

# Some Legal Options to Ensure the Protection of South Africa's Utilisable Groundwater Resources

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## Abstract

Groundwater, which is water that is found underground, is less susceptible than surface water resources to evaporation, and thus offers resilience against the impacts of climate change. Many South African cities, communities and farmers depend on groundwater for domestic or other socio-economic purposes. This implies that groundwater resources which are currently or potentially utilisable should be identified, and suitable legal measures should be implemented to protect these resources from potential risks of harm or damage posed by anthropogenic activity. This article firstly evaluates the effectiveness of the country's existing regulatory framework to effectively protect South Africa's groundwater resources and finds that the framework can be improved upon significantly. Secondly, it explores regulatory opportunities within the existing legal framework to strengthen South Africa's groundwater governance regime, including making use of land-use planning instruments to facilitate the implementation of groundwater protection zones.

## Keywords

Groundwater governance; water law; protection; land-use activities; hydrogeology; aquifer protection zones.

## 1 Introduction

With a total annual renewable water resource of 51,350 Mm<sup>3</sup>/a, South Africa is ranked as the 30th driest country in the world.<sup>1</sup> South Africa's low and highly variable rainfall patterns, coupled with erratic stormwater runoff, high evaporation rates and shallow dam basins exacerbate the fact that the country's demand for water exceeds its availability.<sup>2</sup> To meet the demand, communities are increasingly reliant upon groundwater.<sup>3</sup> In 2005 an estimated two thirds of South Africa's population already depended on groundwater for their domestic water needs.<sup>4</sup> In 2011 the then Department of Water Affairs (DWA)<sup>5</sup> reported that groundwater was the sole or primary source of water for 926 cities, towns, and villages in South Africa.<sup>6</sup> Many of South Africa's aquifers are of significant socio-economic importance, for example, large-scale irrigation of vegetables in areas such as Delmas is completely dependent on groundwater resources, and the city Tshwane is dependent on the Fountains Aquifer for more than 60 per cent of its domestic supply. A drastic increase in groundwater dependence has since been reported; not only for urban domestic purposes,<sup>7</sup> but also for other socio-economic purposes,<sup>8</sup> including agriculture<sup>9</sup> and mining.<sup>10</sup>

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<sup>1</sup> Cole *et al* 2018 *Water Policy* 38.

<sup>2</sup> Cole *et al* 2018 *Water Policy* 38; DWA *National Water Resource Strategy 2013* (the NWRS 2013).

<sup>3</sup> Nel *et al* 2009 *Water Resources Management* 2896.

<sup>4</sup> Rosewarne, Woodford and Girman 2005 [https://dxi97tvbmhbca.cloudfront.net/upload/user/image/1\\_A\\_Woodford20200304180745931.pdf](https://dxi97tvbmhbca.cloudfront.net/upload/user/image/1_A_Woodford20200304180745931.pdf) 2.

<sup>5</sup> Adams *et al* 2015 *South African Journal of Geology* 8; DWA *Development of Reconciliation Strategies* 844.

<sup>6</sup> Adams *et al* 2015 *South African Journal of Geology* 8; while this article focusses on South Africa, the theme may be connected to broader, global considerations as 30 per cent of all fresh water on earth is found underground. USGS 2019 <https://www.usgs.gov/special-topics/water-science-school/science/how-much-water-there-earth>.

<sup>7</sup> Adams *et al* 2015 *South African Journal of Geology* 7.

<sup>8</sup> Forster *et al* *Groundwater Quality Protection* 2.

<sup>9</sup> Nel *Groundwater* 7.

<sup>10</sup> Although the use of groundwater for agricultural purposes has not yet been quantified in the same manner as for domestic use, scholars argue that the dependency on groundwater for agricultural purposes, including irrigation and stock watering, is even higher than the use for domestic purposes, which is significant from a food security perspective. It is also trite that other sectors, such as the mining industry, are also heavily dependent on groundwater for their operational supply.

This implies that appropriate legislative protection of groundwater is essential, and this requires a proper understanding of the sciences underpinning the occurrence and utilisable exploitation potential of, and potential impacts on, groundwater resources.<sup>11</sup> The realisation of the objectives of sustainable development depends on the fruitful interaction between science and law, yet such interactions are notoriously complex.<sup>12</sup> This especially holds true for the interaction between law and the field of hydrogeology, the study of water found underground. As will be argued in more detail below, a better scientific understanding of groundwater systems may render it subject to more optimal legal governance.

In the light of South Africa's growing dependence on groundwater, this article firstly discusses some elements of the science of hydrogeology to provide a general understanding of the complex natural processes that influence groundwater occurrence, and to demonstrate that groundwater resources have significant social, economic, and ecological importance but that they are indeed particularly vulnerable to detrimental effects on groundwater quality and availability due to overexploitation and pollution resulting from anthropogenic activities.<sup>13</sup> However, our current understanding of these systems, interactions, and impacts is limited and riddled with uncertainties which are often difficult to regulate, and this article therefore secondly examines and critically assesses the existing regulatory mechanisms implemented to protect South Africa's aquifers. Considering both the scientific principles and the current regulatory framework, some legal options, in particular planning law initiatives, are discussed that could enhance the protection of groundwater resources that are vulnerable, sensitive and of socio-economic importance. The paper concludes with recommendations to improve the country's regulatory protection of groundwater resources.

## 2 Scientific background

To critically assess the existing regulatory framework that governs and protects South Africa's groundwater, it is necessary to have a general understanding of the hydrogeological environments that host groundwater (aquifers); the processes that influence groundwater quantity and quality; as well as the detrimental effects on aquifers resulting from anthropogenic activities.

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Adams *et al* 2015 *South African Journal of Geology* 7; Jakeman *et al* *Integrated Groundwater Management* 3.

<sup>11</sup> Levy and Xu 2011 *Hydrogeology Journal* 211.

<sup>12</sup> Ellis 2009 [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=1504113](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1504113) 1.

<sup>13</sup> Jakeman *et al* *Integrated Groundwater Management* 4.

## 2.1 Hydrogeological concepts and principles

An estimated 30 per cent of the total global fresh water supply is found underground in aquifers.<sup>14</sup> Aquifers are rocks<sup>15</sup> or geological formations which are saturated with water, or which allow an appreciable flow of water through them. Although the terms "aquifer" and "groundwater" are often used interchangeably, not all water that occurs underground ("groundwater") can be regarded as occurring in an "aquifer", as some water is in the vadose zone,<sup>16</sup> and some water is present as soil moisture, or as interflow (flow within the unsaturated zone).<sup>17</sup>

Precipitation that does not directly reach streams as surface runoff<sup>18</sup> will seep into the ground through the vadose zone and reach the underlying rock strata that are saturated with water (the saturated zone or "aquifer"),<sup>19</sup> This process is known as "aquifer recharge".<sup>20</sup>

The interaction and exchange<sup>21</sup> between water in aquifers and surface water is an essential component of the hydrological cycle<sup>22</sup> and can take anything between months and millennia. The average time for water in aquifers to cycle through the hydrological cycle is 280 years.<sup>23</sup> Because the process is so slow, an impact that occurs today could become evident only 280 years from now, which is one of the main reasons why good groundwater governance is a critical component of sustainability.

Groundwater quality varies in space and time and can be influenced by both natural processes and anthropogenic activities.<sup>24</sup> Natural hydrogeochemical processes that take place as water slowly moves through the host rock from

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<sup>14</sup> Nel *Groundwater* 10; USGS 2018 <https://www.usgs.gov/special-topics/water-science-school/science/where-earths-water>.

<sup>15</sup> Some types of rocks are described as "aquitards", which are confining beds that retard the flow of water to or from an adjacent aquifer. Although an aquitard does not readily release water to streams, boreholes, or springs, it may also function as storage for groundwater. It is not regarded as an "aquifer" from either a scientific or a legal perspective, however. Sun and Zhan 2006 *Journal of Hydrology* 364.

<sup>16</sup> Mutandanyi *Modelling Subsurface Water Flow* 1.

<sup>17</sup> Mutandanyi *Modelling Subsurface Water Flow* 1-3.

<sup>18</sup> Foster *et al Groundwater Quality Protection* 4.

<sup>19</sup> Nel *Groundwater* 12, 15; Saayman *et al Assessment of Aquifer Vulnerability*.

<sup>20</sup> Mutandanyi *Modelling Subsurface Water Flow* 1-3.

<sup>21</sup> Notably, where the rate of exchange of water through the water cycle is about fourteen days for surface water (from falling as precipitation and entering a stream as surface runoff, until evaporating and falling as rain again), the exchange rate is much slower for water in aquifers (from falling as rain, filtering through the vadose zone, being discharged into a spring or stream, evaporating, and falling again as rain). Such an exchange can take millennia.

<sup>22</sup> Nel *Groundwater* 9; Shiklomanov "World Fresh Water Resources" 15; Sun and Zhan 2006 *Journal of Hydrology* 364.

<sup>23</sup> Heath 1983 <https://pubs.usgs.gov/wsp/2220/report.pdf> 1.

<sup>24</sup> Akhtar *et al* 2021 *Water* 3.

recharge to discharge areas will influence groundwater quality,<sup>25</sup> as will processes such as high evaporation rates in recharge areas. Certain minerals dissolve more readily than others, while some rocks are richer in soluble minerals than others. The pH of the water also affects the solubility of minerals. Therefore, the specific chemical composition of water in an aquifer will depend largely on the composition (temperature, pH, and salt composition) of the precipitation that recharges the aquifer, the geology of the aquifer (the composition of the rocks through which the water moves, keeping in mind that some types of lithologies were deposited under marine conditions, and will have a high salt load, while others were deposited under volcanic activity, and could naturally be radio-active), and the presence or absence of oxygen. Oxidation or reduction conditions can vary rapidly over short distances within an aquifer, which will in turn determine the type of substances in the host rock that will dissolve in the groundwater.<sup>26</sup>

In South Africa four primary types of aquifers can be distinguished from one another based on the lithologies (rock systems) in which they occur. These are karstic (dolomitic) aquifers (associated with dolomitic rock), fractured aquifers, intergranular aquifers, and combined fractured and intergranular aquifers.<sup>27</sup> Karstic aquifers are formed by the dissolution of bedrocks, mostly rocks containing carbonate (carbon-oxygen combinations), such as limestone and dolomite, by the circulating groundwater,<sup>28</sup> which creates a network of connected fractures and caves. Notably, recharge from surface water runoff is especially scarce at karstic aquifers. It follows that karstic aquifers are particularly vulnerable in drought periods. It should further be noted that karstic aquifers are extremely vulnerable to contamination, as pollutants can easily enter the aquifer and spread through the network of fractures and caves, often without processes of filtration offered by sandy vadose zones. Karstic aquifers therefore require specific regulatory protection. The same applies to the other types of aquifers, each with its own unique characteristics of geology.<sup>29</sup>

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<sup>25</sup> Ligavha-Mbelengwa and Gomo 2020 *Environmental Earth Sciences* 1, 6.

<sup>26</sup> Chemical oxidation and reduction processes caused by various factors can lead under reducing conditions to the dissolution of oxides and carbonates, the oxidation of sulphides and pyrites, and the denitrification of nitrogen forms. Under oxidising conditions, for example, when rock that was buried for millennia is exposed to the atmosphere, the reverse of these reactions can occur. This is typically measured with an oxidation-reduction potential meter.

<sup>27</sup> Nel *Groundwater* 21.

<sup>28</sup> Bakalowicz 2005 *Hydrogeology Journal* 149; Nel *et al* 2009 *Water Resources Management* 2901.

<sup>29</sup> Fractured rock aquifers, for example, are found in hard rock environments. Groundwater is then stored in the fractures and cavities of the rock mass, but there is little to no decomposition of the rock that allows for groundwater movement. As a result, the storage of groundwater found in fractured aquifers is limited. Intergranular aquifers refers to aquifers in which groundwater flows in openings or void spaces

## 2.2 Anthropogenic impacts on aquifers

South Africa's aquifers are vulnerable due to land-use activities such as active and abandoned tailings dams, municipal and industrial landfills, stockpiles of certain raw materials, storage tanks for fuel and chemicals, and even the incorrect placement of septic tanks.<sup>30</sup> In fact, all land-based human activities have a direct or indirect impact on the natural hydrogeological cycle, as they could affect the occurrence, recharge, discharge, availability, quantity and quality of groundwater. In addition, aquifers are detrimentally affected by urbanisation, which increasingly leads to built-up areas that cover the soils in recharge zones through which precipitation should infiltrate to replenish and sustain the aquifer.

The mere abstraction of groundwater from aquifers can also have serious detrimental effects. It not only leads to physical impacts on land, such as subsidence (which leads to the cracking and even the collapse of buildings and damage to linear infrastructure such as roads and pipelines),<sup>31</sup> but also reduces the availability of water in the aquifer and creates a drawdown effect that cause neighbouring boreholes to become dry. Specifically, the overexploitation of groundwater from karstic aquifers can lead to sinkhole formation, which sterilises land for other types of development, as has happened on the Far West Rand, where dewatering of the karstic aquifers to facilitate gold mining in the 1950s<sup>32</sup> caused sinkhole formation to such an extent that no housing developments can take place on these areas.

The concept of "safe borehole yields" has been developed to curb over-abstraction. A safe borehole yield, in simple terms, is the volume of groundwater that can be abstracted from a borehole without the borehole becoming dry (in other words, the amount that can be abstracted within the limits of the replenishment of the aquifer with recharge). Domestic use for a small household needs a yield of around 1 l/s, while the yield for a municipal wellfield for a medium-sized town is in the order of 30–100 l/s, and to irrigate a 10-ha plot of land would require a yield of around 10 l/s.<sup>33</sup> It goes without saying that these yields can be sustained only if the aquifer is able to deliver these volumes from a hydrogeological perspective and if it is not over-exploited; in other words, if the abstraction rate does not exceed the

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between grains and weathered rock, while combined fractured and intergranular aquifers represent a multi-porous medium that consists of fractures and rock. These types of aquifers are particularly important to determine, for example, how aquifers would respond to the effects of resource degradation, and the possible pathways that pollutants can follow from a contamination source to a potential receptor. Nel *et al* 2009 *Water Resources Management* 2900-2901.

<sup>30</sup> Adetunji and Odetokun 2011 *Malaysian Journal of Microbiology* 160.

<sup>31</sup> Knüppe 2011 *Water SA* 69; Nel *Groundwater* 22.

<sup>32</sup> Foote 1967 *Science* 1045.

<sup>33</sup> Nel *Groundwater* 41.

recharge rate, which is dependent on precipitation, infiltration into the vadose zone and percolation to the aquifer. Notably, each unique borehole will have its own specific borehole yield.<sup>34</sup>

With the dependence on groundwater on the increase,<sup>35</sup> the prevention of overexploitation and pollution of groundwater resources that have significant socio-economic value should be prioritised. This is, however, not currently the case, as is evidenced in the case of the Botleng Dolomitic Aquifer, for example. The Botleng Aquifer used to be the primary groundwater source for domestic water supply in the Delmas area, east of Johannesburg, but due to groundwater contamination in the area as a result of poor sanitation service delivery, the Delmas community witnessed a number of serious outbreaks of water borne diseases, including cholera and typhoid fever.<sup>36</sup> As a result, domestic supply from this aquifer had to be discontinued, with the community now being supplied by Rand Water, with water from the already stressed Vaal Dam system. The Delmas area is known for its agricultural production of vegetables for the Gauteng area, which crops are still being irrigated from the Botleng Aquifer, but new mining activities on top of this aquifer are now placing this beneficial use of the aquifer at additional risk. Together with the impacts accompanying socio-economic development, the reality of climate change and population growth are expected to add even more pressure on South Africa's groundwater resources.<sup>37</sup> In addition, as groundwater is less susceptible to the effects of climate change, it is evident that the appropriate protection and sustainable governance of South Africa's groundwater resources are of critical importance.

### **3 Regulation of the groundwater resources of South Africa**

#### **3.1 Historic regulatory context**

Historically the legal status of groundwater in South Africa has been rather vague and not clearly defined.<sup>38</sup> Prior to the Dutch colonisation of South Africa in 1652, African customary law governed the use and enjoyment of water as a natural resource.<sup>39</sup> Accordingly, water was treated as being part of the "commons". It follows that water was free to all members of the community and could not be owned privately.<sup>40</sup> Following the Dutch

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<sup>34</sup> Levy and Xu 2011 *Hydrogeology Journal* 211; Nel *Groundwater* 21.

<sup>35</sup> Adams *et al* 2015 *South African Journal of Geology* 7.

<sup>36</sup> In September 2005 a total of 3 000 people were diagnosed with diarrhoea and 561 with typhoid fever. Five deaths were officially recorded. Adams *et al* 2015 *South African Journal of Geology* 12; Nel *et al* 2009 *Water Resources Management* 2899.

<sup>37</sup> Shiklomanov "World Fresh Water Resources" 23.

<sup>38</sup> Pienaar and Van der Schyff 2007 *Law, Environment and Development Journal* 181.

<sup>39</sup> Tewari 2009 *Water SA* 693.

<sup>40</sup> Tewari 2009 *Water SA* 695.

occupation and later colonisation of the Cape of Good Hope in 1652, the Roman-Dutch law was transplanted to areas of South Africa. The Roman-Dutch law introduced the concept of "*res communes*", or the idea of "a resource common to all".

The British colonisation of the Cape in 1806, of KwaZulu-Natal in 1843 and of the northern provinces in 1901 saw the introduction of the riparian rights system into South Africa's water law. In the case of *Hough v Van der Merwe*,<sup>41</sup> De Villiers CJ confirmed for example that there is a legally significant distinction between public and private streams; and held that an upper riparian owner of land adjacent to a public stream is entitled to divert a portion of water for the purposes of irrigation, limited by certain rights of other riparian owners.<sup>42</sup> The British system also regarded groundwater as "private water"<sup>43</sup> and gave landowners the right to use groundwater occurring on their properties without government control, thereby establishing a link between groundwater and landownership. As private law generally regulated the acquisition, protection and transfer of land as private property, groundwater was mainly defined and regulated in a private property regime.<sup>44</sup> This implies a direct legal link between land use and groundwater.

The historical classification of South Africa's groundwater resources as "private water", in contrast to "public water", however, effectively minimised the power of the state to control and regulate the resource. This arrangement, which allowed for the unrestricted use of the resource, perpetuated and resulted in various instances of over-exploitation and contamination. In the year 1950, due to a rapid increase of boreholes drilled for irrigation purposes, the Hall Commission, for example, heard evidence regarding the weakening flow conditions of the Uitenhage Artesian Aquifer.<sup>45</sup>

Although section 1 of the *Water Act 54* of 1956 still distinguished between "private water" and "public water", and still regarded groundwater as "private water", this Act also gave the then Minister of Water Affairs the power to declare so-called subterranean government water control areas in which, in certain circumstances, the Minister could override private rights to use water.<sup>46</sup> As a result, the use of groundwater that occurred in subterranean control areas became subject to statutory allocation rules. The water use right granted in these areas was a restricted right in involving prescribed

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<sup>41</sup> *Hough v Van der Merwe* 1874 4 Buch 148.

<sup>42</sup> *Hough v Van der Merwe* 1874 4 Buch 148.

<sup>43</sup> *Struben v Cape Town District Water Works Co* 1892 9 SC 68.

<sup>44</sup> *Hiscock v De Wet* 1881 Buch AC 249; Knüppe 2011 *Water SA* 70.

<sup>45</sup> Maclear 2001 *Water SA* 499.

<sup>46</sup> Section 28 of the *Water Act 54* of 1956.

quantities and purposes. In terms of the 1956 Act, the following subterranean government water control areas were subsequently declared:

Primary drainage region	Tertiary/Quaternary drainage region	Description of subterranean government water control are	Government Notice No.	Government Gazette Date
H	H30	Baden	136	1967-06-16
A	A30	Bo-Molopo	1324	1963-08-30
C	C30	Bo-Molopo	1993	1965-12-17
D	D41	Bo-Molopo	R634	1966-04-29
A	A24	Crocodile River Valley	208	1981-10-23
A	A21	Crocodile River Valley	18	1983-02-18
A	A21, A22	Kroondal-Marikana	180	1963-06-17
G	G10, G30	Lower Berg River Valley/Saldanha	185	1976-09-10
A,B	A60, B50, B31	Nyl River Valley	56	1971-03-26
G	G30	Strandfontein	2463	1988-12-09
M	M10, M20, M30	Uitenhage	260	1957-08-23
G	G30	Wadrif	992	1990-05-11
G	G20	Yzerfontein	27	1990-02-09
G	G30	Graafwater	1423	1990-06-29
A	A70	Dendron-Vivo	813	1994-04-29
A	A60	Dorpsrivier	312	1990-02-16
C	C24	Ventersdorp	777	1995-06-02

Table 1: Subterranean government water control areas established under the *Water Act* 54 of 1956, as captured in the General Authorisation in GN 665

Although the *Water Act* 54 of 1956 has since been repealed, some of its regulations retained legal standing under the *National Water Act* 36 of 1998 (NWA). Specifically, the subterranean government water control areas listed in Table 1 above are listed in the General Authorisations (GAs) promulgated under section 37 of the NWA<sup>47</sup> for water uses as described under section 21(g) of the NWA, namely the disposal of waste in a manner that may detrimentally affect a water resource, where they are excluded from allowing such disposal under these GAs. This implies that these areas are regarded as too sensitive to allow the disposal of waste under a GA, and disposal of waste on these protected aquifers has to be authorised through the issuance of a water use licence (WUL).

### 3.2 Regulatory framework

Today the legal status of groundwater in South Africa is determined by a combination of the constitutional recognition of the right to access to water (section 27 of the *Constitution of the Republic of South Africa, 1996*)<sup>48</sup> and the right to have the environment protected, including groundwater

<sup>47</sup> Schedule 3 of GN 665 in GG 36820 of 6 September 2013.

<sup>48</sup> Viljoen 2020 *J Energy Nat Resources* L 10.

resources (section 24 of the Constitution), through reasonable legal and other measures, within the country's available resources.<sup>49</sup>

To achieve the progressive realisation of the constitutional water and environmental rights, a process was initiated in the year 1993 to review all of South Africa's water-related legislation.<sup>50</sup> South Africa's water regulatory framework underwent a dramatic transformation with a new set of policies and legislation. A reformation of the water regulatory framework started in the mid-1990s and culminated in the NWA, which was specifically promulgated to "provide for fundamental reform of the law relating to water resources".<sup>51</sup> A comprehensive analysis of each is beyond the scope of this paper, but the key policies and pieces of legislation include the *White Paper on a National Water Policy for South Africa* of 1997 (WPNWP), which contained 28 Fundamental Principles for Water Law Reform, the NWA, the *White Paper on Water Supply and Sanitation Policy* of 1994 (WSSP), the *Water Services Act* 108 of 1997, the *National Environmental Management Act* 107 of 1998 (NEMA), the *National Water Resource Strategy* of 2004 (NWRS) and the NWRS of 2013. To this list one also needs to add the *Policy and Strategy for Groundwater Quality Management* of 2000 and the *National Groundwater Strategy* of 2010.

The 28 Fundamental Policy Principles contained in the WPNWP set out the country's policy positions for the protection, use, development, conservation, management and control of South Africa's water resources. Of particular relevance to this discussion are:

- Principle 2: "All water, where-ever it occurs in the hydrological cycle, is a resource common to all, the use of which shall be subject to national control, and all water has a consistent status in law, irrespective of where it occurs";
- Principle 3: "There is no ownership of water, only a right to use water";
- Principle 4: "The location of water in relation to land doesn't confer preferential rights to use"; and
- Principle 18: "Since many land uses have a significant impact upon the water cycle, the regulation of land use shall, where appropriate, be

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<sup>49</sup> Due to the scope of this article, the content and meaning of ss 24 and 27(1)(b) of the *Constitution of the Republic of South Africa, 1996* (the Constitution), as well as the obligations of the state in terms of the constitutional water and environmental rights, will not be discussed in detail.

<sup>50</sup> Knüppe 2011 *Water SA* 70.

<sup>51</sup> Long title of the *National Water Act* 36 of 1998 (NWA).

used as an instrument to manage water resources within the broader integrated framework of land use management."

The WPNWP further stipulates *inter alia* that the "national government will act as custodian of the nation's water resources and its powers in this regard will be exercised as a public trust", that the "the government department or agency responsible for water resource protection must be able to influence land use planning decisions which could lead to unacceptable impacts on water resources", and that "provision has to be made for the licensing of land uses that substantially impact on the availability of water in an area" due to the fact that "water management cannot be separated from land use activities such as mining, human settlements, industrial activity, etc." The WPNWP further specifically acknowledges and provides for the regulation of groundwater. In fact, it stipulates that water resources cannot be managed in isolation; that water availability is governed by the water cycle; and that rain that falls may sink through the ground to be stored as groundwater in underground aquifers. The WSSP of 1994 also openly acknowledged the importance of groundwater and specifically articulated the need for increased knowledge about the characteristics of groundwater resources in South Africa. With the *Policy and Strategy for Groundwater Quality Management* of 2000 the Department of Water and Forestry identified approaches to provide the adequate protection and efficient management of groundwater quality. An important first step was to embark on a groundwater characterisation and mapping programme to identify utilisable groundwater resources. In addition, the *National Groundwater Strategy* of 2010 highlights the need for implementing protection zones around groundwater abstraction points. The Strategy also identifies the value and need for using groundwater vulnerability mapping in regulating groundwater resources. Such groundwater vulnerability maps, as well as maps indicating the utilisable exploitation potential of South Africa's groundwater resources, have already been produced.<sup>52</sup>

The NWA is the cornerstone of groundwater governance in South Africa,<sup>53</sup> by means of which these policy principles have been given legislative effect, and for this reason a critical assessment of the groundwater regulatory measures provided for in the NWA as well as the current level of implementation of these policy principles and measures is contained in the next paragraph.

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<sup>52</sup> DWAF 2005 <https://www.dwa.gov.za/groundwater/GRAAll.aspx>.

<sup>53</sup> Knüppe 2011 *Water SA* 70; Viljoen 2020 *J Energy Nat Resources* L 10.

### **3.3 The development and implementation of measures to regulate and protect South Africa's water resources**

In terms of section 3 of the NWA the national government, as public trustee, is mandated to protect, use, develop, conserve, manage and control the country's water resources in an integrated manner.<sup>54</sup> Section 1 of the NWA defines "water resources" to include "a water course, surface water, estuary, or aquifer". "Aquifer" is defined to mean "a geological formation which has structures or textures that hold water or permit appreciable water movement through them."<sup>55</sup>

Although some authors conclude that the NWA is rather vague about groundwater resources governance,<sup>56</sup> this is not the case, as groundwater occurring in aquifers is implicitly part of the definition of water resource as indicated above. This misconception actually demonstrates the lack of understanding of the more complex processes that play a role in hydrogeology. Nevertheless, while the NWA has created equality in regulatory mechanisms for both surface and groundwater, this lack of understanding of groundwater is reflected in the mechanisms created for the implementation of the NWA, which often still have a bias towards surface water. Some of the deficiencies in these mechanisms in respect of groundwater regulation are discussed in the following paragraphs.

#### *3.3.1 Control of water use through authorisation*

The national government has overall responsibility for and authority over the country's water resources, including the equitable allocation and beneficial use thereof in the public interest. Chapter 4 of the NWA sets out the legal framework by which the national government is expected to publicly allocate and regulate the use of South Africa's water resources by means of a tiered authorisation system. Section 21 of the NWA describes several activities as "water uses" which require authorisation under Chapter 4 of the NWA. As it is not possible to regulate each individual activity that may potentially affect a water resource, only those activities that pose significant threats to the water resource and/or to other users of the water resource require regulatory intervention. Section 22 of the NWA, entitled "Permissible Water Use", therefore establishes a tiered authorisation system to optimise the regulation of water use. In accordance with subsection 22(1), a water use as described under section 21 must be authorised by means of a WUL, unless such water use is permissible under Schedule 1 of the NWA; or

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<sup>54</sup> Adams *et al* 2015 *South African Journal of Geology* 7; Viljoen 2020 *J Energy Nat Resources* L 13.

<sup>55</sup> These definitions imply that not all groundwater (water occurring underground) is regarded as part of the water resource, as water in the vadose zone, for example, is excluded.

<sup>56</sup> Viljoen 2020 *J Energy Nat Resources* L 3.

permissible as a continuation of an Existing Lawful Use (ELU);<sup>57</sup> or permissible in terms of a GA issued under section 39 by Notice in the Government Gazette; or the Minister of the Department of Water and Sanitation (DWS) has dispensed with the requirement for a WUL (if the water use has been authorised in terms of another law that will address the requirements of the NWA), as provided for in subsection 22(3) of the NWA.

Sections 43 to 49 create a system of compulsory licensing of any aspect of water use in respect of one or more water resources in a specific geographic area and is intended to be used in areas which are or are soon likely to be under "water stress" (for example, where the demands for water are approaching or exceed the available supply, where water quality problems are imminent or already exist, or where the water resource quality is under threat), or where it is necessary to review the prevailing water use to achieve equity of the access to water. Compulsory licensing could therefore be declared for any activity overlying or potentially impacting a sensitive aquifer or an aquifer of particular socio-economic importance, for example.

The Tosca Molopo catchment, a portion of the Lower Vaal Catchment, is the only area in the country where the statutory measure of compulsory licensing was introduced for groundwater governance.<sup>58</sup> The Tosca area was historically a stock farming area with cattle and game farming, but following the rapid development of irrigation in the 1990s,<sup>59</sup> the socio-economic and environmental profile of the area changed considerably. These changes resulted in the over-exploitation of groundwater. In 2003, compliance and enforcement actions were taken against various water users due to over abstraction, but as the water requirements for the Tosca catchment continue to exceed the amount available, the catchment was prioritised for compulsory licensing.<sup>60</sup>

The first published NWRS of 2004<sup>61</sup> stipulates that the national government, in allocating and regulating the country's water resources, should ensure that authorisation decisions are taken in the beneficial interest of all persons, and that such decisions must be constitutionally compliant. In addition, the government must ensure that the goals in relation to sustainability, equity and efficiency are met. The responsibility of the

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<sup>57</sup> Section 32 of the NWA defines an ELU as any water use which has lawfully taken place in the two years preceding the commencement of the NWA, namely, between 1 October 1996 and 30 September 1998. In accordance with section 34 of the NWA, a person, or that person's successor-in-title, may continue with an ELU, subject to any existing conditions or obligations attaching to that use; its replacement by a WUL in terms of the NWA; or any other limitation or prohibition by or under the NWA.

<sup>58</sup> DWS 2022 <https://www.dws.gov.za/WAR/Tosca.aspx>.

<sup>59</sup> DWS 2022 <https://www.dws.gov.za/WAR/Tosca.aspx>.

<sup>60</sup> GN 708 in GG 33453 of 12 August 2010.

<sup>61</sup> DWAF *National Water Resource Strategy 2004* (the NWRS 2004) A 1, Principle 13; GN 708 in GG 33453 of 12 August 2010.

national government therefore includes the duty to manage and protect access to water resources for the intergenerational benefit of its citizens. Naturally, therefore, the notion of a tiered authorisation system should in theory help to ensure that activities that could have potential detrimental impacts on groundwater resources that are located in areas where sensitive aquifers with high socio-economic value occurs are well regulated and have adequate management measures in place to ensure that the risk of groundwater pollution is minimal.

It is regrettable to note that the existing WUL Application Regulations, published under sections 26 and 41 of the NWA<sup>62</sup> do not require specific investigations for WUL applications for activities conducted on existing subterranean control areas.<sup>63</sup> Moreover, the electronic WUL Application Assessment System (eWULAAS) does not even identify or mention aquifers as part of the water resource, although it is defined as such in the NWA.

Except for the GA under GN 655, that lists the subterranean government control areas, and the compulsory licensing for the Tosca area, the implementation of the authorisation mechanisms under the NWA are not currently adequately addressing the identification of sensitive aquifers or aquifers of significant socio-economic importance, and therefore the protection of these aquifers is currently ineffective and lacking.

### 3.3.2 *Water resource protection mechanisms under Chapter 3 of the NWA*

Chapter 3 of the NWA is entitled "Protection of Water Resources" and contains mechanisms to classify all water resources in order to designate their level of use, the setting of a Reserve for each significant water resource,<sup>64</sup> and the establishment of resource quality objectives (RQOs),<sup>65</sup> which should set out the intended objectives to be achieved with the management of each significant water resource. As for the authorisation of water use, while the sections in the NWA are written for the water resource

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<sup>62</sup> GN R267 in GG 40713 of 24 March 2017.

<sup>63</sup> This is regrettable as these are already identified as sensitive groundwater resources.

<sup>64</sup> "Reserve" is defined in section 1 of the NWA to mean "the quantity and quality of water required - (a) to satisfy basic human needs by securing a basic water supply, as prescribed under the Water Services Act 108 of 1997, for people who are now or who will, in the reasonably near future, be - (i) relying upon; (ii) taking water from; or (iii) being supplied from, the relevant water resource; and (b) to protect aquatic ecosystems in order to secure ecologically sustainable development and use of the relevant water resource."

<sup>65</sup> "Resource quality" is defined in section 1 of the NWA to mean "the quality of all the aspects of a water resource, including the quantity, pattern, timing, water level and assurance of instream flow; the water quality, including the physical, chemical and biological characteristics of the water; the character and condition of the instream and riparian habitat; and the characteristics, condition and distribution of the aquatic biota."

as a whole, the mechanisms developed for their implementation are biased towards surface water, as discussed in the next paragraphs.

### 3.3.2.1 The water resource classification system

Sections 12 to 15 of the NWA require the development of a classification system to determine different classes of water resources<sup>66</sup> and specify in section 12(2)(b)(iii) that such a classification system must *inter alia* set out land-based activities which must be regulated or prohibited in order to protect the water resource. The classification system is thus used to direct the state or public trustee in the management of the country's water; and to protect the quality of such water.

A water resource classification system has been established under regulations made in terms of section 12(1) of the NWA,<sup>67</sup> in terms of which water resources are grouped into classes representing different levels of protection.<sup>68</sup> A Class I water resource is one that is minimally used, and in which the configuration of the ecological categories of the water resources in the catchment gives an overall condition of that water resource that is minimally altered from its pre-development condition.<sup>69</sup> A Class II resource is one that is moderately used, and in which the configuration of ecological categories of the water resources in the catchment give an overall condition of that water resource that is moderately altered from its pre-development condition.<sup>70</sup> In turn, a Class III water resource is one which is heavily used, and in which the configuration of ecological categories of the water resources in the catchment gives an overall condition of that water resource that is significantly altered from its pre-development condition.<sup>71</sup>

Inopportunately, however, the authors hereof posit that the classification system is surface water-biased<sup>72</sup> in that it is based on the configuration of ecological categories which apply only to surface water resources and not to groundwater resources, and that it does not meet the requirements of section 12(2)(b)(iii) since it does not specify land-based activities which must be regulated or prohibited in order to protect the water resource. The absence of a regulatory classification system for groundwater resources based on their vulnerability or potential for exploitation or socio-economic importance should be flagged as a significant omission in the current mechanisms established for the classification of water resources. There is unfortunately no mechanism provided for in the NWA to amend the

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<sup>66</sup> See GN 999 in GG 31417 of 19 September 2008.

<sup>67</sup> GN 810 in GG 33541 of 17 September 2010.

<sup>68</sup> See Levy and Xu 2011 *Hydrogeology Journal* 210.

<sup>69</sup> See Reg 2(3)(a) in GN 810 in GG 33541 of 17 September 2010.

<sup>70</sup> See Reg 2(3)(b) in GN 810 in GG 33541 of 17 September 2010.

<sup>71</sup> See Reg 2(3)(c) in GN 810 in GG 33541 of 17 September 2010.

<sup>72</sup> See GN 810 in GG 33541 of 17 September 2010.

classification system as published, and unless there is an amendment to the NWA itself, the classification system will continue to be unsuited to the classification of groundwater resources to facilitate their protection.

### 3.3.2.2 The Reserve

Sections 16 to 18 of the NWA call for the establishment and implementation of the Reserve to enable the national government to manage and protect access to water resources, including aquifers. Part of the state's function is to make sure that the "water required to ensure that all people have access to sufficient water" and the "water necessary to maintain environmental sustainability" is reserved. The Reserve, as defined by chapter 1 of the NWA, read with the explanatory note of chapter 3 of the NWA, is the quantity and quality of water required to satisfy basic human needs and to protect aquatic ecosystems in order to secure ecologically sustainable development.<sup>73</sup> It follows that the Reserve consists of two parts, namely the basic human needs reserve and the ecological reserve.<sup>74</sup>

The first part of the Reserve, the basic human needs reserve, imposes on the public trustee a duty to reserve such water required to ensure that all people have access to sufficient water *inter alia* for the purposes of drinking, food preparation and personal hygiene.<sup>75</sup> Although challenged by a series of court cases,<sup>76</sup> the basic human needs reserve was quantified by Regulation<sup>77</sup> as 25 litres per person per day or 6 kilolitres per household per month within 200 metres from the household.<sup>78</sup> The ecological reserve is more complex to determine, however. In fact, the accurate quantification of groundwater contributions to both parts of the Reserve is particularly challenging due to the widespread occurrence of fractured-rock aquifers, for example.<sup>79</sup>

Nevertheless, it is part of the fiduciary duty of the national government to assess the needs of the Reserve and to make sure that the determined amount of water required to meet such needs is set aside before any water is allocated to any productive use such as irrigation.<sup>80</sup> Unfortunately none of the reserve determinations established or published to date has made provision of a "reserve" insofar as to protect the groundwater resources

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<sup>73</sup> Viljoen 2017 *LDD* 191-194.

<sup>74</sup> Knüppe 2011 *Water SA* 70.

<sup>75</sup> Takacs 2016 *Berkeley J Int'l L* 80.

<sup>76</sup> *Mazibuko v City of Johannesburg* 2008 4 All SA 471 (W); *City of Johannesburg v Mazibuko* 2009 3 SA 592 (SCA); *Mazibuko v City of Johannesburg* 2010 3 BCLR 239 (CC).

<sup>77</sup> GN R509 in GG 22355 of 8 June 2001.

<sup>78</sup> Levy and Xu 2011 *Hydrogeology Journal* 210.

<sup>79</sup> Levy and Xu 2011 *Hydrogeology Journal* 206.

<sup>80</sup> Any other use would include basic human needs and the needs of the ecological reserve. Knüppe 2011 *Water SA* 70.

currently being used for domestic supply. It is also inopportune that no mechanism is provided for in the NWA to amend the reserve determinations as published. Unless there is an amendment to the NWA itself, the reserves that have been established will continue to be unsuited to the protection of groundwater resources.

### 3.3.2.3 Resource Quality Objectives (RQOs)

Sections 13 to 15 of the NWA also require the establishment of RQOs, which must be determined in accordance with their class, and must indicate the level of use of the resource that is deemed acceptable and is unlikely to damage a water resource beyond repair, so that the resource can be managed accordingly. The Classes and RQOs for a number of catchments have been promulgated. As discussed above, the Classes of resources were established based on a classification system that is biased towards surface water, and therefore all the subsequent published classes of water resources have failed to appropriately classify groundwater resources.

With regard to the RQOs that have been promulgated, these are also inadequate in properly setting management objectives for groundwater, although the definition for RQOs clearly indicates that it relates to the quality of all aspects of the water resource, including aquifers, and that it includes both the physical and chemical characteristics of the water resource. The only RQOs that were published to date that take cognisance of the scientific attributes of the quality of groundwater were the draft RQOs for groundwater resources for the Mokolo, Matlabas, Crocodile (West) and Marico catchments.<sup>81</sup> Most of the RQOs that have been published specify that the quality of groundwater occurring naturally must comply with the SANS 241 Drinking Water Standard, which is both legally and scientifically flawed, as groundwater reflects the quality of the host rock within which it occurs and this is not always suitable for human consumption, and could sometimes even be harmful to humans, as it could contain naturally high levels of magnesium, sulphates, arsenic, selenium or uranium, for example.<sup>82</sup>

As with the classification system and the reserve determination, no mechanism is provided for in the NWA to amend the RQOs as published, and unless there is an amendment to the NWA itself the RQOs that have been published will continue to be unsuited to the protection of groundwater resources. Thus, although the NWA makes provision for the protection of groundwater resources, these provisions have not been translated into the mechanisms established for their implementation.

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<sup>81</sup> GN 1388 in GG 41310 of 8 December 2017.

<sup>82</sup> Sami and Druzynski *Predicted Spatial Distribution* 2-6.

### **3.4 An assessment of South Africa's existing groundwater regulatory measures under the NWA**

While the NWA provided an ideal opportunity for the judicious governance of South Africa's groundwater resources, the preceding discussion shows that the Act's implementation, when it comes to groundwater issues, remains rather weak.<sup>83</sup> It may be argued on the basis of the above discussion that the mechanisms developed to implement South Africa's regulatory framework under the NWA do not always adequately provide for the governance and protection of groundwater, and are still biased towards surface water resources. The discussion has highlighted a number of implementation inadequacies especially in relation to the existing WULA Application Regulations, published under sections 26 and 41 of the NWA;<sup>84</sup> the Water Resource Classification System, the establishment of RQOs, and even the determination of the Reserve.<sup>85</sup> The principles relating to groundwater as outlined in the WPNWP<sup>86</sup> especially making use of land-use planning mechanisms to prevent the overexploitation and contamination of groundwater have therefore not been given proper consideration in the mechanisms developed for the implementation of the NWA.

The development and use of land are consistent elements in the list of potential threats to the quality of groundwater. It follows that, to protect South Africa's aquifers, the principles of environmental management and land-use management need to be revisited. Considering the need for the protection of vulnerable aquifers and aquifers that have significant socio-economic importance against contamination arising from land-based activities and overexploitation in the light of the lack of sufficient legislative measures to facilitate such protection, the next paragraph explores the regulatory measures under legislation other than the NWA designed to protect the country's groundwater. This is necessitated by the fact that the principles of hydrogeology discussed above<sup>87</sup> highlight the direct connection between land-based or anthropogenic activities and potential impacts on groundwater, and legislation other than the NWA governs certain land-uses.

## **4 Environmental and land-use management**

### **4.1 National environmental management principles**

The *National Environmental Management Act* 107 of 1998 (NEMA) was promulgated to provide a framework for co-operative environmental

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<sup>83</sup> Knüppe 2011 *Water SA* 70; Viljoen 2020 *J Energy Nat Resources* L 3.

<sup>84</sup> See section 3.3.1 above.

<sup>85</sup> See section 3.3.2 above.

<sup>86</sup> See section 3.2 above.

<sup>87</sup> See section 2 above.

governance and aims to achieve this by establishing principles for state decision-making on matters that affect the environment.<sup>88</sup> Section 1(xi) of the NEMA defines the "environment" to include the surroundings within which humans exist and that are made of the land, water, atmosphere, plant or animal life, or any part or combination thereof. Section 2 of the NEMA sets out several environmental management principles. The importance of these principles has been recognised by the courts.<sup>89</sup> They include that any land use development must be socially, environmentally, and economically sustainable; that government should promote public participation when making decisions about the environment;<sup>90</sup> that decisions must be taken in an open and transparent manner;<sup>91</sup> that the cost of remedying pollution, environmental degradation and negative impacts on health must be paid by those responsible for such pollution, degradation and health impacts (the "polluter pays" principle);<sup>92</sup> that the environment is held in trust by the state for the benefit of all South Africans;<sup>93</sup> and that a risk-averse and cautious approach should be followed when making decisions that could have environmental consequences.

These principles should guide the interpretation, administration and implementation of the NEMA and any other law concerned with the protection or management of the environment, which naturally includes any legislation that could have an effect on South Africa's aquifers,<sup>94</sup> including the NWA, which has been declared a Specific Environmental Management Act (SEMA) under the NEMA<sup>95</sup> and which is therefore similarly subject to the principles contained in section 2 of the NEMA.

#### **4.2 Environmental authorisations**

As part of the Act's attempt to protect the environment from undesirable impacts, environmental authorisations must be obtained for activities listed under section 24 of the NEMA, which requires that an Environmental Impact Assessment (EIA) be prepared in accordance with EIA Regulations.<sup>96</sup>

The purpose of the EIA process is to determine, assess and evaluate the consequences of a proposed development, activity, or project.<sup>97</sup> Naturally

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<sup>88</sup> Long title of the *National Environmental Management Act 107 of 1998* (the NEMA).

<sup>89</sup> See, for example, the case of *Fuel Retailers Association of SA (Pty) Ltd v Director General, Environmental Management Mpumalanga* 2007 2 SA 163 (SCA) that was decided on NEMA principles.

<sup>90</sup> Section 2(4)(f) of the NEMA.

<sup>91</sup> Section 2(4)(k) of the NEMA.

<sup>92</sup> Section 2(4)(p) of the NEMA.

<sup>93</sup> Section 2(4)(o) of the NEMA.

<sup>94</sup> Section 2(1)(e) of the NEMA.

<sup>95</sup> The NWA was declared as a SEMA under the *National Environmental Management Laws Amendment Act 25 of 2014*.

<sup>96</sup> GN 40772 in GG 40772 of 7 April 2017.

<sup>97</sup> Regulation 2 in GN R982 in GG 38282 of 4 December 2014.

the EIA process ought to be relevant when new anthropogenic activities in the vicinity of an aquifer are planned. The EIA must consider the strategic context of a development proposal along with societal needs, the natural resource base and the public interest. The EIA process should address ways to avoid negative impacts and enhance benefits. The EIA process includes a determination of whether an application for an environmental authorisation is required;<sup>98</sup> and if so, whether the Basic Assessment Process or the scoping and EIA process must be undertaken. The listing notices as published identify activities on a different level of risk and identify certain activities in sensitive areas that require an EIA process, where undertaking such an activity in a less sensitive area does not require such a process, or requires the Basic Assessment instead of the full EIA process.

The National Department of Forestry, Fisheries and the Environment (DFFE) has developed a web-based screening tool<sup>99</sup> that assists with the EIA-process, which geolocates the proposed activity in terms of possible sensitivities of the environment in which it is located in order to identify the type of assessment required, and the relevant specialist studies that may be required. The submission of a report generated by the screening tool in support of an application for an EIA has been compulsory since 2019,<sup>100</sup> and the DFFE now intends to adopt the screening tool as an Environmental Management Instrument.<sup>101</sup> Although it identifies sensitive surface water resources, the screening tool does not address groundwater aspects at all, and that means that sensitive aquifers, as identified on the DWS's maps, or aquifers used for community water supply purposes, etc., are currently not considered as relevant when using this screening tool to determine the potential impacts of new developments. Adopting the Screening Tool as it currently stands as a National Environmental Management Instrument will thus not highlight the potential impact of development on aquifers.

It may therefore be held that the EIA process can help to ensure that activities that could have potential detrimental impacts on groundwater resources that are located in areas where sensitive aquifers with high socio-economic value occur are well regulated and have adequate management measures in place to ensure that the risk of groundwater pollution is

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<sup>98</sup> Any activity that is listed in Listing Notice 1, Listing Notice 2 and Listing Notice 3 of the Environmental Impact Assessment (EIA) Regulations is subject to environmental authorisation. The difference between the Listing Notices is in the process that needs to be followed. Listing Notice 1 activities are subject to Basic Assessment and those in Listing Notice 2 to Scoping and Impact Assessment. For ease of reference, the term EIA is used when information is relevant to both these processes.

<sup>99</sup> DFFE 2021 <https://screening.environment.gov.za/screeningtool/>.

<sup>100</sup> GN 960 in GG 42561 of 5 July 2019.

<sup>101</sup> GN 2464 in GG 46867 of 6 September 2022.

minimal.<sup>102</sup> Unfortunately, the current Government Notices that include the listed activities of the EIA Regulations do not identify or list sensitive aquifers, and it will require an amendment of the existing Listing Notices to ensure that sensitive aquifers or aquifers with high socio-economic importance are properly addressed in the Listing Notices.

### **4.3 Planning law**

Planning law generally comprises two distinct yet interrelated subdivisions, namely land management planning and land development management. These are instruments that are legislatively regulated by the *Spatial Planning and Land Use Management Act 16 of 2013 (SPLUMA)*, and supported by the provinces' legislation. Land development planning takes place by means of integrated development plans, spatial development frameworks and land-use schemes. Land management planning, which is also known as land-use planning, is the creation of a blueprint for future land use that will support sustainable development. The underlying principle to this blueprint is "zoning".<sup>103</sup> Zoning is used to allocate different land uses for different purposes while protecting *inter alia* the health, safety and welfare of the inhabitants of the area, as well as the character of the area itself.<sup>104</sup>

As it is the centrepiece of land-management planning, it is necessary to take a closer look at what zoning entails. Milton<sup>105</sup> describes "zoning" as the creation of districts or areas in which different use activities are generally permitted or prohibited. It follows that zoning or land-use planning can in principle be used to minimise the potential of groundwater contamination by human activities that occur on or below the surface of the land. In spite of the specific policy statement in Principle 18 of the WPNWP, namely that the regulation of land use should be used as an instrument to manage water resources in the broader integrated framework of land-use management this has unfortunately not been incorporated into the land-use planning or zoning that has been undertaken in terms of the SPLUMA. However, as integrated development plans, spatial development frameworks and land-use schemes have to be reviewed once every five years, this creates the opportunity to incorporate measures for the protection of groundwater in sensitive aquifers or in aquifers with a high socio-economic value when these land-use planning instruments are being updated without the need to amend any existing legislation.

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<sup>102</sup> As confirmed by *Philippi Horticultural Area Food & Farming Campaign v MEC for Local Government, Environmental Affairs and Development Planning: Western Cape* 2020 3 SA 486 (WCC).

<sup>103</sup> Van Wyk *Planning Law* 222.

<sup>104</sup> Van Wyk *Planning Law* 222.

<sup>105</sup> Milton 1985 *Acta Juridica* 267-288.

In fact, a number of countries including, for example, the United Kingdom (UK), Portugal, Germany and Australia have already developed and adopted planning law-related measures to protect groundwater resources against contamination from land-use activities,<sup>106</sup> and some of these measures are discussed in the next paragraph.

## **5 Planning law and groundwater governance: Insights from foreign law**

When some form of regulatory control is established over activities taking place on land which overlies vulnerable aquifers, the impact on both the quality and the quantity of the groundwater resource can be minimised. This section introduces the concept of a "groundwater or aquifer protection zone" as a control measure to prevent, minimise or control groundwater pollution from human activities taking place on land.<sup>107</sup>

### **5.1 The concept of a "groundwater protection zone"**

As noted above, the concept of a zone of protection for areas containing groundwater has been developed in several countries.<sup>108</sup> These countries have adopted, to varying degrees, a regulatory mechanism whereby they declare a certain area as a "groundwater protection zone". Once such a declaration has been made, constraints on certain land use activities are imposed.<sup>109</sup> Notably, in the countries where the concept is implemented, protection zones are used in conjunction with existing regulatory tools such as environmental permitting and other pollution control legislation. These therefore serve as additional layers of control and offer specific protection for aquifers.

Groundwater protection zones are used to restrict or control activities that could detrimentally impact on groundwater resources.<sup>110</sup> Commonly, in the legal systems of the countries mentioned above these restrictions are set through the use of legislation for land-use planning. The specific designation of the zone triggers relevant land-use restrictions or introduces additional permitting requirements. Once a protection zone or vulnerable area has been identified and designated, activities are defined which are either acceptable, unacceptable or need to be controlled by permitting in the protection zones.

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<sup>106</sup> Chave *et al* "Groundwater Protection Zones" 472-476.

<sup>107</sup> Chave *et al* "Groundwater Protection Zones" 466.

<sup>108</sup> Chave *et al* "Groundwater Protection Zones" 472-476; Nel *et al* 2009 *Water Resources Management* 2896.

<sup>109</sup> Chave *et al* "Groundwater Protection Zones" 466.

<sup>110</sup> Nel *et al* 2009 *Water Resources Management* 2896.

## 5.2 Delineating groundwater protection zones

Examples from foreign law where groundwater protection zones are designated show that the number of groundwater protection zones varies between countries, but usually, two to four zones are delineated.<sup>111</sup> Generally, the first is the zone immediately adjacent to the site of the well or borehole. This zone (often referred to as the wellhead protection zone) is delineated to prevent the rapid ingress of contaminants or damage to the wellhead.<sup>112</sup> The second zone (the inner protection zone) is delineated based on the time expected to be needed for a considerable reduction in pathogen presence to an acceptable level.<sup>113</sup> Thirdly, the outer protection zone is defined based on the time needed for the dilution and effective attenuation of slowly degrading substances to an acceptable level.<sup>114</sup> A fourth, much larger zone then covers the whole of the recharge area of a particular groundwater abstraction.<sup>115</sup> The land-use constraints are increasingly stringent, moving from the outer protection zone to the wellhead (borehole) operational zone. In other words, the degree of land-use restriction reduces as the distance from the abstraction point increases.<sup>116</sup>

Existing scholarship provides an exposition of the typical land-use constraints for the respective protection zones:<sup>117</sup> In the wellhead operation zone, all constraints of an inner protection zone and outer protection zone apply, plus land-use constraints such as some forms of agriculture (for example feedlots) and forms of traffic. In an inner protection zone, all constraints of an outer protection zone apply, in addition to land-use constraints such as waste disposal, mining and cemeteries. In the outer protection zone, constraints include wastewater and sewage treatment facilities, large informal settlements using pit latrines, and chemical plants or nuclear reactors. Naturally, choosing the appropriate protection zoning requires hydrogeological knowledge. Although this brief description of

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<sup>111</sup> Chave *et al* "Groundwater Protection Zones" 467; DVGW *Code of Practice W101 for Drinking Water Protection Areas Part 1, Protective Areas for Groundwater* (1995); National Rivers Authority *Policy and Practice for the Protection of Groundwater* (1992).

<sup>112</sup> Chave *et al* "Groundwater Protection Zones" 466; DVGW *Code of Practice W101 for Drinking Water Protection Areas Part 1, Protective Areas for Groundwater* (1995); Foster *et al* *Groundwater Quality Protection* 34; National Rivers Authority *Policy and Practice for the Protection of Groundwater* (1992).

<sup>113</sup> Chave *et al* "Groundwater Protection Zones" 467; Nel *et al* 2009 *Water Resources Management* 2902, 2903.

<sup>114</sup> Chave *et al* "Groundwater Protection Zones" 467; Nel *et al* 2009 *Water Resources Management* 2903.

<sup>115</sup> Chave *et al* "Groundwater Protection Zones" 467; Nel *et al* 2009 *Water Resources Management* 2903.

<sup>116</sup> Nel *et al* 2009 *Water Resources Management* 2903.

<sup>117</sup> Chave *et al* "Groundwater Protection Zones" 486; Nel *et al* 2009 *Water Resources Management* 2904; Foster *et al* *Groundwater Quality Protection* 38.

foreign practices may be elementary, aquifer protection zoning is a proactive step towards protecting the groundwater resources by the management of land use, recharge areas and potential contamination sources.

In the UK, for example, decisions on protection zones are taken squarely on the basis of hydrogeology, and more specifically, aspects of assessing the abstraction rate, specific yield, saturated thickness, the likely impact of a pollutant, and the degree to which attenuation occurs in the geological strata influencing the source.<sup>118</sup> The national Policy and Practice for the Protection of Groundwater (National Rivers Authority, 1992), provides for three distinct source protection zones. Zone I, known as the Inner Source Protection Zone, is located immediately adjacent to the groundwater source, and is designed to protect against the effects of activities which would have an immediate outcome on the source. Zone I is defined as the area within which water would take 50 days to reach the abstraction point from any point below the water table, subject to a minimum of 50 m radius from the source. In turn Zone II, or the Outer Source Protection Zone, covers either the area corresponding to 400 days or the whole of the recharge area, calculated on the basis of 25 per cent of the long-term abstraction rate for the source. Zone III, known as the Source Catchment, covers the whole of the catchment area of the source, based on the area needed for long-term annual recharge to support the abstraction.

In Germany, comparable guidelines on the definition of zones are available through a Code of Practice.<sup>119</sup> The sizes of the respective areas to be placed under protection are also dependent upon hydrogeological considerations, including the abstraction and recharge rates in the catchment area. The Code defines three zones.<sup>120</sup> Zone I, the Well Field Protection Zone, is designed to protect individual wells and their immediate environment against any contamination and interference. Zone I has fixed dimensions of 10 m.<sup>121</sup> Zone II, the Narrow Protection Zone, aims to provide protection against contamination by pathogenic bacteria and viruses and is based on a 50 day travel time.<sup>122</sup> Due to the area of land required to meet the 50-day criterion it is not always possible to fix a boundary in karst terrains. Zone II may therefore vary in size, but should in any case comprise all areas from which a risk to a karst aquifer may emanate. Zone III, the Wide Protection Zone, serves to protect wells against long-range impairments, and usually

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<sup>118</sup> Environmental Agency 1997 <http://ea-lit.freshwaterlife.org/archive/ealit:1144/OBJ/19000622.pdf> 9.

<sup>119</sup> Chave *et al* "Groundwater Protection Zones" 486.

<sup>120</sup> Chave *et al* "Groundwater Protection Zones" 485.

<sup>121</sup> Chave *et al* "Groundwater Protection Zones" 474.

<sup>122</sup> Chave *et al* "Groundwater Protection Zones" 474.

covers the entire subsurface catchment area (recharge area).<sup>123</sup> Chave *et al*<sup>124</sup> argue that if the catchment area is larger, with a boundary more than 2 km from the well, it may be sub-divided into Zone III A and Zone III B, with different levels of land-use restrictions.

These foreign planning law initiatives could also be utilised in South Africa to enhance the protection of the country's groundwater that is vulnerable, sensitive, and/or of socio-economic importance.

The feasibility and beneficial use of harnessing science (hydrogeology) and planning law to protect South Africa's aquifers can be illustrated by a brief case study.

### **5.3 Feasibility of aquifer protection zones in South Africa**<sup>125</sup>

Between 2015 and 2019 the City of Cape Town (CoCT) experienced its worst drought since 1904. Dam levels began declining in 2015, with the peak of the water shortage crisis occurring from mid-2017 to mid-2018, when water levels hovered between 15 and 30 per cent of total dam capacity, with some dam levels dropping as low as 11 per cent.<sup>126</sup> As a result the CoCT explored alternative water resources, and one of the proposed alternatives entailed using the groundwater from the Cape Flats Aquifer and the Table Mountain Group Aquifer to augment bulk water supply for domestic use.<sup>127</sup> The CoCT acknowledged the importance of the aquifers and understood the dire need to protect them. The CoCT then incorporated elements of land-use planning, but remarkably did so in addition to existing legislation by introducing "groundwater protection schemes" or "zones" under its spatial framework planning mechanisms.

In an effort to control activities in these zones the CoCT has merged them into the District Spatial Development Framework as well as the Municipal Spatial Development Framework. The zones are used as a management tool during spatial development assessments and are set to lead to rigorous land-use conditions or a decline in the authorisation of applications. Although potentially contaminating activities already exist in the delineated protection zones, the CoCT is committed to utilising these delineated zones for new applications for development, and also to assisting with monitoring and mitigation measures.<sup>128</sup> Therefore, while the CoCT may still develop and enhance the beneficial use of its protection zones, their example is

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<sup>123</sup> Chave *et al* "Groundwater Protection Zones" 474.

<sup>124</sup> Chave *et al* "Groundwater Protection Zones" 474.

<sup>125</sup> See also Nel *et al* 2009 *Water Resources Management* 2906.

<sup>126</sup> City of Cape Town Drought 2021 <https://www.capetowndrought.com/>.

<sup>127</sup> CoCT 2020 <https://resource.capetown.gov.za/documentcentre/Documents/City%20strategies,%20plans%20and%20frameworks/Cape%20Town%20Water%20Strategy.pdf> 35-37.

<sup>128</sup> Nel *et al* 2009 *Water Resources Management* 2905.

evidence of the fact that planning law may be well suited to ensuring the protection of South Africa's aquifers. In fact, land-use planning zones and regulations at aquifer level can be effective tools for groundwater resource conservation and quality protection, since they add scientific authority and clarity to decision-making processes. As shown in the CoCT, groundwater protection zones can readily be incorporated into local government land-use planning zones, with restrictions imposed to ensure acceptable land use. This paper postulates that this initiative should be formally included in the country's groundwater regulatory framework.

## **6 Concluding remarks**

Groundwater is an integral part of the natural water cycle, and the primary water source for many cities, towns, and villages in South Africa. This paper has described the extreme vulnerability of South Africa's groundwater as well as some of the complexities associated with the science of hydrogeology. The paper has showed that a poor scientific understanding of groundwater systems not only leads to the groundwater resources being undervalued, but may render them subject to suboptimal legal protection. As a result, South Africa's aquifers remain vulnerable to contamination and over-exploitation.

Although South Africa's groundwater governance is elevated in the novel regulatory framework instated by the NWA and groundwater is no longer regarded as "private water", the mechanisms developed for the implementation of NWA still largely focus on surface water resources. In fact, existing subterranean government water control areas have not even been considered in the establishment of RQOs, and classification systems for aquifers have not been developed. Unfortunately, the systems that have been developed and implemented cannot be amended or reviewed, and such a review would require an amendment of the NWA itself. Consequently, South Africa's vulnerable aquifers remains compromised due to contamination and depletion because of anthropogenic activities.

A possible regulatory tool to address these insufficiencies would be the introduction of the concept of aquifer protection zoning. Based on principles of hydrogeology, this mechanism uses land-use planning mechanisms to protect sensitive or vulnerable aquifers that are of socio-economic importance. This link between land-use planning and groundwater protection has long been recognised in developed countries as protecting valuable groundwater resources.

Generally a delineated aquifer protection zone refers to the area of land that contributes to the delivery of groundwater at a specific borehole or wellfield. The delineation of a protection zone is the process of determining the area of land to include in such a zone, and the type of land-use activities that

should be allowed or disallowed in the protection zone, taking cognisance of the local geology, and of whether pathways of transport or exposure exist for the contamination of groundwater to occur, or whether the potential for over-abstraction exists. The delineation could include the protection of the recharge zone. The implementation of such zoning would subject the respective zones to operational monitoring and would ensure that groundwater was effectively protected at the point of abstraction. Protection zone monitoring also includes checking whether the required restrictions in land use and human activities are being adhered to. Consequently, groundwater protection zones play a key component in the provision of water security for a given groundwater supply.

The delineation of groundwater protection zones has not yet been formally translated into control mechanisms in the broader South African regulatory framework, although it has been used for example in the CoCT. To ignore groundwater considerations in land-use decision making and land management would detrimentally affect both water and food security. Consequently, this article recommends, from a hydrogeological and planning-law perspective, that aquifer protection zoning should be formally introduced into the legislative framework aimed at protecting South Africa's aquifers. Declaring recharge areas especially as "groundwater protection zones" and limiting the type of anthropogenic activities that can take place in these areas would facilitate the protection of significant groundwater resources that support socio-economic activities such as domestic use and agricultural operations. These could be statutorily introduced through regulations under the SPLUMA,<sup>129</sup> as well as an amendment of the EIA regulations to prevent development on identified aquifer protection zones. It is further recommended that policy documents and guidelines be drafted by geohydrologists and environmental law specialists to facilitate the establishment of these zones as a matter of priority, in order to ensure a water-secure future for South Africa.

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<sup>129</sup> Both Acts already contain the appropriate mechanisms to make such regulations.

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Berkeley J Int'l L	Berkeley Journal of International Law
CoCT	City of Cape Town
DFFE	Department of Forestry, Fisheries and the Environment
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EIA	Environmental Impact Assessment
ELU	Existing Lawful Use
eWULAAS	electronic Water Use License Application Assessment System
GA	General Authorisation
J Energy Nat Resources L	Journal of Energy and Natural Resources Law
LDD	Law, Democracy and Development
NEMA	National Environmental Management Act 107 of 1998

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NWA	National Water Act 36 of 1998
NWRS	National Water Resource Strategy
RQOs	Resource Quality Objectives
SEMA	Specific Environmental Management Act
SPLUMA	Spatial Planning and Land Use Management Act 16 of 2013
UK	United Kingdom
WPNWP	White Paper on a National Water Policy for South Africa
WSSP	White Paper on Water Supply and Sanitation Policy
WUL	Water Use License