Raw Water Quality

What does this dashboard relate to?

With the **water quality** information available to the DWS, we would like to show where untreated surface water (i.e. untreated water in dams and rivers) is, or has been, of such poor quality that it could pose a health risk to those who drink it.

What is water quality?

The term "water quality" describes the microbiological, physical and chemical properties of water that determine its fitness for use. Many of these properties are controlled or influenced by substances which are either dissolved or suspended in the water.

What types of questions does the information product aim to answer?

The dashboard aims to answer the following questions:

- What problematic water quality constituents pose the greatest risk to human health in areas where they are routinely measured?
- Where do we know that drinking untreated water may be risky? The dashboard includes a map of communities to give an idea of where people are likely to be exposed to risk.
- What are the trends of the problem constituents at sites where routine measurements are available?

<u>What is the main purpose of the dashboard?</u>

The main purpose is to provide an overview of some potential water related health risks people are exposed to in South Africa. This information can help guide necessary intervention.

<u>What are some limitations associated with this dashboard?</u>

Some limitations include:

- Financial constraints limit the geographic extent of the monitoring network and the frequency of monitoring. Many water bodies in South Africa are not sampled or the results are not available on the central database. Reporting on the potential health risks of water bodies in South Africa is restricted to those with adequate information.
- Some monitoring sites have very few recent analyses. Water quality can vary over time, so the analysed information available may have missed water pollution events.
- It can take months for sampled water to be analysed, and then captured in WMS. The water risk information may thus be outdated by the time it is in NIWIS.

- Hundreds, even thousands, of potentially harmful compounds may be present in water, but facilities are only available for measuring a selected few.

<u>What information is used to determine if the water quality poses a risk to human health?</u>

The water samples taken by the Department of Water and Sanitation are compared to water quality guidelines captured in the 2nd edition of the South African Water Quality Guidelines(DWAF, 1996) and Health Guidelines: Drinking Water Quality (Department of Health, 1995). A well-illustrated summary of these guidelines is captured in the document entitled **"The Quality of Domestic Water Supplies,Volume 1: Assessment guide"**. The document can be downloaded by clicking on this **LINK**. The South African water quality guidelines are based on research here and in other countries on the recommended amounts of various substances in drinking water. The guidelines are currently under review in order to better estimate the risk to users.

<u>What water quality health risk related constituents are considered in this dashboard?</u>

The dashboard considers the water quality constituents in Table 1: : not all are equally hazardous. The table includes an indicator of moderate risk for information – the actual analytical process uses five or more ranges.

Table 1: A summary of water quality variables, effects and the values at which moderate risk occurs. Please consult https://www.dwa.gov.za/iwqs/AssessmentGuides/AssessmentGuide/AssessmentGuide.pdf for details.

Variable	Effects	Moderate Risk
Electrical conductivity (total dissolved salts)	Electrical conductivity is a general indicator of total dissolved salts (TDS). It is a measure of whether the water tastes drinkable and is capable of slaking thirst.	< 370 mS/m
pH	pH has a marked effect on the taste of the water and also indicates possible corrosion problems. Low pH can cause copper, zinc and cadmium to be more soluble and therefore toxic.	4.5 to 10.0
Turbidity	Turbidity affects the appearance, and thus the aesthetic acceptability, of the water. Turbidity is high in surface waters after heavy runoff. It is sometimes associated with contamination by microbial pathogens	< 20 NTU

	whose presence in water suggests faecal contamination with disease producing bacteria, viruses and protozoa.	
E. coli	*E. coli* is an indicator organism whose presence in the water suggests faecal contamination with disease producing bacteria, viruses and protozoa.	(definitely < 10)
Faecal coliform	Faecal coliform counts are another indicator of the possible presence of disease-causing organisms in the water. They are a sign of faecal contamination.	< 10 counts / 100mL
Total coliforms	Total coliforms are a more general indicator of microbial pathogens and ineffective disinfection.	< 100 counts / 100mL
Free available chlorine(residual chlorine)	Free available chlorine is a measure of the effectiveness of the disinfection of treated municipal water. It is unlikely to be present in water resources..	
Arsenic	Arsenic may be present in groundwater, particularly in mining areas and can cause arsenic poisoning.	< 0.2 mg/L
Cadmium	Cadmium usually occurs along with zinc in acidic waters where it may have been dissolved from appliances.	< 0.02 mg/L
Copper	Copper affects the colour of the water and can cause diarrhoea. Chronic exposure can cause Wilson's disease in susceptible individuals. Normally occurs only when copper piping is used to carry water with a low pH value.	< 2 mg/L
Zinc	Zinc affects the taste of water and people are unlikely to be able to drink toxic amounts.	< 20 mg/L for taste
Iron	Iron affects the taste of the water and may cause a reddish brown discolouration.	< 5 mg/L
Nitrate and nitrite	Nitrate and nitrite are common in borehole samples, particularly in areas of intensive agricultural activity,	< 20 mg/L for infants

	downstream of sewage works or where pit latrines are used. Severe toxic effects are possible in infants.	
Fluoride	Fluoride is often elevated in groundwater in hot, arid areas. While essential in low concentrations, high concentrations of fluoride can cause damage to the skeleton and mottling of teeth.	< 1.5 mg/L
Chloride	Chloride is often elevated in hot, arid areas, and on the western and southern Cape coasts (particularly in groundwater). It causes nausea and vomiting at very high concentrations, so voluntary consumption is likely.	< 600 mg/L
Sulphate	Saline water with high sulphate concentrations causes diarrhoea, particularly in users not accustomed to drinking water containing sulphate.	< 600 mg/L
Sodium	Sodium affects the taste of the water. Often high in hot, arid areas and on the western and southern Cape coasts, particularly in groundwater.	< 400 mg/L
Calcium	Calcium can cause scaling and can reduce the lathering of soap, but is unlikely to be toxic.	< 300 mg/L
Magnesium	Magnesium affects the taste of the water. It is bitter at high concentrations. Common in some areas, it accentuates the effect of sulphate in causing diarrhoea.	< 200 mg/L
Manganese	Manganese is a common reason for brown or black discolouration of fixtures and for stains in laundry, but is unlikely to affect human health.	< 4 mg/L
Potassium	Potassium affects the taste of the water and is bitter at elevated concentrations.	< 100 mg/L
Hardness, Total	Hardness is a combination of calcium and magnesium. It is associated with scaling and inhibition of soap lathering, but is unlikely to be toxic.	< 600 mg/L

When comparing the analysed value of each respective constituent against the constituents are classified as being either (i) ideal water quality, (ii) good water quality, (iii) marginal water quality, (iv) poor water quality, or (v) unacceptable water quality.

For the purposes of this dashboard, these five categories have been re-categorised as follows:

Ideal water quality	No health risk
Good water quality	No health risk
Marginal water quality	Medium health risk
Poor water quality	High health risk
Unacceptable water quality	High health risk

Is this dashboard for operational or for planning purposes?

Water Quality sampling and analysis can take weeks to months before the result can be verified and uploaded into the information system used to store this information (WMS). Only once the information is stored in the WMS can the calculations be done to assess the risk of observed and analysed water quality concentrations to the people's health. The information is generally therefore not real-time or even near-real time in nature, and is thus more suited for planning. If verified water quality readings become available more quickly, the dashboard might help in guiding operational water management decisions. Note that water boards and municipalities test the water that they provide at a greater frequency and with a shorter turnaround time.

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Data / Information discussion:

- **What data is used?**

  The dashboard uses water quality information derived from monitoring data compared with water quality guidelines. NIWIS then aggregates this information into three classes.

- **How is data extracted and from where?**

  RQIS and regional staff collect water quality samples at prescribed intervals, and submit them for analysis at RQIS or other appointed laboratories. The water quality results are validated, and then captured in the WMS database. The validation and upload into WMS can take several months. A stored procedure, which is a script in the WMS database, compares the values of the observed verified water quality readings against water quality guidelines.The stored procedure for annual information uses the yearly median values of each variable in the above table and compares it to the guidelines for drinking water. The stored procedure for monthly values uses the monthly mean value of each variable and compares it to the guidelines.

The stored procedure reports sites where the annual median or 95th percentile for any variable exceeds the lower boundary of the drinking water or domestic use guidelines containing one of these descriptions: serious health effects, serious risk, danger, increasing risk, increasing health risk, acute health risk, burns, chronic health, chronic effects, dehydration, poisoning, diarrhoea, definite health risk

The classes are (i) ideal water quality, (ii) good water quality, (iii) marginal water quality, (iv) poor water quality, or (v) unacceptable water quality. For ease of interpretation, NIWIS collapses the five classes into three.

- **Calculations done in NIWIS to attempt to answer the key questions**

To answer the question “what are the problematic water quality constituents in a geographic area, e.g. National, WMA or local site”, NIWIS performs the following analysis:

National scale	Let the count of the number of high risk classes found across all monitoring stations in South Africa for each constituent be **X**. Let the total number of high risk classes of all constituents in South Africa, be **Y**. Divide **X** by **Y**. Then rank the result from worst to best.
WMA scale	Let the count of the number of high risk classes found in all monitoring stations in a selected WMA for each constituent be **A**. Let the total count by the total number of high risk classes of all constituents in the selected WMA, be **B**. Divide **A** by **B**. Finally rank the result from worst to best.
Local site	Let **C** be the count of the number of high risk classes at the site of interest for each constituent. Let **D** be the total number of high risk classes of all constituents at the

	site. Divide **C** by **D**. Lastly, rank the result from worst to best.

To map at National or WMA level which monitoring sites have high records of red (high risk) classes for a given constituent, the following calculation is done:

National	Let the count of the number of high risk classes for a given constituent at each monitoring site in South Africa, be **E**. Let the total number of constituent high risk classes for all monitoring sites in South Africa, be **F**. Divide the **E** by **F** for each respective site. As a final step, rank the result from worst to best.
WMA	Let the count of the number of high risk classes for a given constituent at each monitoring site in the selected WMA, be **G**. Also let the total number of constituent high risk classes for all monitoring sites in the WMA, be **H**. Divide the **G** by **H** for each respective site. In finality, rank the result from worst to best.

To show the trends at National and WMA scale, the total numbers of red, green and yellow classes per month for a given constituent are counted. The counts are displayed in a stacked bar graph.

- **Key assumptions**
  - Monitoring is geographically and temporally uniform.
  - All constituents have the same monitoring frequency at a monitoring site.
  - The observed water quality readings are correct and no errors or omissions have taken place when storing the information on WMS.
  - The calculations are appropriate.
  - The analytical procedures have detected all hazardous substances.

Links to other sources of related information

https://www.dwa.gov.za/iwqs/default.aspx
https://www.dwa.gov.za/iwqs/wms/default.aspx

Are there any limitations / cautions related to using this information?

Yes, please refer to the below:

- Data collection varies in intensity across WMAs, thus the National and WMA results are inherently biased. Always check the data at the local site scale before drawing conclusions. Sometimes the classification may be based on the result of a single sample.
- Some analyses are more expensive, so they may be performed less frequently and the results may appear to be less meaningful than they are, when aggregated in this way.
- The process of verifying the data can take weeks to months. Results are therefore not real-time or near-real time.
- Errors may occur during data capture or verification.
- Hundreds of toxic substances exist, and DWS can only analyse a few of them.