THE IMPLEMENTATION OF MINE CLOSURE: A CASE STUDY OF CLOSURE CERTIFICATES ISSUED IN MPUMALANGA AND GAUTENG PROVINCE

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DECLARATION

I, **ANITA YEVAI GUTU**, do hereby declare that this research report in its entirety is my own original work submitted for the Master's Degree in Environmental Sciences at the University of Witwatersrand. It has not been previously submitted to this or any other tertiary institution. I fully acknowledge the rules of the University with this regard and will abide by the consequences of being in breach of the rules and regulations with regards to plagiarism.

Signature of candidate

Date: November 2018

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ABSTRACT

This research report critically reviews the implementation of the current mine closure process in South Africa utilising case studies of gold and coal mines in Gauteng and Mpumalanga Provinces respectively. In order to relinquish liabilities, mining companies are required to sustainably rehabilitate land and obtain a mine closure certificate from the Department of Mineral Resources. Historically, mine closure was not well regulated which has resulted in an adverse legacy that sees over 5,000 derelict and ownerless mines across the South African landscape which have become a national liability for the government to rehabilitate. In an effort to discontinue this legacy, the legislative framework for mine closure has radically transformed. This study finds that the current framework is in line with internationally recognised best practice and demonstrates alignment with the principles of sustainability. However, despite this legislative transformation, there is a perception that mine closure certificates are not being granted. This research set out to analyse this perception and it was found that there is generally a low success rate for mine closure certificates applied for. Challenges influencing the implementation of the mine closure process include the reluctance of the regulating authority to relinquish liabilities which are linked to legacy issues associated with mine closure, the complex and entangled nature of the legislative framework and a potential lack of capacity of the regulating authority contributing to the ineffective execution of the process. Overall this research concludes that these challenges present a hindrance to the implementation of mine closure which comprises of rehabilitating land in a manner that allows it to be ceded for other sustainable land uses. This in turn presents a risk of further perpetuating the legacy of inadequate mine closure which directly negates the intent of the legislative transformation for mine closure.

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AMD	Acid Mine Drainage
BA	Basic Assessment
BAR	Basic Assessment Report
DEA	Department of Environmental Affairs
DMR	Department of Mineral Resources
ECA	Environmental Conservation Act (Act No. 73 of 1989)
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
I&APs	Interested and Affected Parties
ICMM	International Council on Mining and Metals
IFC	International Finance Corporation
LED	Local Economic Development
MP	Mining Permit
MPRDA	Mineral and Petroleum Resources Development Act (Act No. 28 of 2002)
MR	Mining Right
NEMA	National Environmental Management Act (Act No. 107 of 1998)
NEMAQA	National Environmental Management: Air Quality Act (Act No. 39 of 2004)
NEMBA	National Environmental Management: Biodiversity Act (Act No. 10 of 2004)
NEMWA	National Environmental Management: Waste Act (Act No. 59 of 2008)
NWA	National Water Act (Act 36 of 1998)
PAIA	Promotion of Access to information Act, 2000 (Act No. 2 of 2000)
PR	Prospecting Right
TIPS	Trade & Industry Policy Strategies
TSF	Tailings Storage Facility
WUL	Water Use Licence

1. INTRODUCTION

Section 24 of the Constitution of the Republic of South Africa (1996) states that: “Everyone has a right to an environment that is not harmful to their health and well-being”. Prior to the promulgation of the Constitution environmental legislation and related issues in South Africa were closely linked to the socioeconomic climate of the country (Kidd, 2011). As a result, South Africa failed to progress with the initial international changes and paradigm shifts regarding environmental issues (Steyn, 2005). During the Apartheid Era, South Africa was isolated at a time when the world began to pay closer attention to environmental issues. For example, South Africa did not participate in the United Nations Conference on the Human Environment held in 1972 nor the Conference on Environment and Development held in 1992 and as such failed to keep pace with the initial shift into sustainable development in the 1980s (Steyn, 2005). As a result, high impact industries such as the mining industry were not adequately regulated in terms of their environmental impacts, some of which are still experienced to date.

This research is broadly concerned with environmental management, under the principles of sustainable development, within the mining industry. Mining activities in South Africa date back to the late 1860s when diamonds were discovered in the Northern Cape Province and subsequently the discovery of goldfields on the Witwatersrand in 1886 (Antin, 2013). The mining industry has been at the heart of the South African economy since its inception and has also largely contributed to the global economy (Neingo & Tholana, 2016). Both Antin (2013) and Neingo and Tholana (2016) provide that in more recent times there have been challenges to the South African mining sector due to various factors including resource depletion that has seen a decline in the productivity and economic gains from the sector. To this end, mine closures have also become increasingly common.

From an environmental perspective, it is well known that mining activities have detrimental impacts on the environment. The physical exploitation of mineral resources beneath the earth’s surface poses high risk for the pollution of air, soil and water resources as well as has the potential to generate large volumes of hazardous and acid generating waste. These environmental implications require effective management and monitoring during and post mining operations.

Environmental management during and post mining operations was not always strictly regulated and mining related practices, including mine closure, lagged behind in ensuring sustainable post mining land uses. As a result, many historical mines were abandoned without being adequately rehabilitated. These ownerless mines are now a liability for the

government to rehabilitate and prevent subsequent residual adverse environmental and socioeconomic impacts.

Given the long history of mining in South Africa and related legacy issues associated with abandoned and/or ownerless mines, South Africa has seen radical transformation in mineral and environmental law in an effort to remain on par with international practices and systems. In order to relinquish liabilities, mining companies are required to sustainably rehabilitate land and obtain a mine closure certificate from regulating authorities.

Within the realm of environmental management in the mining industry the focus of this research is specifically concerned with the current mine closure process in South Africa, namely, the issuing of mine closure certificates based on the assumption that obtaining a closure certificate means that all reasonable and acceptable measures have been taken to rehabilitate land to provide options for future sustainable land uses.

1.1. Problem Statement

In 2012, a total of 5 858 derelict and ownerless mines were recorded in South Africa (van Wyngaardt, 2012) and it has been reported that more abandoned mines are being identified continuously. These derelict and ownerless mines are mainly linked to historical operations under weak legislation governing mine closure processes. They have now become a liability of the government to rehabilitate and ensure the prevention and/or minimisation of adverse residual impacts. Mine closure and how it is regulated is therefore pertinent to the current South African mining industry to prevent the persistence of the legacy of derelict and ownerless mines. Over and above this, mine closure is a complex process due to potential residual or latent impacts mainly pertaining to long term management of mine water which necessitates stringent regulations. Water related issues mainly pertain to Acid Mine Drainage (AMD) formation resulting from water interaction over time with the mine voids. The quantification of such risk is done through predictive modelling of potential future scenarios, however, it is a difficult impact to manage if it has occurred years after mining has ceased and even more difficult to rehabilitate. This presents an example of the kind of challenges associated with mine closure which the legislative framework attempts to address through the system of multiple applicable legislation.

In an effort to ensure that the legacy of inadequately decommissioning and rehabilitating mining areas and/or abandoning mining operations does not continue, legislation regulating mine closure processes has and continues to radically transform. The Mineral and Petroleum Resource Development Act, 2002 (Act No. 28 of 2002) (MPRDA) and the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and their associated regulations, govern the mine closure process in South Africa. Ultimately, the

holder of a mining related right or permit is required to obtain a closure certificate through various processes to relinquish the holder from liability of that mining area. In theory, obtaining a closure certificate in this context means that all acceptable and reasonable measures have been taken, based on the environmental impacts present at the cessation of an operation, to prevent further land and water degradation. This comprises either returning land to its pre-mining state or an alternative agreed upon land use which does not perpetuate environmental damage caused by mining activities. .

Internationally recognised principles/guidelines including the International Council on Mining and Metals' (ICMM) Planning for Integrated Mine Closure: Toolkit (2008) and the International Finance Corporation's (IFC) Environmental, Health and Safety Guidelines – Mining (2007) provide a basis for what is globally considered as best practice for mine closure. These guidelines have informed mine closure policies at operational level as well as mine closure legislation for various countries around the world.

According to Alberts *et al*. (2017) South Africa's current legislative framework for mine closure on paper aligns with internationally recognised standards. However, various discussions on mine closure in South African today as cited in Liefferink (2017), Davies (2014), van Eeden (2009), Olalde (2017), and Watson and Olalde (2018) perceive that mine closure certificates are not being granted. It has been said that the Department of Mineral Resources (DMR), who is the competent authority in issuing closure certificates, is reluctant to relinquish liabilities from mining companies so as to avoid taking responsibility for any future residual impacts and has limited capacity to administer the mine closure process (van Eeden, 2009 and Olalde 2017). This, however, leaves room for mining areas to be abandoned without being adequately rehabilitated during a prolonged closure process. Given this scenario, the ultimate issue of concern is whether the current mine closure process has improved and resulted in more effective mine closure or if the legacy of unsustainable mine closure is continuing.

1.2. Selected Study Area

The selected case study areas which are investigated in this report are the provinces of Mpumalanga and Gauteng. Mpumalanga Province borders Gauteng Province to the east and the countries Mozambique and Swaziland are bordered to the west of Mpumalanga. Mpumalanga is characterised by the grassland biome which is richly diverse and covers a surface area of 76 492 square kilometres (Mpumalanga Province Government, ND). The province is largely associated with extensive coal mining.

Gauteng Province is surrounded by four provinces, namely Free State, North West, Limpopo and Mpumalanga. Gauteng is situated on the Witwatersrand which is formed from

conglomerates, quartzite and shale which runs through Gauteng. The Witwatersrand is estimated to be the source of 40% of all the gold ever mined on earth (Gauteng Province Government, ND). Similarly, Gauteng is characterised by the grassland biome and covers a total surface area of 17 000square kilometres (Gauteng Province Government, ND).

Gauteng and Mpumalanga are mainly associated with gold and coal mining respectively and these provinces have experienced rapid growth and transformation throughout their history as a result of mining activities. Of interest to this report is significant decline in gold and coal mining activities in these provinces within the last decade as has been documented which would necessitate mine closure. Further detail pertaining to the selected study areas and the rationale for their selection is provided in Chapter three: Methodology.

1.3. Research Aim and Questions

1.3.1. Research Aim

The overarching aim of this research is to assess the implementation of the current mine closure process in South Africa of granting mine closure certificates, as well as compare this process with internationally recognised practices for mine closure for its effectiveness.

1.3.2. Objectives of Research

The objectives of the research to achieve the aim detailed above are as follows:

a) To define and evaluate the legislative process for mine closure in South Africa.
b) To assess closure applications (pending and granted) of mining operations within Mpumalanga and Gauteng.
c) To provide a comparison of the requirements of the mine closure process in South Africa to internationally recognised practices, namely the ICMM and IFC Guidelines.

1.3.3. Main Research Question

Based on the aim and objectives identified above, the main research question for this research is as follows:

> *Is the current mine closure process in South Africa (of granting closure certificates) being effectively implemented?*

1.3.3.1. Research Questions

1. What are the legal requirements for mine closure in South Africa?
2. What is the status of closure certificates being granted in the provinces of Mpumalanga and Gauteng?

3. Is there a correlation between the operating mines recorded in Mpumalanga and Gauteng compared to the resultant number of closure certificates granted within these provinces?

4. How does the established mine process in South Africa compare to internationally recognised best practice principles, namely the ICMM and IFC guidelines?

1.4. Limitations to the Research

This research is based on desktop assessments of existing data to answer the research questions listed above. The scope of the research is limited to mine closure requirements set out under the MPRDA and NEMA as well as their associated regulations. It is recognised that other processes and/or authorisations related to public health and safety as well as socioeconomic mine closure considerations also form part of the mine closure process; however, these are not specifically dealt with in this research.

The existing data of the number of mine closure certificates applied for and those granted which were assessed for the selected study area was found to be incomplete and present some contradicting information. As a result, assumptions based on the literature reviewed and data of other provinces were made to make conclusions on the research.

It is further noted that the quality of information supplied to the DMR for a closure application is a contributing factor in decision-making for granting a closure certificate. The quality of mine closure certificate applications submitted to the DMR are not discussed or taken into account in this research.

1.5. Research Report Overview

Chapter one served as an introductory chapter to the research providing an overview of the problem and/or area of concern identified with respect to the mine closure process within South Africa; context is given on the study area and rationale behind its selection as an appropriate representative sample of the success of the current mine closure process. Furthermore, the research aim, objectives and questions which will guide the research have been presented.

The table below provides a summary of the contents of the remaining chapters of this report.

Table 1: Outline of Chapters

Chapter two: Literature Review	The literature review provides a body of literature and current discussions relating to mine closure that is integral to this study and addresses the research gaps that will be filled as well as the contribution this study will make to the knowledge base in the topic.
Chapter three: Methodology	The methodology section provides an overview of the selected study areas as well as highlights the main data to be utilised and how this data will be analysed for each research question.
Chapter four: Research Findings and Discussions	The findings and interpretation of the data analysed is presented in Chapter four. The data is analysed as per the research objectives and/ or questions.
Chapter five: Conclusion and Recommendations	In this chapter, the outcomes of the research are discussed and a conclusion of the overarching aim is presented. Furthermore, recommendations for possible improvements are discussed.

2. LITERATURE REVIEW

This Chapter provides an overview of the current knowledge and discussions pertaining to mine closure.

2.1. Emergence of Mine Closure

Sustainable development is most commonly defined as: “Development that meets the needs of the present generation without compromising the ability for future generations to meet their own needs” (WCED, 1987). Sustainable development comprises of environmental, social and economic aspects associated with any development. Overtime people have begun to understand that the earth’s carrying capacity and resilience of the environment to withstand disturbance is limited (Arrow *et al.* 1995). Ultimately the driving force for sustainable development is conserving the natural environment upon which people and the economy depend on for present as well as future generations to survive.

Globally mining activities have and continue to result in large scale adverse environmental impacts which call for more sustainable practices during and post-mining operations. All forms of development rely on inputs from natural resources directly or indirectly to produce goods and services that generate economic advancements. As such, the extraction of minerals remains a key component to development despite the associated adverse environmental implications. Krezemien *et al.* (2016) recognise that the mining industry has a well-established reputation of degradation and there is a general lack of adequate acceptable measures to prevent adverse impacts during operations, at closing and post-closure periods. Hilson and Murck (2000) recognise that the mining industry can however promote more sustainable mineral extraction as well as improved environmental management practices and social performances to move towards sustainable development within the industry.

Environmental management practices throughout the Life of Mine have evolved since the 20th Century to align with the concepts of ecological sustainability as far as practicable (McCullough *et al.* 2018). Monitoring of various environmental aspects as well as the socio-economic related impacts caused by the presence of mining is undertaken with prescribed mitigation measures carried out throughout the Life of Mine to limit adverse impacts. Mining is, however, a temporary land use and over time it has become increasingly evident that there are long-term environmental and socioeconomic impacts associated with large scale mining activities that can persist beyond the Life of Mine. Key detrimental impacts mainly pertain to water pollution and public health and safety related issues associated with mining infrastructure which need to be addressed. Ideally subsequent to the cessation of mining operations, closure must result in sustainable land uses and communities (Alberts *et al.*

2017). This, at minimum, requires provision for the availability of adequate water supply, clean air as well as opportunities for future land owners and occupiers to meet their needs from the natural resources directly available to them. The last few decades have therefore seen increased attention paid to mine closure planning and practices in an attempt to assure sustainable land uses following mining.

2.2. What is Mine Closure?

The term mine closure is most commonly associated with the remediation of the environment following the cessation of a mining operation (Nehring and Cheng, 2016). The closure process involves the decommissioning of mining infrastructure and rehabilitation of disturbed areas in order for land to serve an agreed upon subsequent land use.

Mine closure can either be planned or premature which has an implication on how the process is carried out. Ideally mine closure occurs when the targeted mineral reserve is depleted in accordance with the mine plan. Laurence (2006) however provides that only a small number of mines are closed as per the mine plan. Premature mine closure can occur for a variety of reasons including:

- Mining becoming economically unviable as a result of commodity prices.
- Unexpected decrease in ore grade as a result of inaccurate geological investigations.
- Mechanical malfunctions or irreversible environmental breaches.
- Changes in political structures and policies that provide hindrances to the continuation of mining operations.

At closure, the main categories of issues that should be considered are environmental, technological, final land use, community and safety (Maiti, 2012). Impacts to the environment mainly include chronic soil erosion, heavy metals overloading, AMD and pollution to water systems and the air.

Various tools are recognised for assessing risks associated with mine closure which aim to ensure that the sustainable environmental best practices are executed, public safety is maintained and that there are sufficient funds to cover the costs associated with closure (Laurence, 2006). Many countries ensure that a financial provision is made from the onset of planning to carry out rehabilitation at the end of operations. This fund is also provided to make provision for instances where governments need to undertake the remedial works should the mining company become insolvent (Nehring and Cheng, 2016).

2.3. Challenges to Mine Closure

Mine closure is a complex process which should be considered from the initial planning stages of a mining operation and refined throughout the Life of Mine in line with concurrent

rehabilitation practices for it to be effective. Mine closure comprises environmental and socioeconomic aspects which are equally important in assuring effective closure that allows for sustainable post-mining land uses. McCullough *et al.* (2018) provide that the mining industry faces vast challenges relating to the appropriate planning and execution of closure objectives that effectively result in positive physical rehabilitation of the environment as well as meet the expectations of stakeholders in terms of the post-mining land use. Very few examples exist in key mining regions such as Australia of "successful" mine closure and closure is often deferred with many large mining operations being placed on care and maintenance for extended periods of time (McCullough *et al.* 2018)

Similar sentiments are echoed by Murphy (2016) who provides that very few mine sites have been relinquished in many of the key mining regions around the globe as a result of inadequate future land use planning. Where mining land has been transformed, this is typically a response to high demand of land for mining areas that are in proximity to urban and rural areas.

In terms of the physical environment, one of the main challenges faced in mine closure is the lack of sustainable practices through actions such as concurrent rehabilitation during mining operations. Often, mine closure occurs prematurely and not when ore is exhausted and as such the state of the environmental impacts must be managed continuously. Furthermore, should mine closure occur prematurely due to economic constraints, the rehabilitation process may never be carried out resulting in the abandonment of mines which has occurred extensively globally. In the developing world, for example, it is recognised that mining operations are usually managed by multinational companies under loose national regulatory requirements within the countries they operate and as such proactive environmental management is not practiced (Hilson and Murck, 2000). In such instances, when mine closure occurs, there is greater risk of ineffective closure and abandonment with respect to ensuring safety, prevention of land and water pollution as well as rehabilitating the land in a manner that provides options for sustainable future land uses. Hilson and Murck (2000) argue that mine management during operations and the closure process cannot be solely guided by legislative requirements but rather by the principles of sustainable development. Practical closure plans need to be developed and continuously scrutinised based on the state of operations to ensure that at closure, be it premature or planned, environmental impacts can be effectively managed.

Laurence (2006) provides that over the last few decades attention has been given to mine closure and it continues to be recognised as being significant as any other phase of mining operations.

Many countries have legislated the requirement for financial provision before the commencement of a mining operation to ensure funds are in place to carry out rehabilitation and also as a contingency should mining companies become insolvent and regulators are left to carry out rehabilitation and final closure activities (Maiti, 2012).

In terms of the socio-economic aspects, mine closure inevitably results in direct unemployment of mining operations employees and indirect unemployment to goods and service providers to mining operations (McCullough *et al.* 2018). These impacts are especially intensified in mining dependent communities which establish over time as a result of the presence of mining in the area. Further to this, mining infrastructure such as remaining Tailings Storage Facilities (TSFs) and pit voids can present public health and safety risks which are a challenge to closure, often requiring continuous post-closure monitoring and maintenance.

However, Murphy (2016) argues that closure planning and practices seen across the world often place too much focus on achieving the physical pre-mining land-use without enough consideration of socioeconomic opportunities present at closure for a more effective and sustainable post-mining land use. In the South African context this is noted under Section 38 of the MPRDA where provision is made that as far as possible land must be rehabilitated to its natural predetermined state or to a land use that conforms to the principles of sustainable development. Closure plans are therefore typically formulated around the pre-mining environmental state although other socio-economic factors may provide a greater driver for mine closure. Stacey *et al*. (2010) provide that communities are often dependent on mining activities and as such mine closure has a significant socio-economic implication which is often overlooked. This challenge is becoming increasingly apparent and efforts to incorporate environmental and social closure are being realised.

2.4. Established Mine Closure Practises

Based on lessons learnt across the world, best practice principles generally advocate for closure planning from the initial planning phase of any mine development, revision and update of closure strategies throughout the life of mine as well as making financial provision for final rehabilitation recognised today. These principles are consistent in globally recognised best practice guidelines such as the ICMM and IFC guides. The endorsement of mine closure best practice by financiers and mining companies has seen more closure planning from the initial planning phase and throughout the life cycle of mining operation (Morrison-Saunders, 2016). Globally, there is greater attention paid to mine closure today than in the past (Botha, 2012) as many countries experience adverse environmental and social legacy issues as a result of ineffective closure.

Research undertaken by Laurence (2007) analysed mines that were closed in Australia between 1981 and 2005 which comprised of 800 mine closures. The study revealed that only 25% of these mine closures were as a result of resource depletion (planned closure) while a further 8% were closed as a result of open pit resource depletion where the remaining underground reserves were not exploited. The remainder of the closures were mostly associated with financial, economic and/or technological constraints which are thus considered unplanned closures. Premature closure resulted in vast environmental and social impacts in Australia, including AMD which is mostly associated with gold, base metal and coal mines which were closed as well as the associated Tailings Storage Facilities (TSFs), waste rock dumps and open pit voids which were not well managed effectively following mine closure. In 2010, Western Australia amended its Mining Act (1978) to make provisions for mine closure plans which must be approved by regulators as part of an initial mine proposal and includes aspects such as stakeholder consultation, risk assessment, financial provisioning and some completion criteria (Nguyen, 2012). Such provisions demonstrate the recognition of the importance of closure planning but also demonstrate how closure practices have lagged behind with respect to environmental management within the mining industry.

A study undertaken by Morrison-Saunders (2016) evaluated closure processes established in various African countries including South Africa, Tanzania, Nigeria, Ghana, Zambia, Kenya and Mozambique. The study revealed that the core principles for mine closure were similar to those established under the South African legislative framework and are incorporated into the EIA process. This results in mine closure planning and requirements for financial provisioning being undertaken during the planning and approval stages of proposed mining developments (Morrison-Saunders, 2016).

It is however noted that mechanisms for the management of abandoned mines are not well defined. Furthermore, the requirement for financial provision in most of the studied countries is relatively new and as such legacy issues, similar to those in South Africa, are also seen elsewhere. Another notable similarity identified is the provision made of multi-agency/ “whole-of-government” involvement with closure planning and implementation. It is recognised that mine closure has a range of implications both socioeconomic and environmental, therefore engagement with potentially affected; entities at different levels is necessary.

2.5. Mining and Closure in South Africa

2.5.1. Past Mine Closure Experiences in South Africa

A large number of mining areas have been left unrehabilitated throughout the history of mining in South Africa as a result of unregulated practices within the mining industry which came about as a result of complex past environmental and mineral legislation. Legislation specifically relating to mine closure only came into effect in 1956 with the first notable guidelines for mining land rehabilitation being published by the Chamber of Mines in 1981 (van Druten and Bekker, 2017).

One of the first concrete attempts to address abandoned mines was through the Fanie Botha Accord which was an agreement made in 1975 between the Minister of Water Affairs and Chamber of Mines (Mhlongo and Amponsah-Dacosta, 2016). According to the agreement, the government assumed full responsibility for the rehabilitation of all mines which were closed or abandoned prior to 1976, 50% responsibility of mines closed and/or abandoned between 1976 and 1986, and after 1986 owners of mines were fully liable for the closure and rehabilitation of their mining operations. The implementation of the Fanie Botha Accord may not have been as effective as intended as there were no firm regulations to monitor and track mine closure. In 1991, the Minerals Act, 1991 (Act No. 50 of 1991) made the first provision for a regulatory process for mine closure, however, at this stage, mining activities had been taking place for over a century therefore the impacts of unregulated mine closures were already extensive.

Many mining operations were simply abandoned once operations ceased and often the companies that abandoned mines were not traceable or were liquidated prior to planned closure (Swart, 2009). In 2012, a total of 5 858 derelict and ownerless mines were recorded in South Africa (van Wyngaardt, 2012). Long-term residual and latent impacts mainly pertaining to socioeconomic, public health, safety and environmental pollution are still experienced around the country (Mhlongo and Amponsah-Dacosta, 2016). These derelict, ownerless or abandoned mines are now a liability for the government to rehabilitate and prevent subsequent adverse environmental and socioeconomic impacts. Notably, historic mining including in some instance where legal mine closure has been granted have resulted in AMD formation which became a liability for the government to address. This may further the reluctance of government to issue closure certificates as it is well understood that residual impacts may occur in the long-term and it is uncertain what processes or procedure will be applicable to address such impacts, often resulting in the liability falling on the government.

Swart (2009) argues that the government's ability to address the magnitude of mining closure legacy is limited and government has had to prioritise on issues such as water quality and public safety which receives media scrutiny and are now well documented. For example, the AMD situation in South Africa, which has been largely associated with abandoned Tailings Storage Facilities (TSFs) and unrehabilitated workings of gold and coal fields in Gauteng and Mpumalanga respectively, worsens daily and is expected to continue for centuries to come and is thus a priority issue (Kgari, 2016). On the other hand, communities previously dependent on mining experience significant economic and social impacts as a result of closure.

In 2014, Milaras *et al.* estimated the legacy of mining requiring rehabilitation to amount toR30 billion. By 2017, van Druten and Bekker reported an estimate of 800 years and R100 billion required to rehabilitate derelict, ownerless and abandoned mines across South Africa.

2.5.2. Recent Experiences of Mine Closure in South Africa

As indicated above, mining in South Africa commenced over 132 years ago and has been a leading industry in the development of the economy. The mining industry is still ranked fifth in the world and continues to play a major role in economic development (Ledwaba and Mutemeri, 2018). Minerals are however finite resources and the reserves particularly for gold and coal are diminishing. Hartnady (2010) provides that coal reserves, including the Mpumalanga coalfields, have been significantly reduced. This is similar for the Witwatersrand gold reserves which have been mined for over a century. Mining of these commodities today faces challenges such as infrastructure and technological constraints, low grade of the remaining reserves, decreasing commodity prices and/or regulatory uncertainty which have seen an estimated loss of 115,000 jobs within the decade between 1994 and 2014 (Ledwaba and Mutemeri, 2018). Given these increasing constraints on the mining industry, the closure of coal and gold mines in Mpumalanga and Gauteng respectively where major reserves of these commodities have been extensively exploited has been a more apparent reality in recent years. This gives rise to the need for alternative sustainable land use and economic activities across these landscapes.

In response to the legacy of derelict, ownerless and abandoned mines across the country, the legislative framework governing mine closure has been vastly transformed. The current framework introduced provisions which, as cited by Humby (2014) and Alberts *et al.* (2017), appear orderly and on par with international mine closure practices. Ultimately, a mining operation is required to obtain a mine closure certificate indicating that land has been fully rehabilitated in a manner that allows for it to be ceded for other sustainable productive uses.

It has however been cited by various authors including Liefferink (2017); Davies (2014), van Eeden (2009), Olalde (2017), Humby (2014), Milaras et al. (2014) and Watson and Olalde (2018) that despite the advances in the legislative framework, the mine closure process has proved to not be effectively implemented. Closure certificates are rarely granted for large-scale mining operations although physical closure of mining operations is apparent. This has been generally attributed to the reluctance of the DMR to issue closure certificates in an effort to avoid taking on the responsibility over any future residual impacts. Furthermore, the capacity of the DMR to administer the mine closure process and unpack the legislative framework effectively has been raised as a concern which may present a contributing hindrance to its success.

Milaras *et al.* (2014) attempted to identify the gap between the legislative framework and practice of mine closure; the study found that obtaining a closure certificate is viewed as practically impossible. Notably, a professional who contributed to the study indicated that there is an expectation by regulators to reduce the risk of residual impacts to zero and since this is generally unachievable closure certificates are not granted. Consequently, despite best possible practice to rehabilitate and reduce environmental impacts, closure certificate applications are likely to be rejected which demotivates mining companies to apply for a mine closure certificate. The study further identifies that there are few successful examples of closure applications to encourage and assure the merit of the legal process. In addition to these challenges, van Druten and Bekker (2017) provide that there is a clear shortage of relevant mine closure skills and understanding by the regulator as well as capacity to audit and monitor closure processes adequately.

As the dominance of mining continues to decline across the country alternatives to legal mine closures which have become increasingly apparent are either to place operations on extended care and maintenance or sale of operations to low-cost producers once mining becomes economically unviable and transfer associated environmental liabilities (Watson and Olalde, 2018). The Financial Provision Regulations (2015) which were published under NEMA make provisions under Regulation 16(4)(a) to regulate the placement of mines on care and maintenance by providing specific criteria for a mine to be eligible to be placed on care and maintenance and limiting the period to five years. However, due to the lack of capacity within the DMR to enforce these provisions, care and maintenance is not well monitored (Watson and Olalde, 2018).

In terms of the transfer of rights and associated environmental liability, mining operations are usually sold to smaller less well-resourced mining companies which Humby (2014) views as a way for large mining companies to avoid having to undertake the legal closure process.

This usually presents challenges in the long run as these smaller companies typically do not have the capacity to adequately rehabilitate land and revert back to care and maintenance and this eventually leads to abandonment. Despite the future environmental risks associated with selling operations to smaller companies which are inadequately resourced to undertake sustainable closure, this alternative is preferred by regulators as it results in less job losses than the complete cessation of an operation (van Druten and Bekker, 2017). This alternative may also be preferred as it presents an opportunity for the re-mining of old mine sites which, from a resource efficiency perspective, promotes a more sustainable land use option to leaving sites derelict. This sentiment echoed by Milaras et al. (2014) provides that legal closure is politically impossible as it results in extensive job losses which regulators are subsequently expected to account for.

To this end, existing literature indicates that the transformation of the legislative framework governing mine closure presents a new set of challenges which have an implication on its success. As an alternative to legal mine closure, there has been an increase in on-selling of mines or placing mines on care and maintenance. The intent thereof is perceived to not meet its desired objective.

The subsection below provides an overview of the transformation of the legislative framework governing mine closure in South Africa to provide context to the past and more recent closure experiences provided above.

2.5.3. The Evolution of the South African Mine Closure Legislation

2.5.3.1. History of Mineral and Environmental Law in South Africa

Mining activities in South Africa date back to the late 1860s when diamonds were discovered in the Northern Cape and later, the discovery of gold in 1886 (Swart, 2009). Based on the knowledge of environmental impacts associated with mining, it is imperative that legislation governing mineral resources and legislation governing sustainable environmental practices within a country work hand in hand. However, the development of mineral law and environmental law in South Africa did not happen concurrently.

Prior to 1994, mineral law in South Africa had been based on Roman Dutch law which held the view that a landowner is also the owner of mineral embedded in and under the soil of the land owned (Pope, 2010). However, with better understanding of minerals and the unique conditions under which they are found in South Africa, various mineral related legislations were formed to regulate access to mineral resources although the landowner ultimately still retained ownership over the mineral resources. During this period, impromptu environmental legislation relating to conservation of wild animals and pollution prevention were developed.

Notable environmental legislation included the National Water Act, 1956 (Act No. 54 of 1956) and The Atmospheric Pollution Prevention Act, 1965 (Act No. 45 of 1965).

The Environmental Conservation Act (Act No. 73 of 1989) (ECA) is said to have been promulgated as a result of global focus on environmental issues and was concerned with a wider spectrum of environmental aspects. Mining related practices, including mine closure, lagged behind in terms of being adequately regulated to ensure sustainable post mining land uses. Even as mining related provisions were promulgated, mining remained focused on economic gains and the absolute minimum requirements were met with a reactive approach to environmental issues (Swart, 2009).

2.5.3.2. Overview of Current Mineral and Environmental Legislation

The MPRDA was enacted to make provision for equitable access to the nation's mineral and petroleum resources (Herbert, 2006). For the first time, a distinction was made between the landowner and the owner of minerals beneath the surface. The state was cited in the MPRDA as the owner of all mineral resources within South Africa. Objective *h* of the MPRDA, makes provision for the responsibility to give effect to Section 24 of the Constitution by ensuring that the nation's mineral and petroleum resources are developed in an orderly and ecologically sustainable manner while promoting justifiable social and economic development. This in itself is a difficult task given the nature of mining activities and adverse environmental impacts thereof. According to Herbert (2006) the MPRDA was the first legislation in South African mining history that involved environmental and social impacts of mining. The state has the mandate of implementing regulations that ensure sound sustainable development within mining which brought about the relationship between the MPRDA and NEMA.

NEMA is the overarching environmental legislation in South Africa that provides decision makers with environmental governance through the principles that are stipulated in Section 2 of the Act. These principles are echoed in Section 37 of the MPRDA and are applicable to all prospecting and mining activities. NEMA aims to ensure integrated environmental management within the frame of sustainable development. The main instrument through which this aim is achieved is Environmental Impact Assessments (EIAs) which, as defined by Kidd (2011), is written national procedure for the evaluation of the potential impacts of proposed activity on the environment which assists decision makers by giving them information regarding the possible consequences of the proposed activity on the environment. As part of the EIA process, Environmental Management Plans (EMPs) are developed to mitigate against identified impacts as well as provides broad environmental management mechanisms for various environmental aspects throughout the life of a

development. For mining activities this typically includes concurrent rehabilitation activities that are aimed at reducing environmental liabilities at closure. Furthermore, Section 38 of the MPRDA gives provisions for the rehabilitation of the environment, responsibility of damage and managing environmental impacts post mining operations.

According to Kidd (2011), the relationship between the MPRDA and NEMA has not always been aligned to meet the core objectives of environmental management.. In some instances the economic advantages of mining have been prioritised over detrimental or irreversible adverse environmental impacts. Furthermore, the administration of the MPRDA and NEMA previously rested with different competent authorities, namely the DMR and the Department of Environmental Affairs (DEA). On the 8th of December 2014, amendments to NEMA's EIA regulations were promulgated which recognised the Minister of Mineral Resources as the Competent Authority in matters relating to Environmental Authorisations for mining related activities. Needless to say, this was a controversial transition because although the DMR, through the provisions of the MPRDA, has a strong responsibility to prevent and minimise adverse impacts to environment it has a mandate to ensure the economic sustainability of the mining industry in South Africa. This raises concern on whether sufficient monitoring and regulating of environmental impacts is being carried out during operations which ultimately plays a crucial role in the liability at closure.

2.5.3.3. Current Legislative Framework for Mine Closure

Given the long history of mining in South Africa and related legacy issues associated with abandoned mines, South Africa has seen radical transformation in mineral and environmental law as well as an effort to remain on par with international practices and systems namely through the current MPRDA and the NEMA. Humby (2014) provides that the current legislative process gives an impression of an orderly mine closure process to obtain a mine closure certificate, however in reality the process is complex, particularly as provision is made to transfer mineral related rights and associated environmental liabilities.

The table below provides an overview of the current mine closure framework that is applicable to South Africa.

Table 2: Requirements for Mine Decommissioning, Closure and Post-Closure

National Act	Description
MPRDA	The MPRDA came into effect on 1 May 2004. The MPRDA is aimed at making provision for equitable access to the nation's mineral resources as well as ensuring that they are developed sustainably in accordance with the principles set out in NEMA. All mining operations are governed by the MPRDA and its associated regulations including the closure and rehabilitation phase. Mine closure is stipulated under Section 43 of the MPRDA with Regulation 57 of the MPRDA providing the regulatory process for a mine closure certificate application.
MPRDA Regulations (GN R527 in Government Gazette 26275 of 23 April 2004)	
NEMA	NEMA was promulgated, with effect from 29 January 1999, with the intent of promoting co-operative environmental governance through principles of decision-making on matters affecting the environment and the enforcement of established environmental management laws. The EIA Regulations 2014, which were promulgated under NEMA, provide the procedure and criteria for the preparation, evaluation, submission, processing and decision-making process on applications for Environmental Authorisation (EA) which is subject to an EIA. Mining operations include a number of activities which are in the Listing Notices 1 to3 and their impacts are managed through an approved Environmental Management Plan (EMP). The EMP would also mitigate measures for the final decommissioning, rehabilitation and closure phase of the project which must be executed accordingly to ensure compliance to the EMP. The Financial Provisioning Regulations were promulgated under NEMA to determine and regulate financial provisioning for the costs associated with the undertaking of decommissioning, rehabilitation and final closure from prospecting and mining operations as well as residual environmental impacts that may occur in future. A mining operation is required to annually assess its environmental liability in a prescribed manner and must increase the financial provision to the satisfaction of the DMR. Alternately, environmental liability can be decreased if concurrent rehabilitation activities are undertake which reduce the environmental liability.
EIA Regulations, 2014 (GN R982 in Government Gazette 38282 of 4 December 2014)	
Financial Provisioning Regulations, 2015 (GN R1147 in Government Gazette 39425 of 20 November 2015)	
Mine Health and Safety Act (Act 29 of 1996) (MHSA)	The MHSA was promulgated to provide for the health and safety of employees and other persons at mines. The Act promotes health and safety which is carried into the closure phase of a mining operation. At closure the Act provides provisions to ensure that once a mine is decommissioned, it does not pose a health and safety risk to the public.
National Water Act (Act 36 of 1998) (NWA)	The NWA provides the law relating to the use and management of water resources. The protection of water resources is a crucial component for mine closure, particularly for gold and coal mines which are associated with AMD as residual impacts. Mining operations usually operate with a Water Use Licence (WUL) in terms of Section 21 of NWA to manage the mining activities' interactions and use of water resources. The WUL together with other provisions of the NWA are applicable to the decommissioning, rehabilitation and closure of a mine.

The current legislative framework aims to eliminate an increase in the number of abandoned and derelict mines. Alberts *et al*. (2017) indicate that South Africa's current legislative framework for mine closure on paper aligns with internationally recognised standards. The legal framework provided above sets out the main legislation applicable to the procedural requirements for mine closure as well as environmental management during the decommissioning and closure phase of a mining operation. In addition to the above, Alberts *et al.* (2017) provide an extensive list of other legislation which is relevant to mine closure which includes, but is not limited to:

- Auxiliary environmental legislation.
- Income Tax Act, 1962 (Act No. 58 of 1962).
- Nuclear Energy Act, 1999 (Act No. 46 of 1999).
- Provincial Land Use Planning Ordinances.
- Various strategies, policies and regulations such as the Strategic Framework for Implementing Sustainable Development in the South African Minerals Sector (Department of Minerals and Energy, 2009), the Water Conservation and Water Demand Management Strategy for the Industry, Mining and Power Generation Sector (Department of Water Affairs, 2004) and the National Norms and Standards for the Remediation of Contaminated Land and Soil Quality (2014).
- Various mine closure and rehabilitation related guidelines such as the series of guidelines published by the Department of Water Affairs pertaining to mining operations and mine closure related activities as well as guidelines pertaining to specific aspects of environmental protection including biodiversity management, management of contaminated land as well as waste and residue stockpile management post mine closure.

The legislative framework also makes provision for retrospective and perpetual liability in an effort to address some of the legacy issues associated with historic mining. Under Section 43 of the MPRDA, the Minister has the authority to retain a portion of the financial provision set up for environmental liabilities to address any future residual and latent impacts that may occur. Amendments to the MPRDA expanded on perpetual liability under Section 43(1A) where it was provided that despite the issue of a closure certificate, a mining company remains liable for latent and residual impacts and their responsibilities include pumping and treating contaminated water and any other kind of pollution which may become known in the future (Humby, 2014). Furthermore, perpetual liability can be executed through the Polluter Pays Principle under NEMA where provision is made that anyone responsible for causing pollution has a responsibility for its remediation. As indicated above, the principles of NEMA

are echoed in the MPRDA and therefore using this principle, mining companies can be held liable for residual or latent impacts following mine closure.

In order to relinquish such liabilities, mining companies are required to sustainably rehabilitate land and obtain a mine closure certificate from regulating authorities. To obtain a closure certificate an Environmental Assessment and Authorisation process which includes a detailed Closure Plan and Environmental Management Programme must be undertaken in accordance to provisions provided in NEMA and the MPRDA. Furthermore, health and safety requirements need to be considered. The application for a closure certificate is considered across various commenting authorities who are considered responsible for the administration of any law which relates to any matter affecting the environment, for example water, waste and air (Warburton, 2017). These commenting authorities must provide in writing that all issues pertaining to health and safety, labour relations, management and prevention of water and land pollution at minimum are addressed in terms of Section 43 of the MPRDA. Subsequent to consensus regarding the acceptability of the closure process undertaken, a closure certificate may be granted by the DMR as the Competent Authority. Once obtained a holder is relinquished from liabilities to the land and surrounding environment to an extent as there is provision for retrospective liability. The process for a mine closure certificate application is further evaluated under Chapter four of this research report.

As indicated above, a key aspect of mine closure is the initial planning and concurrent rehabilitation during the life of mine in order to reduce the burden of environmental liability at closure. This is further motivated by the fact that during operations, mining companies are generating income which can be used for rehabilitation whereas at closure (particularly if the closure is unplanned) funds may not be available and companies will have to rely solely on the financial provision. Watson and Olalde (2018) provide that financial provisioning is often underestimated which can present a challenge at closure, should all rehabilitation be left to the end of the mine life.

NEMA makes provision for the development of a closure plan at the project planning phase as part of the Environmental Authorisation Process governed under the EIA Regulations (2014) and concurrent rehabilitation throughout the life of mine governed under the Financial Provisioning Regulations, 2015. Under these regulations, mining companies are required to assess their rehabilitation efforts on an annual basis and are provided an opportunity to reassess their liability and reduce their calculated environmental liability costs accordingly.

To this end, the current legislative framework has transformed to include key mine closure aspects, namely, closure planning at the project planning phase, progressive environmental

rehabilitation throughout the life of mine as well as perpetual liability in response to closure legacy.

2.6. Conclusion

The outcome of an effective mine closure process in South Africa is obtaining a closure certificate. Van Eeden *et.al* (2009) argue that there is generally a reluctance from government and companies to take responsibility of land following mine closure. This stems from the inability of government to address the existing damage and as such there is an increase in pending closure of mines. In hindsight of the legacy issues of abandoned mines and potential adverse impacts that could occur post mining, it is understandable that regulators are cautious of relinquishing all liability of mining companies. Furthermore, the legislative framework governing environmental management at mine closure has been extensively adapted and comprehensively makes provisions that are aimed at ensuring all potential residual and latent risks are addressed. However, to effectively implement the legislative requirements, a robust bureaucratic system is required which has been cited as a limiting factor for the regulating authority. Ultimately these factors leave room for mines not to be adequately rehabilitated and thus abandoned, leaving a greater legacy of local and global pollution.

Studies have been carried out which assess the impacts of the legacy of abandoned mines and give an overview of challenges associated with the current process, however, detailed quantitative analyses of the current success of mine closure process in terms of mining companies obtaining closure certificates has been deemed a research gap. In a recent study undertaken by Mark Olalde (2017) data was obtained of mine closure applications and those granted across South Africa. The research discovered that large mining operations are generally not granted closure certificates. Based on the assumption that obtaining a closure certificate means that all acceptable and reasonable measures have been taken to prevent further land and water degradation and provide opportunities for sustainable land uses as well as feasible socioeconomic opportunities thereafter, this research thus aims to provide an assessment of this data and evaluate the implementation of mine closure under the current legislative framework, by answering the following research questions:

- What are the legal requirements for mine closure in South Africa?
- What is the status of closure certificates being granted in the provinces of Mpumalanga and Gauteng?
- Is there a correlation between the operating mines recorded in Mpumalanga and Gauteng compared to the resultant number of closure certificates granted within these provinces?

- How does the established mine process in South Africa compare to internationally recognised best practice principles, namely the ICMM and IFC guidelines?

An interpretation of the most recent quantitative data pertaining to mine closure in Gauteng and Mpumalanga is provided in Chapter four below which will answer the posed research questions above.

3. METHODOLOGY

The methodology a researcher uses to collect primary data is dependent on the nature of the research problem (Noor, 2008). This research project is primarily based on a quantitative research method which, as defined by Babbie (2010), utilises numerical, mathematical and statistical measurements to draw conclusions regarding a particular phenomenon.

To achieve the research aim and objectives, a desk research technique (also commonly referred to as secondary research) was employed. Desk research comprises of the collection and utilisation of resources in order to answer a research question (PMR Research, ND). Various data sources and analysis techniques were utilised during the undertaking of this research which together provided the necessary data to deduce the research's aim.

3.1. Research Approach

Typically, the approach to research is distinguished between three forms of inference that form the basis of an investigation namely: inductive, deductive or abductive approach (Woo *et al.* 2017). A deductive research approach stems from an idea and is utilised to test the validity of existing conclusions and/or assumptions whereas the inductive approach is based on making conclusions and/or general assumptions based on observations. Finally, the abductive approach stems from "surprising" and/or "incomplete" observations from which a research process is utilised for their explanation (Velazquez-Quesada *et al.* 2013). In contrast to deduction and induction, abduction seeks to provide the most feasible explanation for an observed phenomenon, and the development of theories based on the formulated explanations behind a phenomenon (Woo *et al.* 2017).

This research makes use of case studies, quantitative data of the number of closure certificates issued, and production data of coal and gold in the selected study areas to assess the implementation of the closure practice. Furthermore, an analysis of the national legislative requirements and a comparison of this with international best practice was undertaken to provide an explanation for this perspective. This research approach therefore primarily makes use of deduction and abduction research forms to analyse the perception that mine closure is not being granted and provide explanation for its occurrence.

The figure below provides a schematic of how these approaches are used and combined to determine the success of the current mine closure process implemented in South Africa.

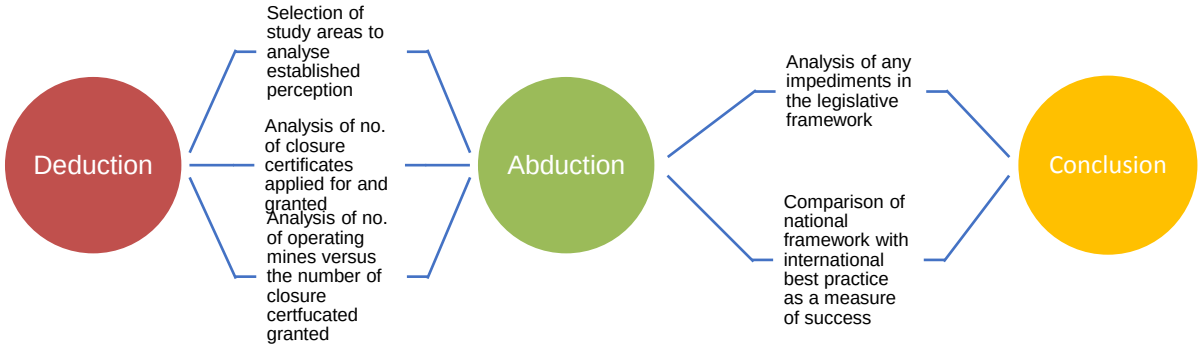

Figure 1: Research Approach

3.2. Sample size and Study Area

The focus area for this research and motivation for the selection of Mpumalanga and Gauteng Provinces as representative samples for this research has been discussed in detail in subsections below. The sample size of the two provinces was deemed appropriate as it would allow for comparative analysis while also providing a thorough assessment from each province. The sample size was further broken down into selected samples, of data from these provinces for each research question, which were limited to a specific value. Table 3 below presents the specific samples for each research question.

3.2.1. Mpumalanga Province

The main economic activities within Mpumalanga include coal mining, associated power generation and the metal industry (Campbell *et al.* 2017). The boom of these industries within the province has seen the manifestation of various documented environmental issues as well as induced impacts of influx of migrants into the province which requires management. A Provincial Review undertaken by Trade and Industry Policy Strategies (TIPS) in 2016 revealed that mining activities contribute to 22% of the provincial real economy sector and 22% to the overall national mining sector. TIPS (2016) also noted that the province's performance is greatly impacted by commodity prices as a mining-dependent economy.

In a study undertaken by Tracy Davies of the Centre of Environmental Rights (2014) it was provided that coal mining in Mpumalanga has had a devastating impact on food and water security for South Africa. The Olifants River Catchment which is characterised by an intrinsic wetland system plays a significant role in preserving water quality and has been adversely impacted and lost as a result of coal mining within the province. In terms of food security, 46% of South Africa's arable soils are found in the Mpumalanga Province which is being lost

over time as a result of the high concentration of coal mines (Davies, 2014). The study revealed that land use applications of the Mpumalanga Province are dominated by Mining Right, Mining Permit or Prospecting Right applications, as illustrated in Figure 2 below. Thus, it is evident that mining will continue to play a dominant role in sustaining livelihoods in the province as well as food security related concerns. However, the rate of depletion of coal reserves is a limiting factor to the viability of future mining operations within the province.

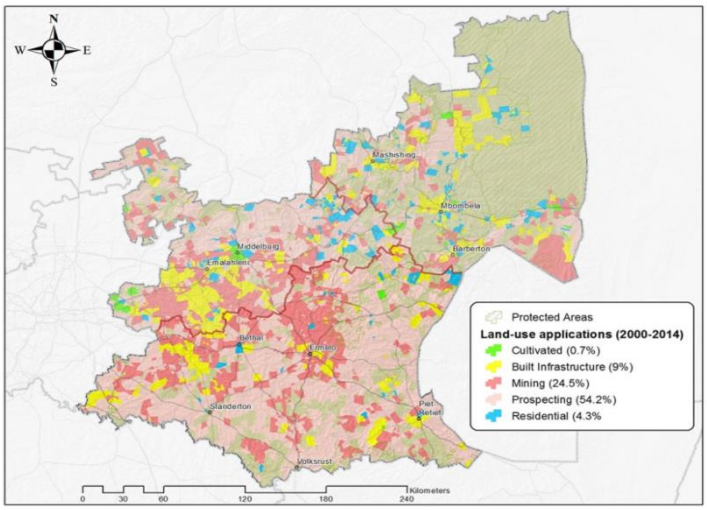

Figure 2: Land Use Applications in Mpumalanga between 2000 and 2014

(Source: Davies, 2014)

Provided that the majority of economic activity in Mpumalanga is based on non-renewable resources, there is a crucial need to manage the vulnerabilities associated with such activity (Campbell *et al.* 2017). Mpumalanga is at high risk of irreversible adverse social and environmental implications once mineral reserves are depleted. As such there is a growing need for long-term vision and effective closure planning and management to ensure effective decommissioning and rehabilitation of mining areas once activities are ceased as well as ultimately the creation of sustainable future land uses and social environments. Davies (2014) argues that the current state of coal mining in the province shows that concurrent rehabilitation is not taking place and there is a lack of compliance monitoring and enforcement by the regulating authority. Furthermore it has been described that the DMR has an “extremely cavalier” attitude towards closure of mines and their rehabilitation as a preventative measure to environmental impacts.

3.2.2. Gauteng Province

The Witwatersrand has been mined for over a century since the discovery of gold in 1886 which resulted in the development of a world-class gold mining industry (AngloGold Ashanti,

2007). It is the world's largest basin of gold and uranium with more than 43 500 tons and 73 000 tons of these minerals having been mined out respectively (Liefferink, 2017).

Gauteng is home to 24% of South Africa's population as well as the largest city which was initially established as a result of the mining industry of the Witwatersrand. In the Provincial Review undertaken by TIPS (2016) for Gauteng it was revealed that mining today contributes a total of 2% of the province's Gross Domestic Product (GDP) and a total of 11% of the national mining economy. These figures indicated a decline in mining production today as the main economic source for the province; however it still contributes significantly to the national mining sector.

The legacy of gold and uranium mining within the province is still evident. According to Liefferink (2017) there are over 270 TSF in the Witwatersrand which cover approximately 400 square kilometres of surface area in Gauteng as well as six billion tons of pyrite tailings which are estimated to contain approximately 600 000 tons of uranium. Many of these form part of the derelict, ownerless mining infrastructure and unrehabilitated mining areas of South Africa. These TSFs are largely associated with extensive dust, soil and water pollution as there were no regulated pollution prevention measures such as liners of TSFs to prevent seepage or requirements to vegetate the TSFs to prevent dust generation when the tailings were deposited.

More recently as a result of advances in technology, reclamation activities of these TSFs for remaining gold, uranium and other recoverable elements has become feasible and more common. This has contributed to reducing the voluminous infrastructure from Gauteng's landscape and ideally should also be ceding more land for other sustainable productive land uses. Notably, illegal mining activities and the establishment of informal settlements over and around non-operational mining areas (typically shafts, opencast pits and TSFs) is evident and of a growing concern.

3.2.3. Summary of Rationale

Based on the discussion above, it is evident that the exploitation of mineral resources, namely coal and gold, in Mpumalanga Province and Gauteng Province respectively has and continues to play a key role in sustaining livelihoods and economic advancements. In the case of Gauteng, the mining sector has declined since its inception in 1886; however related challenges such as illegal mining and occupation of contaminated mining areas is evident while in Mpumalanga mining is still a significant contributing and growing activity although it is noted that the mineral reserves are depleting and therefore closure is increasingly becoming a reality.

Both provinces experience closure as a result of the depletion of feasible mineral resources and/or the mineral reserve. For Mpumalanga the rehabilitation and closure of mining operations needs to be effective and support sustainable future land uses and promote the establishment of communities that are not solely reliant on mining activities. While in Gauteng, legacy issues of abandoned gold and uranium mines have already severely impacted the environment from the voluminous TSFs which are now being partially being rehabilitated as a result of the rise in reclamation activities but still need attention as well as the management of socioeconomic activity over and around contaminated mining areas.

This research aims to assess the implementation of the mine closure process in South Africa by evaluating whether closure certificates are being granted in these provinces. Utilising Mpumalanga and Gauteng as a representative sample to achieve this aim has been deemed appropriate because there is a clear need for effective closure in Mpumalanga, while in Gauteng there is an established understanding of impacts of unsustainable closure which should influence how current closure application and practices are handled. An evaluation of closure within these two provinces will provide an interesting perspective based on the background of mining within the two provinces and how closure is reviewed in an effort to avoid the repetition of legacy issues.

Furthermore, coal and gold mining have both been associated with AMD as a long-term residual impact which is one of the main environmental impact concerns with the closure of mines.

3.3. Data Sources

Data obtained by Olalde (2017), of the Oxpeckers Reporters, on mine closure certificates applied for and those granted for the period 2011 to 2015 was utilised for this research. Olalde (2017) produced a comprehensive database of information pertaining to the mine closure applications processed across all nine provinces of South Africa. The data comprised of information obtained through a request under the Promotion of Access to information Act, 2000 (Act No. 2 of 2000) (PAIA) submitted by Oxpeckers Reporters in 2015 for access to lists of all mine closure certificates applied for in the country between 2012 and 2015. These lists were to be provided by each provincial DMR as the competent authority with respective to mine closure certificate applications within its respective province. Furthermore, the datasets produced also considered and combined information obtained through a Parliamentary request submitted by the Democratic Alliance (DA) on closure certificates which was answered on 22 April 2016. The aim of the investigation by Olalde (2017) was to expose the lack of effective implementation of the mine closure certificate by the DMR with respect to closure certificates that have been applied for being issued.

In addition to the above, the D1 database which provides a record of all operating mines across the country, the legislated framework for mine closure as stipulated under the MPRDA and NEMA as well as international best practice documents was assessed to address the research questions. A summary of the primary data sources are presented in Table 3 below.

3.4. Data Analysis

Table 3 below provides a description of how data was analysed for each research question and how it is presented in this report.

Table 3: Research Methodology

Research Question	Main Data Source	Sample Size	Data Analysis Description
1. What are the legal requirements for mine closure in South Africa?	The South African legislated framework for mine closure will be assessed.	Limited to the provisions made under NEMA and the MPRDA, their associated regulations and auxiliary legislation.	An assessment was undertaken of the legal requirements associated with mine closure certificate application process. The results are presented as a flow diagram including timeframes and specific deliverables as well as the relevant competent authorities to provide a full picture of the requirement involved in the closure application process.
2. What is the status of closure certificates being granted in the provinces of Mpumalanga and Gauteng?	Available database of closure certificate applications in South Africa obtained by Mark Olalde (2017) from the DMR.	Limited to closure applications between 2012 and 2015.	The closure certificates granted, pending and rejected in Mpumalanga and Gauteng were mapped out. These applications were also divided into the type of operation (i.e. Mining Right, Prospecting Right or Mining Permit) to provide an understanding of the status of applications and whether the application type plays a role in granting closure certificates. This data was presented in a table format according to the mine category.
3. Is there a correlation between the operating mines recorded in Mpumalanga and Gauteng compared to the resultant number of closure certificates granted within these provinces?	1) DMR D1 databases 2) Closure certificate; and applications database in South Africa Olalde (2017); and 3) The South African legislated framework for mine closure.	Limited to the recorded number of operating mines in the study area versus what is recorded as closed mines with closure certificates (2010-2017). The D1 database only provides figures of Mining Rights and not any other type of mineral authorisation.	Utilising information pertaining to the status of applications (number of closure certificates applied for and number of closure certificates granted) a comparison is made to the number of recorded operating mines on the D1 database. A further analysis of gold and coal production figures is undertaken to interpret these findings.
4. How does the established mine process in South Africa compare to internationally recognised best practice principles, namely the ICMM and IFC guidelines?	1) ICMM Toolkit (2008). 2) IFC Guidelines (2007).	Limited to the data source guidelines.	A comparative analysis of the mine closure process in South Africa with the ICMM toolkit and IFC guidelines on closure was undertaken. Common themes were identified from the ICMM toolkit and IFC guidelines which were utilised to assess where and/or if these are covered in the mine closure process employed in South Africa.

3.5. Determining Criteria

The determination of effective mine closure is challenging due to the complexities associated with residual and latent impacts. However, the following criteria are deemed appropriate best practice principles for effective mine closure:

- Closure is being granted and subsequently land is ceded for other sustainable productive uses.
- There is a correlation between the real production figures compared to closure certificates applied.
- The legislative process allows for closure applications to be scrutinised fully and all aspects especially relating to latent impacts be assessed without the process being too onerous resulting in delays or standstills in the decision making process.
- The closure process is in line with internationally recognised best practice.

4. RESEARCH RESULTS AND DISCUSSION

This chapter addresses the research questions presented in Section 1.3.3.1. above. The subsections below provide an analysis for each research question that needs to be addressed and the data has been interpreted in accordance with the research methodology presented in Chapter three above. The criteria determined for each research question was then utilised to ultimately respond to each research question.

4.1. What are the legal requirements for mine closure in South Africa?

The mine closure process is regulated under the MPRDA and the NEMA and their associated regulations.

The overall legislative framework applicable to mine closure in terms of the MPRDA and NEMA is provided in Section 2.5.4 above. The subsection below provides the specific requirements for the application of a mine closure certificate within this framework.

4.1.1. Legislated Process for Mine Closure

Section 43 of the MPRDA provides provision for the issuing of a closure certificate in terms of the act with specific regulatory processes set out in the MPRDA Regulations, namely Regulation 57. Furthermore, the application for mine closure triggers a Listed Activity in terms of the EIA Regulations promulgated under NEMA which therefore requires that at minimum a Basic Assessment Process be undertaken as part of the closure certificate application process. The table below provides a summary of the relevant provisions associated with the application for a mine closure certificate and is subsequently illustrated in Figure 3.

Table 4: Legislated Process for Mine Closure

Legal Provision	Requirements
SECTION 43 of the MPRDA	Section 43(1) provides that the holder of any mineral authorisation type remains responsible for any environmental liability until the Minister issues a closure certificate in terms of the Act. In subsequent subsections, notable provision is made for the following: • Section 43(2) - Transfer of environmental liabilities and responsibilities including the closure plan. • Section 43(3) - The requirement for a closure certificate in the event that a mining operation is lapsed and/or abandoned, cessation of a mining related operation, relinquishment of any portion of the land associated with the approved mining area and the completion of a prescribed closure plan to which a mining related authorisation relates. • Section 43(4) - An application for a closure certificate is required to be made within 180 days of the cessation and/or abandonment of operations including all the required information prescribed under the MPRDA Regulations and under NEMA. • Section 43(5) - The Chief Inspector as well as all government department who

	administer any law relating to any matter affecting the environment are required to provide written confirmation that the provisions pertaining to health and safety and management of pollution to water resources and conditions of the EA have been addressed. • Section 43(6) - Upon issuing of the closure certificate the Minister must return the financial provision put up by the mining authorisation holder, although any portion of such financial provision may be retained for latent and safety, health or environmental impact which may become known in the future. • Section 43(11) - The holder of a mining related authorisation must at the commencement of closure of programmes, plans or EAs accordingly submit a closure plan for approval by the Minister which is aligned to promulgated closure strategies available under the Act. • Section 43(13) - No closure certificate may be issued unless the Council of Geoscience has confirmed in writing that the required documentation in terms of the Act have been submitted to the Council of Geoscience.
MPRDA REGULATIONS (GN R 527)	Regulation 56 provides the principles of mine closure which stipulates that the risks pertaining to environmental impacts must be quantified and proactively managed throughout the life of mining and that health requirements in terms of the MHSA must be complied with. Furthermore Regulation 60 provides that the closure objectives must form part of the EMP. Regulations specifically relating to the application of a closure certificate are provided in Regulation 57 which stipulates that the following documentation must be submitted as part of the closure application to the Minister for approval: • A closure plan in terms of Regulation 62. • An environmental risk report in terms of Regulation 60. • A final performance assessment in terms of Regulation 55(9). • A completed application form for either the transfer of environmental liabilities and responsibilities (Form O) or a closure certificate (Form P) which are provided as annexures of the Regulations.
	The contents of a closure plan, as prescribed in Regulation 62, must include but are not limited to: • Description of the closure objectives. • A summary of the environmental risk report and identified residual and latent impacts. • Summary of the results of progressive rehabilitation undertaken. • Description of any long-term management and maintenance expected. • Proposed closure cost and financial provision for monitoring, maintenance and post closure management. • Record of Interested and Affected Parties (I&APs) consulted. • Plans illustrating the final and future land use proposal and arrangements for the site.
	The contents of an environmental risk report, as prescribed in Regulation 60, must include but are not limited to: • Screening level environmental risk assessment where possible all environmental risks at closure are identified and qualitatively ranked. • Second level risk assessment on aspects which are identified as significant risks in the screening level assessment where a more detailed quantitative risk assessment is undertaken. • Risk management strategies including the residual and latent impacts and timeframes for the implementation of the management measures.
	The contents of a performance assessment, as prescribed in Regulation 55, must include but are not limited to: • The performance assessment must be undertaken by an independent competent

	person. • The audit must be conducted on the approved closure plan and/or objectives and EMP to ensure the commitments have been met. • Assessment of the environmental risks identified and latent impacts and their management thereof. • The performance assessment must either precede or accompany the closure certificate application.
	The application form relevant for mine closure, Form P, contains administrative information as well as reasons for the application and provides that the application must be made within 180 days of the cessation and/or abandonment of a mining operation.
SECTION 24 of NEMA	Section 24 of NEMA provides provisions for EAs which, as previously discussed, relate to Listed Activities which require authorisation prior to commencement as prescribed in the EIA Regulations. For mine closure Section 24P and 24R are applicable which specify provisions for financial provision for the remediation of environmental damage and mine closure on EA respectively.
	Section 24P provides that the holder of a mining related authorisation must make financial provision for the management and rehabilitation of environmental impacts. At closure, should the owner of the mine fail to rehabilitate or manage resultant impacts to the environment all or part of the financial provision may be used by the government to rehabilitate and manage the impacts concerned. It is then further provided under Section 24P(5) that the financial provision may be returned to the holder once a closure certificate is granted, however, a portion of the financial provision may be retained by the Minister to manage residual and latent impacts that may occur in future.
	Section 24R reiterates the MPRDA in that the holder of a mining authorisation remains responsible for any environmental liability until such a time as a closure certificate is issued
EIA REGULATIONS (2014), NEMA	The application for mining related closure certificates triggers Activity 22 of Listing Notice 1 (GN R983) which requires EA through the undertaking of a Basic Assessment Process. It is noted that should the associated decommissioning and rehabilitation activities as set out in the closure plan trigger other Listed Activities these must also be applied for accordingly.
	Regulation 19 prescribes the content of the Basic Assessment Report which includes the EMP as well as a closure plan which must include but is not limited to: • Closure objectives. • Measures to rehabilitate the environment. • The process for managing the environment. • Details of public consultation conducted as part of the compilation of the closure plan. • Details of the associated financial provision. This must be submitted with the Basic Assessment for the triggered Listed Activities associated with the mine closure application.
	Regulation 34 provides provision for environmental auditing of compliance with EA, EMPs and closure plans. During the period of validity an environmental audit must be conducted on the closure plan and submitted to the competent authority.
FINANCIAL PROVISIONING REGULATIONS (2015), NEMA	These regulations make provisions for the compilation and implementation of a Final Rehabilitation, Decommissioning and Mine Closure Plan which should form part of the EMP. This echoes the provisions set out in the EIA Regulations which are applicable for the Basic Assessment Process associated with the mine closure application.
NWA REGULATION (GN R 704)	Regulation 704 of the NWA makes provisions for the use of water for mining and related activities with the aim of the protection of water resources. Under Regulation 2(2)(b) it is provided that the Department of Water and Sanitation must be notified 14 days prior to the temporary or permanent cessation of a mining operation. Furthermore, Regulation 9 provides

	that at cessation of a mining activity the owner of the mining operation must ensure that pollution control measures are complied with.
SECTION 2 of the MHSA	The MHSA under Section 2 provides that the owner of a mine remains responsible for health and safety matters until such a time as a closure certificate is granted.

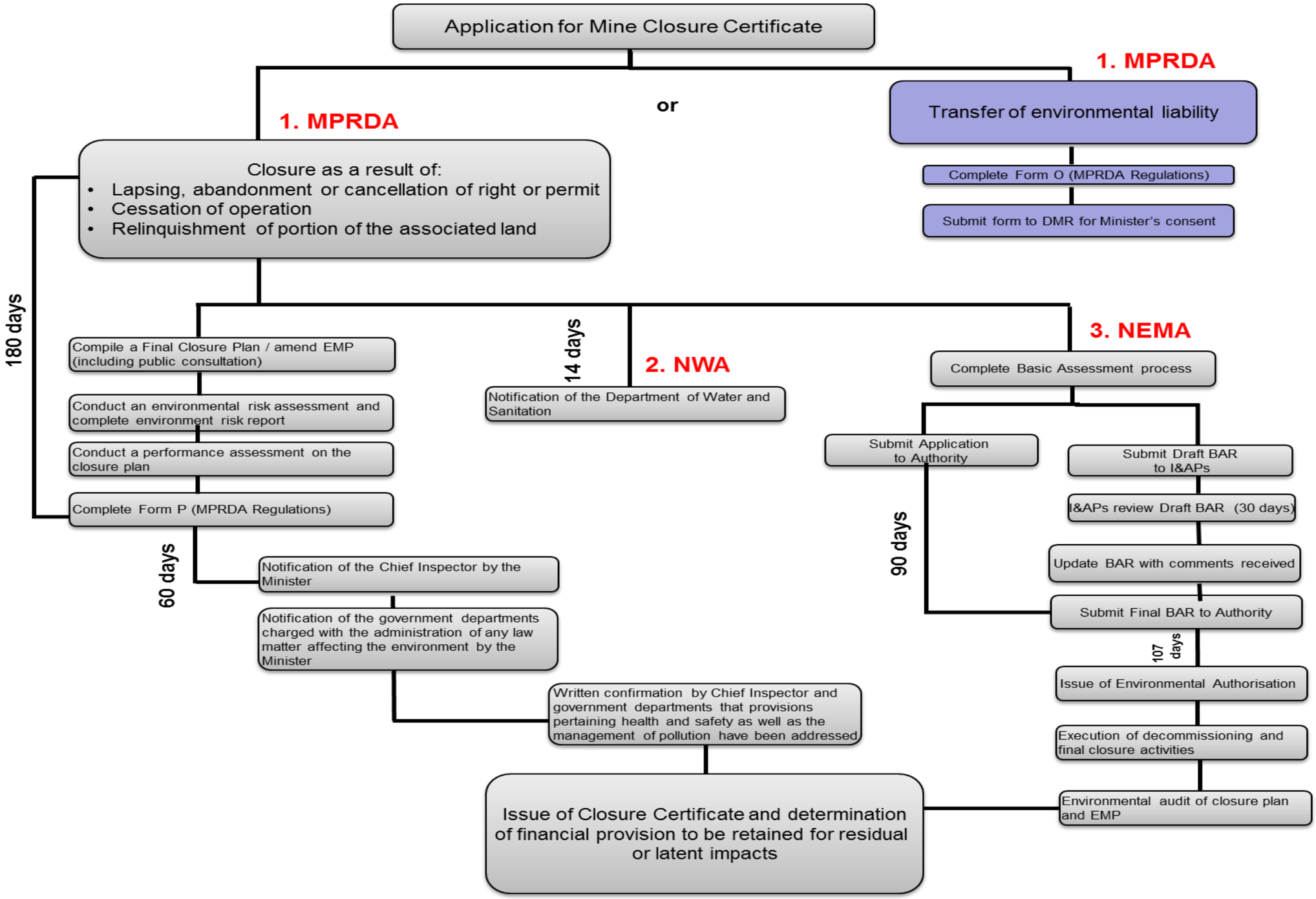

Figure 3: Legislated Process for a Mine Closure Certificate Application in terms of the MPRDA and NEMA Regulations

(Source: MPRDA and NEMA Regulations)

4.1.2. Discussion of Findings

There is a wide range of legislation which is applicable to environmental management during mine closure. The MPRDA recognises the principles of NEMA and promotes the sustainable practices throughout the life of mine. The following aspects have been identified as the main findings of the legislative framework and mine closure certificate process detailed above:

- Clear intent of mine closure legislative framework.
- Extensive but recursive bureaucratic system for mine closure certificates.
- Challenge to management of legislative requirements.
- Impact of the provision for Mineral Right transfer.

These findings are discussed in detail in the subsections below.

4.1.2.1. Clear intent of the Legislative Framework

The legislative framework for mine closure (Table 2 and Table 4 above) is clearly aimed at rehabilitating land to its pre-mining and/or alternate unpolluted state that allows for productive land uses as well as ensuring that any future mining related pollution which may occur is accounted for and mitigated against accordingly.

In addition to the MPRDA and NEMA, auxiliary legislation to NEMA including the National Environmental Management: Waste Act (59 of 2008) (NEMWA), National Environmental Management: Air Quality Act (Act 39 of 2004) (NEMAQA) and National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA) provide specific provisions for the protection of the environment which would be applicable when considering an application for a mine closure certificate. Provision under NWA are a pertinent component to the consideration of granting a mine closure certificate as the key residual and/or latent impacts usually pertain to the long-term management of mine water such as AMD for example.

From the framework, all environmental aspects which are likely to be adversely impacted by mining operations including the loss of biodiversity as well as land, water and air pollution are addressed individually as well as holistically through their integration into a closure plan.

Another clear intent of the legislation is the consideration of mine closure throughout the life of mine. As revealed in the Literature Review, a major component of sustainable mine closure lies in the continuous concurrent rehabilitation activities undertaken during the active mining years. Therefore, the legislative framework is not intended to only take effect at mine closure but rather to form part of ongoing rehabilitation throughout the life of mine. Mine closure therefore forms part of the mine planning phase with provisions made in the EIA process and Financial Provisioning Regulations to establish and implement a rehabilitation and closure plan as well as monitor the progress of such activities. The legislative framework

for mine closure makes provision for concurrent rehabilitation to be undertaken throughout the life of mine. Rehabilitation activities are evaluated on an annual basis based on the ARCP that is required to be submitted to the DMR. To this end, final rehabilitation at closure should comprise rehabilitation of a limited disturbed footprint which was still operational. It is however noted that this may not be the case for unscheduled closure.

Alberts *et al.* (2017) conclude that the full legislated framework including all applicable environmental and socioeconomic consideration are complex and at times confusing due to the vast number of applicable legislation, guiding material and ministries with powers and functions related to mine closure. Mining operations are expected to keep up with and comply with the requirements set out by different authorities, mainly the DMR, DEA and DWS on environmental matters throughout the mining operation.

4.1.2.2. Extensive and Recursive Bureaucratic Process

The application for a mine closure certificate requires that several processes be undertaken which are governed under different environmental related legislation. At a broader view, this involves a dual authorisation process, namely a closure certificate application in terms of the MPRDA and an application for EA for closure in terms of NEMA.

Based on the timeframes and requirements, the process in terms of NEMA must commence first and the required EA which includes an assessment of the status quo of the environment, Final Decommissioning, Rehabilitation and Closure Plan and EMP pertaining to the management of the closure activities must be approved by the DMR. Within 180 days of the cessation of mining, a closure certificate in terms of the MPRDA must be applied for which requires that a final closure plan, environmental risk report and final performance assessment be submitted with the application. This documentation requires extensive investigation to determine the environmental risks at the end of mining which will inform the final closure objectives and closure plan. In doing this, a public consultation process must be undertaken in determining the closure agreements and future land use. A performance assessment, which may be submitted after the formal application, must be undertaken to assess the compliance to the closure plan and success thereof. Section 43(11) provides that a closure plan must be submitted for approval by the Minister at the commencement of closure, therefore although it forms part of the mine closure certificate application process will be evaluated separately, approved and then implemented prior to issuing a closure certificate.

Certain aspects such as the requirement for a closure plan, assessments of environmental risks and mechanisms for their management and the requirement for a performance assessment (environmental audit under NEMA) form part of both processes. The

requirements for these activities have specific criteria in terms of the MPRDA and NEMA respectively. It is generally found that the requirements under NEMA are more extensive; however, these activities ultimately seek to achieve the same outcomes. Undertaking these activities separately as part of different application processes further extends the bureaucratic process and effort spent to obtain a mine closure certificate.

A key component of the MPRDA mine closure certificate application evaluation process is confirmation from the Chief Inspector and various commenting authorities that provisions pertaining to health and safety and management of pollution to water resources and conditions of the EA have been addressed. This may involve further evaluation to meet specific requirements of each ministry which would be unknown until such a time as the application is being processed. Given the vast potential environmental pollution impacts associated with mining as well as risk for residual impacts, it can be expected that confirmation particularly from bodies such as the DWS governing water and DEA who are the overall custodian of environmental protection related matters would require extensive engagement and further assessment to those contained in the closure plan based on MPRDA provisions. No timeframes in the legislation or process flow is set out for the evaluation process in this regard or specific criteria for each commenting authority.

Although perpetual liability through the retention of part of the financial provision as deemed by the DMR is in place, the issuing of a closure certificate relinquishes a major responsibility from mining companies particularly with respect to future unknown risks which will then rest with the DMR. To this end, it is important to ensure that all issues are addressed; however the mechanisms in doing so must be effective and efficient to allow for decision making to take place timeously and without added complexities that result in resistance and lack of confidence from mining companies in the bureaucratic process.

4.1.2.3. Challenge to the management of legislative requirements

In an effort to improve environmental management within the mining industry, more regulations such as the Financial Provisioning Regulations and guidelines are being promulgated under NEMA, however the competent authority for their enforcement remains the DMR. This presents a possible challenge regarding the capacity of the department to enforce rehabilitation and mine closure related provisions throughout the life of mine as well as managing the coordination amongst the different ministries with powers and functions. The perceived lack of capacity of the DMR to regulate environmental management within the mining industry has been well established (van Druten and Bekker (2017), Watson and Olalde (2018) and Davies (2014)) and therefore not having a more streamlined legislative

framework has been deemed to present complexities that may potentially hinder the implementation of laws that enable sustainable mine closure.

In May 2018, the Minister of Mineral Resources delivered an address at the *Budget for Vote 29* where it was indicated that proper processing of mining licences applications is a challenging aspect for the DMR with some unprocessed new applications and/or renewals dating as far back as 2010 (DMR, 2018). The backlog of applications and renewals potentially speak of the limitations of the administrative capacity of the DMR which is likely also applicable to closure applications processed through the department. The Minister further provides that aspects such as corruption and unexplained red-tape contribute to this backlog and there are no internal systems in place to detect delays in the processing of applications (DMR, 2018). This shows that not only may the closure process be prolonged because of technical requirements or reluctance based on the legacy of closure but also as a result of inadequate administrative systems to track and maintain applications.

4.1.2.4. Provision for the Transfer of Rights

It is also noted that provision is made for a process to transfer mineral rights and their associated environmental liability which, as cited by Humby (2014) and Watson and Olalde (2018), is becoming an increasingly apparent alternative to legal mine closure. This can be argued to be in contradiction with the objective of sustainable closure and significantly influences the success of the mine closure process. The transfer of mineral rights and associated environmental liabilities may be seen as a preferred alternative from a socioeconomic perspective as the continuation of mining results is likely to result in less job losses. However, as the majority of closure occurs due to financial, economic and/or technological constraints and not the reserve depletion (Laurence, 2007), the motivation for on-selling is likely aligned with such constraints which would eventually present a challenge for the buying company as well as further unwarranted environmental degradation. This increases the likelihood of mines being placed on care and maintenance or abandonment as mineral rights are usually sold to relatively smaller low-cost producing companies which may not have sufficient capacity to adequately carry out the required rehabilitation and closure activities.

4.2. What is the status of closure certificates being granted in the provinces Mpumalanga and Gauteng?

This research question has been addressed utilising the data obtained by Olalde (2017) for mine closure applications for each DMR department as well as information obtained through the Parliamentary request.

Mineral authorisation types are categorised according to the MPRDA which requires a closure certificate in order to be relinquished for the obligations of such authorisation. Without a closure certificate a mining operation with a mineral authorisation cannot be considered legally closed and subsequently cannot therefore be ceded for other land uses in theory. The mineral authorisation categories according to the MRPDA are summarised in the table below.

Table 5: Mineral Authorisation Types (MPRDA, 2002)

Mineral Authorisation	MPRDA Section	Description
Prospecting Right (PR)	Section 17	The MPRDA provides that a PR is required to intentionally search for minerals through physical disturbance of the surface, subsurface or mineral residue stockpile such as gold TSF. The MPRDA does not provide the extent to a PR; however once granted a PR is valid for a period of three years which can subsequently be renewed through application with the DMR. Given the nature of prospecting techniques, typically BQ/NQ size invasive diamond core drilling holes, prospecting activities are usually limited in extent of disturbance.
Mining Permit (MP)	Section 27	The MPRDA provides that a MP is required for the mining of mineral resource that is limited in disturbance extent and duration. For one to obtain a MP the extent of mining including all associated auxiliary infrastructure cannot exceed a disturbance extent of five hectares and should be undertaken within a duration of two years. A MP can be renewed through an application with the DMR.
Mining Right (MR)	Section 23	A MR is issued for any mining of minerals that exceeds the thresholds of a MP. Mining activities associated with a MR are generally considered to be extensive with bigger environmental impacts and typically require auxiliary infrastructure or authorisations related to mining that trigger Listed Activities in terms of NEMA. The validity period of a MR is determined by the Life of Mine (LOM) plan but cannot exceed a period of 30 years. The mining period can however be subsequently renewed.

It is recognised that the MPRDA also makes provision for reconnaissance and exploration rights but these are not considered in this report as they do not follow the same legal process for mine closure. In relation to the NEMA authorisation process, the application for a PR or MP falls under Listing Notice 1 of the EIA Regulations (2014) therefore requiring a Basic Assessment Process to be followed, unless other associated activities trigger Listing Notice 2, generally indicating that these mining activities are expected to be limited in impact as discussed in Chapter two above. A MR falls under Listing Notice 2 of the EIA Regulations (2014) therefore requiring a Scoping EIA process to be followed. This indicates that mining operations that fall within the threshold of a MR are expected to have more extensive and prolonged environmental impacts. This type of closure being granted (MP, PR or MR) is crucial in understanding whether large scale mines with more extensive environmental

impacts are being granted closure certificates, indicating that all requirements for rehabilitation have been met.

The data obtained during the Parliamentary request showed that a total of 445 mine closure certificates were granted for the period 2011 to 2016, as follows:

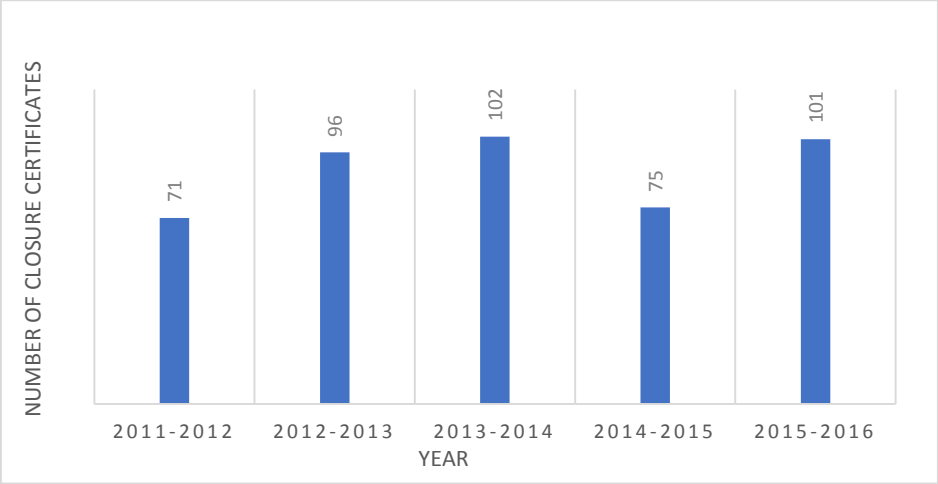

Figure 4: National Number of Closure Certificates Granted (Parliamentary Enquiry 2016)

However, the combined database, which used information from the Parliamentary enquiry as well as data obtained for the provincial DMRs, revealed a total number of 803 closure certificates having been granted across the country between 2011 and 2016.

Based on the information obtained by Oxpeckers (Olalde, 2017) it has been revealed that of the 803 closure certificates granted across South Africa the majority are for PRs and MPs and this includes borrow pits and other highway construction activities. These all, as discussed above, constitute relatively small-scale operations. Less than 4% (a total of 27 closure certificates) were granted for MRs. On this point, it is noted that 20 of these MR closure certificates were granted in the Western Cape Province and are not associated with gold or coal mineral commodities which are typically associated with AMD as the main potential environmental liability post-closure.

The subsections below provide the results obtained from the datasets from the study areas under investigation. All mining related applications are submitted to provincial DMR departments for processing. It should be noted that not all information requested by Oxpeckers Reporters through the PAIA application was provided by each provincial DMR department. As such the datasets are incomplete.

4.2.1. Mine Closure Certificates Granted

The database (Olalde, 2017) shows that a total of 15 mine closure certificates were granted in Gauteng Province while a total of six mine closure certificates were granted in

Mpumalanga Province during the period 2012 to 2015. Figure 5 below illustrates the total number of closure certificates granted and their respective mining authorisation category. Details pertaining to these applications are provided in the table below.

Figure 5: Mine Closure Certificates Granted in Gauteng and Mpumalanga Province (2012-2015)

(Source: Olalde, 2017)

Table 6: Mine Closure Certificates Granted, Gauteng Province (2012-2015)

Gauteng Province			Mpumalanga Province		
Name	**Mining No.**	**Type**	**Name**	**Mining No.**	**Type**
Transnet	124MP	MP	Hampfuna Mining and Exploration (Pty) Ltd	MP 30/5/1/1/3/2/938, 941, 942, 943, 944, 946, 948, 949, 962 & 958 EM; MP 30/5/1/1/3/2/1/950, 951, 952, 954, 955, 956, 957, 960 & 962 EM	PR
Transnet	126MP	MP	Western Crown Properties 107 (Pty) Ltd	MP 30/5/1/2/3/2/1/446 EM	MR
Transnet	127MP	MP	Copper Sunset Trading 148 (Pty) Ltd	MP 30/5/1/1/3/2/1/835 EM	PR
Blue Dot Consumer Services	459PR	PR	Taung Gold Exploration Limited	MP 30/5/1/2/3/2/965 EM	PR
Coromining (PTY) Ltd	27PR	PR	Vhakoni Mineral Resources (Pty) Ltd	MP 30/5/1/1/3/2/1 (4049) EM	PR
Coromining (PTY) Ltd	11PR	PR	Mafatiki Geoinformatic CC	MP 30/5/1/1/3/2/1/(4019)Em	PR
Coromining (PTY) Ltd	109PR	PR			
Lengeo (Pty) Ltd	404PR	PR			
SANRAL	62MP	MP			
SANRAL	63MP	MP			
SANRAL	64MP	MP			

SANRAL	65MP	MP
SANRAL	66MP	MP
SANRAL	67MP	MP
SANRAL	69MP	MP

4.2.2. Mine Closure Applications Submitted

Given the relatively low number of closure certificates granted, an analysis of the number of applications submitted was undertaken to understand whether mine closure is being applied for. According to the database assessed, a total of 33 closure certificate applications were applied for in Gauteng during the period 2012 to 2015. The figure below illustrates the total number of closure certificates applied for and their respective mining authorisation category. Details pertain to these applications are provided in the table below.

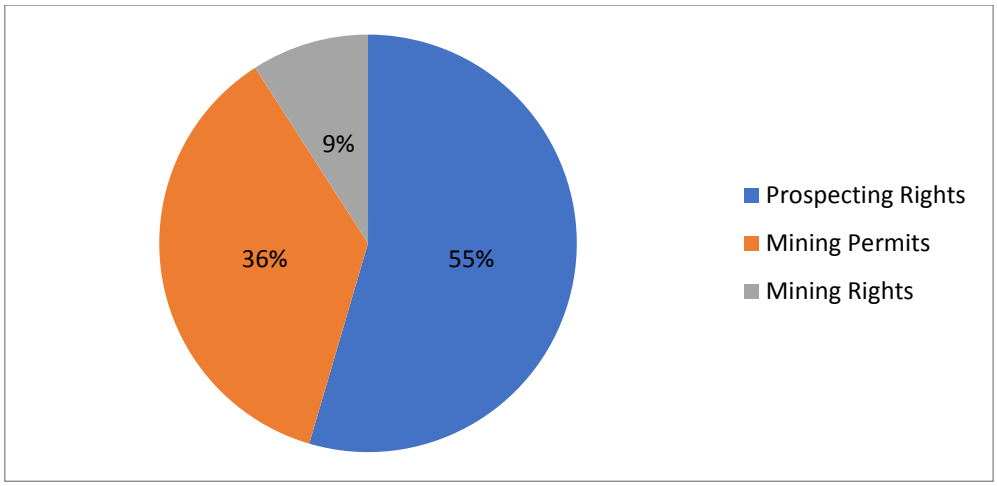

Figure 6: Mining Closure Application in Gauteng Province (2012-2015)

(Source: Olalde, 2017)

Table 7: Mine Closure Applications, Gauteng Province (2012-2015)

Name	Mining No.
Transnet	124 MP **- Granted**
Transnet	126 MP**- Granted**
Transnet	127 MP**- Granted**
Transnet	128 MP
Muhanga mines	494 PR
Blue Dot Consumer Services (Pty) Ltd	GP 459 PR**- Granted**
ERPM Limited	151 MR
Brikor Limited	244 MR
llangabi Investments (Pty) Ltd	122 MR
Coromining (Pty) Ltd	GP 27 PR**- Granted**
Coromining (Pty) Ltd	GP 11 PR**- Granted**
Coromining (Pty) Ltd	GP109 PR**- Granted**
Four Rivers Trading 263 (Pty) Ltd	506 PR
Orsmond Family Trust	159 MP

Sky Sands (Pty) Ltd	285 PR
Crystal View Trading	360 PR
Wanachi Power Corporation (Pty) Ltd	480 PR
Lengeo (Pty) Ltd	404 PR**- Granted**
Vibrant Veterans Coal (Pty) Ltd	569 PR
Vibrant Veterans Coal (Pty) Ltd	508 PR
Vibrant Veterans Coal (Pty) Ltd	509 PR
Vibrant Veterans Coal (Pty) Ltd	510 PR
Taung Gold (Pty) Ltd	476 PR
Taung Gold (Pty) Ltd	485 PR
Taung Gold (Pty) Ltd	491 PR
Taung Gold (Pty) Ltd	500 PR
SANRAL	GP 62 MP**- Granted**
SANRAL	GP 63 MP**- Granted**
SANRAL	GP 64 MP**- Granted**
SANRAL	GP 65 MP**- Granted**
SANRAL	GP 66 MP**- Granted**
SANRAL	GP 67 MP**- Granted**
SANRAL	GP 69 MP**- Granted**

No data was provided on the number of mine closure certificates applied for in the Mpumalanga Province.

4.2.3. Discussion of Findings

The database analysed provides insightful information regarding mine closure certificates being applied for and those being granted which gives an indication of the implementation of mine closure certificates as a tool for effective mine closure. The following aspects have been identified as the main findings of the results provided above:

- Data quality and accessibility.
- Lack of closure of large scale mining.
- Low relative success rate.

These findings are discussed in detail in the subsections below.

4.2.3.1. Data Quality and Accessibility

Information pertaining to mine closure applications is not readily accessible to the public. In a paper on the state of mine closure in South Africa undertaken by Watson and Olalde (2018), which also made use of the databases obtained, it is noted that the PAIA application took approximately 21 months to obtain the information requested from all provincial departments. A legal process had to be followed to obtain such information and even with the legal mandate for the information to be provided, not all information requested was provided such as the exact number of mine closure applications submitted for the

Mpumalanga Province is unknown. This discrepancy makes it difficult to establish with certainty whether closure certificates are being granted accordingly.

Furthermore, the accuracy of the information may be a potential limitation. The number of certificates stated in the Parliamentary enquiry differs from the number established from the combined databases. This may be accredited to a lack of effective internal data management and consistent data management within the provincial departments. The extended time period it took to obtain this information further supports this assumption as it appears that there is no readily available system for mine closure certificate information which can be provided upon request.

For the success of mine closure certificates system, it is imperative that detailed information and efficient systems be available to track and manage applications in a consistent manner across the DMR offices. Although it may not be necessary for all details to be in the public domain, to create accountability and allow for cross-checking of the systems implemented public access to such information should not require such an onerous process.

3.1.1.1. Lack of closure of large scale mining

A total of 33 mine closure certificates are said to have been applied for in Gauteng over the four-year period between 2012 and 2015. No data was made available of the number of closure certificate applications submitted for Mpumalanga Province, however it can be assumed mine closure is occurring based on the understanding of the history of extensive coal mining and more recent decline in production within the province.

In Gauteng, only 9% of mine closure certificates applied for were for MRs, however, it has been established that there is a continuing decline in gold mining operations which are most likely to fall within the thresholds of MRs than small-scale MPs. This result supports the statement discussed in the Literature Review above that most large-scale mines opt to be placed on care and maintenance until such a time as their Right is bought by another company or in the worst case are abandoned due to the fact that achieving the desired zero-risk outcome expected is impossible especially for large-scale mines that may have to some extent have irreversible environmental impacts. It is therefore perceived that mine closure certificates will never be granted which subsequently results in the lack of motivation to undergo the process. The lack of MR closure certificate application in itself reflects a fragmentation in the mine closure certificate process because it is known that large-scale mines are closing which is especially true for gold and coal mines evaluated in this study.

In terms of mine closure certificates granted, the majority of certificates granted for both provinces were only for PRs and MPs with only one MR certificate being granted for a MR in Mpumalanga Province. This corresponds with the type of closure certificates applications

being applied for. For Gauteng Province, it is notable that the MPs granted were only related to Transnet and SANRAL operations which are typically borrow pits associated with linear developments. For Mpumalanga, one MR for Western Crown Properties 107 (Pty) Ltd (associated with coal mining) and five PRs were granted during the study period. Based on these statistics it appears that, with the exception of one operation, no gold or coal mines within the study areas are closing.

3.1.1.2. Low Relative Success Rate

With no data of applications submitted for the Mpumalanga Province, this analysis was only carried out for Gauteng Province. During the period 2012 to 2015, a total of 33 mine closure certificates were applied for and a total of 15 certificates were granted. This generally indicates a success rate of 45%. This low success rate supports the statement that mine closure certificates are not being granted. Of the three MR applications which were applied for between October 2012 and March 2013, none of these applications received closure certificates. Of the remaining 18 MPs and PRs which did not receive closure certificates the earliest application within the time period was submitted in September 2012 with the latest being April 2015. This possibly indicates that the processing time can be prolonged (if the status of the applications is still pending) or that a large number of applications are unsuccessful (if the applications were rejected).

In terms of processing times, no indication is provided on the actual time it took from the submission of the application to issuing of the mine closure certificate. To gain this understanding a more detailed database where application and authorisation dates are provided was reviewed, namely for the Northern Cape Province. It was found that the processing time ranged from eleven years to one year for a decision to be made on the application. This supports the possible indication that the application processing time may be prolonged and this potentially increases the risk of abandonment of mining areas as mining would have been ceased for a long period of time while the closure certificate application is being processed. Furthermore, land cannot be legally ceded for other land uses until such a time as a closure certificate is granted. As such, this increases the likelihood of illegal occupation of land (as seen in Gauteng where informal settlements were established over mine tailings contaminated land) or missed economic opportunities from leaving land which has potential for other land uses untenanted.

For Mpumalanga a total of six certificates were granted between 2012 and 2015. The number of closure certificates applied for was not available for assessment.

Ultimately it is concluded that the low success rates of issuing mine closure certificates during the study period can therefore potentially be attributed to two main aspects namely:

prolonged processing times which may be linked to the reluctance of the DMR to relinquish liabilities as observed in consulted literature which has been deemed most likely or applications are being rejected. In either scenario, the risk of abandonment is more likely which subsequently results in land not legally being ceded for other land uses.

4.3. Is there a correlation between the operating mines recorded in Mpumalanga and Gauteng compared to the resultant number of closure certificates granted within these provinces?

On an annual basis the DMR releases a list of all operational mines within South Africa, known as the D1 Database. The D1 database only indicates MRs and not all other categories of mineral authorisations. This database provides information on mineral right holders, their location and commodity.

The number of operational mines in Gauteng and Mpumalanga Province for between the period 2010 to 2017 are presented in subsections below. The purpose of this assessment is to identify whether the decline of mining operations in the study areas, as established through literature consulted in this report, is recognised and recorded. Having established the number of closure certificates applied for and granted an understanding of what is recognised as operating mines will provide insight into the status of closure management in South Africa.

It is noted that the data presented below does not consider mining operation which may have been amalgamated or have been placed on official care and maintenance.

4.3.1. Operating Mines in Gauteng between 2010 and 2017

Figure 7 below presents the total number of operating mines recorded in Gauteng between the years 2010 and 2017. According to the D1 database, the total number of mines has generally increased from 167 in 2010 to 185 in 2017. Notably, slight decreases from previous years were recorded in 2012 and 2013 but on average the databases show an increase in mining operations. The database showed a relatively steady number of gold mining operations within the province over the assessed period with increases in general from 26 mining operations in 2010 to 29 in 2017.

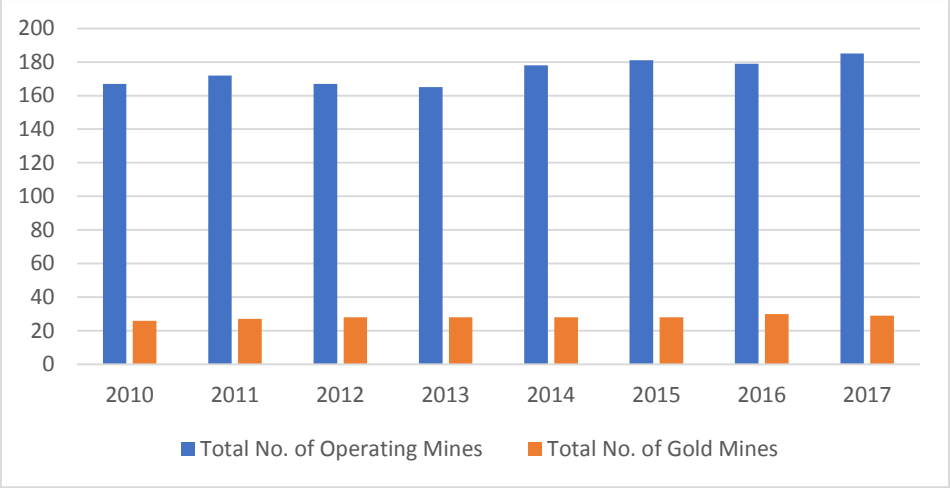

Figure 7: Operating Mines in Gauteng (2010 to 2017)

(Source: DMR D1 Databases, 2010 – 2017)

Table 8 below provides the full list of recorded operating gold mines within Gauteng Province in 2010 and in 2017. From this comparison it is found that all mines which were operational in 2010 are still operational in 2017 with three additional mines having opened within the observed period.

Table 8: Operating Gold Mines recorded in Gauteng in 2010 and 2017

2010		2017	
Mine Code	**Name**	**Mine Code**	**Name**
3968	Blaauwbank	13968	Blaauwbank Mine
0054	Blyvooruitzicht Gold Mine	10054	Blyvooruitzicht Gold Mine
1148	Consolidated Modderfontein Mines Ltd	11148	Consolidated Modderfontein Mines Ltd
3173	Crown Gold Recoveries (Pty) Ltd	13173	Ergo Mining (Pty) Ltd
0176	East Rand Proprietary Mines Limited	10176	East Rand (Pty) Mines Ltd
4374	Ezulwini Mining Company	14374	Ezulwini Mining Company
4613	Ferreira Estate & Invest Co - Slot 8	14613	Ferreira Estate & Invest Co - Slot 8
1283	Goldplat Recovery (Pty) Ltd	11283	Goldplat Recovery (Pty) Ltd
1369	Gravelotte Mines Ltd	11369	Gravelotte Mines Ltd
0254	Grootvlei Proprietary Mines Ltd	10254	Grootvlei Proprietary Mines Ltd
0344	Kloof	10344	Kloof Gold Mine
4191	Middelvlei	14191	Middelvlei
4363	Modder East	14363	New Kleinfontein-Modder East Operation
3577	Mogale Gold (Pty) Ltd	13577	Mogale Gold (Pty) Ltd
2837	Newberry Recovery Works Cc	12837	Newberry Recovery Works Cc
2937	Nigel Gold Mining Co (Pty) Ltd	12937	Nigel Gold Mining Co (Pty) Ltd
0519	Primrose Gold Mine	10519	Primrose Gold Mine
1098	Rand Refinery	11098	Rand Refinery
4600	Rand Uranium (Pty) Ltd	14600	Rand Uranium (Pty) Ltd
0528	Randfontein Operations	10528	Randfontein Operations
0172	Driefontein	10172	Sibanye Gold Ltd - Driefontein Div
071	South Deep Gold Mine	10711	South Deep Gold Mine
2115	Sub - Nigel Gold Mine	12115	Sub - Nigel Gold Mine
3339	Waste Product Utilisation (Pty) Ltd	13339	Waste Product Utilisation (Pty) Ltd
0713	West Wits Operations	10713	West Wits Operations
3443	Al-Falaam Mine	13443	Indaba Digging Industry Cc
		10558	East Rand Metals Beneficiation (Pty) Ltd
		12691	Lancaster Gold Mine
		13755	Impala Platinum Ltd - Refineries

4.3.2. Operating Mines in Mpumalanga between 2010 and 2017

Figure 8 presents the total number of operating mines in Mpumalanga between the years 2010 and 2017. Similar to the data for Gauteng, the D1 database generally showed an increase in mining operations over the seven-year period. In 2010, a total of 194 operating mines were recorded which has gradually increased to 238 in 2017. In terms of coal related operations specifically, 85 were recorded in 2010 which increased to 123 by 2017.

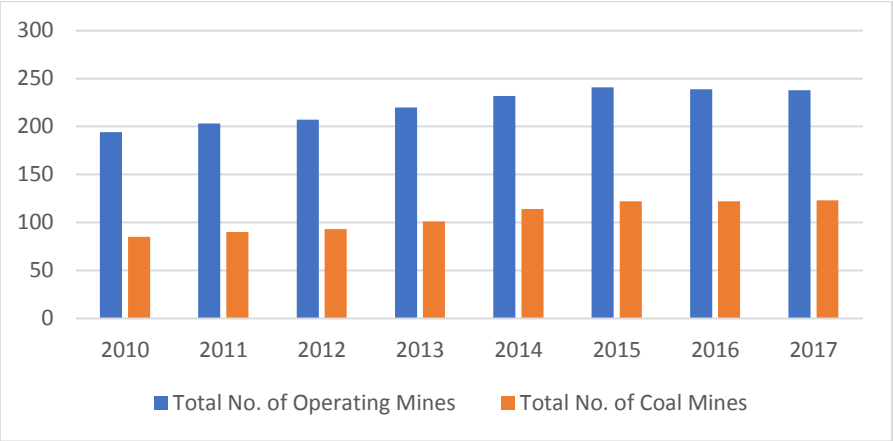

Figure 8: Operating Mines in Mpumalanga (2010 to 2017)

(Source: DMR D1 Databases, 2010 – 2017)

The table below provides the full list of recorded operating coal mines within Mpumalanga Province in 2010 and in 2017. From this comparison it is found that 13 mines which were operational in 2010 are no longer said to still be operational in 2017. By 2017 an additional 51 operating mines have been recorded.

Table 9: Operating Coal Mines recorded in Mpumalanga in 2010 and 2017

2010		2017	
Mine No.	**Name**	**Mine No.**	**Name**
1272	Arthur Taylor Colliery - (Atc)	11272	Arthur Taylor Colliery - (Atc)
2659	Arthur Taylor Opencast Mine - (Atcom)	12659	Arthur Taylor Opencast Mine - (Atcom)
3071	Doornrug Colliery	13071	Doornrug Colliery
2994	Elandsfontein Colliery (Pty) Ltd	12994	Elandsfontein Colliery (Pty) Ltd
3599	Goedgevonden Colliery	13599	Goedgevonden Colliery
4218	Graspan Leeuwfontein Lakeside Bankfonfontein Middelburg Townlands	14218	Graspan Leeuwfontein Lakeside Bankfontein & M'burg Townlands
0906	Greenside Colliery	10906	Greenside Colliery
4301	Inyanda Coal Mine	14301	Inyanda Coal Mine
4478	Kendal Colliery	14478	Kendal Colliery
4475	Khanyisa Colliery	14475	Khanyisa Colliery
1691	Khutala Colliery	11691	Khutala Colliery
3947	Kleinfontein Colliery	13947	Kleinfontein Colliery
3684	Klipspruit Colliery	13684	Klipspruit Colliery Services Ltd

2928	Landau Colliery	12928	Khwezela Colliery - A Division Of South Africa Coal Estates
3412	Mooifontein Colliery	13412	Mooifontein Colliery
0446	New Clydesdale Colliery	10446	Universal Coal Development Viii
0598	South Witbank Colliery	10598	South Witbank Colliery
3198	Tweefontein Colliery	13198	Tweefontein Colliery
5050	Kangra Coal (Pty)Ltd T/A Savmorecolli	15050	Kangra Coal (Pty)Ltd
1122	New Denmark Colliery	11122	New Denmark Colliery
3441	Nkomati Anthracite	13441	Nkomati Anthracite
0013	Arnot Colliery	10013	Arnot Colliery
3328	Bhp Billiton Energy Coal Sa	13328	Energy Coal Sa
3046	Black Wattle Colliery (Pty) Ltd	13046	Black Wattle Colliery (Pty) Ltd
1439	Goedehoop Colliery (Includes Bank 2 And Bank 5 Collieries)	11439	Goedehoop Colliery
3415	Ilanga Coal Mines (Pty) Ltd	13415	Ilanga Coal Mines (Pty) Ltd
4612	Just Coal (Bankfontein 48 Joint Ventu	14612	Just Coal (Bankfontein 48 Joint Ventu
0048	Koornfontein Mines	10048	Koornfontein Mines
4356	Mafube Colliery	14356	Mafube Colliery
0793	Middelburg Mine Services (Pty) Ltd	10793	South32 Coal Processing - Middelburg Mine Services (Pty) Ltd
4335	Middelkraal Colliery	14335	Middelkraal Colliery
0474	Optimum Colliery	10474	Optimum Coal Mine (Pty) Ltd
1707	Polmaise Colliery (Pty) Ltd	11707	Polmaise Colliery (Pty) Ltd
1994	Silver Unicorn Trad - Malhleni Collie	11994	Silver Unicorn Coal And Minerals (Pty) Ltd
4589	Vuna Colliery	14589	Vuna Colliery
1963	Woestalleen Colliery	11963	Woestalleen Colliery
1596	Bosjesspruit Mine	11596	Bosjesspruit Mine
1475	Brandspruit Mine	11475	Brandspruit Mine
3768	Eng & Op Serv (Central Workshop/Ots)	13768	Eng & Op Serv (Central Workshop/Ots/Mining Services)
1496	Middelbult Mine	11496	Middelbult Mine
1460	Sasol C S Plant	11460	Sasol Coal Supply Plant
3826	Sasol Surface Services (Secunda)	13826	Surface Services (Project Management)
2543	Syferfontein Colliery	12543	Syferfontein Colliery
1488	Twistdraai Mine	11488	Twistdraai Mine
2765	Golfview Mine	12765	Golfview Mine
4617	Mooiplaats Colliery	14617	Mooiplaats Colliery
0602	Spitzkop Colliery	10602	Spitzkop Colliery
1087	Tselentis Colliery	11087	Tselentis Colliery
3771	Umlabu Colliery	13771	Umlabu Colliery
2895	Leeuwpan Colliery	12895	Exxaro Coal Leeuwpan Colliery
3561	Delmas Coal (Pty) Ltd (Includes Ikhwezi Colliery)	13561	Delmas Coal (Pty) Ltd
3205	Delmas Colliery - Stuart	13205	Stuart Colliery
4533	Norwesco Colliery	14533	Norwesco Colliery
3419	Droogvallei Colliery	13419	Droogvallei Colliery
3794	Eastside Coal Company	13794	Eastside Coal Co (Pty) Ltd
2798	Groenvallei Colliery	12798	Pembani Coal Carolina (Pty) Ltd
3416	Grootpan Colliery	13416	Klippan Colliery
3486	Mimosa Colliery	13486	Mimosa Colliery

1727	Strathrae Colliery	11727	Strathrae Colliery
3308	Dorstfontein Colliery	13308	Dorstfontein Coal Mines (Pty) Ltd
4652	Elandsfontein Colliery - Sudor	14652	Elandsfontein Colliery - Sudor
2996	Forzando Coal Mines (Pty) Ltd	12996	Forzando Coal Mines (Pty) Ltd
3799	Halfgewonnen Colliery	13799	Halfgewonnen Colliery
3728	Isibonelo Colliery	13728	Isibonelo Colliery
0014	Kriel Colliery	10014	Kriel Colliery
2310	Matla Colliery - Mine No 1	12310	Matla Colliery - Mine No 1
2355	Matla Colliery - Mine No 2	12355	Matla Colliery - Mine No 2
2402	Matla Colliery - Mine No 3	12402	Matla Colliery - Mine No 3
3450	Matla Colliery - Mine No 5	13450	Matla Colliery - Mine No 5
0503	Phoenix Colliery	10503	Phoenix Colliery
0633	Tavistock Colliery	10633	Tavistock Colliery
6272	Glisa Colliery	16272	Glisa Colliery
2650	Langkloof Mine		
4400	Onverdacht Colliery		
2325	Mashala Resources (Pty) Ltd (Includes Geluk And Wesselton Mines)		
2176	Paardeplaatz Colliery		
3165	Siyabusa Mining West		
4059	Kleinkopje Colliery		
4588	Klip Colliery		
0947	Douglas Colliery Services Ltd		
4662	Driefontein Colliery		
4540	Elitheni		
4661	Penumbra Coal Mining		
4644	Zevenfontein Colliery		
4423	Leeuwpoort Colliery		
		14753	Anglo Inyosi Coal - Zibulo Colliery
		15348	Bankfontein
		14880	Brakfontein Colliery
		15228	Exxaro Coal Leeuwpan Mine
		15221	Fentonia Colliery
		14794	Hakhano Colliery
		15261	Impumelelo Colliery
		15028	Intibane Colliery
		15134	Iyanga - Klipfontein Colliery
		15044	Kangala
		14818	Kiepersol Colliery
		14925	Klip 25 Colliery
		15183	Kromdraai Coal
		14956	Leeuwpoort Colliery
		11630	Londani Coal (Pty) Ltd
		14975	Majuba Underground Coal Gasification
		15168	Manungu Colliery
		15041	Mbali Colliery - Mbali Coal (Pty) Ltd
		14865	Nelpan (Pty Ltd
		15088	Nkk Colliery
		15040	Noodhulp Colliery

	11046	Ntshovelo Mining Resources - Vlakvarkfontein Colliery
	15004	Nungu Colliery
	15110	Opgoedenhoop
	15339	Overlooked Colliery
	14946	Penumbra Coal Mining (Pty) Ltd
	15014	Phalanndwa Colliery
	14793	Phola Coal Processing Plant
	15079	Rirhandzu Colliery
	15283	Shonland Colliery
	15161	Singani Colliery
	15167	Sisebenzile Colliery
	14923	Thutsi Mining
	15036	Tndb Colliery
	15020	Tumelo Coal Mines (Pty) Ltd
	15043	Twistdraai Export Plant
	14989	Ukufisa Investment Holding
	15032	Umsimbithi Mining - Wonderfontein
	15019	Umzobanzi Coal & Engergy
	14735	Usutu Colliery
	15190	Vaalbult Colliery
	14983	Vanggatfontein Colliery
	15346	Verkeerdepan Colliery
	14882	Vierfontein Colliery
	14812	Vlakfontein Colliery
	15177	Welgemeend Colliery (Pty) Ltd
	14734	Weltevreden Coal
	15231	Wescoal Mining Elandspruit
	14994	Wildfontein Colliery
	14869	Wolwekrans Colliery
	15133	Yoctoluc Investments (Pty) Ltd

4.3.3. Discussion of Findings

The D1 databases revealed that the number of operating mines in Gauteng and Mpumalanga have increased in the last seven years including gold and coal mines in the respective provinces. Based on the literature reviewed a different impression is given on the status of mining for the provinces. Watson and Olalde (2018) provide that:

Statistics recently presented by the Department of Water and Sanitation (July 2017) indicate that there are almost double the number of closed coal, gold and base metal mines in South Africa (n=2787), than operational mines (n=1654), yet that very few of these, if any, have received closure certificates.

Data presented by the Chamber of Mines (2016) reveals a clear decline in the production of coal and gold across the country as illustrated in the figures below. Various factors including production cut-backs and low ore grade can be attributed to the decline in production. This could also possibly result in the decline in the number of operational mines which supports the cited perception that gold and coal mining operations are declining not only in the study areas but across the country.

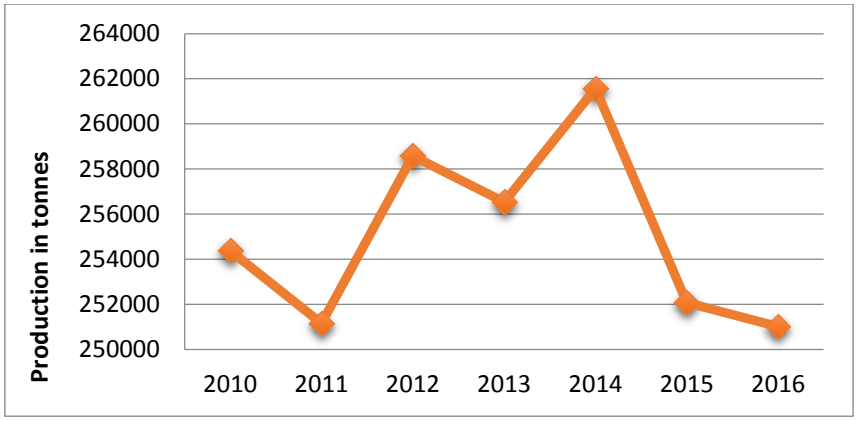

Figure 9: Coal Production in South Africa (2010 to 2016)

(Source: Chamber of Mines, 2016)

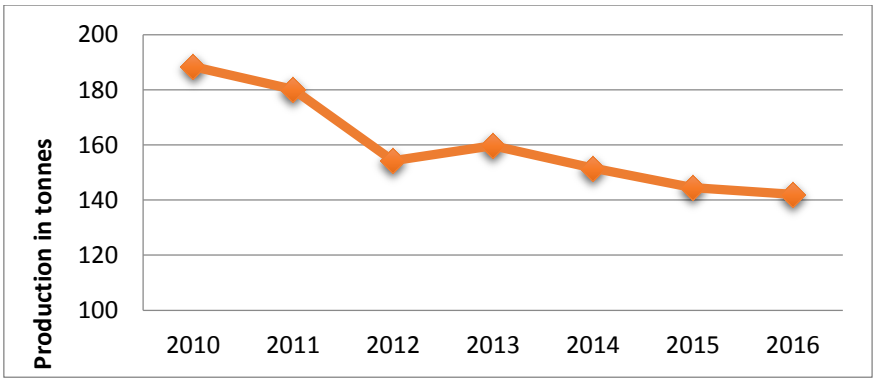

Figure 10: Gold Production in South Africa (2010 to 2016)

(Source: Chamber of Mines, 2016)

The *Budget for Vote 29* delivered by the Minister provides notable information which further indicates that there is a decline in gold and coal mining (DMR, 2018). According to the Minister a total of 26 notices in terms of Section 52 of the MPRDA were received during the year ending March 2018 mostly for gold, coal and platinum mines. Section 52 of the MPRDA makes provision for profitability and curtailment of mining operations. Under this section, provision is made that mining operations that experience a 6% or more decrease in their average profit to revenue ratio or downscaling of more than 10% or 500 workers (whichever is greater) within a 12 month period must notify the Minister in writing. Following such notice, the Minister may provide a directive to take corrective action which is aimed at preventing the downscaling of operations and job losses. The submission of twenty six Section 52 notices therefore indicates that gold and coal mines are experiencing downscaling and possible closure. Based on the above there is an indication that mining production is decreasing for gold and coal mines and it is therefore possible that mines are ceasing to operate.

4.3.3.1. Discrepancies in the number of Closure Certificates Granted

Although the D1 database shows increase in the number of operating mines in both provinces it is noted that 13 mines in Mpumalanga which were operational in 2010 are no longer operational by 2017 based on the MR reference numbers. In Section 4.2.2 it was shown that only one MR closure certificate had been granted in Mpumalanga between 2012 and 2015. Further analysis in the same study period reveal that by 2013 eight of the operating mines which were listed in 2010 were no longer operational, however no closure certificates for these mines were issued up to the year 2015. This indicates a miscorrelation between the operating mines recorded in Mpumalanga compared to the resultant number of closure certificates granted.

Assuming that the established perception that mine closure certificates are applied for but are not being granted (Liefferink (2017), Davies (2014), van Eeden (2009), Olalde (2017), and Watson and Olalde (2018)) is correct, this presents a gap in the understanding the state of mining within the study area. Furthermore, this presents a possible challenge to information management and accurate tracking of operations that have ceased using the D1 database. As discussed above, the prolonged process associated with the issuing of a mine closure certificate increases the risk of the abandonment of mining areas without legal closure. This subsequently results in a higher probability of unsustainable mine closure as the overarching objectives are not met.

This can therefore result in the following impacts:

- Abandonment by mining companies who have not received a closure certificate for the affected land.
- Illegal occupation/use of land as a result of its lack of management by mining companies once operations have been ceased; and/or
- Increased public health and safety risks associated with any remaining infrastructure which are not correctly handed over or residual environmental pollution impacts.

It is noted that the lack of a closure certificate does not necessarily represent a lack of rehabilitation efforts but rather insufficient administrative processes to assess closure applications and subsequently relinquish land for other productive land uses. However, even in instances where land is rehabilitated, there are risks associated with an incomplete mine closure process particularly with respect to how the land is managed during this prolonged process that could result in illegal land occupation and the development of unsuitable land uses. Ultimately, should such risks materialise the sustainable closure objectives and efforts are not effectively realised.

Based on the D1 databases and knowledge of the reality of mining in the study area, it can be deemed a likely possibility that the status given of “operating mine” may not necessarily reflect a mine in active operation but is likely to also apply to closed mines where a closure certificate has not been granted. Alternatively this may reflect a mine that has ceased operating, but is undertaking rehabilitation (reflecting a long lag time between ceasing operations and being granted a closure certificate). This has been deemed a further flaw to the mine closure process currently implemented in South Africa as it leaves room for potential mismanagement of land and hand over as described above.

4.4. How does the established mine process in South Africa compare to internationally recognised best practice principles, namely the ICMM and IFC guidelines?

The IFC has developed various guidelines within the sphere of environmental management which primarily focus on the identification of environmental and social impacts associated with developments and methods for assessing their significance. The IFC Environmental, Health and Safety Guidelines for Mining provide good practice guidelines for the mining sector and include guidelines for mine closure which are recognised and utilised by many mining companies internationally.

The ICMM is an organisation recognised across many countries around the world and is made up of 27 mining and metals companies located in different regions. The main aim of the organisation is to provide guidance and guidelines for safe and sustainable mining practices as well as promoting change which will result in a greater contribution of the mining industry to the societies in which they operate. For mine closure, the Planning for Integrated Mine Closure Toolkit (2008) (hereafter ICMM closure toolkit) has been developed, which similarly to the IFC Environmental, Health and Safety Guidelines for Mining (2007) (hereafter the IFC Guidelines), provides best practice principles that should be employed for sustainable mine closure.

Together, these guidelines have been deemed an appropriate representation of internationally recognised best practice for mine closure. The subsections below evaluate the provisions made for mine closure in these guidelines against those discussed for South African legislation above. The aim of this evaluation is to establish whether the perspective as cited by Alberts *et al*. (2017) that the legislative framework for mine closure is on par with international practices is justified. Furthermore, the evaluation aims to identify any gaps in the South African legislation compared to international best practices that could aid in

addressing fragmentations identified throughout this chapter for the mine closure certificate process that is currently being implemented.

4.4.1. IFC Guidelines for Mine Closure

The IFC guidelines provide that mine closure forms an integral part of the entire mine life cycle and should be aimed at ultimately ensuring public health and safety, beneficial and sustainable future land use for affected communities in the long term and the enhancement of socioeconomic benefits after the cessation of mining.

The table below summarises the key principles for mine closure recognised in the IFC Environmental, Health and Safety Guidelines for Mining:

Table 10: IFC Guidelines for Mine Closure

Principle	Description
Establishment of a Mine Reclamation and Closure Plan (MRCP)	An MRCP should be included at the planning stage of the development and include envisioned closure and post-closure activities. The MRCP should be seen as a working document which is reviewed and updated as mining progresses. The continuous refinement of the MRCP throughout the life of mine based on the physical and socioeconomic environment change as a result of the mine is imperative to its success. At closure stage, a detailed MRCP with specific actions for implementation in terms of physical rehabilitation and socioeconomic considerations should be developed that align with the future beneficial land use targeted. Furthermore, a crucial component of the MRCP is multi-stakeholder engagement, including relevant regulators, in determining the future land use.
Measures for post-closure monitoring	Post-closure monitoring is required to identify and manage residual impacts that may occur. In general, post-closure monitoring should be undertaken for at least a five year period following closure or longer depending on the severity of environmental risks identified.
Financial feasibility analysis	As part of initial closure planning a feasibility analysis must be carried out to ensure the necessary funds will be available to adequately undertake the identified rehabilitation and closure activities. An acceptable funding system such as financial guarantees through a reputable institution, must be set up at the mine's inception and reviewed at least annually and subsequently adjusted accordingly where there have been changes.
Physical integrity	Physical integrity at closure relates to the stability of remaining infrastructure which should not pose a risk to public health and safety. The IFC guidelines provide that long-term safety measures for infrastructure such as open pits or TSFs which pose a risk of pollution and as a public hazard must be correctly implemented and permanently blocked as part of decommissioning and closure.
Chemical integrity	The chemical integrity mainly pertains to the prevention of surface and groundwater pollution and the post-closure protection of these resources to prevent water quality impacts to downstream systems and impacts to public health.
Ecological habitat integrity	The ecological habitat integrity relates to the replacement and enhancement of biodiversity lost as a result of mining. Rehabilitation efforts throughout the life of mine and at closure should aim to restore biodiversity and manage the infestation of alien species. The successful restoration of biodiversity is a key monitoring component post closure.

4.4.2. ICMM Mine Closure Toolkit

The ICCM Mine Closure Toolkit provides a set of tools that should be considered when determining closure objectives and methods of closure implementation. The toolkit highlights that positive outcomes for mine closure include but are not limited to: community participation, progressive reduction of environmental liabilities, identification and refinement of lasting benefits throughout the life of mine and the timeous identification of risk and appropriate long term risk reduction mitigation. Similarly to the IFC guidelines, it is recognised that closure planning is essential for the project planning phase. During the project life, various closure related activities should be executed to reduce liability with a detailed closure plan being put in place and implemented at the end of operations. This concept is depicted in Figure below.

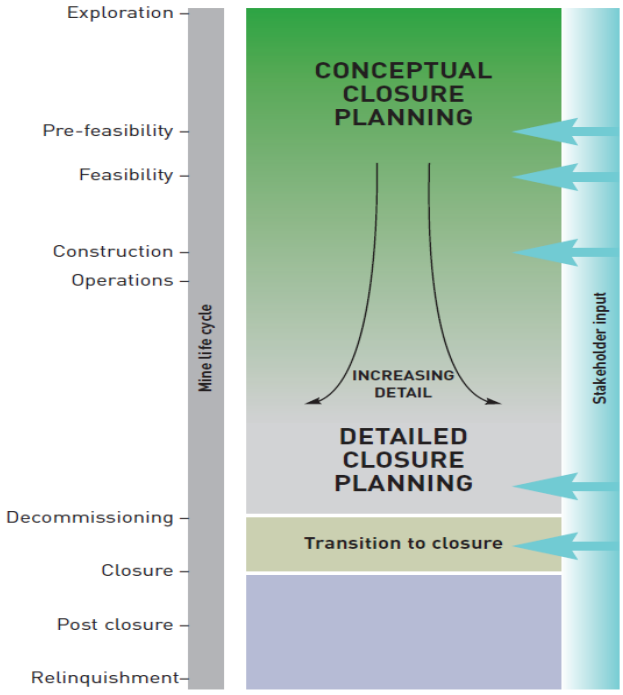

Figure 11: Mine Closure Planning

(Source: ICCM Mine Closure Toolkit, 2008)

The tools established by ICMM for sustainable mine closure are summarised in the table below.

Table 11: ICMM Mine Closure Toolkit (2008)

Tool		Description
1	Stakeholder Engagement	Mechanisms for stakeholder participation for mine closure planning and determining of closure objectives must be established. This is aimed at ensuring that the end land use is agreed upon with the future custodians of the land and their needs and interests are appropriately incorporated. Stakeholder engagement on mine closure should be maintained throughout the life of mine as the closure plan is refined.
2	Community Development	The broader tool focuses on the socioeconomic dimensions aimed at ensuring that quality of life, particularly of dependent community can be sustained post-closure. The tools include: • Stakeholder identification tool. • Social baseline study tool. • Social impact and opportunities assessment tool. • Opportunity ranking. • Overview of monitoring and evaluation tools. These tools are aimed at establishing the community baseline which will inform potential opportunities and programmes that can be implemented to develop affected communities.
3	Company/ Community Interactions to Support Integrated Closure Planning	This tool provides that mechanisms must be in place to develop a relationship between a mining company and the communities surrounding its operation. Building trust and mutual respect is key in ensuring a social licence to operate is given and closure planning is inclusive and constructive throughout the mine's life. The toolkit provides examples of potential mechanisms that can be employed.
4	Risk/ Opportunity Assessment and Management	Applicable risks (including residual risks) at closure must be identified and quantified in order to establish and implement measures to reduce risks post-closure. The toolkit provides for the evaluation based on specific issues such as biodiversity or evaluations based on closure goals and risks to meeting that goal.
5	Knowledge Platform Mapping	This tool provides mechanisms for assessing what is known as well as what in unknown for the closure planning process. It is recognised that the understanding of the validity of assumptions made is important and the number of unknowns should be reduced throughout the life of mine leading up to final closure.
6	Conceptual Closure Plan	A conceptual closure plan should be developed which assesses the potential issues that could arise at closure. This conceptual plan should be based on baseline studies and the impacts that are expected to occur during the life of mine. In addition, feasibility studies should be conducted to ensure the closure objectives are achievable.
7	Goal Setting	Sustainable closure goals (objectives) should be set from the conceptual closure phase which should be refined throughout the process.
8	Brainstorming Support Table for Social Goal Setting	This tool provides mechanisms for social goal setting which are more complex as the socioeconomic environment presents different risks and opportunities and vast changes throughout the life of mine. These mechanisms include qualitative as well as quantifiable goals as well as multi-stakeholder inclusion.
9	Brainstorming Support Table for Environmental Goal Setting	Similar to social goal setting, mechanisms are provided to set environmental goals which correlate with the desired end land use as well as action to reduce environmental risks and liabilities throughout the life of mine. Quantifiable goals must be set in closure planning and it is important that the list of goals is not exhaustive to ensure key, concise and realistic goals are set.
10	Cost Risk Assessment for Closure	This tool provides mechanisms for calculating the cost of achieving the identified closure objectives. The ICMM (2005) provides guidelines for Financial Assurance for Mine Closure and Reclamation. The cost of closure must be determined at the early planning stages and the required provision must be made to adequately provide for final closure activities. The tool recognises four structural aspects, namely: quantification of activity, cost rate per unity quantity, allowance for variance to quantity prices and contingencies for unplanned events.

11	Change Management Worksheet	This tool recognises that change inevitably occurs from the pre-feasibility planning stage and throughout the life of mine that may impact the closure plan and key objectives. The tool provides mechanisms for tracking and management change affecting the closure plan.
12	The Domain Model	The domain model pertains to the division of closure activities into manageable work packages for specific areas associated with the operation. The tool provides mechanisms for dealing with each domain as a separate entity with its own specific closure actions and desired outcomes. This is most relevant at the detailed closure plan stage and considers aspects such as specific requirements for infrastructure (for example closure of an open pit), applicable legislation, cost estimates and associated risks that are applicable to that specific area.
13	Biodiversity Management	Biodiversity management is a crucial component for closure which should be implemented throughout the life of mine. The ICMM provides good practice guidance for biodiversity management within the mining industry which can be utilised.

4.4.3. Discussion on findings

Six common themes are identifiable in the international best practice for mine closure which broadly includes:

- Closure considerations at the mine planning stage through the development of a working rehabilitation and closure plan.
- Collaborative determination of closure objectives and/or goals with affected stakeholders;
- Financial provisioning for mine closure.
- Reducing liability throughout the life of mine.
- Environmental and social risk considerations in closure planning and execution.
- Provision for post-closure monitoring.

The mine closure certificate process currently implemented in South Africa involves processes which are in line with the international best practice described above. Prior to the cessation of operations and application of a mine closure certificate, various legislated provisions are also in place that aim to ensure that closure planning is initiated at the mine planning stage and that processes are in place to enforce concurrent rehabilitation activities so as to reduce liability throughout the life of mine.

Any proposed mining operation requires EA in terms of NEMA prior to its commencement. As part of the EA application a closure plan must be developed in accordance with the EIA Regulations, 2014. Furthermore, Financial Provisioning in terms of the Financial Provisioning Regulations, 2015 requires that the estimated cost of rehabilitation and closure be determined as part of the closure planning stage and an appropriate mechanism, typically bank guarantees or assurances, be put in place to secure the cost of closure. These Regulations also make provision for an annual assessment of rehabilitation efforts through

an Annual Rehabilitation and Closure Plan (ARCP) which must be submitted to the DMR which includes a reassessment of liability based on the progression of concurrent rehabilitation throughout the life of mine. The ARCP also provides opportunity to refine closure objectives based on the changes experienced in the physical and socioeconomic environment. To this end, the South Africa legislative framework for mine closure meets the standard of international best practice from the mine planning stage.

International best practice also strongly recognises that closure involves both environmental and socioeconomic considerations which form the basis of sustainable mine closure. As discussed above, the South African legislative framework for mine closure is spread across several pieces of applicable legislation, with some pertaining to specific aspects associated with environmental and social closure. As part of the environmental related requirements under NEMA and MPRDA, provision is made for public consultation of closure plans both at the initial planning phase (mainly through the EA application process which is required to include a closure plan) as well as at the final stage when a closure certificate is being applied for.

Another key component identified is the need to undertake post-closure monitoring and maintenance where required. The IFC Guidelines indicate that a MRCP must include post-closure activities that are aimed at monitoring, identifying and managing residual impacts for a minimum period of five years following closure. Similar provisions are found in the South Africa mine closure framework. Under the MPRDA Regulations, it is stipulated that a closure plan must include provisions for post-closure management. This is further detailed under Regulation 3 d(v) of the NEMA Financial Provisioning Regulations (2015) that the closure plan must contain monitoring and maintenance activities post-closure which are aimed at ensuring the successful re-establishment of biodiversity and prevention of residual and latent impacts. Although a minimum timeframe is not provided, it is stipulated under these regulations that the proposed post-closure monitoring and maintenance period must be motivated and demonstrate that this period is sufficient to achieve the relinquishment criteria.

The statement that the legislative framework is on par with international best practice (Alberts *et al.* 2017) is therefore deemed correct. It is noted that the components of international best practices are spread across different pieces of legislation and processes which require the collaboration of different regulators to enforce their implementation. The DMR remains the overarching competent authority responsible for ensuring that all provisions are correctly enforced throughout the life of mine. This requires sufficient capacity within the organisation as well as understanding of the standards of all other government entities with jurisdiction over environmental matters that may be affected by mine closure.

Davies (2014) provides that capacity of the DMR to enforce environmental management within mining is an established flaw which ultimately then adversely impacts the execution of mine closure best practice. This sentiment is also shared by van Druten and Bekker (2017) who raise concern regarding the relevant skill and capacity of the DMR to monitor, audit and therefore ultimately implement closure processes.

5. CONCLUSION AND RECOMMENDATIONS

This research set out to determine the effective implementation of the mine closure process in South Africa based on the granting of closure certificates. An effective mine closure process comprises rehabilitation of land in a manner that allows for it to be legally ceded for other sustainable productive land uses. The need for this investigation rose from the fact that despite the drastic and continual transformation in the legal process for mine closure, which came about as a response to historic unsustainable closure practices, there is an established perception that there is a reluctance to issue closure certificates particularly to large scale mining operations such as gold and coal mines. This, however, leaves room for mining areas to be abandoned without being adequately rehabilitated during a prolonged closure process. Given this, the issue of concern is whether the current mine closure process has improved and resulted in the effective implementation of mine closure or if the legacy of unsustainable mine closure is continuing.

Using case studies of the Mpumalanga and Gauteng Province, recent data pertaining to the number of closure certificates applied for and those granted was used to analyse this perception. Furthermore, this study also evaluated the legislative framework governing mine closure to identify impediments which may potentially influence the success of the closure process as well as its shortcomings against internationally recognised best practice/principles.

This chapter provides a summary of the key findings of this research against its overarching aim as well as possible explanations for these findings. Subsequently, recommendations for future studies and concluding remarks are provided.

5.1. Consolidated Discussion on Findings

The legislative framework for mine closure in South Africa shows a clear intent to ensure that land is rehabilitated to its pre-mining state or a zero-risk alternate agreed upon land-use. Various pieces of legislations (namely promulgated under MPRDA, NEMA and NWA) pertaining to various aspects of the environment make specific provision for environmental management which are applicable to concurrent mine rehabilitation and final closure activities. This, as supported by several cited literature, shows that the legislative framework is in line with international best practices and principles of sustainable development throughout the life of mine, including at final closure. A comparative analysis of the South African legislative framework to the IFC Guidelines and ICMM toolkit revealed that the provisions of the framework are in line with what is considered best practice internationally. Common themes identified include closure planning from the planning stage of an operation,

reducing environmental liability throughout the life of mine and post-closure monitoring which advocates the adaption of mine closure policy in South Africa in an effort to develop sustainable practices.

The DMR is the competent authority with respect to enforcing regulations pertaining to environmental management at closure in addition to its responsibility to ensuring financial viability of mining as the custodian of mineral resources. The technical and administrative capacity of the DMR of the DMR to fulfil both roles has been raised as a concern which may be a potential hindrance to the implementation of the mine closure process. Given that the environmental legislative framework for mine closure is spread across multiple pieces of legislation and processes. A legislative framework for mine closure will inevitably be complex given that various environmental aspects need to be managed as well as unknown residual impacts which may occur in future. However, the framework needs to be streamlined as far as possible to allow for effective closure processes that allow for land to be rehabilitated in a manner that allows for it to be ceded for other sustainable land uses. Although the South African legislative framework for mine closure has potential alignment with best practice as demonstrated by Alberts et al. (2017) and the consideration of all applicable aspects, it is deemed complex and entangled which adversely influences the success of mine closure.

In terms of the requirements for a mine closure certificate under Section 57 of the MPRDA, provision is made for the undertaking of various tasks within 180 days of the cessation of mining which includes an environmental risk assessment, final closure plan and performance assessment. The application of a closure certificate also triggers a Listed Activity in terms of NEMA, requiring at minimum that a Basic Assessment Process be undertaken. Furthermore, notification to the DWS of the cessation of mining must be undertaken. A closure certificate application can therefore be seen as a dual application process under the MPRDA and NEMA. Certain tasks which are required to be undertaken such as the closure plan, evaluation of associated risks and undertaking of a performance assessment (environmental audit under NEMA) as well as undertaking public consultation processes form part of both processes. This necessitates extensive and recursive efforts which could be better streamlined into one comprehensive process.

Following an application for a closure certificate, as part of the adjudication process, the Minister is required to obtain written confirmation from any government bodies with jurisdiction over matters affecting the environment. This requires the collaboration of different regulators and an understanding of technical aspects and potential risks to make an informed decision. The perceived lack of capacity of the DMR here again may provide as a potential hindrance to evaluate, coordinate and efficiently process mine closure certificate applications. The dual application process is an extensive and recursive bureaucratic

process which presents a challenge to the management of the application process as well as monitoring of the execution of the final closure plan. Overall, the broader legislative framework and specific legal requirements for a closure certificate application has positive attributes and intent as it accounts for all major environmental aspects, it is inclusive of affected stakeholders and makes provision to monitor and audit closure activities; however, without sufficient capacity and skill to adequately align the applicable legislation and collaborate resources and actors for its execution the framework is fruitless and impedes the success of the mine closure process both in terms of the actual issuing of closure certificates as well as ensuring that land is rehabilitate in a manner that allows for it to be ceded for other productive land uses.

The evaluation of the number of closure certificates applied for and granted in Mpumalanga and Gauteng Provinces revealed a low success rate. Out of a total of 33 closure certificate applications made in Gauteng between 2012 and 2015, 15 closure certificates were issued therefore indicating a 45% success rate. No data pertaining to the number of closure certificates applied for in Mpumalanga was available for assessment. Only six closure certificates were granted in Mpumalanga which is deemed a low success rate as it is expected more closure certificated would have been applied for. Notably, amongst the 21 closure certificates granted in both provinces only one closure certificate in Mpumalanga was associated with a MR. The remainder of the closure certificates were either for PRs or MPs which are relatively small-scale with fewer environmental implications. Further evaluation revealed that the majority of MPs were granted to SANRAL or Transnet and therefore are likely to be borrow pits associated with linear developments where limited environmental disturbance can be expected. Based on this it would appear that no large scale coal or gold mines are closing which is contrary to expectation, given the decreasing number of operating mines and reduced production numbers.

An analysis of the number of operating mines (in terms of MRs) as recording in the DMR D1 database was undertaken to further understand and explain the state of mining and mine closure in the study areas. The database revealed that within the last seven years, the number of operating mines in both provinces has increased. This revelation, as with the number of closure certificates granted, contradicts the apparent reality of gold and coal mining in South Africa. It is noted that these commodities have and are likely to continue to play a key role to economic development, however the reality of resource depletion will continue to see an increase in mine closure. Other sources of data such as the production figures for gold and coal mining support this perspective.

The contradictions between recorded data of the number of closure certificate applications and those granted as well as number of operating mines reveals a possible issue related to

data management and monitoring systems. With respect to the number of closure certificates applied for and granted, it was found that data is generally difficult to access and the data is potentially inaccurate. The data utilised was obtained by Olalde (2017) through a PAIA application as well as Parliamentary enquiry made by the DA. The data obtained from both sources was incomplete and showed some inconsistency. This speaks to inadequate management systems and once again to the potential lack of capacity of the DMR to manage and track the mine closure process. In May 2018 the Minister stated that there is a backlog in new mining related authorisations applications and that there is no internal system in place to detect delays in processing. This is likely to also be applicable to closure applications as they are under the same administration. Not only do the administrative systems potentially result in prolonged processes this in turn opens up the risk for an ineffective closure process as operations can be abandoned without being adequately rehabilitated or ceded for other productive land uses. The illegal occupation of land has already been identified on previous mining land which is a health and safety risk that could be avoided if mine closure processes are effective and efficient.

5.2. Recommendations for Future Studies

This study provides insight into the gaps and potential challenges to the success of the established mine closure process in South Africa. It has been established that there are impediments to the legislative framework governing mine closure and the case studies reveal a low success rate in the issuing of closure certificates. As discussed above, the legislative framework has greatly adapted to improve mine closure practices and discontinue the negative legacy of mine closure from a time where legislation was weak. Therefore, the evident challenges and low success of mine closure is a significant concern which requires extensive investigation. This research provides the possible influences to the evident lack of success of mine closure, however in-depth studies of specific aspects which may be a hindrance would be required.

Based on the findings of this research, the following is recommended:

- It is recommended that further studies aimed at assessing the administrative system (including application tracking and monitoring systems as well as specific timeframes for processing) for the implementation of mine closure processes by regulators be undertaken. The capacity of the DMR to successfully execute and issue mine closure certificate has been deemed a potential limiting challenge. This challenge may presents a significant hindrance to successful mine closure which is a key concern.
- It is recommended that further studies which focus on establishing what happens to ceased operations in the period while undertaking the prolonged closure certificate

application process be undertaken. This will assist in understanding how land is ceded without legal closure and establish the associated risk to future sustainable land uses.

5.3. Concluding Remarks

Effective mine closure is internationally recognised as the rehabilitation of land in a manner that allows for it to be ceded for other sustainable productive uses. In the South African context this comprises granting of a closure certificate. This research report shows that the key drivers for issuing closure certificates are complex and multifaceted. A closure certificate can only be issued once the regulator is assured that land has been sufficiently rehabilitated to its pre-mining state or an alternate land use that conforms to the principles of sustainable development and that all potential residual/latent risks are accounted for. Gaining such assurance is challenging and can be contested as unattainable which prevents the issuing of closure certificates. Closure can have serious long term negative impacts on the environment and the surrounding communities that the current legislation are attempting to mitigate. Water related issues such as AMD formation associated with gold and coal mines for example are a crucial residual risk that can result in irreversible impacts preventing the issuing of closure certificates. Other identified drivers include sufficient knowledge and skill to evaluate and assess closure applications in coordination with all relevant parties.

Criteria were established in Chapter three, which provide for effective mine closure. A summary of the findings against the points of criteria are provided below.

1) **Closure is being granted and subsequently land is ceded for other sustainable productive uses**

The data for this was limited, however, this research found that the success rate of granting mine closure certificates is low (below 50%). Without legal closure land cannot be ceded for other land uses and will still be considered mining land under the liability of the mining company. However, when such land is left unoccupied, the risk of illegal occupation is increased as has been seen on mine contaminated land in Johannesburg. This poses health and safety risks if some mine infrastructure such as open pits or waste rock dumps remain on the landscape. Furthermore, occupants are more expose to potential residual impacts or even existing threats if rehabilitation activities are not adequately carried out. Based on the data analysed it appears that closure is not being granted for coal and gold mines within the study areas and it is therefore deemed that this criterion has not been met.

2) **There is a correlation between the real production figures compared to closure certificates applied.**

The D1 database shows that the number of mining operations (MRs) has increased for both gold and coal mines in Gauteng and Mpumalanga respectively. The data pertaining to the number of closure certificates granted indicated that only one MR closure certificate for a coal mine in Mpumalanga has been granted. Comparison of operating mines in 2010 with those in 2017, indicates that more coal mines have ceased operating than have been issued with closure certificates In theory it would then appear as though the data correlates as no mines are legally closing. However, an understanding of the on-the-ground status of gold and coal mines in the study areas which is supported by literature and recorded production figures reveal that this data is contradictory. Therefore, this criterion cannot be deemed to be met although further investigation is required. Notably alternatives such as the transfer of rights and associated environmental liabilities as well as the placement of operations on care and maintenance is said to be increasing which may influence this criterion.

3) **The legislative process allows for closure applications to be scrutinised fully and all aspects especially relating to latent impacts be assessed without the process being too onerous resulting in delays or standstills in the decision making process.**

The legislative framework and legal process to obtain a mine closure certificate was found to be extensive but in line with the principles of sustainability. Furthermore, provision is made for risks associated with residual and latent impacts. However, the framework is spread across various pieces of legislation and the process requires various actors which when coupled with the perceived insufficient capacity of the DMR to manage the process has resulted in a complex and confusing process which is often prolonged. The inability to process closure certificate applications timeously leaves room for mining areas to be left abandoned, resulting in unsustainable closure. It is therefore deemed that although the legislation has good intent, its complexity and the lack of effective and efficient implementation is a hindrance to closure and therefore this criterion is not being met at present.

4) **The closure process is in line with internationally recognised best practice**

Common themes were identified in the IFC Guidelines and ICMM Toolkit which form the basis of mine closure best practices for which the South Africa legislative process for mine closure was found to be in line with. From a purely policy formation perspective, the closure process in on par with international best practice and all applicable aspects have been included. Based on this, this criterion can be said to have been met. This research has however found that policy on paper does not automatically translate to effective

implementation. Overall the mine closure process has been found to be ineffectively implemented within the selected study areas although adequate provisions are in place.

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