Fracking the Karoo

Mitigating environmental damages

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Abstract

As the fracking boom gains momentum around the globe, South Africa must prepare a comprehensive frack-related legal framework and commence with the extraction of the enormous wealth buried deep within the Karoo desert.

The objective of this paper is to examine the applicability of South Africa’s legal framework to the mitigation of the water related environmental risks posed by fracking activities, and to propose possible legislative solutions where legal lacunas exist. A close look will be taken at the fracking laws of the USA which today is largely the most advanced fracking nation in the world, with a view of importing the extensive knowledge into South Africa’s own legal system.

The analysis conducted in this paper will demonstrate how South Africa’s existing legislation provides a degree of protection to surface and underground water which may be affected by fracking operations, but that further legislative development is necessary in order to mitigate the potential risks as far as possible. In developing suitable laws, lawmakers and relevant authorities must keep human rights and socio-economic principles at the forefront of their mind.
Table of Contents

1. Introduction ........................................................................................................................................p 4
2. Water Related Environmental Risks Posed by Fracking .................................................................p 7
   2.1. Water Volume .................................................................................................................................p 7
   2.2 Chemical Mix .................................................................................................................................p 9
   2.3. Well Construction ........................................................................................................................p 10
   2.4 Wastewater ....................................................................................................................................p 13
   2.5. Concluding Remarks .....................................................................................................................p 14
3. Tackling the Risks through an Effective Legal Framework ...............................................................p 15
   3.1. Existing South African Legislation ...............................................................................................p 16
      3.1.1. The Constitution ......................................................................................................................p 16
      3.1.3. National Environmental Management Act 107 of 1998 (NEMA) .........................................p 22
      3.2.1. Illinois Hydraulic Fracturing Regulatory Act (HB2615) ..............................................................p 27
      3.2.2. Bolstering South African Fracking Laws ..................................................................................p 32
4. Concluding Remarks ..........................................................................................................................p 37
Bibliography ............................................................................................................................................p 40
1. Introduction

By developing a robust legal framework and requiring operational best practices, shale gas extraction through hydraulic fracturing, or simply ‘fracking’, can be safe and highly rewarding. The vast shale gas reserves found in the Karoo desert of South Africa have the potential to bestow widespread socio-economic benefits upon the country’s inhabitants. The flipside of the shale coin however is tainted by environmentally fuelled controversy.

Shale gas extraction is an unexplored field in South Africa, and with the exception of the USA, a relatively nascent industry throughout the world. Consequently, South African law is currently not adequately geared to fully mitigate the potential hazards arising from the extraction thereof.\(^1\) Deficient regulation and legislation may expose the health and safety of people and the environment to several risks, most notable of which are water related. Consequently, new laws must be developed to protect South African communities and environments, focusing especially on the shale-rich southern Karoo Basin of the Great Karoo desert.

The discovery of shale gas in the Karoo has completely transformed the potential economic value of this once sterile land, into a place impregnated by tremendous national wealth. Extraction of this wealth would require a complicated multi-faceted procedure which at several stages of its implementation, including \textit{inter alia}, transport and storage of water and chemicals, drilling and construction of the well, fluid injection, and wastewater storage and disposal, has the potential to contaminate and/or deplete water sources and contribute to air pollution.

Briefly, a wellbore is drilled vertically into the shale rock formation, and then horizontally through the shale, at a depth of between 2000m and 6000m underground.\(^2\) A water based fracking fluid with a small amount of additives is then

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\(^2\) http://www.treasurethekaroo.co.za/fracking-facts
injected at high pressure into the shale formation, fracturing the rocks. The added chemicals reduce the friction of the fluid as it travels through the pipes and into the shale stratum. The induced fractures increase the surface area and create additional permeability, releasing the gas trapped therein, which then flows to the well head.

The complex and potentially hazardous nature of fracking and its ancillary activities, juxtaposed with its tremendous wealth inducing capabilities, puts states in a tricky situation. A plethora of conflicting issues have generated highly polarised schools of thought, each guided by different ideals and motivations, which in their simplest forms, range from environmental protection, to significant socio-economic stimulation.

Proponents argue that socio-economic benefits far outweigh any environmental concerns. It has been estimated by the United States Energy Information
Administration that the Karoo Basin may hold up to 485 TcF of technically recoverable shale gas, which at the time of writing, makes it the 5th largest shale reserve in the world. According to a study by Econometrix, ‘Just 10% of the US EIA estimated 485 tcf (trillion cubic feet) shale resource could add R200 billion to GDP annually and create 700 000 sustainable jobs.’

Environmentally, burning natural gas generates 50% fewer emissions than coal and can contribute to South Africa’s goal of a cleaner energy future, while alleviating the nation’s high dependency on coal. Furthermore, the exploitation of shale gas would transform South Africa’s energy sector by decreasing price volatility and increasing security of supply in a nation currently experiencing severe electricity supply scarcity.

Opponents on the other hand claim that the damage to the environment is too severe to be justified. They praise the Karoo for its natural beauty and serenity, and remain sceptical over the oil and gas industry’s ability to create jobs and distribute wealth amongst the poverty stricken region. Most notably however, opponents fret over the controversial procedures which must be utilised to extract the gas, and the lack of regulation to protect the Karoo’s sentimental and delicate environment, especially, its scarce water resources.

Through the remainder of this paper, the scope of my analysis will be limited to an analysis of water related environmental issues which may potentially arise as a result of hydraulic fracturing activities. Air contamination and seismic risks are outside the scope of this analysis. In chapter 2 I will introduce the technical aspects of water related environmental risks to provide the reader with a technical background upon which a legal framework must be built. In chapter 3 I will initially introduce existing South African legislation that may be applicable to mitigate the risks, followed by an analysis of the Illinois Hydraulic Fracturing Regulatory Act (HB2615) which provides

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3 Econometrix, Media Release, Economic report: Karoo shale gas development could boost GDP and create hundreds of thousands of jobs, 2 March 2012
some of the most stringent and insightful fracking laws in the world. I will then analyse the legislative gaps in South African law and suggest solutions. In chapter 4 I will summate my findings and conclude that the existing South African legal framework should be refined through a combination of goal setting and prescriptive laws to ensure that fracking extracts the maximum benefits for the nation while inflicting minimal damage on the environment and populace.

2. Water Related Environmental Risks Posed by Fracking

In order to understand the legal framework required to promote responsible and environmentally acceptable fracking practices, we must first identify the potential risks posed by the industry. Only then will it be possible to evaluate the suitability of existing legislation to mitigate the risks, identify lacunas which pose environmental threats, and subsequently develop legal methodologies to tackle these gaps.

There are three key interconnected concerns relating to water usage in shale gas exploration and production. Firstly, high water requirements raise water scarcity and depletion concerns. Secondly, several of the numerous chemicals used in the fracking process are considered to be toxic, raising fears of water contamination and chemical spills. Accordingly, the chemical mixture and well case integrity are paramount. Finally, storage and disposal of flow-back and produced water. Delivery of the water to and from the well site presents additional ancillary concerns which will be mentioned in passing.

2.1 Water Volume

Fraking is a water intensive process and can require up to 20 million litres of water to drill and fracture a well, depending on the geological formation. To put that into perspective, an Olympic sized swimming pool contains approximately 600 000 litres of water. According to Shell who has applied for exploration rights in the Karoo

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6 Supra (note 1), 40
7 http://www.treasurethekaroo.co.za/fracking-facts
Basin, there could be as many as 32 wells per well pad, and between 4 to 6 well pads in an area of 10km².  

Notably, researchers claims that electricity generation via fracking remains more water efficient than electricity generation via fossil fuels such as coal. Nevertheless, the large water requirements are exacerbated by the fact that South Africa is a water scarce country with a nationwide rainfall of 500mm per year. The Karoo Basin has an average rainfall of 200mm per year, making water supply and sourcing potentially problematic. A hydraulic fracturing operation could require upwards of 1000 truck trips for a single well, with over a third required for water transportation. The number in South African would vary, depending on where the water will be sourced from. Water is generally drawn from underground aquifers or from surface water. This could affect aquatic habitats or the quantity and quality of water availability for drinking and other purposes. Environmental and social implications will have to be thoroughly assessed, taking into account the water needs of the surrounding community.

The industry is pursuing innovative methods to reduce water consumption. Today, the use of brackish water or sea water up to a salinity of 80g/L can be used, although significant studies have not yet been conducted as to the environmental impact thereof. Brackwater reservoirs as well as large seawater reservoirs have been found deep underground in the Karoo. One concern is that such water may sterilise the soil in the event of escape from the containment systems. Another
alternative is the use of coal mine drainage, should the circumstances be economically viable. A trend that has been gaining recent popularity is the use of recycled wastewater from previous fracking activities, rather than acquiring water from aquifers or surface resources.

These innovations, coupled with the promulgation of appropriate regulations, could alleviate some of the fears surrounding water scarcity. Water use laws must take into account the local hydrology of the relevant zone as well as the water requirements of the effected inhabitants. Regulation must accommodate site specific conditions, and allow companies to employ operational best practices with the aim of reducing water usage, as well as encouraging where possible, the use of recycled water.

2.2 Chemical Mix

Hydraulic fracturing operations in South Africa are expected to use fracking fluid termed slick water. Slick water is a low viscosity chemical mixture comprising approximately 98% water, fine sand particles, and a small amount of chemical additives. The sand is used to keep the fractures propped open, while the additives are used for a variety of purposes, such as to protect the well case from corrosion and reduce the friction of the fluid as it travels through the pipes and into the crevices.

Massive amounts of water and chemicals must often be delivered to fracking sites by thousands of trucks. These fluids are then stored on site until injection into the wells, and must be stored once again upon collection of flowback and produced water (wastewater). A number of the chemical additives contained in the fracking fluid are potentially harmful to humans and the environment if they migrate into local water sources. The chemicals can enter water sources during transport, storage, injection into the well, or the subsequent return of wastewater. Consequently, all these areas

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19 Supra (note 1), 11
20 Mark Zoback, Saya Kitasei, Brad Copithorne, Addressing the Environmental Risks from Shale Gas Development, July 2012, 10
21 Ibid
should be subject to regulation and monitoring with a view of mitigating all potential chemical spills and water contamination.

The additives used in each case vary depending on the shale composition, thickness, depth and temperature, and can therefore not be identified prior to thorough investigation of site-specific conditions. Up to 750 different chemicals have been identified in different fracking fluids. This complicates the possibility of prior investigation and assessment into the environmental impacts thereof.

Furthermore, fracking companies have been reluctant to disclose the chemical constituents and their respective concentrations as they consider the mixture to be a trade secret which provides them with a competitive edge. As trade secrets are protected by law, environmentalists, especially in the USA, often struggle to prove the toxicity of the chemical components and subsequently, the environmental harm caused therefrom. In the USA, the Ground Water Protection Council (GWPC) and the Interstate Oil and Gas Compact Commission (IOGCC) launched an online chemical registry called Fracfocus wherein companies are either required to make discovery of the fracturing fluid by state law, such as in Texas, or can choose to do so voluntarily.

### 2.3 Well Construction

Good well construction and maintenance of well bore integrity is a crucial activity in the fracking process for several reasons. Firstly, isolating the internal conduit of the well from the surface and subsurface environment is essential for protecting the environment and to enable well drilling and production. Additionally, well integrity is necessary to isolate and contain the well’s produced fluid to a production conduit.

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23 De Wit (note 4), 5
24 Ibid
25 www.fracfocus.org
26 Supra (note 10), 6
within the well. High quality well construction minimises the potential of fracking fluid or shale gas from migrating into water sources, or escaping into the air.

Briefly, well construction begins with the vertical insertion of a steel pipe (conductor casing) into a drilled wellbore in order to stabilise the well. Operators then continue drilling vertically and insert surface casing which should be required by law to extend from the ground’s surface past the depth of all potable aquifers. Most fracking laws require that the space between the surface casing and the wellbore (the annulus) is then fully cemented and sealed before further drilling can commence. Inadequate cementing of the annulus could lead to the migration of natural gas, fracking fluids and formation water along the outside of the wellbore and into natural water sources and the surrounding environment. Operators may be legally obliged to install blowout prevention equipment at the surface to prevent any pressurised fluids encountered during drilling from moving through the space between the drill pipe and the surface casing. Regulation may require that deep wells be inserted with surface casing to further stabilise the well. Drilling and casing continues in sequentially smaller sizes until the targeted shale formation is reached, where-after the well is directed horizontally. The well must be pressurised at several stages to test the integrity of the cement.

The low permeability of shale gas requires wells to be pressurised and fractured up to 20 times in one direction, and possibly more if fractured in multiple directions. The horizontal wells extend over large distances, creating the risk that an induced fracture may intersect with existing vertical faults in the surrounding rocks, or extend beyond the target formation into water aquifers. Repeated fracking could increase well casing failure over time and subsequently the risk of gas or fracking fluids escaping through broken casing as a result of well case rupture. New faults could also be formed between previously isolated natural aquifers of differing water quality,
thus creating the possibility of interaction, and a decline in the water quality.\textsuperscript{34} These concerns are however usually assuaged by the fact that the majority of gas bearing shale formations exist thousands of meters below drinkable aquifers.\textsuperscript{35}

Preventative action could reduce leakage through activities such as 3D seismic monitoring and strict borehole control. Companies should be required to use high-quality cements, which in the future are expected to comprise less brittle materials. Site activities and structural integrity should be monitored regularly by authorities as well as independent chemical forensic experts.\textsuperscript{36} Leaking wells can be detected by spiking fracking fluids with tracer chemicals or fingerprinting gases for their isotopic signature. Such preventative methods are often neglected by cost-conscious companies. Nevertheless, incidents of fracturing fluids migrating up the well bore as a result of poor well construction are very rare, and any resultant contamination of underground water resources is yet to be proven.\textsuperscript{37}

The highly technical nature of well construction escalates the risk of corporations attaining substandard well integrity. Regulatory authorities should insist on the application of industry best practices, and adopt legislation governing well design.

\begin{itemize}
\item \textsuperscript{34} Ibid
\item \textsuperscript{35} Zoback (note 20), 7
\item \textsuperscript{36} De Wit (note 4), 4
\item \textsuperscript{37} Supra (note 1)
\end{itemize}
and construction. Fracking laws must guide corporations to ensure that research and development are utilised optimally to enhance human and environmental protection, and prevent corporations from employing cheap alternatives which may compromise human health and the environment.

2.4 Wastewater

Fracking wastewater includes flowback water and produced water. Flowback water is the portion of fracking fluids which returns back up the wellbore to the surface after a hydraulic fracture is complete. It contains some of the original fracking fluid, as well as high levels of dissolved solids such as salts, metals, and naturally occurring radioactive materials (NORM) originating from the shale. The flowback period usually lasts a few weeks, over which period the amount of flowback water can vary significantly from well to well. In the Marcellus Shale, approximately 25% of fracking fluid is recovered during flowback. This nevertheless represents hundreds of thousands of litres of potentially toxic liquids which must be handled in a manner which will not harm the environment.

Produced water is naturally occurring water originally present in the shale formation, and may be produced throughout the lifetime of the well. It is brought to the surface together with the gas and contains hydrocarbons, salts, NORM and various other compounds with which it has been in contact with underground for centuries. Wastewater could potentially contaminate surface water and soil if care is not taken in the storage, transport and disposal thereof.

Management of wastewater must be handled with great care to avoid any spills and contamination. Transport and temporary storage in open pits or tanks may increase the chances of soil and subsequent aquifer contamination through spillage following

38 Ibid
39 Penn State University, Cooperative Extension College of Agricultural Science, Water’s Journey through Shale Gas Drilling and Production Process in the Mid-Atlantic Region, 2012, 4
40 Zoback (note 20) 10
41 Ibid
42 http://www.netl.doe.gov/technologies/pwmis/intropw/
heavy rains, wind, and other factors.\textsuperscript{43} Regulations should require safe transportation and storage of wastewater, ideally in closed containers, which would additionally improve water retention for potential reuse.\textsuperscript{44} Authorities should require regular monitoring and testing of all equipment used to move the fluids between storage tanks or pits and the wellhead.

Governments and corporations must seek to manage wastewater effectively and efficiently, protecting the environment while at the same time enabling economical operating circumstances.\textsuperscript{45} Regulations and best management practices should impose disposal and treatment requirements which minimise contamination risks and prevent industry players from taking questionable shortcuts in the storage, transportation, treatment and disposal of wastewaters.\textsuperscript{46}

\subsection*{2.5 Concluding Remarks}

According to the chairman of Shell South Africa, Bonang Mohale,

\begin{quote}
It is possible to have responsible fracking with respect to the environment and to the people of the Karoo.

The first commitment that we made was never to compete with the people of the Karoo for their water needs in this pristine and ecologically sensitive area so we, in the initial stages, certainly when we drill the first well, bring portable water in from outside.
\end{quote}

\begin{thebibliography}{9}
\bibitem{Zoback} Zoback (note 20) 11
\bibitem{Ibid} Ibid
\end{thebibliography}
The risks to the environment are well understood, well-articulated and I think they can be totally and utterly mitigated, especially the issues of water contamination, the aquifers, and the scarcity of water.\textsuperscript{47}

Lawmakers, research teams and committees of environmentalist, scientists and engineers from around the world, but predominantly the USA, have been carefully scrutinizing the hydraulic fracturing process, identifying risks and presenting viable solutions. South Africa’s own legal system must make use of international knowledge and develop a robust legal system to ensure that the negative effects of fracking are mitigated. The adequacy of the existing legal framework must be reviewed with a purpose of identifying all the shortfalls and omissions in the system.

3. **Tackling the Risks through an Effective Legal Framework**

South Africa has laws in place which to lesser or greater extents deal with the potential hazards of fracking. Many of these laws have been enacted over the years to deal with similar threats posed by the mining and hydrocarbon industry, such as large water consumption, water contamination and waste disposal. Others have been enacted with the intention of providing general protection to the environment. None of these laws however have been drafted specifically with fracking in mind, and consequently, several legislative lacunas do exist.\textsuperscript{48}

The current challenge is to create fracking-specific laws to manage and promote the development of the shale gas industry while simultaneously protecting people and the environment. South Africa stands to learn from foreign regulation in which fracking is a more advanced industry, but must keep in mind that simply adopting foreign legislation is not a solution, as each country and specific location has its own particularities when it comes to fracking.\textsuperscript{49} In section 3.1 I will discuss South African legislation which may be most applicable to fracking. This will be followed by a close look at the recently promulgated Illinois Hydraulic Fracturing Regulatory Act

\textsuperscript{47} \texttt{http://edition.cnn.com/2012/03/23/business/south-africa-fracking-shell}

\textsuperscript{48} \texttt{http://www.caveatlegal.com/fracking-the-challenge-facing-our-lawmakers/}

\textsuperscript{49} Ibid
(HB2615) which I have chosen due to its holistic and rigid regulatory perspective; the contents of which are highly insightful and therefore useful to the development of a robust South African regulatory fracking regime. I will conclude the chapter by assessing the gaps in South African fracking laws, and providing suggestions to address the lacunas.

3.1 Existing South African Legislation

While many acts exist in South African legislation which relate to environmental protection, incorporating water management, waste management, and ancillary topics, I have selected those which provide the most direct application and provide the foundations upon which fracking-specific regulations can be developed. Additionally, it must be noted that several published guides by government departments do exist for environmentally related issues, but have not been promulgated into law, and will not be discussed herein.

3.1.1 The Constitution

As a starting point to South Africa’s human rights and environmental protection, one must turn to the Bill of Rights contained in the Constitution.50

Section 24 of the Bill of Rights provides as follows:

‘Everyone has the right

  a. to an environment that is not harmful to their health or well-being; and
  b. to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that
     i. prevent pollution and ecological degradation;
     ii. promote conservation; and

iii. secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.'

This section sets the basic standards to which all South African activities and laws must adhere. The elements introduced are directly relevant to fracking: extraction of shale gas via fracking could potentially, but not assuredly, deplete and contaminate water sources, thereby harming human health and damaging the environment. Section 27 of the Bill of Rights goes on to state that everyone has the right to have access to sufficient food and water, and the state must take legislative and other measures to achieve the realisation of these rights.

While both these sections offer human and environmental umbrella protection, they do not delve into industry specific attributes. In other words, it is not the objective of the Constitution to determine the merits of fracking, but simply to establish and guarantee certain human rights, the likes of which are to be achieved through the development of appropriate legislation.

In paragraph 20 of Director: Mineral Development, Gauteng Region and Sasol Mining (Pty) Ltd v Save the Vaal Environment and Others 1999 (2) SA 709 (SCA), the Supreme Court of Appeal stated:

"Our Constitution, by including environmental rights as fundamental justiciable human rights, by necessary implication requires that environmental considerations be accorded appropriate recognition and respect in the administrative process in our country. Together with the change in our ideological climate must come a change in our legal and administrative approach to environmental concerns."

The protection of human rights and wellbeing is further established through the right of access to information that is required for the ‘…exercise or protection of any rights.’ Viewed from a fracking context, this right to information as guaranteed by section 32 of the Bill of Rights should provide an interested or potentially affected party with the right to be informed, amongst other things, of the water volumes and
sources used, and the chemical mixture utilised in the fracking process. This exposes corporations to an inquisitive public which can be expected to closely scrutinise the hazards posed by toxic additives. Discovery should encourage corporations to adhere to industry best practice, and keep the toxicity levels of any additives to the minimum.

Consequently, the Constitution lays the groundwork upon which South Africans are required to develop laws to promote human rights, in a moral and socially responsible manner. “The Bill of Rights applies to all law, and binds the legislature, the executive, the judiciary and all organs of state.”51 All economic and social development must adhere to the guiding principles embodied in the Constitution.

### 3.1.2 National Water Act 36 of 1998 (NWA)

The NWA is South Africa’s primary legislation regulating water resource management and quality.52 The purpose of the NWA is to ‘ensure that the nation’s water resources are protected, used, developed, conserved, managed and controlled’ taking into account, amongst other factors, the basic human needs of present and future generations, and promoting equitable access to water.53

The large volume of water used for fracking will require a use license as provided for in the NWA, as well as registration with the Department of Water Affairs and Forestry.54 Section 21 of the NWA defines water use to include, *inter alia*, taking and storing water, waste discharges, and disposals. The licence applicant must provide certain information about the corporation, its activities, intended water source and water use55, and may be required to conduct environmental or other assessments which may then be subject to independent review.56 The responsible authority may further “conduct its own investigation on the likely effect of the proposed licence on

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51 Ibid, s8(1)
53 National Water Act 36 of 1998, s2
56 Supra (note 53), Chapter 4 Part 7
the protection, use, development, conservation, management and control of the water resource.” Factors taken into account by the relevant authority include factors such as the effect on other water users, the impact of the water use on the resource, the duration of the use, socio-economic impacts and public interest. Organs of state and interested persons may be invited to comment on the matter. License applications for areas under “water stress” such as the Karoo, fall under Part 8 of chapter 4 of the Act and include a further requirement for the relevant authority to prepare schedules detailing how the available water will be allocated to existing and new users. Allocations must take into regard the public interest, the need to achieve equity, and protection of water quality.

Should the license be granted, it will be accompanied by certain license conditions under which the water can be used. Conditions must include issues such as the period for which the license applies, the water use for which it is issued and the property or area in respect of which it is issued. Licence conditions may further determine elements such as, inter alia, the quantity of water that can be used and stored, time of usage, locations or water sources from which water may be drawn and payment of charges for such use. The preparation and approval of, and adherence to a water management plan may also be required. Furthermore conditions may specify management practices, including ‘requiring the monitoring and analysis of and reporting on every water use and imposing a duty to measure and record aspects of water use, specifying measuring and recording devices to be used.’ If necessary, the authority that has issued the license may change the conditions for usage, but not the duration of the licence. Authorities may for example reduce the amount of water authorised for use by the licence. Water users who do not comply with the conditions set out in their water use licence despite notice to correct any failure, may have their licence revoked and may face prosecution.

57 Ibid, s 41(2)(b)
58 Ibid, s 27(1)
59 Ibid, s 41(2)(c)
60 Ibid, s 43(1)
61 Ibid, s 28
62 Ibid, s 29(1)
63 Ibid, s 29 (1) (b) (iii)
64 Ibid, s 29(1)(b)(ii)
Conditions regulating the return flow, discharge and disposal of waste are also likely to be included in the licence. Authorities may specify the amount of return flow or waste which may be returned to an indicated water resource, or require other methods of disposal. Wastewater may also be subjected to specific treatment prior to discharge. Additionally, the chemical and physical components of the wastewater may be specified, potentially impacting the chemicals used in the fracking fluid.

Chapter 3 Part 4 of the Act deals with ‘...pollution prevention, and in particular the situation where pollution of a water resource occurs or might occur as a result of activities on land.’ The person who owns, controls, occupies or uses the land in questions is required to take all reasonable steps to prevent pollution of water resources. The measures for the prevention of pollution may require, amongst others, the cessation of any act or process which causes or may cause pollution, the elimination of any source of pollution, and the containment or prevention of the movement of pollutants. In the event that such person fails to take the appropriate measures, the catchment management agency may direct such person to take the necessary measures, or may itself do whatever is necessary to prevent the pollution or remedy its effects, and recover all reasonable costs from the person responsible. In an emergency situation, such as the spilling of pollutants that find or may find their way into a water resource, the onus for remedying the situation is placed on the person/s responsible for the incident or the substance. Again, failure to act may induce the relevant catchment management agency to take the necessary steps and recover the costs.

In the matter of Minister of Water Affairs and Forestry v Stilfontein Gold Mining Co Ltd and Others 2006 (5) SA 333 (W), mining activities had resulted in a situation where underground water would pollute valuable water resources if the underground water is not raised to the surface and treated appropriately. The Court stated that the objective of the NWA ‘...is to prevent pollution of valuable water resources.' It went to on to reiterate that To permit mining companies and their directors to flout

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65 Ibid, s 29(1)(c)
66 Ibid, s 19 (2)
67 Ibid s 19 (3), (4) and (5)
68 Ibid, Part 5
environmental obligations is contrary to the Constitution, the Mineral and Petroleum Resources Development Act and the National Environmental Management Act.’ This approach is illustrative of the tough stance taken by South African courts in the preservation of the environment. It further illustrates the effective laws which are already in place in South Africa, with a view of tackling environmental hazards.

As a way of encouraging reduction in waste and efficient water use, water use charges are implemented with a pricing strategy which may be differentiated according to geographical location, water quality, and user. Rebates can be granted for water returned to the source. The pricing strategy may further take into account a number of elements, including the physical and socio-economic aspects of different geographical areas, manner and quantity of withdrawal, discharge and disposal, as well as water quality and manner of use. Incentives and disincentives may be considered to promote water use efficiency and reduce waste.

Chapter 14 of the Act places a duty on the Minister of Water Affairs and Forestry to establish national monitoring systems on water resources and to collect and assess data relating to quantity, quality and use of water in the various water resources. Quality monitoring shall include physico-chemical, toxicity and radioactivity monitoring. Information for decision making must comprise of the quality and quantity of water in the relevant surface and ground water resource. Monitoring systems set up by the Minister, together with monitoring requirements which may be set in the licence conditions as per s29(1)(b)(ii) of the Act will allow authorities to record any degradation in water quality which may have occurred as a result of fracking, and to take the necessary steps should such degradation be evident.

The NWA provides the Minister of Water Affairs and Forestry with a broad range of powers, encompassing “the ultimate responsibility to fulfil certain obligations relating

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69 Ibid, s 56(3)(a)
70 Ibid, s 56(3)(d)
71 Ibid, s 56(4) and 56(5)
72 Ibid, s 137
73 National Water Resources Strategy 2004, Chapter 3 Part 6
74 Ibid
to the use, allocation and protection of and access to water resource.”

Nevertheless, it does not set quantifiable requirements, clear rules, or regulations concerning fracking and ancillary activities. Licencing authorities are provided wide discretion when considering licence conditions, and “may” insert specific terms or request certain information or procedures. The lack of experience and knowhow of South African authorities in the shale industry may lead to a situation of inconsistent, inefficient and insufficient licence conditions which may in turn induce various undesirable outcomes for fracking corporations, the public or both. Shale gas excavation may be rendered economically unviable due to unnecessarily strict or unsuitable licence conditions. Alternatively, conditions which are too lax may cause irreparable environmental harm and damage to water sources.

3.1.3. National Environmental Management Act 107 OF 1998 (NEMA)

NEMA establishes a general framework of environmental management principles to be followed and implemented through cooperative and coordinated governance by organs of state when making decisions on matters affecting the environment.

One of the key principles of NEMA is the protection of people, taking into account social, economic and environmental factors. The principles set out in the Act stress the State’s responsibility to ‘respect, protect, promote and fulfil the social and economic rights in Chapter 2 of the Constitution.’

Section 2(2) of the Act states that ‘[e]nvironmental management must place people and their needs at the forefront of its concern, and serve their physical, psychological, developmental, cultural and social interests equitably.’ These factors must be identified and evaluated with respect to environmental planning, implementation and decision-making in order to ensure that any development affecting the environment serves present and future

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75 Supra (note 53), Chapter 1
76 National Environmental Management Act 107 of 1998, s 2(1)
77 Ibid, s2(1)(a)
generations, a concept referred to as ‘sustainable development’. Alternatives must be considered with a view of ‘minimising negative impacts, maximising benefits and promoting compliance with the principles of environmental management’.

To ensure continuous and informed environmental protection, NEMA established a National Environmental Advisory Forum with a view of informing and advising the Minister on matters concerning environmental management, development and monitoring. Additionally, a committee for Environmental Coordination was established to promote and coordinate environmental functions by organs of state and to promote the achievement of the objective of environmental plans. The purpose of environmental plans is to coordinate and harmonise policies and plans of the various national departments, and they must be prepared by every national department which exercises environment-related functions.

The Environmental Impact Assessment Amendment Regulations, 2010 (EIA) were promulgated under the auspices of NEMA, to ensure that certain activities are assessed and investigated prior to authorisation for commencement. Under section 7(1) of the EIA regulations, ‘a competent authority is entitled to all information that reasonably has or may have the potential of influencing any decision with regard to an application unless access to that information is protected by law.’ Fracking companies would be required to submit to the competent authority a scoping report, followed by an Environmental Impact Assessment Report (EIR), conducted by a qualified independent Environmental Impact Practitioner (EIP). The reports must contain detailed information about, *inter alia*, the proposed activity, the location, the environment, possible impacts and affects, advantages and disadvantages of the activity, and possible mitigation measures. A draft environmental management

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76 *Fuel Retailers Association of Southern Africa v Director-General: Environmental Management, Department of Agriculture, Conservation and Environment, Mpumalanga Province and Others* 2007 (10) BCLR 1059 (CC); 2007 (6) SA 4 (CC)
79 *Supra* (note 76), s23(2)(b)
80 Ibid, s3
81 Ibid, s7
82 Ibid, s12
83 Ibid, s11(1)
84 Environmental Impact Assessment Amendment Regulations 2010, s28
85 Ibid, s31
programme must provide proposed management and mitigation measures taken to address the environmental impacts, including elements such as planning and design, construction activities, activity operation, environmental rehabilitation and eventual closure.\textsuperscript{86}

The EIA process contributes to the environmental management principles outlined by NEMA and assists decision makers in making informed authorisations, subject to thorough assessment and investigation of the proposed activities. Elements relating to water volume, sources, and quality can be scrutinized within the context of scarcity, public interest, and possible contamination. Corporations are forced to consider the environment and develop mitigation strategies to protect the environment and the public. The environmental management programme relating to construction activities and operation could presumably influence well construction, though the efficacy of such influence remains to be seen, especially given the fact that authorities have little experience in the fracking industry.

NEMA provides state organs with significant powers and responsibilities which shall come into play when considering shale gas operation sites, surrounding areas, and their respective environments. Socio-economic interests of inhabitants affected by the shale operations must play substantial roles in the environmental management plans and implementation thereof. Environmental authorities and decision makers will be required to balance human and environmental concerns with the proposed socio-economic benefits which can be achieved via fracking operations and ancillary issues.\textsuperscript{87} For example, underground aquifers and other bodies of water which may potentially be used for fracking, or contaminated as a consequence thereof, would have to be scrutinized within the context of environmental protection and human well-being. On the socio-economic side, improved infrastructural development, employment opportunities, monetary injections and other associated socio-economic developments will be considered. Authorities combine these factors and evaluate their contributions to sustainable development.\textsuperscript{88}

\textsuperscript{86} Ibid, s33
\textsuperscript{87} Havemann (note 22), Par 58
\textsuperscript{88} Ibid
The principles stated in NEMA must be applied by authorities in their formulation of environmental policies and plans. As with the NWA, these principles do not comprise concrete terms, and do not provide clear quantifiable methods with which to evaluate environmental or socio-economic impacts. Governmental decision and policy makers are left to their own device, guided by NEMA and the spirit of the Constitution to collect and evaluate relevant information, and formulate well structured, *bona fide* decisions in preparation of their environmental management plans.

### 3.1.4 Mineral and Petroleum Resources Development Act 28 of 2002 (MPRDA)

The aim of the MPRDA is ‘[t]o make provision for equitable access to and sustainable development of the nation's mineral and petroleum resources; and to provide for matters connected therewith.’ The act provides a system in terms of which mining and prospecting rights are granted and regulated. This act, as with those discussed above, reaffirms as one of its guiding principles the state’s obligations to protect the environment for the benefit of the people, ensuring and promoting social and economic development.

Companies wishing to investigate fracking viability in a specific area would first apply for a Technical Co-operation Permit under Section 77(1) which enables them to assess an area’s natural gas potential via desktop studies and seismic data. Exploration of shale gas would then require an Exploration Permit as per Section 79 of the MPRDA. Finally, a Production Right may be applied for in terms of Section 83. The Petroleum Agency of South Africa (PASA) is tasked under the MPRDA with the evaluation and issuing of such permits. Sections 79(4)(b) and 83(4)(b) of the Act respectively require any person that applies for an exploration or production license to conduct an environmental impact assessment and submit an environmental assessment report.

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89 Minister of Public Works and Others v Kyalami Ridge Environmental Association and Another (Mukwevho Intervening) 2001 (3) SA 1151 (CC).
90 Mineral and Petroleum Resources Development Act 28 of 2002, preamble
91 Petroleum Agency SA. Guidelines For Application Procedure In Respect Of Permits And Rights To Petroleum Resources
management programme as per section 39 of the Act. Impacts upon the environment and socio economic conditions must be scrutinised.\textsuperscript{92} Furthermore, the applicant must describe the manner intended to remedy and prevent any pollution.\textsuperscript{93} The approval of the plan is a prerequisite for the coming into force of the exploration or production right. The general objectives of integrated environmental management laid down in the NEMA must serve as 'guidelines for the interpretation, administration and implementation of the environmental requirements of this Act.'\textsuperscript{94}

In paragraph 75 of \textit{Bengwenyama Minerals (Pty) Ltd and Others v Genorah Resources (Pty) Ltd and Others (CCT 39/10) [2010] ZACC 26} (30 November 2010), concerning mining rights, the Constitutional Court, referring to the MPRDA, stated as follows:

It is one of the objects of the Act to give effect to the environmental rights protected in 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. In terms of section 17(1)(c) of the Act the Minister must grant a prospecting right if, amongst other requirements, the prospecting will not result in unacceptable pollution, ecological degradation or damage to the environment...

The MPRDA, like the NWA and NEMA, forces both fracking companies and authorities to consider environmental and ecological issues prior to the commencement of any activity. Once again, in-depth assessments are required via environmental management programmes, thereby creating a layer of environmental protection in addition to those provided by the NWA’s water use license applications, and NEMA’s environmental impact assessments and governmental environmental plans.

\textsuperscript{92} Supra (note 90), s39(3)(b)
\textsuperscript{93} Ibid, s39(3)(d)
\textsuperscript{94} Ibid, s37(1)

The main focus of this section is the introduction of foreign laws which can assist in plugging any legal lacunas in South African fracking laws, and in the development of a robust legal framework to regulate the fracking industry.

In the USA, regulation of oil and gas traditionally occurs at the state level, rather than federal level.95 Individual state regulators have been hard at work developing fracking-specific legislation which deals to a lesser or greater extent with the numerous risks posed by fracking. In 2011-2012, over 150 bills were introduced in 26 states that specifically address hydraulic fracturing.96 The Illinois Hydraulic Fracturing Act will form the focus of my analysis, as it provides one of the most holistic and comprehensive regulatory frameworks for the shale gas industry to date.

3.2.1 Illinois Hydraulic Fracturing Regulatory Act (HB2615)

On 17 June 2013, the state of Illinois passed the Hydraulic Fracturing Regulatory Act (Illinois Act), hailed by Gov. Quinn of Illinois as containing ‘the nation’s strongest environmental protections when it comes to hydraulic fracturing’.97 The Act contains provisions to protect water sources, water quality, the public, and the environment by setting strict requirements which must be adhered to by fracking companies. It establishes an interconnected system of permitting, disclosure and monitoring requirements which enable governmental agencies and the public to monitor fracking activities from inception to eventual closure.98

Corporations intending to commence fracking operations must first register with the Illinois Department of Natural Resources (IDNR) and apply for a High Volume

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95 Supra (note 10), 19
97 http://www.bryancave.com/files/Publication/167e5f17-191f-4a01-bb0c-b71155020f9f/Presentation/PublicationAttachment/16845022-ab1f-44f3-aef0-84e2524b16d2/ENR_Alert_7-2-13.pdf
98 Ibid
Horizontal Fracturing Permit from the department.\textsuperscript{99} The public is given 30 days to review and comment on the permit application prior to issue.\textsuperscript{100} An interested or potentially adversely affected party may file objections to the permit application and may request a public hearing during the public comment period.\textsuperscript{101} The permit applicant is required to provide intricate information regarding the proposed activity. Amongst the necessary information is a detailed description of the proposed well including the location where the well is to be drilled, various elements of the proposed depth of the well, the angle and length of the horizontal wellbore, depths of aquifers, injection and fracture pressure, the total volume of water or alternative base fluid anticipated for the operations, chemical additives, and more.\textsuperscript{102} Applicants must submit a comprehensive water management plan in which they describe the water sources to be used and their locations, the volumes and rates of withdrawal from each source, and the months during which withdrawal will take place, along with methods they will use to minimize water withdrawals and any adverse effects on aquatic life.\textsuperscript{103}

In order to protect the public and any water sources from possible threats, strict requirements have been imposed regarding the possible location of a well. Wells may not be drilled within 500 feet of any residence, place of worship, school, hospital and water well or spring intended for human or animal consumption; within 300 feet of any perennial stream, any river, lake or pond; within 750 feet of a nature reserve; and within 1500 feet of a surface water or ground water intake of a public water supply.\textsuperscript{104} The State of New York under pending Senate Bill 1230, is considering imposing well location restrictions of 10 miles from any New York City water supply infrastructure or watershed.\textsuperscript{105}

The Act further provides stringent chemical disclosure provisions. The permit application must be accompanied by a chemical disclosure report identifying all the

\textsuperscript{99} Hydraulic Fracturing Regulatory Act (HB 2615), s30
\textsuperscript{100} Ibid s45(a)
\textsuperscript{101} Ibid s50(a)
\textsuperscript{102} Ibid s35
\textsuperscript{103} Ibid s35(b) (10)
\textsuperscript{104} Ibid s25
\textsuperscript{105} \url{http://legiscan.com/NY/text/S01230/2011}
base fluids and all chemicals and proppants intended to be used at every stage of the fracking operations, along with their concentrations as a percentage by mass. Each additive must be accompanied by the trade name, vendor, a brief description of its intended use or function and a Material Safety Data sheet (MSDS) if applicable.\textsuperscript{106} The disclosure obligations endure both before and after fracking, and must be posted on the Illinois Department of Natural Resources’ website.\textsuperscript{107} Companies are however entitled to request trade secret protection of the chemical mix to protect qualified trade secrets from the general public.\textsuperscript{108} Health needs trump companies’ rights for trade secret protection, and any protection may be subjected to public challenge. Several states, including Indiana (House Bill 1107) and Louisiana (House Bill 957) have imposed provisions requiring the disclosure of fracking fluid volumes as well as additive volumes and descriptions.\textsuperscript{109}

A casing and cementing plan must be submitted with the permit application.\textsuperscript{110} Well integrity provisions require adherence to numerous operational best practices for site preparation, well construction, casement and maintenance.\textsuperscript{111} The Act sets out a comprehensive list of technical requirements related to drilling and cementing operations, necessary casings, pressure tests, cementing and casing depths and thicknesses, and additional related elements of the well construction process. Effectively, construction and cementing activities must prevent ‘migration of oil, gas and other fluids into the fresh groundwater and coal seams, and prevent pollution or diminution of fresh groundwater.’\textsuperscript{112} Importantly, casings and cementing requirements must conform to the current industry standards published by the American Petroleum Institute (API).\textsuperscript{113} Specific mention is made of certain cementing requirements such as isolation and protection of groundwater, the prevention of gas flow into the annulus, the need for compressive strength tests, and the installation of
blow out preventers.\textsuperscript{114} Copies of the cement job log must be available to the IDNR upon request.\textsuperscript{115}

As part of the permit application, applicants must submit a plan with regards to the handling, storage, transportation, disposal or reuse of fracking fluids and flowback, as well as identify specific oil and gas production related wells (Class II wells\textsuperscript{116}) that will be used for the injection and disposal of fracking fluid and flowback.\textsuperscript{117} Storage at the well site of fracturing fluids, additives, and waste produced via flowback and produced water, must be stored in above-ground tanks during all stages of the fracking operations, until removed for proper disposal.\textsuperscript{118} The tanks must be closed, watertight and corrosion resistant, and must be routinely inspected for corrosion.\textsuperscript{119} Fluids must be removed therefrom within 60 days of completion of the fracking operation.\textsuperscript{120} Reserve pits are allowed for temporary storage of flowback only in the event of a lack of capacity for tank storage due to unexpectedly high flowback rates or volumes.\textsuperscript{121} The pit must comply with strict requirements regarding minimum thickness, resistance and capacity standards, and constructed in accordance with manufacturers specifications and good engineering practices to prevent overflow.\textsuperscript{122} Any flowback contained in such reserve pit must be removed from the well site within 7 days. The transport of all fracking fluids, flowback and produced water must be undertaken by a liquid oilfield waste hauler permitted under the Illinois Oil and Gas Act.\textsuperscript{123}

Companies are required to conduct water sampling and testing several times throughout the fracking process, and upon completion.\textsuperscript{124} Prior to commencement of any fracking activities, an independent third party under the supervision of

\textsuperscript{114} Ibid, s70(d)(4)
\textsuperscript{115} Ibid, s70(d)(9)
\textsuperscript{116} http://water.epa.gov/type/groundwater/uic/class2/index.cfm
\textsuperscript{117} Supra (note 99), s 35(b)(11)
\textsuperscript{118} Ibid, s75 (c)
\textsuperscript{119} Ibid, s75(c)(4)
\textsuperscript{120} Ibid, s75(c)(5)
\textsuperscript{121} Ibid, s75(c)(2)
\textsuperscript{122} Ibid, s75(c)(5)
\textsuperscript{123} Ibid, s75(c)(10)
\textsuperscript{124} http://www.huffingtonpost.com/2013/06/17/illinois-gas-drilling-rules-fracking_n_3455668.html?utm_hp_ref=green
professional engineer or geologist must be designated to conduct baseline water sampling of all water sources within 1500 feet of the well site. Samples must be analysed by an independent laboratory and the results are submitted to the IDNR who then posts them on their website. Further testing must again occur in the same manner 6 months, 18 months, and 30 months after fracking operations have been completed.

Fracking flowback must be tested for its organic and inorganic chemical composition, heavy metals, and NORMs prior to removal from the site, and the results are provided to the IDNR. Flowback may only be disposed of by injection into a Class II well, and produced water may be disposed of into a water flood operation, whereby water is injected into a reservoir formation to enhance oil capture. Both may be treated and recycled for reuse in fracking fluid. Discharge of fracking fluid, flowback or produced water into surface water or water drainage way is prohibited. In the event of pollution or diminution of a water source, the act creates a rebuttable presumption of liability against a fracking company operating within 1500 feet of such water source. The onus is the placed upon the companies to prove by clear and convincing evidence that they are not the cause of the contamination. A presumptive impact area of 2500 feet from the vertical wellbore is similarly created in Maryland by House Bill 1123, for a period of 365 days. Furthermore, H.B. 1123 requires a permittee to replace the water supply which has been contaminated as a result of the fracking operations.

The Illinois Act prescribes the need for operational best practices and sets minimum standards which must be applied in fracking operations. By combining these two legislative tools of setting minimum standards and demanding optimal industry

125 Supra (note 99), s80(b)
126 Ibid, s80(c)
127 Ibid, s75(c)(7)
128 Ibid, s75(c)(8)
129 http://www.arcanres.com/operations/waterflood-operations/
129 Ibid, s75(c)(8)
130 Supra (note 99), s75(c)(8)
131 Ibid, s75(c)(9)
132 Ibid, s85
133 Maryland House Bill 1123, sC(1)
134 Ibid, sD
practices, Illinois creates a watertight legal framework which requires corporations to achieve high operational standards while forcing them to keep up with new technologies which are constantly improving the standards of operational best practice.

3.2.2 Bolstering South African Fracking Laws

While the South African Constitution provides umbrella protection which can and should be applied to all environmental and public issues inherent to fracking, its guiding principles must be expanded into a comprehensive and transparent legal system characterised by legal certainty. Laws should reflect a thoroughly balanced set of moral, environmental and socio-economic principles, indicating that lawmakers have applied their minds to the pursuit of bettering all aspects of the nation and its people. The applicable South African legislation discussed above provides a degree of coverage but may be insufficient to guarantee adequate protection for the environment and the people.

The NWA coupled with the obligatory environmental impact assessment under NEMA and the environmental management programme under the MPRDA cover several of the water related aspects discussed under the Illinois Act. The discretionary nature of the licence conditions which may be applied by licencing authorities under the NWA are however in stark contrast to the obligatory demands imposed on permit applications under the Illinois Act. The Illinois Act provides measurable benchmark standards which impose minimum requirements on all permit applicants and operators. This approach ensures greater transparency and legal certainty. On the other hand, the discretionary nature of licencing conditions under the NWA and the lack of benchmark standards guiding management programmes increases the possibility that certain potentially hazardous terms are overlooked which may in the future result in precarious and costly scenarios. Unregulated issues enable a company to substitute safety for cost efficiency by exploring a variety of options, some of which may compromise environmental security. A well-defined checklist of ‘non-negotiable’ requirements as embodied in
the Illinois fracking permit reinforces the probability that all activities have undergone thorough consideration and planning. Mandatory information provided in a permit application enables the relevant authorities to make well informed comparative analyses and subsequent decisions. To ensure environmental protection and mitigate potential contamination, it is essential to qualify contentious issues as early as possible, and provide benchmark standards which must be achieved.

Nevertheless, South African legislation, and in particular the NWA and EIA under NEMA provide a tight set of regulations regarding water volume, withdrawals and storage. Water withdrawal must be monitored and reported, along with water quality and degradation. Laws are in place which require all reasonable steps to be taken to prevent pollution, and which provide for the cessation of activities should pollution occur, including subsequent measures to remedy its effects. Issues of water scarcity and equitable allocation are vehemently stressed and must be given thorough consideration when water licences are granted, and certain activities authorised.

To reduce water volume demands, operators should consider the use of non-potable water for fracking operations when practicable.\(^{135}\) The use of low quality aquifer water, brackish water, sea water, coal mine drainage, power plant cooling water, flowback, or other innovative solutions can be encouraged via regulation and water cost incentives. However, as the economic and logistic viability of such options is ambivalent and varies from location to location, strict requirement as regards such alternatives will be difficult to impose, and should perhaps be considered on an ad hoc basis when evaluating licence applications, EIAs, management programmes, and governmental environmental management plans. Requirements to replenish water sources could also be imposed where appropriate.

The chemical composition of the fracking fluid may be influenced by licence conditions and wastewater treatment standards. Requirements may be inserted in the licence conditions or included as a necessary part of the environmental management programmes, but since there are no frack-specific laws in the South Africa, there are no comprehensive guidelines regarding the use or concentration of

\(^{135}\) Supra (note 45), VII
certain chemicals. Discovery of the chemical components and concentrations are supported by section 32 of the Bill of Rights, but should be further enforced and expanded through fracking regulation. As with the Illinois Act, discovery should be comprehensive and transparent, requiring aspects such as trade name, vendor, and description of each chemical which is intended be used and has in fact been used at any stage of the fracking operation. Material Safety Data Sheets (MSDS) for each chemical should be obtained from the supplier or manufacturer and should contain information regarding proper storage, environmental hazards, and spill clean-up procedures.\(^{136}\) In the event that a chemical additive qualifies for trade secret protection in South Africa, such protection could be limited as is the case in Colorado to the chemical name, but the chemical family name must be disclosed. Under special circumstances, further information must also be disclosed at the request of regulators or medical professionals.\(^{137}\) Alternatively, by refusing to grant trade secret protection to fracking chemicals, the increased transparency may assist in the pursuit of achieving superior chemical mixtures and minimal environmental damage. An online chemical disclosure registry such as Fracfocus could enhance transparency and expose chemical mixtures to public scrutiny, thereby further promoting operational best practices.

In South Africa, Shell have claimed that they will fully disclose all chemical additives used in their operations and that they will not use unacceptable additives.\(^{138}\) Nevertheless, legislation should be imposed to enforce such discovery and enable on-site testing for banned substances.\(^{139}\) Public disclosure of the chemical mix would also enable regulatory agencies, water authorities, and interested parties to conduct site by site tests to determine environmental and health impacts, and respond appropriately in the event of contamination or exposure.\(^{140}\) Regulatory developments could eventually include operational best practices regarding the use of biodegradable substances, or a reduction in the concentration of the toxicity of the

\(^{136}\) Supra (note 45), 5
\(^{137}\) Pless (note 9), 6
\(^{138}\) De Wit (note 4), 5
\(^{139}\) Ibid
\(^{140}\) Zoback (note 20),10
constituents. Ultimately, research and development should hopefully lead to the use of non-toxic chemicals, a goal pursued by industry specialists such as CleanStim.¹⁴¹

One of the most paramount activities to mitigate environmental damage is to ensure proper well construction and integrity. Research conducted by the Energy Institute at the University of Texas suggests that there is no direct link between fracking and groundwater pollution, but rather that above ground spills, leaking drill casings and wastewater mishandling could be a more probable cause of groundwater pollution.¹⁴² The lack of shale gas extraction via hydraulic fracturing in South Africa means that laws corresponding to fracking wells are absent, potentially exposing the environment to an increased risk of contamination. Strict regulation on well construction is absolutely crucial to the security of the environment and the public, as the highly technical nature of the construction increases the likelihood of well failure. Issues such as well casings, proper cementing of the annulus, pressure tests, well depth as relative to aquifer depths; and well proximity to, inter alia, water sources and residences, must be properly regulated to at least prescribe minimum requirements, while promoting operational best practices. When a well becomes uneconomical and is subsequently abandoned, regulation should require that such well be plugged with cement or other suitable material. Failure to do so could lead to the migration of hydrocarbons, formation water and fracturing fluids along the wellbore and potentially into aquifers or other water sources.¹⁴³

According to a 2009 survey by GWPC, 25 states require surface casing to be set below the deepest groundwater, and 21 require cement set-up times, or cement testing.¹⁴⁴ The API has published Well Construction and Integrity Guidelines providing a comprehensive guide to industry best practices that help to ensure that aquifers and the environment are protected.¹⁴⁵ While the details of well construction may vary depending on geological, environmental and operational settings, best

¹⁴¹ Halliburton’s CleanStim products
¹⁴² Pless (note 9), 7
¹⁴³ Zoback (note 20), 5-6
¹⁴⁴ Zoback (note 20), 10
practices in well construction remain similar throughout. The wealth of long researched and refined best practice guidelines provided by the API should assist South African law makers to structure highly technical best practice procedures to ensure proper well construction and integrity.

The NWA contains general provisions creating obligations of pollution prevention and preventative action. Furthermore, chemical storage as well as wastewater storage and disposal may be dealt with under the water-use licence conditions as per the NWA. To avoid sub optimal wastewater storage practices however, such as the common use of open pits and sub-standard pit liners, South African regulators should insist on operational best practices to mitigate the possibility of spillage or overflow. All fracture fluids and additives should be managed properly at all stages of the fracking operation, and should ideally only be blended when needed. As with the Illinois Act, mandatory practices should include storage of wastewater and chemicals in closed, watertight, above-ground, corrosive resistant tanks, which tanks should be routinely inspected for corrosion, and maintained. Should the need arise to use reserve pits for emergency temporary storage, such pits must comply with minimum requirements as regards material durability, thickness, and capacity. A maximum allowable period for storage prior to removal from site should also be allocated.

The various methods of wastewater disposal should be strictly regulated to prevent contamination, and where possible, to promote recycling and reuse. As with the Illinois Act, wastewater should be tested for organic and inorganic substances, as well as heavy metals and NORMS, prior to removal from the site. Subject to a permit granted by government authorities, untreated water could be injected into deep saline aquifers which are located far below any fresh water aquifers. It is recommended that the identification of specific injection wells be included in management plans or programmes. The API classifies such wells as Class IID in its

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146 Supra (Note 27), Scope
147 Supra (Note 45)
148 Ibid, Chpt 7.1
149 Zoback (note 20), 10
150 Water process
151 Supra (Note 45) 5
Underground Injection Control (UIC) programme. Subject to practicality and the ability of a facility to deal with the recorded wastewater contaminants, wastewater can be sent to municipal or private industrial waste treatment facilities. Treated wastewater which complies with certain requirements can then be reused in subsequent fracking operations. This decreases both the amount of new water required for fracking, and the amount of wastewater that must be disposed of. Alternatively, treated water may be discharged into bodies of natural water such as lakes or rivers, if it meets stringent discharge standards.

As per chapter 14 of the NWA, water sources within a defined area must undergo sampling, testing and monitoring in order to determine the water's respective quality and quantity. Specific monitoring requirements may be set up in the water use license. Regulations should ensure that water monitoring be repeated even once operations have ceased, since contamination can occur even after completion of fracking activities. A presumptive impact area should be set up which presupposes a rebuttable presumption of liability against fracking companies with regards to water contamination within the area.

Fines for any contravention of the applicable rules and laws should be imposed and should amount to greater value than the cost of compliance. This ensures that a contravention of a law and the ensuing fine are not economically justified.

4. Concluding Remarks

Existing South African legislation provides a set of laws capable of influencing several important fracking-related environmental issues, and at the very least, such laws provide a springboard for fracking-specific regulation. Guided by the spirit of the constitution, the above mentioned legislation is aimed at achieving social and economic welfare in a manner which most benefits the people and the environment.
and promotes ecologically sustainable development. The manner of achieving the
goal is often left unqualified allowing affected parties to employ a variety of methods
to ensure compliance.

This approach is useful in the sense that it provides wide protection, and should
encourage parties who are most closely related to the given industry to employ the
most effective means to achieve the blanket goals set by the legislation.
Nevertheless, it exposes areas of contention or ambiguity to sub optimal practices.
This is especially risky in an immature industry where legislators, operators, and the
public have a deficit of knowledge and expertise, and are therefore often unaware of
the types of risks, the reasons for the risks, and the methods to control the risks.
Methods of achievement are left at the behest of the industry players, and more
experienced operators may take advantage of legal lacunas or ambiguities in an
effort to reduce costs, subject only to the scrutiny of novice, or even corrupt
government officials and licencing authorities.

Research suggests that in order to ensure that South Africa’s environment, water
sources and public are adequately protected, frack-specific laws should be
developed, which provide quantifiable and qualitative benchmarks concerning all the
elements of fracking, while imposing operational best practices. This will ensure that
not only are minimum requirements set, but also the need to strive for best practices
for any given activity. This allows operators to increase efficiency and efficacy by
applying industry advancements to achieve their own economic goals, and perhaps
more importantly, the environmental conservation goals of the legislators. This
approach should also be extended to areas outside the scope of this paper’s
analysis, such as air contamination issues including venting and flaring, and the
potential for mild seismicity.

Lawmakers should turn to more experienced nations in the industry and employ the
abundance of foreign technical and legislative fracking knowledge to boost South
Africa’s own fracking laws. As the USA’s fracking industry is extensively ahead of
any other nation in the world, the sensible approach would be to learn as much as
possible from their frack-related legal framework. Experience should be shared via
training programmes, professional and trade associations, literature, and most importantly, industry standards and recommended practices.\footnote{Supra (note 27) 1}

The primary conclusion reached is that South African legislation does offer environmental and water protection, but should be strengthened to further mitigate and target the possible risks of fracking. As per the recommendations of the Department of Mineral Resources, fracking exploration should be allowed to proceed under existing laws; a special monitoring committee should be established; appropriate regulation must be developed; and fracking should be authorised under the strict supervision of the monitoring committee.\footnote{Supra (Note 1) 7} Any fracking moratorium would deprive the nation of the enjoyment of immense socio-economic benefits, ranging from job creation, energy security, increased GDP, infrastructural development and a myriad other consequential benefits.

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