water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

# SUSTAINABLE DEVELOPMENT GOAL 6

# 2020 DATA DRIVE

## SOUTH AFRICAN RESPONSE TO UNITED NATIONS ENVIRONMENT PROGRAMME (UNEP)

## SDG Target 6.6

*Indicator 6.6.1*

*Change in the Extent of Water-Related Ecosystems Over Time*

**June 2020**

2020 | DATA DRIVE
UN-WATER INTEGRATED MONITORING INITIATIVE FOR SDG 6

SUSTAINABLE DEVELOPMENT GOALS

# TABLE OF CONTENTS

## 1. INTRODUCTION

| | |
|---|---|
| Goal 6: | Ensure availability and sustainable management of water and sanitation for all. |
| Target 6.6: | *By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes* |

Sustainable Development Goal (SDG) Target 6.6 seeks to halt the degradation and destruction of these ecosystems, and to assist the recovery of those already degraded. The target includes water-related ecosystems such as wetlands, rivers, lakes, reservoirs and groundwater which play a special role in storing freshwater and maintaining water quality.

In South Africa, SDG 6 directly relates to Section 24 of the South African Constitution and the mandates of the Department of Water and Sanitation (DWS) and the Department of Environment, Fisheries and Forestry (DEFF):

Section 24 of the Constitution of South Africa states that, '*everyone has the right to an environment that is not harmful to their health or well-being; and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development*'. This right is upheld by various government institutions but predominantly by the DWS and DEFF.

In terms of water resource management, the DWS acts in terms of the South African National Water Act (Act 36 of 1998) and is the custodian of South Africa's water resources. It is primarily responsible for the formulation and implementation of policy governing the water sector and for ensuring the sustainable and equitable use of water and protection of the quality of water resources for the benefit of all users. The DWS is the focal point in South Africa for reporting in SDG 6.6 on behalf of the sector and works closely with its sector partners.

*In terms of SDG 6.6.1, key sector partners include:-*

- The *South African Water Research Commission* (WRC), who promote coordination, cooperation and communication in the area of water research and development; establishing water research needs and priorities; stimulating and funding water research according to priority; promoting effective transfer of information and technology; and enhancing knowledge and capacity building within the water sector.
- The *DEFF*, whose legal mandate and core business is to manage, protect and conserve South Africa's environment and natural resources and promote sustainable development.
- *South African National Biodiversity Institute* (SANBI) who contributes to South Africa's sustainable development by facilitating access to biodiversity data, generating information and knowledge, building capacity, providing policy advice, showcasing and conserving biodiversity in its national botanical and zoological gardens. In mid-2019 SANBI became the official spatial base dataset custodian for wetland data in South Africa.
- *Council for Scientific and Industrial Research* (CSIR) undertakes directed, multidisciplinary research and technological innovation and have developed water resource decision-support frameworks and tools, including the South African Inventory of Inland Aquatic Ecosystems, for improved water resource quality and quantity.

- *Department of Agriculture, Land Reform and Rural Development and Land Reform* (DALRRD) who provide for the conservation of the natural agricultural resources of South Africa by maintaining the production potential of land, by combating and preventing erosion and the weakening or destruction of water sources, and by the combating of weeds and invader plants. This department is also the home of the Chief Directorate: National Geo-spatial Information or CD:NGI, which is the data custodian of topographical maps and related data in South Africa.
- The *Agricultural Research Centre* (ARC), who is the principal agricultural research institution in South Africa and has a dedicated water unit.
- The *South African National Space Agency* (SANSA) who foster research in space science, including remote sensing sciences, advancing scientific engineering through developing human capital, and supporting industrial development in space technologies.

Target 6.6 only has one global indicator (6.6.1): *"**Change in the Extent of Water Related Ecosystems over time**"*

Indicator 6.6.1 responds to SDG 6 in that it seeks to provide data and information to support the management and protection of water-related ecosystems, so that ecosystem services – especially those related to water– continue to be available to society. In South Africa a number of initiatives are in place that enables reporting on SDG Indicator 6.6.1. This includes the:

- National Aquatic Ecosystem Health Monitoring Programme (NAEHMP), which includes a National Estuary Monitoring programme, National River Eco-Status Monitoring Programme and the newly established National Wetland Monitoring Programme,
- National Groundwater Monitoring Programme,
- National Hydrological (Rivers and Dams) Monitoring Programme,
- National Eutrophication Monitoring Programme (NEMP),
- National Chemical Monitoring Programme (NCMP), and the
- National Biodiversity Assessments (NBA), undertaken every 5-7 years.

Data generated by these initiatives are stored on various open access databases which are administered by the DWS and SANBI.

Many of these are continually improving through investments by the South African government, non-governmental organisations, academia and the private sector in order to provide more accurate data for decision making toward achieving national, regional and local environmental targets.

## 2. REQUEST BY UNITED NATIONS ENVIRONMENT PROGRAMME (UNEP)

The 2020 Data Drive is part of the UN-Water Integrated Monitoring Initiative for SDG 6 (IMI-SDG6):'*Ensure availability and sustainable management of water and sanitation for all*'. The Data Drive involves countries collecting and reporting data on various SDG 6 indicators to multiple UN agencies, coordinated by UN-Water. On 20 April 2020, the South African DWS SDG Focal Point for Target 6.6 received the following request from UNEP:

**1. Review national 6.6.1 statistics**

South Africa was requested to review the national statistics related to SDG indicator 6.6.1 that have been produced, as documented on the sdg661 data portal. UNEP plans to report these national statistics to the United Nations Statistical Office on 15th June 2020. Queries and responses are to be sent to sdg661@un.org.

**2. Report in-situ measurement of groundwater**

In-situ measurements of river flow and groundwater can be submitted by countries to UNEP upon request, to complement the global Earth Observation and modelling based 6.6.1 statistics. At this present time only groundwater data was required to be submitted to UNEP using the template provided in the annexure of the methodology that was distributed with the request by UNEP. It was noted that river flow data may be requested at a later date/year, depending on the outcome of the formal revision and update of the Framework on the Convention of Biological Diversity for the post 2020 period.

## 3. OVERVIEW OF DATA PROVIDED FOR VERIFICATION ON THE SDG6.6.1 PORTAL

*Data provided by UNEP on change in spatial extent and water quality of water-related ecosystems in South Africa based on earth observation data is shown below.*

***Table 3A. SDG6.6.1 Data Portal – aggregated results for South Africa***

| Category | Sub-category | Time period | Change over time | |
|---|---|---|---|---|
| Lakes & Rivers | Permanent water dynamics | 2000 - 2018 | -19.74 % | -209.00 $Km^2$ |
| | Seasonal water dynamics | 2000 - 2018 | 31.77 % | 190.00 $Km^2$ |
| Reservoirs | Minimum water extent | 2000 - 2018 | -24.89 % | -379.00 $Km^2$ |
| | Maximum water extent | 2000 - 2018 | -11.45 % | -185.00 $Km^2$ |
| Wetlands | | 2016 - 2018 | | 6144.31 $Km^2$ |
| Mangroves | | 1996 - 2016 | -5.77 % | 24.97 $Km^2$ |
| Water Quality | Turbidity State | 2017 - 2019 | 5 out of 21 lakes affected | 23.81 % |
| | Trophic State | 2017 - 2019 | 0 out of 21 lakes affected | 0% |

*Downloadable data that was provided on the online SDG 661 data portal consisted of:*

**(1) A global surface water dataset (Pekel *et al*. 2016[1]) produced by the European Commission's Joint Research Centre.**

UNEP SDG results used the Pekel *et al.* 2016 data (calculated from the Landsat 1984/5 to about October 2015, and thereafter Sentinel-2 to date), which is the only and best estimates of change in lacustrine systems (permanent and seasonal). Long term (since 1984 onward) dynamics in the extent of surface water ecosystems were captured at 30x30 metre pixel resolution for naturally occurring vs artificial (reservoir), ranging from permanent to seasonal and ephemeral? water surfaces. The global surface water datasets were made available as multiple GEOTIFFS (one per year from 1984 to 2019), a points dataset summarising data per hydrobasin (one point per year from 1984 to 2019), and a shapefile summarising the surface water extent per administrative boundaries (including all years from 1984 to 2019). The statistics are divided into permanent / estimated permanent water and seasonal / estimated seasonal water / seasonal that occurred over <2 months of the year / in 2-6 months of the year (with extent measured in $km^2$) / in >6 months of the year (with extent measured in $km^2$).

Data is available at an aggregated result per hydrobasin or per administrative boundary. Administrative boundaries are given as district municipalities of South Africa.

1 Jean-Francois Pekel, Andrew Cottam, Noel Gorelick, Alan S. Belward, High-resolution mapping of global surface water and its long-term changes. Nature 540, 418-422 (2016). (doi:10.1038/nature20584)

**(2) Water quality information for lakes/reservoirs representing 'the total percentage deviation, from a baseline, for turbidity and trophic state'**.

A five year baseline (2006-2010), per lake has been produced for both parameters. This was used to measure change against recent years (2017-2019). The data represents the number of lakes impacted by degradation of their environmental conditions (i.e. showing a deviation in turbidity and trophic state from the baseline) compared to the total number of lakes within a country. The values produced account for different sized lakes.

Turbidity is described as an indicator of water clarity, quantifying the haziness of water and acting as an indicator of underwater light availability. Trophic state refers to the degree at which the organic matter accumulates in the water body and is most commonly used in relation to monitoring eutrophication. In this context both water parameters may be used to infer a particular state or quality, of freshwater body.

The data show:

- Turbidity time series chart showing monthly turbidity categories (low, medium, high, extreme)
- Turbidity time series chart showing annual turbidity categories (low, medium, high, extreme)
- Trophic state time series chart showing monthly trophic state categories (low, medium, high, extreme)
- Trophic state time series chart showing annual trophic state categories (low, medium, high, extreme)'

The global statistics presented for South Africa showed only 21 'reservoirs' are recognized as per the Lehner *et al*. (2011)[2] database.

## 4. RESPONSE: REVIEW OF NATIONAL 6.6.1 STATISTICS FOR SOUTH AFRICA

South Africa defines an aquatic ecosystem as 'an ecosystem that is permanently or periodically inundated by flowing or standing water, or which has soils that are permanently or periodically saturated within 0.5 m of the soil surface' (Ollis et al., 2013[3]). Three broad systems are recognised, including marine, estuarine and inland systems. The last two systems correlate with those listed under the indicators of SDG 6.6.1.

South Africa has a number of projects and programmes which have generated data that is at least partially comparable to the global SDG dataset (Pekel *et al*., 2016). These datasets are explained in Van Deventer et al, 2018a[4], b[5], and Van Niekerk et al, 2018[6] and the latest spatial datasets for marine, estuarine and inland systems are available at http://bgis.sanbi.org/Projects/Detail/221.

[2] Lehner, B., C. Reidy Liermann, C. Revenga, C. Vörösmarty, B. Fekete, P. Crouzet, P. Döll, M. Endejan, K. Frenken, J. Magome, C. Nilsson, J.C. Robertson, R. Rodel, N. Sindorf, and D. Wisser. 2011. High-resolution mapping of the world's reservoirs and dams for sustainable river-flow management. Frontiers in Ecology and the Environment 9 (9): 494-502.

[3] Ollis, D.J., Snaddon, C.D., Job, N.M. & Mbona, N. 2013. Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems. SANBI Biodiversity Series 22. South African National Biodiversity Institute, Pretoria.

[4] Van Deventer, H.; Smith-Adao, L.; Mbona, N.; Petersen, C.; Mbona, N.; Skowno, A. & Nel, J.L . 2018. Review of available data for a South African Inventory of Inland Aquatic Ecosystems (SAIIAE). Water SA Vol. 44 http://dx.doi.org/10.4314/wsa.v44i2.05

[5] Van Deventer, H.; Smith-Adao, L.; Mbona, N.; Petersen, C.; Skowno, A.; Collins, N.B.; Grenfell, M.; Job, N.; Lötter, M.; Ollis, D.; Scherman, P.; Sieben, E. & Snaddon, K. 2018. South African Inventory of Inland Aquatic Ecosystems. South African National Biodiversity Institute, Pretoria. Report Number: CSIR report number CSIR/NRE/ECOS/IR/2018/0001/A; SANBI report number http://hdl.handle.net/20.500.12143/5847.

[6] Van Niekerk, L., Adams, J.B., Fernandes, M., Harris, L., Lamberth, S.J., MacKay, CF., Petersen, C., Ramjukhad, C.-L., Riddin, T., Van Deventer, H. & Weerts, S.P., 2019, ' Chapter 4: Extending the Estuary Functional Zone to include key habitats and processes', South African National

Table 4A below provides a summary of these datasets as well as comments on their comparison with the global datasets which were made available on the SDG6.6.1 Freshwater Ecosystems Explorer application (www.sdg661.app)

*.**Table 4A. Summary of RSA Ecosystem Extent Databases and comments on comparison with Global SDG 6.6.1 Data***

| Water-Resource Type | RSA Data Set | Reference | Results | Comment: comparison with Global Dataset |
|---|---|---|---|---|
| Lakes and Rivers Permanent vs Seasonal water bodies | **Lakes extent:** National Wetland Map 5, 2018.<br><br>http://bgis.sanbi.org/SpatialDataset/Detail/2691 | Van Deventer *et al.*, 2018[5]; 2020 | Eight Permanent Freshwater Lakes have been identified thus far in South Africa and have been mapped as part of the South African National Wetland Map version 5 (NWM5). The extent of these eight lakes as mapped in 2012 was 133.7 km$^2$. Estuarine Lakes are included under the estuaries ecosystem datasets.<br>No trend results on change in extent exist at this stage | SA defines a lake as a limnetic depression with a depth of /water level greater than 2 m at the average annual low-water level of an open waterbody[3].<br><br>It is not clear how UNEP has defined a lake and the statistics provided did not disaggregate the data into lakes and rivers making comparison of statics with local data difficult. |
| | **Rivers Location:** National Biodiversity Assessment Rivers 2018<br>http://bgis.sanbi.org/SpatialDataset/Detail/3697 | Van Deventer et al., 2019 | 164 018 km (main stem rivers: 76 830 km, tributaries: 87 188 km) | Global dataset does not pick up the smaller rivers in RSA. |
| | **Rivers Extent:** South African National Land Cover 2018<br><br>https://egis.environment.gov.za/<br><br>RSA Topographical Map series.<br><br>http://www.ngi.gov.za/index.php/what-we-do/maps-and-geospatial-information | Thompson, M. 2019[7]<br><br>National Geo-spatial Information (NGI), 2020[8] | South Africa has a partial River extent dataset. It currently underrepresents the true extent of Rivers.<br><br>No trend results on extent of waters within Rivers is readily available | Compared to the South African datasets, the SDG 6.6.1 Global dataset underrepresents RSA rivers. Based on spot checks of the Global data is it estimated that only around 10% of South African rivers are represented. |

Biodiversity Assessment 2018: Technical Report. Volume 3: Estuarine Realm. South African National Biodiversity Institute, Pretoria. Report Number: SANBI/NAT/NBA2018/2019/Vol3/A

[7] Thompson, M. 2019. South African National Land-Cover 2018 Report & Accuracy Assessment. A report for the Department of Environmental Affairs, South Africa. GeoTerra Image (GTI) Pty Ltd.

[8] http://www.ngi.gov.za/

| Water-Resource Type | RSA Data Set | Reference | Results | Comment: comparison with Global Dataset |
|---|---|---|---|---|
| | **Estuaries Extent:**<br><br>Estuarine Map, 2019<br><br>http://bgis.sanbi.org/Projects/Detail/224 | Van Niekerk et al, 2019. | South Africa has 290 estuaries and 42 micro-estuaries which have been classified into 22 estuarine ecosystems types.<br><br>In South Africa, Estuarine mapping is undertaken for the Estuarine Functional Zone (EFZ) - defined as the area that not only encapsulates the estuary waterbody, but also the supporting physical and biological processes necessary for estuarine function and health.<br><br>The total extent of the mapped estuarine functional zone in South Africa in 2018 was 2007.3 km2. Compared to the extent in 2011 (1710.5 km2) this represents a 17.35% increase. | Most, if not all estuaries have been included in the Global Dataset. However, global dataset maps open water extent and does not distinguish between estuaries and rivers and separate statistics are not available to cross check with local datasets. This said, national dataset for EFZ's are available but not for open water of estuaries. |
| | **Open water/lacustrine systems - Permanent vs Seasonal water bodies**: South African National Land Cover (SANLC) 2018<br><br>https://egis.environment.gov.za/ | Thompson, M. 2019 | 2 318 km² of permanent water and 3 765.4 km² of seasonal water were mapped in 2018<br><br>No trend results in permanent vs seasonal waters within open water bodies is currently available. | The Global Surface Water Dataset reports only 59% of permanent water mapped in the SANLC, (2018) and only 48% of seasonal water.<br><br>The Global Surface Water Dataset reports only 9.02% of permanent water and 5.05% of seasonal water mapped in the 2018 SANLC. |
| Reservoirs | **Reservoir location:**<br>1. DWS National Dam Layer<br>2. DWS Dam Safety register<br>3. SANBI Artificial systems layer, contained in National Wetland Map 5<br>4. Integrated Dams Layer, | 1. DWA, 2015[9]<br>2. DWS, 2020[10]<br>3. Van Deventer et. al., 2020 [11][12]<br>4. Rajah et al. 2019 [13] | The Department of Water and Sanitation (DWS, 2020) Dam Safety layer for waterbodies has 7 300 dams. The latest Reservoir layer produced by the CSIR & SANBI, documented a total of 190 573 dams | Compared to the Global Surface Water Dataset, the number dams are likely underrepresented. |

[9] Department of Water and Sanitation (2015) National dams 1:50 000 map, shapefile.

[10] Department of Water and Sanitation (2020) National dams register, spreadsheet

[11] Van Deventer H, Van Niekerk L, Adams J, Dinala MK, Gangat R, Lamberth SJ, et al. National Wetland Map 5 – An improved spatial extent and representation of inland aquatic and estuarine ecosystems in South Africa. Water SA. 2020;46(1):66–79. https://doi.org/10.17159/wsa/2020.v46.i1.7887

[12] Skowno, A. & Van Deventer, H. 2018. Appendix G: Artificial water bodies map for South Africa. South African Inventory of Inland Aquatic Ecosystems (SAIIAE): Technical Report. SANBI report.

| Water-Resource Type | RSA Data Set | Reference | Results | Comment: comparison with Global Dataset |
|---|---|---|---|---|
| | in prep | | | |
| | **Reservoir extent**:<br>*Mzansi Amanzi*<br>https://www.water-southafrica.co.za/ | GeoTerra Image, 2020[14] | Trend data in extent is expected to become accessible to DWS in late 2020 and will map trends from 2016. | |
| Wetlands | **Wetlands:**<br>Wetland National Wetland Map 5, 2018<br>http://bgis.sanbi.org/SpatialDataset/Detail/2691 | Van Deventer et al, 2020. | In South Africa natural wetlands are divided into palustrine, inundated and arid systems.<br>The total areal extent of wetlands mapped to date (based on data accumulated between 2006-2018) is 46 000 km². 70% of the extent of catchments in the country (assessed at a quinary drainage region scale) underrepresent the extent of wetlands and are therefore considered low in confidence .<br>No trends on change in extent are available at this stage | The global indicator for the full extent of wetlands underestimates the true extent by at least by 87% (Van Deventer, H. Pers. Comm 19 May 2020). Further detail on how SDG 6.6.1 defines a wetland is required. |
| Mangroves | **Mangrove Extent**:<br>Mangrove Layer, 2019 Nelson Mandela University | Adams and Rajkaran, 2020.[15] | Recent estimations are that there has been an increase of 1.08 km² from 15.64 km² to 16.72 (6.9% increase) in mangrove area between 1930 and 2019 | The global mangrove extent data of 24.97 km² is an over-estimation of mangrove habitat in RSA, and indicates a loss of 5.77% since 1996. In contrast, local data shows a small increase of 7% measured from 1930 to 2019. |
| Water Quality | Earth Observation – National Eutrophication Monitoring Programme (EONEMP), 2018<br>http://eonemp.cyanolakes.com | Mathews, M. 2014[16] | SA water bodies have a history of nutrient enrichment problems in some areas and with the EONEMP more than 102 Dams/reservoirs can be monitored compared to the 21 reported by UNEP. | Using data from the EONEMP project, ten out of 21 dams have trophic status /nutrient enrichment problems; compared to what was reported by the Global dataset (none had problems). |

[13] Rajah, C, Moloele, LS., and Mapulana, J. 2019. SDG 6 . Methodology Indicator 6.6.1: Change in Spatial Extent (d) Artificial Water Bodies. Department of Water and Sanitation, South Africa in: Overarching Methodology Report for SDG 6.6.1 for South Africa.

[14] See: http://www.ee.co.za/article/cloud-based-monitoring-sas-water-resources.html

[15] Adams, J. B. and Rajkaran, A. 2020. Changes in mangroves at their Southern most African distribution limit. Elsevier Journal of Estuarine, Coastal and Shelf Science. https://doi.org/10.1016/j.ecss.2020.106862

[16] Matthews MW, (2014). Eutrophication and cyanobacterial blooms in South African inland waters: 10 years of MERIS observations. Remote Sensing of Environment, Vol: 155; Pg: 161–177

A more detailed description of each of the data comparisons are provided in the sections below.

## 4.1 EXTENT OF RIVERS

River area is currently not separated out in the global reporting from all natural surface water, therefore, river area is not a reported statistic.

South Africa does not have an official and complete river area dataset, but for planning purposes, rivers are represented as lines. The most complete set of data for river location was mapped as part of the South African National Biodiversity Assessment (NBA) of 2018 (Smith-Adao et al., 2019)[17]

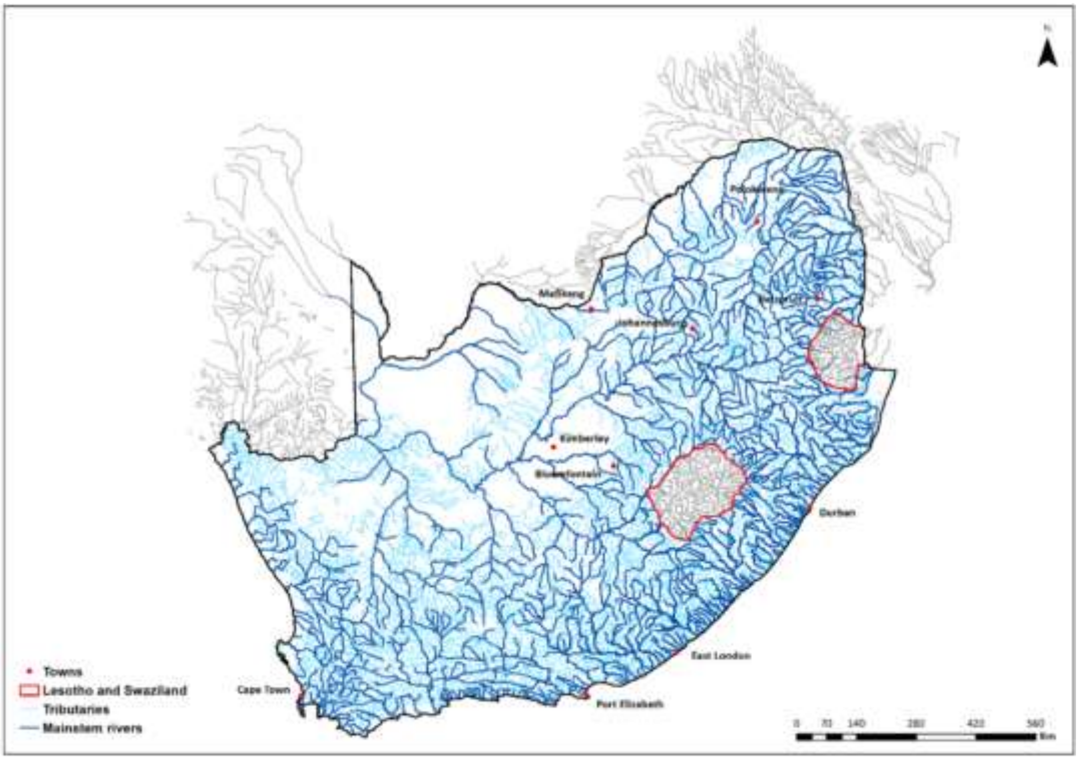



**Figure 4A. NBA 2018 rivers layer with quaternary mainstem rivers and their tributaries. Rivers in grey are shared rivers in neighbouring countries (Van Deventer et al, 2019)**

South Africa does have a partial river area dataset as part of the South African National Land Cover (SANLC) 2018 dataset (Thompson, M. 2019). This dataset broadly describes flow variability using two categories: permanent (perennial and seasonal rivers) and not permanent (ephemeral rivers). In addition, river extent can be extracted from the CD: NGI topographical map series. However, these datasets severely under-represent river area for those rivers in South Africa where surface water is regularly present.

The available global surface water dataset was reviewed against the above-mentioned South African datasets by means of several spot checks against topographic sheet areas. The global dataset represent less than 10% at a subjective estimate of the already under-representative South African data. The Figure 4B and 4C shows an example for a spot check undertaken for the Limpopo River.

[17] Smith-Adao, L.; Petersen, C.; Nel, J.; Silberbauer, M.; Scherman, P. and Grenfell, M. Chapter 2: Origin, development and improvement of the rivers data set. South African Inventory of Inland Aquatic Ecosystems (SAIIAE): Technical Report. CSIR report number CSIR/NRE/ECOS/IR/2018/0001/A.

(i) Google Earth

(ii) CD: NGI

(iii) SANLC 2018

(iv) SDG 6.6 Global Dataset

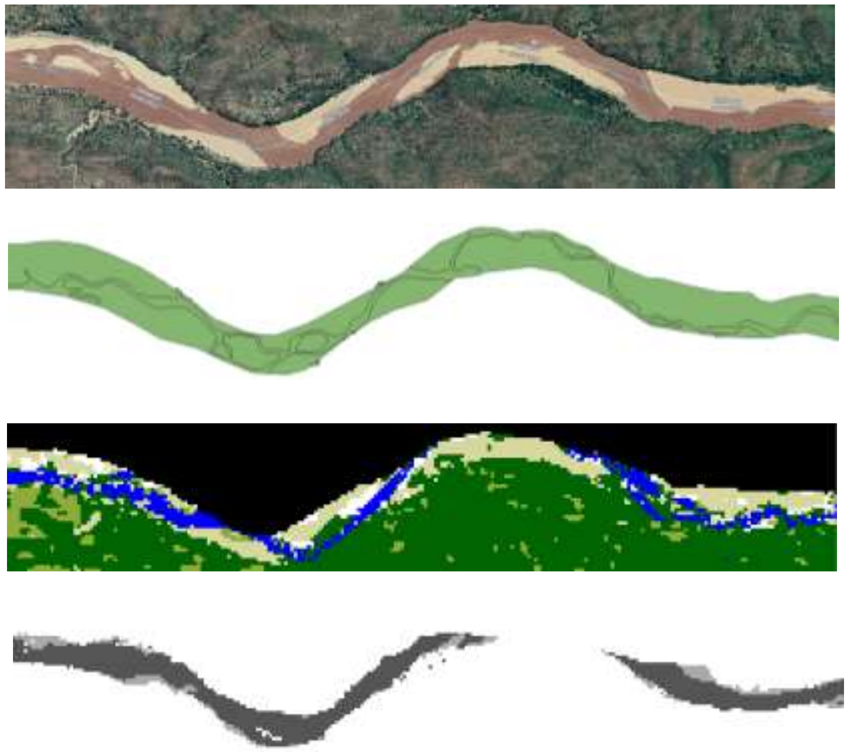


**Figure 4B. Comparison of the Limpopo River extent between i) Google earth, (ii) SA CD:NGI, (iii) SA NLC (2018) and (iv) UNEP SDG 6.6.1 Global dataset**

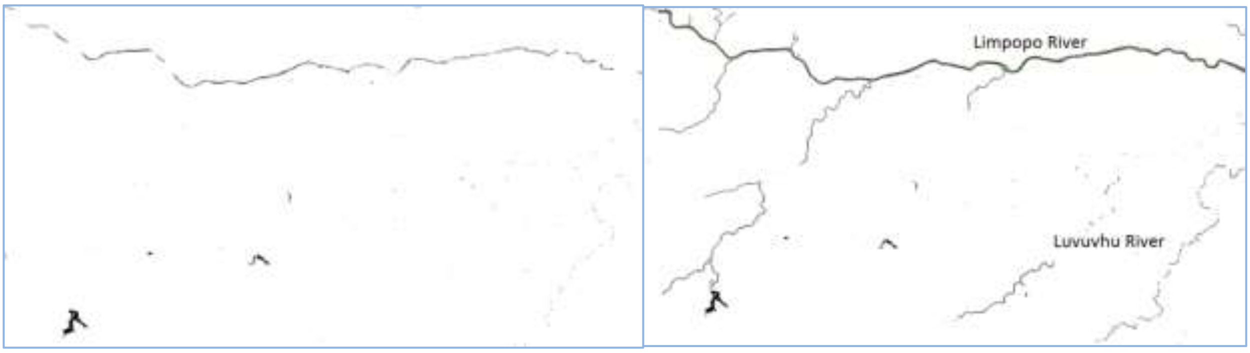



**Figure 4C. Comparison of the Limpopo River, just above the confluence with the Levuvhu between i) UNEP SDG 6.6.1 Global dataset and ii) RSA CD:NGI River Area dataset.**

Moving forward South Africa will work towards preparing a baseline river area dataset for priority large rivers, against which the global change datasets could be applied.

## 4.2 EXTENT OF LAKES

As with river area, Lakes contained in the SDG 6.6.1 Surface water data are currently not separated out from all other natural surface waters and is therefore not a reported statistic for SDG 6.6.1.

South Africa is predominantly semi-arid to arid, with few inland wetlands (11%), rivers or estuaries (18%) having open water cover (Van Deventer et al., 2020) at the extent detectable by space-borne optical Landsat and Sentinel 2 sensors. Natural lakes are rare in South Africa. Eight freshwater lakes have been identified to date, making up less than one percent of South Africa's land area. The surface area of South Africa's lakes was captured at desktop level using satellite imagery and colour orthophotos from 2012 (Van Deventer et al., 2019).

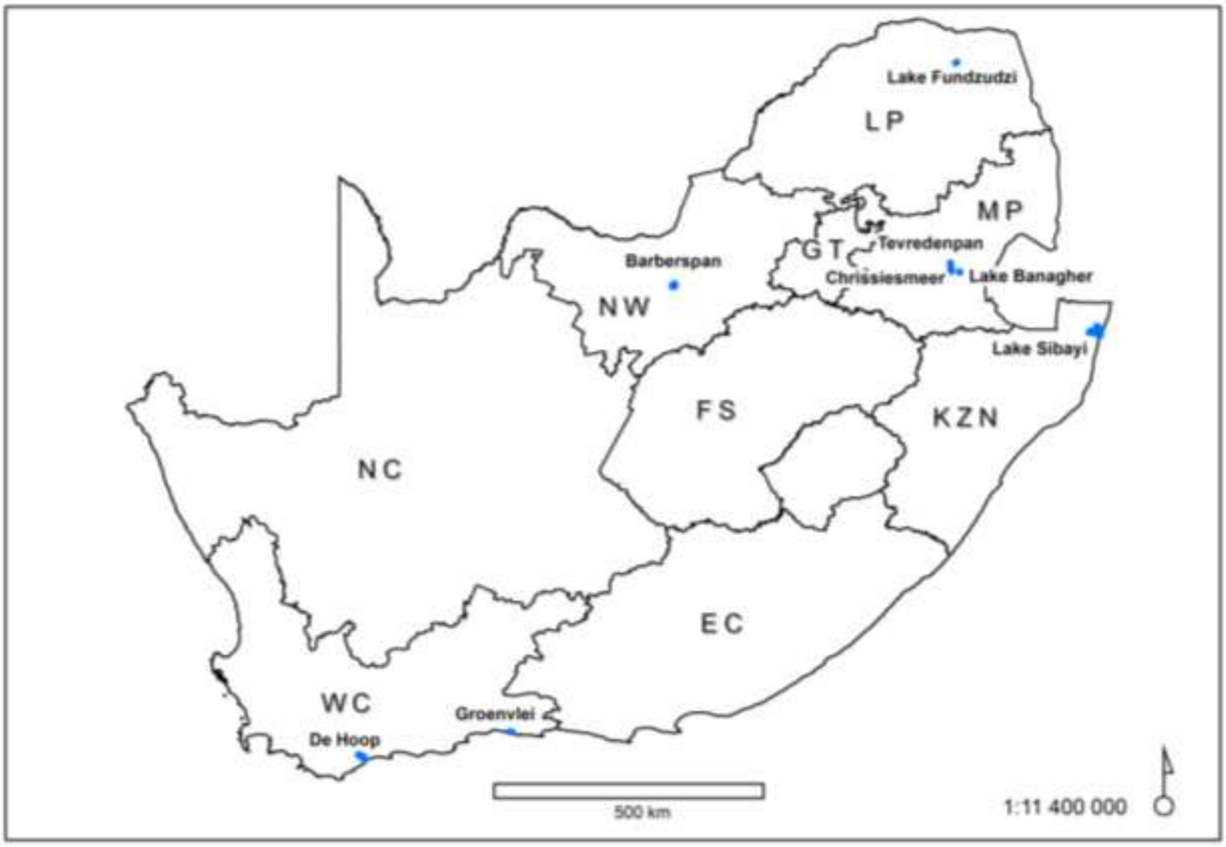



**Figure 4D. The South African Freshwater Lakes (Van Deventer et al., 2018; 2019)**

South Africa distinguishes between freshwater and estuarine lakes, though only the former is reported on this report. Natural freshwater lakes are rare in South Africa and eight freshwater lakes (Figure 4D) have been identified to date (Van Deventer et al., 2018 from the NBA Report published in 2019). These eight lakes in South Africa are limnetic (>2m deep at the average annual low-water level) but includes four systems of >8 km and four of <8 km, whereas globally only lakes >8 km are considered lakes.

The areal extent of 75 estuarine lakes considered limnetic in nature, is included in the all-encompassing Estuarine Functional Zone (EFZ) of the estuaries in National Wetland Map 5 (NWM5), and has not been mapped separately (Van Deventer et al., pers comm). Changes in the areal extent of these 80+ lakes can in future be monitored, the bathymetry validated and used in for future SDG reporting.

The DWS, in collaboration with its partners such as SANBI, CSIR and WRC will in future need to undertake further studies to validate and identify any other lakes that may exist in the country.

## 4.3 EXTENT OF ESTUARINE SYSTEMS

South Africa has more than 300 estuaries (290 estuaries and 42 micro-estuaries. Estuaries are located in four different biogeographical regions: tropical, sub-tropical, warm temperate and cool temperate (Figure 4E). South African estuarine systems are refined and further classified into nine different types according to Van Niekerk et al., 2019[6]. This classification system is based on key physical characteristics of estuaries. The nine different types are estuarine lakes, estuarine bays, estuarine lagoons, predominantly open estuaries, large temporary closed estuaries, small temporary closed estuaries, large fluvial dominated river mouth, small fluvial dominated river mouth and arid predominantly closed.

The distribution of the estuary types according to Van Niekerk et al. (2019) within the four biogeographical areas of the South African coast is reflected in Table 4B.


**Figure 4E. The four biogeographical regions of the South African coast:** Cool Temperate (Orange to Ratel), the Warm Temperate (Heuningnes to Mendwana), the Subtropical (Mbashe to St Lucia), and the Tropical (uMgobezeleni to Kosi) (After Van Niekerk et al. (2019).

***Table 4B Distribution of estuary types in the four biogeographical regions of the South African coast (Van Niekerk et al. 2019).***

| ESTUARY TYPE | BIOGEOGRAPHICAL REGION | | | |
|---|---|---|---|---|
| | COOL TEMPERATE | WARM TEMPERATE | SUB TROPICAL | TROPICAL |
| Estuarine Lakes | 4 | 3 | 3 | 2 |
| Estuarine Bay | 0 | 1 | 1 | 0 |
| Estuarine Lagoon | 1 | 0 | 0 | 0 |
| Predominantly Open Estuaries | 3 | 25 | 16 | 0 |
| Large Temporary Closed Estuaries | 9 | 40 | 45 | 0 |
| Small Temporary Closed Estuaries | 8 | 48 | 60 | 0 |
| Large Fluvial Dominated River Mouth | 1 | 1 | 5 | 0 |
| Small Fluvial Dominated River Mouth | 1 | 6 | 0 | 0 |
| Arid Predominantly Closed | 6 | 0 | 0 | 0 |
| TOTAL | 33 | 124 | 131 | 2 |

The highest number of Large- And Small Temporary Closed Estuaries occurs in the subtropical region, while the highest numbers of Predominantly Open Estuaries and Small Fluvial Dominated River Mouths occur in the warm temperate region. The highest number of Large Fluvial Dominated River Mouths, occur in the sub-tropical region. This is reflective of the role that rainfall plays in dictating the type and number of estuaries. This is further observable by the limited number of estuaries in the cool temperate region.

Divided according to size categories (Table 4C), the greatest number of the Estuaries with South Africa are very small (24%), with only 8% (24 estuaries) falling in the very large size category (estuaries that are >500ha in size).

*Table 4C Distribution of estuary size classes in South Africa( adapted from Van Niekerk et al. 2019).*

| Estuary Size Category | ha | $km^2$ | Number of Estuaries | % in RSA |
|---|---|---|---|---|
| Very large: | >500 ha | >5 $km^2$ | 24 | 8% |
| Large: | 100-500 ha | 1-5 $km^2$ | 40 | 14% |
| Medium: | 50-100 ha | 0.5-1 $km^2$ | 24 | 8% |
| Small: | 15-50 ha | 00.15-0.5 $km^2$ | 72 | 25% |
| Very Small: | <15 ha | <0.15 $km^2$ | 130 | 45% |

In addition three types of micro-systems (Table 4D) have also been identified by Van Niekerk *et al.* (2019). Some of these systems have previously been classified as estuaries.

- *Micro-estuaries* are defined as small, permanent coastal water bodies where mixing of saline and freshwater takes place as a result of tidal over wash. These systems are likely to support low densities and limited number of estuarine species.
- *Micro-outlets* are small water bodies (<1 ha or <50 m in length) and ephemeral in nature. They are elevated above sea level and have a perched outlet that does not facilitate tidal exchange.
- *Coastal waterfalls* are waterbodies that is elevated more than 10 m above mean sea level. There is no connectivity between fresh and marine water, but the freshwater outflow from these water bodies may support unique marine biotic assemblages along the rocky coast.

***Table 4C Number of estuaries in each micro-system type across the four biogeographical regions in South Africa according to Van Niekerk et al. (2019).***

| MICRO-SYSTEM TYPE | COOL TEMPERATE | WARM TEMPERATE | SUBTROPICAL | TROPICAL |
|---|---|---|---|---|
| Micro-estuary | 5 | 13 | 24 | |
| Micro-outlet | 26 | 31 | 96 | |
| Waterfall outlet | | | 7 | |
| TOTAL | 31 | 44 | 127 | |

As part of the 2011 and 2018 South African National Biodiversity Assessments (NBA's), undertaken by SANBI and the South African Council for Scientific and Industrial Research (CSIR) (Van Nierek and Turpie, 2012; van Niekerk et al., 2019), the extent of South Africa's estuaries was mapped. The South African classification system for estuaries specifies the boundary of an estuary to include the Estuarine Functional Zone (EFZ). The EFZ is defined as "the area that not only encapsulates the estuary waterbody, but also the supporting physical and biological processes and habitats necessary for estuarine function and health. It includes all dynamic areas influenced by long-term estuarine sedimentary processes, i.e. sediment stored or eroded during floods, changes in channel configuration, aeolian transport processes, and changes due to coastal storms. It also encompasses all the multiple ecotones of floodplain and estuarine vegetation that contribute detritus (food source) and provide refuge from strong currents during high flow events" (van Niekerk et al., 2019)

In the 2011 and 2018 NBA, various sources of data were used to define the EFZ. The extent of the estuarine functional zone per biographical region are summarised in Table 4D, showing a 17.35% increase in extent.

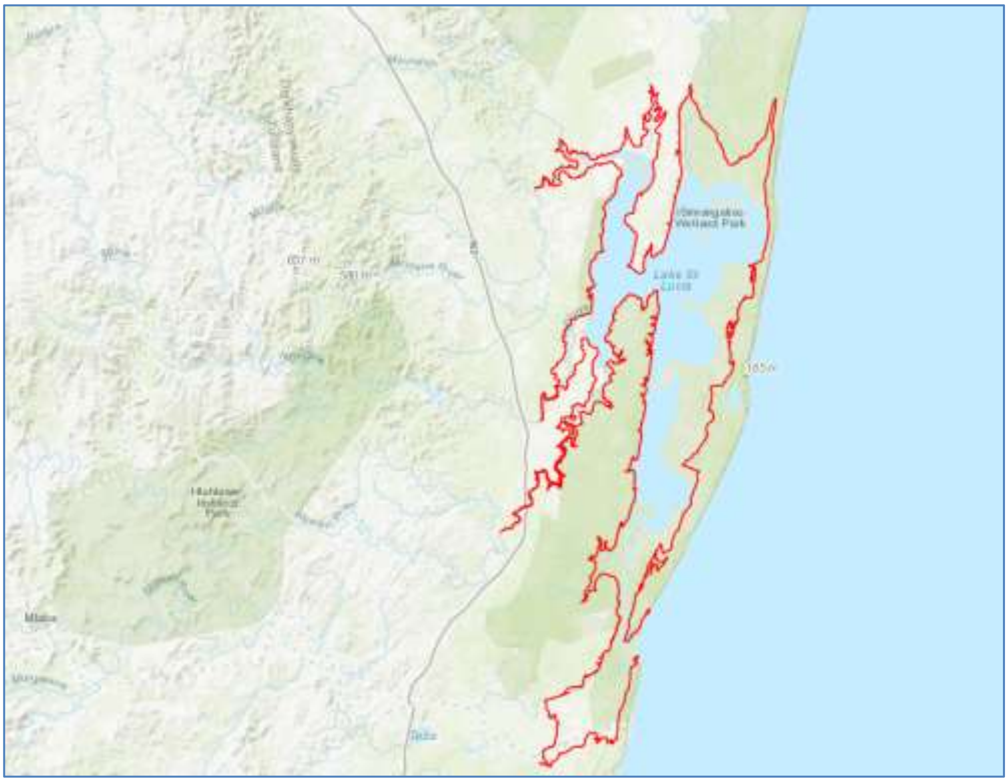


**Figure 4F.** Example of the Estuarine Functional Zone. Mapped for the St Lucia Estuary (van Niekerk *et al*., 2019, accessed from https://maps.coastkzn.co.za/CoastKZN/)

***Table 4D. A comparison of the extent of the South African Estuarine Functional Zone according to the 2011 NBA based on Van Niekerk and Turpie (2012) and the 2018 NBA (Van Niekerk et al., 2019).***

| BIOGEOGRAPHICAL REGION | 2011 NBA – PROPORTIONAL EFZ (HA) | 2011 NBA – PROPORTIONAL EFZ (HA) | 2011 NBA -% OF TOTAL EFZ | 2018 NBA -% OF TOTAL EFZ |
|---|---|---|---|---|
| Cool Temperate | 26 516 | 37 680 | 16 | 17 |
| Warm temperate | 41 785 | 44 500 | 24 | 20 |
| Subtropical | 102 746 | 110 390 | 60 | 50 |
| Tropical | | 8 170 | | 4 |
| **Total** | **171 046** | **220 730** | | |

A list of all South African estuaries, along with their classification type and coordinates has been included as Appendix A to this report.

The global dataset for SDG 6.6.1 surface waters provides data on the presence of water (seasonal or permanent) at a 0.0009 $km^2$ scale and it is expected that all of the estuaries in South Africa have been picked up, including the arid (seasonal) systems. However given that estuarine area is currently not separated out in the global reporting from all other natural surface waters, estuarine open water area is not a reported statistic. Should this statistics become available an exercise would need to be undertaken within South Africa in order to verify the statistics as existing datasets within South Africa do not map open water extents for Estuaries but rather changes in the EFZ, which is undertaken in order to sufficiently inform management actions.

### 4.4 EXTENT OF ARTIFICIAL SYSTEMS (RESERVOIRS)

The global statistics presented for South Africa reported a change of -24.89% for the minimum extent and -11.45% in the maximum extent of the systems.

As with rivers and estuaries, the reservoir area was not provided as a separate data file on the SDG 6.6.1 Freshwater Ecosystems Explorer application (www.sdg661.app)

and comparisons with local datasets were thus not possible. However it is likely that the number and aerial extents are significantly underrepresented: According to the methodology provided by UNEP on SDG 6.6.1, the total number of artificial reservoirs for the entire globe is 8869. The DWS layer for waterbodies captured in the National Dams Register (DWS, 2020)[18] has 7300 dams, and the reservoir layer produced by SANBI, documented a total of 190 573 dams[19].

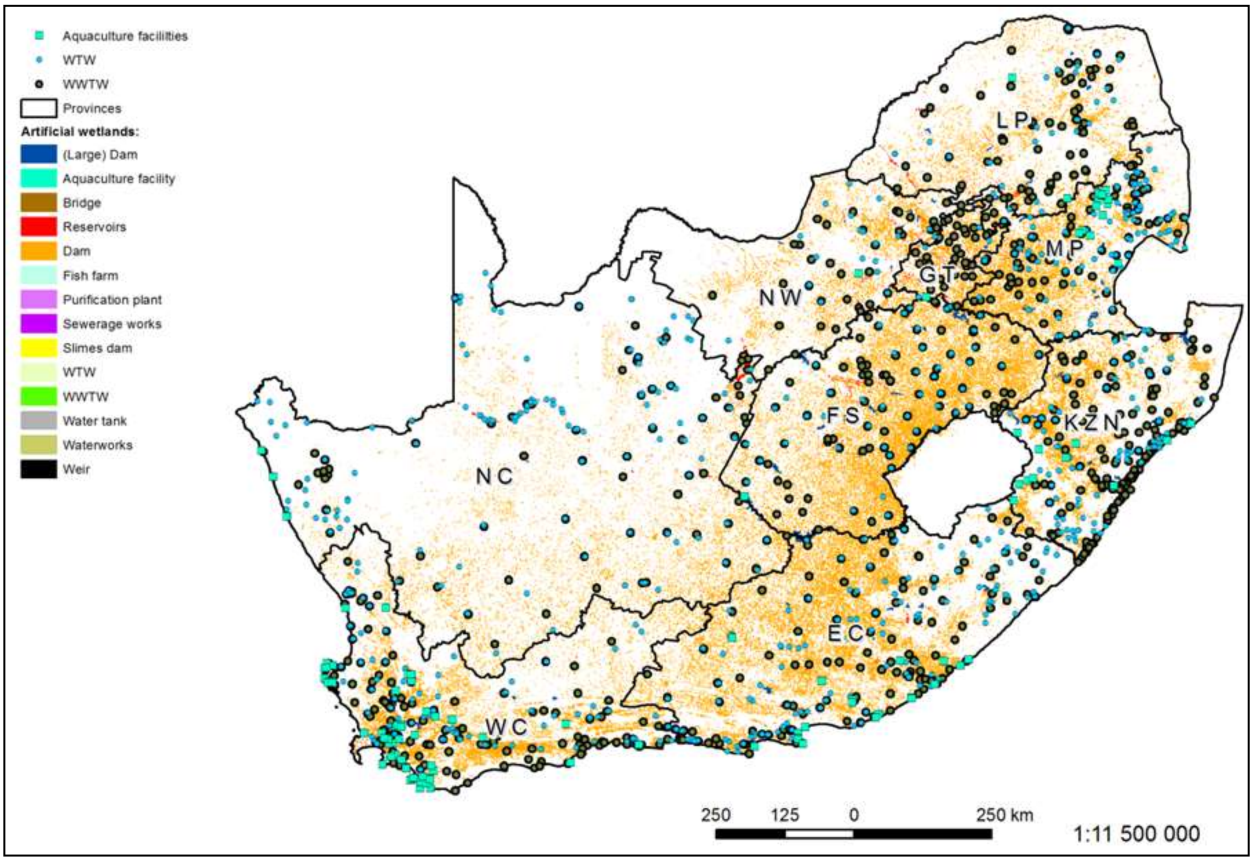



**Figure 4G. Artificial wetlands in the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Van Deventer et al., 2018).**

When overlaid with the GeoTiffs sourced from the surface water dynamics dataset (representing both permeant and seasonal water) currently available on the SDG661 Freshwater Ecosystems Explorer

[18] Department of Water and Sanitation (2020) National dams register, spreadsheet

[19] Skowno, A. & Van Deventer, H. 2018. Appendix G: Artificial water bodies map for South Africa. South African Inventory of Inland Aquatic Ecosystems (SAIIAE): Technical Report. SANBI report.

application (www.sdg661.app), reservoirs did align well with the extents mapped. The figure below shows the artificial waterbodies from the GeoTiffs compared to the Department of Water and Sanitation (DWS, 2015) Dam shapefile layer.

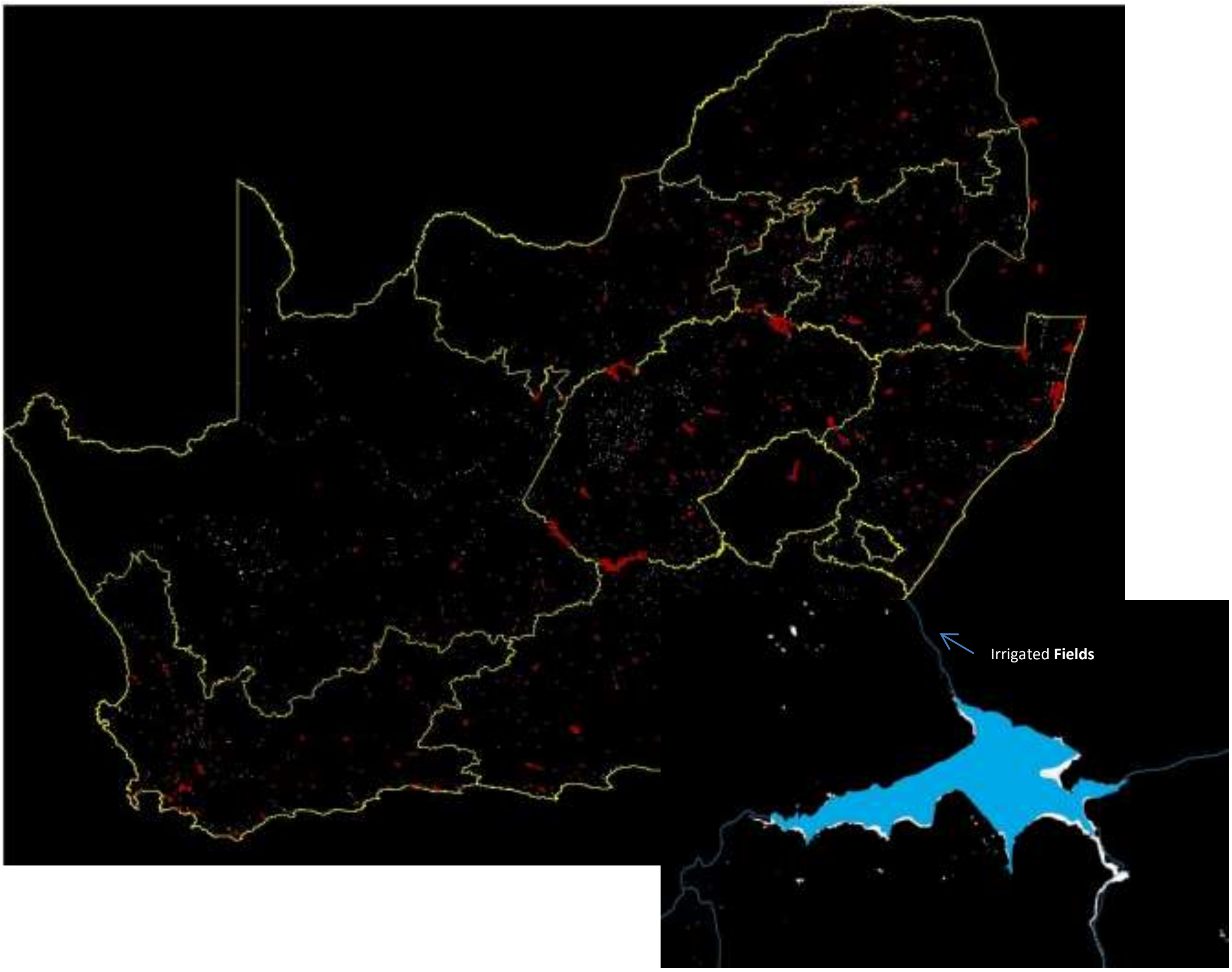



**Figure 4H. i: Comparison of UNEP Geotiffs (2017) with DWS Dam layer (Red). ii: Hartebeespoort Dam: UN Geotiffs with DWS Dam layer (blue)**

When interpreting the maximum and minimum changes in extent as provided by UNEP in the request to South Africa, it should be noted that baseline dataset includes a drought year which affected 26% of the summer rainfall extent (90%) of South Africa (Malherbe et al., 2015)[20]. The percentage of loss indicated for the most recent target period (2015-2019) includes change to a decadal drought of 2015/6, which affected a large percentage of the summer and winter rainfall regions of the country, with some of the areas still in recovery of this drought. Limitations to the use of gauge plates, is that they are not ideally positioned to monitor these systems during extreme droughts, since the gauge plates then often end up outside the shoreline of the reservoirs and lakes. Using remote sensing data can therefore complement

[20] Malherbe, J.; Dieppois, B.;Malukeke, P, . 2015. South African droughts and decadal variability. Natural Hazards 80(1) DOI: 10.1007/s11069-015-1989-y

the gauge plate monitoring in determining extent or volume. A local remote sensing study in South Africa by GeoTerraImage[21] tracked changes in land cover and open waterbodies between 1990 and 2013/4. This study mapped 3 183.9 km² of artificial open-water system with a decrease of < 1% over the reporting.

Similar to the open water inland wetlands (natural), we recommend that changes be reported for South Africa against a mean value derived from 36 years of data (Pekel *et al.,* 2016), refined to the categories mapped in the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) under the artificial wetlands layer. The baseline and reference dataset of the SDG reported on the app includes both drought years, and if not normalized across a 30+ year period, may not be as meaningful for interpretation. Similar to the open water system for the natural wetlands, the downscaled data to HYDROSHEDs data is not as useful to South Africa, since most of South Africa's planning occur with the use of a primary to sub-quaternary catchment level data, which do not align well with HYDROSHEDs. South Africa can disaggregate to smaller scale using the available grids from the GSWE.

***The way forward for Reservoir mapping in South Africa:***

As alluded to above, there are number of datasets on the location of dams that currently exist in South Africa, these include:

- Hydrological features from the SANLC 2018 Dataset (Chief Directorate: National Geospatial Information, 2016),
- The Artificial Systems layer produced by SANBI as part of the 2018 National Biodiversity Assessment (Skowno and van Deventer, 2018)
- Dam and reservoirs (1:50 000 scale dataset) produced by the Department of Water and Sanitation (DWS, 2015a),
- National dam safety register of the Department of Water and Sanitation – a spread sheet with details of all registered dams with build data and dimensions (Department of Water and Sanitation, 2015b), and
- Dams registered on the Water use Authorization & Registration Management System (WARMS) of the Department of Water and Sanitation.

The DWS has recently initiated a project to produce an integrated Dam layer. The final product is expected to become available in early 2021.

This layer will then be used to determine changes in extent, from 2016 as a baseline using the data procured by SANAS. This data is generated through the Mzansi Amanzi initiative – this is a Web-based monthly water monitoring tool that enables users to visualise and determine the extent of surface water resources across the entire country, using earth observation technologies. A brief summary of this tool is available at https://www.ee.co.za/article/cloud-based-monitoring-sas-water-resources.html

## 4.5 EXTENT OF WETLANDS

The SANBI is the spatial base dataset custodian for South African wetland data. In 2006 the first National Wetland Map was produced and has since significantly been improved by recent

[21] GTI, 2016. South Africa Land Cover Water Feature Splits [1990-2013/4]. Data Users Report and Meta Data [Version 2]. GTI, Pretoria, South Africa

advancements as documented in van Deventer et al 2018, 2019[22], resulting in the latest National Wetland Map, Version 5 (NWM5, 2018) (Figure 4I).

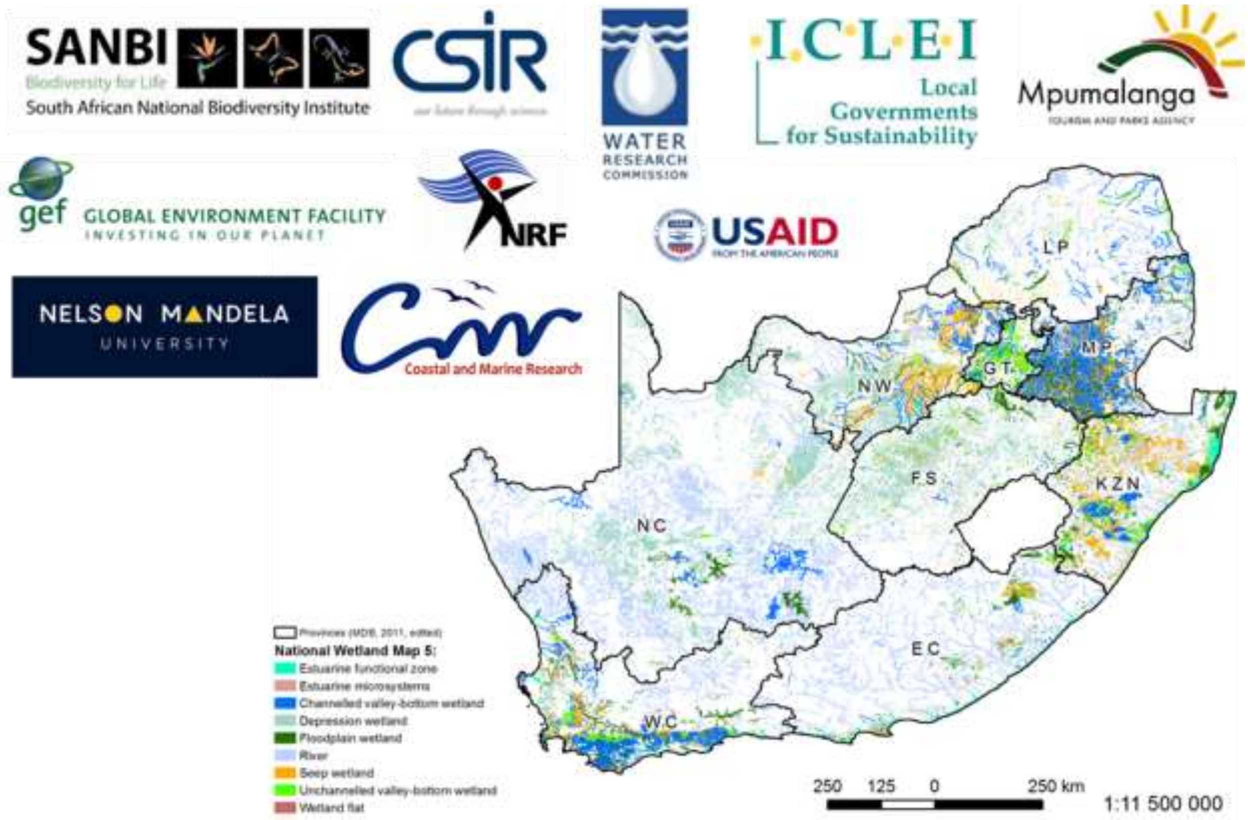



**Figure 4I: National Wetland Map 5 (Van Deventer *et al*., 2020)**

Central to understanding the statistics on wetlands is ensuring that definitions of wetlands are clear and comparable. From the UNEP methodology report for SDG 6.6.1, reported statistics are for vegetated wetlands only. This is comparable with the palustrine wetlands mapped in the NWM 5.

Although the SDG reporting includes lacustrine and palustrine systems, countries with arid climates also have systems which are not predominantly (>70%) lacustrine or palustrine. In arid areas inundation may occur only every 7 years or more, and during a large part of the system's cycle, it has a bare ground cover. South Africa distinguish these systems as "arid", and they are ephemeral in nature. For the short period of time that they are inundated or saturated, they temporarily support wetland-related fauna and flora[23.] These wetlands are also seen as having an ecological significance and should be included for country-level reporting for South Africa. Time-series analysis over a period of at least 10 years is required to accurately determine these types. About 34% of the extent of inland wetlands in NWM5 falls within this category (Van Deventer *et al.,* 2019).

The total extents of each of the wetland categories is provided in Table 4E below.

[22] Van Deventer, H.; Van Niekerk, L.; Adams, J.; Dinala, M.K.; Gangat, R.; Lamberth, S.J.; Lötter, M.; Mbona, N.; MacKay, F.; Nel, J.L.; Ramjukadh, C-L.; Skowno, A. & Weerts, S.P. 2020. National Wetland Map 5 – An improved spatial extent and representation of inland aquatic and estuarine ecosystems in South Africa. Water SA, 46(1): 66–79. DOI: https://doi.org/10.17159/wsa/2020.v46.i1.7887

[23] Draft definition, as provided by H van Deventer, 2019. Pers. Comm.

***Table 4E. Extent of wetlands per wetland category mapped in van Deventer et al, 2019***

| ***SOUTH AFRICA: NATIONAL WETLAND MAP 5 (2018)*** | | | |
|---|---|---|---|
| | ***ha*** | ***%*** | ***km²*** |
| *Lacustrine (open water)* | *278,719* | *10.6* | *2,787.2* |
| *Palustrine (vegetated)* | *1,447,932.0* | *54.9* | *14,479.3* |
| *Not vegetated/arid (and not open water)* | *909,157.0* | *34.5* | *9,091.6* |
| **Total Wetlands** | **2,635,808.0** | | **26,358.1** |
| Total Artificial | 598389.4 | | 5,983.9 |
| Total Rivers | 1,146,231.8 | | 11,462.3 |

The global statistics derived from the Global Surface Water dataset (Pekel *et al.,* 2016) and other models for palustrine wetlands, shows that South Africa has 6144.3 km² of wetland areal area, which includes all natural wetlands (inland and estuarine), natural rivers and artificial wetlands (including reservoirs), whether they are predominantly palustrine (vegetated), lacustrine (predominantly open water) or arid (predominantly without open water or vegetation) from a remote sensing view. South Africa's most recent National Wetland Map version 5 however, shows that the total aerial extent of wetlands mapped to date is 46000km², with 70% of the extent country showing a low confidence that all wetlands are represented. Therefore the global indicator for the full extent of wetlands underestimates the true extent by at least by 87%.

The majority of the extent of South Africa (>70%) however still shows an underrepresentation of the extent and number of inland wetlands in this NWM5. While the current map reflects a 2.2% of the country as inland wetlands, regional averages suggest that 15% of catchments would be a more likely average. Estuaries have been mapped at a fine scale, though improvements are still under way, however, may result in a minor increase in extent in future. In addition, considering global losses of wetlands (>85%) and estimations of losses recorded in South Africa (58%; Begg, 1984), accurate and complete representation of inland wetlands may be unlikely.

Surface area is determined based on data from various databases and inventories which have collected data between 2006-2016. Improvements to the representation of wetlands are under way, for improved representation in NWM, version 6.

## 4.6 EXTENT OF MANGROVES

Mangroves are trees that establish in the intertidal zone in permanently open estuaries along the east coast of South Africa north of East London (Figure 4J) where water temperature is usually above 20 °C. The White Mangrove (Avicennia marina) is the most abundant, followed by the Black Mangrove (Bruguiera gymnorrhiza), followed by the Red Mangrove (Rhizophora mucronata) (Van Niekerk et al., 2019)24. Mangroves in South Africa occur at one of the most Southerly locations in the world, which provides a unique opportunity to study their dynamic responses to anthropogenic and natural perturbations. The exposed high-energy South African coastline restricts mangroves to 32 sheltered estuaries of which 18 (56%) are predominantly open to the sea. A large area of mangrove (47% of the

[24] Van Niekerk, L., Adams, J. B., Lamberth, S. J., Mackay, C. F., Taljaard, S., Turpie, J. K., Weerts S. P. and Raimondo, D. C. 2019. South African National Biodiversity Assessment 2018 Technical Report Volume 3: Estuarine Realm. CSIR report. South African National Biodiversity Institute, Pretoria

country total) occurs in the uMhlathuze Estuary – a novel ecosystem formed by the creation of an artificial mouth (Adams and Rajkaran, 2020)[25]

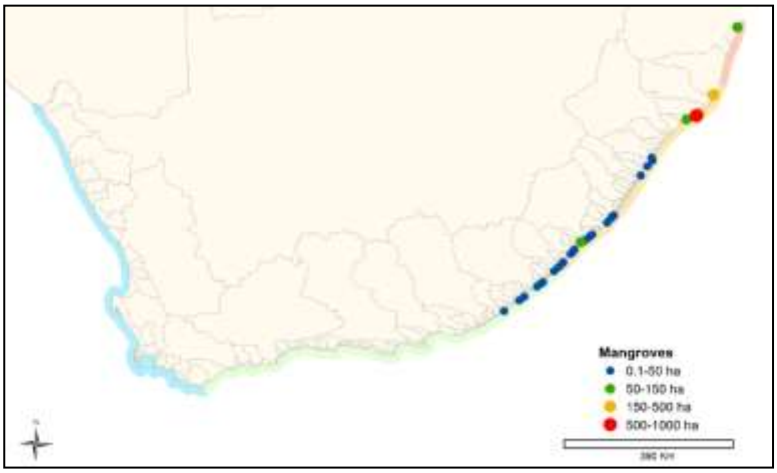



**Figure 4J: Distribution of mangrove habitat in South Africa (van Niekerk et al, 2019)**

Recent data generated by a study by Adams and Rajkaran compared extents from 1930 to 2019 and have shown that there has been an increase of 108 ha from 1564 ha (6.9% increase) in mangrove area. Table 4F shows the change in extent of mangrove habitat in 16 estuaries where the total estuary area is larger than 10 ha. Although the data shows that overall, mangrove area has increased in South Africa due to habitat expansion at the uMhlathuze Estuary, mangroves no longer occur in ten small Kwa-Zulu Natal estuaries as a result of catchment and mouth disturbance (van Niekerk *et al.,* 2019)

***Table 4F. Past and present mangrove areas (ha) in South Africa for estuaries with greater than 10 ha, pressures and protection status.*** *Shaded pink rows indicate estuaries where there have been mangrove losses and grey gains in mangrove area (Adams & Rajkaran, 2020)*

| Estuary | Past area (ha) 1930s | Present area (ha) 2019 | Future Habitat trend | Pressures | Protection status |
|---|---|---|---|---|---|
| **TOTAL FOR COUNTRY** | **1537** | **1672** | I | | |
| Kosi Bay | 60.7 | 71 | I | Harvesting for wood & fish traps, cattle trampling<br>Increase due to sedimentation and expansion | iSimangaliso Wetland Park Authority |
| St Lucia & iMfolozi | 331 | 288 | D | Relinked to degraded Mfolozi catchment, mouth closed, freshening and silt | iSimangaliso Wetland Park Authority |
| Richards Bay | 267 | 171 | D | Harbour expansion and removal of habitat | Echwebeni site of conservation significance |
| uMhlathuze | 80 | 793 | I | Expansion in response to artificial mouth and increase in intertidal area, current pressures :dredging, silt and sediment deposition | Ezemvelo KwaZulu-Natal Wildlife |
| uMlalazi | 30 | 60.7 | I | Sedimentation, mouth is kept open allowing expansion | Ezemvelo KwaZulu-Natal Wildlife |
| uMngeni | 20.3 | 26.8 | I | Sedimentation and natural expansion, growing water quality threats and mouth restriction. | Beachwood Mangrove reserve, Ezemvelo KwaZulu-Natal Wildlife |
| Durban Bay | 451 | 13.4 | D | Harbour expansion and removal of mangroves | Bayhead Natural Heritage Site |
| iSiphingo | 12.5 | 3.8 | D | Development, tidal restriction, poor water quality | None |
| Mntafufu | 10 | 12.4 | I | Expansion due to sediment stability<br>Harvesting for wood and bark | None |
| Mngazana | 145 | 118 | D | Harvesting, cattle and human trampling, sand mining | None |
| Mtakatye | 7.7 | 10 | I | Increase due to sedimentation, cattle browsing, harvesting | None |
| Mtata | 42 | 31 | D | Harvesting | None |
| Xhora | 16 | 25.5 | I | Cattle browsing, harvesting | None |
| Mbashe | 12.5 | 9.2 | D | Cattle browsing, harvesting | Dwesa-Cwebe Marine Protected Area |
| Nqabarana/ Nqabara | 9 | 11.8 | I | Increase due to sedimentation, cattle browsing, harvesting | None |
| Nxaxo/Ngqusi | 14 | 9.5 | D | Cattle browsing, harvesting, trampling | None |

[25] Adams, J. B. and Rajkaran, A. 2020. Changes in mangroves at their Southern most African distribution limit. Elsevier Journal of Estuarine, Coastal and Shelf Science. https://doi.org/10.1016/j.ecss.2020.106862

In terms of South African definitions for estuarine habitats mangroves are part of many other estuarine habitat types, these include salt marshes, swamp forests, reeds and sedges, submerged macrophytes, sand/mud banks and rocks. Data for each of these habitat types is available from the Estuary Botanical Database, currently being maintained by the Nelson Mandela University. Table 4H below provides a summary of the extents for each habitat type, mapped as part of van Niekerk *et al.,* 2019.

***Figure 4H. Area of estuary habitat types (ha) across bioclimatic regions (van Niekerk et al, 2019)***

| | COOL TEMPERATE | WARM TEMPERATE | SUBTROPICAL | TROPICAL | TOTAL AREA |
|---|---|---|---|---|---|
| Open water | 9 541 | 8 484 | 37 550 | 3 447 | 59 022 |
| Intertidal salt marsh | 2 814 | 1 887 | 502 | 58 | 5 261 |
| Supratidal salt marsh | 6 302 | 2422 | 837 | 229 | 9790 |
| Submerged macrophytes | 593 | 1 051 | 488 | 675 | 2 807 |
| Reeds and sedges | 3 831 | 2 651 | 10 800 | 244 | 17 526 |
| Mangroves | 0 | 25 | 1 577 | 71 | 1 673 |
| Sand/mud banks | 897 | 1 717 | 1 223 | 24 | 3 861 |
| Rocks | 11 | 106 | 4 | 0 | 121 |
| Swamp forest | 0 | 1 | 2 077 | 1 286 | 3 364 |
| **Total area (ha)** | | | | | **103 425** |

## 4.7 WATER QUALITY

Twenty one (21) reservoirs/lakes were identified and assessed for 2017-2019 reporting period, namely; Theewaterkloof Dam, Vanderkloof Dam, Spitskop Dam, Bloemhof Dam, Erfens Dam, Allemaskraal Dam, Vaal Dam, Hartbeespoort Dam, Molatedi Dam, Rhenosterkop Dam, Loskop Dam, Ntshingwayo Dam, Woodstock Dam, Sterkfontein Dam, Heyshope Dam, St Lucia Dam, Pongolapoort Dam, Lake Sibaya, Albert Falls Dam and Kosi Bay Lakes. The report states that 5 of the 21 lakes were affected by turbidity whilst none of them were affected by eutrophication. Not all 21 water bodies above are natural lakes. South Africa has 8 natural lakes; the balance of the sites consists of artificial storage reservoirs and estuaries.

The South African National Department of Water and Sanitation (DWS) have a number of monitoring systems that are used to provide information for water resource management. In 2017 the department experienced challenges with regard to monitoring and to validate the EO data historical data and other site specific studies were relied upon for assessment of the turbidity and trophic status data. The below response to the SDG 6.6.1 report on lakes water quality is a synthesis of information from DWS databases and site specific knowledge.

### 2.7.1 Turbidity

Five lakes/reservoirs were reported to be affected by turbidity, namely, St Lucia Lake, Pongolapoort Dam, Allemanskraal Dam, Albert Falls Dam and Rhenosterkop Dam. The turbidity time series plot of Pongolapoort Dam is provided as an example of data depiction from the SDG 6.6.1 platform.

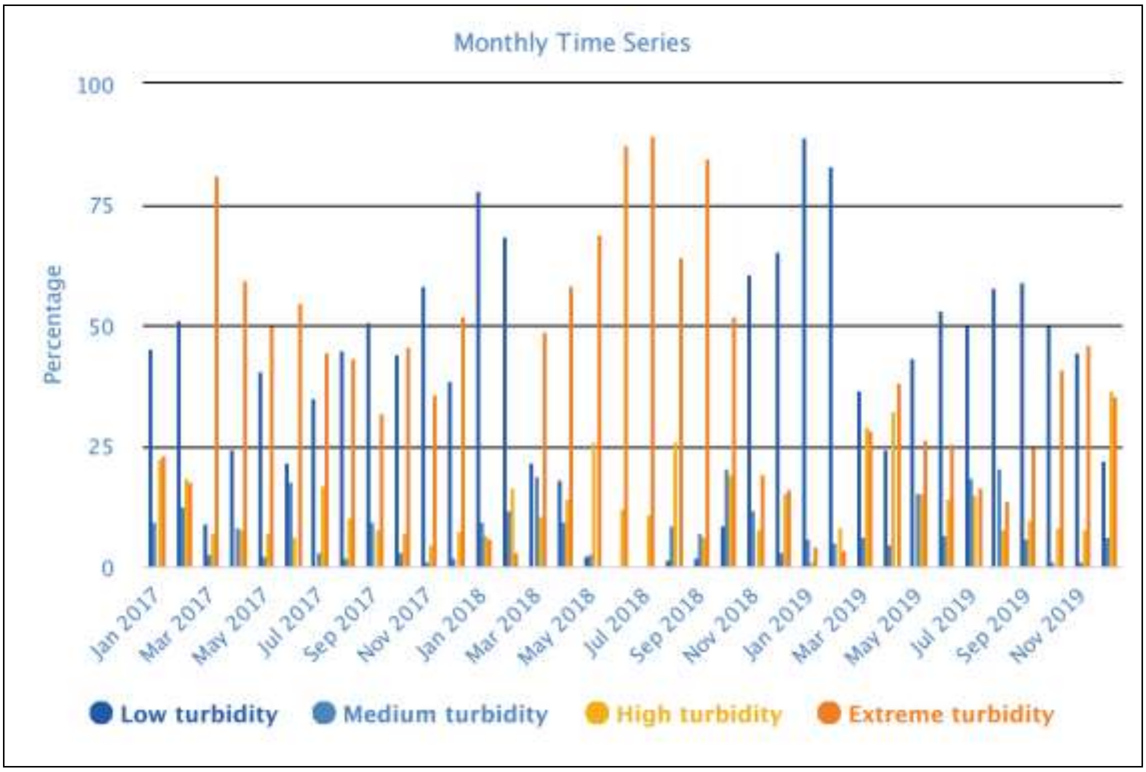
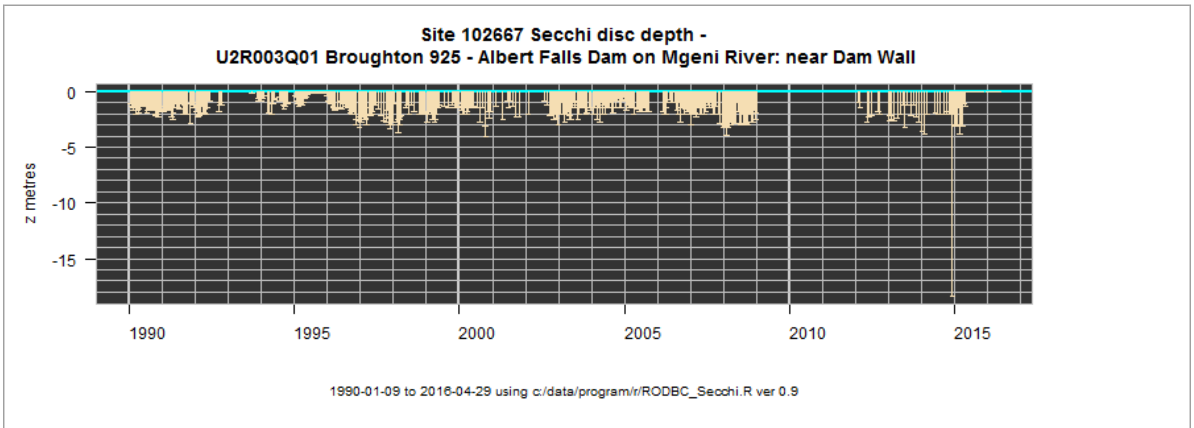



**Figure 4K: Turbidity time series plot of Pongolapoort Dam for the January 2007 to December 2019 period (extracted from: https://map.sdg661app)**

Turbidity is described as an indicator of water clarity, quantifying the haziness of water and acting as an indicator of underwater light availability. DWS uses Secchi disc depth measurements as an indicator of water clarity for lakes and reservoirs/dams. Secchi depth is a measurement of water transparency, which is affected by water color, algae and suspended sediments in a lake or reservoir. Low Secchi disc depth readings are indicative of high turbidity in the system. Figure 4L below proves Secchi disc depth plots for four Dams in South Africa.



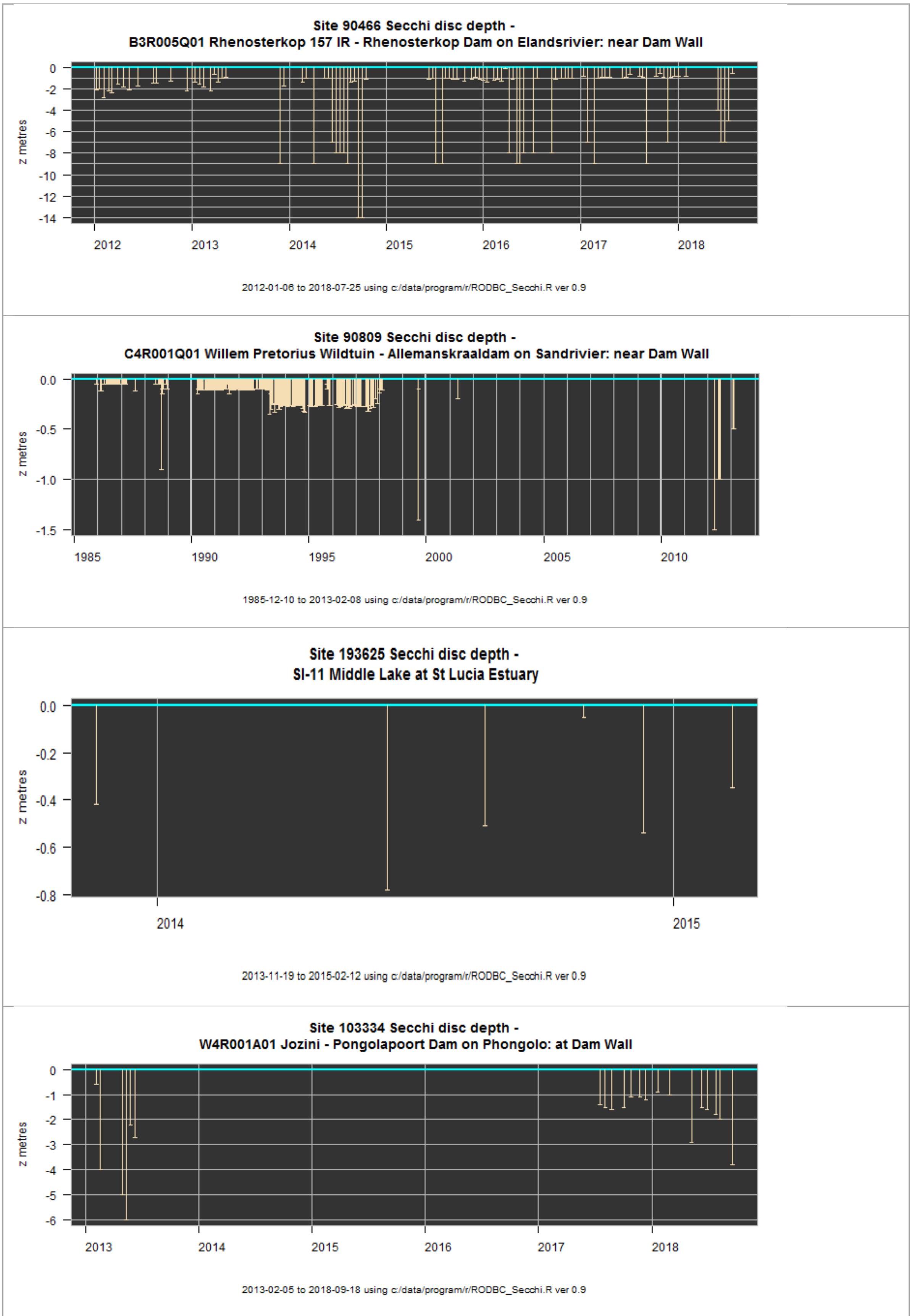



**Figure 4L: Secchi disc depth plots of Albert Falls Dam, Rhenosterkop Dam, Allemanskraal Dam, St Lucia Lake and Pongolapoort Dam.**

The Secchi disc readings for Pongolapoort and Rhenosterkop dams show several episodes where the depth was below 2m for the 2017-2018 periods. This is indicative of fairly turbid systems. Historical data were used to assess turbidity at St Lucia Lake and Allemanskraal Dam. Secchi disc readings of less than 1m were recorded most of the time indicative of a highly turbid system. The historical data for Albert Falls Dam were indicative of a fairly turbid system with Secchi depth <2m for most of the time.

High turbidity in St Lucia Lake is due to silt and sediments from the Umfolozi River. The turbidity levels here are generally high but tend to peak during summer months due to high rainfall and run-off, carrying silts and sediment into St Lucia Lake. Allemanskraal Dam is often impacted by high salinity from the Sand River resulting from intensive mining activities in the catchment. Rhenosterkop Dam is one of the stressed dams affected by soil erosion from agricultural activities in its catchment area. Pongolapoort Dam receives water from return flows and tailwaters from irrigation schemes and coal mining activities and often contains high levels of total dissolved solids (TDS) (de Necker, 2020). The Albert Falls Dam has been subjected to severe storage decline due to prolonged drought in the region. Water quality at Albert Falls Dam has remained fairly constant over the years. There is no data to dispute the high turbidity finding for 2017-2019 period.

### 2.7.2 Trophic Status

None of the 21 lakes were reported (UNEP EO data) to be affected by eutrophication. An example of the trophic state time series plot is provided in Figure 4M below.

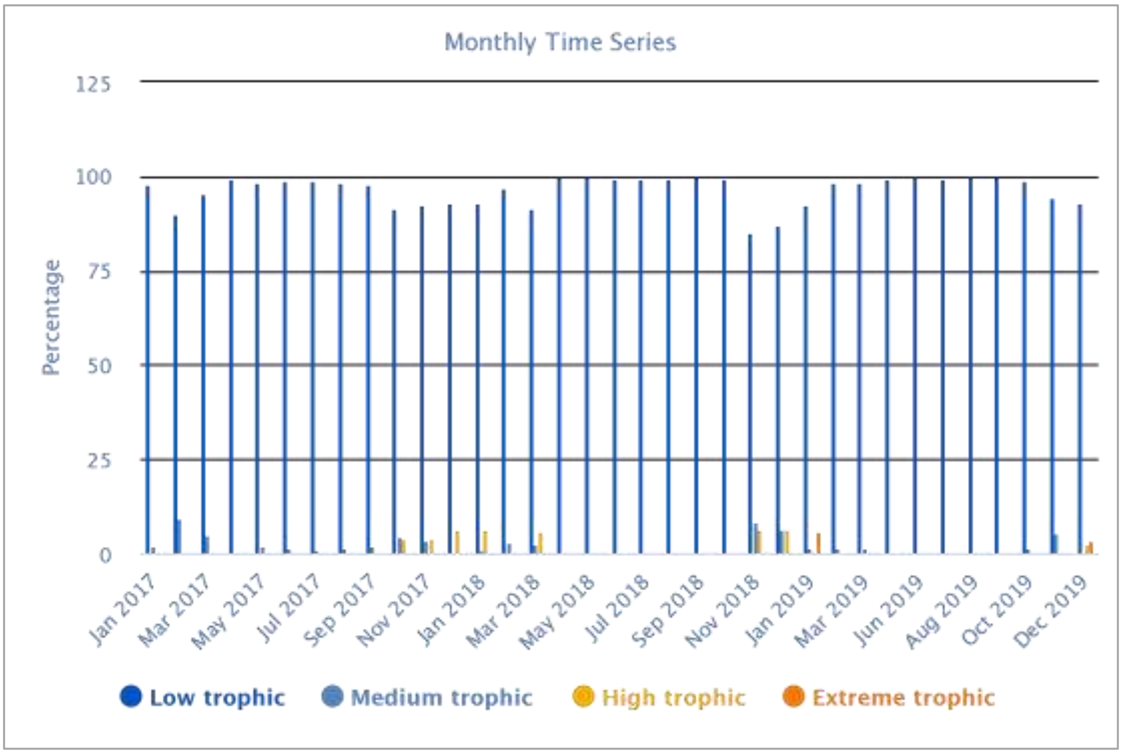



**Figure 4M: Trophic State time series plot of Gariep Dam for the January 2017 to December 2019 period (extracted from: https://map.sdg661app)**

The South African reports on lakes and reservoirs/dams trophic status can be obtained from DWS website (http://www.dwa.gov.za/iwqs/report.aspx). The data is generated through the country's national eutrophication monitoring programme (NEMP) and supplemented by data from the integration of Earth

Observation into the National Eutrophication Monitoring Programme (EONEMP). The latter was a remote sensing or eye-in-the-sky eutrophication monitoring technology designed in 2018 (http://eonemp.cyanolakes.com) to complement the already existing NEMP. It used satellite information from the European Space Agency MERIS sensor, active from 2002 to 2012, retrospectively and European Space Agency's Ocean and Land Colour Instrument (OLCI) – 2017 to date. The design of the EONEMP was a collaborative effort between CyanoLakes, the South African DWS, CSIR, Centre for High Performance Computing, South African National Space Agency (SANSA) and funded by the SA WRC from 2015-2018.

The information from DWS database and Cyanolakes website was used to verify the EO data provided by UNEP. The 2019 period could not be verified due to data limitations.

For the water quality, the SDG 6.6.1 report list 21 reservoirs, though Cyanolakes monitor or provide trophic status information on more than 100 inland systems/lakes and reservoirs. The satellite information from Cyanolakes indicated high chlorophyll A levels for the following sites: Vaal Dam, Spitzkop Dam, Allemanskraal dam, Erfenis Dam, Bloemhof Dam, Gariep Dam, Vanderkloof Dam, Albert Falls Dam, Ntshingwayo Dam and Rhenosterkop Dam. Cyanolakes further flagged possible chlorophyll A overestimation due to high turbidity levels in the following dams: Vanderkloof Dam, Gariep Dam, Vaal dam, Spitzkop Dam, Allemanskraal Dam, Bloemhof Dam, Ntshingwayo Dam and Erfenis Dam. The UNEP EO data does not correlate with our own ground-truth monitoring networks NEMP and EONEMP as it suggests that the country did not have issues related to nutrient enrichment of lakes/dams during the period 2017-2019. The data generated through EONEMP is based on sound rigorous ground-truth validation method/satellite data/algorithm procedures suitable to SA conditions.

## 4.8 CHALLENGES AND RECOMMENDATIONS:

In all cases, when comparing South African datasets against the global SDG6.6.1 datasets the number of years for which such data is available is limited to only one or more years, however in almost all cases the number of water resources (extent) for which the data is available is significantly greater than the global datasets.

A key challenge that existed in the review of the global dataset was that the surface water dynamics dataset (representing both permanent and seasonal water) currently available on the SDG661 Freshwater Ecosystems Explorer application (www.sdg661.app) did not disaggregate surface waters into water resource types (i.e. reservoirs, estuaries, lakes, rivers). Thus although the review could highlight areas where there is likely to be either over or under representation of the number of ecosystems of a particular ecosystem type at any given year, it could not provide updated or more accurate statistics on change over time in extent.

A further challenge is presented in the differing definitions of ecosystem types between the South African ecosystem classification systems for inland and coastal systems and the SDG6.6.1 definitions.

In addition to the above review, there were some discrepancies that were identified on the Hydro-Basins and Administrative Boundaries, where:

- Hydrobasins are provided as point data and not polygons (the points are also not displaying the map. The attribute table shows them as District Municipalities, not River Basins).
- Administrative boundaries are not correct, there are 2 polygons outside the borders of SA and the numbers of district municipalities do not correspond with South African records.

Data submitted through the SDG6.6.1 Freshwater Ecosystems Explorer application has provided further emphasis on the need for South Africa to continue working on finding ways to develop not just statics at a point in time, but to provide continuous datasets that enable the detection of actual trends in water-related ecosystems, in such a way that allows for comparison with global datasets. It is believed that this can be achieved by working with UNEP to improve that datasets being generated for SDG66.1 reporting at a global scale. This collaboration would include using the South African datasets to improve the representation of ecosystem types. There is also a large opportunity for RSA to benefit from the SDG66.1 initiative through future alignment and interaction.

## 5. REPORT ON IN-SITU MEASUREMENT OF GROUND WATER

The DWS is the custodian of a National Groundwater Level Monitoring Programme. The first groundwater level data dates back to the 1940's and is stored in the DWS HYDSTRA database. This programme currently has around 1900 active monitoring sites across 65 geohydrological regions (Figure 5A).

The DWS collect data either manually via a dip meter or autonomously via data loggers. The data is collected monthly, quarterly or bi-annually and is audited before being uploaded to the DWS HYDSTRA database within 30 days after collection and release for extraction from the HYDSTRA database after 7 days. Continuous monitoring takes place throughout the year and the uploading/capturing of the data on the HYDSTRA database occurs daily. Data is accessible at http://www.dwa.gov.za/Groundwater/Default.aspx

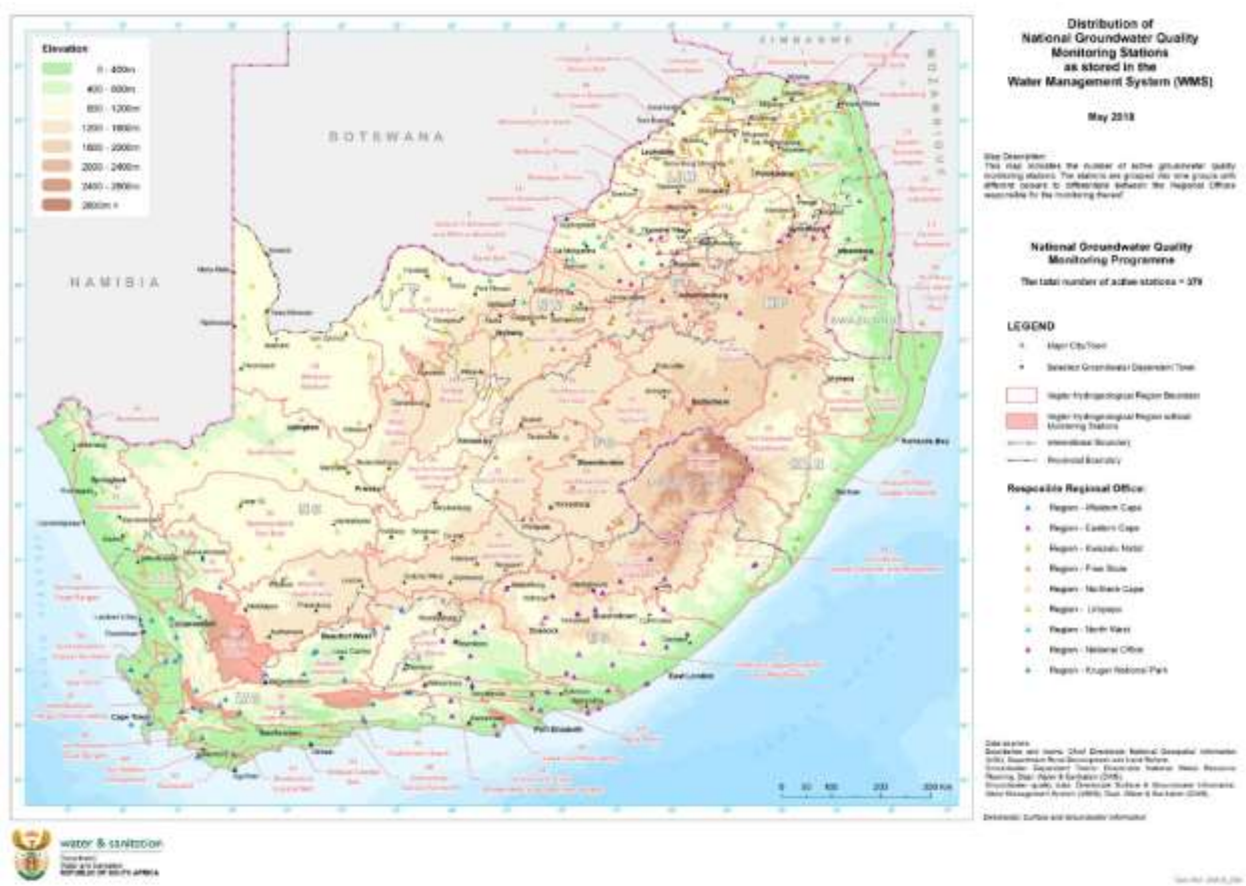
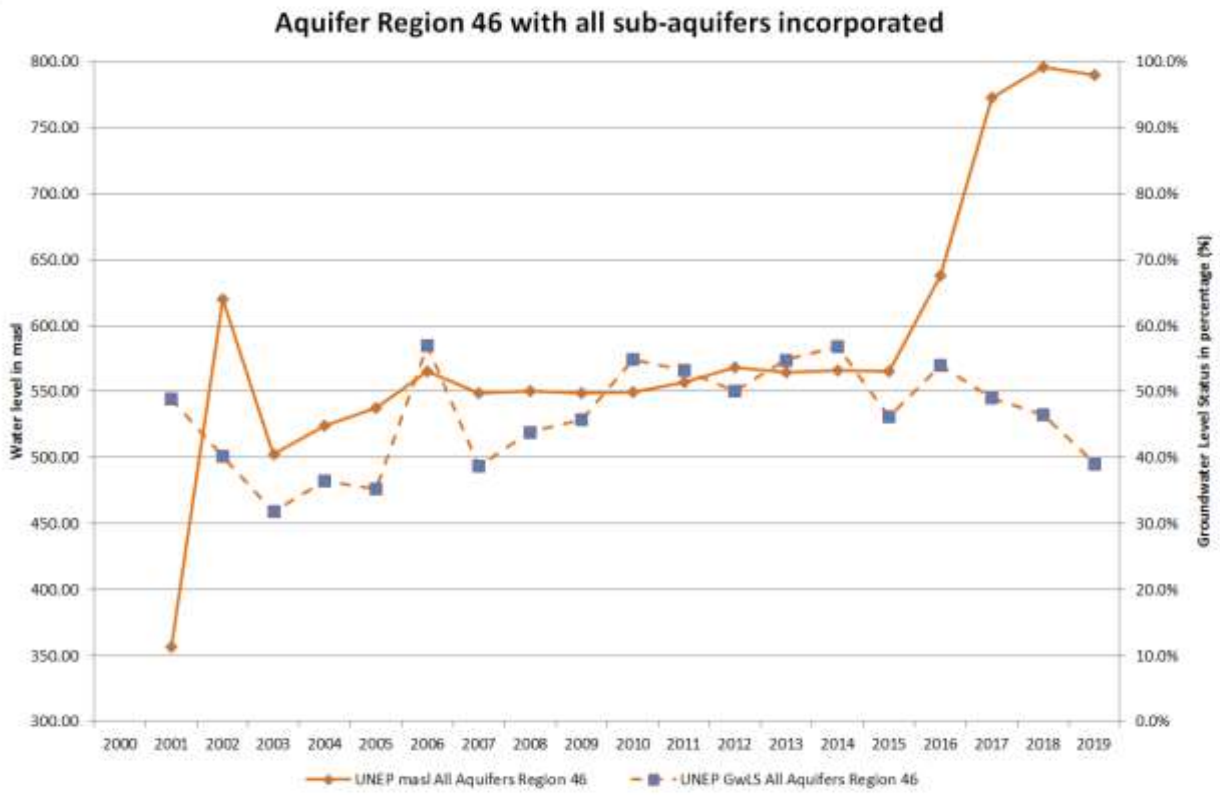



**Figure 5A. Geohydrological Region and Groundwater Level Monitoring Sites in SA.**

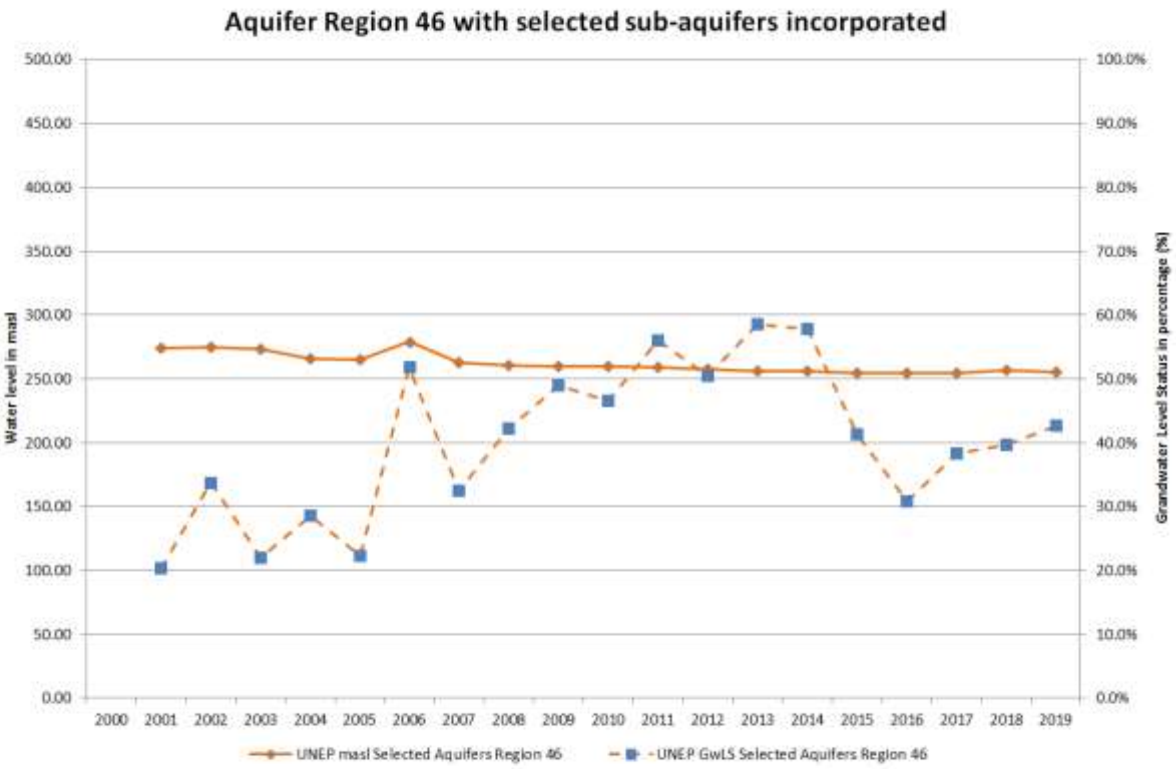
Although the water level data is captured in metres below the ground level (mbgl), data can be extracted in metres above sea (masl) level by subtracting the elevation height from each measurement. Data has been provided as per the template requested by UNEP and is provided below (Table 5A). The presentation of the data in masl highlights the large variation in elevation within regional aquifers as compared to smaller sub-aquifers. Regional aquifers are comprised of several sub-aquifers that are located on various elevations. Graphs 5a and 5b (solid line) indicate the difference in elevation between a regional aquifer and a selected sub-aquifer in metres above sea level.

Although data on groundwater levels may be useful for global comparisons between countries, for the purposes of managing groundwater, the DWS has domesticated the indicator to represent a "groundwater level status" (groundwater levels as a percentage) per hydrological year (October to September) per Hydrogeological Region based on the groundwater level record (*A draft methodology report is available and is currently undergoing peer review)*. The groundwater level status is not an indication of the groundwater availability or the storage levels within an aquifer (volume) but only indicates *the water level in comparison to historical monitoring water levels*. The results that are generated when applying this domesticated method are presented in Table 5B. Graphs 5a and 5b (dash line) indicate the difference between a regional aquifer and a selected sub-aquifer in groundwater level status.

The difference in the maximum and minimum water level measured in mbgl within each Geosite's monitoring history, determines the water level range. The groundwater level status (mbgl) is represented as a percentage and illustrates the last water level measurement in comparison to the water level range.




**Graph 5a: Groundwater level indicated in metres above sea level and Groundwater Level Status percentage of Aquifer Region 46;**




**Graph 5b: Groundwater level indicated in metres above sea level and Groundwater Level Status percentage of Aquifer Region 46 with selected sub-aquifers incorporated.**

The measurement range in region 46 as an example, is over 500m (Graph 5b - solid line), with all the sub-aquifers incorporated because of the difference in elevation. However, if only one sub-aquifer were selected, the range difference is less than 40m. This discrepancy in water level was never a problem because, with the groundwater level status, the individual borehole water level range is used as a percentage and not the elevations (see Graph 5a and 5b dash lines). The considerable differences in the elevations will guide the DWS to re-evaluate the regional aquifer delineation and focus on sub-aquifer scale.

**Table 5A: Groundwater Aquifer Record Sheet (Global Indicator 6.6.1**

This groundwater aquifer level record sheet acts as the template that may be applied to record annual data on the water level of major aquifers.

Unit of measurement is: METERS ABOVE SEA LEVEL (MASL)

Country Name: South Africa

Name of Person completing Record Sheet: Fanus Fourie

Date: 11-06-2020

| Aquifer Regions | No | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Makoppa Dome | 1 | 888.86 | 895.94 | 926.58 | 919.41 | 898.64 | 902.65 | 905.67 | 900.91 | 902.00 | 902.45 | 902.58 | 904.80 | 902.30 | 901.79 | 908.09 | 908.61 | 903.54 | 902.89 | 902.58 | 924.59 |
| Waterberg Coal Basin | 2 | | | | 967.17 | 967.17 | 966.54 | | | 822.00 | 893.96 | 902.62 | 902.61 | 859.66 | 851.37 | 851.81 | 851.61 | 851.42 | 854.37 | 851.26 | 846.76 |
| Limpopo Granulite Gneiss Belt | 3 | 797.41 | 798.08 | 804.12 | 797.64 | 860.75 | 846.92 | 658.67 | 603.09 | 705.77 | 743.44 | 698.95 | 742.05 | 717.09 | 721.93 | 714.37 | 726.31 | 719.63 | 721.97 | 726.32 | 723.68 |
| Limpopo Karoo Basin | 4 | 497.45 | 497.42 | 496.75 | 496.54 | 497.86 | 497.34 | 499.67 | 512.95 | 598.16 | 594.14 | 597.70 | 619.52 | 593.66 | 595.57 | 599.82 | 624.93 | 599.62 | 613.00 | 594.75 | 594.37 |
| Soutpansberg Hinterland | 5 | 786.39 | 786.05 | 785.16 | 790.38 | 789.94 | 542.79 | 431.41 | 451.06 | 509.29 | 510.32 | 549.94 | 625.48 | 521.47 | 525.91 | 556.47 | 593.07 | 592.65 | 587.71 | 571.10 | 595.15 |
| Waterberg Plateau | 6 | 1114.70 | 1062.81 | 1047.83 | 1072.49 | 1147.71 | 1026.42 | 1003.79 | 993.91 | 972.33 | 1026.68 | 1015.46 | 1016.71 | 1085.40 | 1079.98 | 1076.87 | 1076.62 | 1079.28 | 1089.05 | 1084.94 | 1081.54 |
| Pietersburg Plateau | 7 | 1137.92 | 1150.66 | 1158.47 | 1154.07 | 1156.74 | 1163.49 | 1176.57 | 1178.83 | 1207.56 | 1224.01 | 1213.04 | 1202.94 | 1191.39 | 1174.34 | 1166.93 | 1156.58 | 1154.75 | 1158.09 | 1144.08 | 1096.62 |
| Soutpansberg | 8 | | | | 1333.01 | 1249.20 | 660.28 | 616.03 | 644.44 | 650.69 | 666.51 | 659.49 | 620.60 | 639.55 | 654.92 | 689.29 | 703.34 | 701.38 | 689.20 | 678.18 | 661.85 |
| Western Bankeveld and Marico Bushveld | 9 | 1437.18 | 1457.49 | 1482.04 | 1472.26 | 1492.02 | 1485.00 | 1489.13 | 1499.87 | 1506.19 | 1501.86 | 1499.07 | 1488.78 | 1484.46 | 1489.16 | 1486.29 | 1486.61 | 1483.07 | 1483.27 | 1441.92 | 1408.98 |
| Karst Belt | 10 | 1459.52 | 1467.41 | 1464.29 | 1463.03 | 1462.98 | 1482.26 | 1486.08 | 1488.79 | 1478.96 | 1482.20 | 1481.44 | 1472.41 | 1470.08 | 1477.76 | 1471.89 | 1466.91 | 1479.18 | 1466.01 | 1443.15 | 1442.04 |
| Middelburg Basin | 11 | | | | | | 1509.85 | 1510.22 | 1506.98 | 1513.28 | 1512.52 | 1514.20 | 1512.17 | 1507.55 | 1511.73 | 1498.42 | 1482.70 | 1481.13 | 1477.75 | 1458.43 | 1450.41 |
| Eastern Bankeveld | 12 | 1340.03 | 1328.88 | 1312.51 | 1238.03 | 1200.89 | 1129.14 | 1231.85 | 1134.28 | 1103.69 | 1075.62 | 1079.71 | 1097.16 | 1092.10 | 1089.59 | 1090.66 | 1087.20 | 1084.97 | 1086.81 | 1099.92 | 1110.71 |
| Springbok Flats | 13 | 1045.96 | 1045.76 | 1039.34 | 1041.39 | 1045.05 | 1040.64 | 1044.30 | 1039.10 | 1039.82 | 1037.10 | 1026.37 | 1036.37 | 1039.72 | 1035.98 | 1033.61 | 1031.45 | 1036.07 | 1030.62 | 1032.71 | 1026.06 |
| Western Bushveld Complex | 14 | 1015.83 | 1004.11 | 1104.07 | 1065.97 | 1055.73 | 1054.38 | 1059.62 | 1052.08 | 1029.49 | 1042.25 | 1045.70 | 1073.42 | 1068.78 | 1070.98 | 1072.46 | 1067.89 | 1066.70 | 1040.71 | 1006.41 | 1032.84 |
| Eastern Bushveld Complex | 15 | | | | | | | | | 1445.79 | 1445.95 | 1275.86 | 1072.28 | 1036.18 | 1056.07 | 1056.21 | 1049.04 | 1054.57 | 1024.41 | 1022.07 | 1027.50 |
| Northern Bushveld Complex | 16 | 1025.74 | 1034.72 | 1034.81 | 1028.62 | 1053.92 | 1055.39 | 1039.51 | 1034.66 | 1040.49 | 1055.98 | 1062.31 | 1054.73 | 1058.80 | 1056.96 | 1056.41 | 1055.64 | 1055.18 | 1055.54 | 1059.64 | 1055.31 |
| Central Highveld | 17 | 1544.36 | 1548.63 | 1543.17 | 1539.73 | 1529.67 | 1516.53 | 1519.11 | 1523.63 | 1527.26 | 1521.76 | 1517.20 | 1520.81 | 1519.89 | 1521.00 | 1505.10 | 1499.71 | 1497.06 | 1500.00 | 1410.91 | 1379.21 |
| Western Highveld | 18 | 1379.22 | 1386.86 | 1378.22 | 1383.03 | 1385.18 | 1366.86 | 1337.41 | 1339.48 | 1358.02 | 1352.43 | 1285.51 | 1401.16 | 1355.02 | 1309.17 | 1330.99 | 1344.60 | 1290.35 | 1334.76 | 1323.36 | 1350.89 |
| Lowveld | 19 | | 519.85 | 578.74 | 594.89 | 590.44 | 585.39 | 579.07 | 581.26 | 591.91 | 612.05 | 603.31 | 603.47 | 608.11 | 605.68 | 603.97 | 606.06 | 608.19 | 604.88 | 603.47 | 612.55 |
| Northern Lebombo | 20 | | | | 284.75 | 287.01 | 291.47 | 324.85 | 291.26 | 290.90 | 289.92 | 287.57 | 290.99 | 288.37 | 278.76 | 288.22 | 283.39 | 289.68 | 292.07 | 292.37 | 279.24 |
| Southern Lebombo | 21 | | 310.98 | 424.73 | 481.50 | 377.16 | 372.50 | 152.50 | 150.60 | 149.15 | 148.46 | 150.22 | 171.49 | 232.72 | 253.87 | 226.36 | 232.76 | 198.55 | 198.32 | 205.49 | 232.02 |
| Eastern Kalahari | 22 | 1187.55 | 1186.58 | 1184.73 | 1185.88 | 1184.46 | 1203.66 | 1213.29 | 1221.05 | 1196.63 | 1214.31 | 1204.89 | 1199.82 | 1211.76 | 1220.65 | 1164.68 | 1176.40 | 1168.12 | 1172.35 | 1180.40 | 1167.26 |
| Western Kalahari | 23 | 1015.91 | 956.53 | 943.11 | 959.00 | 943.72 | 893.31 | 878.59 | 1135.93 | 1058.14 | | 1182.27 | 1181.42 | 1143.50 | 1075.92 | 1080.65 | 1123.03 | 1120.99 | 1136.50 | 1003.85 | 1062.46 |
| Ghaap Plateau | 24 | 1301.21 | 1286.02 | 1337.27 | 1266.48 | 1243.50 | 1301.24 | 1320.84 | 1283.91 | 1306.96 | 1286.06 | 1306.94 | 1306.53 | 1294.86 | 1290.37 | 1313.57 | 1288.39 | 1293.78 | 1337.03 | 1328.03 | 1335.50 |
| West Griqua Land | 25 | 1225.00 | 1200.86 | 1211.42 | 1226.35 | 1282.44 | 1248.22 | 1256.02 | 1272.07 | 1251.06 | 1241.50 | 1256.62 | 1242.79 | 1249.20 | 1264.58 | 1257.72 | 1252.81 | 1238.47 | 1262.76 | 1261.52 | 1253.05 |
| Bushmanland | 26 | 640.86 | 686.00 | 675.96 | 724.60 | 718.92 | 765.28 | 778.17 | | | | 667.54 | 932.57 | 918.24 | 705.25 | 809.94 | 870.93 | 711.74 | 776.13 | 781.03 | 765.86 |
| Namaqualand | 27 | 313.39 | 340.31 | 326.61 | 313.09 | 309.24 | 297.50 | 312.14 | 342.52 | 326.36 | 339.62 | 319.74 | 317.06 | 318.61 | 385.27 | 415.46 | 402.43 | 461.49 | 348.89 | 425.30 | 356.64 |
| Eastern Highveld | 28 | 1544.13 | 1552.21 | 1535.15 | 1536.51 | 1552.64 | 1557.48 | 1558.76 | 1556.42 | 1559.84 | 1576.03 | 1569.92 | 1559.82 | 1584.02 | 1581.54 | 1594.42 | 1603.72 | 1603.82 | 1607.31 | 1625.43 | 1612.69 |
| Dry Harts-Lower Vaal-Orange Lowland | 29 | 1168.20 | 1179.23 | 1180.85 | 1161.25 | 1163.78 | 1143.27 | 1136.36 | 1173.03 | 1138.98 | 1125.52 | 1116.38 | 1150.25 | 1138.22 | 1124.49 | 1110.26 | 1122.10 | 1115.45 | 1054.56 | 1092.49 | 1085.28 |
| Northeastern Pan Belt | 30 | | | | 1274.79 | 1273.39 | 1273.78 | 1272.84 | 1246.05 | 1270.54 | 1269.53 | 1271.93 | 1272.24 | 1248.47 | 1245.88 | 1262.29 | 1258.97 | 1256.55 | 1259.46 | 1255.14 | 1257.99 |
| Central Pan Belt | 31 | 1211.08 | 1216.49 | 1216.34 | 1219.09 | 1212.91 | 1216.43 | 1228.81 | 1228.05 | 1243.12 | 1242.81 | 1247.24 | 1249.01 | 1207.53 | 1220.43 | 1227.42 | 1225.69 | 1216.42 | 1218.03 | 1216.07 | 1217.60 |
| Southern Highveld | 32 | | | | | | | | | | | | | | | | | | | | |
| Northern Highland | 33 | | | | | | | | | | | | | | | | | | | | |
| Northeastern Upper Karoo | 34 | | | | | | | 1372.45 | 1373.29 | 1372.27 | 1372.43 | 1372.12 | 1375.30 | 1377.80 | 1377.20 | 1377.23 | 1376.28 | 1374.18 | 1375.14 | 1372.33 | 1371.81 |
| Bushmanland Pan Belt | 35 | | | | | | | | | | | | 954.62 | 957.70 | 955.86 | 961.07 | 958.47 | 953.15 | 981.37 | 1018.24 | 1079.12 |
| Hantam | 36 | | | | | | | 228.58 | 221.30 | 224.88 | 225.64 | 225.56 | 868.39 | 870.22 | 866.65 | 839.89 | 874.78 | 871.93 | 855.76 | 865.68 | 872.30 |

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tanqua Karoo | 37 | | | | | | | | | | | | | | 450.00 | 542.23 | 592.08 | 610.64 | 634.77 | 614.18 | 623.23 |
| Western Upper Karoo | 38 | 1153.58 | 1141.34 | 1142.12 | 1140.85 | | | | | | | | 1235.57 | 1250.02 | 1326.43 | 1299.96 | 1203.71 | 1268.30 | 1243.72 | 1191.64 | 1179.15 |
| Eastern Upper Karoo | 39 | 1303.49 | 1301.76 | 1309.69 | 1309.01 | 1288.57 | 1299.79 | 1307.40 | 1317.06 | 1325.19 | 1324.71 | 1332.93 | 1318.27 | 1342.25 | 1355.07 | 1338.21 | 1330.30 | 1360.23 | 1348.74 | 1323.94 | 1342.72 |
| Southeastern Highland | 40 | 1766.26 | 1766.60 | 1766.37 | 1766.15 | 1766.72 | | | | | | 1563.04 | 1563.18 | 1568.32 | 1435.64 | 1438.60 | 1500.80 | 1451.82 | 1457.81 | 1512.82 | 1475.11 |
| Western Great Karoo | 41 | 957.36 | 956.59 | 952.17 | 953.33 | 921.09 | 820.63 | 806.91 | 803.17 | 804.64 | 801.37 | 799.60 | 813.53 | 809.30 | 807.93 | 804.13 | 800.24 | 799.18 | 796.81 | 772.98 | 773.33 |
| Eastern Great Karoo | 42 | 856.42 | 857.38 | 855.49 | 861.35 | 891.41 | 915.48 | 921.16 | 910.41 | 902.69 | 900.03 | 900.67 | 902.56 | 888.47 | 879.03 | 877.38 | 873.82 | 829.50 | 793.01 | 787.23 | 803.96 |
| Ciskeian Coastal Foreland and Middleveld | 43 | 1157.70 | 1156.95 | 1156.94 | 1155.92 | 1156.12 | 1156.09 | 1154.51 | 1154.90 | 1155.67 | 1161.71 | 1159.52 | 1166.80 | 1154.05 | 1162.10 | 1185.37 | 1122.64 | 1074.42 | 1040.21 | 1025.56 | 1055.01 |
| Transkeian Coastal Foreland and Middleveld | 44 | | | | | | | 782.40 | 781.17 | 780.55 | 780.15 | 780.80 | 782.42 | 781.71 | 906.08 | 929.38 | 954.69 | 892.02 | 890.14 | 869.41 | 848.44 |
| Northwestern Middleveld | 45 | | 1236.08 | 1253.78 | 1265.71 | 1194.79 | 1203.42 | 1205.27 | 1169.20 | 1154.85 | 1152.08 | 1186.36 | 1204.77 | 1178.84 | 1215.91 | 1223.49 | 1205.53 | 1194.40 | 1182.15 | 1181.45 | 1208.54 |
| Northeastern Middleveld | 46 | | 356.50 | 620.16 | 502.67 | 523.94 | 537.51 | 565.35 | 549.11 | 550.26 | 548.63 | 549.58 | 557.17 | 568.31 | 564.72 | 566.36 | 564.96 | 637.76 | 772.98 | 796.13 | 789.63 |
| Kwazulu-Natal Coastal Foreland | 47 | | | | | 306.25 | 278.20 | 203.15 | 156.83 | 159.15 | 160.14 | 169.05 | 204.74 | 335.24 | 215.81 | 256.69 | 273.71 | 324.07 | 308.71 | 339.96 | 281.84 |
| Northwestern Cape Ranges | 48 | 186.06 | 163.11 | 150.49 | 119.79 | 127.18 | 157.85 | 177.44 | 182.15 | 192.15 | 170.73 | 172.99 | 161.45 | 160.97 | 181.86 | 185.32 | 172.09 | 174.87 | 166.76 | 174.55 | 175.66 |
| Southwestern Cape Ranges | 49 | 304.00 | 301.94 | 298.56 | 292.58 | 266.13 | 263.73 | 262.28 | 262.95 | 280.23 | 289.98 | 293.24 | 293.14 | 293.49 | 294.19 | 293.76 | 291.54 | 306.15 | 309.96 | 310.34 | 303.57 |
| Southern Cape Ranges | 50 | 348.07 | 334.11 | 373.40 | 429.93 | 566.57 | 574.98 | 540.18 | 564.92 | 613.12 | 582.78 | 654.24 | 662.99 | 667.86 | 673.74 | 672.65 | 644.26 | 637.37 | 649.76 | 607.34 | 570.79 |
| Oudtshoorn Basin | 51 | 380.61 | 374.67 | 369.85 | 369.06 | 369.58 | 501.35 | 517.04 | 548.58 | 544.70 | 549.06 | 547.25 | 547.28 | 543.06 | 543.43 | 543.20 | 540.32 | 540.74 | 542.46 | 542.48 | 541.31 |
| Grootrivier-Klein Winterhoek-Suur-Kaprivier Ranges | 52 | 228.20 | 228.98 | 229.62 | 229.25 | 227.83 | 227.38 | 227.47 | 228.15 | 227.46 | 226.08 | 244.78 | 295.55 | 411.69 | 408.16 | 401.37 | 368.89 | 348.20 | 350.63 | 330.81 | 239.19 |
| Ruensveld | 53 | 135.78 | | | 260.25 | 259.35 | 259.00 | 131.07 | 127.86 | 107.26 | 110.93 | 111.50 | 110.33 | 105.58 | 108.71 | 106.91 | 105.94 | 106.70 | 105.68 | 103.52 | 104.18 |
| Intermontane Tulbagh-Ashton Valley | 54 | 206.03 | 208.01 | 236.85 | 346.47 | 304.59 | 301.18 | 324.95 | 324.57 | 326.74 | 327.95 | 327.18 | 326.82 | 299.80 | 330.37 | 343.36 | 342.62 | 341.56 | 339.69 | 339.04 | 338.72 |
| Richtersveld | 55 | | | 22.71 | 22.71 | 22.69 | | | | | | | | | 25.08 | 24.27 | 25.70 | 25.97 | 24.48 | 21.92 | 22.05 |
| Knersvlakte | 56 | 136.23 | 137.76 | 141.09 | 147.95 | 131.64 | 137.43 | 136.91 | 132.32 | 131.79 | 119.35 | 136.68 | 141.93 | 124.72 | 137.67 | 132.03 | 140.65 | 167.12 | 138.41 | 135.37 | 128.86 |
| Swartland | 57 | 95.36 | 86.02 | 81.08 | 132.33 | 139.47 | 134.18 | 137.38 | 134.66 | 145.81 | 160.14 | 159.36 | 154.56 | 155.80 | 157.12 | 165.27 | 158.24 | 157.88 | 162.04 | 163.26 | 159.08 |
| Outenikwa Coastal Foreland | 58 | | | | | | | | | | | | | 313.70 | 312.87 | 313.29 | 313.40 | 313.40 | 311.82 | 311.09 | 311.61 |
| Southwestern Coastal Sandveld | 59 | 44.21 | 46.70 | 46.00 | 43.26 | 42.03 | 40.40 | 39.59 | 39.41 | 39.34 | 39.33 | 40.23 | 39.75 | 38.96 | 40.04 | 40.00 | 39.21 | 39.06 | 39.16 | 38.84 | 39.34 |
| Die Kelders Embayment | 60 | | | | | | | | | 18.35 | 17.58 | 17.51 | 17.41 | 17.36 | 17.34 | 17.49 | 17.42 | 17.42 | 17.36 | 17.42 | 23.38 |
| Bredasdorp Coastal Belt | 61 | | | | | | | | | | | | | | | | | | | | |
| Stilbaai Coastal Belt | 62 | | | 135.83 | 128.45 | 131.19 | 125.05 | 155.08 | 163.25 | 174.47 | 170.00 | 171.17 | 174.39 | 174.60 | 174.55 | 175.60 | 175.30 | 175.24 | 174.42 | 173.42 | 172.42 |
| Lower Gamtoos Valley | 63 | | | | | | | | | | | | | | | | | | | | |
| Algoa Basin | 64 | 97.61 | 98.20 | 98.09 | 93.32 | 93.00 | 96.17 | 94.60 | 93.74 | 93.94 | 93.10 | 93.61 | 94.81 | 95.50 | 69.99 | 68.36 | 64.03 | 72.38 | 70.83 | 72.02 | 37.88 |
| Northern Zululand Coastal Plain | 65 | 59.29 | 69.27 | 60.31 | 55.45 | 33.39 | 29.00 | 32.11 | 32.90 | 33.34 | 33.94 | 34.63 | 33.58 | 27.39 | 26.96 | 27.38 | 28.44 | 26.78 | 28.75 | 30.11 | 29.71 |

**Table 5B: Groundwater Aquifer Record Sheet (RSA Indicator 6.6.1D)**

This groundwater aquifer level record sheet acts as the template that may be applied to record annual data on the water level of major aquifers.

Unit of measurement is: Groundwater Level Status (percentage%)

Country Name: South Africa

Name of Person completing Record Sheet: Fanus Fourie

Date: 11-06-2020

| Aquifer Regions | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Makoppa Dome | 66.2% | 76.6% | 73.1% | 61.6% | 60.4% | 45.5% | 45.6% | 44.4% | 54.0% | 56.8% | 58.5% | 59.6% | 55.7% | 52.2% | 49.0% | 41.1% | 43.8% | 51.1% | 46.6% | 43.4% |
| Waterberg Coal Basin | | | | 98.9% | 98.9% | 97.1% | | | 36.0% | 23.4% | 17.5% | 17.3% | 41.1% | 32.5% | 50.4% | 40.0% | 30.4% | 32.8% | 20.8% | 10.2% |
| Limpopo Granulite Gneiss Belt | 45.5% | 53.2% | 42.5% | 29.5% | 63.6% | 56.0% | 61.8% | 66.3% | 60.1% | 55.8% | 49.6% | 54.2% | 45.6% | 57.3% | 55.2% | 46.2% | 39.5% | 41.8% | 33.5% | 27.4% |
| Limpopo Karoo Basin | 48.4% | 46.6% | 42.8% | 36.3% | 40.6% | 31.0% | 34.4% | 35.1% | 36.5% | 49.7% | 48.1% | 51.7% | 39.0% | 70.6% | 69.4% | 69.8% | 62.7% | 72.7% | 55.2% | 49.1% |
| Soutpansberg Hinterland | 66.3% | 67.4% | 60.8% | 56.0% | 59.7% | 66.2% | 71.2% | 66.0% | 63.5% | 61.0% | 60.9% | 60.2% | 45.1% | 59.2% | 63.9% | 52.6% | 47.0% | 44.2% | 35.5% | 26.5% |
| Waterberg Plateau | 72.7% | 77.7% | 79.3% | 72.7% | 79.0% | 62.2% | 70.4% | 59.2% | 68.9% | 63.4% | 64.0% | 64.9% | 57.9% | 55.0% | 67.1% | 57.8% | 42.0% | 44.0% | 37.0% | 33.2% |
| Pietersburg Plateau | 73.8% | 76.0% | 78.4% | 72.2% | 68.4% | 64.2% | 64.9% | 53.0% | 42.5% | 53.0% | 64.6% | 69.3% | 61.7% | 64.4% | 73.8% | 69.5% | 58.4% | 55.1% | 48.3% | 39.1% |
| Soutpansberg | | | | 18.8% | 17.9% | 46.8% | 59.5% | 48.7% | 52.6% | 51.4% | 50.7% | 46.3% | 39.3% | 54.7% | 66.0% | 48.6% | 34.2% | 47.5% | 41.8% | 30.1% |
| Western Bankeveld and Marico Bushveld | 67.1% | 63.5% | 54.6% | 42.3% | 40.9% | 43.5% | 52.2% | 41.4% | 55.5% | 56.6% | 66.2% | 72.8% | 60.6% | 53.1% | 59.4% | 51.4% | 49.5% | 60.8% | 51.8% | 51.9% |
| Karst Belt | 60.5% | 64.8% | 62.2% | 52.8% | 46.4% | 47.6% | 49.1% | 43.2% | 47.9% | 50.3% | 55.3% | 64.3% | 60.0% | 55.3% | 57.3% | 50.3% | 48.2% | 50.8% | 51.3% | 48.4% |
| Middelburg Basin | | | | | | 51.8% | 54.0% | 41.1% | 77.1% | 74.3% | 79.0% | 66.0% | 48.3% | 63.1% | 71.3% | 44.6% | 33.9% | 52.0% | 44.6% | 35.4% |
| Eastern Bankeveld | 71.1% | 61.7% | 71.0% | 50.2% | 42.6% | 32.7% | 63.1% | 52.5% | 49.4% | 49.8% | 57.5% | 61.2% | 58.7% | 60.6% | 71.2% | 66.7% | 54.4% | 54.8% | 42.3% | 42.4% |
| Springbok Flats | 62.5% | 66.1% | 74.3% | 68.5% | 65.6% | 57.2% | 58.4% | 46.0% | 58.7% | 69.8% | 75.1% | 84.3% | 73.7% | 74.7% | 72.5% | 69.4% | 56.3% | 51.0% | 38.5% | 28.4% |
| Western Bushveld Complex | 66.5% | 57.0% | 61.4% | 53.4% | 55.0% | 51.6% | 59.1% | 51.1% | 52.2% | 53.8% | 60.7% | 70.1% | 63.6% | 60.0% | 71.2% | 57.0% | 48.3% | 59.5% | 48.8% | 42.2% |
| Eastern Bushveld Complex | | | | | | | | | 77.2% | 78.3% | 77.1% | 80.9% | 69.2% | 61.2% | 61.7% | 55.9% | 50.7% | 47.1% | 30.8% | 22.1% |
| Northern Bushveld Complex | 55.9% | 67.1% | 71.9% | 59.5% | 65.5% | 62.2% | 62.7% | 62.9% | 65.4% | 78.9% | 75.9% | 67.4% | 66.6% | 67.2% | 71.2% | 68.7% | 64.6% | 69.0% | 60.7% | 54.8% |
| Central Highveld | 73.2% | 69.5% | 65.7% | 52.1% | 45.5% | 43.5% | 49.4% | 42.8% | 45.0% | 40.7% | 52.4% | 62.4% | 55.9% | 52.7% | 53.9% | 49.8% | 43.5% | 47.4% | 27.3% | 19.1% |
| Western Highveld | 62.4% | 62.0% | 61.5% | 53.5% | 48.8% | 46.0% | 61.8% | 60.4% | 66.3% | 63.6% | 61.6% | 69.0% | 57.1% | 45.5% | 48.4% | 37.6% | 36.1% | 52.9% | 50.3% | 45.1% |
| Lowveld | | 51.4% | 51.1% | 28.8% | 40.2% | 44.1% | 61.2% | 54.5% | 49.9% | 50.4% | 54.9% | 60.6% | 52.8% | 59.2% | 66.8% | 53.3% | 39.7% | 41.0% | 32.4% | 26.7% |
| Northern Lebombo | | | | 36.9% | 49.3% | 70.1% | 93.2% | 63.8% | 54.7% | 53.0% | 46.0% | 64.1% | 68.8% | 66.0% | 81.0% | 73.8% | 74.3% | 73.2% | 73.8% | 71.9% |
| Southern Lebombo | | 93.1% | 77.1% | 59.0% | 64.9% | 59.6% | 71.5% | 41.8% | 18.9% | 8.2% | 35.8% | 46.6% | 38.4% | 45.8% | 44.9% | 38.4% | 40.7% | 37.6% | 42.7% | 29.4% |
| Eastern Kalahari | 50.4% | 52.5% | 61.3% | 45.9% | 48.5% | 49.9% | 61.1% | 48.7% | 55.0% | 51.2% | 52.3% | 57.2% | 52.2% | 42.9% | 45.1% | 42.0% | 38.1% | 48.5% | 41.3% | 38.0% |
| Western Kalahari | 53.5% | 71.8% | 69.8% | 73.2% | 50.3% | 44.6% | 52.1% | 58.4% | 38.3% | | 52.6% | 53.2% | 94.6% | 66.7% | 66.5% | 55.2% | 49.4% | 57.9% | 52.0% | 46.2% |
| Ghaap Plateau | 49.1% | 48.9% | 58.5% | 48.1% | 37.6% | 35.7% | 50.6% | 57.5% | 47.0% | 42.8% | 41.0% | 49.1% | 45.8% | 43.0% | 51.2% | 45.5% | 42.2% | 49.4% | 47.1% | 40.5% |
| West Griqua Land | 66.2% | 71.2% | 59.1% | 52.0% | 52.9% | 48.2% | 53.1% | 46.4% | 44.1% | 43.2% | 52.1% | 55.5% | 57.7% | 50.8% | 64.5% | 55.4% | 48.9% | 55.0% | 41.4% | 32.7% |
| Bushmanland | 36.3% | 93.7% | 63.0% | 55.7% | 55.4% | 26.6% | 41.8% | | | | | 52.4% | 57.1% | 48.7% | 66.3% | 58.2% | 65.6% | 57.9% | 53.0% | 55.5% |
| Namaqualand | 50.7% | 53.3% | 62.3% | 57.6% | 46.8% | 41.1% | 55.9% | 69.2% | 69.7% | 70.2% | 72.0% | 62.0% | 67.6% | 64.8% | 68.4% | 57.4% | 52.7% | 52.6% | 44.6% | 45.4% |
| Eastern Highveld | 74.5% | 73.2% | 64.8% | 48.5% | 39.6% | 38.6% | 41.3% | 23.6% | 26.4% | 46.2% | 68.7% | 71.7% | 55.1% | 41.7% | 48.3% | 42.7% | 36.4% | 64.6% | 62.3% | 46.1% |
| Dry Harts-Lower Vaal-Orange Lowland | 33.6% | 40.7% | 59.4% | 35.5% | 26.9% | 30.9% | 61.6% | 60.7% | 58.4% | 45.8% | 36.0% | 40.8% | 26.0% | 15.9% | 31.0% | 32.1% | 23.2% | 38.6% | 30.0% | 30.9% |
| Northeastern Pan Belt | | | | 57.0% | 47.5% | 55.5% | 68.5% | 43.7% | 46.6% | 40.5% | 42.1% | 65.0% | 53.0% | 42.8% | 51.7% | 56.1% | 46.9% | 47.5% | 48.8% | 40.2% |
| Central Pan Belt | 49.4% | 48.3% | 51.6% | 44.2% | 47.3% | 45.0% | 54.4% | 50.7% | 45.3% | 41.4% | 42.3% | 60.9% | 57.5% | 58.3% | 51.6% | 47.7% | 42.5% | 42.6% | 37.8% | 35.2% |
| Southern Highveld | | | | | | | | | | | | | | | | | | | | |
| Northern Highland | | | | | | | | | | | | | | | | | | | | |
| Northeastern Upper Karoo | | | | | | | 15.1% | 24.0% | 13.1% | 14.8% | 11.6% | 45.5% | 72.2% | 65.8% | 66.2% | 56.0% | 33.6% | 43.8% | 13.8% | 8.2% |
| Bushmanland Pan Belt | | | | | | | | | | | | 70.6% | 60.2% | 73.9% | 73.6% | 60.3% | 64.3% | 63.2% | 59.2% | 40.4% |
| Hantam | | | | | | | 51.4% | 54.1% | 58.5% | 63.3% | 38.8% | 61.1% | 64.0% | 57.9% | 16.9% | 64.8% | 62.9% | 47.6% | 49.5% | 62.2% |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tanqua Karoo | | | | | | | | | | | | | | 72.8% | 66.9% | 55.3% | 60.7% | 48.6% | 38.9% | 19.2% |
| Western Upper Karoo | 47.7% | 64.8% | 71.1% | 65.6% | | | | | | | | 62.6% | 68.4% | 79.6% | 67.3% | 45.5% | 65.5% | 53.9% | 31.3% | 27.4% |
| Eastern Upper Karoo | 52.0% | 43.3% | 54.8% | 44.9% | 48.4% | 45.2% | 63.4% | 65.4% | 58.0% | 47.4% | 40.2% | 66.6% | 67.1% | 62.4% | 45.1% | 36.0% | 37.4% | 41.1% | 31.0% | 27.5% |
| Southeastern Highland | 48.3% | 64.5% | 53.7% | 43.1% | 70.3% | | | | | | 59.7% | 85.7% | 70.5% | 75.0% | 73.4% | 64.3% | 81.2% | 77.4% | 74.6% | 72.2% |
| Western Great Karoo | 78.5% | 73.9% | 59.9% | 62.3% | 59.5% | 54.0% | 61.3% | 59.3% | 62.6% | 52.1% | 46.1% | 70.7% | 81.1% | 77.1% | 73.4% | 57.3% | 52.3% | 44.2% | 36.1% | 23.7% |
| Eastern Great Karoo | 53.6% | 53.4% | 50.9% | 46.8% | 42.1% | 40.4% | 49.9% | 41.5% | 50.1% | 42.6% | 43.6% | 57.5% | 76.0% | 82.2% | 81.0% | 74.0% | 65.6% | 58.1% | 40.1% | 25.2% |
| Ciskeian Coastal Foreland and Middleveld | 62.4% | 60.8% | 59.2% | 48.5% | 51.3% | 53.4% | 56.0% | 59.8% | 55.6% | 42.6% | 34.1% | 48.7% | 60.0% | 57.5% | 61.8% | 60.2% | 52.9% | 42.2% | 44.7% | 35.0% |
| Transkeian Coastal Foreland and Middleveld | | | | | | | 70.4% | 46.9% | 35.1% | 27.4% | 39.8% | 70.9% | 57.3% | 67.4% | 53.2% | 38.1% | 43.4% | 43.7% | 64.0% | 53.1% |
| Northwestern Middleveld | | 60.3% | 67.8% | 52.2% | 30.6% | 51.9% | 73.3% | 56.1% | 52.9% | 53.0% | 51.8% | 63.0% | 53.0% | 49.3% | 50.8% | 44.2% | 37.9% | 48.8% | 64.7% | 52.6% |
| Northeastern Middleveld | | 48.9% | 40.2% | 31.7% | 36.4% | 35.2% | 56.9% | 38.7% | 43.8% | 45.8% | 54.8% | 53.2% | 50.0% | 54.8% | 56.7% | 39.1% | 29.2% | 40.3% | 45.4% | 46.2% |
| Kwazulu-Natal Coastal Foreland | | | | | 57.6% | 58.2% | 53.0% | 54.3% | 56.1% | 48.6% | 38.7% | 41.4% | 34.3% | 49.6% | 35.8% | 38.2% | 42.9% | 59.5% | 57.5% | 64.1% |
| Northwestern Cape Ranges | 69.8% | 69.4% | 67.4% | 59.4% | 48.4% | 46.7% | 47.1% | 51.0% | 56.5% | 61.1% | 62.1% | 59.5% | 60.8% | 63.7% | 64.4% | 61.0% | 59.2% | 50.1% | 42.7% | 43.9% |
| Southwestern Cape Ranges | 61.9% | 63.7% | 64.1% | 67.2% | 52.9% | 60.4% | 55.5% | 58.8% | 57.6% | 58.2% | 55.9% | 48.8% | 51.6% | 59.7% | 61.5% | 46.7% | 47.8% | 43.2% | 49.7% | 48.7% |
| Southern Cape Ranges | 55.5% | 54.0% | 48.1% | 58.6% | 49.0% | 49.8% | 56.0% | 61.5% | 65.0% | 56.4% | 52.6% | 58.8% | 65.1% | 67.4% | 67.5% | 64.5% | 61.3% | 52.0% | 44.1% | 32.7% |
| Oudtshoorn Basin | 77.0% | 72.9% | 71.7% | 77.1% | 64.8% | 62.5% | 71.4% | 65.3% | 74.3% | 63.8% | 51.1% | 54.9% | 69.1% | 74.6% | 70.8% | 52.6% | 55.8% | 62.5% | 53.4% | 45.2% |
| Grootrivier-Klein Winterhoek-Suur-Kaprivier Ranges | 33.5% | 39.7% | 44.9% | 42.2% | 31.2% | 27.7% | 28.3% | 32.9% | 27.2% | 18.0% | 12.8% | 33.8% | 45.9% | 64.4% | 57.9% | 50.1% | 63.8% | 59.8% | 46.8% | 59.1% |
| Ruensveld | 35.4% | | | 46.2% | 37.8% | 0.0% | 4.7% | 28.4% | 56.5% | 53.8% | 39.4% | 37.2% | 45.9% | 64.0% | 71.1% | 59.7% | 69.7% | 59.5% | 32.0% | 19.9% |
| Intermontane Tulbagh-Ashton Valley | 72.1% | 74.1% | 71.2% | 64.4% | 58.4% | 54.3% | 49.3% | 59.6% | 73.6% | 82.0% | 74.1% | 70.3% | 67.3% | 68.3% | 80.2% | 72.7% | 64.2% | 48.3% | 43.1% | 38.4% |
| Richtersveld | | | 27.6% | 27.7% | 27.3% | | | | | | | | | 64.4% | 51.9% | 74.1% | 78.3% | 55.2% | 15.3% | 17.4% |
| Knersvlakte | 66.1% | 66.2% | 69.5% | 68.1% | 64.4% | 62.8% | 60.3% | 55.7% | 59.8% | 65.4% | 63.0% | 64.7% | 61.6% | 63.5% | 62.6% | 57.0% | 50.1% | 41.6% | 32.8% | 24.4% |
| Swartland | 71.8% | 69.5% | 66.7% | 70.5% | 66.2% | 64.1% | 65.8% | 73.1% | 70.6% | 72.3% | 73.4% | 66.9% | 67.7% | 72.2% | 74.1% | 65.7% | 58.4% | 48.1% | 52.7% | 52.8% |
| Outenikwa Coastal Foreland | | | | | | | | | | | | | 50.3% | 46.2% | 48.7% | 49.3% | 49.3% | 41.5% | 37.9% | 40.5% |
| Southwestern Coastal Sandveld | 61.4% | 58.8% | 59.6% | 53.2% | 51.0% | 43.0% | 37.7% | 50.4% | 61.6% | 66.4% | 62.5% | 53.2% | 47.2% | 51.6% | 60.6% | 54.4% | 47.3% | 37.8% | 35.8% | 35.3% |
| Die Kelders Embayment | | | | | | | | | 74.8% | 61.0% | 53.0% | 47.3% | 42.7% | 42.3% | 55.6% | 49.8% | 47.7% | 43.9% | 50.2% | 37.5% |
| Bredasdorp Coastal Belt | | | | | | | | | | | | | | | | | | | | |
| Stilbaai Coastal Belt | | | 54.7% | 34.0% | 41.2% | 23.6% | 70.0% | 76.6% | 74.0% | 74.5% | 57.5% | 56.7% | 63.0% | 62.1% | 79.9% | 72.6% | 71.4% | 52.4% | 36.8% | 20.9% |
| Lower Gamtoos Valley | | | | | | | | | | | | | | | | | | | | |
| Algoa Basin | 52.4% | 54.9% | 61.4% | 66.5% | 61.7% | 66.6% | 67.4% | 63.1% | 58.6% | 52.9% | 53.8% | 63.4% | 74.6% | 74.0% | 67.3% | 67.1% | 63.8% | 52.6% | 44.3% | 33.2% |
| Northern Zululand Coastal Plain | 85.9% | 78.5% | 71.4% | 62.5% | 58.3% | 59.7% | 56.8% | 58.3% | 57.5% | 51.4% | 43.8% | 50.4% | 46.5% | 49.0% | 47.9% | 45.0% | 40.4% | 49.3% | 43.6% | 38.1% |

# Acknowledgements

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