# NATIONAL WATER RESOURCE QUALITY STATUS REPORT:

# INORGANIC CHEMICAL WATER QUALITY OF SURFACE WATER RESOURCES IN SA – THE BIG PICTURE

Department of Water Affairs and Forestry
Institute for Water Quality Studies

First Edition
2002

**Republic of South Africa**

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**Department of Water Affairs and Forestry**
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# DOCUMENT INDEX

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# EXTENDED EXECUTIVE SUMMARY

# NATIONAL WATER RESOURCE QUALITY STATUS REPORT:

# INORGANIC CHEMICAL WATER QUALITY OF SURFACE WATER RESOURCES IN SA - THE BIG PICTURE

## 1. PURPOSE OF THE REPORT

The aim of this report is to provide information on the major inorganic chemical water quality constituents of surface waters across South Africa to water resource managers, scientists, decision-makers, and the public. It is intended to provide an overview of the status of surface chemical water quality according to the water quality requirements of two water user sectors, namely, domestic water use and irrigated agriculture water use.

## 2. BACKGROUND

Water is an excellent solvent and transport medium for particulates, and as such it tends to become contaminated both by natural processes such as erosion, and dissolution of salts geologically present in soils, as well as by man-induced processes and wastes. The latter are both natural e.g. the contamination of runoff water with excreta, as well as artificial, such as the contamination of water with industrial effluents and synthetic chemicals such as pesticide residues.

Water can thus be contaminated by a whole host of substances including:

- Physical soil and clay particles and organic detritus from storm runoff
- Microorganisms, such as bacteria, viruses, and parasites, from the soil and environment and animal and human wastes.
- Chemical constituents, which can be subdivided into (a) major inorganic chemical salts (such as sodium, chloride, calcium, sulphate, etc.), (b) minor inorganic chemical salts (such as ammonia, fluoride, phosphate and trace metals such as iron, manganese, copper, etc.) and (c) organic substances such as pesticide residues, for example.
- Radioactive substances (which usually occur only in minute concentrations under natural conditions).

This report concentrates mainly on the status of water quality in South Africa, as reflected in predominantly the mineral salt composition. Mineral salts arise both naturally from soil erosion and washout of salts naturally present in the soil, as well as the contribution from human settlements and activities. Land use activities include both domestic (e.g. leading to nutrient enrichment or eutrophication) and industrial (e.g. the contamination of surface waters by acid mine drainage water containing constituents such as sulphate arising from the accelerated oxidation of sulphur bearing minerals in exposed rock consequent to mining operations).

In addition to the information on the major inorganic water quality constituents, information is also given in this report on the nutrient status of selected impoundments in South Africa as reflected by the so-called trophic status of the water bodies.

This report does not deal with the microbiological status of the water resources, as this information is not readily available yet. However, as a general rule, it must be assumed that all surface water has the potential for microbiological contamination, and needs to be disinfected before drinking.

# 3. ASSESSMENT METHODOLOGY

## 3.1 Assessment Basis

To simplify the assessment and to present the information in such a way that it would be useful for water resource management purposes, South Africa is divided into 19 Water Management Areas (WMAs).

Water quality is assessed on the basis of its fitness for use by the domestic and irrigated agriculture water user sectors. These are the two user groups that generally have the most stringent requirements for water quality (with the possible exception of the aquatic environment). Agriculture often does not have the opportunity to pretreat the water to the desired quality before using it. Industry either has similar requirements to those of the above two water users or has the ability to conduct the necessary treatment of the raw water for it to be suitable for their purposes (*e.g.* industries with specific water quality requirements).

The water quality constituents selected for this study are largely limited to those of relevance to domestic and irrigated agriculture water use. The two sets of water quality constituents used as indicators for these water user sectors are:

Table 3.1 Water quality constituents used in the assessment of fitness-for-use for domestic and irrigated agriculture water use

| Domestic Use | Irrigated Agriculture Use |
|---|---|
| Nitrate +Nitrite as N ($NO_3$+$NO_2$ (as N)) | Chloride (Cl) |
| Ammonia as N ($NH_4$ (as N)) | Electrical Conductivity (EC) |
| pH | pH |
| Potassium (K) | Boron (B) |
| Total Dissolved Salts (TDS) | Sodium Adsorption Ratio (Ca; Na; Mg) |
| Fluoride (F) | |
| Turbidity | |
| Sodium (Na) | |
| Magnesium (Mg) | |
| Chloride (Cl) | |
| Calcium (Ca) | |
| Sulphate ($SO_4$) | |

The assessment classification system used for the assessment of the suitability of water for domestic purposes is based on that described in the Assessment Guide for the quality of Domestic Water Supplies (DWAF, DOH and WRC, 1998) and the water quality guidelines presented in the South African Water Quality Guidelines (DWAF, 1996a and DWAF, 1996b, for irrigated agriculture).

Water quality guidelines or criteria are scientific and technical information provided for a particular water quality constituent in the form of numerical data and/or narrative descriptions of its effects on the fitness of water for a particular use or on the health of aquatic ecosystems.

## 3.2 Data Collection

The water quality data that were used in the assessment of the fitness for use of South Africa's surface water resources for domestic and irrigated agricultural use were collected as part of the so-called National Chemical or Salinity Monitoring Programme. This programme has been in operation since the early 1970's and samples are regularly collected at approximately 1 600 monitoring stations at a frequency that varies from weekly to monthly sampling. The samples

collected for this programme are analysed at the laboratories of the Institute for Water Quality Studies and the data is stored on DWAF's database and information management system, namely the Water Management System (WMS).

### 3.3 Sample Site Selection

As far as sample site selection for the status report is concerned, two levels of sampling sites were selected from the chemical water quality database, namely:

- a national level sample site set, and
- a more comprehensive site set selected for each WMA.

The national site set is comprised of sites ideally as close to the downstream end of each tertiary drainage region with a sufficient record length of relatively regular frequency.

The individual WMA sample site sets are based on the national set with the addition of all other sample sites within the WMAs that have sufficient record length and frequency, irrespective of their location within the WMA. Sites are only excluded when their sampling frequencies are too erratic or sparse, or where there are better sample sites geographically close to them. This was done to identify river reaches with sampling sites where water quality problems are prevalent.

### 3.4 Study Period

A study period of 5 years was used for assessing the water inorganic chemical quality status of surface water resources extending from the beginning of 1996 to the end of the year 2000. The median (the most commonly) observed concentration for each variable is used in comparison with the domestic and irrigation use guidelines.

### 3.5 Presentation of Results

The assessment results are presented in a series of Tables and Maps. The symbols used in the assessment maps are referred to as Guideline Compliance Pie Diagrams and illustrate the median concentrations for each of the constituents depicted over the study period. Median constituent concentrations are depicted in a "pie wedge" that only projects beyond the circular "pie" when the concentration falls outside of the *Very Good* range in the case of the domestic use guidelines or the Target Water Quality Range (TWQR) in the case of the agriculture guidelines. If it does project beyond the *Very Good* range then the colour and extent of the projection indicates the extent of exceedence of the median value.

Information from the Trophic Status Project is also included in the report. The trophic status on a national scale of selected impoundments across South Africa, specifically those impoundments managed by DWAF, is reflected in a Table. Information is also given on a priority ranking for the 49 selected impoundments indicating the relative need for eutrophication management.

# 4. RESULTS AND CONCLUSIONS

Various land uses, notably mining and agriculture and the degradation of land, modify the water quality in many parts of the country. At a national scale, however, land cover and geology influence water quality predominantly. Since the bulk of the country is still in a moderately natural state, it is only on proceeding to a finer level of detail, such as the WMA level, that problem areas become more easily apparent.

## 4.1 Water Quality Status for Domestic Use

The main water quality problems throughout the country for domestic use relate to the widespread elevated salt levels (high TDS values) and elevated fluoride (F) levels in certain locations.

Water with elevated TDS tastes salty and does not slake thirst. The elevated salt levels (as expressed by TDS concentrations) also decrease the aesthetic value of water. Consumption of the water may not produce adverse health effects in the short-term, but there is a slight possibility of salt overload in sensitive individuals in the long term. TDS levels were especially elevated in the Lower Orange, Fish to Tsitsikamma and Gouritz WMAs. It would appear that these elevated levels are due to natural reasons. The Breede and Berg WMAs have elevated TDS levels when considering the individual WMA sample sites.

High F levels were evident in the lower Olifants WMA. Health effects and tooth staining can be expected at the concentrations evident at selected sample sites.

At a WMA scale, pH values were also seen to deviate in various parts of the country. The pH was low in the Klip Spruit (of the Olifants WMA) and would likely result in irritation of the mucous membranes of water users in this area. It is likely that the source of the low pH is the acid mine drainage from the coalmines and mine dumps in the area. A notable effect of the low pH would be "burning eyes" with the use of the water for recreational purposes.

Magnesium (Mg), sulphate ($SO_4$), chloride (Cl), sodium (Na) and potassium (K) were also elevated in various parts of the country.

## 4.2 Water Quality Status for Irrigation Use

From an irrigated agriculture use perspective, the sodium adsorption ratio (SAR), electrical conductivity (EC), pH and chloride (Cl) were elevated in various regions of the country.

There were high pH levels in the Luvuvhu and Letaba, Crocodile (West) and Marico, Olifants, Usutu to Mhlatuze, Mzimvubu to Keiskamma, Upper Orange and Lower Orange WMAs.

The Fish to Tsitsikamma and Gouritz WMAs had low pH values and high SAR, EC and Cl values; making irrigated agriculture in these WMAs more challenging, and limiting crop selection to more salt tolerant crops.

The Thukela WMA had high pH values, with the Upper and Middle Vaal WMAs having high EC values.

The South Western Cape (Breede and Berg WMAs) had low pH values evident in some cases and elevated SAR, EC and Cl concentrations, again limiting the potential for growing salt sensitive crops.

### 4.3 Trophic Status of Selected Impoundments

South Africa has disturbingly high levels of nutrient enrichment in many of its impoundments. This is something that requires urgent attention. The most enriched impoundments are often those that have the greatest concentration of humans in their catchment areas.

Apart from the aesthetic aspects of water with a "pea-soup" appearance, eutrophication leads to the frequent occurrence of toxic algal blooms, with the danger of fish and cattle deaths, and the induction of gastro-enteritis in humans.

## 5. RECOMMENDATIONS

The following recommendations are proposed:

- Revision of the existing monitoring network is necessary to terminate sampling at unnecessary sites and expand the network to cover more adequately the sensitive problem areas or those areas with insufficient sampling sites.

- Role players must be informed of the impact of land uses that result in deterioration in the water quality. This is especially important for mining and agriculture.

- Ways to improve the water quality at those negatively impacted sites must be investigated.

- Water users at sites where the water that could be detrimental to their health should be informed to take appropriate precautions. Safe water should be provided to those domestic users who have no access to a safe and healthy water supply.

- Water resources should be protected, in particular the more pristine water sources, in order that their quality does not deteriorate as a result of a change in land use or management practice.

- The trophic status monitoring and assessment programme should be expanded to include more of the impoundments throughout the country and appropriate land use management practises should be encouraged to prevent or minimise large loads of nutrients entering the aquatic environment.

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# INORGANIC CHEMICAL WATER QUALITY OF SURFACE WATER RESOURCES IN SOUTH AFRICA - THE BIG PICTURE

## 1. PURPOSE OF THE STUDY

The aim of this report is to provide information on the major inorganic chemical water quality constituents of surface waters across South Africa to water resource managers, scientists, decision-makers, and the public. It is intended to provide an overview of the status of the chemical water quality of surface water resources according to the water quality requirements of two water user sectors, namely, domestic water use and irrigated agriculture water use.

## 2. INTRODUCTION AND BACKGROUND

Water is an excellent solvent and transport medium for particulates, and as such it tends to become contaminated both by natural processes such as erosion, and dissolution of salts geologically present in soils, as well as by man-induced processes and wastes. The latter are both natural e.g. the contamination of runoff water with excreta, as well as artificial, such as the contamination of water with industrial effluents and synthetic chemicals such as pesticide residues.

Water can thus be contaminated by a whole host of substances including:

- Physical soil and clay particles and organic detritus from storm runoff.
- Microorganisms, such as bacteria, viruses, and parasites, from the soil and environment and animal and human wastes.
- Chemical constituents, which can be subdivided into (a) major inorganic chemical salts (such as sodium, chloride, calcium, sulphate, etc.), (b) minor inorganic chemical salts (such as ammonia, fluoride, phosphate and trace metals such as iron, manganese, copper, etc.) and (c) organic substances such as pesticide residues, for example.
- Radioactive substances (which usually occur only in minute concentrations under natural conditions).

The Constitution of South Africa guarantees everyone a right of access to water and a right to an environment that is not harmful to their health or well-being. Section 24 of the Bill of Rights states that:

*"Everyone has the right*

*(a) to an environment that is not harmful to their health or well-being; and*

*(b) to have the environment protected for the benefit of present and future generations, through reasonable legislative and other measures that*

*(i) prevent pollution and ecological degradation;*

*(ii) promote conservation; and*

*(iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development."*

The Department of Water Affairs and Forestry, as a custodian of the water resources of South Africa must manage and ensure efficient, equitable and sustainable use of our limited water resources. It is, therefore, the responsibility of the Department to support sustainable operations of potable water and sanitation systems, to monitor and evaluate access to services and to

provide the national resource management function with resource quality and technical information.

Status reporting is an obligation of the Department of Water Affairs and Forestry in terms of the National Water Act (Act 36 of 1998). A comprehensive status report would cover a range of water quality problems, including:

- inorganic chemical water quality (major ions and trace metals),
- trophic status of water resources,
- microbiological water quality,
- organic chemical water quality,
- aquatic ecosystem health, and
- radioactivity levels in water resources.

In the broader perspective, status reporting should ideally be carried out on a regular basis for surface water, groundwater and estuaries.

## 2.1 National Water Quality Monitoring Programmes

DWAF has had a national monitoring programme (the so-called Chemical or Salinity monitoring programme) in place since the early 1970's, as well as established assessment procedures for assessing the inorganic chemical water quality of surface waters. For this programme, samples are regularly collected at approximately1 600 monitoring stations on rivers, at a frequency that varies from weekly to monthly sampling.

A Trophic Status Monitoring Programme is conducted on a much smaller scale for selected South African impoundments that are managed by the Department of Water Affairs. The design of a more extensive Eutrophication Monitoring Programme has been completed and the Trophic Status Programme will be integrated with this programme as soon as it becomes operational.

A national microbiological water quality monitoring programme has been designed and is currently being implemented. At present only a limited sampling network exists and work is underway to extend this network, however, it will be several years before it can provide a national indication of the microbiological water quality.

Organic surface water resource quality sampling occurs for a very small number of sampling sites and no national network is feasible at present because of the costs of sampling and analysis. Initiatives are underway to develop a National Toxicants Monitoring Programme that will include monitoring of organic and heavy metal pollutants. Radioactivity monitoring is done at a regional level only where such problems exist.

This report concentrates mainly on the status of water quality in South Africa, as reflected in predominantly the mineral salt composition. Mineral salts arise both naturally from soil erosion and washout of salts naturally present in the soil, as well as the contribution from human settlements and activities. Land use activities include both domestic (e.g. leading to nutrient enrichment or eutrophication) and industrial (e.g. the contamination of surface waters by acid mine drainage water containing constituents such as sulphate arising from the accelerated oxidation of sulphur bearing minerals in exposed rock consequent to mining operations).

In addition to the information on the major inorganic water quality constituents, information is also given in this report on the nutrient status of selected impoundments that are monitored in South Africa as reflected in the so-called trophic status of the water bodies.

This report does not deal with the microbiological status of the water resources, as this information is not yet readily available. However, as a general rule it must be assumed that all

surface water has the potential for microbiological contamination, and needs to be disinfected before drinking.

# 3. ASSESSMENT METHODOLOGY

## 3.1 Assessment Basis

Water quality is assessed on the basis of its fitness for use by the domestic and irrigated agriculture water user sectors. These are the two user groups that generally have the most stringent requirements for water quality (with the possible exception of the aquatic environment). Agriculture often does not have the opportunity to pretreat the water to individual requirements before using it. Industry either has similar requirements to those of the above two water users or has the ability to conduct the necessary treatment of the raw water for it to be suitable for their purposes (*e.g.* industries with specific water quality requirements).

The water quality constituents selected for this study are largely limited to those of relevance to domestic and irrigated agriculture water use. The two sets of water quality constituents used as indicators for these water user sectors are reflected in Table 3.1.

Table 3.1 Water quality constituents used in the assessment of fitness-for-use for domestic and irrigated agriculture water use

| Domestic Use | Irrigated Agriculture Use |
|---|---|
| Nitrate +Nitrite as N ($NO_3$+$NO_2$ (as N)) | Chloride (Cl) |
| Ammonia as N ($NH_4$ (as N)) | Electrical Conductivity (EC) |
| pH | pH |
| Potassium (K) | Boron (B) |
| Total Dissolved Salts (TDS) | Sodium Adsorption Ratio (Ca; Na; Mg) |
| Fluoride (F) | |
| Turbidity | |
| Sodium (Na) | |
| Magnesium (Mg) | |
| Chloride (Cl) | |
| Calcium (Ca) | |
| Sulphate ($SO_4$) | |

The assessment classification system used for the assessment of the suitability of water for domestic purposes is based on that described in the Assessment Guide for the quality of Domestic Water Supplies (DWAF, DOH and WRC, 1998) and the water quality guidelines presented in the South African Water Quality Guidelines (DWAF, 1996a and DWAF, 1996b, for irrigated agriculture).

Water quality guidelines or criteria are scientific and technical information provided for a particular water quality constituent in the form of numerical data and/or narrative descriptions of its effects on the fitness of water for a particular use or on the health of aquatic ecosystems.

The two sets of water quality constituents were used as indicators for the relevant water user sectors and the motivation for including these indicators are presented below (DWAF, DOH and WRC, 1998; DWAF, 1996a; DWAF 1996b). The indicators can be linked to specific problems that may be associated with specific land uses and activities. These water quality problems include salination (measured by TDS), acidification by mines and atmospheric deposition and potential toxicity (measured by pH), the impact of erosion (measured by turbidity), nutrient and other problems associated with sewage treatment works and excess fertiliser application in agriculture (measured by constituents such as $NH_4$ and $NO_3$+$NO_2$).

The water quality constituents selected for the assessment of fitness for domestic use have been divided into two groups (Domestic Use – "Health" and Domestic Use – "Salinity") for map representation reasons; primarily since there are too many constituents to be presented clearly on one diagram. The "Health" set includes those variables where there may be a more health-related impact on domestic users, while those constituents in the "Salinity" set are most often those that have an aesthetic (taste and/or scaling) effect on domestic users. The properties of these indicators are described in more detail in the Tables below.

The assessment classification system used for the assessment of the suitability of water for domestic purposes is based on that described in the Assessment Guide for the quality of Domestic Water Supplies (DWAF, DOH and WRC, 1998) and the South African Water Quality Guidelines: Domestic Use (DWAF, 1996a) and for irrigation agriculture, the South African Water Quality Guidelines - Agricultural Use: Irrigation (DWAF, 1996b). The classification system that describes the effects of the different classes of water on the various domestic uses is presented below (Table 3.2 and Table 3.3).

Table 3.2 Domestic "Health" Set: Water quality constituents relevant to the health of domestic water users (DWAF, 1996a and DWAF, DOH and WRC, 1998)

| Constituent | Range | Colour Classification | Suitability for Domestic Use |
|---|---|---|---|
| TDS (mg.$\ell^{-1}$)<br>The TDS concentration provides a measure of the salination of water. It can be enhanced by, for example, excessive use of fertilisers or by the discharge of industrial waste products into a water body or river. TDS also affects the taste of the water, and at high concentrations does not slake thirst. | 0 – 450 | Blue<br>**Very good water quality** | No health effects. |
| | 450 – 1000 | Green<br>**Good water quality** | Insignificant effect on sensitive groups. |
| | 1000 – 2400 | Yellow<br>**Fair water quality** | Slight possibility of salt overload in sensitive groups and a slightly salty taste. |
| | 2400 – 3400 | Red<br>**Poor water quality** | Possible health risk to all individuals and a salty taste. |
| | > 3400 | Purple<br>**Not acceptable water quality** | Increasing risk of dehydration and a very salty taste. |
| $NO_3$+$NO_2$ (as N) (mg. $\ell^{-1}$)<br>Nitrate plus nitrite is common in groundwater samples, particularly in areas of intensive agricultural activity, or where pit latrines are used. Severe toxic effects are possible in infants (DWAF, DOH and WRC, 1998). | 0 – 6.0 | Blue<br>**Very good water quality** | Negligible health effects. |
| | 6.0 – 10.0 | Green<br>**Good water quality** | Insignificant risk. |
| | 10.0 – 20.0 | Yellow<br>**Fair water quality** | Slight chronic risk of blue baby syndrome to some babies. |
| | 20.0 – 40.0 | Red<br>**Poor water quality** | Possible chronic risk to some babies. |
| | > 40.0 | Purple<br>**Not acceptable water quality** | Increasing acute health risk to babies. |
| $NH_4$ (as N) (mg. $\ell^{-1}$)*<br>Ammonium may be indicative of organic waste in the water or excess runoff from fertilised agricultural lands. High concentrations of ammonia can give rise to nitrite that is potentially toxic to infants (DWAF, 1996a). | 0 – 1.0 | Blue<br>**Very good water quality** | No health or aesthetic effects. |
| | 1.0 – 2.0 | Green<br>**Good water quality** | Possible taste and odour complaints. |
| | 2.0 – 10.0 | Yellow<br>**Fair water quality** | Consumer complaints of objectionable taste and odour. Disinfection by chlorine can be compromised. |
| | > 10.0 | Red<br>**Poor water quality** | Danger of formation of nitrite. Chlorination is severely compromised. |
| pH<br>The pH value has a marked effect on the taste of the water and also indicates possible corrosion problems (DWAF, DOH and WRC, 1998). | < 3.0 | Brown<br>**Not acceptable water quality** | Acid burns. |
| | < 4.0 | Red<br>**Poor water quality** | Severe irritation of mucous membranes. |
| | 4.0 – 4.5 | Salmon<br>**Fair water quality** | Irritation of mucous membranes. |
| | 4.5 – 5.0 | Yellow<br>**Good water quality** | Mild irritation of mucous membranes. |
| | 5.0 – 9.5 | Blue<br>**Very good water quality** | No health effects. |
| | 9.5 – 10.0 | Light blue<br>**Good water quality** | Mild irritation of mucous membranes. |
| | 10.0 – 10.5 | Light pink<br>**Fair water quality** | Irritation of mucous membranes. |
| | 10.5 – 11.0 | Pink<br>**Poor water quality** | Severe irritation of mucous membranes. |
| | > 11.0 | Purple<br>**Not acceptable water quality** | Alkali burns. |
| F (mg. $\ell^{-1}$)<br>Fluoride (F) is often elevated in groundwater in hot, arid areas and can cause damage to the skeleton and mark teeth (DWAF, DOH and WRC, 1998). | < 0.7 | Blue<br>**Very good water quality** | No health effects. |
| | 0.7 – 1.0 | Green<br>**Good water quality** | Insignificant health effects on sensitive groups and insignificant tooth staining. |
| | 1.0 – 1.5 | Yellow<br>**Fair water quality** | Increasing effects in sensitive groups and tooth staining. |
| | 1.5 – 3.5 | Red<br>**Poor water quality** | Possible health effects in all individuals and marked tooth staining. |
| | > 3.5 | Purple<br>**Not acceptable water quality** | Increasing risk of skeletal damage. |

* Ammonium guideline only sourced from DWAF (1996a)

Table 3.3 Domestic "Salinity" Set: Constituents of concern and water quality guidelines to assess the suitability for domestic use (DWAF, 1996a and DWAF, DOH and WRC, 1998)

| Constituent | Range | Colour Classification | Suitability for Domestic Use |
|---|---|---|---|
| Ca (mg. $\ell^{-1}$)<br>Calcium can cause scaling in electrical appliances and reduce the lathering properties of soap. | 0 – 80 | Blue<br>**Very good water quality** | No health effects. |
| | 80 – 150 | Green<br>**Good water quality** | Insignificant effects. |
| | 150 – 300 | Yellow<br>**Fair water quality** | Increased effects in sensitive groups only. |
| | > 300 | Red<br>**Poor water quality** | Chronic health effects in sensitive groups only. |
| Mg (mg. $\ell^{-1}$)<br>Magnesium (Mg) affects the taste of water, being bitter at high concentrations (DWAF, DOH and WRC, 1998). | 0 – 70 | Blue<br>**Very good water quality** | No health effects. |
| | 70 – 100 | Green<br>**Good quality water** | Insignificant health effects in sensitive groups only. |
| | 100 – 200 | Yellow<br>**Fair water quality** | Increasing effects in sensitive groups only. |
| | 200- 400 | Red<br>**Poor water quality** | Potential diarrhoea in all new users (some adaptation is possible). |
| | > 400 | Purple<br>**Not acceptable water quality** | Diarrhoea in all individuals. |
| $SO_4$ (mg. $\ell^{-1}$)<br>Sulphate is particularly common in mining areas and may cause diarrhoea, particularly in users not accustomed to drinking water with high sulphate levels (DWAF, DOH and WRC, 1998). It also affects the taste of the water. | 0 – 200 | Blue<br>**Very good water quality** | No health effects. |
| | 200 – 400 | Green<br>**Good water quality** | Insignificant health effects. |
| | 400 – 600 | Yellow<br>**Fair water quality** | Slight chance of diarrhoea in sensitive groups, but disappears with adaptation. |
| | 600 – 1000 | Red<br>**Poor water quality** | Possibility of diarrhoea. Poor adaptation in sensitive individuals. |
| | > 1000 | Purple<br>**Not acceptable water quality** | High chance of diarrhoea. No adaptation. |
| Cl (mg. $\ell^{-1}$)<br>Chloride is often elevated in hot, arid areas and may cause nausea and vomiting at very high concentrations (DWAF, DOH and WRC, 1998). It also affects the taste of water at higher concentrations. | 0 – 100 | Blue<br>**Very good water quality** | No health effects. |
| | 100 – 200 | Green<br>**Good water quality** | Insignificant health effects. |
| | 200 – 600 | Yellow<br>**Fair water quality** | Increasing health risk to sensitive groups. |
| | 600 – 1200 | Red<br>**Poor water quality** | Possible long-term health effects. |
| | > 1200 | Purple<br>**Not acceptable water quality** | Dehydration in infants, nausea and vomiting. |
| Na (mg. $\ell^{-1}$)<br>Sodium affects the taste of water. | 0 – 100 | Blue<br>**Very good water quality** | Negligible health effects. |
| | 100 – 200 | Green<br>**Good water quality** | Insignificant health effects. |
| | 200 – 400 | Yellow<br>**Fair water quality** | Slight risk to some sensitive groups. |
| | 400 – 1000 | Red<br>**Poor water quality** | Possible health risk, particularly in sensitive groups. |
| | > 1000 | Purple<br>**Not acceptable water quality** | Definite health risk. |
| K (mg. $\ell^{-1}$)<br>Potassium affects the taste of water and may also be bitter at high concentrations (DWAF, DOH and WRC, 1998). | 0 – 25 | Blue<br>**Very good water quality** | Negligible health effects. |
| | 25 – 50 | Green<br>**Good water quality** | Insignificant health effects. |
| | 50 – 100 | Yellow<br>**Fair water quality** | Slight risk to some sensitive groups. |
| | 100 – 500 | Red<br>**Poor water quality** | Possible health effects. |
| | > 500 | Purple<br>**Not acceptable water quality** | Definite health risk to all individuals. |

The effects of the different classes of water on irrigated agriculture are listed in Table 3.4.

Table 3.4 Water quality guidelines applicable to the Irrigated Agriculture Use (DWAF, 1996b)

| Constituent | Range | Colour Classification | Suitability for Irrigated Agriculture |
|---|---|---|---|
| SAR<br>The Sodium Adsorption Ratio is an index of the potential of a given irrigation water to induce sodic soil conditions. Negative effects associated with soil sodicity include: reduced crop yield and quality as a result of sodium uptake through the roots of sodium sensitive plants; and impaired soil physical conditions (reduced soil permeability) (DWAF, 1996b). | ≤ 2.0 TWQR | Blue<br>**Very good water quality** | Should prevent sodium toxicity from developing, provided that water is applied to the soil surface, limiting sodium uptake through the roots. |
| | 2.0 – 8.0 | Green<br>**Good water quality** | The most sodium-sensitive crops absorb toxic levels of sodium through roots. Crops vary in sensitivity. |
| | 8.0 – 15.0 | Yellow<br>**Fair water quality** | Sodium-sensitive crops absorb toxic levels of sodium through roots. Crops vary in sensitivity. |
| | > 15.0 | Red<br>**Poor water quality** | All sodium-sensitive crops absorb toxic levels of sodium through root uptake. A number of economically important crops can be irrigated without sodium toxicity developing. |
| EC ($mS.m^{-1}$)<br>Electrical Conductivity is increased when increasing levels of salt are present in the irrigation water, which introduces salt into the soil profile. When little or no leaching of the salt takes place from the soil profile, salt accumulates and saline soil is formed (DWAF, 1996b). Yield is reduced in crops that are sensitive to soil salinity. | ≤ 40 TWQR | Blue<br>**Very good water quality** | Should ensure that salt-sensitive crops can be grown without yield decreases when using low frequency irrigation systems. |
| | 40 – 90 | Green<br>**Good water quality** | A 95% relative yield of moderately salt-sensitive crops can be maintained by using a low frequency irrigation system. |
| | 90 – 270 | Yellow<br>**Fair water quality** | A 90 % relative yield of moderately salt-tolerant crops can be maintained by using a low frequency irrigation system. |
| | 270 – 540 | Red<br>**Poor water quality** | An 80 % relative yield of moderately salt-tolerant crops can be maintained by using a low frequency irrigation system. |
| | > 540 | Purple<br>**Not acceptable water quality** | These waters can still be used for irrigation of selected crops provided sound irrigation management is practised and yield decreases are acceptable. |
| pH<br>The pH value of water does not have direct consequences except at the extremes (DWAF, 1996b). The adverse effects of pH result from the solubilisation of toxic heavy metals and the protonation or deprotonation of other ions. | < 6.5 | Red<br>**Not Very good water quality (acid)** | Increasing problems with foliar damage. |
| | 6.5 – 8.4 TWQR | Blue<br>**Very good water quality** | Should not cause foliar damage |
| | > 8.4 | Purple<br>**Not Very good water quality (alkali)** | Increasing problems with foliar damage |
| Cl ($mg.\ell^{-1}$)<br>Chloride is an essential plant micronutrient and is relatively non-toxic to most crops (DWAF, 1996b). However, when the accumulated chloride concentration in leaves exceeds the crop's tolerance, injury symptoms develop in the form of leaf burn that affect crop production (DWAF, 1996b). | < 100 TWQR | Blue<br>**Very good water quality** | Should prevent accumulation of chloride to toxic levels in all but the most sensitive plants. |
| | 100 – 175 | Green<br>**Good water quality** | Crops sensitive to foliar absorption accumulate toxic levels of chloride when foliage is wetted. |
| | 175 – 350 | Yellow<br>**Fair water quality** | Crops moderately sensitive to foliar absorption accumulate toxic levels of chloride when foliage is wetted. |
| | 350 – 700 | Red<br>**Poor water quality** | Crops moderately sensitive to foliar absorption increasingly accumulate toxic levels of chloride when foliage is wetted. |
| | > 700 | Purple<br>**Not acceptable water quality** | Crops tolerant to foliar absorption increasingly accumulate toxic levels of chloride when foliage is wetted. |
| B ($mg.\ell^{-1}$)<br>Boron is an essential plant nutrient that is toxic to plant growth at low concentrations (DWAF, 1996b). Boron tends to be found in association with saline conditions. | < 0.5 TWQR | Blue<br>**Very good water quality** | Should prevent accumulation of boron to toxic levels (through root uptake) in all but the most sensitive plants. |
| | 0.5 – 1.0 | Green<br>**Good water quality** | Crops very sensitive to boron accumulate toxic levels (through root uptake). Plants start to display symptoms of foliar injury and/or yield decreases. |
| | 1.0 – 2.0 | Yellow<br>**Fair water quality** | Crops sensitive to boron accumulate toxic levels and start to display foliar injury and/or yield decreases. |
| | 2.0 – 4.0 | Red<br>**Poor water quality** | Crops moderately sensitive to boron accumulate toxic levels and start to display foliar injury and/or yield decreases. |
| | > 4.0 | Purple<br>**Not acceptable water quality** | Crops moderately tolerant to boron accumulate toxic levels and start to display foliar injury and/or yield decreases. |

## 3.2 Land Cover

Land cover and land use is known to affect water quality. The human activities conducted on land adjacent to rivers and water bodies have an impact on the water quality in a number of ways. Disturbing the land cover may result in erosion and, therefore, increase turbidity, the discharge of treated and untreated wastes into rivers increases the nutrient and ammonia levels, and the diffuse release of excess fertilisers applied to agricultural fields entering rivers and water bodies affects the nutrient balance, amongst other impacts. The geology and natural plant growth also have an impact on water quality and may result in elevated levels of various constituents even in the absence of disturbance by human intervention.

A vast range of land cover types is evident over South Africa (Map 1 and Table 3.5). This would lead one to believe that the water quality would also reflect this complexity by exhibiting a range of specific water quality problems and characteristics. Appendix 8.2 presents the four most dominant (by aerial extent) land cover types in each of the 19 Water Management Areas (WMAs). This information may be of interest to certain readers of this report.

The land cover types reflected in Map 1, Table 3.5 and Appendix 8.2 are extensive and certain effects can be expected of various land cover and land use types. For example:

- Mining and quarries can be expected to be associated with deterioration in water quality due to the exposure of elements previously covered by soil or deep underground to rainfall and runoff. Specific types of mining would be expected to be associated with elevated levels of specific water quality constituents, such as sulphate in the case of coal mining.
- Cultivated lands can also be expected to be associated with specific water quality perturbations, such as: increased turbidity due to increased soil erosion of exposed land; and increased nutrient and salt concentrations due to return flows of fertiliser-carrying irrigation water. If herbicides and pesticides were used, then these could also be expected to make their way into water courses after rain or irrigation events (these substances are not included in this study).
- Various types of degraded lands are often a result of unsustainable human and livestock pressure on the land, with associated increases in turbidity due to the surface cover being removed and then rainfall and runoff carrying the soil to the nearest water course.
- Urban or built-up areas are often associated with increased levels of nutrients and other pollutants.
- Bush, shrub, herb, forest and grassland, if natural and undisturbed, would not be expected to be a reason for water quality perturbations since the vegetation cover should shield the soil from the erosive effects of rainfall and the ground cover should also protect the soil surface.
- Plantations may be associated with higher levels of nutrients if the plantations are fertilised and also higher turbidity levels since there is implicit disturbance in the planting, tending and harvesting of plantations.

The land cover in the vicinity of each sample site (based on Map 1) is presented in Table 3.5.

Map 1 Land cover of South Africa (after Fairbanks *et al.,* 2000)

Table 3.5 List of land cover in the vicinity of national assessment sample sites selected, grouped per WMA

| No. | Sample Site Number | Location of the Site | Land Cover in the Vicinity of the Site |
|---|---|---|---|
| Limpopo WMA | | | |
| 9 | A4H013Q01 | Mokolo River at Moorddrift/Vught | Bush and Forest |
| 10 | A5H006Q01 | Limpopo River at Botswana/Sterkloop | Bush and Degraded land |
| 11 | A5H008Q01 | Palala River at Ga-Seleka/Bosche Diesch | Bush |
| 12 | A7H001Q01 | Sand River at Waterpoort | Bush and Forest |
| Luvuvhu and Letaba WMA | | | |
| 13 | A9H011Q01 | Luvuvhu River at Pafuri/Kruger National Park | Forest |
| 14 | A9H012Q01 | Luvuvhu River at Mhinga | Cultivated land and Forest |
| 15 | B8H008Q01 | Great Letaba River at Letaba Ranch | Forest and Cultivated land and Bush |
| 16 | B9H003Q01 | Shingwidzi River at Kanniedood Dam/Kruger National Park | Bush |
| Crocodile (West) and Marico WMA | | | |
| 1 | A2H019Q01 | Roodekopjes Dam on Crocodile River: Down Stream Weir | Bush and Cultivated land |
| 2 | A2H021Q01 | Pienaars River at Buffelspoort | Forest and Cultivated land |
| 3 | A2H059Q01 | Crocodile River at Vaalkop/Atlanta | Bush and Cultivated land |
| 4 | A2H094Q01 | Bospoort Dam on Hex River: Down Stream Weir | Bush |
| 5 | A2H111Q01 | Vaalkop Dam on Elands River: Down Stream Weir | Bush |
| 6 | A2H116Q01 | Paul Hugo Dam on Crocodile River: Down Stream Weir | Cultivated land and Bush |
| 7 | A3R003Q01 | Kromellenboog Dam on Little Marico River: Near Dam Wall | Bush and Cultivated land |
| 8 | A3R004Q01 | Molatedi Dam on Great Marico River: Near Dam Wall | Bush and Degraded land |
| Olifants WMA | | | |
| 17 | B1H010Q01 | Witbank Dam on Olifants River: Down Stream Weir | Grass, Cultivated land, Urban and Mining |
| 18 | B1H015Q01 | Middelburg Dam on Little Olifants River: Down Stream Weir | Grass, Cultivated land and Urban |
| 19 | B2H015Q01 | Wilge River at Zusterstroom | Grass, Cultivated land and Urban |
| 20 | B3H001Q01 | Olifants River at Loskop North | Degraded land and Cultivated land |
| 21 | B3H021Q01 | Elands River at Scherp Arabie | Cultivated land and Forest |
| 22 | B4H011Q01 | Steelpoort River at Alverton | Bush and Cultivated land |
| 23 | B6H004Q01 | Blyde River at Chester | Bush and Cultivated land |
| 24 | B7H009Q01 | Olifants River at Finale/Liverpool | Cultivated land, Degraded land and Bush |
| Inkomati WMA | | | |
| 150 | X1H003Q01 | Komati River at Tonga | Forest and Cultivated land |
| 151 | X1H014Q01 | Mlumati River at Lomati | Forest, Plantation and Cultivated land |
| 152 | X2H013Q01 | Krokodil River at Montrose | Plantation |
| 153 | X2H016Q01 | Krokodil River at Tenbosch/Kruger National Park | Cultivated land and Forest |
| 154 | X2H022Q01 | Kaap River at Dolton | Bush, Cultivated land and Plantation |
| 155 | X2H032Q01 | Krokodil River at Weltevrede | Bush and Cultivated land |
| 156 | X3H008Q01 | Sand River at Exeter | Forest, Bush and Degraded land |
| Usutu to Mhlatuze WMA | | | |
| 143 | W1R004Q01 | Lake Msingazi at Arboretum | Cultivated land and Plantation |
| 144 | W2H005Q01 | White Mfolozi River at Overvloed/Ulundi | Bush, Grass and Degraded land |
| 145 | W3H015Q01 | Hluhluwe River at Valsbaai/St Lucia Inflow | Bush, Plantation and Cultivated land |
| 146 | W4H004Q01 | Bivane River at Welgelegen/Pivaansbad | Grass and Plantation |
| 147 | W4H006Q01 | Phongolo River at M'Hlati | Forest and Cultivated land |
| 148 | W4H009Q01 | Phongolo River at Ndume Game Reserve | Forest, Bush and Cultivated land |
| 149 | W5H022Q01 | Assegaai River at Zandbank | Grass and Plantation |
| Thukela WMA | | | |
| 135 | V1H001Q01 | Tugela River at Tugela Drift/Colenso | Grass and Bush |
| 136 | V1H010Q01 | Little Tugela River at Winterton | Cultivated land and Grass |

| No. | Sample Site Number | Location of the Site | Land Cover in the Vicinity of the Site |
|---|---|---|---|
| 137 | V1H038Q01 | Klip River at Ladysmith Townlands/Army Camp | Grass, Urban and Bush |
| 138 | V2H008Q01 | Mooi River at Keate's Drift | Grass, Cultivated land and Degraded land |
| 139 | V3H010Q01 | Buffalo River at Tayside | Grass, Cultivated land and Plantation |
| 140 | V5H002Q01 | Tugela River at Mandini | Cultivated land, Bush and Grass |
| 141 | V6H002Q01 | Tugela River at Tugela Ferry | Grass, Cultivated land and Degraded land |
| 142 | V7H012Q01 | Little Boesmans River at Estcourt | Grass and Bush |
| Upper Vaal WMA | | | |
| 25 | C1H002Q01 | Klip River at Sterkfontein/Delangesdrift | Grass and Cultivated land |
| 26 | C1H017Q01 | Vaal River at Villiers (Flood Section) | Cultivated land and Grass |
| 27 | C2H004Q01 | Suikerbosrand River at Uitvlugt (RW S2) | Cultivated land, Grass and Urban |
| 28 | C2H005Q01 | Riet Spruit at Kaal Plaats (RW RV2) | Cultivated land, Urban and Grass |
| 29 | C2H071Q01 | Klip River at Kookfontein/Vereeniging Rail Bridge | Cultivated land and Urban |
| 30 | C2H085Q01 | Mooi River at Hoogekraal/Kromdraai | Cultivated land and Grass |
| 31 | C8H001Q01 | Wilge River at Frankfort | Grass and Cultivated land |
| 32 | C8H027Q01 | Wilge River at Ballingtomp | Grass and Cultivated land |
| Middle Vaal WMA | | | |
| 33 | C2H007Q01 | Vaal River at Pilgrims Estate/Orkney | Cultivated land and Grass |
| 34 | C2H073Q01 | Skoon Spruit at Goedgenoeg/Orkney Bridge | Grass and Urban |
| 35 | C4H004Q01 | Vet River at Fizantkraal/Nooitgedacht | Cultivated land and Grass |
| 36 | C4R001Q01 | Allemanskraal Dam on Sand River: Near Dam Wall | Grass, Cultivated land and Bush |
| 37 | C4R002Q01 | Erfenis Dam on Great Vet River: Near Dam Wall | Cultivated land and Grass |
| 38 | C6H003Q01 | Vals River at Mooifontein/Bothaville | Cultivated land, Grass and Urban |
| 39 | C7H006Q01 | Renoster River at Arriesrust | Cultivated land and Grass |
| Lower Vaal WMA | | | |
| | | No sites met the selection criteria | |
| Mvoti to Umzimkulu WMA | | | |
| 123 | T5H007Q01 | Mzimkulu River at Bezweni/Island View | Cultivated land, Grass, Plantation and Degraded land |
| 124 | U1H006Q01 | Mkomazi River at Delos Estate | Bush and Cultivated land |
| 125 | U2H001Q01 | Mgeni River at Howick | Cultivated land, Grass, Plantation and Urban |
| 126 | U2H006Q01 | Karkloof River at Shafton | Cultivated land, Grass and Plantation |
| 127 | U2H011Q01 | Msunduze River at Henley Dam | Grass and Cultivated land |
| 128 | U2H014Q01 | Albert Falls Dam on Mgeni River: Down Stream Weir | Cultivated land and Grass |
| 129 | U2H022Q01 | Msunduze River at Inanda/Nomfihlelo | Grass, Bush and Cultivated land |
| 130 | U2H041Q01 | Msunduze River at Hampstead Park/Moto-X (Darville) | Grass and Urban |
| 131 | U2H043Q01 | Mgeni River at Inanda/Mgeni Confluence (Mngs) | Grass, Cultivated land and Degraded land |
| 132 | U3H005Q01 | Hazelmere Dam on Mdloti River: Down Stream Weir (Hmro) | Cultivated land and Urban |
| 133 | U4H008Q01 | Canal (Left) from Mvoti River at Hlazane/Glendal | Cultivated land and Bush |
| 134 | U8H003Q01 | Mpambanyoni River at Umbeli Belli | Cultivated land and Bush |
| Mzimvubu to Keiskamma WMA | | | |
| 107 | R1H015Q01 | Keiskamma River at Farm 7/Howard Shaw Bridge | Bush and Grass |
| 108 | R2R003Q01 | Bridle Drift Dam on Buffalo River: Near Dam Wall | Shrub and Bush |
| 109 | R3H001Q01 | Gqunube River at Outspan | Bush and Grass |
| 110 | R3H003Q01 | Nahoon Dam on Nahoon River: Down Stream Weir | Bush, Urban and Grass |
| 111 | R3H004Q01 | Nahoon Dam on Nahoon River: Pipe to Purification Works | Grass and Bush |
| 112 | S1R001Q01 | Xonxa Dam on White Kei River: Near Dam Wall | Grass, Bush, Cultivated land and Degraded land |
| 113 | S3H006Q01 | Klaas Smits River at Weltevreden/Queenstown | Grass, Bush and Degraded land |
| 114 | S5H002Q01 | Tsomo River at Wyk Maduma/Tsomo | Degraded land, Cultivated land and Grass |
| 115 | S7H001Q01 | Gcuwa River at Butterworth | Bush, Grass and Degraded land |
| 116 | S7H004Q01 | Great Kei River at Area 8 Sprigs B/Transkei Border | Bush and Grass |
| 117 | T1H004Q01 | Bashee River at Bashee Bridge | Degraded land and Cultivated land |
| 118 | T3H004Q01 | Mzintlana River at Slangfontein/Kokstad | Grass and Cultivated land |

| No. | Sample Site Number | Location of the Site | Land Cover in the Vicinity of the Site |
|---|---|---|---|
| 119 | T3H005Q01 | Tina River at Mahlungulu | Degraded land and Cultivated land |
| 120 | T3H006Q01 | Tsitsa River at Xonkonxa/Tsitsa Bridge | Degraded land, Cultivated land and Grass |
| 121 | T3H008Q01 | Mzimvubu River at Kromdraai/Inungi | Grass, Cultivated land and Degraded land |
| 122 | T7H001Q01 | Mngazi River at Mgwenyana 22/Mngazi | Grass, Cultivated land and Degraded land |
| Upper Orange WMA | | | |
| 40 | D1H001Q01 | Wonderboom/Stormboom Spruit at Diepkloof/Burgersdorp | Shrub and Bush |
| 41 | D1H003Q01 | Orange River at Aliwal North | Grass, Cultivated land and Shrub |
| 42 | D1H005Q01 | Orange River at White Hill (Lesotho G4) | Grass |
| 43 | D1H006Q01 | Kornet Spruit at Maghaleen | Grass and Cultivated land |
| 44 | D1H009Q01 | Orange River at Oranjedraai | Grass, Cultivated land and Degraded land |
| 45 | D1H011Q01 | Kraai River at Roodewal | Grass and Cultivated land |
| 46 | D2H012Q01 | Little Caledon river at the Poplars | Cultivated land and Grass |
| 47 | D2H036Q01 | Caledon River at Kommissiedrift | Shrub, Grass and Cultivated land |
| 48 | D2R004Q01 | Welbedacht Dam on Caledon river: Near Dam Wall | Grass and Cultivated land |
| 49 | D3H013Q01 | Orange River at Roodepoort | Shrub and Bush |
| 50 | D3R003Q01 | Vanderkloof Dam on Orange River: Near Dam Wall | Shrub and Cultivated land |
| Lower Orange WMA | | | |
| 51 | D3H008Q01 | Orange River at Marksdrift | Shrub, Bush and Cultivated land |
| 52 | D5H021Q01 | Sak River at De Kruis/Williston | Shrub |
| 53 | D7H008Q01 | Orange River at Boegoeberg Reserve/Zeekoebaart | Shrub, Bush and Cultivated land |
| 54 | D7H015Q01 | South Canal from Orange River at Kakamas/Neusberg | Shrub, Bush and Cultivated land |
| 55 | D8H003Q01 | Orange River at Vioolsdrift | Herb |
| 56 | D8H008Q01 | Orange River at Pella Mission | Shrub and Grass |
| Fish to Tsitsikamma WMA | | | |
| 81 | K8H001Q01 | Kruis River at Farm 508 Pineview | Cultivated land and Bush |
| 82 | K8H002Q01 | Elands River at Kwaai Brand Forest Reserve/Witelbos | Cultivated land, Bush and Urban |
| 83 | L3R001Q01 | Beervlei Dam at Windheuvel | Shrub and Degraded land |
| 84 | L6H001Q01 | Heuningklip River at Campherspoort | Shrub and Bush |
| 85 | L7H006Q01 | Groot River at Grootrivierspoort | Shrub, Bush and Cultivated land |
| 86 | L8H005Q01 | Kouga River at Stuurmanskraal | Shrub, Bush and Cultivated land |
| 87 | N1H013Q01 | Mackiesputs Eye at Graaf-Reinet/Van Reyneveldspas | Bush, Grass, Urban and Cultivated land |
| 88 | N2H007Q01 | Sundays River at De Draay | Shrub |
| 89 | N3H002Q01 | Voël River at Rietvley | Shrub and Bush |
| 90 | N4H003Q01 | Sundays River at Addo Drift East/Addo Bridge | Bush, Shrub and Cultivated land |
| 91 | P1H003Q01 | Boesmans River at Donkerhoek/Alicedale | Bush, Grass, Shrub and Cultivated land |
| 92 | P3H001Q01 | Kariega River at Smithfield/Lower Waterford | Bush, Grass and Forest |
| 93 | P4H001Q01 | Kowie River at Bathurst/Wolfscrag | Bush, Grass and Cultivated land |
| 94 | Q1H012Q01 | Teebus River at Jan Blaauws Kop/Beaconsfield | Shrub and Cultivated land |
| 95 | Q1H017Q01 | Right Canal from Great Fish River at Katkop/Zoutpansdrift | Shrub and Cultivated land |
| 96 | Q1H022Q01 | Grassridge Dam on Great Brak River – Outlet to River | Shrub and Cultivated land |
| 97 | Q2H002Q01 | Great Fish River at Zoutpansdrift | Shrub and Cultivated land |
| 98 | Q4H013Q01 | Tarka River at Bridge Farm/Tarka Bridge (New Weir) | Shrub, Grass and Cultivated land |
| 99 | Q4R002Q01 | Kommandodrift Dam on Tarka River at Kommandodrift | Shrub |
| 100 | Q6H003Q01 | Baviaans River at Botmansgat/De Klerkdal | Shrub, Bush and Cultivated land |
| 101 | Q7H003Q01 | Great Fish River at Leeuwe Drift | Shrub, Cultivated land and Forest |
| 102 | Q8H011Q01 | Little Fish River at Rietfontein/Junction Drift | Shrub and Bush |
| 103 | Q9H001Q01 | Great Fish River at Fort Brown Peninsula | Bush and Shrub |
| 104 | Q9H002Q01 | Koonap River at Adelaide | Bush and Shrub |
| 105 | Q9H018Q01 | Great Fish River at Matomela's Reserve/Outspan | Shrub, Bush and Cultivated land |
| 106 | Q9H029Q01 | Kat River at Fort Beaufort | Bush, Degraded land and Cultivated land |
| Gouritz WMA | | | |

| No. | Sample Site Number | Location of the Site | Land Cover in the Vicinity of the Site |
|---|---|---|---|
| 68 | H8H001Q01 | Duiwenhoks River at Dassjes Klip | Shrub and Cultivated land |
| 69 | H9H005Q01 | Goukou River at Farm 216 (SWQ 4A-11) D/S River | Cultivated land |
| 70 | J1H019Q01 | Groot River at Buffelsfontein/Van Wyksdorp | Shrub |
| 71 | J2H010Q01 | Gamka River at Huisrivier | Shrub, Bush and Cultivated land |
| 72 | J2H016Q01 | Gamkapoort Dam on Gamka River: Down Stream Weir | Shrub and Bush |
| 73 | J2R004Q01 | Gamka Dam on Gamka River: Near Dam Wall | Shrub |
| 74 | J3H011Q01 | Olifants River at Warm Water | Shrub, Cultivated land and Plantation |
| 75 | K1H005Q01 | Moordkuil River at Banff | Shrub, Cultivated land and Plantation |
| 76 | K2H004Q01 | Great Brak River at Vishoek | Shrub |
| 77 | K3H001Q01 | Kaaimans River at Upper Barbiers Kraal | Bush and Plantation |
| 78 | K3H003Q01 | Maalgate River at Knoetze Kama/Buffelsdrift | Cultivated land, Shrub and Bush |
| 79 | K4R002Q01 | Swart Vlei at Ronde Valley/Hoogekraal | Bush, Plantation and Cultivated land |
| 80 | K7H001Q01 | Bloukrans River at Lottering Forest Reserve | Forest, Plantation and Bush |
| Olifants/Doorn WMA | | | |
| 57 | E1R001Q01 | Bulshoek Dam on Olifants River: Near Dam Wall | Shrub and Cultivated land |
| 58 | E2H002Q01 | Doring River at Elands Drift/Aspoort | Shrub |
| 59 | E2H003Q01 | Doring River at Melkboom | Shrub, Cultivated land and Bush |
| Breede WMA | | | |
| 63 | G4H007Q01 | Palmiet River at Farm 562- Welgemoed/Kleinmond | Shrub and Herb |
| 64 | H4H024Q01 | Robertson Canal from Bree River at De Goree | Shrub and Cultivated land |
| 65 | H5H005Q01 | Bree River at Wagenboomsheuvel/Drew | Cultivated land and Shrub |
| 66 | H6H009Q01 | Riviersonderend at Reenen | Cultivated land and Shrub |
| 67 | H7H006Q01 | Bree River at Swellendam | Cultivated land and Shrub |
| Berg WMA | | | |
| 60 | G1H031Q01 | Berg River at Misverstand/Die Brug | Cultivated land |
| 61 | G1H036Q01 | Berg River at Vleesbank/Hermon Bridge | Cultivated land and Shrub |
| 62 | G2H015Q01 | Eerste River at Faure | Cultivated land, Urban and Shrub |

## 3.3 Data Collection and Availability

The water quality data that were used in the assessment of the fitness for use of South Africa's surface water resources for domestic and irrigated agricultural use were collected as part of the so-called National Chemical or Salinity Monitoring Programme. This programme has been in operation since the early 1970's and samples are regularly collected at approximately 1 600 monitoring stations at a frequency that varies from weekly to monthly sampling. The samples collected for this programme are analysed at the laboratories of the Institute for Water Quality Studies and the data is stored on DWAF's database, namely, the Water Management System (WMS).

The number of sample records per sample site for the study period (1996 to 2000) is presented in Table 3.6. The value is based on the number of Total Dissolved Salts (TDS - which is approximately equivalent to Dissolved Major Salts "DMS" in WMS terminology) results per sample site over the review period of five years. There is some variability as regards the number of records for other constituents, but TDS was considered to be an adequate indicator of the availability of data per sample site.

### 3.3.1 Trophic status

The only information that was available from other projects covering a national scale was that of the Trophic Status Project (van Ginkel *et al.,* 2001). The Trophic Status Project (TSP) considered the trophic status of selected impoundments across South Africa, specifically those impoundments managed by DWAF.

The trophic status of an impoundment refers to its level of enrichment with plant nutrients (van Ginkel *et al.,* 2001), that is, how productive the system is. An impoundment may be described as being *oligotrophic* (low productivity), *mesotrophic* (moderate productivity), or *eutrophic* (very productive).

The relative desirability of the various trophic status classes is influenced by the intended use of the impoundment. From a water resources perspective, the *oligotrophic* state is most desirable since it reflects the cleanest water (requiring the lowest level of purification so that it is suitable for domestic use). At the opposite end of the spectrum, the water in a *eutrophic* impoundment is the least desirable from a domestic use perspective because it will need a much higher level of purification before it is suitable for drinking purposes. The *mesotrophic* state is situated between the two extremes.

The study conducted by van Ginkel *et al.* (2001) included the following impoundments across the country, subdivided into the following WMAs:

***The Luvuvhu and Letaba WMA***

- the Ebenezer Dam; Magoebaskloof Dam and Tzaneen Dam.

***The Crocodile (West) and Marico WMA***

- the Bon Accord Dam; Buffelspoort Dam; Hartbeespoort Dam; Klipvoor Dam; Kosterrivier Dam; Lindleyspoort Dam; Rietvlei Dam; Roodekopjes Dam; Roodeplaat Dam and Vaalkop Dam.

***The Olifants WMA***

- the Bronkhorstspruit Dam; Loskop Dam; Middelburg Dam and Witbank Dam.

***The Usutu to Mhlatuze WMA***

- the Klipfontein Dam.

***The Upper, Middle and Lower Vaal WMAs***

- the Allemanskraal Dam; Bloemhof Dam; Boskop Dam; Erfenis Dam; Grootdraai Dam; Koppies Dam; Sterkfontein Dam and Vaal Dam.

***The Mvoti to Umzimkulu WMA***

- the Albert Falls Dam; Inanda Dam; Midmar Dam; Nagle Dam; Hazelmere Dam and Shongweni Dam.

***The Mzimvubu to Keiskamma WMA***

- the Bridledrift Dam and Laing Dam.

***The Upper and Lower Orange WMAs***

- the Gariep Dam; Cook's Lake; Disaneng Dam; Lotlamoreng Dam and Setumo Dam.

***The Fish to Tsitsikamma WMA***

- the Bo-Lang Vlei; Groen Vlei; Onder-Lang Vlei; Ronde Vlei; Sedgefield Lagoon; Swart Vlei and Wilderness Lagoon.

***The Berg WMA***

- the Misverstand Weir; Voëlvlei Dam and Wemmershoek Dam.

The assessment of the trophic status at each of these impoundments is presented later in the report (Section 4.4).

## 3.4 Sample Site Selection

To simplify the assessment and to present the information in such a way that it would be useful for water resource management purposes, data from suitable sampling sites were selected from each of the 19 Water Management Areas (WMAs).

As far as sample site selection for this report is concerned, two levels of sampling sites were selected from the chemical water quality database, namely:

- a national level sample site set
- a more comprehensive site set selected for each WMA.

The WMAs are (see Map 2):

1. the Limpopo,
2. the Luvuvhu and Letaba,
3. the Crocodile (West) and Marico,
4. the Olifants,
5. the Inkomati,
6. the Usutu to Mhlatuze,
7. the Thukela,
8. the Upper Vaal,
9. the Middle Vaal,
10. the Lower Vaal,
11. the Mvoti to Umzimkulu,
12. the Mzimvubu to Keiskamma,
13. the Upper Orange,
14. the Lower Orange,
15. the Fish to Tsitsikamma,
16. the Gouritz,
17. the Olifants/Doorn,
18. the Breede, and
19. the Berg WMA.

The rationale behind the sample site selection was based on the overall sample site selected for a national assessment of surface chemical water quality, with the addition of all other suitable water quality sample sites within the various WMAs. A suitable water quality sample site is considered to be one with an adequate level of sampling (not too infrequent or sparse) over the chosen study period. An adequate and regular frequency of samples is necessary to ensure that

the statistical analyses of the data set provide results that are representative of the study period. The selection of suitable sample sites is a qualitative process.

Since the intention is to make the best use of the available data, sample site selection may be more rigorous in those WMAs with a large number of frequently sampled sites than those WMAs that do not have a high density of sample sites with regular samples having been taken.

**For the national assessment:**

For the national assessment, a sample site is selected for each tertiary drainage region, ideally as close to the outflow point of the tertiary drainage region as possible, as a descriptor of the water quality within that drainage region. In those cases where no suitable site exists, the next closest site with a suitable data record is selected.

**For the WMA-level assessment:**

For the WMA-level assessment, sample sites in the national assessment sample site set are used together with additional sites with sufficient data throughout each tertiary drainage region in order to better be able to link land use types and activities with the water quality sampled in the rivers.

Map 2 presents the location of the national assessment sample sites as listed in Table 3.6.

Table 3.6 contains a list of all of the sample sites selected for the national assessment of chemical surface water quality. Both the WMS code and the older DWAF sample site number of each site are given. Refer to Map 2 for the geographical location of the sample sites throughout the country. The number in the first column in Table 3.6 corresponds with the sample site number on Map 2.

Map 2 The location of the national assessment sample sites

Table 3.6 List of national assessment sample sites selected grouped per WMA

| No. | WMS Code | Sample Site Number | No. of Records | Location of the Site |
|---|---|---|---|---|
| Limpopo WMA | | | | |
| 9 | 90334 | A4H013Q01 | 88 | Mokolo River at Moorddrift/Vught |
| 10 | 90340 | A5H006Q01 | 42 | Limpopo River at Botswana/Sterkloop |
| 11 | 90341 | A5H008Q01 | 55 | Palala River at Ga-Seleka/Bosche Diesch |
| 12 | 90370 | A7H001Q01 | 51 | Sand River at Waterpoort |
| Luvuvhu and Letaba WMA | | | | |
| 13 | 90398 | A9H011Q01 | 103 | Luvuvhu River at Pafuri/Kruger National Park |
| 14 | 90399 | A9H012Q01 | 128 | Luvuvhu River at Mhinga |
| 15 | 90524 | B8H008Q01 | 112 | Great Letaba River at Letaba Ranch |
| 16 | 90583 | B9H003Q01 | 110 | Shingwidzi River at Kanniedood Dam/Kruger National Park |
| Crocodile (West) and Marico WMA | | | | |
| 1 | 90167 | A2H019Q01 | 133 | Roodekopjes Dam on Crocodile River: Down Stream Weir |
| 2 | 90168 | A2H021Q01 | 131 | Pienaars River at Buffelspoort |
| 3 | 90203 | A2H059Q01 | 255 | Crocodile River at Vaalkop/Atlanta |
| 4 | 90220 | A2H094Q01 | 46 | Bospoort Dam on Hex River: Down Stream Weir |
| 5 | 90230 | A2H111Q01 | 126 | Vaalkop Dam on Elands River: Down Stream Weir |
| 6 | 90233 | A2H116Q01 | 128 | Paul Hugo Dam on Crocodile River: Down Stream Weir |
| 7 | 90325 | A3R003Q01 | 32 | Kromellenboog Dam on Little Marico River: Near Dam Wall |
| 8 | 90326 | A3R004Q01 | 52 | Molatedi Dam on Great Marico River: Near Dam Wall |
| Olifants WMA | | | | |
| 17 | 90412 | B1H010Q01 | 227 | Witbank Dam on Olifants River: Down Stream Weir |
| 18 | 90414 | B1H015Q01 | 218 | Middelburg Dam on Little Olifants River: Down Stream Weir |
| 19 | 90442 | B2H015Q01 | 202 | Wilge River at Zusterstroom |
| 20 | 90444 | B3H001Q01 | 196 | Olifants River at Loskop North |
| 21 | 90458 | B3H021Q01 | 114 | Elands River at Scherp Arabie |
| 22 | 90473 | B4H011Q01 | 95 | Steelpoort River at Alverton |
| 23 | 90491 | B6H004Q01 | 122 | Blyde River at Chester |
| 24 | 90506 | B7H009Q01 | 89 | Olifants River at Finale/Liverpool |
| Inkomati WMA | | | | |
| 150 | 102933 | X1H003Q01 | 212 | Komati River at Tonga |
| 151 | 102935 | X1H014Q01 | 79 | Mlumati River at Lomati |
| 152 | 102958 | X2H013Q01 | 95 | Krokodil River at Montrose |
| 153 | 102963 | X2H016Q01 | 293 | Krokodil River at Tenbosch/Kruger National Park |
| 154 | 102965 | X2H022Q01 | 90 | Kaap River at Dolton |
| 155 | 102975 | X2H032Q01 | 182 | Krokodil River at Weltevrede |
| 156 | 103014 | X3H008Q01 | 43 | Sand River at Exeter |
| Usutu to Mhlatuze WMA | | | | |
| 143 | 102832 | W1R004Q01 | 62 | Lake Msingazi at Arboretum |
| 144 | 102834 | W2H005Q01 | 182 | White Mfolozi River at Overvloed/Ulundi |
| 145 | 102871 | W3H015Q01 | 150 | Hluhluwe River at Valsbaai/St Lucia Inflow |
| 146 | 102897 | W4H004Q01 | 55 | Bivane River at Welgelegen/Pivaansbad |
| 147 | 102898 | W4H006Q01 | 49 | Phongolo River at M'Hlati |
| 148 | 102901 | W4H009Q01 | 27 | Phongolo River at Ndume Game Reserve |
| 149 | 102914 | W5H022Q01 | 99 | Assegaai River at Zandbank |
| Thukela WMA | | | | |
| 135 | 102695 | V1H001Q01 | 84 | Tugela River at Tugela Drift/Colenso |
| 136 | 102704 | V1H010Q01 | 58 | Little Tugela River at Winterton |
| 137 | 102718 | V1H038Q01 | 72 | Klip River at Ladysmith Townlands/Army Camp |
| 138 | 102740 | V2H008Q01 | 62 | Mooi River at Keate's Drift |
| 139 | 102755 | V3H010Q01 | 200 | Buffalo River at Tayside |

| No. | WMS Code | Sample Site Number | No. of Records | Location of the Site |
|---|---|---|---|---|
| 140 | 102779 | V5H002Q01 | 79 | Tugela River at Mandini |
| 141 | 102781 | V6H002Q01 | 76 | Tugela River at Tugela Ferry |
| 142 | 102797 | V7H012Q01 | 56 | Little Boesmans River at Estcourt |
| Upper Vaal WMA | | | | |
| 25 | 90585 | C1H002Q01 | 275 | Klip River at Sterkfontein/Delangesdrift |
| 26 | 90597 | C1H017Q01 | 275 | Vaal River at Villiers (Flood Section) |
| 27 | 90615 | C2H004Q01 | 322 | Suikerbosrand River at Uitvlugt (RW S2) |
| 28 | 90616 | C2H005Q01 | 283 | Riet Spruit at Kaal Plaats (RW RV2) |
| 29 | 90654 | C2H071Q01 | 273 | Klip River at Kookfontein/Vereeniging Rail Bridge |
| 30 | 90668 | C2H085Q01 | 308 | Mooi River at Hoogekraal/Kromdraai |
| 31 | 90859 | C8H001Q01 | 279 | Wilge River at Frankfort |
| 32 | 90884 | C8H027Q01 | 273 | Wilge River at Ballingtomp |
| Middle Vaal WMA | | | | |
| 33 | 90618 | C2H007Q01 | 244 | Vaal River at Pilgrims Estate/Orkney |
| 34 | 90656 | C2H073Q01 | 240 | Skoon Spruit at Goedgenoeg/Orkney Bridge |
| 35 | 90795 | C4H004Q01 | 147 | Vet River at Fizantkraal/Nooitgedacht |
| 36 | 90809 | C4R001Q01 | 71 | Allemanskraal Dam on Sand River: Near Dam Wall |
| 37 | 90810 | C4R002Q01 | 87 | Erfenis Dam on Great Vet River: Near Dam Wall |
| 38 | 90847 | C6H003Q01 | 137 | Vals River at Mooifontein/Bothaville |
| 39 | 90853 | C7H006Q01 | 255 | Renoster River at Arriesrust |
| Lower Vaal WMA | | | | |
| No suitable sites were located at the time of sample site selection | | | | |
| Mvoti to Umzimkulu WMA | | | | |
| 123 | 102606 | T5H007Q01 | 38 | Mzimkulu River at Bezweni/Island View |
| 124 | 102620 | U1H006Q01 | 54 | Mkomazi River at Delos Estate |
| 125 | 102621 | U2H001Q01 | N/A | Mgeni River at Howick |
| 126 | 102624 | U2H006Q01 | N/A | Karkloof River at Shafton |
| 127 | 102626 | U2H011Q01 | N/A | Msunduze River at Henley Dam |
| 128 | 102629 | U2H014Q01 | N/A | Albert Falls Dam on Mgeni River: Down Stream Weir |
| 129 | 102632 | U2H022Q01 | N/A | Msunduze River at Inanda/Nomfihlelo |
| 130 | 102651 | U2H041Q01 | N/A | Msunduze River at Hampstead Park/Moto-X (Darville) |
| 131 | 102653 | U2H043Q01 | N/A | Mgeni River at Inanda/Mgeni Confluence (Mngs) |
| 132 | 102675 | U3H005Q01 | N/A | Hazelmere Dam on Mdloti River: Down Stream Weir (Hmro) |
| 133 | 102679 | U4H008Q01 | 194 | Canal (Left) from Mvoti River at Hlazane/Glendal |
| 134 | 102693 | U8H003Q01 | 59 | Mpambanyoni River at Umbeli Belli |
| Mzimvubu to Keiskamma WMA | | | | |
| 107 | 102504 | R1H015Q01 | 78 | Keiskamma River at Farm 7/Howard Shaw Bridge |
| 108 | 102525 | R2R003Q01 | 74 | Bridle Drift Dam on Buffalo River: Near Dam Wall |
| 109 | 102526 | R3H001Q01 | 37 | Gqunube River at Outspan |
| 110 | 102527 | R3H003Q01 | 27 | Nahoon Dam on Nahoon River: Down Stream Weir |
| 111 | 102528 | R3H004Q01 | 53 | Nahoon Dam on Nahoon River: Pipe to Purification Works |
| 112 | 102534 | S1R001Q01 | 16 | Xonxa Dam on White Kei River: Near Dam Wall |
| 113 | 102545 | S3H006Q01 | 52 | Klaas Smits River at Weltevreden/Queenstown |
| 114 | 102553 | S5H002Q01 | 55 | Tsomo River at Wyk Maduma/Tsomo |
| 115 | 102565 | S7H001Q01 | 45 | Gcuwa River at Butterworth |
| 116 | 102568 | S7H004Q01 | 58 | Great Kei River at Area 8 Sprigs B/Transkei Border |
| 117 | 102573 | T1H004Q01 | 34 | Bashee River at Bashee Bridge |
| 118 | 102586 | T3H004Q01 | 58 | Mzintlana River at Slangfontein/Kokstad |
| 119 | 102587 | T3H005Q01 | 46 | Tina River at Mahlungulu |
| 120 | 102588 | T3H006Q01 | 45 | Tsitsa River at Xonkonxa/Tsitsa Bridge |
| 121 | 102590 | T3H008Q01 | 60 | Mzimvubu River at Kromdraai/Inungi |

| No. | WMS Code | Sample Site Number | No. of Records | Location of the Site |
|---|---|---|---|---|
| 122 | 102615 | T7H001Q01 | 40 | Mngazi River at Mgwenyana 22/Mngazi |
| Upper Orange WMA | | | | |
| 40 | 101788 | D1H001Q01 | 151 | Wonderboom/Stormboom Spruit at Diepkloof/Burgersdorp |
| 41 | 101789 | D1H003Q01 | 253 | Orange River at Aliwal North |
| 42 | 101790 | D1H005Q01 | 16 | Orange River at White Hill (Lesotho G4) |
| 43 | 101791 | D1H006Q01 | 127 | Kornet Spruit at Maghaleen |
| 44 | 101793 | D1H009Q01 | 127 | Orange River at Oranjedraai |
| 45 | 101795 | D1H011Q01 | 113 | Kraai River at Roodewal |
| 46 | 101808 | D2H012Q01 | 59 | Little Caledon river at the Poplars |
| 47 | 101816 | D2H036Q01 | 99 | Caledon River at Kommissiedrift |
| 48 | 101820 | D2R004Q01 | 54 | Welbedacht Dam on Caledon river: Near Dam Wall |
| 49 | 101828 | D3H013Q01 | 126 | Orange River at Roodepoort |
| 50 | 101837 | D3R003Q01 | 35 | Vanderkloof Dam on Orange River: Near Dam Wall |
| Lower Orange WMA | | | | |
| 51 | 101824 | D3H008Q01 | 240 | Orange River at Marksdrift |
| 52 | 101869 | D5H021Q01 | 35 | Sak River at De Kruis/Williston |
| 53 | 101878 | D7H008Q01 | 230 | Orange River at Boegoeberg Reserve/Zeekoebaart |
| 54 | 101884 | D7H015Q01 | 200 | South Canal from Orange River at Kakamas/Neusberg |
| 55 | 101888 | D8H003Q01 | 229 | Orange River at Vioolsdrift |
| 56 | 101893 | D8H008Q01 | 234 | Orange River at Pella Mission |
| Fish to Tsitsikamma WMA | | | | |
| 81 | 102313 | K8H001Q01 | 31 | Kruis River at Farm 508 Pineview |
| 82 | 102314 | K8H002Q01 | 35 | Elands River at Kwaai Brand Forest Reserve/Witelbos |
| 83 | 102329 | L3R001Q01 | 64 | Beervlei Dam at Windheuvel |
| 84 | 102349 | L6H001Q01 | 31 | Heuningklip River at Campherspoort |
| 85 | 102353 | L7H006Q01 | 139 | Groot River at Grootrivierspoort |
| 86 | 102358 | L8H005Q01 | 81 | Kouga River at Stuurmanskraal |
| 87 | 102386 | N1H013Q01 | 54 | Mackiesputs Eye at Graaf-Reinet/Van Reyneveldspas |
| 88 | 102392 | N2H007Q01 | 59 | Sundays River at De Draay |
| 89 | 102422 | N3H002Q01 | 73 | Voël River at Rietvley |
| 90 | 102425 | N4H003Q01 | 77 | Sundays River at Addo Drift East/Addo Bridge |
| 91 | 102430 | P1H003Q01 | 110 | Boesmans River at Donkerhoek/Alicedale |
| 92 | 102435 | P3H001Q01 | 99 | Kariega River at Smithfield/Lower Waterford |
| 93 | 102438 | P4H001Q01 | 76 | Kowie River at Bathurst/Wolfscrag |
| 94 | 102440 | Q1H012Q01 | 129 | Teebus River at Jan Blaauws Kop/Beaconsfield |
| 95 | 102443 | Q1H017Q01 | 119 | Right Canal from Great Fish River at Katkop/Zoutpansdrift |
| 96 | 102445 | Q1H022Q01 | 105 | Grassridge Dam on Great Brak River – Outlet to River |
| 97 | 102448 | Q2H002Q01 | 173 | Great Fish River at Zoutpansdrift |
| 98 | 102455 | Q4H013Q01 | 133 | Tarka River at Bridge Farm/Tarka Bridge (New Weir) |
| 99 | 102457 | Q4R002Q01 | 58 | Kommandodrift Dam on Tarka River at Kommandodrift |
| 100 | 102463 | Q6H003Q01 | 219 | Baviaans River at Botmansgat/De Klerkdal |
| 101 | 102464 | Q7H003Q01 | 120 | Great Fish River at Leeuwe Drift |
| 102 | 102475 | Q8H011Q01 | 130 | Little Fish River at Rietfontein/Junction Drift |
| 103 | 102478 | Q9H001Q01 | 123 | Great Fish River at Fort Brown Peninsula |
| 104 | 102479 | Q9H002Q01 | 88 | Koonap River at Adelaide |
| 105 | 102487 | Q9H018Q01 | 137 | Great Fish River at Matomela's Reserve/Outspan |
| 106 | 102496 | Q9H029Q01 | 83 | Kat River at Fort Beaufort |
| Gouritz WMA | | | | |
| 68 | 102123 | H8H001Q01 | 61 | Duiwenhoks River at Dassjes Klip |
| 69 | 102130 | H9H005Q01 | 82 | Goukou River at Farm 216 (SWQ 4A-11) D/S River |
| 70 | 102148 | J1H019Q01 | 83 | Groot River at Buffelsfontein/Van Wyksdorp |

| No. | WMS Code | Sample Site Number | No. of Records | Location of the Site |
|---|---|---|---|---|
| 71 | 102168 | J2H010Q01 | 89 | Gamka River at Huisrivier |
| 72 | 102173 | J2H016Q01 | 37 | Gamkapoort Dam on Gamka River: Down Stream Weir |
| 73 | 102179 | J2R004Q01 | 48 | Gamka Dam on Gamka River: Near Dam Wall |
| 74 | 102183 | J3H011Q01 | 181 | Olifants River at Warm Water |
| 75 | 102207 | K1H005Q01 | 64 | Moordkuil River at Banff |
| 76 | 102243 | K2H004Q01 | 58 | Great Brak River at Vishoek |
| 77 | 102248 | K3H001Q01 | 67 | Kaaimans River at Upper Barbiers Kraal |
| 78 | 102250 | K3H003Q01 | 62 | Maalgate River at Knoetze Kama/Buffelsdrift |
| 79 | 102283 | K4R002Q01 | 62 | Swart Vlei at Ronde Valley/Hoogekraal |
| 80 | 102312 | K7H001Q01 | 145 | Bloukrans River at Lottering Forest Reserve |
| Olifants/Doorn WMA | | | | |
| 57 | 101900 | E1R001Q01 | 132 | Bulshoek Dam on Olifants River: Near Dam Wall |
| 58 | 101902 | E2H002Q01 | 54 | Doring River at Elands Drift/Aspoort |
| 59 | 101903 | E2H003Q01 | 165 | Doring River at Melkboom |
| Breede WMA | | | | |
| 63 | 101998 | G4H007Q01 | 222 | Palmiet River at Farm 562- Welgemoed/Kleinmond |
| 64 | 102088 | H4H024Q01 | 202 | Robertson Canal from Bree River at De Goree |
| 65 | 102099 | H5H005Q01 | 172 | Bree River at Wagenboomsheuvel/Drew |
| 66 | 102107 | H6H009Q01 | 55 | Riviersonderend at Reenen |
| 67 | 102119 | H7H006Q01 | 53 | Bree River at Swellendam |
| Berg WMA | | | | |
| 60 | 101935 | G1H031Q01 | 215 | Berg River at Misverstand/Die Brug |
| 61 | 101939 | G1H036Q01 | 224 | Berg River at Vleesbank/Hermon Bridge |
| 62 | 101975 | G2H015Q01 | 211 | Eerste River at Faure |

Map 3 indicates the location of the "hot spot" sites that represent those sites in the individual WMA sample sites sets (a separate but associated study that is also underway) whose median concentrations exceed the *Very Good* and *Good* classes. This is information that is additional to the national assessment sample site set.

Map 3 The location of the “hot spot” sample sites on a national scale

## 3.5 Study Period

A study period of 5 years was used for assessing the water inorganic chemical quality status of surface water resources extending from the beginning of 1996 to the end of the year 2000. The median (the most commonly) observed concentration for each variable is used in comparison with the domestic and irrigation use guidelines.

### 3.6 Presentation of Results

Assessment of the water quality across South Africa is described in terms of fitness-for-use for domestic and irrigated agricultural use, and by means of the trophic status of selected impoundments. The results of the assessment of the water quality are depicted by means of maps and also in a tabular format.

Maps for the depiction of land cover and water quality across South Africa include:

i) The Land Cover of South Africa (after Fairbanks *et al.*, 2000) which was detailed previously (Map 1);
ii) A Maucha diagram map showing the salt balances at each of the national assessment sample sites (Map 4);
iii) The Guideline Compliance Pie Diagrams for South Africa, with the constituent sets outlined in Section 2 above, for the national assessment sample site set (Map 5, 7 and 9); and
iv) The Guideline Compliance Pie Diagrams for South Africa, with the constituent sets outlined in Section 2 above, for the "hot spot" sites (Maps 6, 8 and 10).

The Guideline Compliance Pie Diagrams (Figure 1) illustrate the median concentrations for each of the constituents depicted over the study period. Median constituent concentrations are depicted in a "pie wedge" that only projects beyond the circular "pie" when the concentration falls outside of the *Very Good* range in the case of the domestic use guidelines or the Target Water Quality Range (TWQR) in the case of the agriculture guidelines. If it does project beyond the *Very Good* (or TWQR) range then the colour and extent of the projection indicates the extent of exceedence of the median value.

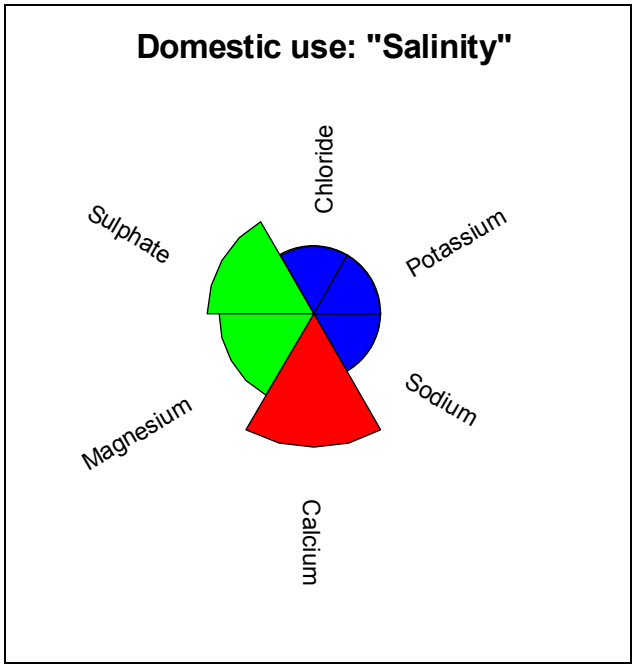


Figure 1 A typical compliance pie diagram for the fitness-for-use class Domestic Use: "Salinity"

Two sets of three Guideline Compliance Pie Diagram maps were produced for South Africa (Maps 5 to 10). The first set of three maps (Map 5, 7 and 9) represent the national assessment sample site set and the second set of three maps (Map 6, 8 and 10) represent the "hot spot" sites that were highlighted during the process of producing the maps for the individual Water Management Areas (WMAs). In order for the maps to be compared between the national assessment sample site and the "hot spots", the latter follow on immediately from the former for each water user class reported. The water quality "hot spots" are those sample sites where water quality median values exceed the *Very Good* and *Good* guideline values for sites that may not be part of the national sample site set, but are on the individual WMA sample site sets.

The first four maps (Map 5 to Map 8) are for the comparison of the median water quality values evident with domestic use guidelines (DWAF, 1996a and WRC, 1998) – of:

- firstly, $NO_3$+$NO_2$; $NH_4$; pH; TDS; and F (the Domestic Use "Health" maps, Maps 5 and 6), and
- secondly, Na; Mg; K; Cl; Ca; and $SO_4$ (the Domestic Use "Salinity" maps, Maps 7 and 8).

The Domestic Use results were split in to the two sets ("Health" and "Salinity") on a largely arbitrary basis due to the limited space available for variables on the Guideline Compliance Pie Diagrams. All of the desired variables would not have fitted onto one symbol and still been easily legible.

The last two maps, Maps 9 and 10, considered certain constituents important to irrigated agriculture (SAR; Cl; EC; B; and pH) compared with their respective irrigation water use guidelines (DWAF, 1996b).

The assessment results are presented in a series of Maps and Tables. The symbols used in the assessment maps are referred to as Guideline Compliance Pie Diagrams (Figure 1) and illustrate the median concentrations for each of the constituents depicted over the study period. Median constituent concentrations are depicted in a "pie wedge" that only projects beyond the circular "pie" when the concentration falls outside of the *Very Good* range in the case of the domestic use guidelines or the Target Water Quality Range (TWQR) in the case of the agriculture guidelines. If it does project beyond the *Very Good* range, then the colour and extent of the projection indicates the extent of exceedence of the median value.

Information from the Trophic Status Project is also included in the report. The trophic status on a national scale of selected impoundments across South Africa, specifically those impoundments managed by DWAF is reflected in Table 4.7. Information is also given on a priority ranking for the 49 selected impoundments indicating the relative need for eutrophication management (Table 4.8).

# 4. WATER QUALITY STATUS

## 4.1 Maucha diagrams

The Maucha Diagram map (Map 4) provides an indication of the salt balances at the various national assessment sample site sets. To a large extent it provides an indication of the salt balances due to natural geology.

It can be seen that the Western Cape, Eastern Cape and KwaZulu Natal coasts are sodium chloride dominant – a legacy of their marine geology and proximity to the ocean. The more inland areas, including the Orange and Vaal WMAs have high alkalinity as represented by the high bicarbonate levels. The water in these regions is typically harder and has a pH above 7. It will not lather as well as water that is softer (for example, mountain water) and may also result in faster scaling of kettles and other water heaters and steam irons.

Map 4 Maucha diagram map showing salt balances for the national sample site set

## 4.2 Domestic Use

### 4.2.1 "Health" constituents

The first two of the Guideline Compliance Pie Diagram maps (Map 5 and Map 6) relate to the following constituents: $NO_3$+$NO_2$; $NH_4$; pH; TDS and F. The median water quality at almost all of the sample sites is within the *Very Good* and *Good* water quality ranges for domestic (drinking) water use (DWAF, 1996a and DWAF, DOH and WRC, 1998) when compared to the ranges in Table 3.2, however, at isolated sites median concentrations exceed the *Very Good* and *Good* ranges. The sites in Table 3.6 are included in Map 5.

Table 3.2 (earlier in the document) lists the applicable water quality guideline classifications. Table 4.1 contains a list of sample sites for which certain of the constituents had median concentrations exceeding the *Good* range for domestic (drinking) use (DWAF, DOH and WRC, 1998).

Table 4.1 Sample sites exceeding the *Very Good* and *Good* range for domestic water use for the Domestic Health Water Quality Constituents

| Sample Site | Constituent/s Exceeding Good Range | Extent of Exceedence | Location of Site |
|---|---|---|---|
| Olifants WMA | | | |
| B3H021Q01 | F | Yellow | Elands River at Scherp Arabie |
| Upper Vaal WMA | | | |
| C2H004Q01 | TDS | Yellow | Suikerbosrand River at Uitvlugt |
| Lower Orange WMA | | | |
| D5H021Q01 | TDS | Red | Sak River at De Kruis/Williston |
| Fish to Tsitsikamma WMA | | | |
| L6H001Q01 | TDS | Red | Heuningklip River at Campherspoort |
| N1H013Q01 | TDS | Purple | Mackiesputs Eye at Graaf-Reinet/Van Reyneveldspas |
| N2H007Q01 | TDS | Yellow | Sundays River at De Draay |
| N4H003Q01 | TDS | Red | Sundays River at Addo Drift East/Addo Bridge |
| P1H003Q01 | TDS | Red | Boesmans River at Donkerhoek/Alicedale |
| P3H001Q01 | TDS | Red | Kariega River at Smithfield/Lower Waterford |
| P4H001Q01 | TDS | Yellow | Kowie River at Bathurst/Wolfscrag |
| Q4H013Q01 | F; TDS | Red; yellow | Tarka River at Bridge Farm/Tarka Bridge (New Weir) |
| Q8H011Q01 | TDS | Yellow | Little Fish River at Rietfontein/Junction Drift |
| Q9H001Q01 | TDS | Yellow | Great Fish River at Fort Brown Peninsula |
| Q9H018Q01 | TDS | Yellow | Great Fish River at Matomela's Reserve/ Outspan |
| Gouritz WMA | | | |
| J1H019Q01 | TDS | Purple | Groot River at Buffelsfontein/Van Wyksdorp |
| J3H011Q01 | TDS | Purple | Olifants River at Warm Water |
| K2H004Q01 | TDS | Purple | Great Brak River at Vishoek |
| K4R002Q01 | TDS | Purple | Swart Vlei at Ronde Valley/Hoogekraal |

It would appear that Fluoride (F) and Total Dissolved Salts (TDS) are, from a domestic use point of view, the major concerns at certain of the sampling sites (refer to the guideline values in Table 3.2 and Table 4.1 and Map 5 that indicates water quality fitness-for-use for Domestic Use: "Health" and the sites with elevated levels).

**Fluoride (F)**

On the Elands River at Scherp Arabie (Olifants Water Management Area) and especially at the Tarka River at Bridge Farm/Tarka Bridge (Fish to Tsitsikamma WMA), fluoride levels are elevated. The fluoride levels could result in tooth staining at both sites and also health effects (including skeletal damage) at the latter site (refer to Table 3.2 for the possible effects). Fluorosis is the term given to the disease condition where there is malformation of either the teeth (dental fluorosis) and/or the bony skeleton (skeletal fluorosis), due to chronic exposure to elevated fluoride intake.

**Total Dissolved Salts (TDS)**

The TDS levels were elevated at many of the sites in Table 4.1 and can be considered to be Poor or Not Acceptable in terms of human health at the Sak River at De Kruis/Williston (Lower Orange WMA), Heuningklip River at Campherspoort, Sundays River at Addo Drift East, Boesmans River at Donkerhoek/Alicedale, Kariega River at Smithfield (all in the Fish to Tsitsikamma WMA), and especially in the Gouritz WMA where it was *Not Acceptable* at the Groot River at Buffelsfontein, Olifants River at Warm Water, Great Brak River at Vishoek and Swart Vlei at Ronde Valley. The health effects range from salt overload in sensitive groups to an increasing risk of dehydration (refer to Table 3.2). It should be noted that the main effect, however, is aesthetic (the water has a salty taste and does not slake thirst at high concentrations).

***Link to land cover***

Refer to Table 3.5 and Map 1 and the location of the sites above for an explanation.

The elevated fluoride levels evident at the two sites is most probably due to natural geology since the land cover at the Elands River at Scherp Arabie is cultivated land and forest and at the Tarka River at Bridge Farm it is shrub, grass and cultivated land.

The elevated TDS levels would also appear to be a result of natural geology in most cases, with the possible exception of those sites near to where there is cultivated land and/or plantations (Sundays River at Addo Drift East, Boesmans River at Donkerhoek – both in the Fish to Tstitsikamma WMA, Olifants River at Warm Water and Swart Vlei at Ronde Valley – both in the Gouritz WMA) that may be fertilised and thereby contribute to the salt load. It is likely that the Swart Vlei at Ronde Valley site is strongly influenced by seawater intrusion.

Map 5 Water quality fitness for use from a Domestic Use “Health” perspective reported at the national assessment sample sites

**"Hot Spot" Information from Additional WMA Sites**

The sample sites exceeding the *Very Good* and *Good* categories ("hot spots") are visually located in Map 6 and are presented in Table 4.2. They are the sites from the individual WMAs (and the national assessment sample site set) that exceed the above-mentioned ranges for the selected variables and fitness-for-use class.

Table 4.2 WMA sample sites ("hot spot" sites) exceeding the *Very Good* and *Good* range for domestic water use for the Domestic Use "Health" Water Quality Constituents

| WMA Site | Sample Site | Constituent/s Exceeding Good Range | Extent of Exceedence | Location of Site |
|---|---|---|---|---|
| Olifants WMA | | | | |
| 95 | B1H002Q01 | TDS | Yellow | Spook Spruit At Elandspruit |
| 96 | B1H004Q01 | pH | Red | Klip Spruit At Zaaihoek |
| 125 | B3H021Q01 | F | Yellow | Elands River At Scherp Arabie |
| 148 | B7H019Q01 | TDS; F | Yellow; Red | Ga-Selati River At Loole/Foskor |
| Usutu to Mhlatuze | | | | |
| 671 | W3H012Q01 | TDS | Yellow | Mzinene River At Cloete |
| 675 | W3H023Q01 | TDS | Yellow | Nkongolwana River At Veelsgeluk/ Kongolana (Cp5) |
| 686 | W3R002Q01 | TDS | Purple | Lake St Lucia At Lister's Point |
| Upper Vaal WMA | | | | |
| 162 | C2H004Q01 | TDS | Yellow | Suikerbosrand River At Uitvlugt (Rw S2) |
| 179 | C2H132Q01 | TDS | Yellow | Riet Spruit At Tamboekiesfontein |
| 180 | C2H133Q01 | TDS | Yellow | Blesbok Spruit At Heidelberg |
| 187 | C2H146Q01 | TDS | Yellow | Blesbok Spruit At Dagafontein – 2Km D/Stream N17 |
| 188 | C2H147Q01 | TDS | Yellow | Blesbok Spruit At Grootvaly/Betw Mine Bridge And N17 |
| 189 | C2H149Q01 | TDS | Yellow | Blesbok Spruit At Nigel East – R51 Bridge (B8) |
| 200 | C2H234Q01 | TDS | Yellow | Suikerbosrant River At Badfontein |
| Middle Vaal WMA | | | | |
| 231 | C2H139Q01 | TDS | Yellow | Koekemoer Spruit At Buffelsfontein |
| Lower Orange WMA | | | | |
| 283 | D5H017Q01 | TDS | Purple | Renoster River At Leeuwenkuil |
| 284 | D5H021Q01 | TDS | Red | Sak River At De Kruis/Williston |
| Fish to Tsitsikamma WMA | | | | |
| 444 | K8H001Q01 | pH | Yellow | Kruis River At Farm 508 Pineview |
| 450 | L6H001Q01 | TDS | Yellow | Heuningklip River At Campherspoort |
| 452 | L7H007Q01 | TDS | Purple | Groot River At Sandpoort |
| 459 | M1H012Q01 | TDS | Yellow | Swartkops River At Uitenhage/Nivens Bridge |
| 461 | N1H013Q01 | TDS | Purple | Mackiesputs Eye At Graaf-Reinet/ Van Reyneveldspas |
| 463 | N2H007Q01 | TDS | Yellow | Sundays River At De Draay |
| 466 | N3H002Q01 | TDS | Yellow | Voël River At Rietvley |
| 468 | N4H003Q01 | TDS | Red | Sundays River At Addo Drift East/ Addo Bridge |
| 469 | N4H005Q01 | TDS; F | Purple; yellow | Coerney River At Selborne/Carlton |
| 470 | P1H003Q01 | TDS | Red | Boesmans River At Donkerhoek/ Alicedale |
| 472 | P3H001Q01 | TDS | Red | Kariega River At Smithfield/Lower Waterford |
| 475 | P4H001Q01 | TDS | Yellow | Kowie River At Bathurst/Wolfscrag |
| 481 | Q3H004Q01 | TDS; F | Yellow; yellow | Pauls River At Coutzenburg |
| 483 | Q4H013Q01 | TDS; F | Yellow; red | Tarka River At Bridge Farm/Tarka Bridge (New Weir) |

| WMA Site | Sample Site | Constituent/s Exceeding Good Range | Extent of Exceedence | Location of Site |
|---|---|---|---|---|
| 488 | Q7H005Q01 | TDS | Yellow | Great Fish River Atsout Vleij/Sheldon |
| 489 | Q8H008Q01 | TDS | Yellow | Little Fish River At Doornkraal |
| 491 | Q8H011Q01 | TDS | Yellow | Little Fish River At Rietfontein/ Junction Drift |
| 493 | Q9H001Q01 | TDS | Yellow | Great Fish River At Fort Brown Peninsula |
| 495 | Q9H012Q01 | TDS | Yellow | Great Fish River At Brandtlegte/ Piggot's Bridge |
| 497 | Q9H018Q01 | TDS | Yellow | Great Fish River At Matomela's Reserve/Outspan |
| Gouritz WMA | | | | |
| 378 | H9H006Q01 | pH | Yellow | Canal From Kougou River At Groote Bosch |
| 383 | J1H017Q01 | TDS | Yellow | Sand River At Buffelsfontein/Van Wyksdorp |
| 384 | J1H019Q01 | TDS | Purple | Groot River At Buffelsfontein/Van Wyksdorp |
| 387 | J1H031Q01 | TDS | Yellow | Miertjeskraal Dam On Brak River: Down Stream Weir |
| 388 | J1R002Q01 | TDS | Yellow | Bellair Dam On Brak River: Near Dam Wall |
| 391 | J2H005Q01 | TDS | Yellow | Huis River At Zoar |
| 401 | J3H011Q01 | TDS | Purple | Olifants River At Warm Water |
| 414 | K1H009Q01 | TDS | Purple | Hartenbos River At Hartenbosch/ Hotel At Estuary |
| 415 | K1H013Q01 | TDS | Purple | Hartenbos River At Hartenbosch/ Tributary Confluence |
| 421 | K2H004Q01 | TDS | Purple | Great Brak River At Vishoek |
| 424 | K3H002Q01 | pH | Salmon | Rooi River At George |
| 431 | K3R003Q01 | TDS | Purple | Ronde Vlei At Ronde Valley |
| 432 | K3R004Q01 | TDS | Purple | Upper Lang Vlei At Klein Krantz |
| 433 | K3R005Q01 | TDS | Purple | Lower Lang Vlei At Klein Krantz (East Shore) |
| 434 | K3R006Q01 | TDS | Purple | Touws River Estuary At Wilderness |
| 436 | K4H002Q01 | pH | Yellow | Karatara River At Karatara Forest Reserve |
| 438 | K4R001Q01 | TDS | Red | Groen Vlei At Ruygte Valley |
| 439 | K4R002Q01 | TDS | Purple | Swart Vlei At Ronde Valley/ Hoogekraal |
| 441 | K5R001Q01 | TDS | Purple | Knysna Lagoon At Knysna |
| 443 | K7H001Q01 | pH | Yellow | Bloukrans River At Lottering Forest Reserve |
| Olifants/Doorn WMA | | | | |
| 298 | G3H001Q01 | TDS | Yellow | Kruis River At Tweekuilen/Eendekuil |
| Breede WMA | | | | |
| 332 | G4R003Q01 | TDS | Purple | Bot River Vlei On Bot River At Ysterklip/Hermanus |
| 333 | G4R004Q01 | TDS | Purple | Klein River Vlei On Klein River At Rocklands/Yacht |
| 334 | G5H008Q01 | TDS | Purple | Sout River At Kykoedy |
| 340 | H1H015Q01 | TDS | Red | Bree River At Die Nekkies (Onder Brandvlei) |
| 350 | H3H011Q01 | TDS | Yellow | Kogmanskloof River At Goudmyn |
| 354 | H4H018Q01 | TDS | Purple | Poesjenels River At La Chasseur |
| 355 | H4H019Q01 | TDS | Yellow | Vink River At De Gorree |
| 356 | H4H020Q01 | TDS | Yellow | Nuy River At Doornrivier |
| 369 | H7H005Q01 | pH | Yellow | Hermitage River At Swellendam Forest Reserve |
| 371 | H7H007Q01 | pH | Yellow | Grootkloof River At Sparkenbosch |
| Berg WMA | | | | |
| 302 | G1H009Q01 | TDS | Yellow | Brakkloof Spruit At Knolvlei Forest Reserve |
| 309 | G1H024Q01 | TDS | Purple | Berg River At Kliphoek |
| 311 | G1H034Q01 | TDS | Purple | Moorreesburg Spruit At Holle River |
| 312 | G1H035Q01 | TDS | Yellow | Matjies River At Matjiesfontein |
| 314 | G1H039Q01 | TDS; F | Red; yellow | Doring River At Grensplaas/Diepe Gat |

| WMA Site | Sample Site | Constituent/s Exceeding Good Range | Extent of Exceedence | Location of Site |
|---|---|---|---|---|
| 315 | G1H040Q01 | TDS | Yellow | Fish River At La Fonteine |
| 321 | G2H012Q01 | TDS | Yellow | Diep River At Malmesbury |

Map 6 Domestic Use “Health” as represented by the “hot spot” sample site set

### 4.2.2 "Salinity" constituents

The second set of the Guideline Compliance Pie Diagram maps (Maps 7 and 8) pertain to the following constituents: Sodium (Na); Calcium (Ca); Magnesium (Mg); Sulphate ($SO_4$); Chloride (Cl) and Potassium (K) and the guidelines depicted in Table 3.3 (earlier in the document). Note that the median water quality for the desired constituent set is less often within the *Very Good* and *Good* water quality range for domestic (drinking) water use (DWAF, DOH and WRC, 1998) than was the case with the previous constituent set. The sites in Table 3.6 are included in Map 7.

From Map 7 and Table 4.3 it can be seen that it is in the Usutu to Mhlatuze, Upper Vaal, Lower Orange, Fish to Tsitsikamma, Gouritz and Breede WMAs that the median concentrations for the constituents reflected in the Domestic Use "Salinity" set are greater than the *Good* range for certain of those constituents. Table 3.3 lists the applicable water quality guideline classifications. Table 4.3 contains a list of sample sites for which certain of the constituents had median concentrations exceeding the *Good* range for domestic use.

Table 4.3 Sample sites exceeding the *Very Good* and *Good* ranges for domestic water use for the Domestic Use "Salinity" Water Quality Constituents

| Sample Site | Constituent/s Exceeding Good Range | Extent of Exceedence | Location of Site |
|---|---|---|---|
| Usutu to Mhlatuze WMA | | | |
| W3H015Q01 | Cl | Yellow | Hluhluwe River at Valsbaai/St Lucia Inflow |
| Upper Vaal WMA | | | |
| C2H004Q01 | $SO_4$ | Yellow | Suikerbosrand River at Uitvlugt (RW S2) |
| Lower Orange WMA | | | |
| D5H021Q01 | $SO_4$; Cl; Na | Red; red; red | Sak River at De Kruis/Williston |
| Fish to Tsitsikamma WMA | | | |
| L6H001Q01 | Mg; $SO_4$; Cl; Na | Yellow; yellow; red; red | Heuningklip River at Campherspoort |
| N1H013Q01 | Ca; Mg; $SO_4$; Cl; Na | Yellow; yellow; red; red; red | Mackiesputs Eye at Graaf-Reinet/Van Reyneveldspas |
| N2H007Q01 | Cl; Na | Red; yellow | Sundays River at De Draay |
| N3H002Q01 | Cl | Yellow | Voël River at Rietvley |
| N4H003Q01 | Cl; Na | Red; red | Sundays River at Addo Drift East/Addo Bridge |
| P1H003Q01 | Mg; Cl; Na | Yellow; red; red | Boesmans River at Donkerhoek/Alicedale |
| P3H001Q01 | Mg; Na | Yellow; red | Kariega River at Smithfield/Lower Waterford |
| P4H001Q01 | Cl; Na | Red; red | Kowie River at Bathurst/Wolfscrag |
| Q4H013Q01 | Cl; Na | Yellow red | Tarka River at Bridge Farm/Tarka Bridge (New Weir) |
| Q8H011Q01 | Cl; Na | Yellow; yellow | Little Fish River at Rietfontein/Junction Drift |
| Q9H001Q01 | Cl; Na | Yellow; yellow | Great Fish River at Fort Brown Peninsula |
| Q9H018Q01 | Cl; Na | Yellow; yellow | Great Fish River at Matomela's Reserve/ Outspan |
| Gouritz WMA | | | |
| J1H019Q01 | Mg; $SO_4$; Cl; Na | Yellow; yellow; purple; purple | Groot River at Buffelsfontein/Van Wyksdorp |
| J3H011Q01 | Mg; $SO_4$; Cl; Na | Red; purple; purple; purple | Olifants River at Warm Water |
| K2H004Q01 | Ca; Mg; $SO_4$; Cl; Na; K | Red; purple; purple; purple; purple; red | Great Brak River at Vishoek |
| K4R002Q01 | Mg; $SO_4$; Cl; Na; K | Red; yellow; purple; purple; yellow | Swart Vlei at Ronde Valley/Hoogekraal |
| Breede WMA | | | |
| H5H005Q01 | Cl | Yellow | Bree River at Wagenboomsheuvel/Drew |

From Table 4.3 it can be seen that the median concentrations of Calcium (Ca), Magnesium (Mg), Sulphate ($SO_4$), Chloride (Cl) and Sodium (Na) were greater than the *Very Good* or *Good* ranges at selected sample sites in the national assessment sample site set.

**Calcium (Ca)**

The elevated median calcium concentrations would result in hard water and scaling of domestic water pipes and appliances at the site at Mackiesputs Eye at Graaf-Reinet (Fish to Tsitsikamma WMA) and may additionally result in chronic health effects in sensitive groups at the site on the Great Brak River at Vishoek (Gouritz WMA).

**Magnesium (Mg)**

The elevated median magnesium concentrations could be expected to have a bitter taste and increasing health effects in sensitive individuals at the Groot River at Buffelsfontein (Gouritz WMA), Heuningklip River at Campherspoort, Mackiesputs Eye at Graaf-Reinet, Boesmans River at Donkerhoek and Kariega River at Smithfield (all in the Fish to Tsitsikamma WMA). Potential diarrhoea can result in all individuals using the water for drinking purposes at the site on the Olifants River at Warm Water and at Swart Vlei at Ronde Valley (both in the Gouritz WMA). The Mg levels in the water at the Great Brak River at Vishoek (Gouritz WMA) can be described as Not Acceptable and can be expected to result in diarrhoea in all individuals using it for drinking purposes. Furthermore, magnesium contributes to the total hardness of water.

**Sulphate ($SO_4$)**

The median sulphate concentrations could result in a slight chance of diarrhoea in sensitive groups (but disappears with adaptation) at the Suikerbosrand River at Uitvlugt (Upper Vaal WMA), Groot River at Buffelsfontein, Swart Vlei at Ronde Valley (both in the Gouritz WMA) and the Heuningklip River at Campherspoort (Fish to Tsitsikamma WMA). There is a possibility of diarrhoea (with poor adaptation in sensitive individuals) at the Mackiesputs Eye at Graaf-Reinet (Fish to Tsitsikamma WMA). There is a high chance of diarrhoea (with little likelihood of adaptation) at the Olifants River at Warm Water and the Great Brak River at Vishoek (both in the Gouritz WMA).

**Chloride (Cl)**

The median chloride concentrations could pose increasing health risks to sensitive groups at the Bree River at Wagenboomsheuvel (Breede WMA), Voël River at Rietvley, Tarka River at Bridge Farm, Little Fish River at Rietfontein, Great Fish River at Fort Brown Peninsula, Great Fish River at Matomela's Reserve (all in the Fish to Tsitsikamma WMA) and Hluhluwe River at Valsbaai (Usutu to Mhlatuze WMA). The Cl concentrations could have possible long-term health effects at the Sak River at De Kruis (Lower Orange WMA), Heuningklip River at Campherspoort, Mackiesputs Eye at Graaf-Reinet, Sundays River at De Draay, Boesmans River at Donkerhoek and Kowie River at Bathurst (all in the Fish to Tsitsikamma WMA). The Cl concentrations could result in dehydration in infants, nausea and vomiting at the Groot River at Buffelsfontein, Olifants River at Warm Water, Great Brak River at Vishoek and Swart Vlei at Ronde Valley (all in the Gouritz WMA). The most prominent effect with humans is aesthetic, with a salty taste to the water that does not slake thirst.

**Sodium (Na)**

The median sodium concentrations could result in a slight health risk to some sensitive groups at the Sundays River at De Draay, Little Fish River at Rietfontein, Great Fish River at Fort Brown Peninsula and Great Fish River at Matomela's Reserve (all in the Fish to Tsitsikamma WMA). The Na concentrations could have a possible health risk, particularly in sensitive groups, at the Sak River at De Kruis (Lower Orange WMA), Heuningklip River at Campherspoort, Mackiesputs Eye at Graaf-Reinet, Sundays River at Addo Drift East, Boesmans River at Donkerhoek, Kariega River at Smithfield, Kowie River at Bathurst and Tarka River at Bridge Farm (all in the Fish to Tsitsikamma WMA). There is a definite Na-related health risk

to using the water at the Groot River at Buffelsfontein, Olifants River at Warm Water, Great Brak River at Vishoek and Swart Vlei at Ronde Valley (all in the Gouritz WMA). The most prominent effect will be aesthetic, with salty tasting water that does not slake thirst.

**Potassium (K)**

The median potassium concentrations are likely to result in slight risk to some sensitive groups at the Swart Vlei at Ronde Valley (Gouritz WMA). There are possible health effects associated with potassium at this site.

Map 7 “Salinity” effects on the Domestic Use of water reported at the national assessment sample sites

***Link to land cover***

Refer to Table 3.5 and Map 1 and the location of the sites above for an explanation.

**Calcium (Ca)**

The elevated calcium levels at the two sites mentioned above are more than likely due to the natural geology in the area. This is probably especially true at the Great Brak River at Vishoek where the land cover is shrub (Table 3.5). The cultivate land and urban land cover at Mackiesputs Eye at Graaf-Reinet may have resulted in an increase in the calcium levels due to disturbance, but the source of calcium is probably still natural.

**Magnesium (Mg)**

The elevated magnesium concentrations at the sites mentioned above are more than likely due to the natural geology in the area. At some of the sites the levels may be elevated due to the disturbance of the soil surface due to cultivation, forestry and plantations (Table 3.5). The sites that are not largely natural and where water may have a bitter taste include: Mackiesputs Eye at Graaf-Reinet (bush, grass, urban and cultivated land), Boesmans River at Donkerhoek (bush, grass, shrub and cultivated land) and Kariega River at Smithfield (bush, grass and forest). The potential for diarrhoea increases at the Olifants River at Warm Water (shrub, cultivated land and plantation) and at the Swart Vlei at Ronde Valley (bush, plantation and cultivated land). The unacceptably high magnesium levels at the Great Brak River at Vishoek appear to be natural since the land cover is comprised of shrub.

**Sulphate ($SO_4$)**

The elevated sulphate concentrations at the sites mentioned previously are most probably due to natural reasons at the Groot River at Buffelsfontein (shrub), and the Great Brak River at Vishoek (shrub). Due to there being some man-modified land cover at the following sites, the elevated sulphate concentrations may be affected by human activities: Suikerbosrand River at Uitvlugt (cultivated land, grass and urban), Swart Vlei at Ronde Valley (bush, plantation and cultivated land), Mackiesputs Eye at Graaf-Reinet (bush, grass, urban and cultivated land) and the Olifants River at Warm Water (shrub, cultivated land and plantation).

**Chloride (Cl)**

The elevated chloride concentrations would appear to be related to the natural geology in almost all cases. It is only at the Bree River at Wagenboomsheuvel (cultivated land and shrub), Tarka River at Bridge Farm (shrub, grass and cultivated land) Great Fish River at Matomela's Reserve (shrub, bush and cultivated land), Hluhluwe River at Valsbaai (bush, plantation and cultivated land), Mackiesputs Eye at Graaf-Reinet (bush, grass, urban and cultivated land), Boesmans River at Donkerhoek (bush, grass, shrub and cultivated land), Kowie River at Bathurst (bush, grass and cultivated land), Olifants River at Warm Water (shrub, cultivated land and plantation) and the Swart Vlei at Ronde Valley (bush, plant and cultivated land) that there appear to be marked human impacts at a national scale.

**Sodium (Na)**

The elevated sodium concentrations appear to be related to natural sources. The land cover at the Sundays River at De Draay is shrub, at the Little Fish River at Rietfontein it is shrub and bush, at the Great Fish River at Fort Brown Peninsula it is shrub, bush and cultivated land, at the Great Fish River at Matomela's Reserve it is shrub, bush and cultivated land, at the Sak River at De Kruis it is shrub, at the Heuningklip River at Campherspoort it is shrub and bush, at the Mackiesputs Eye at Graaf-Reinet it is bush, grass, urban and cultivated land, at the Sundays River at Addo Drift East it is bush, shrub and cultivated land, at the Boesmans River at Donkerhoek it is bush, grass, shrub and cultivated land, at the Kariega River it is bush, grass and forest, at the Kowie River at Bathurst it is bush, grass and cultivated land, at the Tarka River at Bridge Farm it is shrub, grass and cultivated land, at the Groot River at Buffelsfontein it is shrub, at the Olifants River at Warm Water it is shrub, cultivated land and plantation, at the Great Brak River at Vishoek it is shrub and at the Swart Vlei at Ronde Valley it is bush, plantation and cultivated land.

**"Hot Spot" Information from Additional WMA Sites**

Refer to Map 8 and Table 4.4 for the salinity effects based on the "hot-spot" sites. They are the sites from the individual WMAs (and the national assessment sample site set) that exceed the *Very Good* and *Good* classes for the selected variables and fitness-for-use class.

Table 4.4 WMA sample sites ("hot spot" sites) exceeding the *Very Good* and *Good* range for domestic water use for the Domestic Use "Salinity" Water Quality Constituents

| WMA Site | Sample Site | Constituent/s Exceeding Good Range | Extent of Exceedence | Location of Site |
|---|---|---|---|---|
| Olifants WMA | | | | |
| 95 | B1H002Q01 | $SO_4$ | Red | Spook Spruit At Elandspruit |
| 96 | B1H004Q01 | $SO_4$ | Yellow | Klip Spruit At Zaaihoek |
| 104 | B1H019Q01 | $SO_4$ | Yellow | Noupoort Spruit At Naauwpoort |
| 148 | B7H019Q01 | $SO_4$; K; Mg | Red; yellow; yellow | Ga-Selati River At Loole/Foskor |
| Usutu to Mhlatuze | | | | |
| 671 | W3H012Q01 | Cl; Na | Yellow; yellow | Mzinene River At Cloete |
| 673 | W3H015Q01 | Cl | Purple | Hluhluwe River At Valsbaai/St Lucia Inflow |
| 675 | W3H023Q01 | $SO_4$; Ca | Red; yellow | Nkongolwana River At Veelsgeluk/ Kongolana (Cp5) |
| 686 | W3R002Q01 | $SO_4$; Cl; K; Na; Mg | Red; purple; red; purple; red | Lake St Lucia At Lister's Point |
| Upper Vaal WMA | | | | |
| 162 | C2H004Q01 | $SO_4$ | Yellow | Suikerbosrand River At Uitvlugt (Rw S2) |
| 179 | C2H132Q01 | $SO_4$; Ca | Yellow; yellow | Riet Spruit At Tamboekiesfontein |
| 180 | C2H133Q01 | $SO_4$; Ca | Yellow; yellow | Blesbok Spruit At Heidelberg |
| 189 | C2H149Q01 | $SO_4$; Ca | Yellow; yellow | Blesbok Spruit At Nigel East – R51 Bridge (B8) |
| 190 | C2H153Q01 | $SO_4$; Ca | Yellow; yellow | Wonderfontein Spruit At Ranfontein Azaadville Bridge |
| 200 | C2H234Q01 | $SO_4$ | Yellow | Suikerbosrant River At Badfontein |
| Middle Vaal WMA | | | | |
| 231 | C2H139Q01 | $SO_4$ | Red | Koekemoer Spruit At Buffelsfontein |
| Mzimvubu to Keiskamma WMA | | | | |
| 513 | R2H016Q01 | Cl; Na | Yellow; red | Zwelitsha Spruit At Malakalaka |
| Lower Orange WMA | | | | |
| 283 | D5H017Q01 | $SO_4$; Cl; Na; Mg | Purple; purple; purple; yellow | Renoster River At Leeuwenkuil |
| 284 | D5H021Q01 | $SO_4$; Cl; Na | Red; yellow; red | Sak River At De Kruis/Williston |
| Fish to Tsitsikamma WMA | | | | |
| 450 | L6H001Q01 | $SO_4$; Cl; Na; Ca; Mg | Red; purple; red; yellow; yellow | Heuningklip River At Campherspoort |
| 452 | L7H007Q01 | $SO_4$; Cl; Na; Ca; Mg | Purple; purple; purple; yellow; red | Groot River At Sandpoort |
| 459 | M1H012Q01 | Cl; Na | Yellow; yellow | Swartkops River At Uitenhage/Nivens Bridge |
| 461 | N1H013Q01 | $SO_4$; Cl; Na; Ca; Mg | Red; red; red; yellow; yellow | Mackiesputs Eye At Graaf-Reinet/ Van Reyneveldspas |
| 463 | N2H007Q01 | Cl; Na | Red; yellow | Sundays River At De Draay |
| 466 | N3H002Q01 | Cl | Yellow | Voël River At Rietvley |
| 468 | N4H003Q01 | Cl; Na | Red; red | Sundays River At Addo Drift East/ Addo Bridge |
| 469 | N4H005Q01 | $SO_4$; Cl; Na; Mg | Red; purple; purple; yellow | Coerney River At Selborne/Carlton |
| 472 | P3H001Q01 | Cl; Na; Ca; Mg | Purple; red; yellow; yellow | Kariega River At Smithfield/Lower Waterford |
| 475 | P4H001Q01 | Cl; Na | Red; red | Kowie River At Bathurst/Wolfscrag |
| 483 | Q4H013Q01 | Cl; Na | Yellow; red | Tarka River At Bridge Farm/Tarka Bridge (New Weir) |
| 488 | Q7H005Q01 | Cl; Na | Yellow; yellow | Great Fish River Atsout Vleij/Sheldon |

| WMA Site | Sample Site | Constituent/s Exceeding Good Range | Extent of Exceedence | Location of Site |
|---|---|---|---|---|
| 491 | Q8H011Q01 | Cl; Na | Yellow; yellow | Little Fish River At Rietfontein/ Junction Drift |
| 493 | Q9H001Q01 | Cl; Na | Yellow; yellow | Great Fish River At Fort Brown Peninsula |
| 495 | Q9H012Q01 | Cl; Na | Yellow; yellow | Great Fish River At Brandtlegte/ Piggot's Bridge |
| 497 | Q9H018Q01 | Cl; Na | Yellow; yellow | Great Fish River At Matomela's Reserve/Outspan |
| Gouritz WMA | | | | |
| 383 | J1H017Q01 | Cl; Na | Red; red | Sand River At Buffelsfontein/Van Wyksdorp |
| 384 | J1H019Q01 | $SO_4$; Cl; Na; Mg | Yellow; purple; red; yellow | Groot River At Buffelsfontein/Van Wyksdorp |
| 388 | J1R002Q01 | Cl; Na | Yellow; yellow | Bellair Dam On Brak River: Near Dam Wall |
| 390 | J1R004Q01 | Cl; Na | Yellow; yellow | Miertjeskraal Dam On Brand River: Near Dam Wall |
| 393 | J2H007Q01 | Cl | Yellow | Joubert River At Opsoek |
| 401 | J3H011Q01 | $SO_4$; Cl; Na; Ca; Mg | Purple; purple; purple; red; red | Olifants River At Warm Water |
| 411 | J3R002Q01 | Cl | Yellow | Stompdrif Dam On Olifants River: Near Dam Wall |
| 414 | K1H009Q01 | $SO_4$; Cl; K; Na; Ca; Mg | Purple; purple; red; purple; red; purple | Hartenbos River At Hartenbosch/Hotel At Estuary |
| 415 | K1H013Q01 | $SO_4$; Cl; K; Na; Mg | Yellow; purple; yellow; purple; yellow | Hartenbos River At Hartenbosch/ Tributary Confluence |
| 418 | K1R001Q01 | Cl | Yellow | Hartebeeskuil Dam On Hartenbos River: Near Dam Wall |
| 421 | K2H004Q01 | $SO_4$; Cl; K; Na; Ca; Mg | Purple; purple; red; purple; red; purple | Great Brak River At Vishoek |
| 429 | K3H011Q01 | Cl | Yellow | Duiwe River At Klein Krantz |
| 431 | K3R003Q01 | $SO_4$; Cl; K; Na; Mg | Yellow; purple; yellow; purple; red | Ronde Vlei At Ronde Valley |
| 432 | K3R004Q01 | Cl; K; Na; Mg | Purple; yellow; purple; yellow | Upper Lang Vlei At Klein Krantz |
| 433 | K3R005Q01 | Cl; K; Na; Mg | Purple; yellow; purple; yellow | Lower Lang Vlei At Klein Krantz (East Shore) |
| 434 | K3R006Q01 | $SO_4$; Cl; K; Na; Mg | Yellow; purple; yellow; purple; red | Touws River Estuary At Wilderness |
| 438 | K4R001Q01 | Cl; Na | Red; red | Groen Vlei At Ruygte Valley |
| 439 | K4R002Q01 | $SO_4$; Cl; K; Na; Mg | Yellow; purple; yellow; purple; red | Swart Vlei At Ronde Valley/ Hoogekraal |
| 441 | K5R001Q01 | $SO_4$; Cl; K; Na; Ca; Mg | Purple; purple; red; purple; red; purple | Knysna Lagoon At Knysna |
| Olifants/Doorn WMA | | | | |
| 298 | G3H001Q01 | Cl; Na; Mg | Red; red; yellow | Kruis River At Tweekuilen/Eendekuil |
| Breede WMA | | | | |
| 326 | G4H006Q01 | Cl | Yellow | Klein River At Can Q5-8/ Wagenboomsdrift |
| 332 | G4R003Q01 | $SO_4$; Cl; K; Na; Mg | Red; purple; yellow; purple; red | Bot River Vlei On Bot River At Ysterklip/Hermanus |
| 333 | G4R004Q01 | $SO_4$; Cl; K; Na; Ca; Mg | Purple; purple; red; purple; red; purple | Klein River Vlei On Klein Riv At Rocklands/Yacht |
| 334 | G5H008Q01 | Cl; Na; Mg | Purple; purple; red | Sout River At Kykoedy |
| 340 | H1H015Q01 | Cl; Na; Mg | Red; red; yellow | Bree River At Die Nekkies (Onder Brandvlei) |
| 350 | H3H011Q01 | Cl; Na | Red; red | Kogmanskloof River At Goudmyn |
| 352 | H4H016Q01 | Cl; Na | Yellow; yellow | Keisers River At Mc Gregor Commonage/Vrolykheid |
| 354 | H4H018Q01 | $SO_4$; Cl; Na; Ca; Mg | Yellow; purple; red; yellow; yellow | Poesjenels River At La Chasseur |
| 355 | H4H019Q01 | Cl; Na | Red; yellow | Vink River At De Gorree |
| 356 | H4H020Q01 | Cl; Na | Yellow; red | Nuy River At Doornrivier |
| 362 | H5H004Q01 | Cl | Yellow | Bree River At Wolvendrift/Secunda |
| 363 | H5H005Q01 | Cl | Yellow | Bree River At Wagenboomsheuvel/ Drew |
| Berg WMA | | | | |
| 302 | G1H009Q01 | Cl; Na | Red; yellow | Brakkloof Spruit At Knolvlei Forest Reserve |
| 309 | G1H024Q01 | $SO_4$; Cl; K; Na; Mg | Yellow; purple; yellow; purple; red | Berg River At Kliphoek |
| 311 | G1H034Q01 | Cl; Na; Ca; Mg | Purple; purple; yellow; red | Moorreesburg Spruit At Holle River |
| 312 | G1H035Q01 | Cl; Na | Red; red | Matjies River At Matjiesfontein |

| WMA Site | Sample Site | Constituent/s Exceeding Good Range | Extent of Exceedence | Location of Site |
|---|---|---|---|---|
| 314 | G1H039Q01 | Cl; Na | Purple; red | Doring River At Grensplaas/Diepe Gat |
| 315 | G1H040Q01 | Cl; Na | Yellow; yellow | Fish River At La Fonteine |
| 321 | G2H012Q01 | Cl; Na | Yellow; yellow | Diep River At Malmesbury |

Map 8 “Salinity” effects on Domestic Use as represented by the “hot spot” sample site set

## 4.3 Irrigated Agriculture Use

The third set of the Guideline Compliance Pie Diagram maps (Maps 9 and 10) relate to the following constituents: Sodium Adsorption Ratio (SAR); pH; Boron (B); Conductivity; and Chloride (Cl), that are important for irrigated agriculture (DWAF, 1996b) and the water quality guidelines are depicted in Table 3.4 (earlier in the document). There are isolated sites where median concentrations may be greater than the Target Water Quality Range (TWQR) (DWAF, 1996b). The sites in Table 3.6 are included in Map 9.

From Map 9 and Table 4.5 it can be seen that it is in the Luvuvhu and Letaba, Crocodile (West) and Marico, Olifants, Usutu to Mhlatuze, Upper Vaal, Mzimvubu to Keiskamma, Upper Orange, Lower Orange, Fish to Tsitsikamma, Gouritz and Breede WMAs that the median concentrations for the constituents reflected in the Irrigated Agriculture constituent set are greater than the TWQR for certain of those constituents at certain sampling sites. Table 3.4 lists the applicable water quality guideline classifications. Table 4.5 contains a list of sample sites for which certain of the constituents had median concentrations that indicate the water as being of *Fair* or *Not Acceptable* quality for irrigation use.

Map 9 Water quality effects on Irrigated Agriculture Use reported at the national assessment sampling sites

Table 4.5 Sample sites exceeding the TWQR for Irrigated Agriculture Water Use for the Irrigated Agriculture Water Quality Constituents

| Sample Site | Constituent/s Exceeding Good Range | Extent of Exceedence | Location of Site |
|---|---|---|---|
| Luvuvhu and Letaba WMA | | | |
| B9H003Q01 | pH | Purple | Shingwidzi River at Kanniedood Dam/Kruger National Park |
| Crocodile (West) and Marico WMA | | | |
| A2H094Q01 | pH | Purple | Bospoort Dam on Hex River: Down Stream Weir |
| Olifants WMA | | | |
| B3H021Q01 | EC | Yellow | Elands River at Scherp Arabie |
| B4H011Q01 | pH | Purple | Steelpoort River at Alverton |
| B7H009Q01 | pH | Purple | Olifants River at Finale/Liverpool |
| Usutu to Mhlatuze WMA | | | |
| W3H015Q01 | EC; Cl | Yellow; yellow | Hluhluwe River at Valsbaai/St Lucia Inflow |
| W4H006Q01 | pH | Purple | Phongolo River at Ndume Game Reserve |
| Upper Vaal WMA | | | |
| C2H004Q01 | EC | Yellow | Suikerbosrand River at Uitvlugt (RW S2) |
| C2H005Q01 | EC | Yellow | Riet Spruit at Kaal Plaats (RW RV2) |
| Mzimvubu to Keiskamma WMA | | | |
| S3H006Q01 | pH | Purple | Klaas Smits River at Weltevreden/Queenstown |
| Upper Orange WMA | | | |
| D1H001Q01 | pH | Purple | Wonderboom/Stormboom Spruit at Diepkloof/ Burgersdorp |
| Lower Orange WMA | | | |
| D5H021Q01 | SAR; EC; pH; Cl | Yellow; red; purple; red | Sak River at De Kruis/Williston |
| Fish to Tsitsikamma WMA | | | |
| K8H001Q01 | pH | Red | Kruis River at Farm 508 Pineview |
| K8H002Q01 | pH | Red | Elands River at Kwaai Brand Forest Reserve/ Witelbos |
| L3R001Q01 | EC | Yellow | Beervlei Dam at Windheuvel |
| L6H001Q01 | SAR; EC; Cl | Yellow; red; purple | Heuningklip River at Campherspoort |
| L7H006Q01 | Cl | Yellow | Groot River at Grootrivierspoort |
| N1H013Q01 | SAR; EC; Cl | Yellow; red; purple | Mackiesputs Eye at Graaf-Reinet/Van Reyneveldspas |
| N2H007Q01 | EC; Cl | Red; red | Sundays River at De Draay |
| N3H002Q01 | EC; Cl | Yellow; yellow | Voël River at Rietvley |
| N4H003Q01 | SAR; EC; Cl | Yellow; red; purple | Sundays River at Addo Drift East/Addo Bridge |
| P1H003Q01 | SAR; EC; pH; Cl | Yellow; red; purple; purple | Boesmans River at Donkerhoek/Alicedale |
| P3H001Q01 | SAR; EC; Cl | Yellow; purple; purple | Kariega River at Smithfield/Lower Waterford |
| P4H001Q01 | SAR; EC; Cl | Yellow; red; purple | Kowie River at Bathurst/Wolfscrag |
| Q2H002Q01 | EC; pH | Yellow; purple | Great Fish River at Zoutpansdrift |
| Q4H013Q01 | SAR; EC; pH; Cl | Yellow; red; purple; red | Tarka River at Bridge Farm/Tarka Bridge (New Weir) |
| Q6H003Q01 | EC; pH | Yellow; purple | Baviaans River at Botmansgat/De Klerkdal |
| Q7H003Q01 | EC; pH | Yellow; purple | Great Fish River at Leeuwe Drift |
| Q8H011Q01 | EC; pH; Cl | Yellow; purple; yellow | Little Fish River at Rietfontein/Junction Drift |
| Q9H001Q01 | EC; pH; Cl | Yellow; purple; yellow | Great Fish River at Fort Brown Peninsula |
| Q9H018Q01 | EC; pH; Cl | Yellow; purple; yellow | Great Fish River at Matomela's Reserve/Outspan |
| Gouritz WMA | | | |
| J1H019Q01 | SAR; EC; Cl | Yellow; purple; purple | Groot River at Buffelsfontein/Van Wyksdorp |
| J3H011Q01 | SAR; EC; Cl | Red; purple; purple | Olifants River at Warm Water |
| K2H004Q01 | SAR; EC; Cl | Red; purple; purple | Great Brak River at Vishoek |
| K3H001Q01 | pH | Red | Kaaimans River at Upper Barbiers Kraal |
| K4R002Q01 | SAR; EC; Cl | Red; purple; purple | Swart Vlei at Ronde Valley |
| K7H001Q01 | pH | Red | Bloukrans River at Lottering Forest Reserve |
| Breede WMA | | | |
| H5H005Q01 | EC; Cl | Yellow; yellow | Bree River at Wagenboomsheuvel/Drew |

It would appear that there are sampling sites with constituents of real concern from the constituent set (Table 3.4) from an irrigated agriculture use point of view, especially those sites indicated in Table 4.5.

**Sodium Adsorption Ratio (SAR)**

Sodium-sensitive crops can be expected to absorb toxic levels of sodium through the roots at the median SAR values at the Sak River at De Kruis (Lower Orange WMA), Groot River at Buffelsfontein (Gouritz WMA), Heuningklip River at Campherspoort, Mackiesputs Eye at Graaf-Reinet, Sundays River at Addo Drift East, Boesmans River at Donkerhoek, Kariega River at Smithfield, Kowie River at Bathurst and Tarka River at Bridge Farm (all in the Fish to Tsitsikamma WMA).

All sodium-sensitive crops absorb toxic levels of sodium through root uptake (while a number of economically important crops can be irrigated without sodium toxicity developing) at the Olifants River at Warm Water, Great Brak River at Vishoek and Swart Vlei at Ronde Valley (all in the Gouritz WMA).

**Electrical Conductivity (EC)**

According to median electrical conductivity values, a 90 % relative yield of moderately salt-tolerant crops can be maintained by using a low frequency irrigation system at the Elands River at Scherp Arabie (Olifants WMA), Suikerbosrand River at Uitvlugt, Riet Spruit at Kaal Plaats (both in the Upper Vaal WMA), Bree River at Wagenboomsheuvel (Breede WMA), Beervlei Dam at Windheuvel, Groot River at Grootrivierspoort, Voël River at Rietvley, Great Fish River at Zoutpansdrift, Baviaans River at Botmansgat, Great Fish River at Leeuwe Drift, Little Fish River at Rietfontein, Great Fish River at Fort Brown Peninsula, Great Fish River at Matomela's Reserve (all in the Fish to Tsitsikamma WMA) and Hluhluwe River at Valsbaai (Usutu to Mhlatuze WMA).

An 80 % relative yield of moderately salt-tolerant crops can be maintained by using a low frequency irrigation system at the Sak River at De Kruis (Lower Orange WMA), Heuningklip River at Campherspoort, Mackiesputs Eye at Graaf-Reinet, Sundays River at De Draay, Sundays River at Addo Drift East, Boesmans River at Donkerhoek, Kowie River at Bathurst and Tarka River at Bridge Farm (all in the Fish to Tsitsikamma WMA).

The water with median electrical conductivity values recorded at the following sites can still be used for irrigation of selected crops provided that sound irrigation management is practised and yield decreases are acceptable: the Groot River at Buffelsfontein, Olifants River at Warm Water, Great Brak River at Vishoek, Swart Vlei at Ronde Valley (all in the Gouritz WMA) and Kariega River at Smithfield (Fish to Tsitsikamma WMA).

**pH**

Due to the nature of the pH range, an undesirable value can be one that is lower or higher than the *Very Good* range.

The median pH was not *Very Good* (too acid) and results in increasing problems of foliar damage at the Kaaimans River at Upper Barbiers Kraal, Bloukrans River at Lottering Forest Reserve (both in the Gouritz WMA), Kruis River at Farm 508 Pineview and Elands River at Kwaai Brand Forest Reserve (both in the Fish to Tsitsikamma WMA).

The median pH was not *Very Good* (too alkaline) and also results in increasing problems with foliar damage at the Bospoort Dam on Hex River (Crocodile West and Marico WMA), Steelpoort River at Alverton, Olifants River at Finale (both in the Olifants WMA), Shingwidzi River at Kanniedood Dam (Luvuvhu and Letaba WMA), Wonderboom/ Stormboom Spruit at Diepkloof (Upper Orange WMA), Sak River at De Kruis (Lower Orange WMA), Boesmans River at Donkerhoek, Great Fish River at Zoutpansdrift, Tarka River at Bridge Farm, Baviaans River at Botmansgat, Great Fish River at Leeuwe Drift, Little Fish River at Rietfontein, Great

Fish River at Fort Brown Peninsula, Great Fish River at Matomela's Reserve (all in the Fish to Tsitsikamma WMA), Klaas Smits River at Weltevreden (Mzimvubu to Keiskamma WMA) and Phongolo River at Ndume Game Reserve (Usutu to Mhlatuze WMA).

**Chloride (Cl)**

According to median chloride concentrations, crops moderately sensitive to foliar absorption accumulate toxic levels of chloride when foliage is wetted at the Bree River at Wagenboomsheuvel (Breede WMA), Groot River at Grootrivierspoort, Voël River at Rietvley, Little Fish River at Rietfontein, Great Fish River at Fort Brown Peninsula, Great Fish River at Matomela's Reserve (all in the Fish to Tsitsikamma WMA) and Hluhluwe River at Valsbaai (Usutu to Mhlatuze WMA).

Crops moderately sensitive to foliar absorption increasingly accumulate toxic levels of chloride when foliage is wetted at the Sak River at De Kruis (Lower Orange WMA) and Tarka River at Bridge Farm (Fish to Tsitsikamma WMA).

Crops tolerant to foliar absorption increasingly accumulate toxic levels of chloride when foliage is wetted at the Groot River at Buffelsfontein, Olifants River at Warm Water, Great Brak River at Vishoek, Swart Vlei at Ronde Valley (all in the Gouritz WMA), Heuningklip River at Campherspoort, Mackiesputs Eye at Graaf-Reinet, Sundays River at Addo Drift East, Boesmans River at Donkerhoek, Kariega River at Smithfield and Kowie River at Bathurst (all in the Fish to Tsitsikamma WMA).

**Boron (B)**

No sites had elevated boron levels, but it must be said that boron was sampled at very few sites and this, therefore, does not indicate that there are no locations were boron was elevated.

***Link to land cover***

Refer to Table 3.5 and Map 1 and the location of the sites above for an explanation.

**Sodium Adsorption Ratio (SAR)**

The land cover at the sites with elevated sodium adsorption ratio values is as follows: shrub at the Sak River at De Kruis; shrub at the Groot River at Buffelsfontein; shrub and bush at the Heuningklip River at Campherspoort; bush, grass, urban and cultivated land at the Mackiesputs Eye at Graaf-Reinet; bush, shrub and cultivated land at the Sundays River at Addo Drift East; bush, grass, shrub and cultivated land at the Boesmans River at Donkerhoek; bush, grass and forest at the Kariega River at Smithfield; bush, grass and cultivated land at the Kowie River at Bathurst; and shrub, grass and cultivated land at the Tarka River at Bridge Farm.

The land cover at the sites with more elevated sodium adsorption ratio values is as follows: shrub, cultivated land and plantation at the Olifants River at Warm Water; and bush, plantation and cultivated land at the Swart Vlei at Ronde Valley.

**Electrical Conductivity (EC)**

The land cover at the sites with elevated electrical conductivity values resulting in a 90 % relative yield of moderately salt tolerant crops is as follows: cultivated land at the Elands River at Scherp Arabie; cultivated land, grass and urban at the Suikerbosrand River at Uitvlugt; cultivated land, urban and grass at the Riet Spruit at Kaal Plaats; cultivated land and shrub at the Bree River at Wagenboomsheuvel; shrub and degraded land at the Beervlei Dam at Windheuvel; shrub, bush and cultivated land at the Groot River at Grootrivierspoort; shrub and bush at the Voël River at Rietvley; shrub and cultivated land at the Great Fish River at Zoutpansdrift; shrub, bush and cultivated land at the Baviaans River at Botmansgat; shrub, cultivated land and forest at the Great Fish River at Leeuwe Drift; shrub and bush at the Little Fish River at Rietfontein; bush and shrub at the Great Fish River at Fort Brown Peninsula; shrub, bush and cultivated land at the Great Fish River at Matomela's Reserve; and bush, plantation and cultivated land at the Hluhluwe River at Valsbaai.

The land cover at the sites with elevated electrical conductivity values resulting in an 80 % relative yield of moderately salt tolerant crops is as follows: shrub at the Sak River at De Kruis; shrub and bush at the Heuningklip River at Campherspoort; bush, grass, urban and cultivated land at the Mackiesputs Eye at Graaf-Reinet; shrub at the Sundays River at De Draay; bush, shrub and cultivated land at the Sundays River at Addo Drift East; bush, grass, shrub and cultivated land at the Boesmans River at Donkerhoek; bush, grass and cultivated land at the Kowie River at Bathurst; and shrub, grass and cultivated land at the Tarka River at Bridge Farm.

The land cover at the sites with even more elevated electrical conductivity values is as follows: shrub at the Groot River at Buffelsfontein; shrub, cultivated land and plantation at the Olifants River at Warm Water; shrub at the Great Brak River at Vishoek; bush, plantation and cultivated land at the Swart Vlei at Ronde Valley; and bush, grass and forest at the Kariega River at Smithfield.

The range of land cover types seen in each class indicates that there is not a strong correlation between land cover and the electrical conductivity value.

**pH**

Land cover types where the water was too acid: bush and plantation at the Kaaimans River at Upper Barbiers Kraal; forest, plantation and bush at the Bloukrans River at Lottering Forest Reserve; cultivated land and bush at the Kruis River at Farm 508 Pineview; and cultivated land, bush and urban at the Kwaai Brand Forest Reserve.

Land cover types where the water was too alkaline: bush at the Bospoort Dam on the Hex River; bush and cultivated land at the Steelpoort River at Alverton; cultivated land, degraded land and bush at the Olifants River at Finale; bush at the Shingwidzi River at Kanniedood Dam; shrub and bush at the Wonderboom/Stormboom Spruit at Diepkloof; shrub at the Sak River at De Kruis; bush, grass, shrub and cultivated land at the Boesmans River at Donkerhoek; shrub and cultivated land at the Great Fish River at Zoutpansdrift; shrub, grass and cultivated land at the Tarka River at Bridge Farm; shrub, bush and cultivated land at the Baviaans River at Botmansgat; shrub, cultivated land and forest at the Great Fish River at Leeuwe Drift; shrub and bush at the Little Fish River at Rietfontein; bush and shrub at the Great Fish River at Fort Brown Peninsula; shrub, bush and cultivated land at the Great Fish River at Matomela's Reserve; grass, bush and degraded land at the Klaas Smits River at Weltevreden; and forest, bush and cultivated land at the Phongolo River at Ndume Game Reserve.

**Chloride (Cl)**

The land cover at sites where crops moderately sensitive to foliar absorption accumulate toxic levels of chloride when foliage is wetted are as follows: cultivated land and shrub at the Bree River at Wagenboomsheuvel; shrub, bush and cultivated land at the Groot River at Grootrivierspoort; shrub and bush at the Voël River at Rietvley; shrub and bush at the Little Fish River at Rietfontein; bush and shrub at the Great Fish River at Fort Brown Peninsula; shrub, bush and cultivated land at the Great Fish River at Matomela's Reserve; bush, plantation and cultivated land at the Hluhluwe River at Valsbaai.

The land cover at sites where crops moderately sensitive to foliar absorption increasingly accumulate toxic levels of chloride when foliage is wetted are as follows: shrub at the Sak River at De Kruis; and shrub, bush and cultivated land at the Tarka River at Bridge Farm.

The land cover at sites where crops tolerant to foliar absorption increasingly accumulate toxic levels of chloride when foliage is wetted are as follows: shrub at the Groot River at Buffelsfontein; shrub, cultivated land and plantation at the Olifants River at Warm Water; shrub at the Great Brak River at Vishoek; bush, plantation and cultivated land at the Swart Vlei at Ronde Valley; shrub and bush at the Heuningklip River at Campherspoort; bush, grass, urban and cultivated land at the Mackiesput Eye at Graaf-Reinet; bush, shrub and cultivated land at the Sundays River at Addo Drift East; bush, grass, shrub and cultivated land at the Boesmans River at Donkerhoek; bush, grass and forest at the Kariega River at Smithfield; and bush, grass and cultivated land at the Kowie River at Bathurst.

**"Hot Spot" Information from Additional WMA Sites**

Refer to Map 10 and Table 4.6 for the location of the "hot spots" as they relate to irrigated agriculture. They are the sites from the individual WMAs (and the national assessment sample site set) that exceed the Target Water Quality Range for the selected variables and fitness-for-use for irrigated agriculture.

Map 10 Water quality effects on Irrigated Agriculture Use reported at the “hot spot” sample sites

Table 4.6 WMA sample sites ("hot spot" sites) exceeding the TWQR for Irrigated Agriculture Water Use for the Irrigated Agriculture Water Quality Constituents

| WMA Site | Sample Site | Constituent/s Exceeding Good Range | Extent of Exceedence | Location of Site |
|---|---|---|---|---|
| Luvuvhu and Letaba WMA | | | | |
| 94 | B9H003Q01 | pH | Purple | Shingwidzi River At Kanniedood Dam/ Kruger National Park |
| Crocodile (West) and Marico WMA | | | | |
| 11 | A2H033Q01 | pH | Purple | Nouklip Eye At Hartbeeshoek |
| 26 | A2H094Q01 | pH | Purple | Bospoort Dam On Hex River: Down Stream Weir |
| 39 | A2R012Q01 | pH | Purple | Klipvoor Dam On Pienaars River: Near Dam Wall |
| 41 | A2R016Q01 | pH | Purple | Leeukraal Dam On Apies River: Near Dam Wall |
| Olifants WMA | | | | |
| 95 | B1H002Q01 | EC | Yellow | Spook Spruit At Elandspruit |
| 96 | B1H004Q01 | pH; EC | Red; yellow | Klip Spruit At Zaaihoek |
| 104 | B1H019Q01 | EC | Yellow | Noupoort Spruit At Naauwpoort |
| 105 | B1H020Q01 | EC | Yellow | Koring Spruit At Vaalkranz |
| 125 | B3H021Q01 | EC | Yellow | Elands River At Scherp Arabie |
| 132 | B4H011Q01 | pH | Purple | Steelpoort River At Alverton |
| 145 | B7H009Q01 | pH | Purple | Olifants River At Finale/Liverpool |
| 147 | B7H015Q01 | pH | Purple | Olifants River At Mamba/Kruger National Park |
| 148 | B7H019Q01 | EC; Cl | Yellow; yellow | Ga-Selati River At Loole/Foskor |
| Usutu to Mhlatuze WMA | | | | |
| 669 | W3H008Q01 | pH | Purple | Mkuze River At Doornhoek |
| 671 | W3H012Q01 | EC; Cl | Yellow; red | Mzinene River At Cloete |
| 673 | W3H015Q01 | EC; Cl | Yellow; yellow | Hluhluwe River At Valsbaai/St Lucia Inflow |
| 675 | W3H023Q01 | EC | Yellow | Nkongolwana River At Veelsgeluk/ Kongolana (Cp5) |
| 686 | W3R002Q01 | SAR; pH; EC; Cl | Purple; purple; purple; purple | Lake St Lucia At Lister's Point |
| 688 | W4H006Q01 | pH | Purple | Phongolo River At M'Hlati |
| Thukela WMA | | | | |
| 611 | V1H009Q01 | pH | Purple | Bloukrans River At Frere |
| 638 | V6H003Q01 | pH | Purple | Wasbank River At Kuikvlei |
| 642 | V6H011Q01 | pH | Purple | Wasbank River At Uithoek |
| 643 | V6H013Q01 | pH | Purple | Wasbank River At Wasbank |
| 644 | V6H016Q01 | pH | Purple | Mkomazana River At Wasbank |
| 645 | V6H017Q01 | pH | Purple | Blinkwater River At Lynwood |
| 646 | V6H018Q01 | pH | Purple | Tholeni River At Vaalkop |
| 647 | V6H019Q01 | pH | Purple | Wasbank River At Vaalkop |
| 648 | V6H020Q01 | pH | Purple | Wasbank River At Asynkraal |
| Upper Vaal WMA | | | | |
| 162 | C2H004Q01 | EC | Yellow | Suikerbosrand River At Uitvlugt (Rw S2) |
| 163 | C2H005Q01 | EC | Yellow | Riet Spruit At Kaal Plaats (Rw Rv2) |
| 166 | C2H013Q01 | EC | Yellow | Upper Turffontein Eye At Turffontein |
| 173 | C2H069Q01 | EC | Yellow | Mooirivierloop (River) At Blaaubank |
| 179 | C2H132Q01 | EC | Yellow | Riet Spruit At Tamboekiesfontein |
| 180 | C2H133Q01 | EC | Yellow | Blesbok Spruit At Heidelberg |
| 181 | C2H134Q01 | EC | Yellow | Cowles Dam Outflow At Springs |
| 182 | C2H135Q01 | EC | Yellow | Natal Spruit At Rietfontein |
| 183 | C2H136Q01 | EC | Yellow | Riet Spruit At Waterval |

| WMA Site | Sample Site | Constituent/s Exceeding Good Range | Extent of Exceedence | Location of Site |
|---|---|---|---|---|
| 187 | C2H146Q01 | EC | Yellow | Blesbok Spruit At Dagafontein – 2Km D/Stream N17 |
| 189 | C2H149Q01 | EC | Yellow | Blesbok Spruit At Nigel East – R51 Bridge (B8) |
| 190 | C2H153Q01 | EC | Yellow | Wonderfontein Spruit At Randfontein Azaadville Bridge |
| 191 | C2H154Q01 | EC | Yellow | Wonderfontein Spruit At Bridge On The Doornkop |
| 193 | C2H161Q01 | EC | Yellow | Wonderfontein Spruit On Gravel Road Bridge |
| 200 | C2H234Q01 | EC | Yellow | Suikerbosrant River At Badfontein |
| 201 | C2R001Q01 | pH | Purple | Boskop Dam On Mooi River: Near Dam Wall |
| 202 | C2R003Q01 | pH | Purple | Klerkskraal Dam On Mooi River: Near Dam Wall |
| 203 | C2R004Q01 | pH | Purple | Potchefstroom Dam On Mooi River: Near Dam Wall |
| Middle Vaal WMA | | | | |
| 230 | C2H073Q01 | EC | Yellow | Skoon Spruit At Goedgenoeg/Orkney Bridge |
| 231 | C2H139Q01 | EC | Yellow | Koekemoer Spruit At Buffelsfontein |
| 232 | C2R002Q01 | pH | Purple | Johan Nesser Dam On Skoon Spruit: Near Dam Wall |
| 234 | C4H016Q01 | EC; Cl | Yellow; yellow | Sand River At Bloudrif |
| 235 | C4H017Q01 | EC; Cl | Yellow; yellow | Sand River At Doring River/Bloudrif |
| 244 | C7R001Q01 | pH | Purple | Koppies Dam On Renoster River: Near Dam Wall |
| Mvoti to Umzimkulu WMA | | | | |
| 600 | U6H005Q01 | SAR; EC | Red; yellow | Sterk Spruit At Zigzag/Claires Est/ Shongweni Dam- |
| Mzimvubu to Keiskamma WMA | | | | |
| 510 | R2H009Q01 | pH | Purple | Ngqokweni River At Sheshegu 5/ Mgqokweni 19 |
| 512 | R2H015Q01 | pH; EC; Cl | Purple; yellow; yellow | Yellowwoods River At Fort Murray Outspan |
| 513 | R2H016Q01 | SAR; pH; EC; Cl | Red; purple; red; red | Zwelitsha Spruit At Malakalaka |
| 522 | S1R001Q01 | pH | Purple | Xonxa Dam On White Kei River: Near Dam Wall |
| 525 | S3H004Q01 | pH | Purple | Black Kei River At Cathcarts Gift/ Endwell |
| 526 | S3H005Q01 | pH | Purple | Oskraal River At Whittlesea |
| 527 | S3H006Q01 | pH | Purple | Klaas Smits River At Weltevreden/ Queenstown |
| 539 | S7H004Q01 | pH | Purple | Great Kei River At Area 8 Sprigs B/ Transkei Border |
| Upper Orange WMA | | | | |
| 261 | D1H001Q01 | pH | Purple | Wonderboom/Stormb. Spruit At Diepkloof/Burgersdorp |
| Lower Orange WMA | | | | |
| 283 | D5H017Q01 | SAR; EC; Cl | Red; purple; purple | Renoster River At Leeuwenkuil |
| 284 | D5H021Q01 | SAR; pH; EC; Cl | Red; purple; red; red | Sak River At De Kruis/Williston |
| 285 | D5R001Q01 | pH | Purple | Rooiberg Dam On Hartbees River: Near Dam Wall |
| Fish to Tsitsikamma WMA | | | | |
| 444 | K8H001Q01 | pH | Red | Kruis River At Farm 508 Pineview |
| 445 | K8H002Q01 | pH | Red | Elands River At Kwaai Brand Forest Reserve/Witelsbos |
| 449 | L3R001Q01 | EC | Yellow | Beervlei Dam At Windheuvel |
| 450 | L6H001Q01 | SAR; pH; EC; Cl | Red; purple; purple; purple | Heuningklip River At Campherspoort |
| 452 | L7H007Q01 | SAR; EC; Cl | Purple; purple; purple | Groot River At Sandpoort |
| 453 | L8H001Q01 | pH | Red | Wabooms River At Diepkloof |
| 459 | M1H012Q01 | EC; Cl | Yellow; red | Swartkops River At Uitenhage/Nivens Bridge |
| 461 | N1H013Q01 | SAR; EC; Cl | Red; red; purple | Mackiesputs Eye At Graaf-Reinet/ Van Reyneveldspas |
| 462 | N1R001Q01 | SAR; EC; Cl | Red; red; purple | Van Reyneveldspas Dam On Sundays River |
| 463 | N2H007Q01 | pH; EC; Cl | Purple; red; purple | Sundays River At De Draay |
| 464 | N2H009Q01 | pH; EC | Purple; yellow | Volkers River At Volkersrivier |
| 465 | N2R001Q01 | pH | Purple | Darlington Dam On Sundays River At Dwaas |

| WMA Site | Sample Site | Constituent/s Exceeding Good Range | Extent of Exceedence | Location of Site |
|---|---|---|---|---|
| 466 | N3H002Q01 | EC; Cl | Yellow; yellow | Voël River At Rietvley |
| 467 | N4H001Q01 | pH; EC | Purple; yellow | Sundays River At Korhaanspoort/ Couransdrift |
| 468 | N4H003Q01 | SAR; pH; EC; Cl | Red; purple; red; purple | Sundays River At Addo Drift East/ Addo Bridge |
| 469 | N4H005Q01 | SAR; EC; Cl | Purple; purple; purple | Coerney River At Selborne/Carlton |
| 470 | P1H003Q01 | SAR; pH; EC; Cl | Red; purple; red; purple | Boesmans River At Donkerhoek/ Alicedale |
| 471 | P1R003Q01 | SAR; pH; EC; Cl | Red; purple; red; purple | Nuwejaars Dam On Nuwejaars Spruit At Nuwejaars Drift West |
| 472 | P3H001Q01 | SAR; EC; Cl | Red; purple; purple | Kariega River At Smithfield/Lower Waterford |
| 475 | P4H001Q01 | SAR; EC; Cl | Red; red; purple | Kowie River At Bathurst/Wolfscrag |
| 480 | Q2H002Q01 | pH; EC | Purple; yellow | Great Fish River At Zoutpansdrift |
| 481 | Q3H004Q01 | pH; EC | Purple; yellow | Pauls River At Coutzenburg |
| 483 | Q4H013Q01 | SAR; pH; EC; Cl | Red; purple; red; red | Tarka River At Bridge Farm/Tarka Bridge (New Weir) |
| 485 | Q5H005Q01 | SAR; pH; EC; Cl | Red; purple; red; red | Great Fish River At Van Stadens Dam/Mortimer Weir |
| 486 | Q6H003Q01 | pH; EC | Purple; yellow | Baviaans River At Botmansgat/De Klerkdal |
| 487 | Q7H003Q01 | pH; EC | Purple; yellow | Great Fish River At Leeuwe Drift |
| 488 | Q7H005Q01 | pH; EC; Cl | Purple; yellow; yellow | Great Fish River Atsout Vlei/Sheldon |
| 489 | Q8H008Q01 | pH; EC | Purple; yellow | Little Fish River At Doornkraal |
| 490 | Q8H010Q01 | pH; EC | Purple; yellow | Little Fish River At Grootvlakte |
| 491 | Q8H011Q01 | pH; EC; Cl | Purple; yellow; yellow | Little Fish River At Rietfontein/Junction Drift |
| 492 | Q8R001Q01 | pH | Purple | De Mist Kraal Dam On Little Fish River |
| 493 | Q9H001Q01 | SAR; | Purple; yellow; yellow | Great Fish River At Fort Brown Peninsula |
| 495 | Q9H012Q01 | pH; EC; Cl | Purple; yellow; yellow | Great Fish River At Brandtlegte/ Piggot's Bridge |
| 496 | Q9H017Q01 | pH | Purple | Blinkwater River At Blinkwater |
| 497 | Q9H018Q01 | SAR; | Purple; yellow; yellow | Great Fish River At Matomela's Reserve/Outspan |
| Gouritz WMA | | | | |
| 374 | H8H003Q01 | pH | Red | Duiwenhoks Dam On Duiwenhoks River: Down Stream Weir |
| 375 | H9H002Q01 | pH | Red | Vet River At The Camp |
| 376 | H9H004Q01 | pH | Red | Kruis River At Aan De Kruisrivier/Swq 3-44 |
| 378 | H9H006Q01 | pH | Red | Canal From Goukoul River At Groote Bosch |
| 379 | H9H010Q01 | pH | Red | Korinte-Vet Dam On Korinte River: Down Stream Weir |
| 380 | H9R001Q01 | pH | Red | Korinte-Vet Dam On Korinte River: Near Dam Wall |
| 383 | J1H017Q01 | SAR; EC; Cl | Red; red; purple | Sand River At Buffelsfontein/Van Wyksdorp |
| 384 | J1H019Q01 | SAR; EC; Cl | Red; purple; purple | Groot River At Buffelsfontein/Van Wyksdorp |
| 388 | J1R002Q01 | pH; EC; Cl | Purple; yellow; red | Bellair Dam On Brak River: Near Dam Wall |
| 390 | J1R004Q01 | EC; Cl | Yellow; red | Miertjeskraal Dam On Brand River: Near Dam Wall |
| 391 | J2H005Q01 | EC; Cl | Yellow; yellow | Huis River At Zoar |
| 401 | J3H011Q01 | SAR; EC; Cl | Purple; purple; purple | Olifants River At Warm Water |
| 411 | J3R002Q01 | EC; Cl | Yellow; yellow | Stompdrif Dam On Olifants River: Near Dam Wall |
| 416 | K1H017Q01 | EC; Cl | Yellow; yellow | Hartebeeskuil Dam On Hartenbos River: Down Stream |
| 417 | K1H021Q01 | EC; Cl | Yellow; red | Hartenbos River At Hartenbosch |
| 418 | K1R001Q01 | EC; Cl | Yellow; yellow | Hartebeeskuil Dam On Hartenbos River: Near Dam Wall |
| 423 | K3H001Q01 | pH | Red | Kaaimans River At Upper Barbiers Kraal |
| 426 | K3H004Q01 | pH | Red | Malgas River At Blanco |
| 427 | K3H005Q01 | pH | Red | Touws River At Farm 162/Geo.F.12-8 |
| 430 | K3R002Q01 | pH | Red | Garden Route Dam On Swart River: Near Dam Wall |

| WMA Site | Sample Site | Constituent/s Exceeding Good Range | Extent of Exceedence | Location of Site |
|---|---|---|---|---|
| 434 | K3R006Q01 | SAR; EC; Cl | Purple; purple; purple | Touws River Estuary At Wilderness |
| 435 | K4H001Q01 | pH | Red | Hoekraal River At Eastbrook |
| 436 | K4H002Q01 | pH | Red | Karatara River At Karatara Forest Reserve |
| 438 | K4R001Q01 | SAR; pH; EC; Cl | Purple; purple; red; purple | Groen Vlei At Ruygte Valley |
| 439 | K4R002Q01 | SAR; EC; Cl | Purple; purple; purple | Swart Vlei At Ronde Valley/ Hoogekraal |
| 440 | K5H002Q01 | pH | Red | Knysna River At Milwood Forest Reserve |
| 441 | K5R001Q01 | SAR; EC; Cl | Purple; purple; purple | Knysna Lagoon At Knysna |
| Olifants/Doorn WMA | | | | |
| 298 | G3H001Q01 | SAR; EC; Cl | Red; red; purple | Kruis River At Tweekuilen/Eendekuil |
| Breede WMA | | | | |
| 326 | G4H006Q01 | EC; Cl | Yellow; yellow | Klein River At Can Q5-8/ Wagenboomsdrift |
| 330 | G4R001Q01 | pH | Red | Steenbras Dam On Steenbras River: Near Dam Wall |
| 331 | G4R002Q01 | pH | Red | Eikenhof Dam On Palmiet River: Near Dam Wall |
| 332 | G4R003Q01 | SAR; EC; Cl | Purple; purple; purple | Bot River Vlei On Bot River At Ysterklip/Hermanus |
| 333 | G4R004Q01 | SAR; EC; Cl | Purple; purple; purple | Klein River Vlei On Klein Riv At Rocklands/Yacht |
| 334 | G5H008Q01 | SAR; EC; Cl | Purple; purple; purple | Sout River At Kykoedy |
| 337 | H1H007Q01 | pH | Red | Wit River At Drosterskloof |
| 338 | H1H009Q01 | pH | Red | Holsloot River At Boontjiesrivier |
| 341 | H1H018Q01 | pH | Red | Molenaars River At Hawequas Forest Reserve |
| 342 | H1H033Q01 | pH | Red | Elands River At Hawequas Forest Reserve |
| 347 | H2H010Q01 | EC; Cl | Red; red | Hex River At Worcester/Drie Riviere (Bridge) |
| 350 | H3H011Q01 | SAR; EC; Cl | Red; red; purple | Kogmanskloof River At Goudmyn |
| 352 | H4H016Q01 | EC; Cl | Yellow; yellow | Keisers River At Mc Gregor Commonage/Vrolykheid |
| 354 | H4H018Q01 | SAR; EC; Cl | Red; purple; purple | Poesjenels River At La Chasseur |
| 355 | H4H019Q01 | EC; Cl | Red; red | Vink River At De Gorree |
| 356 | H4H020Q01 | EC; Cl | Red; purple | Nuy River At Doornrivier |
| 360 | H4R003Q01 | pH | Red | Klipberg Dam On Konings River: Near Dam Wall |
| 362 | H5H004Q01 | EC; Cl | Yellow; yellow | Bree River At Wolvendrift/Secunda |
| 363 | H5H005Q01 | EC; Cl | Yellow; yellow | Bree River At Wagenboomsheuvel/ Drew |
| 364 | H6H005Q01 | pH | Red | Baviaans River At Genadendal Mission Station |
| 369 | H7H005Q01 | pH | Red | Hermitage River At Swellendam Forest Reserve |
| 371 | H7H007Q01 | pH | Red | Grootkloof River At Sparkenbosch |
| Berg WMA | | | | |
| 302 | G1H009Q01 | EC; Cl | Yellow; red | Brakkloof Spruit At Knolvlei Forest Reserve |
| 303 | G1H012Q01 | pH | Red | Watervals River At Watervalsberge/ Lower Watervals |
| 309 | G1H024Q01 | SAR; EC; Cl | Purple; purple; purple | Berg River At Kliphoek |
| 311 | G1H034Q01 | SAR; EC; Cl | Purple; purple; purple | Moorreesburg Spruit At Holle River |
| 312 | G1H035Q01 | SAR; EC; Cl | Red; red; purple | Matjies River At Matjiesfontein |
| 314 | G1H039Q01 | SAR; EC; Cl | Red; red; purple | Doring River At Grensplaas/Diepe Gat |
| 315 | G1H040Q01 | EC; Cl | Yellow; red | Fish River At La Fonteine |
| 317 | G1H064Q01 | PH | Purple; red | Banghoek River At Bosmanshoek (Compensation Water) |
| 321 | G2H012Q01 | EC; Cl | Yellow; red | Diep River At Malmesbury |

## 4.4 Trophic Status

The trophic status of each of the previously mentioned impoundments is reflected in Table 4.7.

Table 4.7 The Trophic Status of Selected Impoundments (after van Ginkel *et al.,* 2001)

| Water Management Area | Impoundment | Trophic Status |
|---|---|---|
| Luvuvhu and Letaba | Ebenezer Dam | Oligotrophic |
| | Magoebaskloof Dam | Oligotrophic to mesotrophic |
| | Tzaneen Dam | Oligotrophic |
| Crocodile (West) and Marico | Bon Accord Dam | Eutrophic to hypereutrophic |
| | Buffelspoort Dam | Not sampled |
| | Hartbeespoort Dam | Eutrophic to hypereutrophic |
| | Klipvoor Dam | Hypereutrophic |
| | Kosterrivier Dam | Eutrophic |
| | Lindleyspoort Dam | Eutrophic |
| | Rietvlei Dam | Hypereutrophic |
| | Roodekopjes Dam | Oligotrophic to mesotrophic |
| | Roodeplaat Dam | Hypereutrophic |
| | Vaalkop Dam | Mesotrophic to Eutrophic |
| Olifants | Bronkhorstspruit Dam | Oligotrophic |
| | Witbank Dam | Mesotrophic |
| | Middelburg Dam | Oligotrophic |
| | Loskop Dam | Mesotrophic |
| Usutu to Mhlatuze | Klipfontein Dam | Hypereutrophic to eutrophic |
| Upper, Middle and Lower Vaal | Allemanskraal Dam | Hypereutrophic |
| | Bloemhof Dam | Eutrophic to hypereutrophic |
| | Boskop Dam | Mesotrophic |
| | Erfenis Dam | Hypereutrophic |
| | Grootdraai Dam | Eutrophic |
| | Koppies Dam | Eutrophic |
| | Sterkfontein Dam | Mesotrophic |
| | Vaal Dam | Eutrophic to hypereutrophic |
| Mvoti to Umzimkulu | Albert Falls Dam | Mesotrophic to eutrophic |
| | Inanda Dam | Mesotrophic |
| | Midmar Dam | Mesotrophic |
| | Nagle Dam | Mesotrophic (towards Eutrophic) |
| | Hazelmere Dam | Mesotrophic (towards Eutrophic) |
| | Shongweni Dam | Hypereutrophic |
| Mzimvubu to Keiskamma | Bridledrift Dam | Eutrophic to hypereutrophic |
| | Laing Dam | Eutrophic to hypereutrophic |
| Upper and Lower Orange | Gariep Dam | Eutrophic |
| | Cook's Lake | Hypereutrophic |
| | Disaneng Dam | Mesotrophic |
| | Lotlamoreng Dam | Hypereutrophic to eutrophic |
| | Setumo (Modimola) Dam | Eutrophic |
| Fish to Tsitsikamma | Bo-Lang Vlei | Eutrophic |
| | Groen Vlei | Mesotrophic |
| | Onder-Lang Vlei | Mesotrophic |
| | Ronde Vlei | Eutrophic |
| | Sedgefield Lagoon | Oligotrophic |
| | Swart Vlei | Oligotrophic |
| | Wilderness Lagoon | Mesotrophic |
| Berg | Misverstand Dam | Eutrophic to hypereutrophic |
| | Voëlvlei Dam | Mesotrophic |
| | Wemmershoek Dam | Mesotrophic to Oligotrophic |

It is rather disturbing to note the number of impoundments listed in Table 4.7 that have a trophic status in the eutrophic to hypereutrophic classes. The list of impoundments that are classified by van Ginkel *et al*. (2001) as oligotrophic or mesotrophic is shorter: the Roodekopjes Dam; Bronkhorstspruit Dam, Witbank Dam; Middelburg Dam; Loskop Dam; Ebenezer Dam; Magoebaskloof Dam; Tzaneen Dam; Boskop Dam; Sterkfontein Dam; Disaneng Dam; Voëlvlei Dam; Wemmershoek Dam; Groen Vlei; Onder-Land Vlei; Sedgefield Lagoon; Swart Vlei; Wilderness Lagoon; Inanda Dam and Midmar Dam.

The impoundments are ranked according to the greatest need to undertake eutrophication management (van Ginkel *et al.*, 2001) in Table 4.8.

Table 4.8 The priority ranking of selected impoundments throughout South Africa out of 49 impoundments included in the study of van Ginkel *et al.* (2001) indicating the relative need for eutrophication management

| Water Management Area | Impoundment | Priority ranking |
|---|---|---|
| Crocodile (West) and Marico | Rietvlei Dam | 1 |
| Crocodile (West) and Marico | Klipvoor Dam | 2 |
| Upper and Lower Orange | Cooke's Lake | 3 |
| Crocodile (West) and Marico | Roodeplaat Dam | 4 |
| Crocodile (West) and Marico | Bon Accord Dam | 5 |
| Crocodile (West) and Marico | Hartbeespoort Dam | 6 |
| Upper, Middle and Lower Vaal | Erfenis Dam | 7 |
| Upper and Lower Orange | Lotlamoreng Dam | 8 |
| Upper, Middle and Lower Vaal | Bloemhof Dam | 9 |
| Mvoti to Umzimkulu | Shongweni Dam | 10 |
| Mzimvubu to Keiskamma | Bridledrift Dam | 11 |
| Upper, Middle and Lower Vaal | Koppies Dam | 12 |
| Mzimvubu to Keiskamma | Laing Dam | 13 |
| Berg | Misverstand Dam | 14 |
| Upper, Middle and Lower Vaal | Allemanskraal Dam | 15 |
| Upper and Lower Orange | Gariep Dam | 16 |
| Upper, Middle and Lower Vaal | Vaal Dam | 17 |
| Crocodile (West) and Marico | Kosterrivier Dam | 18 |
| Crocodile (West) and Marico | Lindleyspoort Dam | 19 |
| Upper and Lower Orange | Setumo Dam | 20 |
| Upper, Middle and Lower Vaal | Grootdraai Dam | 21 |
| Fish to Tsitsikamma | Bo-Lang Vlei | 22 |
| Usutu to Mhlatuze | Klipfontein Dam | 23 |
| Fish to Tsitsikamma | Ronde Vlei | 24 |
| Crocodile (West) and Marico | Vaalkop Dam | 25 |
| Mvoti to Umzimkulu | Inanda Dam | 26 |
| Olifants | Bronkhorstspruit Dam | 27 |
| Crocodile (West) and Marico | Roodekopjes Dam | 28 |
| Mvoti to Umzimkulu | Albert Falls Dam | 29 |
| Mvoti to Umzimkulu | Hazelmere Dam | 30 |
| Olifants | Witbank Dam | 31 |
| Mvoti to Umzimkulu | Nagle Dam | 32 |
| Olifants | Middelburg Dam | 33 |
| Fish to Tsitsikamma | Onder-Lang Vlei | 34 |
| Luvuvhu and Letaba | Magoebaskloof Dam | 35 |
| Mvoti to Umzimkulu | Midmar Dam | 36 |
| Upper, Middle and Lower Vaal | Sterkfontein Dam | 37 |
| Upper and Lower Orange | Disaneng Dam | 38 |
| Luvuvhu and Letaba | Tzaneen Dam | 39 |
| Berg | Voël Vlei | 40 |
| Olifants | Loskop Dam | 41 |
| Luvuvhu and Letaba | Ebenezer Dam | 42 |
| Upper, Middle and Lower Vaal | Boskop Dam | 43 |
| Fish to Tsitsikamma | Groen Vlei | 44 |
| Berg | Wemmershoek Dam | 45 |
| Fish to Tsitsikamma | Wilderness Lagoon | 46 |
| Fish to Tsitsikamma | Sedgefield Lagoon | 47 |
| Fish to Tsitsikamma | Swart Vlei | 48 |
| Crocodile (West) and Marico | Buffelspoort Dam (not sampled) | 49 |

According to Table 4.8, the impoundments most in need of eutrophication management are situated in the Crocodile (West) Marico WMA, with five out of the top ten priority impoundments being situated in this WMA.

# 5. CONCLUSIONS

## 5.1 Domestic Use

The main water quality problems throughout the country for domestic use relate to the widespread elevated salt levels (high TDS values) and elevated fluoride levels in certain locations.

Water with elevated TDS levels tastes salty and does not slake thirst. The elevated salt levels (as expressed by TDS concentrations) also decrease the aesthetic value of water. Consumption of the water may not produce adverse health effects in the short-term, but there is a slight possibility of salt overload in sensitive individuals in the long term. TDS levels were especially elevated in the Lower Orange, Fish to Tsitsikamma and Gouritz WMAs. It would appear that these elevated levels are due to natural reasons. The Breede and Berg WMAs have elevated TDS levels when considering the individual WMA sample sites.

High fluoride (F) levels were evident in the lower Olifants WMA. Health effects and tooth staining can be expected at the concentrations evident at selected sample sites.

At a WMA scale, pH values were also seen to deviate in various parts of the country. The pH was low in the Klip Spruit (of the Olifants WMA) and would likely result in irritation of the mucous membranes of water users in this area. It is likely that the source of the low pH is the acid mine drainage from the coalmines and mine dumps in the area. A notable effect of the low pH would be "burning eyes" with the use of the water for recreational purposes.

Magnesium (Mg), sulphate ($SO_4$), chloride (Cl), sodium (Na) and potassium (K) were also elevated in various parts of the country.

## 5.2 Irrigation Use

From an irrigated agriculture use perspective, the sodium adsorption ratio (SAR), electrical conductivity (EC), pH and chloride (Cl) were elevated in various regions of the country.

There were high pH levels in the Luvuvhu and Letaba, Crocodile (West) and Marico, Olifants, Usutu to Mhlatuze, Mzimvubu to Keiskamma, Upper Orange and Lower Orange WMAs.

The Fish to Tsitsikamma and Gouritz WMAs had low pH values and high sodium adsorption ratio, electrical conductivity and chloride values; making irrigated agriculture in these WMAs more challenging, and limiting crop selection to more salt tolerant crops.

The Thukela WMA had high pH values, with the Upper and Middle Vaal WMAs having high electrical conductivity values.

The South Western Cape (Breede and Berg WMAs) had low pH values evident in some cases and elevated sodium adsorption ratio, electrical conductivity and chloride values, again limiting the potential for growing salt sensitive crops.

## 5.3 Trophic Status of Selected Impoundments

South Africa has disturbing levels of nutrient enrichment at many of its impoundments. This is something that requires urgent attention. The most enriched impoundments are often those that have the greatest concentration of humans in their catchment areas. The top ten impoundments in need of nutrient management are:

- Rietvlei Dam (in the Crocodile (West) and Marico WMA),
- Klipvoor Dam (in the Crocodile (West) and Marico WMA),
- Cooke's Lake (in the Upper and Lower Orange WMAs),
- Roodeplaat Dam (in the Crocodile (West) and Marico WMA),
- Bon Accord Dam (in the Crocodile (West) and Marico WMA),
- Hartbeespoort Dam (in the Crocodile (West) and Marico WMA),
- Erfenis Dam (in the Upper, Middle and Lower Vaal WMAs),
- Lotlamoreng Dam (in the Upper and Lower Orange WMAs),
- Bloemhof Dam (in the Upper, Middle and Lower Vaal WMAs), and
- Shongweni Dam (in the Mvoti to Umzimkulu WMA).

Apart from the aesthetic aspects of water with a "pea-soup" appearance, eutrophication leads to the frequent occurrence of toxic algal blooms, with the danger of fish and cattle deaths, and the induction of gastro-enteritis in humans.

## 6. RECOMMENDATIONS

The following recommendations are proposed:

- Revision of the existing monitoring network is necessary to terminate sampling at unnecessary sites and expand the network to cover more adequately the sensitive problem areas or those areas with insufficient sampling sites.

- Role players must be informed of the impact of land uses that result in deterioration in the water quality. This is especially important for mining and agriculture.

- Ways to improve the water quality at those negatively impacted sites must be investigated.

- Water users at sites where there is water that could be detrimental to their health should be informed to take appropriate precautions. Safe water should be provided to those domestic users who have no access to a safe and healthy water supply.

- Water resources should be protected, in particular the more pristine water sources, in order that their quality does not deteriorate as a result of a change in land use or management practice.

- The trophic status monitoring and assessment programme should be expanded to include more of the impoundments throughout the country and appropriate land-use management practises should be encouraged to prevent or minimise large nutrient loads entering the aquatic environment.

## 7. REFERENCES

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# 8. APPENDICES

## 8.1 Appendix A: Basic Statistics for the National Sampling Site Set

## 8.2 Appendix B: Land cover types and extent of areal cover across South Africa per WMA (after Fairbanks *et al.*, 2000)

## 8.3 Appendix C: Barcode Graphs for the National Sampling Sites that Exceed the *Very Good* and *Good* (or TWQR) Categories

## 8.1 Appendix A: Basic Statistics for the National Sampling Site Set

| WMS No. | Feature Name | Type of Statistics | pH | $NO_3$+$NO_2$-N | $NH_4$-N | F | Na | Mg | $SO_4$ | Cl | K | Ca | EC | DMS | SAR | TURB (NTU) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 90167 | A2H019Q01 | Number of Elements | 145 | 145 | 145 | 145 | 145 | 145 | 145 | 145 | 145 | 145 | 145 | 145 | 143 | 130 |
| 90167 | A2H019Q01 | Median | 8.26 | 0.594 | 0.17 | 0.37 | 46.8 | 24.37 | 71 | 57.9 | 6.43 | 38 | 61.4 | 429.3 | 1.456 | 1 |
| 90167 | A2H019Q01 | 95% Percentile | 8.494 | 2.036 | 0.4048 | 0.48 | 60.98 | 29.94 | 88.12 | 74.13 | 7.649 | 46.98 | 71.88 | 495 | 1.809 | 9.924 |
| | | | | | | | | | | | | | | | | |
| 90168 | A2H021Q01 | Number of Elements | 145 | 145 | 145 | 145 | 145 | 145 | 145 | 145 | 145 | 145 | 145 | 145 | 140 | 128 |
| 90168 | A2H021Q01 | Median | 8.31 | 0.3 | 0.051 | 0.45 | 50.3 | 17.87 | 51.1 | 48.6 | 8.58 | 35.5 | 56.2 | 420 | 1.7 | 2 |
| 90168 | A2H021Q01 | 95% Percentile | 8.94 | 0.8738 | 0.2874 | 0.538 | 71.18 | 22.18 | 66.46 | 67.28 | 10.57 | 41.28 | 70.46 | 511.8 | 2.443 | 13.95 |
| | | | | | | | | | | | | | | | | |
| 90203 | A2H059Q01 | Number of Elements | 279 | 279 | 279 | 279 | 279 | 279 | 279 | 279 | 279 | 279 | 279 | 279 | 271 | |
| 90203 | A2H059Q01 | Median | 8.283 | 0.74 | 0.035 | 0.42 | 54.3 | 27 | 76.9 | 69.1 | 6.04 | 43.3 | 68.1 | 481 | 1.61 | |
| 90203 | A2H059Q01 | 95% Percentile | 8.496 | 1.826 | 0.0931 | 0.551 | 79.01 | 35.22 | 100.4 | 112.4 | 7.261 | 54.99 | 89.16 | 618.1 | 2.07 | |
| | | | | | | | | | | | | | | | | |
| 90220 | A2H094Q01 | Number of Elements | 46 | 46 | 46 | 46 | 46 | 46 | 46 | 46 | 46 | 46 | 46 | 46 | 46 | |
| 90220 | A2H094Q01 | Median | 8.42 | 0.152 | 0.02 | 0.169 | 39.05 | 22.15 | 76.1 | 65.05 | 6.4 | 45.35 | 61.3 | 414.5 | 1.2 | |
| 90220 | A2H094Q01 | 95% Percentile | 8.835 | 1.861 | 0.2413 | 0.2053 | 48.55 | 31.65 | 94.08 | 95.42 | 8.698 | 57.35 | 77.68 | 531.6 | 1.505 | |
| | | | | | | | | | | | | | | | | |
| 90230 | A2H111Q01 | Number of Elements | 138 | 138 | 138 | 138 | 138 | 138 | 138 | 138 | 138 | 138 | 138 | 138 | 137 | 135 |
| 90230 | A2H111Q01 | Median | 8.33 | 0.098 | 0.06 | 0.469 | 28.8 | 16.85 | 43.57 | 34.25 | 4.657 | 28.4 | 43.65 | 302.5 | 1.049 | 1 |
| 90230 | A2H111Q01 | 95% Percentile | 8.594 | 0.7838 | 0.1378 | 0.5904 | 39.6 | 21.64 | 56.68 | 53.1 | 6.227 | 33.87 | 54.75 | 365.6 | 1.347 | 27.3 |
| | | | | | | | | | | | | | | | | |
| 90233 | A2H116Q01 | Number of Elements | 139 | 139 | 139 | 139 | 139 | 139 | 139 | 139 | 139 | 139 | 139 | 139 | 133 | |
| 90233 | A2H116Q01 | Median | 8.353 | 0.523 | 0.034 | 0.46 | 57 | 26.6 | 73 | 70.5 | 6.917 | 45.5 | 69.7 | 497 | 1.68 | |
| 90233 | A2H116Q01 | 95% Percentile | 8.64 | 1.472 | 0.0771 | 0.55 | 81.44 | 38.42 | 103 | 115.4 | 8.47 | 60.17 | 92.97 | 667.1 | 2.191 | |
| | | | | | | | | | | | | | | | | |
| 90325 | A3R003Q01 | Number of Elements | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 36 | |
| 90325 | A3R003Q01 | Median | 8.117 | 0.137 | 0.031 | 0.26 | 5.4 | 7.1 | 13.6 | 5 | 2.346 | 14.81 | 17.4 | 126.6 | 0.28 | |
| 90325 | A3R003Q01 | 95% Percentile | 8.34 | 0.4828 | 0.1036 | 0.3632 | 7.13 | 9.807 | 18.75 | 6.14 | 3.086 | 20.03 | 22.26 | 159.6 | 0.445 | |
| | | | | | | | | | | | | | | | | |

| WMS No. | Feature Name | Type of Statistics | pH | $NO_3$+$NO_2$-N | $NH_4$-N | F | Na | Mg | $SO_4$ | Cl | K | Ca | EC | DMS | SAR | TURB (NTU) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 90326 | A3R003Q01 | Number of Elements | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 53 | |
| 90326 | A3R003Q01 | Median | 8.29 | 0.092 | 0.024 | 0.26 | 5.9 | 13.35 | 8.9 | 4.9 | 4.183 | 16.3 | 23.1 | 179 | 0.27 | |
| 90326 | A3R003Q01 | 95% Percentile | 8.5 | 0.2327 | 0.0657 | 0.34 | 8.284 | 18.36 | 16.05 | 5.5 | 4.823 | 24.99 | 31.41 | 234.1 | 0.344 | |
| | | | | | | | | | | | | | | | | |
| 90334 | A4H013Q01 | Number of Elements | 98 | 98 | 98 | 98 | 98 | 98 | 98 | 98 | 98 | 98 | 98 | 98 | 95 | 61 |
| 90334 | A4H013Q01 | Median | 7.45 | 0.022 | 0.02 | 0.128 | 6.4 | 2.4 | 4.353 | 7 | 0.855 | 4.5 | 8.09 | 56 | 0.59 | 3.25 |
| 90334 | A4H013Q01 | 95% Percentile | 7.732 | 0.08315 | 0.0782 | 0.1781 | 8.303 | 3.071 | 9.26 | 11.68 | 2.561 | 6.845 | 10.3 | 74.15 | 0.7825 | 52 |
| | | | | | | | | | | | | | | | | |
| 90340 | A5H006Q01 | Number of Elements | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 10 |
| 90340 | A5H006Q01 | Median | 8.19 | 0.081 | 0.02 | 0.304 | 22.9 | 10.95 | 27.41 | 29.08 | 4.35 | 20.35 | 33.45 | 215.1 | 1.015 | 15.35 |
| 90340 | A5H006Q01 | 95% Percentile | 8.627 | 0.5817 | 0.0682 | 0.4355 | 50.87 | 26.42 | 67.78 | 70.75 | 6.803 | 40.25 | 61.23 | 438.5 | 1.586 | 106.8 |
| | | | | | | | | | | | | | | | | |
| 90341 | A5H008Q01 | Number of Elements | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 66 | 33 |
| 90341 | A5H008Q01 | Median | 7.75 | 0.178 | 0.02 | 0.16 | 8.3 | 2.812 | 7.2 | 10.9 | 1.04 | 7.2 | 11 | 74 | 0.675 | 2 |
| 90341 | A5H008Q01 | 75% Percentile | 7.971 | 0.3735 | 0.029 | 0.194 | 15.68 | 5.306 | 10.4 | 20.95 | 1.398 | 10.4 | 19.7 | 115.7 | 1.014 | 12 |
| | | | | | | | | | | | | | | | | |
| 90370 | A7H001Q01 | Number of Elements | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 57 | |
| 90370 | A7H001Q01 | Median | 7.88 | 0.131 | 0.029 | 0.12 | 5.3 | 4.6 | 5.6 | 8.2 | 0.98 | 10.2 | 12.5 | 91 | 0.39 | |
| 90370 | A7H001Q01 | 95% Percentile | 8.491 | 0.762 | 0.064 | 0.21 | 63.84 | 22.25 | 33.9 | 119.1 | 4.25 | 31.77 | 70.8 | 437.5 | 2.108 | |
| | | | | | | | | | | | | | | | | |
| 90398 | A9H011Q01 | Number of Elements | 109 | 109 | 109 | 109 | 109 | 109 | 109 | 109 | 109 | 109 | 109 | 109 | 109 | 63 |
| 90398 | A9H011Q01 | Median | 7.94 | 0.085 | 0.02 | 0.125 | 9.4 | 5.6 | 5.9 | 11.7 | 0.78 | 7.445 | 14.3 | 101.2 | 0.62 | 6 |
| 90398 | A9H011Q01 | 95% Percentile | 8.234 | 0.5334 | 0.063 | 0.302 | 40.73 | 16.23 | 12.3 | 48.91 | 2.348 | 14.16 | 41.06 | 278.4 | 1.729 | 111.8 |
| | | | | | | | | | | | | | | | | |
| 90399 | A9H012Q01 | Number of Elements | 139 | 139 | 139 | 139 | 139 | 139 | 139 | 139 | 139 | 139 | 139 | 139 | 138 | 5 |
| 90399 | A9H012Q01 | Median | 7.95 | 0.258 | 0.029 | 0.11 | 7.2 | 5.2 | 4.788 | 6.8 | 0.78 | 8.4 | 12.7 | 95.25 | 0.47 | 6.46 |
| 90399 | A9H012Q01 | 95% Percentile | 8.201 | 0.6501 | 0.0701 | 0.1664 | 8.807 | 7.182 | 10.91 | 11.58 | 1.316 | 11.5 | 16.43 | 118.4 | 0.54 | 39.22 |
| | | | | | | | | | | | | | | | | |
| 90412 | B1H010Q01 | Number of Elements | 267 | 267 | 267 | 267 | 267 | 267 | 267 | 267 | 267 | 267 | 267 | 267 | 266 | |
| 90412 | B1H010Q01 | Median | 8.27 | 0.06 | 0.024 | 0.4 | 26.2 | 25 | 155.8 | 14.94 | 5.728 | 40.4 | 55.3 | 378 | 0.81 | |

| WMS No. | Feature Name | Type of Statistics | pH | $NO_3$+$NO_2$-N | $NH_4$-N | F | Na | Mg | $SO_4$ | Cl | K | Ca | EC | DMS | SAR | TURB (NTU) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 90412 | B1H010Q01 | 95% Percentile | 8.985 | 0.4874 | 0.0747 | 0.4697 | 34.07 | 37.77 | 265 | 22.26 | 6.739 | 66.2 | 72.1 | 509.7 | 1.019 | |
| | | | | | | | | | | | | | | | | |
| 90414 | B1H015Q01 | Number of Elements | 265 | 265 | 265 | 265 | 265 | 265 | 265 | 265 | 265 | 265 | 265 | 265 | 264 | |
| 90414 | B1H015Q01 | Median | 8.023 | 0.083 | 0.02 | 0.316 | 19.7 | 22 | 133.3 | 14.02 | 6.58 | 33.6 | 46.2 | 314.2 | 0.629 | |
| 90414 | B1H015Q01 | 95% Percentile | 8.25 | 0.3824 | 0.0626 | 0.39 | 23.24 | 29.58 | 190.6 | 17.63 | 7.898 | 44.74 | 57.06 | 389.8 | 0.7487 | |
| | | | | | | | | | | | | | | | | |
| 90442 | B2H015Q01 | Number of Elements | 221 | 221 | 221 | 221 | 221 | 221 | 220 | 221 | 221 | 221 | 221 | 221 | 214 | 121 |
| 90442 | B2H015Q01 | Median | 7.956 | 0.111 | 0.026 | 0.23 | 10 | 8 | 38.8 | 7.4 | 2.85 | 18.2 | 23.2 | 158 | 0.479 | 1.04 |
| 90442 | B2H015Q01 | 95% Percentile | 8.23 | 0.313 | 0.075 | 0.31 | 13.73 | 10.9 | 88.15 | 11.8 | 4.13 | 35.47 | 32.4 | 215 | 0.6422 | 16 |
| | | | | | | | | | | | | | | | | |
| 90444 | B3H001Q01 | Number of Elements | 214 | 214 | 214 | 214 | 214 | 214 | 214 | 214 | 214 | 214 | 214 | 214 | 205 | 150 |
| 90444 | B3H001Q01 | Median | 8.218 | 0.4165 | 0.03 | 0.5 | 37.55 | 17.5 | 101.5 | 25.15 | 4.689 | 30.7 | 47.85 | 334 | 1.32 | 1 |
| 90444 | B3H001Q01 | 95% Percentile | 8.551 | 1.03 | 0.0784 | 1.207 | 140.2 | 36.92 | 175.1 | 139.3 | 6.308 | 48.71 | 109.5 | 820.7 | 3.654 | 14.55 |
| | | | | | | | | | | | | | | | | |
| 90458 | B3H021Q01 | Number of Elements | 135 | 135 | 135 | 135 | 135 | 135 | 135 | 135 | 135 | 135 | 135 | 135 | 127 | 136 |
| 90458 | B3H021Q01 | Median | 8.298 | 0.467 | 0.024 | 1.27 | 106.5 | 32.8 | 126 | 144.6 | 7.95 | 54.48 | 100.4 | 682.7 | 2.741 | 2.945 |
| 90458 | B3H021Q01 | 95% Percentile | 8.656 | 1.357 | 0.076 | 1.733 | 192.8 | 58.51 | 193.7 | 255.1 | 9.941 | 74.78 | 166.8 | 1071 | 3.9 | 29.5 |
| | | | | | | | | | | | | | | | | |
| 90473 | B4H011Q01 | Number of Elements | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 69 |
| 90473 | B4H011Q01 | Median | 8.55 | 1.153 | 0.03 | 0.16 | 31.4 | 26.2 | 27.1 | 25.8 | 1.13 | 30.9 | 48.8 | 370 | 1.02 | 7 |
| 90473 | B4H011Q01 | 95% Percentile | 8.83 | 2.317 | 0.0665 | 0.273 | 88.57 | 72.68 | 81.19 | 86.05 | 1.761 | 39.85 | 108.7 | 874.7 | 2.019 | 168.8 |
| | | | | | | | | | | | | | | | | |
| 90491 | B6H004Q01 | Number of Elements | 134 | 134 | 134 | 134 | 134 | 134 | 134 | 134 | 134 | 134 | 134 | 134 | 134 | 71 |
| 90491 | B6H004Q01 | Median | 8.1 | 0.169 | 0.0215 | 0.12 | 4.5 | 8.461 | 10.37 | 4.6 | 0.515 | 14.6 | 17.15 | 127.5 | 0.23 | 0.5 |
| 90491 | B6H004Q01 | 95% Percentile | 8.417 | 0.3284 | 0.0574 | 0.1987 | 6.135 | 11.74 | 14.94 | 5.735 | 1.677 | 19.59 | 22.34 | 168.7 | 0.2835 | 2.06 |
| | | | | | | | | | | | | | | | | |
| 90506 | B7H009Q01 | Number of Elements | 98 | 98 | 98 | 98 | 98 | 98 | 98 | 98 | 98 | 98 | 98 | 98 | 97 | 29 |
| 90506 | B7H009Q01 | Median | 8.52 | 0.3095 | 0.0255 | 0.33 | 37.95 | 22.65 | 52.75 | 40.4 | 3.095 | 32.7 | 51.5 | 366 | 1.22 | 1 |
| 90506 | B7H009Q01 | 95% Percentile | 8.732 | 0.6291 | 0.057 | 0.4115 | 65.65 | 39.23 | 92.83 | 91.29 | 4.565 | 40.01 | 76.49 | 533.4 | 1.824 | 611 |
| | | | | | | | | | | | | | | | | |

| WMS No. | Feature Name | Type of Statistics | pH | $NO_3$+$NO_2$-N | $NH_4$-N | F | Na | Mg | $SO_4$ | Cl | K | Ca | EC | DMS | SAR | TURB (NTU) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 90524 | B8H008Q01 | Number of Elements | 120 | 120 | 120 | 120 | 120 | 120 | 119 | 120 | 120 | 120 | 120 | 120 | 118 | 44 |
| 90524 | B8H008Q01 | Median | 8.125 | 0.1155 | 0.029 | 0.184 | 24.3 | 9.25 | 10.9 | 28.95 | 2.265 | 15.4 | 28.45 | 194.5 | 1.21 | 1 |
| 90524 | B8H008Q01 | 95% Percentile | 8.415 | 0.4997 | 0.0643 | 0.273 | 55.88 | 17.21 | 25.83 | 74.62 | 3.595 | 27.31 | 54.08 | 366.7 | 1.947 | 31.75 |
| | | | | | | | | | | | | | | | | |
| 90583 | B9H003Q01 | Number of Elements | 113 | 113 | 113 | 113 | 113 | 113 | 113 | 113 | 113 | 113 | 113 | 113 | 108 | 38 |
| 90583 | B9H003Q01 | Median | 8.44 | 0.097 | 0.042 | 0.21 | 35.7 | 17.6 | 10.4 | 19.1 | 5.692 | 31.4 | 44 | 379 | 1.28 | 9 |
| 90583 | B9H003Q01 | 95% Percentile | 8.762 | 2.954 | 0.9248 | 0.28 | 207.3 | 55.23 | 50.2 | 252.2 | 17.57 | 46.52 | 160.4 | 1105 | 5.048 | 235.9 |
| | | | | | | | | | | | | | | | | |
| 90585 | C1H002Q01 | Number of Elements | 277 | 277 | 277 | 277 | 277 | 277 | 277 | 277 | 277 | 277 | 277 | 277 | 265 | |
| 90585 | C1H002Q01 | Median | 8.21 | 0.048 | 0.021 | 0.21 | 15.8 | 13.27 | 18.34 | 8.7 | 1.873 | 24.12 | 30.2 | 235.9 | 0.64 | |
| 90585 | C1H002Q01 | 95% Percentile | 8.492 | 0.167 | 0.0732 | 0.29 | 26.84 | 22.62 | 30.76 | 14.9 | 3.508 | 36.82 | 46.9 | 377.2 | 0.87 | |
| | | | | | | | | | | | | | | | | |
| 90597 | C1H017Q01 | Number of Elements | 277 | 277 | 277 | 277 | 277 | 277 | 277 | 277 | 277 | 277 | 277 | 277 | 265 | |
| 90597 | C1H017Q01 | Median | 8.271 | 0.113 | 0.026 | 0.24 | 20.2 | 14.25 | 29.1 | 13.55 | 3.073 | 23.43 | 33.4 | 255 | 0.809 | |
| 90597 | C1H017Q01 | 95% Percentile | 8.64 | 0.787 | 0.0944 | 0.34 | 39.12 | 27 | 45.37 | 28.54 | 4.301 | 41.36 | 55.12 | 444 | 1.226 | |
| | | | | | | | | | | | | | | | | |
| 90615 | C2H004Q01 | Number of Elements | 369 | 359 | 361 | 361 | 354 | 353 | 354 | 359 | 354 | 353 | 1374 | 322 | 350 | 96 |
| 90615 | C2H004Q01 | Median | 8.2 | 0.257 | 0.025 | 0.26 | 119.7 | 49.9 | 447.2 | 110 | 10.44 | 130 | 140 | 1052 | 2.205 | 2 |
| 90615 | C2H004Q01 | 95% Percentile | 8.536 | 0.9697 | 0.26 | 0.34 | 226.6 | 91.88 | 1061 | 199.4 | 18.85 | 267.2 | 263.3 | 2015 | 3.19 | 19 |
| | | | | | | | | | | | | | | | | |
| 90616 | C2H005Q01 | Number of Elements | 337 | 322 | 327 | 329 | 320 | 320 | 316 | 326 | 320 | 320 | 1255 | 283 | 316 | 115 |
| 90616 | C2H005Q01 | Median | 7.89 | 4.707 | 1 | 0.59 | 58.4 | 25.6 | 214.2 | 94 | 11 | 90.45 | 98.3 | 641.2 | 1.382 | 4 |
| 90616 | C2H005Q01 | 95% Percentile | 8.28 | 9.58 | 7.923 | 0.956 | 82.14 | 31.02 | 287.1 | 150 | 18.85 | 110 | 120 | 815.2 | 1.848 | 21.9 |
| | | | | | | | | | | | | | | | | |
| 90618 | C2H007Q01 | Number of Elements | 265 | 265 | 265 | 265 | 265 | 265 | 265 | 265 | 265 | 265 | 265 | 265 | 261 | 117 |
| 90618 | C2H007Q01 | Median | 8.33 | 0.494 | 0.02 | 0.288 | 42.9 | 22.16 | 141.8 | 43.4 | 7.55 | 50.8 | 66.3 | 451 | 1.28 | 7 |
| 90618 | C2H007Q01 | 95% Percentile | 9.078 | 1.589 | 0.089 | 0.3956 | 81.85 | 34.78 | 248.5 | 86.34 | 12.69 | 82.71 | 101.6 | 716.7 | 2.01 | 60 |
| | | | | | | | | | | | | | | | | |
| 90654 | C2H071Q01 | Number of Elements | 319 | 309 | 311 | 311 | 303 | 302 | 304 | 310 | 304 | 302 | 1325 | 273 | 288 | 87 |
| 90654 | C2H071Q01 | Median | 7.98 | 4.868 | 0.151 | 0.28 | 64.15 | 25 | 177.4 | 68.85 | 13.9 | 64.05 | 87 | 589 | 1.63 | 4 |

| WMS No. | Feature Name | Type of Statistics | pH | $NO_3$+$NO_2$-N | $NH_4$-N | F | Na | Mg | $SO_4$ | Cl | K | Ca | EC | DMS | SAR | TURB (NTU) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 90654 | C2H071Q01 | 95% Percentile | 8.341 | 7.209 | 0.999 | 0.34 | 77 | 33 | 256.1 | 87 | 18 | 86.79 | 105 | 703.2 | 2.206 | 15.7 |
| | | | | | | | | | | | | | | | | |
| 90656 | C2H073Q01 | Number of Elements | 267 | 267 | 267 | 267 | 267 | 267 | 267 | 267 | 267 | 267 | 288 | 267 | 260 | 128 |
| 90656 | C2H073Q01 | Median | 8.1 | 3.062 | 0.336 | 0.274 | 57.09 | 37 | 147.4 | 71.13 | 10.39 | 68.06 | 88.15 | 644.2 | 1.37 | 1.1 |
| 90656 | C2H073Q01 | 95% Percentile | 8.563 | 13.49 | 8.533 | 0.37 | 130.5 | 55.57 | 347.7 | 165 | 23.11 | 110.9 | 164.6 | 1129 | 2.621 | 12.13 |
| | | | | | | | | | | | | | | | | |
| 90668 | C2H085Q01 | Number of Elements | 1047 | 312 | 312 | 312 | 312 | 312 | 312 | 312 | 312 | 312 | 1706 | 312 | 305 | 120 |
| 90668 | C2H085Q01 | Median | 8.32 | 0.549 | 0.022 | 0.24 | 35.36 | 43.25 | 101.3 | 38 | 5.12 | 55.58 | 73.85 | 574.3 | 0.85 | 1 |
| 90668 | C2H085Q01 | 95% Percentile | 8.67 | 1.6 | 0.2558 | 0.4036 | 53.07 | 52.65 | 126.6 | 61.75 | 8.537 | 66.24 | 89.43 | 691.3 | 1.246 | 7.145 |
| | | | | | | | | | | | | | | | | |
| 90795 | C4H004Q01 | Number of Elements | 145 | 148 | 148 | 148 | 148 | 148 | 148 | 148 | 148 | 148 | 148 | 148 | 145 | 62 |
| 90795 | C4H004Q01 | Median | 8.3 | 0.036 | 0.0205 | 0.28 | 54 | 15.97 | 52.85 | 70.77 | 6.805 | 35.15 | 60.7 | 407 | 1.809 | 31 |
| 90795 | C4H004Q01 | 95% Percentile | 8.689 | 0.8733 | 0.08 | 0.3347 | 106.3 | 32.83 | 125.1 | 173.9 | 8.976 | 60.67 | 105 | 707.6 | 2.778 | 214.5 |
| | | | | | | | | | | | | | | | | |
| 90809 | C4R001Q01 | Number of Elements | 72 | 72 | 72 | 72 | 72 | 72 | 72 | 72 | 72 | 72 | 72 | 72 | 72 | |
| 90809 | C4R001Q01 | Median | 8.18 | 0.3775 | 0.035 | 0.295 | 15.2 | 5.1 | 16.2 | 7.1 | 5.11 | 11.85 | 18.6 | 155 | 0.94 | |
| 90809 | C4R001Q01 | 95% Percentile | 8.365 | 0.7326 | 0.1349 | 0.3727 | 18.7 | 6.39 | 34.41 | 10.47 | 5.685 | 15.59 | 23.15 | 191.6 | 1.106 | |
| | | | | | | | | | | | | | | | | |
| 90810 | C4R002Q01 | Number of Elements | 93 | 93 | 93 | 93 | 93 | 93 | 93 | 93 | 93 | 93 | 93 | 93 | 90 | |
| 90810 | C4R002Q01 | Median | 8.183 | 0.236 | 0.022 | 0.27 | 13.6 | 6.5 | 15.15 | 7.1 | 4.799 | 14.7 | 21.4 | 165 | 0.7545 | |
| 90810 | C4R002Q01 | 95% Percentile | 8.359 | 0.4806 | 0.111 | 0.3564 | 23.53 | 18.87 | 22.93 | 10.69 | 5.896 | 39.4 | 46.34 | 370.2 | 0.96 | |
| | | | | | | | | | | | | | | | | |
| 90847 | C6H003Q01 | Number of Elements | 159 | 159 | 159 | 159 | 159 | 159 | 159 | 159 | 159 | 159 | 159 | 159 | 157 | 108 |
| 90847 | C6H003Q01 | Median | 8.33 | 0.191 | 0.02 | 0.252 | 29.6 | 12.77 | 31.43 | 18.4 | 5.941 | 28.14 | 38.7 | 296 | 1.19 | 9 |
| 90847 | C6H003Q01 | 95% Percentile | 9.055 | 1.39 | 0.9846 | 0.3355 | 72.11 | 29.34 | 79.8 | 62.66 | 8.853 | 45.15 | 74.03 | 577.1 | 2.108 | 157.2 |
| | | | | | | | | | | | | | | | | |
| 90853 | C7H006Q01 | Number of Elements | 415 | 275 | 275 | 275 | 275 | 275 | 275 | 275 | 275 | 275 | 474 | 275 | 263 | 75 |
| 90853 | C7H006Q01 | Median | 8.24 | 0.051 | 0.024 | 0.24 | 28 | 12.45 | 27.9 | 20.6 | 5.54 | 25.1 | 36.55 | 277.5 | 1.12 | 18.6 |
| 90853 | C7H006Q01 | 95% Percentile | 8.63 | 0.3791 | 0.0879 | 0.31 | 36.43 | 17.13 | 39.66 | 30.63 | 6.541 | 34.3 | 46.47 | 356.3 | 1.468 | 122.4 |
| | | | | | | | | | | | | | | | | |

| WMS No. | Feature Name | Type of Statistics | pH | $NO_3$+$NO_2$-N | $NH_4$-N | F | Na | Mg | $SO_4$ | Cl | K | Ca | EC | DMS | SAR | TURB (NTU) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 90859 | C8H001Q01 | Number of Elements | 281 | 281 | 281 | 281 | 281 | 281 | 281 | 281 | 281 | 281 | 281 | 281 | 271 | |
| 90859 | C8H001Q01 | Median | 8.088 | 0.236 | 0.038 | 0.171 | 10.2 | 6.1 | 15.3 | 5.6 | 2.27 | 15.7 | 18.6 | 144 | 0.57 | |
| 90859 | C8H001Q01 | 95% Percentile | 8.38 | 0.506 | 0.094 | 0.25 | 23.9 | 16.3 | 25.04 | 14.2 | 4.111 | 32.1 | 40 | 315 | 0.955 | |
| | | | | | | | | | | | | | | | | |
| 90884 | C8H027Q01 | Number of Elements | 276 | 276 | 276 | 276 | 276 | 276 | 275 | 276 | 276 | 276 | 276 | 276 | 274 | 123 |
| 90884 | C8H027Q01 | Median | 8.238 | 0.1895 | 0.02 | 0.2 | 16.54 | 9.35 | 18.4 | 8.8 | 2.653 | 21.1 | 26.45 | 202.5 | 0.77 | 10 |
| 90884 | C8H027Q01 | 95% Percentile | 8.534 | 0.465 | 0.0735 | 0.2833 | 28.82 | 19.97 | 25.14 | 16.63 | 4.126 | 34.92 | 46.03 | 357.4 | 1.07 | 157.7 |
| | | | | | | | | | | | | | | | | |
| 101788 | D1H001Q01 | Number of Elements | 155 | 155 | 155 | 155 | 155 | 155 | 155 | 155 | 155 | 155 | 155 | 155 | 145 | 1 |
| 101788 | D1H001Q01 | Median | 8.42 | 0.783 | 0.026 | 0.34 | 51.6 | 28 | 44.2 | 30.1 | 5.17 | 48 | 66.5 | 517 | 1.41 | 857 |
| 101788 | D1H001Q01 | 95% Percentile | 9.022 | 9.193 | 0.2289 | 0.4206 | 93.37 | 45.32 | 90.03 | 89.31 | 11.21 | 69.38 | 98.96 | 795.9 | 2.486 | 857 |
| | | | | | | | | | | | | | | | | |
| 101789 | D1H003Q01 | Number of Elements | 253 | 253 | 253 | 253 | 253 | 253 | 253 | 253 | 253 | 253 | 253 | 253 | 249 | 102 |
| 101789 | D1H003Q01 | Median | 8.11 | 0.187 | 0.026 | 0.14 | 4.9 | 6.556 | 9.5 | 3.9 | 0.81 | 19 | 17.4 | 140 | 0.24 | 32 |
| 101789 | D1H003Q01 | 95% Percentile | 8.406 | 0.5082 | 0.0604 | 0.2094 | 7.279 | 11.1 | 14.94 | 5.3 | 2.104 | 28.74 | 26.74 | 207 | 0.376 | 355 |
| | | | | | | | | | | | | | | | | |
| 101790 | D1H005Q01 | Number of Elements | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 1 |
| 101790 | D1H005Q01 | Median | 8.079 | 0.334 | 0.02 | 0.11 | 4.3 | 6.61 | 9 | 3.9 | 0.58 | 19.1 | 17.5 | 138 | 0.2 | 119 |
| 101790 | D1H005Q01 | 95% Percentile | 8.474 | 0.85 | 0.0358 | 0.2216 | 14.13 | 11.3 | 25.48 | 14.12 | 0.9516 | 28.88 | 29.94 | 219.4 | 0.702 | 119 |
| | | | | | | | | | | | | | | | | |
| 101791 | D1H006Q01 | Number of Elements | 147 | 147 | 147 | 147 | 147 | 147 | 147 | 147 | 147 | 147 | 147 | 147 | 139 | 131 |
| 101791 | D1H006Q01 | Median | 8.1 | 0.234 | 0.022 | 0.14 | 5.6 | 6.6 | 11.07 | 4.2 | 0.95 | 20.4 | 18.5 | 148 | 0.27 | 19.1 |
| 101791 | D1H006Q01 | 95% Percentile | 8.377 | 0.7821 | 0.0754 | 0.2463 | 8.077 | 9.9 | 16.25 | 5 | 2.165 | 27.64 | 26.06 | 201 | 0.392 | 914.5 |
| | | | | | | | | | | | | | | | | |
| 101793 | D1H009Q01 | Number of Elements | 148 | 148 | 148 | 148 | 148 | 148 | 148 | 148 | 148 | 148 | 148 | 148 | 144 | 129 |
| 101793 | D1H009Q01 | Median | 8.05 | 0.2065 | 0.02 | 0.1325 | 4.428 | 5.898 | 8.679 | 3.8 | 0.754 | 17.62 | 15.9 | 128 | 0.2275 | 11.35 |
| 101793 | D1H009Q01 | 95% Percentile | 8.366 | 0.5508 | 0.0607 | 0.19 | 6.056 | 9.93 | 14.19 | 5 | 1.86 | 27.17 | 24.69 | 191 | 0.34 | 693.4 |
| | | | | | | | | | | | | | | | | |
| 101795 | D1H011Q01 | Number of Elements | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 116 | 102 |
| 101795 | D1H011Q01 | Median | 8.24 | 0.0315 | 0.022 | 0.13 | 6.128 | 9.45 | 9.6 | 4.2 | 0.866 | 24.6 | 22.55 | 181.5 | 0.26 | 4.065 |

| WMS No. | Feature Name | Type of Statistics | pH | $NO_3$+$NO_2$-N | $NH_4$-N | F | Na | Mg | $SO_4$ | Cl | K | Ca | EC | DMS | SAR | TURB (NTU) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 101795 | D1H011Q01 | 95% Percentile | 8.441 | 0.1192 | 0.0492 | 0.1962 | 8.729 | 16.77 | 14.71 | 5.9 | 1.981 | 36.26 | 35.03 | 272.4 | 0.354 | 133.8 |
| | | | | | | | | | | | | | | | | |
| 101808 | D2H012Q01 | Number of Elements | 65 | 63 | 65 | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 65 | 63 | 62 | 7 |
| 101808 | D2H012Q01 | Median | 8.314 | 0.053 | 0.02 | 0.15 | 10.7 | 13 | 14.9 | 5 | 1.41 | 33.4 | 32.1 | 256 | 0.395 | 5.04 |
| 101808 | D2H012Q01 | 95% Percentile | 8.514 | 0.181 | 0.065 | 0.21 | 16.57 | 20.3 | 20.57 | 9.09 | 3.135 | 47.61 | 42.76 | 370.9 | 0.5296 | 90.54 |
| | | | | | | | | | | | | | | | | |
| 101816 | D2H036Q01 | Number of Elements | 112 | 112 | 112 | 112 | 112 | 112 | 111 | 112 | 112 | 112 | 112 | 112 | 104 | 95 |
| 101816 | D2H036Q01 | Median | 8.074 | 0.386 | 0.028 | 0.21 | 8.29 | 6.118 | 13 | 5 | 1.812 | 17.62 | 19.05 | 145.7 | 0.43 | 140 |
| 101816 | D2H036Q01 | 95% Percentile | 8.451 | 0.8933 | 0.0854 | 0.33 | 13.46 | 12.85 | 23.11 | 7.045 | 3.05 | 32.97 | 31.88 | 257.8 | 0.5785 | 1823 |
| | | | | | | | | | | | | | | | | |
| 101820 | D2R004Q01 | Number of Elements | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 60 | 15 |
| 101820 | D2R004Q01 | Median | 8.104 | 0.402 | 0.045 | 0.21 | 8.093 | 6 | 12.6 | 5 | 1.76 | 16.7 | 18.5 | 142 | 0.418 | 11.1 |
| 101820 | D2R004Q01 | 95% Percentile | 8.46 | 0.831 | 0.103 | 0.27 | 15 | 15.6 | 29.5 | 9.4 | 3.21 | 37.2 | 38.5 | 302 | 0.5806 | 436 |
| | | | | | | | | | | | | | | | | |
| 101824 | D3H008Q01 | Number of Elements | 265 | 265 | 265 | 265 | 265 | 265 | 265 | 265 | 265 | 265 | 265 | 265 | 257 | 116 |
| 101824 | D3H008Q01 | Median | 8.18 | 0.48 | 0.03 | 0.17 | 7.712 | 7 | 12.09 | 5.1 | 1.337 | 19.57 | 20 | 151.1 | 0.38 | 7 |
| 101824 | D3H008Q01 | 95% Percentile | 8.361 | 0.7918 | 0.073 | 0.22 | 11.26 | 8.2 | 16.64 | 9.78 | 2.848 | 22.48 | 23.88 | 174 | 0.5272 | 51.5 |
| | | | | | | | | | | | | | | | | |
| 101828 | D3H013Q01 | Number of Elements | 147 | 147 | 147 | 147 | 147 | 147 | 147 | 147 | 147 | 147 | 147 | 147 | 141 | 123 |
| 101828 | D3H013Q01 | Median | 8.122 | 0.494 | 0.036 | 0.16 | 5.2 | 5.8 | 9.5 | 4.1 | 1.15 | 16.79 | 16.1 | 129 | 0.276 | 17.9 |
| 101828 | D3H013Q01 | 95% Percentile | 8.394 | 0.8415 | 0.0924 | 0.22 | 7.139 | 6.594 | 13.65 | 5 | 2.695 | 19.15 | 18.4 | 141.8 | 0.4 | 100.9 |
| | | | | | | | | | | | | | | | | |
| 101837 | D3R003Q01 | Number of Elements | 37 | 36 | 37 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 37 | 36 | 36 | |
| 101837 | D3R003Q01 | Median | 8.17 | 0.509 | 0.03 | 0.157 | 5.15 | 6 | 9.35 | 3.85 | 1.305 | 17.1 | 17 | 130 | 0.27 | |
| 101837 | D3R003Q01 | 95% Percentile | 8.366 | 0.781 | 0.0674 | 0.2118 | 6.725 | 7.1 | 13.43 | 5.025 | 2.805 | 19.67 | 19.32 | 147.3 | 0.3375 | |
| | | | | | | | | | | | | | | | | |
| 101869 | D5H021Q01 | Number of Elements | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 34 | |
| 101869 | D5H021Q01 | Median | 8.63 | 0.031 | 0.031 | 0.79 | 692.3 | 88.4 | 624.1 | 588 | 5.93 | 52.8 | 371 | 2660 | 12.89 | |
| 101869 | D5H021Q01 | 95% Percentile | 8.773 | 0.1047 | 0.1237 | 1.073 | 1110 | 164.4 | 1097 | 1090 | 12.01 | 68.46 | 568.5 | 4130 | 18.24 | |
| | | | | | | | | | | | | | | | | |

| WMS No. | Feature Name | Type of Statistics | pH | $NO_3$+$NO_2$-N | $NH_4$-N | F | Na | Mg | $SO_4$ | Cl | K | Ca | EC | DMS | SAR | TURB (NTU) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 101878 | D7H008Q01 | Number of Elements | 239 | 239 | 239 | 239 | 239 | 239 | 239 | 239 | 239 | 239 | 239 | 239 | 235 | 2 |
| 101878 | D7H008Q01 | Median | 8.268 | 0.347 | 0.036 | 0.19 | 14.2 | 9.1 | 22.8 | 13.14 | 2.218 | 23.4 | 27.1 | 194 | 0.64 | 28.25 |
| 101878 | D7H008Q01 | 95% Percentile | 8.561 | 0.7073 | 0.0943 | 0.28 | 31.29 | 15.71 | 69.91 | 33.37 | 5.367 | 34.2 | 45.43 | 314.7 | 1.186 | 38.11 |
| | | | | | | | | | | | | | | | | |
| 101884 | D7H015Q01 | Number of Elements | 216 | 216 | 216 | 216 | 216 | 216 | 216 | 216 | 216 | 216 | 216 | 216 | 204 | |
| 101884 | D7H015Q01 | Median | 8.29 | 0.076 | 0.02 | 0.23 | 19.55 | 11.65 | 28.55 | 16.26 | 2.17 | 26.95 | 33.55 | 240 | 0.8 | |
| 101884 | D7H015Q01 | 95% Percentile | 8.484 | 0.566 | 0.0613 | 0.3048 | 37.2 | 16.7 | 72.13 | 36.65 | 5.411 | 35.43 | 50.93 | 338 | 1.319 | |
| | | | | | | | | | | | | | | | | |
| 101888 | D8H003Q01 | Number of Elements | 244 | 244 | 244 | 244 | 244 | 244 | 244 | 244 | 244 | 244 | 244 | 244 | 239 | 12 |
| 101888 | D8H003Q01 | Median | 8.368 | 0.0255 | 0.02 | 0.27 | 25.05 | 12.9 | 33.85 | 20.85 | 2.9 | 30.7 | 38.6 | 279.2 | 0.955 | 27 |
| 101888 | D8H003Q01 | 95% Percentile | 8.569 | 0.4788 | 0.0627 | 0.36 | 40.28 | 18.3 | 77.34 | 39.1 | 5.509 | 37.55 | 52.55 | 374.8 | 1.361 | 101.8 |
| | | | | | | | | | | | | | | | | |
| 101893 | D8H008Q01 | Number of Elements | 254 | 254 | 254 | 254 | 254 | 254 | 254 | 254 | 254 | 254 | 254 | 254 | 250 | |
| 101893 | D8H008Q01 | Median | 8.362 | 0.042 | 0.023 | 0.26 | 23.85 | 12.49 | 31.55 | 19.35 | 2.649 | 28.88 | 36.9 | 265.3 | 0.922 | |
| 101893 | D8H008Q01 | 95% Percentile | 8.54 | 0.5767 | 0.0747 | 0.34 | 38.78 | 17.34 | 67.87 | 39.34 | 5.476 | 36.81 | 50.5 | 360.1 | 1.383 | |
| | | | | | | | | | | | | | | | | |
| 101900 | E1R001Q01 | Number of Elements | 154 | 154 | 154 | 154 | 154 | 154 | 154 | 154 | 154 | 154 | 154 | 154 | 154 | |
| 101900 | E1R001Q01 | Median | 7.09 | 0.1245 | 0.02 | 0.1 | 14.42 | 3 | 8.05 | 27.71 | 0.9225 | 3.2 | 14 | 68.26 | 1.367 | |
| 101900 | E1R001Q01 | 95% Percentile | 7.44 | 0.3842 | 0.0791 | 0.1304 | 29.57 | 5.318 | 14.92 | 55.24 | 1.528 | 5.542 | 25.84 | 120.6 | 2.217 | |
| | | | | | | | | | | | | | | | | |
| 101902 | E2H002Q01 | Number of Elements | 56 | 56 | 56 | 56 | 56 | 56 | 56 | 56 | 56 | 56 | 56 | 56 | 55 | |
| 101902 | E2H002Q01 | Median | 7.094 | 0.025 | 0.02 | 0.109 | 8.841 | 2.25 | 7.273 | 16.07 | 0.827 | 3.159 | 9.25 | 51 | 0.94 | |
| 101902 | E2H002Q01 | 95% Percentile | 7.635 | 0.1753 | 0.0508 | 0.1483 | 22.02 | 5.082 | 14.8 | 43.57 | 2.705 | 9.8 | 23.73 | 128.1 | 1.516 | |
| | | | | | | | | | | | | | | | | |
| 101903 | E2H003Q01 | Number of Elements | 172 | 172 | 172 | 172 | 172 | 172 | 172 | 172 | 172 | 172 | 172 | 172 | 163 | |
| 101903 | E2H003Q01 | Median | 7.62 | 0.034 | 0.02 | 0.13 | 34.13 | 7.05 | 20.4 | 62.85 | 1.79 | 10.33 | 31.95 | 173.1 | 2.06 | |
| 101903 | E2H003Q01 | 95% Percentile | 8.115 | 0.3632 | 0.0585 | 0.24 | 168.4 | 19.55 | 89.8 | 271.7 | 5.375 | 36.11 | 119.9 | 723.9 | 5.83 | |
| | | | | | | | | | | | | | | | | |
| 101935 | G1H031Q01 | Number of Elements | 221 | 221 | 221 | 221 | 221 | 221 | 221 | 221 | 221 | 221 | 221 | 221 | 217 | |
| 101935 | G1H031Q01 | Median | 7.67 | 0.402 | 0.026 | 0.139 | 33.4 | 6.7 | 16.1 | 57.7 | 2.5 | 8.2 | 30.1 | 164 | 2.13 | |

| WMS No. | Feature Name | Type of Statistics | pH | $NO_3$+$NO_2$-N | $NH_4$-N | F | Na | Mg | $SO_4$ | Cl | K | Ca | EC | DMS | SAR | TURB (NTU) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 101935 | G1H031Q01 | 95% Percentile | 7.95 | 1.69 | 0.125 | 0.24 | 87.7 | 14.5 | 40.4 | 151.6 | 5.41 | 14.2 | 65.9 | 381 | 3.96 | |
| | | | | | | | | | | | | | | | | |
| 101939 | G1H036Q01 | Number of Elements | 231 | 231 | 231 | 231 | 231 | 231 | 231 | 231 | 231 | 231 | 231 | 231 | 227 | |
| 101939 | G1H036Q01 | Median | 7.53 | 0.942 | 0.025 | 0.12 | 23.3 | 3.4 | 12.1 | 29.3 | 2.94 | 7.2 | 20.5 | 124.4 | 1.72 | |
| 101939 | G1H036Q01 | 95% Percentile | 7.885 | 2.487 | 0.119 | 0.1645 | 36.95 | 5.6 | 17.65 | 49.45 | 5.785 | 10.9 | 30.95 | 191 | 2.467 | |
| | | | | | | | | | | | | | | | | |
| 101975 | G2H015Q01 | Number of Elements | 220 | 220 | 220 | 220 | 220 | 220 | 220 | 220 | 220 | 220 | 220 | 220 | 212 | |
| 101975 | G2H015Q01 | Median | 7.7 | 2.294 | 0.0315 | 0.207 | 55.7 | 8.064 | 20.8 | 86.87 | 8.035 | 16.6 | 47.65 | 285.5 | 2.782 | |
| 101975 | G2H015Q01 | 95% Percentile | 8.012 | 5.783 | 0.4104 | 0.2801 | 90.2 | 10.61 | 29 | 126 | 15.54 | 22.64 | 67.42 | 424.1 | 4.039 | |
| | | | | | | | | | | | | | | | | |
| 101998 | G4H007Q01 | Number of Elements | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 224 | |
| 101998 | G4H007Q01 | Median | 6.83 | 0.285 | 0.02 | 0.09 | 14.52 | 2.7 | 14.63 | 25.75 | 0.98 | 3.6 | 13.55 | 77.96 | 1.422 | |
| 101998 | G4H007Q01 | 95% Percentile | 7.276 | 0.7769 | 0.0804 | 0.14 | 23.9 | 4.855 | 25.08 | 45.26 | 2.617 | 5.813 | 21.71 | 121.1 | 1.958 | |
| | | | | | | | | | | | | | | | | |
| 102088 | H4H024Q01 | Number of Elements | 210 | 210 | 210 | 210 | 210 | 210 | 210 | 210 | 210 | 210 | 210 | 210 | 204 | |
| 102088 | H4H024Q01 | Median | 7.53 | 0.223 | 0.024 | 0.13 | 32.04 | 6.2 | 19.3 | 54.22 | 1.41 | 7 | 27.25 | 151 | 2.108 | |
| 102088 | H4H024Q01 | 95% Percentile | 7.83 | 1.118 | 0.0657 | 0.1896 | 58.21 | 11.96 | 38.21 | 97.11 | 3.21 | 12.33 | 48.87 | 271.6 | 3.006 | |
| | | | | | | | | | | | | | | | | |
| 102099 | H5H005Q01 | Number of Elements | 181 | 181 | 181 | 181 | 181 | 181 | 181 | 181 | 181 | 181 | 181 | 181 | 178 | |
| 102099 | H5H005Q01 | Median | 8.07 | 0.107 | 0.022 | 0.26 | 144 | 23.6 | 63 | 220 | 3.72 | 21.1 | 98.7 | 596 | 4.96 | |
| 102099 | H5H005Q01 | 95% Percentile | 8.55 | 0.993 | 0.081 | 0.46 | 277.2 | 49.79 | 121.5 | 430 | 6.27 | 37.63 | 198 | 1134 | 7.112 | |
| | | | | | | | | | | | | | | | | |
| 102107 | H6H009Q01 | Number of Elements | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 54 | |
| 102107 | H6H009Q01 | Median | 7.16 | 0.136 | 0.02 | 0.11 | 29 | 4.4 | 15.8 | 50.5 | 1.15 | 3.7 | 23.9 | 127 | 2.449 | |
| 102107 | H6H009Q01 | 95% Percentile | 7.59 | 0.3428 | 0.0728 | 0.1552 | 120.2 | 14.76 | 39.34 | 197.1 | 2.904 | 8.52 | 72.3 | 448.2 | 5.326 | |
| | | | | | | | | | | | | | | | | |
| 102119 | H7H006Q01 | Number of Elements | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 53 | |
| 102119 | H7H006Q01 | Median | 7.74 | 0.143 | 0.02 | 0.16 | 78.8 | 12.7 | 37.2 | 128.9 | 2.61 | 12.5 | 58.5 | 336 | 3.829 | |
| 102119 | H7H006Q01 | 95% Percentile | 8.161 | 0.7368 | 0.0652 | 0.3192 | 189.7 | 31.57 | 73.42 | 287.6 | 4.353 | 23.11 | 125.5 | 747.7 | 6.023 | |
| | | | | | | | | | | | | | | | | |

| WMS No. | Feature Name | Type of Statistics | pH | $NO_3$+$NO_2$-N | $NH_4$-N | F | Na | Mg | $SO_4$ | Cl | K | Ca | EC | DMS | SAR | TURB (NTU) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 102123 | H8H001Q01 | Number of Elements | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 62 | 1 |
| 102123 | H8H001Q01 | Median | 7.36 | 0.179 | 0.0265 | 0.1275 | 59.7 | 8.435 | 37.3 | 98.35 | 1.55 | 5.9 | 42.05 | 254 | 3.645 | 4 |
| 102123 | H8H001Q01 | 95% Percentile | 7.916 | 0.4929 | 0.0766 | 0.17 | 145.4 | 21.69 | 61.97 | 236.7 | 3.269 | 13.44 | 93.23 | 561.4 | 5.785 | 4 |
| | | | | | | | | | | | | | | | | |
| 102130 | H9H005Q01 | Number of Elements | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 84 | |
| 102130 | H9H005Q01 | Median | 7.47 | 0.022 | 0.02 | 0.15 | 80.1 | 11.5 | 28.5 | 137.6 | 1.86 | 7.8 | 54.8 | 311 | 4.58 | |
| 102130 | H9H005Q01 | 95% Percentile | 8.394 | 0.1357 | 0.0658 | 0.6996 | 565.4 | 51.35 | 139 | 796.2 | 13.25 | 34.35 | 329.2 | 1981 | 14.09 | |
| | | | | | | | | | | | | | | | | |
| 102148 | J1H019Q01 | Number of Elements | 88 | 88 | 88 | 88 | 88 | 88 | 88 | 88 | 88 | 88 | 88 | 88 | 87 | |
| 102148 | J1H019Q01 | Median | 8.213 | 0.0205 | 0.033 | 0.5355 | 1002 | 146.9 | 566.3 | 1541 | 9.785 | 142.3 | 610 | 3916 | 14.24 | |
| 102148 | J1H019Q01 | 95% Percentile | 8.474 | 0.1538 | 0.0737 | 0.6665 | 2212 | 346.5 | 1401 | 3530 | 34.37 | 261.9 | 1217 | 8461 | 21.9 | |
| | | | | | | | | | | | | | | | | |
| 102168 | J2H010Q01 | Number of Elements | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 94 | |
| 102168 | J2H010Q01 | Median | 8.36 | 0.029 | 0.02 | 0.36 | 87 | 22.4 | 64.6 | 108.3 | 5.19 | 53.4 | 86.6 | 599 | 2.576 | |
| 102168 | J2H010Q01 | 95% Percentile | 8.592 | 0.4773 | 0.0718 | 0.4291 | 368.3 | 52.07 | 341.8 | 562.9 | 10.29 | 112.4 | 269.6 | 1658 | 7.098 | |
| | | | | | | | | | | | | | | | | |
| 102173 | J2H016Q01 | Number of Elements | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 34 | |
| 102173 | J2H016Q01 | Median | 8.37 | 0.505 | 0.035 | 0.29 | 60.4 | 9.5 | 53.7 | 64 | 6.03 | 35.71 | 57.9 | 396 | 2.345 | |
| 102173 | J2H016Q01 | 95% Percentile | 8.754 | 0.757 | 0.1426 | 0.384 | 77.56 | 13.74 | 68.24 | 85.22 | 7.092 | 44.6 | 67.9 | 475.6 | 2.71 | |
| | | | | | | | | | | | | | | | | |
| 102179 | J2R004Q01 | Number of Elements | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 51 | |
| 102179 | J2R004Q01 | Median | 8.19 | 0.032 | 0.02 | 0.23 | 15.3 | 10.04 | 21.93 | 9.7 | 1.742 | 28.2 | 30.3 | 226 | 0.634 | |
| 102179 | J2R004Q01 | 95% Percentile | 8.81 | 0.2004 | 0.236 | 0.294 | 19.26 | 14.14 | 29.46 | 15.01 | 3.2 | 35.63 | 37.04 | 283.3 | 0.74 | |
| | | | | | | | | | | | | | | | | |
| 102183 | J3H011Q01 | Number of Elements | 190 | 190 | 190 | 190 | 190 | 190 | 190 | 190 | 190 | 190 | 190 | 190 | 187 | |
| 102183 | J3H011Q01 | Median | 8.15 | 0.024 | 0.047 | 0.48 | 2423 | 249.2 | 1841 | 3612 | 10.91 | 422.6 | 1282 | 9059 | 22.88 | |
| 102183 | J3H011Q01 | 95% Percentile | 8.348 | 0.1343 | 0.1147 | 0.61 | 3795 | 353.9 | 2834 | 6073 | 60.26 | 716.8 | 1931 | 1.40E+04 | 29.83 | |
| | | | | | | | | | | | | | | | | |
| 102207 | K1H005Q01 | Number of Elements | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 68 | |
| 102207 | K1H005Q01 | Median | 7.285 | 0.043 | 0.02 | 0.14 | 43.35 | 5.7 | 16.7 | 72.3 | 0.9065 | 5.211 | 31.45 | 173.3 | 3.107 | |

| WMS No. | Feature Name | Type of Statistics | pH | $NO_3$+$NO_2$-N | $NH_4$-N | F | Na | Mg | $SO_4$ | Cl | K | Ca | EC | DMS | SAR | TURB (NTU) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 102207 | K1H005Q01 | 95% Percentile | 7.712 | 0.2075 | 0.1036 | 0.19 | 65.71 | 8.155 | 34.88 | 110.9 | 2.367 | 7.855 | 47.96 | 260.4 | 4.024 | |
| | | | | | | | | | | | | | | | | |
| 102243 | K2H004Q01 | Number of Elements | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 61 | |
| 102243 | K2H004Q01 | Median | 7.985 | 0.0365 | 0.0505 | 0.44 | 8353 | 969.6 | 2057 | 1.47E+04 | 298.4 | 329.4 | 3575 | 2.69E+04 | 52.48 | |
| 102243 | K2H004Q01 | 95% Percentile | 8.339 | 0.1536 | 0.2449 | 0.5709 | 1.08E+04 | 1257 | 2623 | 1.90E+04 | 386.9 | 417.2 | 4490 | 3.45E+04 | 60.01 | |
| | | | | | | | | | | | | | | | | |
| 102248 | K3H001Q01 | Number of Elements | 73 | 73 | 73 | 73 | 73 | 73 | 73 | 73 | 73 | 73 | 73 | 73 | 73 | |
| 102248 | K3H001Q01 | Median | 5.58 | 0.054 | 0.022 | 0.09 | 20.4 | 3.1 | 16.37 | 38.2 | 0.84 | 2.476 | 16.8 | 96 | 2.041 | |
| 102248 | K3H001Q01 | 95% Percentile | 7.374 | 0.2008 | 0.0826 | 0.144 | 38.3 | 6.6 | 36.46 | 67.68 | 2.984 | 10.26 | 32 | 183.8 | 2.736 | |
| | | | | | | | | | | | | | | | | |
| 102250 | K3H003Q01 | Number of Elements | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 64 | |
| 102250 | K3H003Q01 | Median | 6.74 | 0.109 | 0.027 | 0.12 | 66.6 | 7.691 | 29.31 | 129.2 | 1.56 | 7.55 | 47.45 | 274.5 | 4.05 | |
| 102250 | K3H003Q01 | 95% Percentile | 7.72 | 0.3505 | 0.1288 | 0.18 | 203.1 | 23.98 | 63.7 | 375.6 | 3.808 | 23.25 | 142.5 | 684.3 | 7.272 | |
| | | | | | | | | | | | | | | | | |
| 102283 | K4R002Q01 | Number of Elements | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | |
| 102283 | K4R002Q01 | Median | 7.79 | 0.024 | 0.042 | 0.24 | 2633 | 286.5 | 583.5 | 4674 | 91.42 | 134.2 | 1340 | 8522 | 28.76 | |
| 102283 | K4R002Q01 | 95% Percentile | 8.205 | 0.1205 | 0.1547 | 0.28 | 3685 | 423.9 | 903.2 | 6715 | 144.8 | 175.2 | 1856 | 1.21E+04 | 34.99 | |
| | | | | | | | | | | | | | | | | |
| 102312 | K7H001Q01 | Number of Elements | 152 | 152 | 152 | 152 | 152 | 152 | 152 | 152 | 152 | 152 | 152 | 152 | 145 | 14 |
| 102312 | K7H001Q01 | Median | 4.73 | 0.031 | 0.0255 | 0.07 | 9.6 | 1.8 | 14.95 | 16.4 | 0.41 | 1.7 | 9 | 53.86 | 1.24 | 3 |
| 102312 | K7H001Q01 | 95% Percentile | 6.164 | 0.07245 | 0.0585 | 0.1345 | 13.09 | 2.367 | 29.72 | 22.39 | 1.556 | 3.145 | 11.54 | 71.9 | 1.624 | 17.9 |
| | | | | | | | | | | | | | | | | |
| 102313 | K8H001Q01 | Number of Elements | 31 | 31 | 31 | 31 | 31 | 31 | 31 | 31 | 31 | 31 | 31 | 31 | 29 | 17 |
| 102313 | K8H001Q01 | Median | 4.81 | 0.029 | 0.02 | 0.1 | 8.4 | 1.7 | 13.9 | 14.1 | 0.79 | 1.8 | 7.7 | 52 | 1.08 | 3 |
| 102313 | K8H001Q01 | 95% Percentile | 6.57 | 0.0885 | 0.0615 | 0.145 | 16.55 | 3.1 | 39.85 | 24.15 | 2.58 | 3.55 | 12 | 80.5 | 1.798 | 23.2 |
| | | | | | | | | | | | | | | | | |
| 102314 | K8H002Q01 | Number of Elements | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 33 | 16 |
| 102314 | K8H002Q01 | Median | 5.07 | 0.03 | 0.011 | 0.09 | 11.2 | 2 | 10.8 | 19.3 | 0.64 | 1.5 | 10 | 54 | 1.39 | 3.5 |
| 102314 | K8H002Q01 | 95% Percentile | 6.563 | 0.0842 | 0.0462 | 0.123 | 17.37 | 2.9 | 19.21 | 28.73 | 2.462 | 2.59 | 14.33 | 75.4 | 1.958 | 7.25 |
| | | | | | | | | | | | | | | | | |

| WMS No. | Feature Name | Type of Statistics | pH | $NO_3$+$NO_2$-N | $NH_4$-N | F | Na | Mg | $SO_4$ | Cl | K | Ca | EC | DMS | SAR | TURB (NTU) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 102329 | L3R001Q01 | Number of Elements | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | |
| 102329 | L3R001Q01 | Median | 8.23 | 0.071 | 0.035 | 0.26 | 109 | 17.2 | 91.7 | 149 | 8.731 | 39 | 91 | 574 | 3.55 | |
| 102329 | L3R001Q01 | 95% Percentile | 8.78 | 0.5985 | 0.35 | 0.465 | 505.5 | 76.05 | 461.6 | 801.1 | 13.16 | 134.6 | 356 | 2128 | 8.52 | |
| | | | | | | | | | | | | | | | | |
| 102349 | L6H001Q01 | Number of Elements | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 26 |
| 102349 | L6H001Q01 | Median | 8.385 | 0.035 | 0.0315 | 0.425 | 611.9 | 118.2 | 527.4 | 939.8 | 15.04 | 123.7 | 422.5 | 2728 | 9.876 | 1.015 |
| 102349 | L6H001Q01 | 95% Percentile | 8.849 | 0.7242 | 0.1007 | 0.527 | 1227 | 257 | 1182 | 2043 | 24.24 | 234.1 | 776.1 | 5216 | 13.37 | 51.75 |
| | | | | | | | | | | | | | | | | |
| 102353 | L7H006Q01 | Number of Elements | 158 | 158 | 158 | 158 | 158 | 158 | 158 | 158 | 158 | 158 | 158 | 158 | 152 | 29 |
| 102353 | L7H006Q01 | Median | 8.005 | 0.02 | 0.02 | 0.194 | 112.2 | 19.75 | 68.39 | 177.9 | 3.435 | 26.28 | 85.85 | 492.1 | 4.135 | 4 |
| 102353 | L7H006Q01 | 95% Percentile | 8.315 | 0.1351 | 0.0682 | 0.3412 | 974.1 | 189.1 | 631.8 | 1670 | 12.2 | 149.3 | 614.9 | 3805 | 12.32 | 210.6 |
| | | | | | | | | | | | | | | | | |
| 102358 | L8H005Q01 | Number of Elements | 88 | 88 | 88 | 88 | 88 | 88 | 88 | 88 | 88 | 88 | 88 | 88 | 83 | 18 |
| 102358 | L8H005Q01 | Median | 7.33 | 0.034 | 0.02 | 0.11 | 18.85 | 3.2 | 8.5 | 31.46 | 0.95 | 3.9 | 16.15 | 86.39 | 1.663 | 6 |
| 102358 | L8H005Q01 | 95% Percentile | 7.632 | 0.2714 | 0.0592 | 0.183 | 24.82 | 4.365 | 16.13 | 39.86 | 2.467 | 5.525 | 19.6 | 113 | 2.097 | 55.55 |
| | | | | | | | | | | | | | | | | |
| 102386 | N1H013Q01 | Number of Elements | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 60 | |
| 102386 | N1H013Q01 | Median | 8.069 | 0.086 | 0.094 | 0.703 | 775.4 | 134.3 | 634.1 | 909.2 | 4.989 | 171.6 | 485 | 3490 | 10.73 | |
| 102386 | N1H013Q01 | 95% Percentile | 8.232 | 0.333 | 0.178 | 0.786 | 819 | 149.5 | 693.9 | 973.5 | 16.58 | 187.3 | 519 | 3646 | 12.25 | |
| | | | | | | | | | | | | | | | | |
| 102392 | N2H007Q01 | Number of Elements | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 18 |
| 102392 | N2H007Q01 | Median | 8.314 | 0.035 | 0.0255 | 0.3515 | 369.7 | 70.22 | 258.7 | 659.1 | 9.047 | 108.8 | 291 | 1678 | 6.28 | 1 |
| 102392 | N2H007Q01 | 95% Percentile | 8.686 | 0.588 | 0.185 | 0.517 | 692.9 | 153.6 | 544.1 | 1357 | 14.32 | 230 | 495.9 | 3223 | 9.248 | 147.1 |
| | | | | | | | | | | | | | | | | |
| 102422 | N3H002Q01 | Number of Elements | 78 | 78 | 78 | 78 | 78 | 78 | 78 | 78 | 78 | 78 | 78 | 78 | 72 | 19 |
| 102422 | N3H002Q01 | Median | 8.31 | 0.0445 | 0.0295 | 0.52 | 181.1 | 39.2 | 86.15 | 289.5 | 5.83 | 70.75 | 155.3 | 983 | 4.15 | 15 |
| 102422 | N3H002Q01 | 95% Percentile | 8.583 | 1.019 | 0.1201 | 0.7215 | 279.5 | 65.59 | 142.1 | 545.5 | 8.586 | 117.7 | 245.8 | 1467 | 5.203 | 1201 |
| | | | | | | | | | | | | | | | | |
| 102425 | N4H003Q01 | Number of Elements | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 72 | 21 |
| 102425 | N4H003Q01 | Median | 8.39 | 1.004 | 0.041 | 0.77 | 747.2 | 89.1 | 368.1 | 872.9 | 7.31 | 71.2 | 416 | 2844 | 13.66 | 9 |

| WMS No. | Feature Name | Type of Statistics | pH | $NO_3$+$NO_2$-N | $NH_4$-N | F | Na | Mg | $SO_4$ | Cl | K | Ca | EC | DMS | SAR | TURB (NTU) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 102425 | N4H003Q01 | 95% Percentile | 8.61 | 2.332 | 0.32 | 1.02 | 3113 | 349.8 | 1369 | 4713 | 19.36 | 186.4 | 1522 | 1.05E+04 | 31.77 | 52 |
| | | | | | | | | | | | | | | | | |
| 102430 | P1H003Q01 | Number of Elements | 116 | 116 | 116 | 116 | 116 | 116 | 116 | 116 | 116 | 116 | 116 | 116 | 110 | 20 |
| 102430 | P1H003Q01 | Median | 8.529 | 0.0475 | 0.0255 | 0.781 | 664.6 | 108.3 | 216.6 | 1018 | 5.99 | 55.47 | 396.5 | 2580 | 11.29 | 5 |
| 102430 | P1H003Q01 | 95% Percentile | 8.758 | 0.776 | 0.1125 | 0.952 | 906.6 | 159 | 333.7 | 1396 | 14.21 | 76.66 | 529.8 | 3487 | 14.88 | 20.35 |
| | | | | | | | | | | | | | | | | |
| 102435 | P3H001Q01 | Number of Elements | 105 | 105 | 105 | 105 | 105 | 105 | 105 | 105 | 105 | 105 | 105 | 105 | 102 | 14 |
| 102435 | P3H001Q01 | Median | 8.146 | 0.045 | 0.033 | 0.23 | 790.8 | 141.9 | 126.7 | 1649 | 9.01 | 149.7 | 559 | 3260 | 11.14 | 5 |
| 102435 | P3H001Q01 | 95% Percentile | 8.418 | 0.3968 | 0.2064 | 0.2948 | 1099 | 195.6 | 192.1 | 2291 | 24.99 | 206.1 | 724.8 | 4298 | 13.71 | 15.9 |
| | | | | | | | | | | | | | | | | |
| 102438 | P4H001Q01 | Number of Elements | 83 | 83 | 83 | 83 | 83 | 83 | 83 | 83 | 83 | 83 | 83 | 83 | 83 | 3 |
| 102438 | P4H001Q01 | Median | 8.36 | 0.035 | 0.02 | 0.29 | 474.9 | 80.6 | 103.9 | 867.6 | 7.22 | 69 | 328 | 1896 | 9 | 3 |
| 102438 | P4H001Q01 | 95% Percentile | 8.623 | 1.565 | 0.1219 | 0.3594 | 780 | 142.3 | 173.3 | 1553 | 12.63 | 109.7 | 522.5 | 3042 | 11.8 | 15.6 |
| | | | | | | | | | | | | | | | | |
| 102440 | Q1H012Q01 | Number of Elements | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 133 | 21 |
| 102440 | Q1H012Q01 | Median | 8.185 | 0.5055 | 0.034 | 0.188 | 9.175 | 7.041 | 13.7 | 6 | 1.257 | 18.2 | 20.15 | 153 | 0.47 | 114 |
| 102440 | Q1H012Q01 | 95% Percentile | 8.411 | 0.7852 | 0.1131 | 0.331 | 37.03 | 14.7 | 35.36 | 29.57 | 2.739 | 23.8 | 51.47 | 290.5 | 1.631 | 389 |
| | | | | | | | | | | | | | | | | |
| 102443 | Q1H017Q01 | Number of Elements | 129 | 129 | 129 | 129 | 129 | 129 | 129 | 129 | 129 | 129 | 129 | 129 | 125 | |
| 102443 | Q1H017Q01 | Median | 8.28 | 0.473 | 0.034 | 0.22 | 18 | 8.9 | 18.2 | 10.3 | 1.438 | 20.71 | 27 | 202 | 0.854 | |
| 102443 | Q1H017Q01 | 95% Percentile | 8.561 | 1.563 | 0.1182 | 0.699 | 130.7 | 26.6 | 38.8 | 38.18 | 2.738 | 39.77 | 84.54 | 732.5 | 4.031 | |
| | | | | | | | | | | | | | | | | |
| 102445 | Q1H022Q01 | Number of Elements | 114 | 114 | 114 | 114 | 114 | 114 | 114 | 114 | 114 | 114 | 114 | 114 | 112 | |
| 102445 | Q1H022Q01 | Median | 8.27 | 0.428 | 0.036 | 0.201 | 13.25 | 8.15 | 16.05 | 8 | 1.35 | 19.9 | 23.7 | 178 | 0.635 | |
| 102445 | Q1H022Q01 | 95% Percentile | 8.461 | 0.7354 | 0.0994 | 0.2992 | 25.18 | 12.14 | 25.87 | 16.59 | 2.675 | 23.02 | 32 | 243.7 | 1.103 | |
| | | | | | | | | | | | | | | | | |
| 102448 | Q2H002Q01 | Number of Elements | 193 | 193 | 193 | 193 | 193 | 193 | 193 | 193 | 193 | 193 | 193 | 193 | 188 | 41 |
| 102448 | Q2H002Q01 | Median | 8.516 | 1.601 | 0.05 | 0.9 | 178.9 | 30.99 | 39.11 | 29 | 1.78 | 40.1 | 106.9 | 968.5 | 5.101 | 3.22 |
| 102448 | Q2H002Q01 | 95% Percentile | 8.7 | 2.917 | 0.1468 | 1.051 | 197 | 35.84 | 50.04 | 39.19 | 3.347 | 48.06 | 115.2 | 1040 | 5.716 | 42.1 |
| | | | | | | | | | | | | | | | | |

| WMS No. | Feature Name | Type of Statistics | pH | $NO_3$+$NO_2$-N | $NH_4$-N | F | Na | Mg | $SO_4$ | Cl | K | Ca | EC | DMS | SAR | TURB (NTU) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 102455 | Q4H013Q01 | Number of Elements | 143 | 143 | 143 | 143 | 143 | 143 | 143 | 143 | 143 | 143 | 143 | 143 | 141 | |
| 102455 | Q4H013Q01 | Median | 8.45 | 3.112 | 0.042 | 1.79 | 498.6 | 65.3 | 335.1 | 362.8 | 3.031 | 58 | 284 | 2112 | 10.57 | |
| 102455 | Q4H013Q01 | 95% Percentile | 8.637 | 3.839 | 0.1077 | 2.019 | 561.7 | 76.7 | 383.5 | 409.9 | 9.36 | 65.92 | 310.9 | 2298 | 11.88 | |
| | | | | | | | | | | | | | | | | |
| 102457 | Q4R002Q01 | Number of Elements | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 57 | |
| 102457 | Q4R002Q01 | Median | 8.389 | 0.1135 | 0.0435 | 0.3675 | 27.2 | 11.8 | 17.25 | 16.66 | 4.464 | 26.68 | 36.45 | 283.4 | 1.15 | |
| 102457 | Q4R002Q01 | 95% Percentile | 8.72 | 0.5977 | 0.1766 | 0.5475 | 67.61 | 24.55 | 30.76 | 47.39 | 6.202 | 34.9 | 66.58 | 514.5 | 2.134 | |
| | | | | | | | | | | | | | | | | |
| 102463 | Q6H003Q01 | Number of Elements | 239 | 239 | 239 | 239 | 239 | 239 | 239 | 239 | 239 | 239 | 239 | 239 | 235 | 22 |
| 102463 | Q6H003Q01 | Median | 8.52 | 0.045 | 0.023 | 0.46 | 120.7 | 31.9 | 26.5 | 103.1 | 3.12 | 46.7 | 97 | 745.4 | 2.972 | 9.5 |
| 102463 | Q6H003Q01 | 95% Percentile | 8.873 | 0.4692 | 0.0952 | 0.6 | 166.4 | 43.12 | 40.45 | 154.2 | 4.276 | 71.4 | 123.7 | 962.9 | 4.54 | 163.6 |
| | | | | | | | | | | | | | | | | |
| 102464 | Q7H003Q01 | Number of Elements | 131 | 131 | 131 | 131 | 131 | 131 | 131 | 131 | 131 | 131 | 131 | 131 | 130 | |
| 102464 | Q7H003Q01 | Median | 8.527 | 1.167 | 0.023 | 0.654 | 162.2 | 30.2 | 103 | 118.9 | 2.28 | 37.87 | 108.2 | 815 | 4.787 | |
| 102464 | Q7H003Q01 | 95% Percentile | 8.769 | 1.904 | 0.1 | 1.123 | 289.7 | 48.81 | 172.5 | 246.3 | 3.85 | 58.8 | 190.5 | 1334 | 7.136 | |
| | | | | | | | | | | | | | | | | |
| 102475 | Q8H011Q01 | Number of Elements | 143 | 143 | 143 | 143 | 142 | 143 | 143 | 143 | 143 | 143 | 143 | 143 | 138 | |
| 102475 | Q8H011Q01 | Median | 8.523 | 0.668 | 0.037 | 0.852 | 246 | 34.5 | 138 | 227.3 | 3.856 | 43.8 | 162 | 1090 | 6.649 | |
| 102475 | Q8H011Q01 | 95% Percentile | 8.74 | 1.082 | 0.1853 | 1.497 | 562.5 | 58.41 | 278.4 | 607.7 | 12.47 | 70.19 | 323.5 | 2127 | 12.54 | |
| | | | | | | | | | | | | | | | | |
| 102478 | Q9H001Q01 | Number of Elements | 136 | 136 | 136 | 136 | 136 | 136 | 136 | 136 | 136 | 136 | 136 | 136 | 134 | |
| 102478 | Q9H001Q01 | Median | 8.68 | 0.569 | 0.0265 | 0.817 | 285.5 | 41.98 | 163.9 | 250.4 | 3.788 | 36.82 | 179.5 | 1246 | 7.395 | |
| 102478 | Q9H001Q01 | 95% Percentile | 8.923 | 1.614 | 0.1945 | 1.136 | 419.9 | 57.3 | 234.7 | 405.6 | 6.16 | 55.75 | 240 | 1632 | 10.3 | |
| | | | | | | | | | | | | | | | | |
| 102479 | Q9H002Q01 | Number of Elements | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 96 | 19 |
| 102479 | Q9H002Q01 | Median | 8.3 | 0.035 | 0.021 | 0.327 | 57.2 | 19.8 | 16.9 | 47.96 | 2.333 | 36.8 | 59.3 | 454.2 | 1.79 | 6 |
| 102479 | Q9H002Q01 | 95% Percentile | 8.56 | 0.2 | 0.1 | 0.55 | 118.8 | 37 | 33 | 117.5 | 3.56 | 59.1 | 100.9 | 807 | 3.012 | 237.1 |
| | | | | | | | | | | | | | | | | |
| 102487 | Q9H018Q01 | Number of Elements | 149 | 149 | 149 | 149 | 149 | 149 | 149 | 149 | 149 | 149 | 149 | 149 | 144 | 26 |
| 102487 | Q9H018Q01 | Median | 8.68 | 0.307 | 0.027 | 0.763 | 250.3 | 38.1 | 142.6 | 249.7 | 3.72 | 35.5 | 166 | 1112 | 6.83 | 64 |

| WMS No. | Feature Name | Type of Statistics | pH | $NO_3$+$NO_2$-N | $NH_4$-N | F | Na | Mg | $SO_4$ | Cl | K | Ca | EC | DMS | SAR | TURB (NTU) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 102487 | Q9H018Q01 | 95% Percentile | 8.882 | 1.321 | 0.1818 | 1.05 | 426.8 | 58.28 | 235.3 | 397.9 | 5.26 | 50.98 | 242.8 | 1686 | 9.948 | 282 |
| | | | | | | | | | | | | | | | | |
| 102496 | Q9H029Q01 | Number of Elements | 96 | 96 | 96 | 96 | 96 | 96 | 96 | 96 | 96 | 96 | 96 | 96 | 95 | 10 |
| 102496 | Q9H029Q01 | Median | 8.15 | 0.6155 | 0.0425 | 0.26 | 37.26 | 10.35 | 18.5 | 37.9 | 2.043 | 20.48 | 37.75 | 260.5 | 1.63 | 33 |
| 102496 | Q9H029Q01 | 95% Percentile | 8.444 | 1.563 | 0.2243 | 0.5175 | 84.53 | 24.15 | 36.93 | 117.7 | 3.403 | 41.06 | 79.95 | 552.7 | 2.728 | 152.8 |
| | | | | | | | | | | | | | | | | |
| 102504 | R1H015Q01 | Number of Elements | 84 | 84 | 84 | 84 | 84 | 84 | 84 | 84 | 84 | 84 | 84 | 84 | 82 | 20 |
| 102504 | R1H015Q01 | Median | 8.173 | 0.217 | 0.028 | 0.23 | 35.94 | 9.6 | 15 | 45.87 | 2.15 | 17.1 | 36.65 | 236 | 1.744 | 54 |
| 102504 | R1H015Q01 | 95% Percentile | 8.402 | 0.7952 | 0.0899 | 0.3471 | 69.53 | 17.79 | 26.37 | 102.8 | 3.252 | 29.76 | 64.12 | 416.8 | 2.435 | 526.8 |
| | | | | | | | | | | | | | | | | |
| 102525 | R2R003Q01 | Number of Elements | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 | |
| 102525 | R2R003Q01 | Median | 8.13 | 0.669 | 0.032 | 0.2 | 53 | 10.1 | 21.4 | 68.5 | 3.36 | 15 | 42.8 | 276 | 2.57 | |
| 102525 | R2R003Q01 | 95% Percentile | 8.406 | 1.69 | 0.1186 | 0.289 | 59.32 | 11 | 26.19 | 73.93 | 4.239 | 17.4 | 46.33 | 303.3 | 2.788 | |
| | | | | | | | | | | | | | | | | |
| 102526 | R3H001Q01 | Number of Elements | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 23 |
| 102526 | R3H001Q01 | Median | 8.1 | 0.141 | 0.025 | 0.2 | 43.9 | 10.17 | 16.35 | 55.5 | 2.639 | 16.6 | 38.7 | 267 | 2.092 | 24 |
| 102526 | R3H001Q01 | 95% Percentile | 8.292 | 0.4605 | 0.1056 | 0.251 | 82.09 | 18.06 | 50.21 | 113.3 | 3.759 | 28.7 | 67.39 | 456.1 | 2.779 | 72.7 |
| | | | | | | | | | | | | | | | | |
| 102527 | R3H003Q01 | Number of Elements | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 14 |
| 102527 | R3H003Q01 | Median | 8.026 | 0.3345 | 0.021 | 0.22 | 45.75 | 8.286 | 19.15 | 59.2 | 2.697 | 13.03 | 37.35 | 241.6 | 2.398 | 58 |
| 102527 | R3H003Q01 | 95% Percentile | 8.262 | 0.557 | 0.1105 | 0.24 | 55.67 | 10.87 | 30.18 | 74.42 | 3.79 | 17.18 | 46.52 | 291.2 | 2.627 | 107.8 |
| | | | | | | | | | | | | | | | | |
| 102528 | R3H004Q01 | Number of Elements | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 52 | |
| 102528 | R3H004Q01 | Median | 8.04 | 0.499 | 0.032 | 0.23 | 43.3 | 7.9 | 15.5 | 55.2 | 3.21 | 12.3 | 35.9 | 233 | 2.365 | |
| 102528 | R3H004Q01 | 95% Percentile | 8.21 | 0.6314 | 0.092 | 0.2752 | 50.62 | 9.14 | 34.15 | 62.82 | 4.02 | 15.34 | 41.9 | 255.6 | 2.6 | |
| | | | | | | | | | | | | | | | | |
| 102534 | S1R001Q01 | Number of Elements | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 16 | |
| 102534 | S1R001Q01 | Median | 8.4 | 0.146 | 0.035 | 0.48 | 19.1 | 13 | 8.3 | 11.4 | 1.52 | 24.2 | 32.6 | 247 | 0.785 | |
| 102534 | S1R001Q01 | 95% Percentile | 8.644 | 0.3172 | 0.061 | 0.5552 | 27.42 | 14.04 | 16.7 | 22.21 | 1.915 | 25.52 | 37.1 | 279.6 | 1.198 | |
| | | | | | | | | | | | | | | | | |

| WMS No. | Feature Name | Type of Statistics | pH | $NO_3$+$NO_2$-N | $NH_4$-N | F | Na | Mg | $SO_4$ | Cl | K | Ca | EC | DMS | SAR | TURB (NTU) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 102545 | S3H006Q01 | Number of Elements | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | |
| 102545 | S3H006Q01 | Median | 8.46 | 0.068 | 0.02 | 0.348 | 31.7 | 19 | 19.89 | 22.53 | 3.02 | 29.2 | 44.5 | 348 | 1.18 | |
| 102545 | S3H006Q01 | 95% Percentile | 8.69 | 0.7 | 0.271 | 0.57 | 69.08 | 50.36 | 47.3 | 61.57 | 4.768 | 51.48 | 83 | 643.5 | 1.705 | |
| | | | | | | | | | | | | | | | | |
| 102553 | S5H002Q01 | Number of Elements | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 54 | |
| 102553 | S5H002Q01 | Median | 8.21 | 0.386 | 0.033 | 0.17 | 17.3 | 8.3 | 9 | 15.3 | 1.11 | 15.4 | 24.3 | 172 | 0.96 | |
| 102553 | S5H002Q01 | 95% Percentile | 8.468 | 0.6794 | 0.1078 | 0.24 | 28.65 | 12.33 | 16.96 | 25.76 | 1.714 | 21.77 | 35.24 | 253.1 | 1.248 | |
| | | | | | | | | | | | | | | | | |
| 102565 | S7H001Q01 | Number of Elements | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | |
| 102565 | S7H001Q01 | Median | 8.349 | 0.9295 | 0.0265 | 0.25 | 63.67 | 19.5 | 19.63 | 75.55 | 1.849 | 32.22 | 62.15 | 439 | 2.26 | |
| 102565 | S7H001Q01 | 95% Percentile | 8.73 | 5.632 | 0.1101 | 0.2865 | 107.3 | 35.61 | 27.88 | 135.2 | 3.377 | 49.65 | 95.76 | 691.7 | 2.914 | |
| | | | | | | | | | | | | | | | | |
| 102568 | S7H004Q01 | Number of Elements | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 62 | 12 |
| 102568 | S7H004Q01 | Median | 8.385 | 0.14 | 0.0205 | 0.28 | 34.79 | 13.91 | 12.51 | 35.73 | 1.959 | 23.25 | 40.05 | 289.1 | 1.382 | 28 |
| 102568 | S7H004Q01 | 95% Percentile | 8.739 | 0.4932 | 0.09 | 0.437 | 82.33 | 31.53 | 21.35 | 87.22 | 2.917 | 30.59 | 75.3 | 541.7 | 2.492 | 225.5 |
| | | | | | | | | | | | | | | | | |
| 102573 | T1H004Q01 | Number of Elements | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 34 | |
| 102573 | T1H004Q01 | Median | 8.08 | 0.262 | 0.038 | 0.154 | 11.1 | 5.7 | 8.825 | 11 | 1.13 | 10.2 | 16.5 | 121 | 0.77 | |
| 102573 | T1H004Q01 | 95% Percentile | 8.366 | 0.4831 | 0.0788 | 0.2729 | 21.2 | 9.766 | 14.62 | 22.66 | 1.442 | 16.2 | 27.29 | 190.2 | 1.071 | |
| | | | | | | | | | | | | | | | | |
| 102586 | T3H004Q01 | Number of Elements | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 62 | |
| 102586 | T3H004Q01 | Median | 8.078 | 0.099 | 0.026 | 0.135 | 7.7 | 5.3 | 5.8 | 5.3 | 1.32 | 9.904 | 14.1 | 108 | 0.4785 | |
| 102586 | T3H004Q01 | 95% Percentile | 8.289 | 0.1913 | 0.0883 | 0.189 | 12.22 | 9.28 | 11.59 | 8.87 | 3.193 | 18.16 | 22.7 | 176 | 0.6095 | |
| | | | | | | | | | | | | | | | | |
| 102587 | T3H005Q01 | Number of Elements | 49 | 49 | 49 | 49 | 49 | 49 | 49 | 49 | 49 | 49 | 49 | 49 | 48 | |
| 102587 | T3H005Q01 | Median | 7.99 | 0.344 | 0.027 | 0.14 | 6.6 | 4.4 | 5.2 | 5 | 0.89 | 9.861 | 12.14 | 98.79 | 0.46 | |
| 102587 | T3H005Q01 | 95% Percentile | 8.35 | 0.5236 | 0.0752 | 0.1812 | 9.4 | 7.36 | 12.34 | 6.26 | 1.786 | 15.21 | 18.5 | 142.7 | 0.5565 | |
| | | | | | | | | | | | | | | | | |
| 102588 | T3H006Q01 | Number of Elements | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 47 | |
| 102588 | T3H006Q01 | Median | 7.906 | 0.2005 | 0.0205 | 0.13 | 8.005 | 3.925 | 5.85 | 5.15 | 0.9955 | 8.15 | 11.55 | 90.11 | 0.578 | |

| WMS No. | Feature Name | Type of Statistics | pH | $NO_3$+$NO_2$-N | $NH_4$-N | F | Na | Mg | $SO_4$ | Cl | K | Ca | EC | DMS | SAR | TURB (NTU) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 102588 | T3H006Q01 | 95% Percentile | 8.368 | 0.4539 | 0.1043 | 0.1822 | 14.28 | 9.621 | 10.65 | 12.76 | 1.59 | 18.67 | 26.37 | 189.8 | 0.7922 | |
| | | | | | | | | | | | | | | | | |
| 102590 | T3H008Q01 | Number of Elements | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 63 | 1 |
| 102590 | T3H008Q01 | Median | 7.984 | 0.055 | 0.0215 | 0.148 | 7.7 | 5.1 | 6.408 | 5 | 1.473 | 10.7 | 14.55 | 115.5 | 0.5 | 62.3 |
| 102590 | T3H008Q01 | 95% Percentile | 8.315 | 0.1953 | 0.123 | 0.1995 | 12.87 | 9.915 | 15.5 | 7.25 | 3.458 | 20.57 | 25.58 | 198.7 | 0.749 | 62.3 |
| | | | | | | | | | | | | | | | | |
| 102606 | T5H007Q01 | Number of Elements | 41 | 41 | 41 | 41 | 41 | 41 | 41 | 41 | 41 | 41 | 41 | 41 | 39 | |
| 102606 | T5H007Q01 | Median | 7.92 | 0.216 | 0.024 | 0.136 | 7.002 | 3.502 | 6.607 | 5 | 0.75 | 6.896 | 10.65 | 84 | 0.52 | |
| 102606 | T5H007Q01 | 95% Percentile | 8.23 | 0.393 | 0.066 | 0.18 | 15.1 | 6.1 | 11.2 | 9.2 | 1.469 | 11 | 18.7 | 135 | 0.9713 | |
| | | | | | | | | | | | | | | | | |
| 102615 | T7H001Q01 | Number of Elements | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 42 | |
| 102615 | T7H001Q01 | Median | 8.236 | 0.412 | 0.027 | 0.16 | 22.9 | 9.7 | 7.2 | 22.9 | 1.072 | 13.6 | 25.4 | 187.5 | 1.2 | |
| 102615 | T7H001Q01 | 95% Percentile | 8.575 | 0.8895 | 0.0789 | 0.2189 | 31.31 | 13.88 | 29.8 | 35.01 | 1.891 | 19.74 | 35.97 | 250.5 | 1.359 | |
| | | | | | | | | | | | | | | | | |
| 102620 | U1H006Q01 | Number of Elements | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 57 | |
| 102620 | U1H006Q01 | Median | 7.935 | 0.1705 | 0.027 | 0.15 | 12.49 | 4.25 | 9.65 | 10.95 | 0.817 | 9 | 15.2 | 103.2 | 0.86 | |
| 102620 | U1H006Q01 | 95% Percentile | 8.255 | 0.4284 | 0.0762 | 0.2109 | 28.5 | 8.16 | 20.52 | 31.27 | 1.546 | 16.55 | 31 | 197.3 | 1.442 | |
| | | | | | | | | | | | | | | | | |
| 102679 | U4H008Q01 | Number of Elements | 208 | 208 | 208 | 208 | 208 | 208 | 208 | 208 | 208 | 208 | 208 | 208 | 203 | |
| 102679 | U4H008Q01 | Median | 7.995 | 0.4905 | 0.022 | 0.2 | 25.1 | 6.3 | 10.6 | 26.2 | 1.89 | 9.6 | 23.6 | 154 | 1.57 | |
| 102679 | U4H008Q01 | 95% Percentile | 8.31 | 0.8893 | 0.0677 | 0.2979 | 44.8 | 9.61 | 19.33 | 49.4 | 3.196 | 14.23 | 39.7 | 250.7 | 2.35 | |
| | | | | | | | | | | | | | | | | |
| 102693 | U8H003Q01 | Number of Elements | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 2 |
| 102693 | U8H003Q01 | Median | 8.365 | 0.546 | 0.0225 | 0.459 | 77.03 | 14.55 | 22.17 | 92.72 | 2.123 | 20.34 | 58.55 | 389.7 | 3.165 | 20.5 |
| 102693 | U8H003Q01 | 95% Percentile | 8.666 | 1.085 | 0.0936 | 0.58 | 110.8 | 19.52 | 32.19 | 157.3 | 3.381 | 27.11 | 85 | 534.2 | 4.049 | 20.95 |
| | | | | | | | | | | | | | | | | |
| 102695 | V1H001Q01 | Number of Elements | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 88 | |
| 102695 | V1H001Q01 | Median | 7.96 | 0.2345 | 0.034 | 0.13 | 5.6 | 3.7 | 8.05 | 4.35 | 1.031 | 8.969 | 10.5 | 87.5 | 0.39 | |
| 102695 | V1H001Q01 | 95% Percentile | 8.253 | 0.4119 | 0.0727 | 0.1855 | 9.71 | 6.965 | 14.02 | 6.155 | 1.724 | 15.21 | 18.87 | 144.9 | 0.5795 | |
| | | | | | | | | | | | | | | | | |

| WMS No. | Feature Name | Type of Statistics | pH | $NO_3$+$NO_2$-N | $NH_4$-N | F | Na | Mg | $SO_4$ | Cl | K | Ca | EC | DMS | SAR | TURB (NTU) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 102704 | V1H010Q01 | Number of Elements | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 61 | |
| 102704 | V1H010Q01 | Median | 7.82 | 0.214 | 0.055 | 0.121 | 4.269 | 3 | 5.348 | 4.9 | 0.79 | 8.7 | 9.43 | 80 | 0.31 | |
| 102704 | V1H010Q01 | 95% Percentile | 8.199 | 0.5148 | 0.1657 | 0.1696 | 6.67 | 5.3 | 11.25 | 5.38 | 2.453 | 13.77 | 15.59 | 119 | 0.465 | |
| | | | | | | | | | | | | | | | | |
| 102718 | V1H038Q01 | Number of Elements | 78 | 78 | 78 | 78 | 78 | 78 | 78 | 78 | 78 | 78 | 78 | 78 | 78 | 2 |
| 102718 | V1H038Q01 | Median | 8.137 | 0.0735 | 0.02 | 0.19 | 7.714 | 5.71 | 9.942 | 5 | 1.48 | 13.38 | 16.15 | 131 | 0.4535 | 152.8 |
| 102718 | V1H038Q01 | 95% Percentile | 8.499 | 0.2926 | 0.0813 | 0.2645 | 14.19 | 12.93 | 18.55 | 7.115 | 2.875 | 26.87 | 30.02 | 234 | 0.649 | 289.8 |
| | | | | | | | | | | | | | | | | |
| 102740 | V2H008Q01 | Number of Elements | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 66 | |
| 102740 | V2H008Q01 | Median | 8.03 | 0.1845 | 0.0205 | 0.16 | 9.8 | 6.591 | 8.7 | 6.95 | 1.325 | 11.38 | 17.15 | 131.5 | 0.58 | |
| 102740 | V2H008Q01 | 95% Percentile | 8.636 | 0.4199 | 0.0656 | 0.3734 | 34.49 | 21.1 | 16.38 | 20.16 | 2.623 | 29.74 | 46.06 | 355.7 | 1.212 | |
| | | | | | | | | | | | | | | | | |
| 102755 | V3H010Q01 | Number of Elements | 205 | 205 | 205 | 205 | 205 | 205 | 205 | 205 | 205 | 205 | 205 | 205 | 197 | |
| 102755 | V3H010Q01 | Median | 8.17 | 0.855 | 0.024 | 0.19 | 19.6 | 11.2 | 43.5 | 9.4 | 3.12 | 20.9 | 30.4 | 218 | 0.9 | |
| 102755 | V3H010Q01 | 95% Percentile | 8.908 | 3.11 | 0.0868 | 0.3 | 54.3 | 19.2 | 114.3 | 29.4 | 5.744 | 35.38 | 59.2 | 409.5 | 1.902 | |
| | | | | | | | | | | | | | | | | |
| 102779 | V5H002Q01 | Number of Elements | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 82 | 2 |
| 102779 | V5H002Q01 | Median | 8.17 | 0.11 | 0.021 | 0.21 | 15.3 | 7.8 | 16 | 9.5 | 1.81 | 17.8 | 24 | 172 | 0.7675 | 12.75 |
| 102779 | V5H002Q01 | 95% Percentile | 8.54 | 0.484 | 0.0954 | 0.332 | 35.13 | 15.7 | 31.01 | 25.53 | 2.928 | 25.4 | 40.54 | 293.4 | 1.4 | 13.79 |
| | | | | | | | | | | | | | | | | |
| 102781 | V6H002Q01 | Number of Elements | 78 | 78 | 78 | 78 | 78 | 78 | 78 | 78 | 78 | 78 | 78 | 78 | 75 | |
| 102781 | V6H002Q01 | Median | 8.155 | 0.314 | 0.0215 | 0.22 | 18.55 | 7.85 | 15.75 | 9.75 | 1.511 | 17.3 | 25.4 | 188 | 0.91 | |
| 102781 | V6H002Q01 | 95% Percentile | 8.512 | 0.7806 | 0.0806 | 0.292 | 40.41 | 15.82 | 29.38 | 25.16 | 2.954 | 25.73 | 41.85 | 316.2 | 1.583 | |
| | | | | | | | | | | | | | | | | |
| 102797 | V7H012Q01 | Number of Elements | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | |
| 102797 | V7H012Q01 | Median | 7.882 | 0.5055 | 0.039 | 0.15 | 9.65 | 5.496 | 11.6 | 5.8 | 1.685 | 12.8 | 17.05 | 130.5 | 0.5505 | |
| 102797 | V7H012Q01 | 95% Percentile | 8.209 | 1.227 | 0.225 | 0.19 | 17.69 | 8.731 | 20.05 | 12.58 | 3.016 | 20.24 | 26.1 | 205.3 | 0.9672 | |
| | | | | | | | | | | | | | | | | |
| 102832 | W1R004Q01 | Number of Elements | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 66 | |
| 102832 | W1R004Q01 | Median | 7.795 | 0.038 | 0.031 | 0.282 | 48.65 | 10.1 | 39.3 | 82.55 | 2.205 | 24.75 | 47.85 | 277.5 | 2.08 | |

| WMS No. | Feature Name | Type of Statistics | pH | $NO_3$+$NO_2$-N | $NH_4$-N | F | Na | Mg | $SO_4$ | Cl | K | Ca | EC | DMS | SAR | TURB (NTU) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 102832 | W1R004Q01 | 95% Percentile | 8.116 | 0.1203 | 0.0896 | 0.3486 | 59.17 | 13.55 | 71.18 | 99.02 | 3.58 | 31.89 | 57.92 | 348 | 2.278 | |
| | | | | | | | | | | | | | | | | |
| 102834 | W2H005Q01 | Number of Elements | 186 | 186 | 186 | 186 | 186 | 186 | 186 | 186 | 186 | 186 | 186 | 186 | 183 | |
| 102834 | W2H005Q01 | Median | 8.371 | 0.109 | 0.025 | 0.31 | 24.9 | 13.9 | 21.65 | 14.8 | 1.59 | 20 | 32.6 | 246 | 1.03 | |
| 102834 | W2H005Q01 | 95% Percentile | 8.578 | 0.291 | 0.0665 | 0.41 | 36.2 | 20.8 | 39.78 | 24.19 | 2.758 | 27.6 | 45.58 | 342.5 | 1.32 | |
| | | | | | | | | | | | | | | | | |
| 102871 | W3H015Q01 | Number of Elements | 156 | 156 | 156 | 156 | 156 | 156 | 156 | 156 | 156 | 156 | 156 | 156 | 151 | |
| 102871 | W3H015Q01 | Median | 8.218 | 0.1215 | 0.031 | 0.33 | 198.3 | 40.45 | 31.05 | 297.5 | 3.274 | 52.3 | 146 | 959 | 4.96 | |
| 102871 | W3H015Q01 | 95% Percentile | 8.633 | 0.6245 | 0.068 | 0.4 | 303.9 | 54.32 | 46.05 | 484.4 | 4.342 | 67.95 | 219 | 1342 | 6.338 | |
| | | | | | | | | | | | | | | | | |
| 102897 | W4H004Q01 | Number of Elements | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | |
| 102897 | W4H004Q01 | Median | 7.76 | 0.2815 | 0.0235 | 0.113 | 4.65 | 3.557 | 8.331 | 5 | 0.844 | 6.5 | 9.55 | 71.2 | 0.365 | |
| 102897 | W4H004Q01 | 95% Percentile | 8.056 | 0.5648 | 0.0811 | 0.1751 | 7.027 | 5.215 | 13.42 | 5.305 | 2.02 | 9.943 | 13.71 | 99.82 | 0.493 | |
| | | | | | | | | | | | | | | | | |
| 102898 | W4H006Q01 | Number of Elements | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 54 | 1 |
| 102898 | W4H006Q01 | Median | 8.403 | 0.702 | 0.023 | 0.296 | 55.9 | 20.28 | 19.7 | 41.6 | 1.25 | 22 | 51.7 | 371.1 | 2.1 | 52 |
| 102898 | W4H006Q01 | 95% Percentile | 8.795 | 1.213 | 0.142 | 0.6709 | 163.8 | 42.71 | 38.02 | 95.46 | 2.49 | 31.5 | 110.7 | 903.9 | 4.54 | 52 |
| | | | | | | | | | | | | | | | | |
| 102901 | W4H009Q01 | Number of Elements | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | |
| 102901 | W4H009Q01 | Median | 8.151 | 0.2445 | 0.0405 | 0.26 | 46.7 | 14.7 | 19.75 | 57.75 | 2.055 | 23.55 | 44.2 | 305.5 | 1.955 | |
| 102901 | W4H009Q01 | 95% Percentile | 8.336 | 0.5787 | 0.0868 | 0.3283 | 68.29 | 19.45 | 25.23 | 100.9 | 3.181 | 29.39 | 65.18 | 418.7 | 2.413 | |
| | | | | | | | | | | | | | | | | |
| 102914 | W5H022Q01 | Number of Elements | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 94 | 20 |
| 102914 | W5H022Q01 | Median | 7.88 | 0.184 | 0.026 | 0.13 | 6.739 | 4.6 | 9.4 | 5 | 1.59 | 9.1 | 12.7 | 94 | 0.4885 | 4 |
| 102914 | W5H022Q01 | 95% Percentile | 8.13 | 0.45 | 0.1272 | 0.1702 | 13.02 | 6.21 | 14.34 | 9.63 | 3.295 | 11.71 | 18.19 | 135 | 0.8 | 25.15 |
| | | | | | | | | | | | | | | | | |
| 102933 | X1H003Q01 | Number of Elements | 237 | 237 | 237 | 237 | 237 | 237 | 237 | 237 | 237 | 237 | 237 | 237 | 232 | |
| 102933 | X1H003Q01 | Median | 8.09 | 0.175 | 0.023 | 0.18 | 16.3 | 8.206 | 8.4 | 15.6 | 1.183 | 9.8 | 20.7 | 144.9 | 0.9455 | |
| 102933 | X1H003Q01 | 95% Percentile | 8.452 | 0.5504 | 0.0714 | 0.28 | 66.42 | 20.22 | 16.62 | 81.16 | 2.952 | 21.98 | 56.8 | 373.5 | 2.612 | |
| | | | | | | | | | | | | | | | | |

| WMS No. | Feature Name | Type of Statistics | pH | $NO_3$+$NO_2$-N | $NH_4$-N | F | Na | Mg | $SO_4$ | Cl | K | Ca | EC | DMS | SAR | TURB (NTU) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 102935 | X1H014Q01 | Number of Elements | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 89 | |
| 102935 | X1H014Q01 | Median | 7.803 | 0.324 | 0.0405 | 0.122 | 7.016 | 4.6 | 6.233 | 6.4 | 0.9785 | 6.764 | 11.44 | 82.72 | 0.52 | |
| 102935 | X1H014Q01 | 95% Percentile | 8.115 | 1.025 | 0.0766 | 0.1711 | 15.16 | 10.36 | 12.36 | 21.54 | 2.053 | 13.71 | 24.32 | 168 | 0.788 | |
| | | | | | | | | | | | | | | | | |
| 102958 | X2H013Q01 | Number of Elements | 106 | 106 | 106 | 106 | 106 | 106 | 106 | 106 | 106 | 106 | 106 | 106 | 105 | 72 |
| 102958 | X2H013Q01 | Median | 7.972 | 0.0915 | 0.0205 | 0.1325 | 3.9 | 6.876 | 5 | 5 | 0.773 | 8.652 | 12.27 | 98 | 0.24 | 1 |
| 102958 | X2H013Q01 | 95% Percentile | 8.252 | 0.1965 | 0.0665 | 0.1875 | 4.851 | 8.4 | 8.5 | 5.6 | 1.515 | 10.55 | 14.68 | 117 | 0.3124 | 13.85 |
| | | | | | | | | | | | | | | | | |
| 102963 | X2H016Q01 | Number of Elements | 319 | 319 | 319 | 319 | 319 | 319 | 319 | 319 | 319 | 319 | 319 | 319 | 308 | 101 |
| 102963 | X2H016Q01 | Median | 8.209 | 0.52 | 0.02 | 0.23 | 28.29 | 17.8 | 25.1 | 22.7 | 1.406 | 20.5 | 37.8 | 279 | 1.09 | 2.2 |
| 102963 | X2H016Q01 | 95% Percentile | 8.53 | 0.9227 | 0.0811 | 0.34 | 52.96 | 29.01 | 36.82 | 43.81 | 2.887 | 31.46 | 60.44 | 453.4 | 1.63 | 22 |
| | | | | | | | | | | | | | | | | |
| 102965 | X2H022Q01 | Number of Elements | 103 | 103 | 103 | 103 | 103 | 103 | 102 | 103 | 103 | 103 | 103 | 103 | 101 | 1 |
| 102965 | X2H022Q01 | Median | 8.32 | 0.541 | 0.02 | 0.24 | 26.66 | 25.76 | 40.59 | 16.5 | 1.13 | 25.3 | 44.8 | 338.4 | 0.87 | 4 |
| 102965 | X2H022Q01 | 95% Percentile | 8.587 | 1.008 | 0.0842 | 0.4616 | 70.5 | 49.25 | 77.74 | 35.99 | 3.127 | 39.02 | 77.61 | 646 | 1.84 | 4 |
| | | | | | | | | | | | | | | | | |
| 102975 | X2H032Q01 | Number of Elements | 205 | 205 | 205 | 205 | 205 | 205 | 205 | 205 | 205 | 205 | 205 | 205 | 198 | 71 |
| 102975 | X2H032Q01 | Median | 7.86 | 0.489 | 0.028 | 0.15 | 8.665 | 7.875 | 14.09 | 11 | 1.102 | 12.82 | 18.7 | 132 | 0.481 | 2 |
| 102975 | X2H032Q01 | 95% Percentile | 8.145 | 1.092 | 0.0938 | 0.2196 | 12.48 | 10.5 | 25.61 | 18.31 | 2.728 | 17.94 | 24.68 | 166.8 | 0.6016 | 32 |
| | | | | | | | | | | | | | | | | |
| 103014 | X3H008Q01 | Number of Elements | 49 | 49 | 49 | 49 | 49 | 49 | 49 | 49 | 49 | 49 | 49 | 49 | 49 | 34 |
| 103014 | X3H008Q01 | Median | 7.65 | 0.04 | 0.02 | 0.16 | 15 | 3.272 | 6.635 | 11.81 | 1.12 | 6.6 | 14.5 | 104.4 | 1.2 | 2 |
| 103014 | X3H008Q01 | 95% Percentile | 8.047 | 0.2232 | 0.0654 | 0.22 | 20.8 | 4.7 | 13.48 | 17.67 | 2.66 | 9.395 | 20.26 | 137.2 | 1.522 | 16.8 |

## 8.2 Appendix B: Land cover types and extent of areal cover across South Africa per WMA (after Fairbanks *et al.,* 2000)

| WMA | Total surface area ($km^2$) | 1st Largest Areal Cover Type Extent (and %) | 2nd Largest Areal Cover Type Extent (and %) | 3rd Largest Areal Cover Type Extent (and %) | 4th Largest Areal Cover Type Extent (and %) |
|---|---|---|---|---|---|
| Limpopo | 60 390 | Thicket; Bushland; Bush clumps; High Fynbos<br>31 274<br>(52 %) | Forest and Woodland (Woodland and Wooded Grassland)<br>15 005<br>(25 %) | Degraded land (Thicket; Bushland; Bush clumps; High Fynbos)<br>4 428<br>(7 %) | Cultivated land (temp crops commercial dryland)<br>2 980<br>(5 %) |
| Luvuvhu and Letaba | 25 014 | Forest and Woodland (Woodland and Wooded Grassland)<br>11 426<br>(46 %) | Thicket; Bushland; Bush clumps; High Fynbos<br>6 609<br>(26 %) | Cultivated land (temp crops commercial dryland)<br>3 457<br>(14 %) | Forest Plantations (Exotic)<br>778<br>(3 %) |
| Crocodile (West) and Marico | 47 517 | Thicket; Bushland; Bush clumps; High Fynbos<br>18 819<br>(40 %) | Forest and Woodland (Woodland and Wooded Grassland)<br>10 791<br>(23 %) | Unimproved Grassland<br>4 308<br>(9 %) | Cultivated land (temp crops commercial dryland)<br>3 499<br>(7 %) |
| Olifants | 54 504 | Forest and Woodland (Woodland and Wooded Grassland)<br>14 186<br>(26 %) | Unimproved Grassland<br>12 109<br>(22 %) | Thicket; Bushland; Bush clumps; High Fynbos<br>8 998<br>(17 %) | Cultivated land (temp crops commercial dryland)<br>8121<br>(15 %) |
| Inkomati | 28 670 | Forest and Woodland (Woodland and Wooded Grassland)<br>9 233<br>(32 %) | Unimproved Grassland<br>6 440<br>(22 %) | Thicket; Bushland; Bush clumps; High Fynbos<br>4 783<br>(17 %) | Forest Plantations (Exotic)<br>3 776<br>(13 %) |
| Usutu to Mhlatuze | 45 055 | Unimproved Grassland<br>15 804<br>(35 %) | Thicket; Bushland; Bush clumps; High Fynbos<br>6 164<br>(14 %) | Forest and Woodland (Woodland and Wooded Grassland)<br>5 865<br>(13 %) | Forest Plantations (Exotic)<br>5 001<br>(11 %) |
| Thukela | 29 035 | Unimproved Grassland<br>15 405<br>(53 %) | Thicket; Bushland; Bush clumps; High Fynbos<br>5 698<br>(20 %) | Cultivated land (temporary subsistence dryland)<br>2 064<br>(7 %) | Degraded land (Unimproved Grassland)<br>1 365<br>(5 %) |
| Upper Vaal | 55 463 | Unimproved Grassland<br>33 231 | Cultivated land (temp crops commercial dryland)<br>17 650 | Urban/ Built up land<br>1 086 | Thicket; Bushland; Bush clumps; High Fynbos<br>651 |

| WMA | Total surface area ($km^2$) | 1st Largest Areal Cover Type Extent (and %) | 2nd Largest Areal Cover Type Extent (and %) | 3rd Largest Areal Cover Type Extent (and %) | 4th Largest Areal Cover Type Extent (and %) |
|---|---|---|---|---|---|
| | | (60 %) | (32 %) | (2 %) | (1 %) |
| Middle Vaal | 52 549 | Unimproved Grassland<br>26 043<br>(50 %) | Cultivated land (temp crops commercial dryland)<br>22 212<br>(42 %) | Thicket; Bushland; Bush clumps; High Fynbos<br>2 139<br>(4 %) | Wetlands<br>435<br>(1 %) |
| Lower Vaal | 134 543 | Thicket; Bushland; Bush clumps; High Fynbos<br>71 387<br>(53 %) | Unimproved Grassland<br>25 700<br>(19 %) | Degraded land (Thicket; Bushland; Bush clumps; High Fynbos)<br>11 433<br>(8 %) | Cultivated land (temp crops commercial dryland)<br>10 359<br>(8 %) |
| Mvoti to Umzimkulu | 27 221 | Unimproved Grassland<br>8 815<br>(32 %) | Thicket; Bushland; Bush clumps; High Fynbos<br>4 649<br>(17 %) | Forest Plantations (Exotic)<br>3 425<br>(13 %) | Cultivated land (permanent commercial sugar cane)<br>2 902<br>(11 %) |
| Mzimvubu to Keiskamma | 66 182 | Unimproved Grassland<br>29 804<br>(45 %) | Degraded land (Unimproved Grassland)<br>11 150<br>(17 %) | Thicket; Bushland; Bush clumps; High Fynbos<br>9 585<br>(14 %) | Cultivated land (temporary subsistence dryland)<br>8 001<br>(12 %) |
| Upper Orange | 94 014 | Unimproved Grassland<br>41 990<br>(45 %) | Shrubland and Low Fynbos<br>32 037<br>(34 %) | Cultivated land (temp crops commercial dryland)<br>8 050<br>(9 %) | Thicket; Bushland; Bush clumps; High Fynbos<br>7 331<br>(8 %) |
| Lower Orange | 260 917 | Shrubland and Low Fynbos<br>208 975<br>(80 %) | Unimproved Grassland<br>28 500<br>(11 %) | Thicket; Bushland; Bush clumps; High Fynbos<br>12 805<br>(5 %) | Wetlands<br>2 695<br>(1 %) |
| Fish to Tsitsikamma | 96 950 | Shrubland and Low Fynbos<br>61 766<br>(64 %) | Thicket; Bushland; Bush clumps; High Fynbos<br>17 156<br>(18 %) | Unimproved Grassland<br>8 348<br>(9 %) | Degraded lands (Shrubland and Low Fynbos)<br>3 193<br>(3 %) |
| Gouritz | 52 590 | Shrubland and Low Fynbos<br>44 004<br>(84 %) | Cultivated land (temp crops commercial dryland)<br>2 655<br>(5 %) | Thicket; Bushland; Bush clumps; High Fynbos<br>2 109<br>(4 %) | Degraded lands (Shrubland and Low Fynbos)<br>724<br>(1 %) |
| Olifants/Doorn | 56 748 | Shrubland and Low Fynbos | Cultivated land (temp crops commercial dryland) | Thicket; Bushland; Bush clumps; High Fynbos | Unimproved Grassland |

| WMA | Total surface area ($km^2$) | 1st Largest Areal Cover Type Extent (and %) | 2nd Largest Areal Cover Type Extent (and %) | 3rd Largest Areal Cover Type Extent (and %) | 4th Largest Areal Cover Type Extent (and %) |
|---|---|---|---|---|---|
| | | 45 735<br>(81 %) | 3499<br>(6 %) | 3 400<br>(6 %) | 1 489<br>(3 %) |
| Breede | 19 663 | Shrubland and Low Fynbos<br>10 571<br>(54 %) | Cultivated land (temp crops commercial dryland)<br>5 565<br>(28 %) | Cultivated land (permanent crops commercial irrigated)<br>1 265<br>(6 %) | Thicket; Bushland; Bush clumps; High Fynbos<br>695<br>(1 %) |
| Berg | 13 296 | Cultivated land (temp crops commercial dryland)<br>5 995<br>(45 %) | Shrubland and Low Fynbos<br>3 552<br>(25 %) | Cultivated land (permanent crops commercial irrigated)<br>1 043<br>(8 %) | Thicket; Bushland; Bush clumps; High Fynbos<br>695<br>(5 %) |

## 8.3 Appendix C: Barcode Graphs for the National Sampling Sites that Exceed the *Very Good* and *Good* (or TWQR) Categories