This system was criticized heavily since it used an outdated approach and it did not show to be proactive and dedicated air pollution control and management to protect the much desirable environmental quality. Furthermore, the system was not able to assure industrial co-operation and was restricted in terms of incorporating the innovations on control and strategy because the emission reduction methods were clearly defined under this act (Naiker, 2007). This act did not achieve the expected levels of air quality (Barnard, 1999) and could not prevent the development of more areas where air pollution emissions increased (UNEP/WHO, 1996).

The constitution of South Africa was promulgated in 1996, and it introduced the environmental right in section 24. Other legislation such as the NEMA, PAJA, and PAIA were also introduced following the promulgation of the constitution. The APPA did not conform to this newly introduced legislation and to the constitution. This non-conformity led to the need to change APPA and ensure that it was in compliance with the aforementioned legislation. This led to NEMAQA being published in April 2004, replacing the APPA. This new legislation included, amongst others, the incorporation of international best practice, the international norms and standards as well as the updating of the perspective to environmental approach (Naiker, 2012).

3.3.2 The South African Constitution (Act No.108 of 1996)

The South African constitution was promulgated in 1996, after democratisation of the country. The Constitution also contains the Bill of Rights, enriching the rights of the

people of South Africa and upholding their democratic values of human dignity, equality, and freedom (RSA, 1996). In terms of Section 24 of the constitution:

"*Everyone has the right-*

a) To an environment that is not harmful to their health or well being; and

b) to have the environment protected, for the benefit of the present and future generations, through reasonable legislative and other measures that-

(i) Prevent pollution and ecological degradation;

(ii) Promote conservation; and

(iii) Secure sustainable development and use of natural resources while promoting justifiable economic and social development".

3.3.2.1 Constitutional and legislative imperative

The constitutional imperatives require the co-operation between national and provincial sphere of government on environmental and pollution control issues amongst other matters (Barnwell, 2009). The provincial government is obliged to build capacity in local municipalities, manage and give them support to fulfil their roles and responsibilities regarding functional areas such as "air pollution".

The principle of co-operative governance is addressed in chapter three of the constitution. The constitution compels all three spheres of government to adhere and to observe to this principle. Co-operative governance principle command all three spheres of government to safeguard the health and well-being of all citizens, "*provide an effective, transparent, accountable and coherent government for South Africa, co-operate with one another in mutual trust and good faith, and promote good intergovernmental relations"* (RSA, 1996). In addition to this, section 154. (1) further states that both the "*national government and provincial governments, by legislative and other measures, must support and strengthen the capacity of municipalities to manage their own affairs, to exercise their powers and to perform their functions"* (RSA, 1996).

With regard to environmental governance, Chapter 3 of NEMA gives effect to Chapter 3 of the Constitution, mandating the three spheres of government, more

particularly the departments undertaking activities that might be harmful to the environment to cooperate towards an integrated and holistic environmental management system in RSA.

To give effect to the constitutional and legislative imperatives in air quality management and control, it is crucial that the level of air pollution is conducive to promote a sustainable and healthy environment for communities (Barnwell, 2009). It is necessary to establish environmental air quality standards and to ensure that air quality is monitored, regulated and managed (DEAT, 2007). NEMAQA states that where applicable, the national or provincial department is responsible for compiling an Environmental Management Plan (EMP) or Environmental Implementation Plan (EIP) that must include an AQMP (RSA, 2005) in the national and provincial spheres of governement.

In addition to this, the alignment and integration of the AQMP with various departments' policies, strategies, and guidelines is encouraged in the provincial sphere of government. This includes, among others, those linked to sustainable development, planning energy, climate change, transportation, waste management, health, urban edge, and spatial development. The alignment and integration of AQMPs are applicable to departments involved in environmental issues only.

For municipalities, the Local Government: Municipal Systems Act 32 of 2000 (Municipal Systems Act) makes it a requirement for all municipalities to prepare an Integrated Development Plan (IDP) during an integrated planning process in order to give effect to constitutional imperatives. The act further requires that the municipalities include an AQMP in this IDP.

3.3.3 National Environmental Management Act (NEMA) (Act No. 107 of 1998)

NEMA was promulgated in 1998 with the aim of providing a legislative framework for environmental management and governance (Engelbrecht & Van der Walt, 2012). The significance of this foundation is that it operates as a start for unbiased development, environmental protection and a shift to sustainable development in South Africa. NEMA, as amended, is the framework to enforce section 24 of the

Constitution of South Africa. The main purpose of NEMA is to "*provide for co-operative governance by establishing the principles for decision making on matters affecting the environment, institutions that will promote co-operative governance and procedures for coordinating environmental functions exercised by organs of the state, to provide for certain aspects of the administration and enforcement of other environmental management laws, and to provide for matters connected therewith*" (RSA, 1998).

NEMA characterizes environmental management and grants a legal framework for all other related legislation (Barnard, 1999). Furthermore, NEMA provides a set of environmental principles in Chapter 1. These principles are aimed at encouraging cooperative governance while also acknowledging the value of economic growth and maintaining respect for people's rights. The NEMA principles are also based on the Constitution of South Africa (108 of 1996) and are all aligned with Agenda 21 principles of sustainable development.

NEMA principles are fundamental for the understanding of the AQM national framework and NEMAQA background, as well as the link to report permit and regulatory deviations (Barnwell, 2009:9). The principles are explored below considering air quality management and municipal roles:

Chapter 1 of NEMA has developed principles which have a significant impact on the environment that will enable the state to respect, protect, promote and fulfil social and economic rights (Chapter 2 of the RSA constitution) and the core needs of the underprivileged people as a result of unfair discrimination. The NEMA principles serve as a general framework for the formulation and implementation of environmental management strategies. In addition, the principles also serve as guidelines for intergovernmental cooperation and the roles exercised by the various state organs in decision-making on environmental protection.

The principles also include the need for environmental management to "put people first" by focusing on their needs and ensuring that any decision is taken fairly, representing their physical, psychological, economic, cultural and social interests. The most significant NEMA principle is that developments must be socially, economically and environmentally sustainable. Sustainable development under NEMA accounts for adverse environmental impacts and alternative considerations.

This implies that before a development can be implemented, the disturbance of the ecosystem and loss of biodiversity; emissions and environmental degradation; destruction of habitats and cultural/patrimonial sites, misuse of non-renewable and renewable natural resources and their ecosystems must be avoided or minimised if they cannot be avoided, then remedied. In terms of waste production, avoidance, minimization, remediation and recycling, and reuse are the suggested alternatives.

Risk-averse and precautionary approach (part of sustainable development) that takes account of the constraints of current knowledge on the effects of decisions and actions should be applied. The adverse effects on the people's environmental rights and the environment must be determined and prevented or be minimised and remedied in instances where they cannot be prevented.

Environmental management needs to be integrated and must take into account the consequences of decisions on all environmental aspects and the people. Decision-makers, together with polluters, are encouraged to follow a variety of environmental best practicable options.

Environmental justice needs to be promoted to avoid the distribution of adverse environmental impacts in a way that discriminates unfairly against the vulnerable or disadvantaged individuals. Equitable access to environmentally friendly resources, benefits as well as services to meet basic human needs and ensure the well-being of disadvantaged people must be persuaded.

To ensure that all environmental aspects and their impact on the environment and on people are recognised and given consideration, the involvement of Interested and Affected Parties (I&APs) in environmental governance should be promoted. To maximize the benefits of stakeholders and affected parties, people should be given the opportunity to acquire knowledge, develop skills and capacity to achieve fair and efficient participation. Furthermore, it should be ensured that vulnerable and disadvantaged people are encouraged to participate in environmental issues. NEMA encourages community empowerment and well-being through environmental education and awareness-raising for the sharing of information and experience. Consultative approaches with I&APs must be carried out in legislation-compliant manner.

The polluter pays principle is a commonly accepted practice, where polluters are responsible for the costs of pollution control; environmental degradation; and subsequent negative health effects and for preventing, controlling or minimizing more pollution, damage to the environment or adverse health effects. In the management and planning procedures, stressed habitats or conditions such as the wetlands and atmosphere can require special attention.

Lastly, NEMA prescribes duty of care and remediation of environmental damage in section 28. According to this section *"every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorized by law or cannot reasonably be avoided or stopped, to minimize and rectify such pollution or degradation of the environment*" (RSA, 1998). The duty of care requires the incidence of pollution to be reported and recorded by the polluter, and it also requires the polluters to ensure that necessary remediation is carried out. Industries and polluters must not contravene the right given in section 24 of the Constitution and must comply with the requirements in section 28 of the NEMA. Municipalities are responsible to ensure that the industries comply with relevant legislation and take action where there is non-compliance.

3.3.4 Integrated Pollution and Waste Management Policy (IPWMP) of 2000

The IPWMP is an integrated comprehensive framework and process of management which is designed for pollution prevention and minimisation of pollutants at source, the management of the impacts of pollution and waste on the receiving environment as well as remediation and rehabilitation of the damaged environment (RSA, 2000). The White paper on this policy provides the means by which to update pollution control legislation and includes the principles that define action in environmental management (Naiker, 2007). The policy is influenced by principles set out in White paper on Environmental Management Policy for RSA, and followed by NEMA. Overarching principles of White Paper on IPWM for South Africa are those of the constitution together with the Bill of Rights, and also those in NEMA (RSA, 2000).

The IPMWP depicts a paradigm shift from just waste management after its generation to preventing pollution, minimizing waste, integrating departmental institutions and spheres of government and involving all sectors of society in the management of pollution and waste (RSA, 2000). The IPMWP applies to the society at large, to all government institutions and departments and to all activists who impact on pollution and waste management. It is also part of the RSA government's effort to achieve the objectives of Agenda 21. Issues of governance are specifically addressed, clarification of roles and responsibilities of various departments, their associated line functionaries including provincial and municipal departments as well as enforcement system.

Issues that are only raised with regards to air pollution in the IPWMP focus on the integration of regulations by the three spheres of government and across all other media impacts such as polluted water which may result from atmospheric emissions and gaseous emissions resulting from the disposal of solid waste (Kotze, 2006). The policy is, however, criticized for not addressing integration issues appropriately. Furthermore, the policy does not have a description of standardized pollution standards and it has inadequate timeframes (Naiker, 2007).

3.3.5 National Environmental Management: Air Quality Act (Act No.39 of 2004).

NEMAQA was established in 2004 because a new and progressive legislative approach to air pollution was required due to the failures, limitations, and criticism of the APPA. This was perceived as the updated and restructured approach to controlling air pollution in RSA. NEMAQA was partly passed on 9 September 2005, partly implemented on the same date and completely implemented on 1 April 2010 (Mdluli, 2010). The Act lays the legislative and regulatory framework for Air Quality Management. NEMAQA "*reform the law regulating air quality in order to protect the environment by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development while promoting justifiable economic and social development; to provide for national norms*

and standards regulating air quality monitoring, management, and control by all spheres of government; for specific air quality measures" (DEAT, 2005).

Air quality management was introduced as the new control strategy and approach for air pollution (Naiker, 2012). The purpose of NEMAQA is to ensure protection of the environment through provision of appropriate measures; to prevent air pollution and to fulfil s24 (b) of the constitution (RSA, 2005). NEMAQA should be read together with NEMA, which provides the framework for decision making and the establishment of an Integrated Environmental Management System.

Air quality management under NEMAQA represented a distinct shift from source-based air pollution control to systematic and integrated air quality management (DEA, 2018). It focuses on the adverse effects of air pollution on the atmosphere and sets environmental air quality standards, with a clear indication of what the desired level of environmental quality is needed (Naiker, 2012), something that was not done under APPA. Under NEMAQA, there is a list of controlled activities that have evolved and additionally, emission standards are established and confirmed in order to minimise the amount of pollutants that enters the environment. The main categories which are regulated under NEMAQA are industries (heavy and medium, mineral processing and power generation); animal matter processing as well as waste disposal sectors (Naiker, 2012). The implementation of NEMAQA needs a matching set of other tools in order to accomplish standards such as ambient monitoring, emission inventories, emission reduction measures and dispersion modelling (de Nevers, 1977). All of these tools should be incorporated in the AQMP.

The goals, objectives and considerations and the contents of NEMAQA according to chapters are summarised below. Chapter 1 of the legislation indicates the objectives as follows:

- To improve air quality through environmental protection and provision of reasonable measures for the protection; prevent air pollution and environmental degradation and ensuring ecologically sustainable growth while fostering justified economic and social development.
- To give effect to the requirements of section 24 (b) of the constitution to improve the ambient air quality in order to ensure an environment that is not harmful to people's health and wellbeing.

Chapter 2 of the legislation indicates the importance of the National Environmental Management Framework (NEMF) as one of the significant functions of the NEMAQA. The NEMF is used as a blueprint for the management of air quality and attempts to meet air quality goals as outlined in the preface of NEMAQA.

Chapter 3 of the legislation covers matters relating to organisation and planning. These include the establishment of a National Air Quality Advisory Committee by the minister; appointment of AQOs at the three spheres of government; inclusion of AQMP in the EIP prepared by the national department or province; or EMP prepared in terms of NEMA; and into the IDP prepared by municipalities. This chapter also gives details on the preparation of the AQMPs. Furthermore, it is a requirement for each organ of the state to report on their AQMP implementation in the annual report which is submitted in terms of NEMA.

Measures for air quality management are outlined in Chapter 4 of NEMAQA. The measures are summarize in terms of the following: declaration of Priority Areas; listing of activities which result in atmospheric emissions and have harmful environmental effects; controlled fuels and controlled emitters declaration; other measures to tackle substances which may contribute to air pollution, including implementation of a Pollution Prevention Plan (PPP) or Atmospheric Impact Report (AIR); and the criteria for handling dust, noise, and offensive odours.

Chapter 5 focuses on the Licensing of Listed Activities through AELs, and Chapter 6 is about international air quality management whilst offences and penalties are discussed in Chapter 7.

In summary, NEMAQA indicates that successful reduction and management of air quality needs the following (Tshehla & Wright, 2019):

- ✓ Distribution of activities related to air quality management across the three government spheres;
- ✓ Source identification and quantification
- ✓ compliance monitoring and enforcement;
- ✓ setting of ambient and emissions standards;

- ✓ development of AQMPs by all spheres of government and affected departments,
- ✓ Development of emissions reductions and management plans by all source emitters;
- ✓ access to information and public consultation; and norms and standards for air quality monitoring and management .

3.4 Other air quality related National Legislations

3.4.1 The National Health Act (Act No.6 of 2003)

The National Health Act (NHA) has a direct bearing on the matters related to air quality management. Environmental pollution control is listed as one of the municipal health services under this act (RSA, 2004). In addition to this, NHA designates the health services responsibility to both metropolitan and district municipalities. Municipalities are encouraged to sign a service level agreement as a means for negotiating the provision in the NHA. The Service level agreement indicates the services which the municipality will render; resources which will be availed to render such services; performance standards which will be used to monitor the service provided as well as conditions for contract termination (RSA, 2004). Various other pieces of legislation that affect the implementation of NEMAQA are summarised in the National Framework for Air Quality Management (DEA, 2018).

3.5 Municipal by-laws

According to Section 152(1) (d) of the constitution, municipalities are obligated to promote a safer and healthier environment to communities (RSA, 1996:84). Section 156 (2) of the RSA constitution requires the municipality to make and enforce by-laws for the efficient administration of matters to which the municipality is entitled (RSA, 1996:87). Air pollution is classified as one of the matters under the jurisdiction of local government and the provincial or national government may not hinder the

municipal's right to exercise their authority. The municipalities are allowed to develop the by-laws which include requirements for air pollution management within their regions.

3.5.1 Model Air Pollution Control by-laws

Section 46(1) of the NEMA requires the Minister to make Model By-laws to create measures to manage the environmental impacts of any development within the jurisdiction of the municipality and that the municipality may adopt as municipal by-law. Section 46(2) allows the municipality to request assistance from the Director-General in the drafting of municipal by-laws. Model air pollution control by-laws were developed by the DEA on the 2nd July 2010, with the aim of giving effect to section 24 of the constitution and to bring the matter of co-operative governance to life. The objectives of model air pollution by-laws generally are to give effect to the right contained in s24 of the RSA constitution through air pollution control within the jurisdiction of the municipality; as well as ensuring that air pollution is avoided or minimised (DEA, 2010).

3.5.2 Municipal system Act No. 32 of 2000

As far as the Local Government: Municipal System Act is concerned, it is a requirement for each municipal council to adopt a single, integrated strategic plan as part of the municipality's development (RSA, 2000). This Integrated Development Plan (IDP) is the primary instrument of strategic planning used to guide and inform all decisions concerning planning and development in the municipalities. The IDP must reflect, among other things: the vision of the council for the long-term growth and development of the municipality emphasising mostly on strategic growth and institutional change needs; the council's policy goals and strategies for its term in office, including local economic growth strategies and the municipality's internal transition needs; development strategies of the council that are consistent with national and provincial sectoral policies and policy criteria binding on the municipality

in terms of legislation; organizational strategies of the Council; a financial plan to include expenditure estimates for three years minimum; and key performance measures and performance targets. The IDP is reviewed on an annual basis and as required by changing circumstances. The IDP must contain a municipal AQMP as one chapter.

3.6 Air Quality Management approaches

Different environmental protection strategies to protect the environment have been established. The common theory is that environmental protection is accomplished through the use of various policy strategies, instruments, and methods. However, this implies that a variety of different methods and resources must be considered in order to obtain full benefits. The current framework for environmental management (such as NEMA) provides for the deployment of several environmental management tools (Nel, 2001). Environmental Management approaches such as Command and Control-based (CCAC, 2018), Market-based, Civil-based, and Agreement or Engagement-based tools (Nel, 2001) could be deployed. These approaches have been adopted in air quality management in various countries, although there is little research on their effectiveness.

3.7 Air Quality Management Tools used in South Africa

De Nevers (1977) and Elsom (1987) lists the basic tools needed to carry out the air quality management strategy as ambient air quality standards; emission inventory, air pollution monitoring, mathematical dispersion model (modelling) and emission control measures. Some of these tools are also used in RSA, and are discussed in the following sections:

3.7.1 National Ambient Air Quality Standards

NEMAQA requires National Ambient Air Quality Standards (NAAQS) and emission limits to be established. The standards then serve as essential tools for air quality assessment (RSA, 2009). NEMAQA further requires the development of a National Framework for Air Quality Management, in order to make sure there is compliance with the regulatory obligations which provides for national norms and standards for ambient air quality monitoring (RSA, 2005).

NEMAQA also regulates criteria pollutants and NAAQS are stipulated for all criteria pollutants (**Table 3-1**). NAAQS covers the following priority pollutants, NO_2, O_3, CO, C_6H_6, Pb, PM_{10}, $PM_{2.5}$ and SO_2 (Mdluli, 2010). However, it should be noted that the limits for these pollutants in RSA are set higher (less stringent) than the WHO limits (WHO, 2005). **Table 3-1** also shows regulatory concentrations or limit values according to the averaging periods and the frequency of exceedance (FOE). The averaging period is the time over which an average is determined whilst the FOE is the amount of times the concentration limit value might be exceeded annually. Non-compliance with a standard is recorded when the limit value is exceeded more than the specified number of times in a year (RSA, 2005). Air quality standards are important for effective management of air quality because they provide measures of healthy human exposure levels (RSA, 2009; RSA, 2012).

Table 3-1: South Africa's NAAQS per pollutant and averaging period and FOE (RSA, 2009, RSA, 2012).

Parameter	Averaging period	Concentration	Frequency of exceedence
PM10	24-hour	75 $\mu g.m^{-3}$	4
	annual	40 $\mu g.m^{-3}$	0
PM2.5	24-hour	40 $\mu g.m^{-3}$	4
	annual	20 $\mu g.m^{-3}$	0
SO_2	10-minutes	191 ppb	526
	1-hour	134 ppb	88
	24-hour	48 ppb	4
	annual	19 ppb	0
NO_2	1-hour	106 ppb	88
	annual	21 ppb	0
O_3	8-hour running average	61 ppb	11
CO	1-hour	26 ppm	88
	8-hour running average	8.7 ppm	11
C_6H_6	annual	3.1 ppb	0

N.B $PM_{2.5}$ concentrations were revised in 2012 and became effective from 1 January 2016.

Industrial emission standards are also used as AQM tools which covers all key industrial processes run in RSA. This tool was developed after carefully considering a wide variety of international emission standards and consultation with relevant industries (Mdluli, 2010). Controlled fuels, which include material, or a blend of substances used in combustion processes are also used as air quality management tools.

One other approach currently used in RSA for air quality management is the Priority Area Approach. This approach ensures the proper identification of high pollution zones (Mdluli, 2010). After the identification, a specialized AQMP is developed. Only three national priority areas have been declared by RSA to date. Boundary determination is another tool used in air quality management. RSA uses population density, emission density, topography, and geopolitical boundaries whereas other countries use the common international approach which is to use ambient air quality information and dispersion modelling (Mdluli, 2010).

3.7.2 Emissions Inventory

According to Vallero (2014), an emission inventory is a pollutants database (listed by source) entering the air at a given time, and it provides information about the amount of emissions and the contributing sources, including the details on activities and emission estimates (UNEP/WHO, 1996). The pollutants could be from any source, whether natural or anthropogenic. Some functions of Emission inventories are:

- ✓ Help determine major air pollutant sources and appropriate regulatory actions
- ✓ Development of controls that are equitable,
- ✓ Effective input into mathematical models estimating air quality
- ✓ inform authorities on the choice of control measures,
- ✓ designing monitoring networks,
- ✓ informing land-use planning by identifying areas of high exposure and source locations relative to sensitive areas,
- ✓ When used with atmospheric dispersion model, inventories are able to predict short term ground-level pollutants,

- ✓ Help to identify large sources of pollutants
- ✓ Assessing compliance, especially, large emitters, where quantities of pollutant submitted for compilation must coincide with permitted emissions

The South African National Atmospheric Emission Inventory System (NAEIS) was lauched in 2015 (DEFF, 2015). The NAEIS is intended to provide all stakeholders with appropriate, up-to-date and reliable information on the emissions profile of South Africa for informed decision-making.

3.7.3 Air Quality monitoring programmes

Ambient air quality monitoring and evaluation are carried out in most countries world-wide, including RSA (Wright, 2009). National and or local standards for criteria air pollutants are informed by the WHO guidelines which are established through research on epidemiological studies (WHO, 2005) and then formalised in national or local legislation. Evaluations are conducted using the total amount of emissions, inventories, absolute measured or modelled ambient air quality level to determine the increase or decrease in emissions (Wright, 2009). Monitoring ambient air quality is mainly aimed at ensuring compliance with NAAQS. Although other spheres of government monitor air quality across South Africa, this activity is mostly carried out at the local sphere by the municipality itself or by external consultants. South Africa consists of over 130 fully automated air quality monitoring stations (Gwaze & Mashele, 2018). Air quality data from the monitoring networks is collected, processed and archived through a national air quality database called SAAQIS. The monitoring data is available to the public.

3.7.4 Dispersion modelling

Dispersion modelling is a valuable technique which is commonly used in air quality for scientific investigations and to support emission control policies. Modelling has been recognized as a regulatory tool used to evaluate the effects of a variety of

pollutants under specific meteorological conditions from the perspective of environmental impact assessment as well as ambient air quality compliance. In addition, air quality models are one of the only instruments available for

- ✓ forecasting and analysing of potential impacts of the proposed strategies for reducing emissions,
- ✓ understanding the effect of pollution on the atmosphere,
- ✓ predicting pollutant concentrations at various locations around the source,
- ✓ identifying source contribution to air quality issues,
- ✓ assessing source impacts and design control strategies and,
- ✓ predicting future pollutant concentrations from sources after implementation of new regulatory programs

During the permitting process, air pollution models are often used to verify that a new source of air pollution does not cause the exceedance of ambient air quality standards and the guidelines in place to protect human health and the environment. Models may predict the ambient concentrations of the proposed facility prior to construction, thereby assessing the potential impact of development without actually constructing and operating the facility.

In South Africa, air dispersion modelling regulations were developed under section 53 (f) of NEMAQA. The regulations are pertinent to the development, implementation and maintenance of the priority areas, AQMPs, applications for AELs, atmospheric impact reports, and specialist air quality assessment report as required in terms of various sections of NEMAQA (DEA, 2014).

The South African code of practice for air dispersion modelling first editions is based on the USEPA regulation models. The models are grounded on scientific merit and sound scientific principles, evaluations, reviews and documentations. Those models have also been adopted by other countries which include New Zealand, Canada and Australia. Models recommended for South Africa are SCREEN3; AERSCREEN; AERMOD; CALPUFF; and SCIPUFF (DEA, 2014).

3.7.5 Air Quality Management Plan

AQMPs are prepared in order to promote a strategic approach to air quality management within each sphere of government (Naiker, 2012).Section 15(1) of NEMAQA requires that the AQMP be included in the plan by each national department or province responsible for preparing the environmental implementation plan and the environmental management plan. Section 15(2) of NEMAQA requires municipalities to include AQMP in the IDP in terms of Chapter 5 of the Municipal System Act. In order to meet the requirements of NEMAQA for good air quality management planning and reporting, the national department has developed an AQMP manual with best practice guidance on AQMP objectives, strategies, plans and procedures for each sphere of government (DEAT 2008) The three spheres of government are the indicated in **Figure 3-2** below:

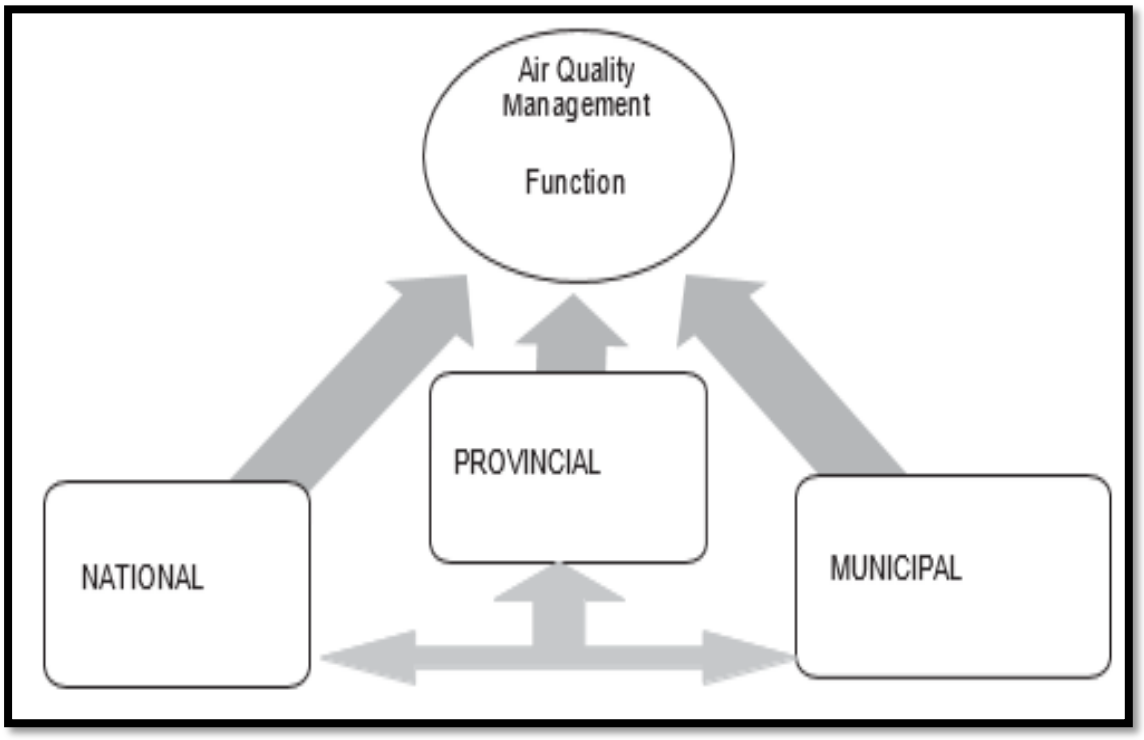

Figure 3-2: The three spheres of government involved in AQM functions.

The roles and responsibilities of these departments are different but interlinked in order to achieve a holistic approach to AQM. DEA (national department) is responsible for developing the national AQMP; review other national Environmental Management Plans (EMPs), provincial EIM and Local AQMPs; compile the

departments AQMP reports; compile and implement the priority area AQMPs and to give support to other two spheres of government. The provincial sphere is responsible for the development, compilation, and implementation of a provincial AQMP as a component of EIP and or EMP; to compile and implement the provincial priority area AQMPs; to compile the AQMPs reports for the department and to give support to local municipalities in air quality management planning process (RSA, 2007). The municipalities (Metro, District, and Local), being the lowest spheres of government, are tasked with developing and implementing AQMP as part of the IDP and to compile AQMP report for the department. It is a requirement for municipalities to incorporate AQMP in their strategic planning documents (Naiker, 2012; RSA, 2007).

The objectives of AQMPs are the following: identification all air pollution sources, development of a baseline report of the existing state of the environment, the setting of air quality management objectives, identification of the resources needed to get the desired state and the implementation, monitoring and reporting against the AQMP (RSA, 2007). This basically means that the AQMP "describes the current state of air quality in an area, how it has been changing over recent years, and what could be done to ensure the clean air quality in the region" (DEAT, 2008). The requirements of the plan are outlined in AQMP and the structure and content are explained in the planning manual which is prepared by the national department (DEAT, 2008). The contents include the following: poor quality impact identification; the methods to address various sources of pollutants and international commitments or obligations, consideration of best practice in air quality management, and the overall objective of air quality improvements (RSA, 2005). **Figure 3-3** indicates the roles and responsibilities of the three spheres of government and other departments in terms of AQMPs.

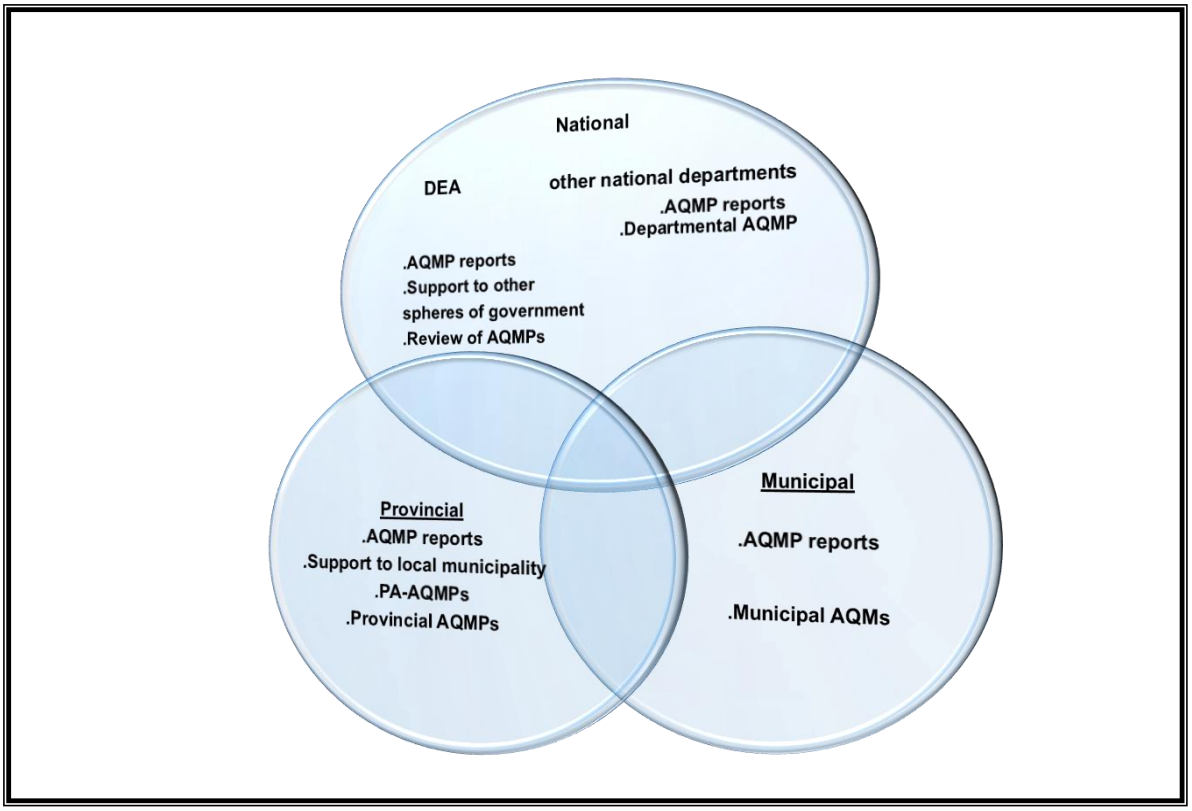

Figure 3-3: Roles and responsibilities of the three spheres of government.

3.8 Methods used for measuring air quality management progress

The methods of measuring progress are incorporated in AQMP as reporting mechanisms. AQMP reports indicating the performance on air quality must be generated annually, as this is a compulsory requirement under NEMAQA for all government departments responsible for air quality management. The report must indicate the air quality management methods, compliance with the legislated ambient air quality standards, priority areas of interest, and monitoring activities undertaken (RSA, 2005). Pollution prevention plans may also be required from emitters (RSA, 2005). Another method is the submission of the state of the environment reports on an annual basis. The difference between the approach used in APPA and the current NEMAQA is that the aspects such as powers of local authorities, enforcement and penalty system, incorporation of innovations in control strategies, human resource and financial resource requirements, consideration of ambient environment, strategic policy guidance and the monitoring, evaluation, and accountability measures, were

given a very low consideration under APPA but with the new approach, they are highly considered.

3.9 International Approach to Air Quality

A similar transition to that of South Africa with regards to air quality management has been observed in the UK, from the “best practicable means” approach to the usage of air quality standards in air quality management (Naiker, 2012). The same approach was adopted in the USA and New Zealand (Longhurst, 2009). The use of this approach in these three countries has shown that AQM has the ability to deal with local air quality concerns and can afford holistic, proactive management with a complementary strategic direction from national authorities (Longhurst, 2009). International bodies such as the UN, WHO, EU and the countries such as the USA and the UK national control standards are very influential when it comes to the control of air pollution globally. Therefore, it is very important to understand these legislation and policy agreements so that the air quality management can be correctly placed in a perspective of international best practice.

3.9.1 The United Nations

The UN is one of the most influential organisations when it comes to legislation and policies across the world. This function was observed in 1992 when the UN held a conference on Environment and Development. In this conference, environmental degradation was highlighted as the main issue and this contributed to the development of Agenda 21, which is the action plan for sustainable development. Agenda 21 was subsequently incorporated into the environmental policies of countries that were involved. UNEP and the UN Economic Commission for Europe (ECE) are the two organisations under the UN which address air quality matters (Naiker, 2007:69). UNEP conducts research and reports on current AQM issues in practice, including the results of the GEMS programme regularly.

UNEP and WHO have worked together in launching GEMS, an urban air pollution monitoring network (GEMS/Air) (UNEP/WHO, 1993:5). The GEMS and WHO operate a joint programme in the UN countries and collect information on environmental quality, including air quality, identifying the trends and levels of urban air quality.

3.9.2 The World Health Organisation

WHO has informed international understanding of the health impacts associated with air pollution levels and the ambient air quality guidelines developed are accepted as the maximum thresholds beyond which significant harmful health effects are experienced (Colls, 1998:34; WHO, 2005:5). WHO air quality guidelines relating to particulate matter (PM), Ozone (O_3), Nitrogen dioxide (NO_2) and Sulfur dioxide (SO_2) are summarised in **Table 3-2** below. The WHO has identified interim targets (ITs) for developing countries who cannot immediately meet the guidelines below.RSA has set some of the ambient air quality standards according to these interim targets.

Table 3-2: WHO Air quality guidelines.

Pollutant	Air Quality guideline	Averaging Time
PM_{10}	20 µg/m^3 50 µg/m^3	Annual mean 24-hour mean
$PM_{2.5}$	10 µg/m^3 25 µg/m^3	Annual mean 24-hour mean
O_3	100 µg/m^3	8-hour mean
NO_2	40 µg/m^3 200 µg/m^3	Annual mean 1-hour mean
SO_2	20 µg/m^3 500 µg/m^3	24-hour mean 10-minute mean

3.9.3 The European Union

The EU consists of 28 member states. EU encourages “environmental concern” amongst the member states, and its directives are binding (Naiker, 2007). The EU has developed some of the world’s high environmental standards. These set of standards by the EU apply uniformly across all nations and are aimed at protecting Europe’s natural resources and protect the health and well-being of the EU citizens. The EU environmental policies are aimed at protecting the natural habitats; keeping the air and water clean among other benefits.

In 1980, the EU drafted its first legislative document on air quality and prescribed limits and guideline values for sulphur dioxide and TSP aimed at addressing urban smog. In 1985, a directive addressing nitrogen dioxide limit values was drafted (Colls, 1998). The NO_x and SO_2 emissions from industrial plants were controlled through BATNEEC using a permit system after the Large Combustion Plant directive was passed in 1988. This directive was superseded by Industrial Emission directive on the 1st January 2016.

The Ambient Air Quality Assessment and Management directive was established in 1996. This directive provided the basic structure for air quality management and subsequent daughter directives, which elaborated with detailed requirements, such as ambient standards, technical specifications, and compliance dates. Currently, ambient air quality standards using limit values are set for SO_2, NO_2, PM_{10}, Pb, CO, and C_6H_6, as well as target values for O_3 and others (EC, 2018). The set limit values are in **Table 3-3** below:

Member states are expected to give effect to directives through national legislation, monitor air quality in accordance with requirements, and develop abatement programmes to eliminate exceedances with reports on implementation.

Table 3-3: EU air quality standards.

Pollutant	Concentration	Averaging period	Permitted exceedances each year
Fine Particles (PM2.5)	25µg/m3	1 year	n/a
Sulphur dioxide (SO2)	350 µg/m3 125 µg/m3	1 hour 24 hours	24 3
Nitrogen dioxide (NO2)	200 µg/m3 40 µg/m3	1 hour 1 year	18 n/a
PM10	50 µg/m3 40 µg/m3	24 hours 1 year	35 n/a
Lead (Pb)	0.5 µg/m3	1 year	n/a
Carbon monoxide (CO)	10 mg/m3	1 year	n/a
Benzene	5 µg/m3	1 year	n/a
Ozone	120 µg/m3	Maximum daily 8 hour mean	25 days averaged over 3 years
Arsenic (As)	6 ng/m3	1 year	n/a
Cadmium (Cd)	5 ng/m3	1 year	n/a
Nickel (Ni)	20 ng/m3	1 year	n/a
Polycyclic Aromatic Hydrocarbons	1 ng/m3 (expressed as concentration of Benzo (a) pyrene)	1 year	n/a

3.9.4 The United Kingdom

The first attempt in air pollution control in the UK started with the passing of the Alkali Work Act in 1863, which controlled emissions from the worst industrial polluters and drastically reduced acid emissions using standards (Beattie *et al.*, 2001). The UK was a strong proponent of the “best practicable means” approach using emission standards determined on the merits of individual industries. The National Alkali Inspectorate was established to administer almost 3000 processes associated with the emission of “noxious and offensive gases” with other processes controlled by local authorities (Elsom, 1992).

The London deadly smog episode of 1952 saw the sulfur dioxide concentrations increasing to as high as 4000 µg/m^3 and particulate matter to about 6000 µg/m^3 and caused about 4700 excess deaths (Elsom, 1992). The government was forced to then initiate a commission of enquiry, which resulted in the Clean Air Act (CAA) in 1956. Under this Act, domestic emissions were to be regulated for the first time. The CAA gave local authorities authority to designate “smoke control areas” within which fuels and heating appliances were strictly controlled. The CAA allowed the central government to compel local authorities to act on smoke control, as well as instructing industries to construct tall stacks to aid the dispersion of pollution (Jacobson, 2002).

The UK became part of the EU in 1973 and then adopted the EU policy through the national legislation and a shift in strategy to air quality management. Seven years later in 1980, ambient standards for SO_2 and smoke were introduced by the EU directive. This move, however, was contradictory to the UK approach which gave industries the duty to determine emissions that correlated the best practice instead of coercive penalties and as such, much resistance was experienced. The implementation date of the set standards was initially set to be in 1983 but was later changed to 1993 as compliance in the urban areas was expected to be challenging.

The Environmental Protection Act (EPA) introduced an integrated approach to pollution control in the UK in 1990 (Guruswamy, 1991). Best available techniques not entailing excessive costs (BATNEEC) was introduced in 1984 as the technical standard for industrial plant, and as a prerequisite for authorisation and applications; and emissions information was made available in public registers (Sorrell, 2002). In the same year, the Government White Paper called “This Common Inheritance”, pronounced change in pollution control introduced effect based controls in the form of air quality standards and created a new framework called Local Air Quality Management (Beattie *et al.*, 2001; Williams, 2004). These amendments were laid down in the 1995 Environment Act and this legislative document required the development of policies relating to the assessment and management of air quality, which was subsequently published as the National Air Quality Strategy (NAQS) and followed by air quality regulations in 1997. All the aforementioned documents form the current AQM practice in the UK. The NAQS is based on several concepts, with the emphasis on setting health-based standards (Mitchell *et al.*, 2005).

NAQS stressed intervention at the local level and the use of an air quality review and assessment process in authorities was characterized. The three-stage process involves the collection of emission information from sources and concentrations and the use of modelling and monitoring data to determine the probability of targets being reached by target dates (Beattie *et al.*, 2001). Advancing to higher levels indicates a greater likelihood of exceeding objectives and requires the use of more innovative tools. As these are the primary concerns of the regulation, consideration must be given to areas of public exposure when determining the risk of exceedances. Different areas that are expected to surpass target dates are declared Air Quality Management Areas (AQMA's) and authorities must prepare Air Quality Action Plans (AQAP's) indicating the actions must be taken to bring the area in line with the objectives (Beattie *et al.*, 2001).

3.9.5 The United States of America

The USA has a lengthy legislation history on the protection of air and was considered a pioneer in solving problems related to air pollution (Kuklinska *et al.*, 2015). The first effort by the US government to legislate air quality began in 1955 with the Air Pollution Control Act (Thornton, 2007:30), which recognized air pollution as a national crisis (Kuklinska *et al.*, 2015:30) after the 1948 Pittsburgh incident where a smog killed about twenty people and symptoms of illness/disease occurred in over six thousand other people (Hamill, 2008; Hopey, 2008). Following the 1955 legislation were the 1963 CAA and 1967 AQA which specified Air Quality Criteria, the Air Quality Control Regions (AQCRs) and the State Implementation Plan (SIPs) process. The establishment of the basic framework for the management of Air Quality in the USA was prompted by two landmark events that took place in 1970. The first event was the development of the U.S Environmental Protection Agency and the second one was the passage of the Clean Air Act Amendments (CAAA) of 1970. The CAAA was further developed and refined with the passage of Clean Air Act Amendments of 1977 and 1990 (Thornton, 2007:30).

The 1970 CAA has for the first time, allowed the establishment of the NAAQS for six criteria pollutants: sulphur-dioxide; nitrogen dioxide; carbon-monoxide; total

suspended particulate matter; hydro-carbons and photochemical oxidants (Jacobson, 2002). In 1976, lead was added as a criteria pollutant, and ozone replaced photochemical oxidants in 1976 whereas hydrocarbons were removed from the list in 1983 (Thornton, 2007). The second achievement of the CAA was the establishment of the National Emission Standards for Hazardous Air Pollutants (NESHAPS) (Naiker, 2007:75). In addition to setting national standards, the act also set the requirements regarding the execution of air quality programs and considerably extended the implementation of motor vehicle emission limits.

The Congress founded the Environmental Protection Agency (USEPA, 2014) in 1970. The EPA was entrusted with the management of the implementation of the air quality standards set out in the CAA. Several states could not meet the set standards, and this resulted in the introduction of amendments to the CAA. In 1977, the regulations on the Prevention of Significant Deterioration (PSD) of air quality in areas achieving NAAQS limits were amended to include requirements for areas not achieving the set limits (USEPA, 1970; USEPA, 2020).

Further changes were made to the CAA in 1990, with the new regulations amending and expanding the Act. The concept of emissions trading was implemented, and the EPA was given more authority to implement and enforce the rules aimed at reducing airborne pollutants. Additional amendments to the act were made with the following intention (EC, 2004; USEPA, 1990):

- Reduction of ozone-depleting substances.
- Reduction of emissions of acid deposition compounds.
- Limiting air pollutant emissions from specific sources.
- Limiting Hazardous Air Pollutants exposure sources.
- Protection and enhancement of visibility in national parks and wildlife areas
- Introducing more stringent emission standards for motor vehicles and using alternative fuels.

Although the CAA sets up ambient air quality standards in the USA and it applies them throughout the country as a federal act, each state is still required to have its own SIP (Greco, 1993). The SIP must contain information that indicates how air

pollution will be monitored in that state and must be compliant with the EPAs requirements. The SIP will only be approved if it complies with the EPA requirements and if not, the EPA may impose sanctions on the state in question (Greco, 1993). The current NAAQS as set by USEPA (2016) are provided in **Table 3 – 4.**

Table 3-4: US National Ambient Air Quality Standards

Pollutant		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide (CO)		Primary	8 hours	9 ppm	Not to be exceeded more than once per year
			1 hour	35 ppm	
Lead (Pb)		Primary and secondary	Rolling 3 month average	0.15 µg/m^3	Not to be exceeded
Nitrogen Dioxide (NO_2)		Primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		Primary and secondary	1 year	53 ppb	Annual Mean
Ozone (O_3)		Primary and secondary	8 hours	0.070 ppm	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Particle Pollution (PM)	$PM_{2.5}$	Primary	1 year	12.0 µg/m^3	annual mean, averaged over 3 years
		secondary	1 year	15.0 µg/m^3	annual mean, averaged over 3 years
		Primary and secondary	24 hours	35 µg/m^3	98th percentile, averaged over 3 years
	PM_{10}	Primary and secondary	24 hours	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide (SO_2)		Primary	1 hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		Secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year

3.10 International Agreements for South Africa

South Africa has signed multiple multilateral air quality environmental agreements and is bound to enforce these agreements. South Africa's international obligations resolve three major air quality issues: greenhouse emissions and related climate change; stratospheric ozone depletion and persistent organic pollutants Ratification of these multilateral agreements is an indication of the country's commitment to embarking on air quality issues, and therefore fulfilling s24 of the constitution. DEA

(2018) list these agreements and their conditions, as well as the obligations for South Africa as a signatory.

3.11 Conclusion

Air quality management is a dynamic, over-reaching issue that can be tackled globally, nationally, regionally and locally. In all instances, the government needs to provide financial and legal support as well as social and institutional tools on air quality issues to ensure the best possible air quality for communities. As stated in NEMAQA, the current air quality management approach can be regarded as a major breakthrough in air pollution control in South Africa (Naiker, 2012). Major changes have been made from the previous legislation, which saw the responsibilities being distributed amongst various spheres of government. Furthermore, AQM has shown that there is a need for planning tools as well as control measures in order to achieve the best air quality results. Some of the most important tools are the preparation of AQMP, the designation of AQM, the development of ambient air quality standards and emission standard for some specific activities and air quality monitoring (Naiker, 2012).

Chapter 4 : Results and Discussion

4.1 Chapter summary

This chapter presents an analysis and discussion of the data collected through interviews, questionnaire and document review.

4.2 Introduction

The present study was aimed at investigating the extent of NEMAQA implementation by two Gauteng municipalities (CoT and CoJ), and determining the reasons for such an extent. Data was collected through interviews, questionnaire and document review. The results obtained for this study are grouped into four main themes and presented in the form of graphs and tables. The themes are biographical information (experience, qualifications, and sector); operations (air quality monitoring reports and AQMPs); resources (human and financial) and communication (inter-governmental and intra-governmental). Data was collected and analysed in order to address the research problem and research questions identified in chapter one.

4.3 Part 1: Biographical Information

This part presents information on the total number of respondents and their biographical information. The questions asked in this part of the questionnaire were developed to determine the overall experience and qualification of the respondents in the air quality management field. This is important as it will indicate if relevant and experienced people were part of the study. **Table 4-1** below indicates the total number of respondents from different sectors/organisations. Only 14 out of 48 (29.2%) individuals that were approached responded to the questionnaire, with most respondents from the government sector. This was a success in that most respondents are people who implement NEMAQA in government on a daily basis. For studies of this nature, a total of between 10 and 25 respondents is normally considered sufficient, especially if representing specific case studies (Yin, 1994b).

Four interviews were conducted, and ten questionnaires were completed independently.

Table 4-1: Total number of respondents in various sectors/organisations

Respondent (sector/ organisation)	Number of invitations sent	Number undelivered	Number responded	% Responded
CoJ	06	0	03	50
CoT	04	0	03	75
GDARD	02	0	02	100
DEFF	01	0	0	0
Industry/ academia	34	0	06	17.6
Total	48	0	14	29.2

Figure 4-1 and **Figure 4-2** illustrates the demographic data analysis in terms of qualification and experience. The questions asked in this part of the questionnaire were to determine the relevant experience and overall experience. This was important because the level of experience and qualifications would indicate the quality and reliability of the answers given regarding air quality management in municipalities.

In terms environmental management qualifications, four respondents (42.9%) possessed an honours degree, six possessed a three-year degree (28.6%) and three had master's degree (21.4%). Only one respondent (7.1%) had a Doctoral degree.

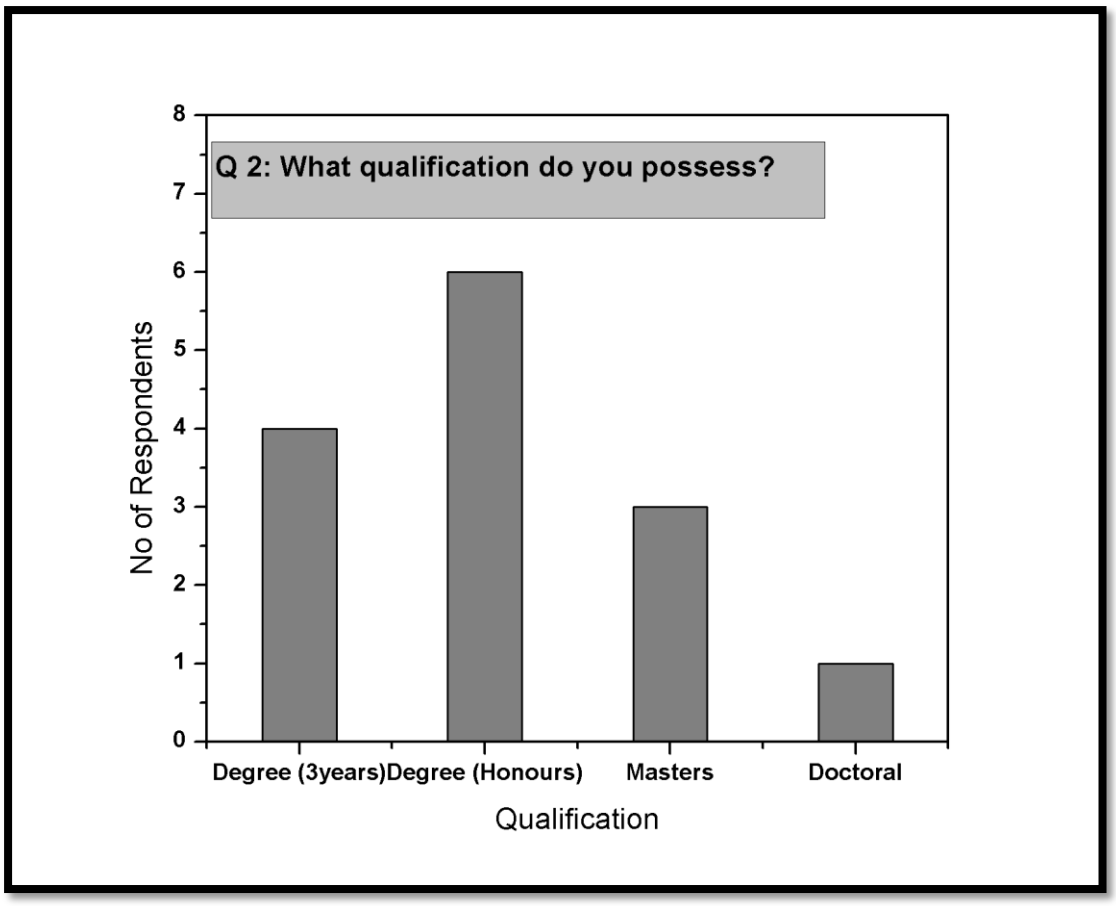

Figure 4-1: Respondents' qualifications.

Figure 4-2 below shows the overall experience of the respondents. Eight respondents (57.1%) had more than 10 years' experience in the AQM field, followed five respondents with 5-10 years (35.7%). Only one respondent (7%) had between 3-5 years' experience.

Figure 4-2: Total years of experience in the AQM.

4.4 Part 2: Operational questions

This section focused on the operational part of the municipalities in terms of air quality management. The two focus areas were the AQMPs and air quality monitoring reports for CoT and CoJ for the period 2013-2018.

4.4.1 AQMPs Review

NEMAQA was promulgated in 2005, as the new and restructured approach to air pollution control in RSA. One of the requirements of the act was that municipalities must develop the AQMP. The CoJ developed their AQMP in 2003 (Scorgie *et al.*, 2003) before the promulgation of NEMAQA, and CoT developed their AQMP in 2006. This was an important and necessary step in that the development of an AQMP gives effect to s24 of the constitution.

In addition to the development of AQMP, review of the AQMP every five years is recommended by the 2007 National Framework (NF) for the development of AQM, as well as the 2012 Manual for the development of AQMP in South Africa as part of the municipality's mandate to improve and monitor air pollution in the cities. The objectives of AQMP review is to, *inter alia*:

- ✓ Assess progress made in AQM in the cities;
- ✓ Establish whether the goals and targets that were previosly identified are implemented effectively;
- ✓ Establish validity of the goals and targets in terms of new developments and economic growth; and
- ✓ Identify possible air quality risks and interventions that could be translated into new goals and objectives.

The research found that both the CoT and CoJ have not complied with the AQMP review recommendation as per the National Framework and the 2012 manual for AQM planning, that AQMPs should be reviewed every five years. The CoT AQMP was first developed and approved between 2006 - 2008 (CoT, 2006) and has never been reviewed since inception. In March 2019, the CoT published the intention to review the 2008 AQMP. The review timeline for CoT is indicated in **Figure 4-3** below. Financial constraints, capacity, difficulties in engaging other departments and dealing with conflicting policies as well as political interference has been cited as the barriers to reviewing the AQMP. From the interviews carried out, the respondents assumed that that air quality is not prioritised or treated as "service delivery" hence there is little, or no finance made available to deal with air quality issues. Although the municipality can rely on the provincial AQMP, it is generic and cannot address issues within the city.

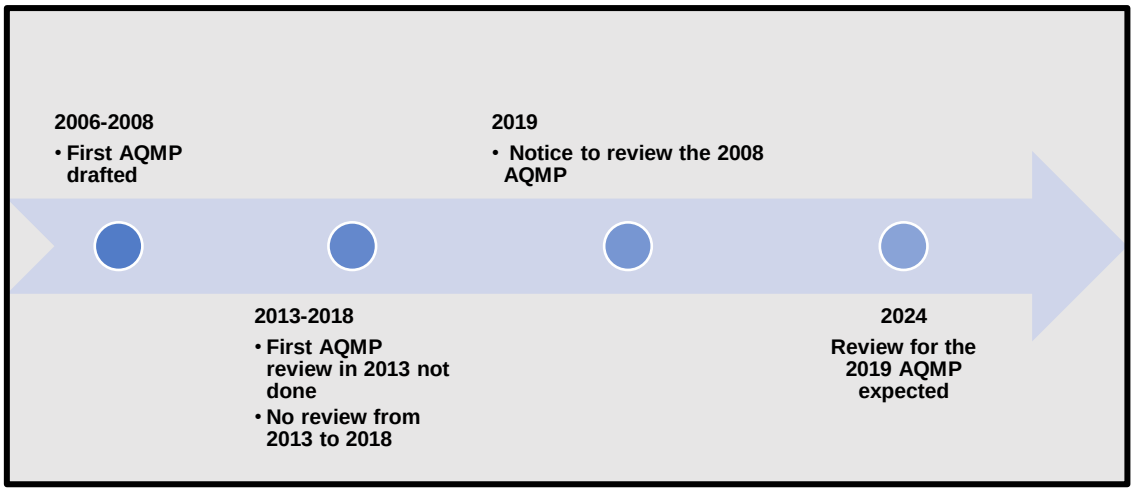

Figure 4-3: CoT AQMP review timeline.

The CoJ, on the other hand, had its first AQMP draft in 2003, before the promulgation of NEMAQA. The first review was expected to be in 2005 when NEMAQA was introduced in order to ensure that the AQMP aligns with the act, or alternatively in 2008 as that marks the five-year period for review. Due to similar barriers alluded by CoT, the first review was endeavoured in 2017, almost fourteen years later since the development of the first AQMP. To date, the reviewed AQMP has not been finalised. The comments period for AQMP lapsed on the 17th September 2018 (CSIR/AIRSHED, 2017). **Figure 4-4** below indicates the review timeline for CoJ.

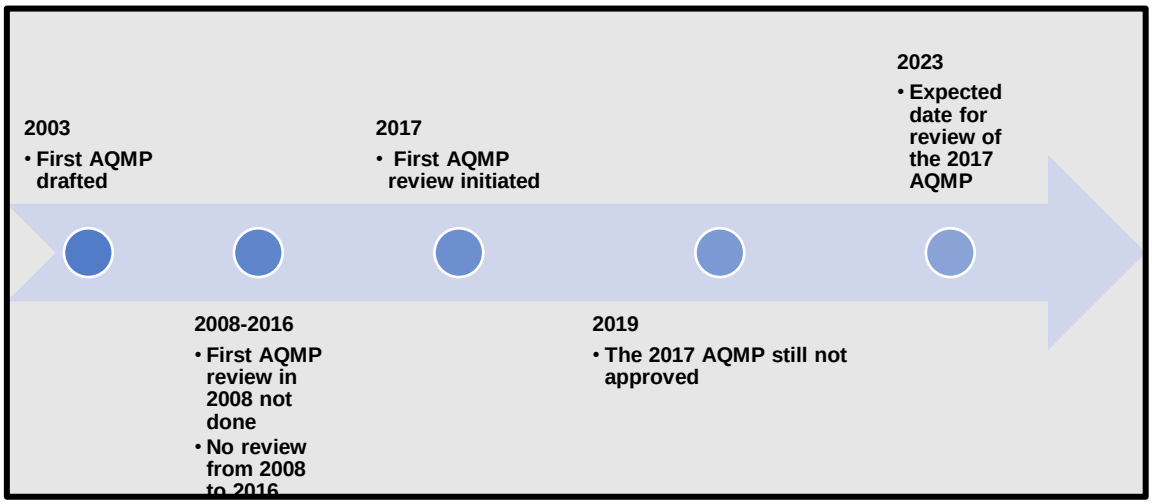

Figure 4-4: CoJ AQMP review timeline.

Although municipalities are allowed to use the provincial AQMP in certain circumstances, GDARD (Provincial) has also not reviewed their AQMP till 2017. Since its inception in 2009, the first review was initiated in 2017 and is yet to be finalised. **Figure 4-5** below indicates the GDARD AQMP review timeline. It is apparent that the reviewing of AQMPs for province as well as CoT and CoJ has not been conducted according to the set requirements. AQMPs must be up to date (as it is guiding a tool), considering an increase in the number of individuals flocking into the province annually, which in turn stimulates a number of other aspects that affects the quality of the air.

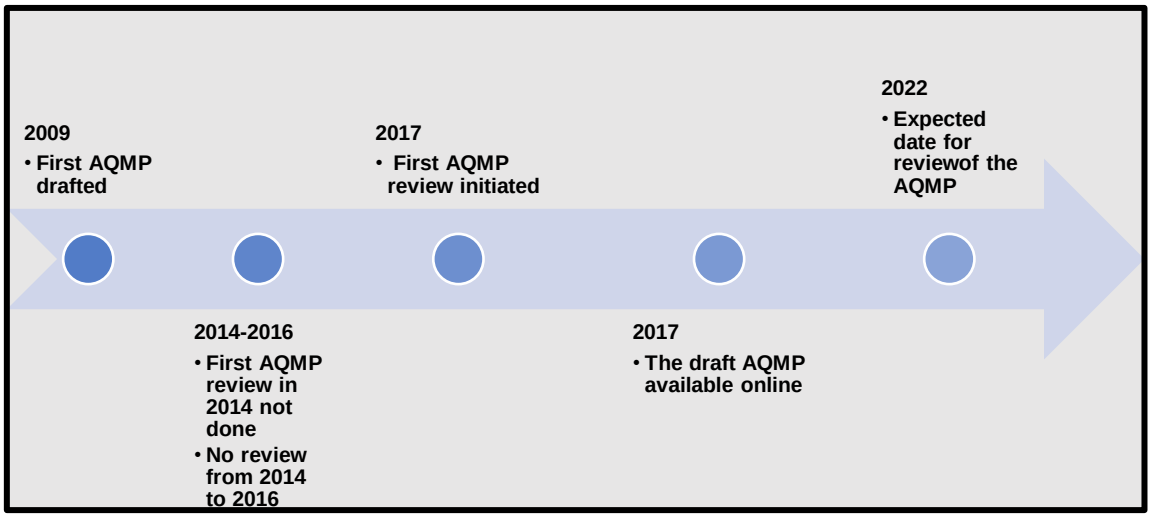

Figure 4-5: GDARD AQMP review timeline.

4.4.1.1 Requirements for reporting on AQMPs

In terms of section 17 of NEMAQA and section 16(1) (b) of NEMA, an annual report on AQMP implementation status must be submitted by provincial or local authorities. Guidelines for air quality management planning are provided in the 2012 AQM manual (DEA, 2012). According to this manual, the report should contain the following information: air quality management initiatives undertaken during the reporting period; the level of compliance with NAAQS; measures undertaken to ensure compliance with the NAAQS; compliance with AQMPs for any priority areas where applicable; air quality monitoring activities as well as compliance monitoring

and reporting. Due to limited access to information, the researcher did not obtain the annual reports for AQMP implementation.

4.4.1.2 How can AQMP implementation be improved

To improve the implementation of AQMP, more national support is needed. The national department must lead in this instance and introduce enforcement mechanisms such as withholding part of the transfer of funds from National if there is no an updated AQMP. Specific action plans for AQMP implementation must be written down and implemented (with a specific timeline). Secondly, the allocation of funds for environmental issues must be centralised at national department for better management of air quality as, the department receives the money directly from the National Treasury. Lastly, municipalities, provincial and national departments should improve relationships and communication with other departments which contributes to air pollution (e.g. human settlement, water, and sanitation, transport, land use planning).

4.4.2 Air Quality monitoring reports

According to (Section 8(a)) of the NEMAQA, it is a requirement for municipalities to monitor ambient air quality and emissions from point and non-point sources, as well as mobile sources. Emission reports from industries and other emitters should, therefore, be studied and analysed by municipalities in order to ensure compliance with AELs conditions (Tshehla & Wright, 2019).

Ambient air quality measurement is a requirement according to NEMAQA, and therefore monitoring reports from municipalities are required in order to determine the quality of the air. The two municipalities have been partially compliant with this requirement because there are periods where air quality monitoring was not conducted. The available monitoring reports and the state of the environment reports, however, indicate that air quality in Tshwane and Johannesburg is slowly declining, with numerous exceedances of the NAAQS.

Air quality monitoring reports for the period of six years (2013-2018) were reviewed in order to determine any improvements in terms of data collection efficiency, data collection gaps, and exceedances. Reports for CoT were obtained from SAWS, which was contracted in 2016 to carry out air quality monitoring for three years. The reports for CoJ (2017 and 2018) were obtained from GDARD and CoJ. The reports for other years (2013-2016) for CoJ could not be obtained. The lack of monitoring information for certain periods makes it harder to make a definite conclusion in terms of compliance.

4.4.2.1 Data collection efficiency

The GDARD is responsible for the operation and maintenance of four stations for the CoT and four for the CoJ. The CoT has nine ambient air quality monitoring stations. Five of these stations are managed and maintained by SAWS since 2016. The stations are Bodibeng, Booysens, Hammanskraal, Olievenhoutbosch and Tshwane Market. The GDARD manages four stations since 2017, i.e. Rosslyn, Ekandustria, Mamelodi and Pretoria West. Prior to this arrangement, all stations were managed and maintained by C& M consulting.

Data on air quality is collected daily from these stations and reported on a monthly basis in a form of a report. Data collection efficiency is important in air quality management as it helps determine whether the collection method is effective on not. Validation of data collected is done for each station and a conclusion is made as to whether the efficiency is good or poor.

Data collection efficiencies for the CoT for the years 2013 (**Figure 4-6),** 2014 (**Figure 4-7),** 2017 (**Figure 4-8)** and 2018 **(Figure 4-9)** are presented below. There was no data collection for the period 2015-2016. The reports were not on SAAQIS and the 2016 and 2017 SOE reports confirmed that there was no data from CoT. Data collection efficiency should be above 80% to be considered representative (SAWS, 2018:10).

***NB**: "According to the South African National Accreditation System (SANAS) guidelines, a minimum of 80% data capture is required to achieve minimum data quality assurance for data manipulation and summary (SANAS TR07-03)".*

4.4.2.1.1 City of Tshwane data collection efficiency

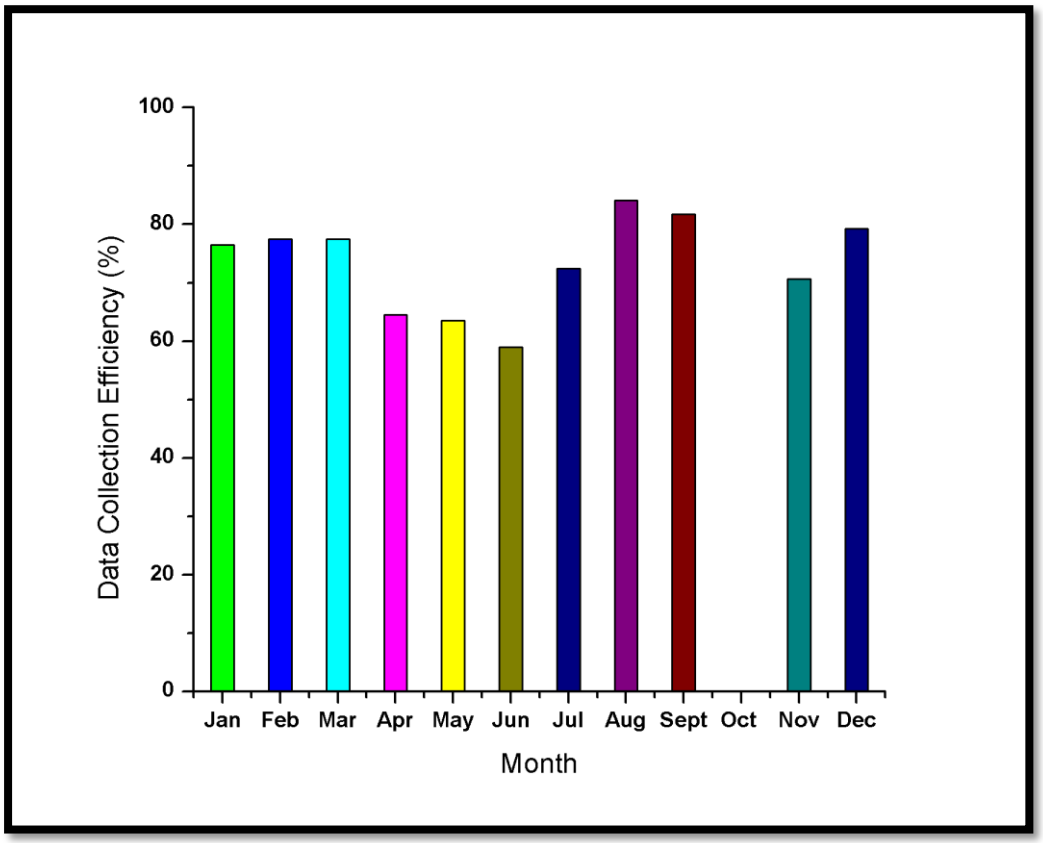

Figure 4-6: Data collection efficiency for CoT in 2013.

Figure 4-6 above shows data collection efficiency for the year 2013 in the CoT. The report for the month of October was not available; however, the city has been consistent in obtaining data for all the other months. The highest collection was observed in August, with 84.13% and the lowest being 58.98% in June.

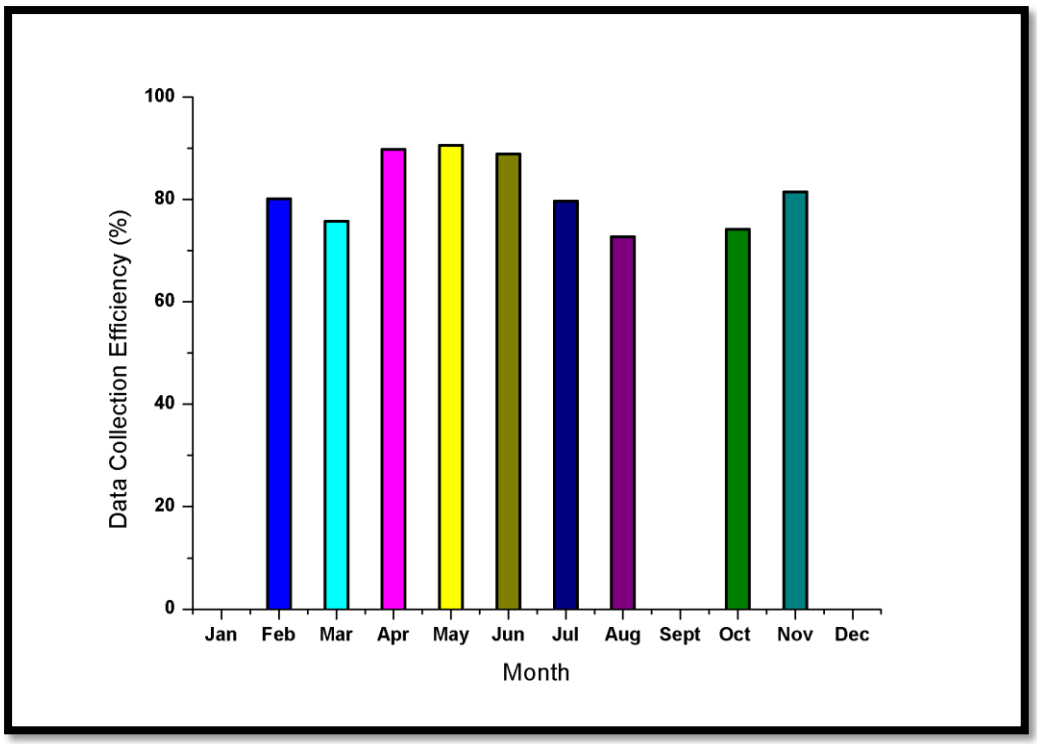

Figure 4-7: Data collection efficiency for CoT in 2014.

In 2014, reports for January, September, and December were not available as indicatedin **Figure 4-7** above. However, there was an improvement from 2013, with several months above 80% collection efficiency. The lowest collection was in August at 72.65%. The was no information for 2015 and 2016 for air quality monitoring.

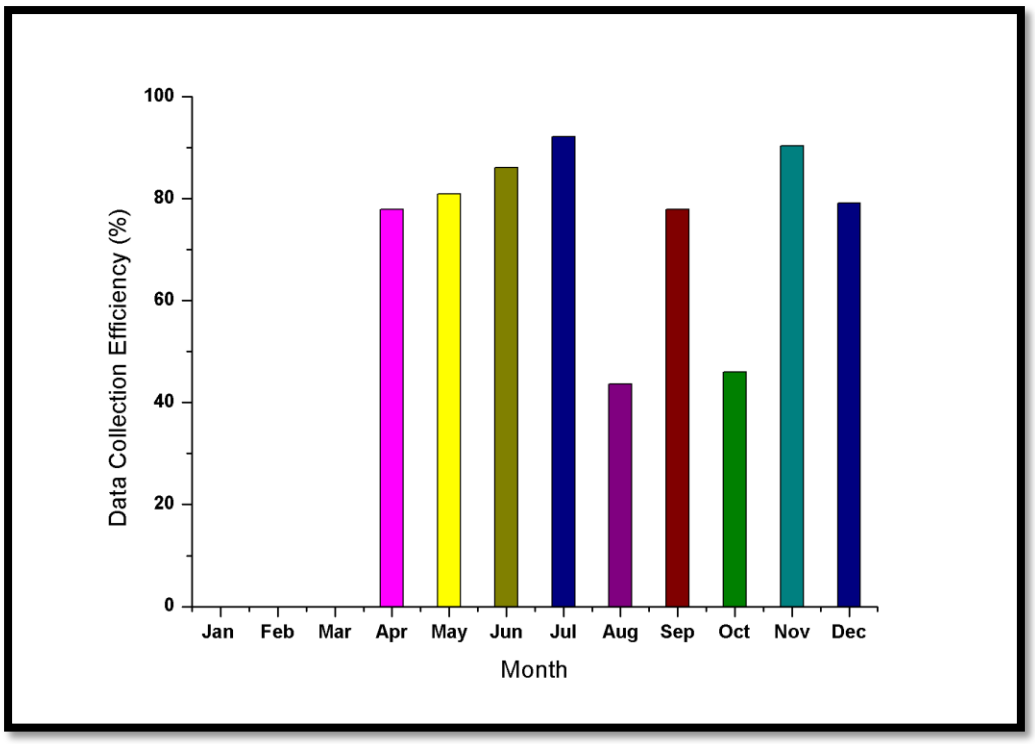

Figure 4-8: Data collection efficiency for CoT in 2017.

Reports for January to March 2017 were not available as indicated in **Figure 4-8** above. Collection efficiency was highest in July at 92.16% and lowest in August at 43.63%.

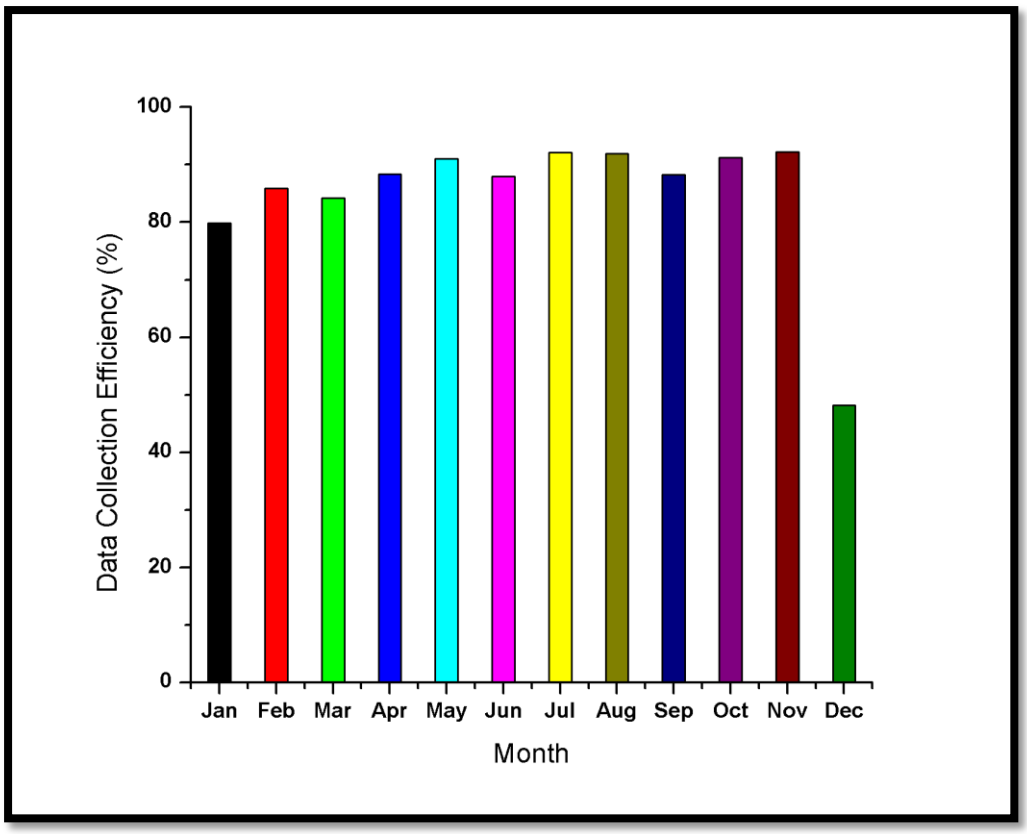

Figure 4-9: Data collection efficiency for CoT in 2018.

Figure 4-9 shows collection efficiency for the year 2018. A great improvement has been realised in terms of reports, with data having been collected for all twelve months. It is also very interesting to see that all collection efficiencies except for January (79.81%) and December (48.21%) are above 80%, indicating a significant improvement from the previous years. The highest collection efficiency was in November at 92.2%.

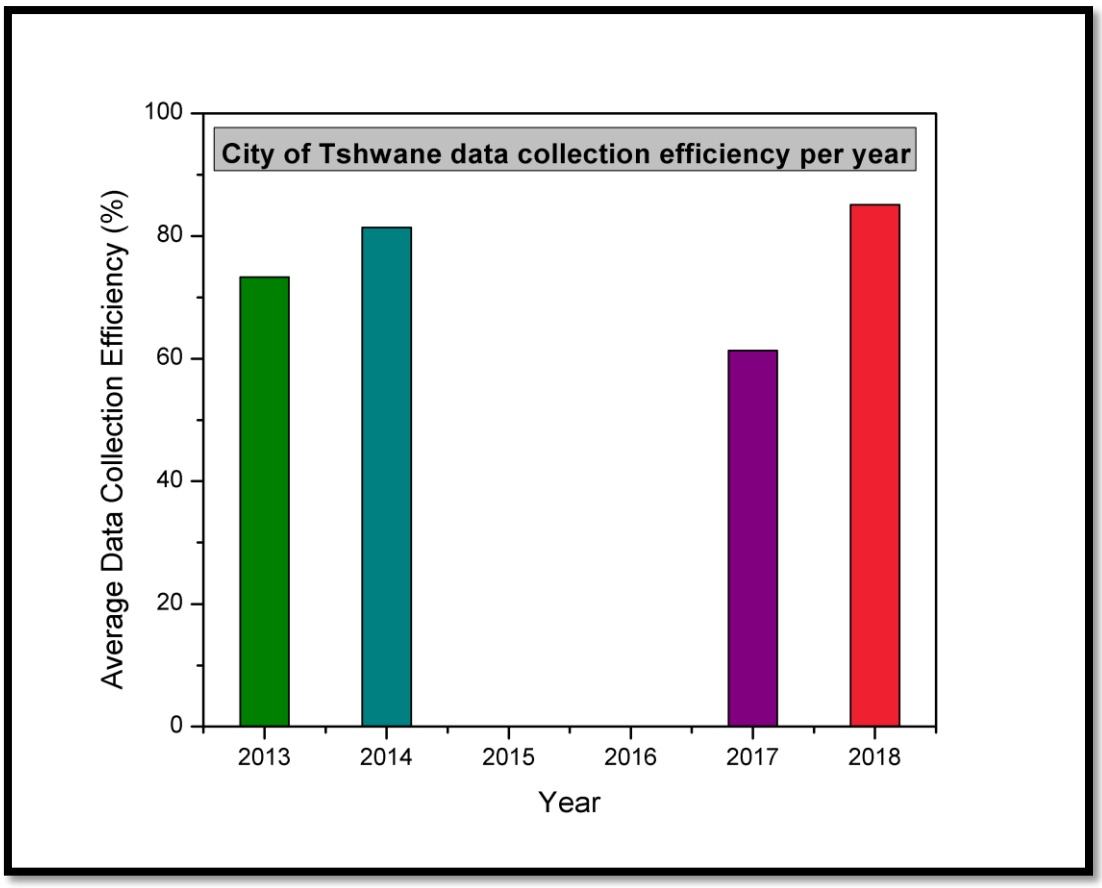

Figure 4-10: Average data collection efficiency for CoT: 2013-2017.

Generally, there has not been much improvement in data collection since 2013 **(Figure 4-10).** The city obtained an estimated average of 73.3% for 2013, 81.4% in 2014, 61.3% in 2017 and 85.1% in 2018. The decrease in data collection in 2017 could be attributed to new changes that were made when stations were divided amongst SAWS and GDARD. The reports for January–March 2017 were not available and therefore, the smaller percentage might not be a true reflection of data collection efficiency for that year. The values indicated are estimates because certain reports were not available for the research.

4.4.2.1.2 City of Joburg data collection efficiency

The CoJ has nine air quality monitoring stations, i.e. Alexandra, Ivory Park, Diepsloot, Jabavu, Orange farm, Buccleuch, Davidsonville, Delta Park, and

Newtown. The four stations managed by GDARD are Alexandra, Diepsloot, Jabavu and Orange farm. The other four are managed by the national department.

Data collection efficiencies for the GDARD managed stations from 2017 (**Figure 4-11**) and 2018 (**Figure 4-12**) are presented below. The reports for stations managed by national department, as well as the reports from 2013-2016 for all stations, could not be accessed from the municipality and were also not available on SAAQIS. From **Figure 4-11** and **Figure 4-12** below, it could be concluded that there is an improvement in data collection efficiency for the GDARD stations, with data for 2018 having been collected for full 12 months and being above the 80% mark required.

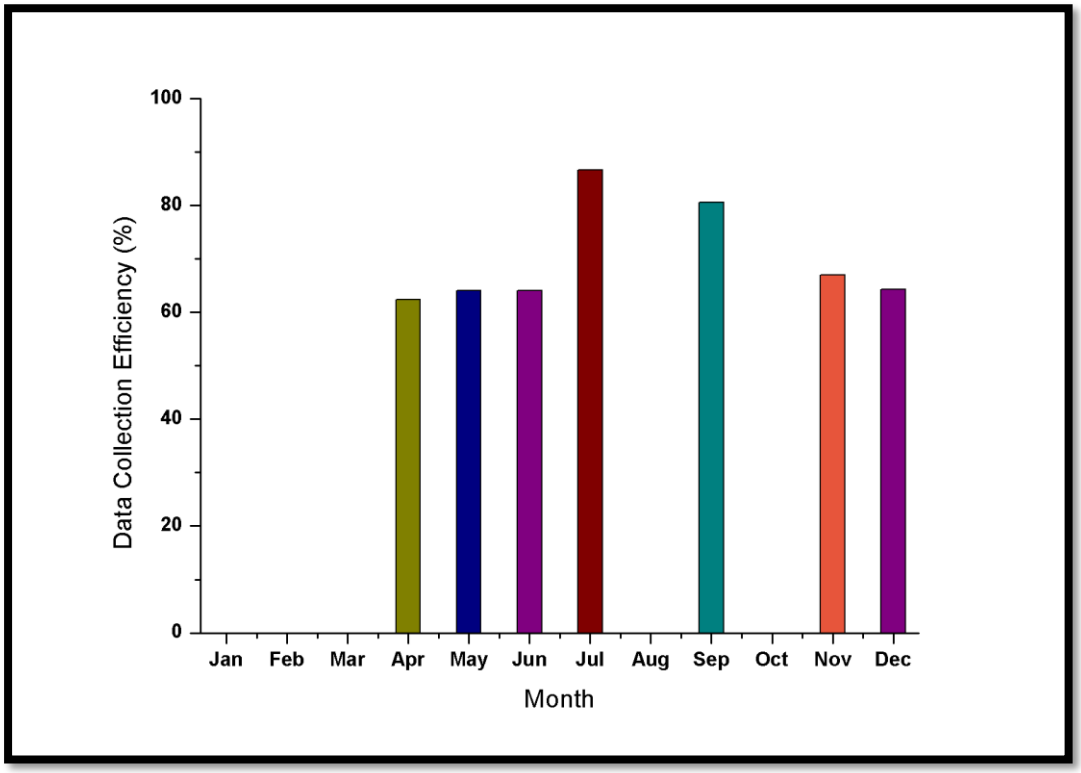

Figure 4-11: Data collection efficiency for CoJ in 2017.

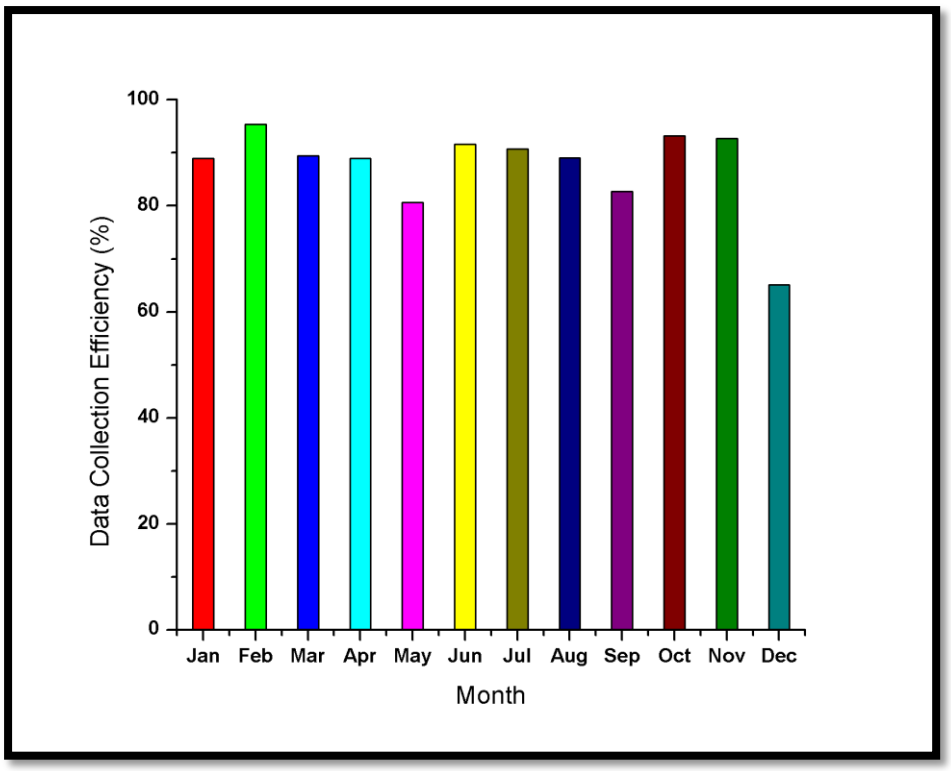

Figure 4-12: Data collection efficiency for CoJ in 2018.

4.4.3 Data Collection Gaps

From the data collection efficiencies above, it is apparent that there are few data collection gaps in the CoT, with the most significant one being of the period 2015-2016. According to the interviews conducted, this was due to inadequate budget for maintenance and management of monitoring stations. There are significant uncertainties when it comes to the continuous running of the stations, especially due to the fact that the municipalities lack the budget and technical capacity, and therefore depend on external service providers. As a result, whenever a contract expires and there is a need to appoint new service providers, data collection is usually compromised, resulting in a huge data collection gap. The CoT also indicated that sometimes it takes longer for service providers to repair damaged equipment as some are not locally manufactured. In addition to this, theft and vandalism of monitoring equipment have been a problem, especially in the CoJ.

For the CoJ, data collection has been an issue for years. In fact, low data recovery in CoJ has been experienced since 2011 (SoER, 2017). **Table 4-2** below gives a summary of data recovery for CoT and CoJ since 2013 according to the SoE reports from 2014-2018.

Table 4-2: Data recovery for CoT and CoJ from 2013 to 2018

SoE report (Year)	CoT	CoJ
2014	Adequate data recovery	The 2013 data recovery was low as some of the stations were not fully operational since 2012.
2015	Adequate data recovery	Low data recovery for 2014 (3 out of 8 stations running)
2016	No data for 2015	No data for 2015
2017	No data since 2015 (instruments not serviced and calibrated since 2014)-contract expired	Low data recovery for 2016
2018	Low data recovery in most stations in 2017	Low data recovery in most stations in 2017
2019	No information	No information

4.4.3.1 Frequency of Exceedances

Exceedance of air quality occurs when the concentrations of pollutants exceed the limit as set in a standard. When pollutant concentrations exceed these limits, the air quality is considered not healthy for human beings. **Table 3-1** indicates the allowed frequency of exceedances permitted per averaging period in RSA. The air quality reports reviewed for this study indicated that the two main pollutants for which there

is a frequent non-compliance with the NAAQS are particulate matter and ozone. Therefore, a comprehensive study of the major ozone precursors is needed to develop ozone reduction strategies. The dynamics and factors shaping policy implementation, such as political buy-in, need to be rethought (through educating of politicians on air quality issues); in particular, with regard to local authorities and societal needs reprioritisation, specifically with regard to housing and economic development in relation to environmental and human health protection. The mostly found to be for O_3, PM_{10}, $PM_{2.5}$, NO_2 and SO_2 in CoT and O_3, $PM_{2.5}$ and PM_{10} in CoJ.

4.5 Part 3: Resources

Figure 4-13 below gives a summary of the interviews/questionnaires results with regards to resources needed for AQM in the municipalities. Each parameter on the graph is thoroughly discussed after this figure.

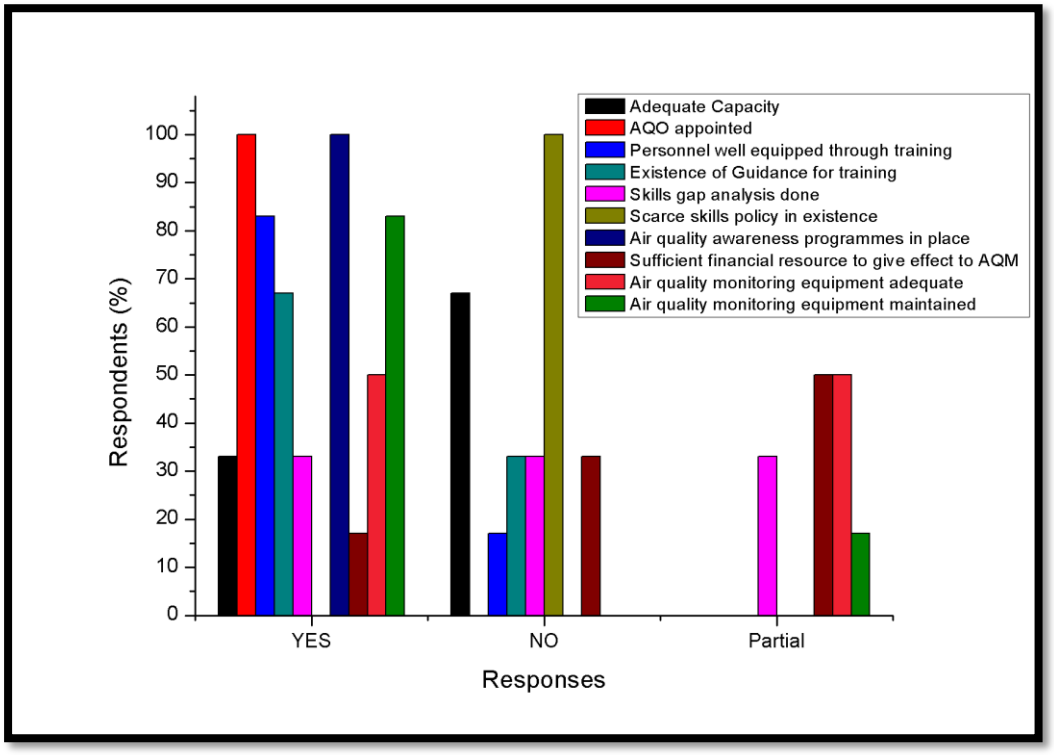

Figure 4-13: Graphical representation of the “resources”.

4.5.1 Adequate Capacity

Capacity should not be perceived as just the addition of human and financial resources or providing additional skills through training and education without any improvement (DEA, 2018).Capacity should be viewed as the provision of resources to ensure that organisations are capable of fulfilling their roles efficiently and effectively.

Human resource capacity (staffing, skilling, and training) is imperative for the fulfilment of the requirement of NEMAQA. It was, therefore, important to understand the staffing resources available in the two municipalities. The CoT has filled the following positions **(Figure 4-14)**:

- ✓ Functional Head: 1 x Air Quality Monitoring, OPS and maintenance,
- ✓ 1x Environmental Officer Air Quality Monitoring, OPS and maintenance
- ✓ 1x Environmental Officer: AELs and Permitting compliance and monitoring
- ✓ Acting Director: Air Quality Management (Director position is vacant)

Specific roles that are carried out by CoT are ambient air quality monitoring, issuing of AEL, compliance and education awareness.

Employees are expected to perform additional duties due to staff shortages. The CoT organogram **(Figure 4-14)** indicates that there should be more people employed in the air quality management section. Although there is satisfactory technical capacity, human capacity is insufficient. There is a need to develop capacity, as currently, the skill is with consultants. For example, the city still relies on external providers to carry out ambient monitoring functions. This indicates that the function was not properly planned in terms of skill development and capacitating. Furthermore, there were no plans for skill transfer from consultants to employees.

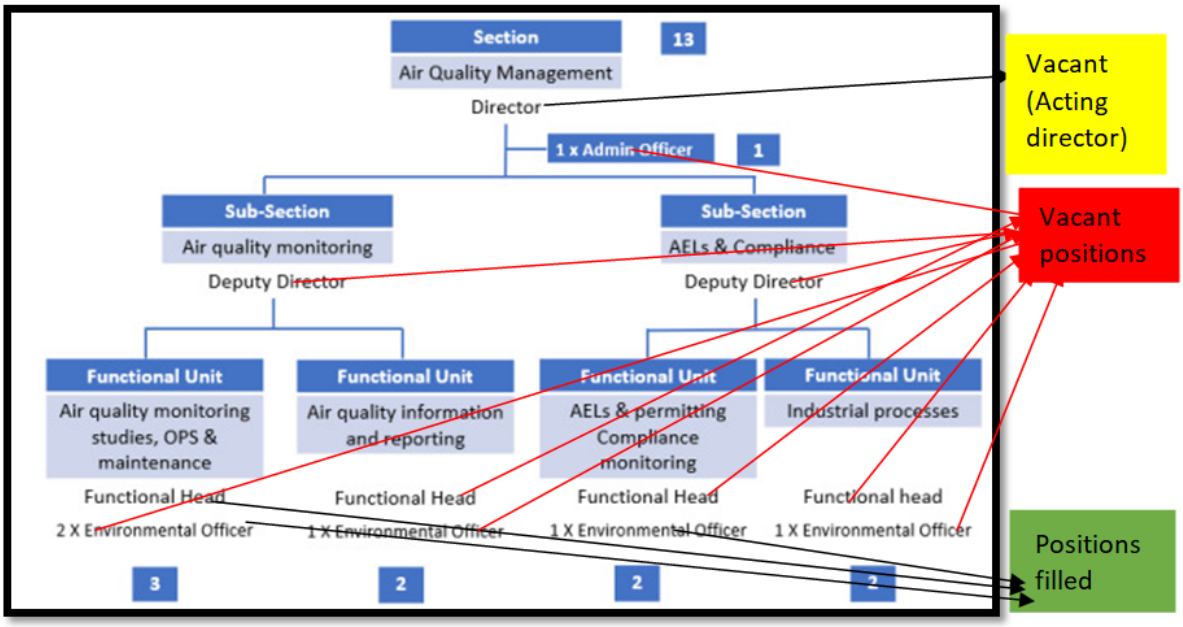

Figure 4-14: Organogram for the CoT Air Quality Department.

For the CoJ, in terms of human resources, the city has at least one person in each air quality management function carried out by the municipality. However, the number of personnel is still not sufficient and there are plans to increase the staff. In total, there are eight Air Quality Management Officers (of which only three are qualified), and five Environmental Management Inspectors. **Figure 4-15** shows the current structure in the Air Quality department in the CoJ.

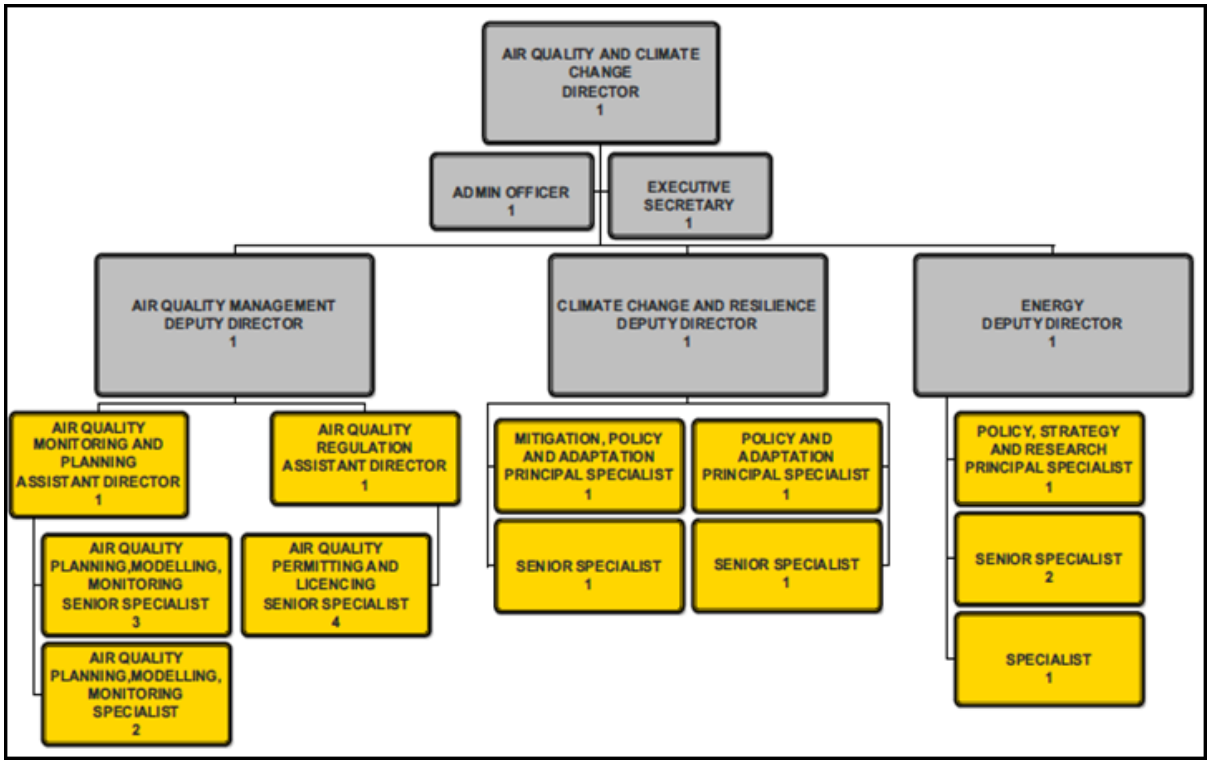

Figure 4-15: Organogram for the CoJ Air Quality Department

Training: Competency of personnel is vital for the implementation and maintenance of AQMPs, and to carry out daily duties in general. Training and skilling of employees are some of the aspects to consider for competency. From **Figure 4-13** above, about 83% of respondents agree that they are well equipped through training, whilst 17% indicated that they are not well equipped. Members from the CoT indicated that they receive training, but only internally and by service providers who are currently responsible for monitoring on behalf of the CoT. The training offered includes Introduction to Air Quality Management, Advanced Air Quality Management Course, Air Quality Monitoring Instrumentation, Fault Finding, Data Management and Validation, Station Maintenance and Zero Span Checks. No external accredited courses are offered to employees. Other courses on pollution prevention are from DEFF and municipalities are supposed to make provision for employees to attend.

The respondents from CoJ have mentioned the following training offered to everyone within the section, mostly offered by DEFF:

- ✓ AQ monitoring;
- ✓ Environmental law;

- ✓ Basic AQ management;
- ✓ Use of air quality softwares and models;
- ✓ Peace officer training;
- ✓ Licensing;
- ✓ AQMP;
- ✓ Data management and inventories;
- ✓ Stacks;and
- ✓ Other Section 86 trainings

Financial Capacity: Most respondents from municipalities have identified financial constraints as a major problem, and that needs to be dealt with at the national level as it is the funding provider (Engelbrecht & Van der Walt, 2012). This is urgent in that it affects everything, from staffing and training of personnel to equipment purchasing and maintenance as well as internal and external awareness-raising programmes. The CoJ however, indicated that the budget is available, just not sufficient. Overall, as indicated in **Figure 4-13,** only 17% of the respondents agree that the budget is sufficient, and 50 % indicates that it is partially sufficient while 33% states that it is not sufficient. Municipalities have limited resources most of the time and rely on the provincial and national governments for assistance. Disregarding the opportunity to capacitate municipalities constitute to wasted efforts to address air quality by both spheres. Generally, in these municipalities, the funding constraints to address some air quality issues are very high. Annual budgets by the Council are hardly given to air quality, and preference is given to tangible service deliverables such as houses, electricity etc.

4.5.2 Appointment of AQO

The appointment of an AQO is a legal requirement in terms of NEMAQA, with Section 14(3) stating that "*each municipality must designate an AQO from its administration to be responsible for co-ordinating matters pertaining to air quality in the municipality"*. Both the CoT and CoJ have complied with this requirement. **Figure**

4-13 indicates that all respondents (100%) agreed that an AQO has been appointed in their respective municipalities.

4.5.3 Guidance for training

Guidance for training is very important because it gives direction on how newly appointed person will be trained, assessed and declared competent before commencing with the work independently. Additionally, relevant courses will be stipulated for each field, preventing instances whereby personnel are sent to courses that are irrelevant to their day-to-day work. This is necessary especially in the air quality field since there is skills shortage in government. This document could also be beneficial if specialists from industries could be part of the training of new personnel, thereby transferring the skill. According to **Figure 4-13**, about 67% of respondents indicated that there is guidance for training, whilst 33% had no knowledge of this document.

4.5.4 Scarce skills Policy

Both cities have no scarce skills policy to retain experienced personnel. The scarcity of skills is a problem, not only in municipalities but across the country. This is the main constraint to service delivery in government. To address this, the Skills Development Act, No.97 of 1998 was passed. This Act provides a framework for developing and implementing strategies for improving skills in the workforce. Skills shortage is still critical in the air quality management field and this requires urgent intervention. It is not only important to develop skills, the strategies and policies to retain the limited specialists in the air quality field or trained personnel need to be in place and implemented.

4.5.5 Air quality awareness programmes

No provision for awareness-raising activities is made in the NEMAQA. Awareness-raising is, however, one of the strategies aimed at addressing air pollution problems, as specified in the air quality governance cycle (DEA, 2018). The purpose of awareness programmes is to raise awareness on air quality matters with the general public and promote positive changes in air quality voluntarily rather than through the command and control approach. This is achieved through the sharing of information on air quality with various stakeholders and through different media. Additionally, making air quality information accessible and educating communities about environmental issues has proven to be successful in encouraging individuals to voluntarily improve the day to day activities that contribute to pollution. Awareness raising strategies include, amongst others, public seminars, media campaigns; and workshops; distribution of information materials and environmental education programmes (DEA, 2018).Both the CoT and CoJ have these programmes in place, and 100% of the respondents confirmed this. The effectiveness of these programmes, however, could not be determined by this study.

4.5.6 Adequacy of monitoring equipment

Adequacy is the state of being sufficient for the purpose concerned. In terms of adequacy of monitoring equipment, **Figure 4-13** indicates that about 50% of respondents were satisfied whilst the other 50% were only partially satisfied. Some of the reasons for the partial satisfaction were that sometimes when equipment is stolen, vandalised or taken for maintenance, they are not immediately replaced with spare equipment for measurements, thus leading to data collection gaps for certain periods.

4.5.7 Maintenance of monitoring equipment

Maintenance of equipment is done by external organisations/ service providers responsible for monitoring. About 83 % of respondents agreed that maintenance of equipment was done whilst only 17% partially agreed that maintenance was done.

4.5.8 Conclusion

It should be noted that lack of resources (capacity, capabilities, funding) in general undermines the credibility of the AQMP. It becomes impossible for municipalities to function without the availability of important resources. The first most important task any authority should undertake will be to ensure that resources for conducting air quality management are established and well in place. Priority should be given to the finances, which will be required for monitoring systems, staffing, training and implementing intervention strategies. Municipalities not only depend on provincial or national government; or council for funds but could also approach sponsors or industries, based on the “polluter pays principle”. In fact, municipalities must exhaust all available avenues of funding. The national government still remains the highest level of government with access to resources being directly funded by the national treasury and being able to receive funds from international donors and governments, therefore, should be able to channel some of these funds to local government in order to ensure that they are well equipped to carry out the air quality management duties as required. Additionally, the implementation of economic instruments available for air quality management could also assist in gathering required funds. The municipalities are focused on giving basic services to communities and therefore, the prioritisation of such issues is very important. By not making funds available for air quality management forces municipalities to choose between basic services and air quality. It could be concluded that the current approach to the implementation of air quality legislation by municipalities seem inadequate. This notion of inadequacy is also supported by Keen and Altieri (2016) and Maponya and Rampedi (2013), in that their research indicated evidence of negative impacts and risks during implementation of NEMAQA.

4.6 Part 4: Communication

Communication is important for meeting the requirements of any policy or legislation in any organisation. In fact, effective communication can help to promote good governance. There is a need for a pro-active communication strategy to engage public and stimulate behavioural change. Various means of communication within the three spheres of government and the public by municipalities are available.

Inter-governmental communication is regarded to be good when a defined process and cross flow of information are existent, and a clear method for including the public and facilitating their participation in AQM are clearly defined. In the CoT and CoJ, communication with both provincial and national governments was purported to be fairly good, with the provincial government being very supportive in terms of funding for air quality projects where municipalities are unable to carry them out. This relationship could however be enhanced further in order to improve the current implementation of NEMAQA. Both municipalities report to both national and provincial on the following issues:

- ✓ Number of AELs issued (as reported on SAAELIP)
- ✓ Air pollution complaints received
- ✓ Air quality monitoring (state of air quality)
- ✓ Any awareness campaigns conducted
- ✓ Any additional by-law or policy development in terms of AQM
- ✓ Compliance, monitoring and enforcement
- ✓ Reported data on SAAQIS
- ✓ Municipalities also annually draft one report for the national government, reporting on the state of the environment.
- ✓ In addition to the above, the three spheres also hold air quality forums and subcommittee meetings to discuss air quality issues within the province.

The relationship between municipalities and other departments, however, was reported to be challenging at times. Although notifications are done when EIAs are to

be undertaken within the province, it becomes difficult for them to have full control as for example, with respect to mining, the Department of Mineral Resources and Energy (DMRE) becomes responsible for issuing AELs and granting environmental authorisations (EAs). EAs are the most important instruments for effective environmental management, as well as air quality management. The DMRE officials are not designated as AQOs and as such air quality-related issues may perhaps not be explored entirely throughout the authorisation process (Tshehla & Wright, 2019). Arrangements such as these might affect the management of air quality, not only within provinces but in the entire country.

The second most important point to note is that air quality is not classified under service delivery projects probably due to a lack of understanding of the matter. Therefore, it becomes more challenging to get other departments to prioritise it. All departments prioritise their mandates; hence the attendance of air quality forums is very low. This leads to weakened collaboration between AQOs from other departments and municipal AQOs, thus affecting air quality management in general. These challenges could be resolved by meetings between departments that are willing and clarifying roles and discussing how to best improve collaboration in order to solve air quality issues. Effective governance to improve air quality needs coordinated action across different departments.

Relationships within municipal departments are reported to be effective. However, departmental “silos” have been reported by some of the respondents, which is purported to be making it difficult to carry out the air quality management mandate at times. For the CoT, there is still no clarity in terms of responsibilities with regard to compliance and enforcement as these are in a different section to air quality management department. Communication is ineffective between departments and there is no proper integrated approach to air quality with other departments. Minimal or lack of consultation and communication on aspects affecting air quality in both municipalities within the departments was reported. Employee awareness and clarification of roles related to inter-departmental communication need to be emphasised as this could help resolve the “silos” issues and improve collaboration and thereby improving air quality. The officials in various departments should ensure that they are conversant with their obligations according to the act.

In terms of communication with the public, municipalities indicated that primary methods such as public participation during EIAs, complaints on air pollution, awareness campaigns and meetings are used. Systems such as SAAQIS are also used to communicate air quality issues across the country.

4.7 AQOs and Expert opinions on the extent of NEMAQA implementation in Municipalities

4.7.1 Air Quality Officers

Operational questions

1. What is your general understanding of the Air Quality Act (AQA)?

AQO	Response
01	"Air Quality Act was promulgated to enable section 24 of the constitution, which is the right to an environment that is not harmful to health and well-being, hence its focus on ambient air quality. AQA therefore sets processes and procedures to manage and monitor air quality. It outlines all the requirements of National Department, Provincial Departments and Municipalities in managing activities giving rise to air pollution within their jurisdictions".
02	"Air Quality Act is a proactive legislation that allows industrial developments while recognising protection of the atmosphere. It is not command and control driven, its purpose embrace issues of promoting social justifiable economic development and protect environmental degradation".

The purpose of the question on the general understanding of NEMAQA was to establish whether the AQOs are familiar with their roles and responsibility. Both respondents seem to have an understanding of the NEMAQA, how it works and how it originated, as the first respondent went further to indicate that the NEMAQA was

promulgated to give effect to the Bill of Rights within Section 24 of the Constitution. Overall, NEMAQA is understood well by these respondents.

2. How is AQM included in your mandate (KPI/KPA)?

AQO	Response
01	"Working under the Provincial Air Quality Officer, my responsibility is to co-ordinate all air quality activities in the province. My KPAs are: • Ambient Air Quality Monitoring. • Atmospheric Emission Licensing. • Atmospheric Emission Inventory. • Emission Reduction Strategies; and • Air Quality Management Planning and co-ordination".
02	"It is included in the form of indicators that aims to assess air quality levels in relation to priority sources and criteria pollutants, take measures to reduce the air quality in hotspots areas. It contributes 90% of my mandate and day to day operations in the form of activities".

The question of how NEMAQA is included in their KPA was to establish whether they work according to the requirements of the NEMAQA. Both respondents have their duties aligned to NEMAQA, and therefore fulfilling the NEMAQA mandate. The list of activities performed by the respondents is mentioned in the table above.

3. To what extent is NEMAQA implemented at provincial level? What are the reasons for that extent?

AQO	Response
01	"NEMAQA is fully implemented at provincial level with 18 officials dedicated to this function. Provincial Department convenes Air Quality Officer's Forum (quarterly), Gauteng Ambient Air Quality Monitoring and Gauteng Atmospheric Emission Licensing, every second month. All these forums ensure that AQA is implemented correctly and in the same manner across the province".
02	"Province is also rendering air quality functions like AELs to listed activities owned by municipalities like Crematoria, conduct ambient air quality monitoring using stations and support municipalities on implementing air quality reduction projects. It also supports in terms of EMIs". "Air quality is a concurrent function from municipalities (Metros and Districts), provinces and National DEFF just the role differs, and these spheres of government can delegate functions across. In Gauteng we implemented all air quality functions due to nature of complexities of ambient air".

The question was asked to establish whether air quality at a higher level than the municipality is given attention. This was necessary because when municipalities fail to perform their duties, the province has to intervene. According to the first respondent, NEMAQA is fully implemented at the provincial level, which might indicate that there is enough capacity to fulfil the required duties. Respondent two also clarifies the role played by the province and how they work together with other spheres.

4. Has air quality improved in the past five years within your jurisdiction?

AQO	Response
01	"It's not easy to ascertain this, as the ambient monitoring data fluctuates and is affected by a number of variables. The ambient air quality standards have

	become stricter and are exceeded in most cases. However, the government activities towards the management of air quality have improved".
02	"No, I will not say it has improved we are still at the basic stage of developing and implementing air quality systems and processes. In some areas there is only one person responsible for air quality. There are challenges like misalignment where air quality is managed by social related professions not technically aligned as air quality requires technical skills in engineering, geography, science and chemistry for understanding pollutants dispersion and industrial processes".

There is no evidence that air quality has improved in the two Gauteng municipalities. Respondent number one indicates that air quality monitoring data fluctuates and that air quality standards are exceeded in most cases. Respondent two on the other hand alluded to the fact that there's no improvement. The respondent indicates challenges such as staffing, and air quality duties being given to people with less technical capabilities and thus making it difficult to deal adequately with air quality issues.

5. In your opinion does the municipality have adequate capacity (financial and human) to comply with the AQA requirements? Please elaborate.

AQO	Response
01	"Municipalities have adequate technical capacity ability to interpret and implement the Air Quality Act. The one municipality which seem to have adequate financial and human capacity is the City of Johannesburg Metropolitan Municipality. The rest of the municipalities are not adequately capacitated but they perform all their required functions as per AQA. Provincial officials are always available to assist municipalities when more capacity is required, especially human capacity".
02	"No, the municipalities do not have adequate resources to conduct air quality.

	Government as a whole still needs to develop capacity on air quality; the skill is with Consultants. Example to conduct ambient monitoring the dependency is on external service providers, challenge the municipalities did not accept this function properly and develop the skills in the last 20 years; they conduct the function on an adhoc basis".

Both respondents indicated that the resources to conduct air quality duties (although respondent one suggests that CoJ is capacitated) are not adequate. Interestingly, respondent one indicates that the skill is still with the consultants. This was observed in the CoT by the researcher where the air quality duties are mostly done by external consultants.

Communication

1. What are the air quality reporting requirements to national government?

AQO	Response
01	"Provincial Departments compile quarterly and annual reports on ambient air quality monitoring, Atmospheric Emission Licensing, Air Quality Management Planning, Enforcement Action plans taken, implementation of municipal by-laws and any other air quality activities (e.g. Awareness programmes)". "The reports are compiled with inputs from all District and Metropolitan municipalities in the province".
02	"There are online systems on ambient air quality data reporting, AELs reporting on SAAELIP. There are Technical Working Groups that involve information from provinces and municipalities, National Air Quality Lekgotla and Quarterly Reports to NAQO".

The air quality reporting to the national government by province includes ambient air quality monitoring reports (quarterly and annual), AELs, AQMP, enforcement actions, municipal by-laws implementation reports to mention a few. Technical Working

Groups are also used to report on information from municipalities and province and there is also an annual National Air Quality Lekgotla, where information on air quality is shared by all three spheres of government.

2. How easy or difficult is it to engage with the municipal and national government around air quality?

AQO	Response
01	"There is a good working relationship with the municipalities and the national department. Municipalities participate in Air Quality Officer's Forum (quarterly), Gauteng Ambient Air Quality Monitoring and Gauteng Atmospheric Emission Licensing (held every second month). Province forms part of the Working Group II meeting, which is held quarterly, where all national air quality issues are discussed". "Province also works with the national department in the implementation of the Air Quality Management Plans for the Vaal Triangle Airshed Priority Area and the Highveld Priority Area".
02	"It depends on the Air Quality Officer of the sphere of government if is fully aware on what is required from him/her on air quality and to market it. On average it is easy to access or engage."

The relationship between provincial and both national and local government is described as being good, with the ability to easily engage with air quality management personnel. The three spheres discuss air quality issues through forums and meetings. Respondent number two also indicates that the AQOs in each sphere are the major role players, and the level of engagement depends on them.

3. What challenges do you experience in addressing complaints with other departments at provincial level with regard to air quality issues?

AQO	Response
01	"At GDARD, we have a section dealing with complaints (air quality complaints included). The officials at Air Quality Directorate provide technical inputs in resolving those complaints".
02	"Sometimes you don't get cooperation from other depts. as air quality is not their priority and makes issues of air quality collaboration very difficult. The issue of silo mentality within depts. is a challenge and make addressing air quality complaints to be slow and unresolved forever".

Although respondent number two indicates that there are some difficulties in getting co-operation from other departments with regard to air quality issues, GDARD has a section to specifically deal with air quality complaints. The effectiveness of this section in dealing with complaints, however, has not been established. Respondent number two clearly indicates that some issues remain "unresolved forever".

4. How does the reporting structure at provincial level influence decision making with regards to air quality issues?

AQO	Response
01	"At a Departmental level, the reporting structure comprises of Director (Provincial Air Quality Officer), Control Environmental Officer Grade B (Deputy Director), 5 Control Environmental Officers Grade A (Assistant Directors) and about 3 officials under each." "Each Control Environmental Officers: A is responsible for one functional area (i.e. Ambient Air Quality Monitoring, Atmospheric Emission Licensing, Atmospheric Emission Inventory, Emission Reduction Strategies, and Air Quality Management Planning and co-ordination)". "Decisions relating to each functional area are made with the team, Control Environmental Officer Grade B and the Director (as the highest decision maker). The structure makes decision making easy and it's always clear as to

	who is supposed to perform what activity". "At a provincial level, discussions are done at various provincial committees and final decisions are taken at the Air Quality Officers Forum".
02	"There are Air Quality Fora that meet every quarter and issues of air quality are addressed. For Gauteng specifically I developed sub committees chaired by provincial staff Assistant Directors to assist municipalities with operational issues and works very good".

The reporting structure is clearly defined by respondent number one. The response also indicates that there is a flow of information within the structures, making it easier to get feedback from various sections and thereby, able to make decisions. One can conclude that the organisation structure is synced with its decision making.

AQO duties according to the AQA

In terms of AQO duties according to the NEMAQA, both AQOs indicated that they perform all duties as required by the legislation. The duties are to: prepare a provincial AQMP as a component of the EIP; Prepare an annual report providing information on progress regarding the implementation of the AQMP and compliance with the provincial implementation plan; Implement the atmospheric emission licensing system, and carry out the responsibility for performing the functions of the licensing authority as set out in Chapter 5 of the NEMAQA, if the applicant is a municipality in the province

Interestingly, the duty for reviewing AQMPs received from the municipalities had two different answers. Respondent number one indicated that "Province doesn't necessarily receive and review the AQMPs. Province gets involved in the drafting of the municipal AQMPs and also gets progress reports in terms of the implementation of the various AQMPs." On the contrary, respondent number two indicated that AQMP's are reviewed "Every 5 years for adequacy and suitability of technology and organisational developments".

Requirement	**Yes/ No**	**Elaboration**	**Yes/ No**	**Elaboration**
Prepare a provincial AQMP as a component of the EIP	**Yes**	Provincial AQMP was reviewed in 2017/18 financial year.	**Yes**	It must embrace the organisation strategy and economic, social growth and have objective of reducing air quality while maximising job opportunities.
Prepare an annual report providing information on progress regarding the implementation of the AQMP and compliance with the provincial implementation plan	**Yes**	Province prepares and submits the annual report to the National Department. This report gets presented at the Air quality governance lekgotla held once a year.	**Yes**	In Gauteng case is the Environmental Outlook report covering air quality and other environmental issues
Implement the atmospheric emission licensing system, and carry out the responsibility for performing the functions of the licensing authority as set out in Chapter 5 of the AQA, if the	**Yes**	Province is carrying out this function and assisting municipalities when capacity is required.	**Yes**	Develop and implement systems and procedures in line with the timeframes and train the staff to understand technical processes in relation to the emissions. Provide support to struggling AEL authorities

applicant is a municipality in the province				
Review the AQMPs received from the municipalities	**No**	Province doesn't necessarily receive and review the AQMPs. Province get involved in the drafting of the municipal AQMPs and also get progress reports in terms of the implementation of the various AQMPs.	**Yes**	Every 5 years for adequacy and suitability of technology and organisational developments

4.8 Air Quality Experts

A total of six experts in the air quality field were consulted for this study. Ten questions about NEMAQA implementation in municipalities were asked and below are the summaries for their opinions for each question.

1. What is the extent of NEMAQA implementation in municipalities? What are the reasons for this extent?

Expert/specialist	Response
01	"The implementation is there in theory, but in practice it is hard. There are priority areas, there are priority issues, and there are good intentions. BUT, lack of funding and a lack of staff (who has the understanding, training and knowledge) is a MAJOR problem everywhere". "Municipalities are often even constrained and cannot do air quality management plans; they do not have plans of action and

	ways forward. It is difficult to make things happen without a management plan".
02	"Implementation in municipalities is intermediate with some parts monitored and compliance enforced with fines (e.g. stationary sources) while implementation is difficult with ambient monitoring and enforcing compliance of ambient monitoring".
03	"Very poor, failure to carry out and execute good policies"
04	"Metropolitan and District municipalities are the licensing authorities in terms of section 36 of the act and can delegate these powers to provincial organ of the state if they are unable to perform the license functions, of which in most cases this happens because of lack of capacity in the municipalities".
05	"In the field of stack emission monitoring, the implementation is quite positive. The air quality officers are trying their level best I think, and the industry tends to organize itself into forums that meet on a regular basis to discuss about the latest requirements and challenges of NEMAQA. Independent consultants also get invited to these forums to offer advice to industry. I think these have collectively helped to raise awareness and compliance". "There`s however still a couple of polluters without licences. This is a challenge that needs to be addressed as soon as possible"
06	"It varies depending on the capacity available at each municipality, as well as the financial resources and management commitment. Metros are advanced, as are industrialised local municipalities. Districts are lagging".

The first question posed to the experts was with regard to the extent of NEMAQA implementation in municipalities. All experts (100%) responded to this question, but there was a mixed set of responses, depending on the angle from which the expert was responding. The lack of capacity and funding for air quality management in municipalities has been identified as determinants of the extent of implementation by certain respondents. Respondent six also indicated a lack of commitment by management as another aspect.

2. In your opinion, is there any "co-operative" governance within the three spheres of government with regard to air quality management? Please elaborate.

Expert/specialist	Response
01	"I think this is case dependent. There are municipalities who work hard to stand together with other spheres of government (and the other way around), and work things out, but mostly the problems in question 1 prevail, and this pervades all aspects of trying to make NEMAQA work". "That being said, government is trying to build capacity where possible. It is difficult because people don't stay in the jobs for long and move on". "There is a lack of communication and understanding between the various spheres". "I think that the roles of various spheres are not clear to all involved".
02	"Legislation is drafted at national level while enforcement is at lower spheres in municipalities. There is some co-operative governance, but a lot can be improved in terms of co-operative governance across all the spheres".
03	"Yes, there is basis for it. This is evidenced by the ONE ENVIRONMENTL SYSTEM which accompanied the 2014 EIA regulations".
04	"There is co-operative governance because Provincial and National Government are always available to assist the Local government wherever they need support, there are joint compliance and enforcement inspection where officials from all three spheres of government conduct site visit together on the same facility at the same time"
05	"From my observation there seems to be cooperation between the three spheres of government even though at times it would seem the three are not totally in sync. Though the national government is burdened with developing policy and legislation, the implementation at local level seems to lag a bit behind. The perception at local government level at times is that the national and provincial government are oblivious to the financial challenges faced by licensees on the ground. Especially when considering the current economic climate".
06	"It does exist, as it is enforced by DEA. Licensing, enforcement and inter-governmental meetings take place cooperatively".

This question wanted to find out whether co-operative governance actually exists with regards to air quality issues according to the experts. Chapter 3 of the

constitution of RSA addresses Co-operative governance within the three spheres of government, i.e. National, provincial and local government. All experts (100%) believe that there is co-operative governance to a greater extent.

3. What are the barriers to implementing the NEMAQA within municipalities?

Expert/specialist	Response
01	"Lack of funding and a lack of staff (who has the understanding, training and knowledge) is a **MAJOR** problem everywhere". "Municipalities are often even constrained and cannot do air quality management plans; they do not have plans of action and ways forward. It is difficult to make things happen without a management plan". "Municipalities often do not even have air quality management plans in place. They are constrained by funds and so achieving goals without having proper documents and studies in place are difficult".
02	"Lack of skilled individuals, understaffed municipalities, proper support from above structures".
03	"Lack of knowledge and political will power".
04	"Lack of budget is a major barrier; most municipalities are understaffed, and some do not even have money to maintain and replace their monitoring equipment's".
05	"Municipalities always complain of inadequate budgets for hiring air quality officers and purchasing equipment". "Due to the weak economic climate experienced by the country, some industry players tend to ignore their environmental obligations".
06	"Training of officials, retention of key staff or transfer of knowledge, funding tools".

All respondents identified issues that they believe are barriers to implementing NEMAQA by municipalities. The most burning issues are lack of funds and training, as well as insufficient skilled personnel to carry out air quality duties. Other barriers

such as the absence of air quality plans and inability to retain experienced individuals were also identified. Respondent number three also mentioned a very interesting point which is the lack of political will. Political will is one of the most important factors in addressing any problem. Key decision-makers (which are politicians mostly) need to have an understanding of the NEMAQA and have to be committed to its proper implementation. The willingness and capability of political leaders to ensure that policies are implemented, and outcomes reached can never be overemphasised.

4. What do you identify as the main weakness of the AQA?

Expert/specialist	Response
01	"There should be a focus on multi-disciplinary cooperation". "The roles, responsibilities and regulatory 'powers' need to be made clear". "There is no real, clear plan, especially with regard to domestic fuel burning (this is essential and needs to be a top priority in my opinion – this is where multi-disciplinary teams need to work together)".
02	"Assigning pollutants to the rightful source that disposed to regions away from points of emission".
03	"Being unrealistic with local inefficiencies and lack of appropriate expertise in RSA".
04	"It does not cater for Domestic fuel burning and it is one the biggest contributors to Air Pollution problem". "It does not cater for financial provision from all the spheres of government to discharge Air Quality duties hence politicians don't see the need because they are bound by law".
05	"Coming from the angle of stack emission monitoring, the AQA has not set the competency criteria for the individuals that perform stack emission monitoring. It only talks to the competencies of companies performing such work, but nothing is being said about the individuals performing the work".
06	"It follows international models where local governance is promoted, as well as autonomy. The constitutional mandate for

	AQM being given to local municipalities is the stumbling block".

All respondents (100%) answered the question on the weaknesses of NEMAQA implementation; however the responses vary from one respondent to another. This could be due to the fact that all respondents come from different industries/organisation. In summary, the weaknesses are:

- ✓ There is no clarity in terms of roles, responsibilities and regulatory 'powers',
- ✓ No clear plan at national or local government to address domestic fuel burning
- ✓ The NEMAQA is unrealistic with local inefficiencies and lack of appropriate expertise in RSA
- ✓ It does not cater for financial provision from all the spheres of government
- ✓ NEMAQA has not set the competency criteria for the individuals that perform stack emission monitoring
- ✓ It follows international models where local governance is promoted, as well as autonomy

5. Do you think municipalities have regulatory powers to influence air quality within their jurisdictions? Please elaborate.

Expert/specialist	Response
01	"To a certain extent, but this is rare, and municipalities don't often have the budget for initiatives". "There are certain levels of regulation with regard to industry, but I think that ultimately decisions come from national government".
02	"Yes, however the municipalities can be suffering from receiving dispersed air pollutants from adjacent municipalities".
03	"YES, they are empowered to do by NEMAQA".
04	"They do , they are the ones who have got the powers to grant the Atmospheric Emission Licenses for industries to operate therefore they can choose not to grant the license if the Industry is exceeding the emission limit, however they have very little control when it comes to domestic fuel burning because there is no regulatory tool for that".
05	"Yes, in the field of point source emission monitoring, municipalities tend to issue atmospheric emission licences

	based on the industries' pollution levels. Heavy polluters tend to have stricter requirements imposed on them than light polluters i.e. heavy polluters will be required to monitor on a quarterly basis and also install continuous emission monitors while light polluters will be required to monitor once per year".
06	"It is limited to licences and poorly defined by-laws. They require a directed by-law with strong punitive measures".

Municipalities in RSA are empowered by the constitution to carry out air quality management duties within their jurisdictions. The respondents indicate that the municipalities have regulatory powers and are empowered through NEMAQA as stated by respondent number three; however, there are certain limitations. The issue of insufficient budget is raised by respondent number one. It should be emphasized that finances affect almost everything when it comes to the implementation of any policy. Without a budget, there would not be any hiring, training, retention of experienced personnel, and buying and maintenance of equipment for air quality.

6. Are municipalities well equipped in terms of financial and human resources to undertake AQM duties?

Expert/specialist	Response
01	"No, there is a lack of funding, a lack of qualified staff". "There are often hurdles with regard to sorting out problems timeously and delays cause networks to deteriorate. It is difficult to keep things running well when the procedures and protocols involved are a hurdle to the success of the network".
02	"No"
03	"NO, very poorly prepared".
04	"Not at all, almost all municipalities in Gauteng do not have budget to undertake AQ function and they go to Provincial and National government for support, very few municipalities have got more than 5 officials focusing on Air Quality".
05	"No, Municipalities always complain of inadequate budgets for hiring air quality officers and purchasing equipment".

	"Due to the weak economic climate experienced by the country, some industry players tend to ignore their environmental obligations".
06	"Very few have these resources available".

All respondents agree that there are insufficient financial and human resources for carrying out AQM duties, with respondent six indicating that only a few municipalities have these resources available. Although financial and human resources not the only challenges for air quality management implementation, they are however the most critical. When municipalities are financially taken care of, it basically means capable and qualified staff can be recruited, trained and retained, air quality projects will be funded and equipment for monitoring purchased and maintained by well-trained staff personnel. Human resource capacity is also of greater importance. The availability of personnel as well as the capacity to carry out air quality management duties is critical for NEMAQA implementation. It is clear why most municipalities fail to implement the NEMAQA as desired as research has shown that the majority of them are not fully capacitated and funds are lacking for AQ projects.

7. How can AQM be improved in municipalities?

Expert/specialist	Response
01	"Capacity building, training and exposure. Hiring people with the correct knowledge and qualifications to lead and train the teams".
02	"Industries within municipalities (stationary and non-stationary) can be managed together with volumetric sources to reduce emissions within the municipalities".
03	"Stick to implementation dates for a more stringent compliance monitoring and legal enforcements".
04	"They must be given enough budget and human resource to discharge their duties and officials need to be well trained on technical aspect of Air Quality to avoid relying more on Consultants".
05	"Avail funds for the procurement of monitoring equipment as well

	as the recruitment and training of air quality officers". "Improve the administration and audit of atmospheric emission licences; Initiate closer interaction between industry, municipality, stakeholders and consultants".
06	"Ongoing training in AQM, regular skills transfer exercises including cooperatively with other spheres of government, removing bureaucratic inertia in decision-making".

The question on the Improvement of air quality management in municipalities was answered by all respondents. Although the answers vary from one respondent to another, capacity building, budget and training are mentioned by most respondents. Without these three, municipalities will struggle to achieve the desired air quality management goals. Firstly, Capacity reflects directly on the ability to implement air quality management functions. Secondly, the availability of funds is a top priority in that it affects almost everything, from recruitment to staffing and training, and of course, hiring consultants to carry out Air quality management duties. A very interesting response was given by respondent number three, which says "*Stick to implementation dates for a more stringent compliance monitoring and legal enforcements"*. In a country such as RSA where there is still a high level of unemployment and the economy is unstable, it becomes difficult to simply close down a company for non-compliance as this will only elevate poverty. The companies as well, use this to their own advantage, indicating lack of funds to ensure full compliance, and therefore just partially complying in most cases.

8. How can inter-departmental relationships relating to air quality be improved?

Expert/specialist	Response
01	"Working together, integration and inclusion in problem solving and identifying issues. Communication is key".
02	"A clear communication structure needs to be developed"
03	"By inter-ministerial collaboration".
04	"I think a lot is being done already, they just need to work more

	on communication".
05	"Unfortunately, I am not well versed in the internal workings and processes of governments, I therefore cannot provide any input here ".
06	"Regular meetings and workshops, special training sessions, SLA's for transfer of key duties to most-capacitated sphere".

Only five out of six respondents answered the question of how to improve inter-departmental relationships. The most important factor stressed by all respondents was the issue of communication, with respondent six adding the idea of "*transfer of key duties to the most capacitated sphere".* The municipal departments and the three spheres of government depend on each other's support for the planning and execution of projects, and therefore, regular and effective communication is needed. A clear and implementable communication strategy is necessary. Communication does not only mean informing each other, it includes sharing of information, involving each other from planning stage and clearly defining roles for each sphere and each department, outlining priorities and desired outcomes, and more importantly, have procedures for monitoring, evaluation, allocation of resources as well as dispute resolution for each project undertaken.

9. Do municipalities possess any integrative guidance to improve intra-governmental co-operation.

Expert/specialist	**Response**
01	n/a
02	no
03	Yes
04	Not sure
05	I unfortunately do not have any information on this
06	Not sure

Integrative guidance is a very important tool that helps the government to improve intra-governmental co-operation. A mixed set of responses were received regarding an integrative guidance for intra-governmental co-operation improvement. Only one respondent indicated that there is integrative guidance whereas the majority are not sure if it exists.

10. Do politics have any effect on the local government duties such as implementation of NEMAQA (including standards and regulations)?

Expert/specialist	Response
01	Yes
02	Yes
03	Yes
04	"Yes, they do, politicians focus more on economic development than environmental management therefore more funds are channelled towards economic development and job creation than reducing pollution and managing environmental impacts".
05	"From the field of point source emission monitoring I have never experienced political interference".
06	"Politics influence everything at local government level and senior management use air quality issues for political leverage".

This question basically looked at political interference in the field of air quality management. Five out of six experts indicated that political interference does actually affect local government duties such as the implementation of NEMAQA. As elaborated by respondent four, the focus is mostly on "*economic development than environmental management*". This has a major impact of the implementation of policies and procedures at the local level in as little or no funds will be availed for certain environmental management issues. It is of utmost importance to ensure that politicians are made aware and understand the impact of environmental issues on future economic developments. Failure to address political interference (through educating politicians) could actually collapse municipalities. The impact of resource constraints on environmental management has detrimental impacts on the

effectiveness and functioning of municipalities to achieve section 24 of the constitution. Alignment of municipal plans and budgets with those of the other spheres of government should be given priority.

One other aspect to consider is that political interference in most cases is as a result of pre-bendalism, which is defined as a system of political patronage where officials of municipalities responsible for service delivery are recruited from amongst the ranks of the political party (Madumo, 2016). This system is currently implemented in countries such as Nigeria (Akpan & Ekanem, 2013) as well as in South Africa. It is therefore always a possibility that the senior management may use environmental management issues such as air quality for *"political leverage"* as indicated by respondent six.

Chapter 5 : Conclusion and recommendations

5.1 Chapter summary

This chapter discuss the conclusions for the study based on the researcher insight gained regarding study findings and limitations. In addition, two sets of recommendations are presented at the end of the chapter.

5.2 Conclusion

The main aim of this research was to investigate the extent to which municipalities are the appropriate sphere of government for air quality management in South Africa, with specific focus on CoT and CoJ municipalities in Gauteng. In order to achieve this aim, two research questions were formulated. The first question determined the extent of implementation of NEMAQA by CoT and CoJ municipalities. Document review, literature review, interviews, and questionnaires were used to address the research questions.

The second research question was to determine the reasons for the extent of NEMAQA implementation. Interviews and questionnaires were used as data collection methods to answer this question. This chapter, therefore, summarises the findings made with the focus on the two questions; and provides recommendations for improvement.

With the information and data collected, it could be concluded that the extent of NEMAQA implementation is minimal. The AQMPs for both municipalities has not been reviewed as per legislation requirements since inception, although the review process for both municipalities have recently commenced. Secondly, there are still exceedances for particulate matter and ozone which need to be addressed as they do not comply with the NAAQ Standards.

The municipalities do carry out the air quality function, such as emission inventories, modelling, monitoring, AQMP development, etc., but due to other barriers such as funding and capacity, it becomes difficult for the municipalities to fully carry out these duties on their own. This could indicate that perhaps there was no planning when the

air quality duties were handed over to municipalities. In as much as municipalities are the constitutionally mandated authority for air quality management, there is a need to identify and address the current barriers for municipalities to fully implement their functions. The reasons for the minimum extent of NEMAQA implementation include funding, human resource capacity, legislative and institutional barriers, lack of political support, communication and lack of other general resources. Other challenges associated with implementation are summarised in **Table 5-1** below:

Table 5-1: Perceived barriers to AQM implementation in municipalities.

Element of failure	CoT	CoJ
Political interference/ lack of political support	✓	✓
Training	✓	
Legislative and institutional barriers	✓	✓
Capacity	✓	✓
Absence of prioritisation	✓	✓
Air quality standards not met	✓	✓
Communication	✓	✓
Cost and resource limitation	✓	✓
Minimal engagement with other departments	✓	✓
Lack of funding and central support	✓	✓
Lack of general resources	✓	✓
Cost of monitoring equipment	✓	✓

A different conclusion on the extent of implementation could be reached provided all municipal employees working under air quality agree to participate in this study and provide information as required. One other important point to note is that effective air

quality management requires a sound policy implementation, air quality monitoring, and legislation enforcement as well as enforcement of standards. In addition to this, there is a need for co-operation between various spheres of government as well as other government departments, the public and other institutions such as research and economic sectors. More importantly, political support and buy-in are needed as this will assist in ensuring that environmental issues including air quality are prioritised during their meetings and proper budget and resource allocation are made to address these issues. The environmental awareness programmes should be made available to politicians as well as this will help them understand the environmental issues better (Romuald, 2011).

5.3 Recommendations for future research

The following recommendations are offered for future research related to NEMAQA implementation:

- ✓ Research on air quality reporting, specifically focusing on SoE reporting, AQOs annual reporting, South African Air Quality Index reporting and National Air Quality Indicators. This will assist in determining further the extent of NEMAQA implementation in municipalities and in South Africa thus far.
- ✓ Skills and capacity in air quality management in RSA: In view of the serious general skills shortages at the municipal level, specific skills around air quality might not be an immediate priority. A better understanding is required of how and where air quality management skills development should be incorporated at the local government sphere.

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ANNEXURES

ANNEXURE A: ETHICS APPROVAL LETTER OF THE STUDY

NORTH-WEST UNIVERSITY
NOORDWES-UNIVERSITEIT
YUNIBESITI YA BOKONE-BOPHIRIMA

Private Bag X1290, Potchefstroom
South Africa 2520
96769
Tel: 018 299-1111/2222
Fax: 018 299-4910
Web: http://www.nwu.ac.za
96769
Senate Committee for Research Ethics
Tel: 018 299-4849
Email: nkosinathi.machine@nwu.ac.za

ETHICS APPROVAL LETTER OF STUDY

Based on the review by the **Faculty of Natural and Agricultural Sciences Ethics Committee (FNASREC)**, the Committee hereby clears your study as no ethical risk. This implies that the FNASREC grants permission that, provided the general conditions specified below are met, the study may be initiated, using the ethics number below.

Study title: A critical evaluation of local government air quality management: The Gauteng experience
Study Leader/Supervisor: Prof FP Retief
Student: K Mohlala

Ethics number:

N	W	U	-	0	1	3	4	2	-	2	0	-	A	9
Institution				Study Number						Year			Status	

Status: S = Submission; R = Re-Submission; P = Provisional Authorisation; A = Authorisation

Application type: Single **Risk Category:** **No Risk**

Commencement date: 01/02/2020
Expiry date: 01/04/2021

General conditions:
The following general terms and conditions apply:

- *The commencement date indicates the date when the study may be started.*
- *In the interest of ethical responsibility, the NWU-SCRE and FNASREC reserves the right to:*
  - *request access to any information or data at any time during the course or after completion of the study;*
  - *to ask further questions, seek additional information, require further modification or monitor the conduct of your research or the informed consent process;*
  - *withdraw or postpone approval if:*
    - *any unethical principles or practices of the study are revealed or suspected;*
    - *it becomes apparent that any relevant information was withheld from the FNASREC or that information has been false or misrepresented;*
    - *submission of the annual (or otherwise stipulated) monitoring report, the required amendments, or reporting of adverse events or incidents was not done in a timely manner and accurately; and / or*
    - *new institutional rules, national legislation or international conventions deem it necessary.*
- *FNASREC can be contacted for further information or any report templates via Roelof.Burger@nwu.ac.za 018 299 4269*

The FNASREC would like to remain at your service as scientist and researcher, and wishes you well with your study. Please do not hesitate to contact the FNASREC or the NWU-SCRE for any further enquiries or requests for assistance.

Yours sincerely,

Prof Roelof Burger
Chairperson Faculty of Natural and Agricultural Sciences Ethics Committee (FNASREC)

File reference: 9.1.5.4.2 Page 1 of 1

ANNEXURE B: REQUEST FOR PERMISSION LETTER

Request for permission to carry out a research project in the municipality

Dear Sir / Madam,

I am a Masters Student at the North West University, Faculty of Natural and Agricultural Sciences, with student number 30347033, undertaking research on the topic “A critical evaluation of air quality management at municipal sphere of Government: The Gauteng experience” under the supervision of Prof F. Retief, Contact no +27 (0)18 299 1586 and email-address Francois.retief@nwu.ac.za.

The study seeks to answer the following research question:

1. To what extent are municipalities the appropriate sphere of government for air quality management in South Africa?

1.1. What is the extent of implementation of NEMAQA by the municipality?

1.2. What are the reasons for the extent of NEMAQA implementation?

Request is herein made for an opportunity to undertake research and for the municipality’s assistance through provision of required information and participation of key personnel in interviews and answering questionnaires. All information provided will be treated strictly as confidential and purely for academic purpose.

Kind regards

Keorapetse Mohlala

tinamohlala@gmail.com

0792451496

ANNEXURE C: PARTICIPATION INVITATION LETTER

Participation Invitation Letter

Dear Prospective Participant,

My name is Keorapetse Mohlala. I am a Masters student at North West University, Faculty of Natural and Agricultural Sciences, with student number 30347033, undertaking a research on the topic “A critical evaluation of air quality management at municipal sphere of Government: The Gauteng experience”, under the supervision of Prof F. Retief, Contact no +27 (0)18 299 1586 and email-address Francois.retief@nwu.ac.za. I am kindly requesting your participation my research study. The purpose of this study is to determine the extent to which municipalities are the appropriate sphere of government for air quality management in South Africa.

The study involves completing basic demographic information and questionnaire (or interview).

Participation in this study is completely voluntary and you may withdraw from the study at any time. The study is anonymous; therefore, it does not require you to provide your name or any other identifying information, but you are also allowed to share any information you are comfortable sharing.

If you would like to participate in the study, please read the Informed Consent letter below.

Your participation in the research will be of great importance as it will help in identifying challenges faced by municipalities in implementing NEMAQA. Recommendations will be made from information provided, and air quality management might improve as a result of this study.

Thank you for your time and participation

Sincerely,

Keorapetse Mohlala

tinamohlala@gmail.com

0792451496

ANNEXURE D: PERMISSION LETTER FROM CITY OF TSHWANE

CITY OF TSHWANE
IGNITING EXCELLENCE

City Strategy and Organizational Performance

Room CSP22 | Ground Floor, West Wing, Block D | Tshwane House | 320 Madiba Street | Pretoria | 0002
PO Box 440 | Pretoria | 0001
Tel: 012 358 7423
Email: NosiphoH@tshwane.gov.za | www.tshwane.gov.za | www.facebook.com/CityOf Tshwane

My ref: **Research Permission/ Mohlala**
Contact person: **Pearl Maponya**
Section/Unit: **Knowledge Management**

Tel: 012 358 4559
Email: PearlMap3@tshwane.gov.za
Date 04 March 2019

Ms Keorapetse Mohlala
9866 Savoury Street Orchards Ext 87
Pretoria North
Pretoria
0116

Dear Ms Mohlala,

RE: A CRITICAL EVALUATION OF AIR QUALITY MANAGEMENT AT MUNICIPAL SPHERE OF GOVERNMENT: THE GAUTENG EXPERIENCE.

Permission is hereby granted to Ms Keorapetse Mohlala, a Master's Programme in Environmental Management Degree candidate at North West University (NWU), to conduct research in the City of Tshwane Metropolitan Municipality.

It is noted that the study aims to investigate the extent to which the municipalities are the appropriate spheres of government for air quality management. The City of Tshwane further notes that all ethical aspects of the research will be covered within the provisions of NWU Research Ethics Policy. You will be required to sign a confidentiality agreement form with the City of Tshwane prior to conducting research.

Relevant information required for the purpose of the research project will be made available as per applicable laws and regulations. The City of Tshwane is not liable to cover the costs of the research. Upon completion of the research study, it would be appreciated that the findings in the form of a report and or presentation be shared with the City of Tshwane.

Yours faithfully,

PEARL MAPONYA (Ms.)
DIRECTOR: KNOWLEDGE MANAGEMENT

ANNEXURE E: PERMISSION LETTER FROM CITY OF JOHANNESBURG

City of Johannesburg
Health Department

4th Floor B Block
Metropolitan Centre

PO Box 31244
Braamfontein
SouthAfrica
2017

Tel +27(0) 11 407 6815
Fax +27(0) 11 339 2195

www.joburg.org.za

TO : **KEORAPETSE MOHLALA**
NORTH WEST UNIVERSITY

FROM : **DR R BISMILLA**
EXECUTIVE DIRECTOR HEALTH

CC **BHEKI SIBEKO,**
DIRECTOR HEALTH DEPARTMENT (INTERGRATED HEALTH POLICY, PLANNING AND RESEARCH UNIT)

DATE : **03 JULY 2019**

SUBJECT : **A CRITICAL EVALUATION OF AIR QUALITY MANAGEMENT AT MUNICIPAL SPHERE OF GOVERNMENT. PROJECT REF: GP_201903_017**

Good day

The City of Joburg Health Department would like to thank you for the request it received to avail its Environmental Health Managers for interviews during your research work.
Having received your scope of your intended learnership to be undertaken at our facility, the City of Joburg health Department has decided the following.

Permission is granted.

The City Health Department is encouraged by the request and hope that it will assist you in achieving the objectives of your studies.
Please note that you will be required to sign an indemnity form on arrival.
You are also requested to call the Environmental Health Department **(011 407 6545)** at least five days before the start of your project

Should you need further clarity/information, please don't hesitate to contact City of Joburg Health Department. Enquiries 011 407 6815

Good luck with your studies.

Thank you

Dr R Bismilla
Executive Director Health

ANNEXURE F: QUESTIONNAIRE FOR MUNICIPALITIES

Questionnaire

(N. B please provide documentary evidence where possible for all questions)

1. **Biographical information**

Municipality	
Position	
e-mail address (optional)	

Your highest qualification

☐ No education

☐ Prior Learning

☐ Matric

☐ Short Courses

☐ Diploma

☐ Degree (3 years)

☐ Degree (Honours)

☐ Degree (Masters)

☐ Degree (Doctoral)

Years of practice in your profession

☐ Less than 1 year

☐ 1-3 years

☐ 3-5 years

☐ 5 to 10 years

☐ More than 10 years

2. <u>Operational questions</u>

1. What is your general understanding of the Air Quality Act (AQA) principles?

   .....
   .....
   .....
   .....

2. What is your role in Air Quality Management (AQM) at the metro?

   .....
   .....
   .....
   .....

3. How is AQM included in your mandate (KPI/KPA)?

   .....
   .....
   .....
   .....

4. To what extent is there clarity and agreement amongst authorities in the various spheres of government about responsibility for regulating air quality in Gauteng, including licensing, compliance monitoring and enforcement? Section 80 (Aa) of municipal system act.

   .....
   .....
   .....
   .....

5. How does the municipality give effect to AQA?

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   .....
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   .....

6. What are the air quality monitoring processes/arrangements currently in place?

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7. How effective is the monitoring processes/arrangements (if there are any)? Elaborate and if possible, provide examples of monitoring reports.

.....
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.....

8. Has air quality improved in the past five years?

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.....

9. Is there adequate capacity for compliance, enforcement and monitoring?

.....
.....
.....
.....

3. **Resources** (Please justify your answer)

1. IN your opinion does the municipality have adequate capacity to comply with the AQA requirements?

YES	NO	Partial

2. Is there Air Quality Officer (AQO) appointed in the municipality?

YES	NO

3. Are the AQM responsibilities allocated to the right personnel (academically qualified and experience in air quality)

YES	NO

4. Are the staff/personnel equipped with necessary knowledge and training, (i.e. workshops etc.) to perform the AQM function and use AQM tools effectively?

YES	NO	Partial

5. Does Guidance for training exist?

YES	NO	partial

6. Has a skills gap analysis been done?

YES	NO	Partial

7. Does a scarce skills policy exist to retain experienced and skilled personnel?

YES	NO

8. Are there air quality awareness programmes in place?

YES	NO

9. Does the municipality have sufficient financial resources to give effect to their air quality mandate?

YES	NO	Partial

10. Is air quality monitoring equipment adequate?

YES	NO	Partial

11. Is the air quality monitoring equipment well maintained?

YES	NO	Partial

12. Are the job descriptions for AQO in line with AQA?

YES	NO	Partial

13. Which types of training are offered (relevant training) to personnel involved in air quality management?

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14. How many Air Quality Officers (Sec 13 of NEMAQ), Qualified environmental management inspectors, Designated Environmental inspectors (Sec 31c NEMA) and Environmental Health Officers are there in your municipality?

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15. Do the designated institutions have sufficient resources to enable them to function efficiently? Do they have approved budgets that allocated sufficient funds?

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4. Communication

1. What are the air quality reporting requirements to provincial and national government?

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2. How easy or difficult is it to engage with the provincial and national government around air quality?

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3. What challenges do the municipality experience in addressing complaints with other departments with regard to air quality issues?

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4. How is the intergovernmental relation between the municipality and other departments?

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5. How does the reporting structure influence decision making with regards to air quality issues?

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ANNEXURE G: QUESTIONNAIRE FOR AQOs

Questionnaire

1. **Biographical information**

Municipality	
Position	
e-mail address (optional)	

2. **Your highest qualification**

☐ No education

☐ Prior Learning

☐ Matric

☐ Short Courses Diploma

☐ Degree (3 years)

☐ Degree (Honours)

☐ Degree (Masters)

☐ Degree (Doctoral)

3. **Years of experience in your profession**

☐ Less than 1year

☐ 1-3years

☐ 3-5years

☐ 5 to 10 years

☐ More than 10 years

1. Operational questions

1. What is your general understanding of the Air Quality Act (AQA)?

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2. How is AQM included in your mandate (KPI/KPA)?

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3. To what extent is NEMAQA implemented at provincial level? What are the reasons for that extent?

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4. Has air quality improved in the past five years within your jurisdiction?

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5. In your opinion does the municipality have adequate capacity (financial and human) to comply with the AQA requirements? Please elaborate.

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ANNEXURE H: QUESTIONNAIRE FOR EXPERTS

Questionnaire

1. **Biographical information**

Municipality	
Position	
e-mail address (optional)	

2. **Your highest qualification**

☐ No education

☐ Prior Learning

☐ Matric

☐ Short Courses Diploma

☐ Degree (3 years)

☐ Degree (Honours)

☐ Degree (Masters)

☐ Degree (Doctoral)

3. **Years of practice in your profession**

☐ Less than 1 year

☐ 1-3 years

☐ 3-5 years

☐ 5 to 10 years

☐ More than 10 years

1. What is the extent of NEMAQA implementation in municipalities? What are the reasons for this extent?

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2. In your opinion, is there any “co-operative” governance within the three spheres of government with regard to air quality management? Please elaborate.

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3. What are the barriers to implementing the NEMAQA within municipalities?

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4. What do you identify as the main weakness of the AQA?

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5. Do you think municipalities have regulatory powers to influence air quality within their jurisdictions? Please elaborate.

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6. Are municipalities well equipped in terms of financial and human resources to undertake AQM duties?

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7. How can AQM be improved in municipalities?

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8. How can inter-departmental relationships relating to air quality be improved?

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9. Do municipalities possess any integrative guidance to improve intra-governmental co-operation.

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10. Do politics have any effect on the local government duties such as implementation of NEMAQA (including standards and regulations)?

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