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Natural resource accounts

Water quality accounts for South Africa, 2000

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Preface

This discussion document contains water quality accounts for South Africa for the reference year 2000. The monitoring and assessment of the quality of water resources is critically important for the determination of their fitness-for-use for various water use sectors.

The different characteristics of a water resource qualify it for some ecological and/or economic uses but not for others. Some water can be drunk without treatment; some can ensure life for certain aquatic species; a third source is already so polluted that it can be used only for cooling, etc. Therefore, water 'quality' is not an objective characteristic and attributing a quality to a water resource is a normative task: the water resource has to be evaluated against its potential uses.

The water accounts in physical terms for the 19 water management areas of South Africa for the hydrology year 2000, constructed according to the recommendations of the United Nations, System of Environmental and Economic Accounting, were published in 2004. The report described the flow of water, which is the supply, use and water assets.

This document envisages assigning quality to the flow of water. By linking this document with the previously published report one could establish the link between the flow of water in the system and the quality thereof. Due to data constraints this was not possible to do.

Abbreviations and acronyms

Ca	calcium
Cl	chloride
DOH	Department of Health
DWAF	Department of Water Affairs and Forestry
EC	electrical conductivity
F	fluoride
K	potassium
Mg	magnesium
mg/l	milligram per litre
mS/m	milliSiemens per metre
$N0_3$+$N0_2$	nitrate plus nitrite
Na	sodium
NH_4	ammonium
NRA	natural resource accounting
NTU	nephelometric turbidity units
RSA	Republic of South Africa
SAR	sodium adsorption ratio
SEEA	System of Environmental and Economic Accounting
SNA	System of National Accounting
SO_4	sulphate
SRU	standard river unit
Stats SA	Statistics South Africa
TDS	total dissolved solids
TWQR	Target Water Quality Range
WMA	water management area
WRC	Water Research Council

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1 Introduction

Water is a vital natural resource, since it is fundamental to any form of life. Categories of water resources include surface water, groundwater, water in impoundments and precipitation. Water has a number of particular characteristics which call for specific treatment in a resource account. It forms one of the ecosystem inputs[1] recorded in the System of Environmental and Economic Accounting (SEEA). In addition to the consumption of water by households, the resource is used in many industrial and agricultural processes. In most cases, and perhaps increasingly in future, water is paid for and represents an intermediate expenditure on a product. Not all categories of water resources are measurable in terms of stock levels, and comprehensive valuations are unlikely at the moment. This will be addressed when evaluation strategies are formulated.

The hydrological cycle adds to water supply by river inflows and precipitation and deducts from it by outflows and evapotranspiration. Other major deductions come from abstractions for economic use, but eventually almost all water abstracted for economic use is returned to the environment. Traditionally it has been supposed that the abstraction of water for economic purposes is marginal compared with the natural recycling of water as it moves down rivers, evaporates and falls again as precipitation. Increasingly there is a concern that this may not be so, at least at some locations and at some times. This is where a supplementary[2] set of physical accounts can be extremely valuable. As with soil resources, much interest in water accounts focuses on the quality of water and not just the quantity available.

More important than measuring the sheer volume of water may be measures of water quality, but measuring water quality is fraught with definitional problems. Water not fit for human consumption may be perfectly satisfactory for some other uses. The use to which water can be put depends crucially on its quality e.g. water used for hydro-electric power generation, industrial purposes and transportation does not require high standards of purity, whereas other uses, such as drinking, recreation, and habitats for aquatic organisms, rely on higher levels of purity.

Water quality accounts can assist in the analysis and design of sustainable water quality development strategies: 'If you can't measure it you can't manage it'. This principle applies as much to water resources management as to managing any other kind of human endeavour. Monitoring and assessing of water quality should be an integral part of water resources management. In South Africa this is stated explicitly in the National Water Act (NWA), Act No. 36 of 1998, which mandates the Minister of Water Affairs and Forestry to establish national monitoring systems that monitor, record, assess and disseminate information on water resources.

This discussion document focuses on the typical water quality problems predominant in South Africa, followed by a brief overview of the principles of water accounting, the national water quality monitoring programme and the methodology that was followed in this assessment. It concludes with an explanation of the conceptual framework and international guidelines applicable in this area of natural resource accounting, and an overview of the relevant available datasets in South Africa.

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[1] Ecosystem inputs are natural resources that provide direct use benefits.
[2] Water Resource accounts comprise stock and flows in physical terms and quality accounts.

2 Conceptual framework

Environmental accounts can facilitate an integrated approach to a range of issues. These include a broader assessment of the consequences of economic growth, the contribution of sectors to particular problems and the sectoral implications of environmental policy measures (for example, regulation charges and incentives). The advantage of an environmental account is that by linking together physical data and monetary data in a consistent framework it is possible to undertake scenario modeling. Issues that could be modeled include assessing the efficiencies in different sectors of the economy, and environment and resource implications of structural change.

The 1993 System of National Accounts (1993 SNA) supports policy-making at a national level; however, historically the methods have had little regard for environmental matters. The main aim of environmental accounting is to assess the sustainability of activities and economic growth by quantifying the depletion and degradation of a natural resource. An environmental account provides an information system that links the economic activities and uses of a resource to changes in the natural resource base.

Environmental accounts extend the boundaries of the 1993 SNA framework to include environmental resources, which occur outside the production and asset boundaries typically measured in such an analysis.

The development of physical accounting has risen from the desire to assess the sustainability of economic activities and their interaction on the depletion and degradation of natural resources. Environmental accounting provides an integrated information system to link environmental and resource issues to economic data sets such as a country's national accounts. This facilitates policy-making and analysis of the interaction between development and environmentally sound and sustainable economic growth.

3 International guidelines

3.1 System of National Accounts

The internationally accepted set of guidelines for the preparation of national accounts is the 1993 SNA. This substantial work represents the efforts of five international economic organisations to define the scope of national accounts and provide guidance on the concepts and methods to be used in their compilation.

For the first time since such international guidelines have been published, the 1993 SNA explicitly discusses the incorporation of environmental information into the national accounts. In fact, two sets of environment-related guidelines are presented. The first set deals with the incorporation of natural resource assets into balance sheet accounts. The second set, which is more far-reaching, describes the development of a 'satellite system for integrated environmental and economic accounting'.

3.2 International practices

The data collected from a sampling point is attributed to a stretch of watercourse. A simplistic way of attribution could be to attribute it to the portion between this point and the next sampling point downstream or upstream; or to a stretch centred at the measurement point. But the attribution can also be done in a more sophisticated manner, e.g. a model that takes into account the behaviour of different physicochemical determinants. When quality classes have been attributed to each stretch, the next step is to assign a quality class to the whole watercourse, the whole river basin or the total national inland waters.

In France, quality was assessed against several families of parameters. One of them, the 'organic matter indicator', takes into consideration the following parameters: dissolved oxygen, biochemical oxygen demand (BOD) at five days, chemical oxygen demand (COD) and ammonium ions (NH_4). Other families of parameters were also tested, notably an euthrophication indicator. The parameter values were grouped into five quality classes, noted 1A (the best), 1B, 2, 3, and not classified (NC). Each stretch of watercourse was described by a quality class and a weight (depending on the length and outflow of the stretch) and, by adding the total weights for each class, the whole French water system could be broken down into five quality classes based on this family of parameters.

3.3 System of Integrated Environmental and Economic Accounting

The System of Integrated Environmental and Economic Accounting developed by the United Nations has two major objectives.

The first major objective of the SEEA is recognition of the standard SNA framework to better serve environmental analysis. One purpose of this reorganization is to make explicit the expenditures on environmental protection activities that prevent and mitigate environmental deterioration or restore the environment. A second purpose is to present in detail the values of natural resources asset stocks and annual changes in the volume of these stocks. This is closely related to the 1993 SNA's recommendation to include natural resource asset values in national balance sheet accounts.

The second major objective of the SEEA is the description of the interaction between the economy and the environment in physical terms. There is a strong emphasis in this component on the use of input–output accounting techniques to link physical data on resource use and waste production to economic data from the standard National Accounts.

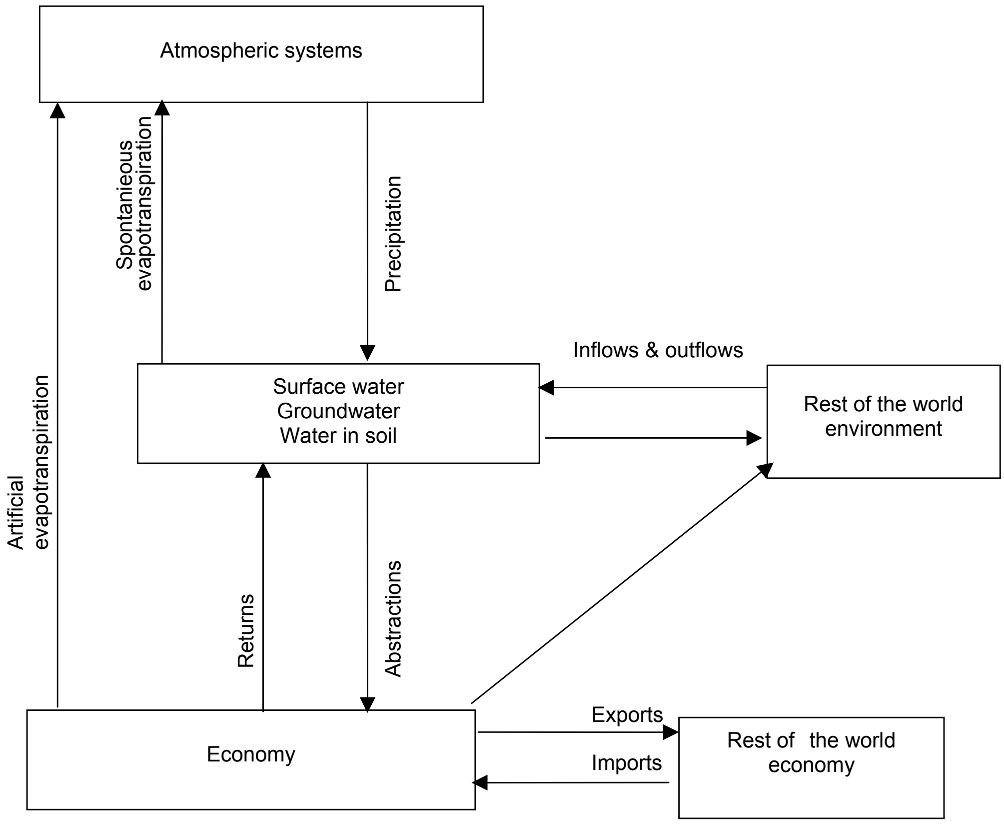
The final major objective of the SEEA is the calculation of an environmentally adjusted measure of Net Domestic Product. This is essentially the traditional Net Domestic Product aggregate of the national accounts adjusted for depletion of natural resources and degradation of the environment.

According to the SEEA, the general structure of quality accounts is conceptually simple however, it presents numerous problems of measurements. Temporal and spatial considerations play important roles in water quality and should be taken into account when compiling quality accounts. The quality of a river, for example, might increase enormously during particular weather conditions, and decrease rapidly when the conditions change.

Water Quality Accounts are done in the same way as the Asset Account (including an opening stock, changes in stock and a closing stock). Once quality classes are defined, water quality accounts can be constructed following the same general structure as an asset account. The accounts show the opening and closing stocks together with the changes in stocks during the accounting period for each quality class. Annexures 1 and 2 give examples of the water quality account framework for one water management area and for South Africa respectively.

The exchanges of water between the environment and the economy include direct abstraction, irrigation, and returns of water to groundwater, surface water, the sea and brackish water. The passive uses of water by the economy which do not involve direct abstraction, such as recreation or transportation, are not considered here. The storage and release of water in dams are not considered to take place within the economy but within the hydrological system. This is because it is difficult to make a distinction between the direct economic use of the water and what is required for regulating the discharge of the rivers for, say, flood prevention or to support runoff in summer, as illustrated by the next diagram.

Schematic representation of the interaction between the hydrological system and the economy



Source: Based on Tafi and Weber, 2000

4 Principles of water quality accounting

Water quality accounts describe a specific aspect of the state of an inland water system. They enable the comparison of the quality of water resources between different inland water systems and the assessment of the evolution of the same water system between two dates. Quality accounting is specific to various use sectors (see Annexure 3). As quality is not an additive characteristic, the general way to construct assets accounts is to define quality classes. These are then applied to the same structure as an asset account in quantity terms, with the quality as another dimension. The account then shows the opening and closing stocks together with the changes in stocks during the accounting period for each quality class.

Quality accounting is particularly useful for following the evolution of the quality of water resources and judging the efficiency of the measures taken to protect or improve the state of water bodies. Combined with emission accounts (and in particular when both accounts are developed at the level of a river basin), quality accounts enable the analysis of impacts of economic activities, which itself helps in the elaboration of new measures.

Two steps are generally used to describe the quality of a water system:

a) defining quality and quality classes,
b) defining units, enabling the aggregation of water volumes sorted by quality classes.

A methodology for defining units enabling aggregation of water volumes sorted by quality classes, initiated by the French Institute for the Environment (Ifen), has been successfully tested in other European countries (England, Wales, Ireland and Slovenia). This methodology could be applied in any country where water quality is regularly monitored on an adequate sample of sites. For European countries in particular, an appropriate use of the EuroWaterNet results would allow for the establishment of regular water quality accounts. This methodology can be applied in any country where water quality is regularly monitored on adequate sampling sites.

Quality is a characteristic of a given volume of water at a given point in time and location. As water flows, quality changes. It is thus necessary to assign a quality measure to the water flowing at a given location and to weight this quality by a quantity representative of the total flow at this location. A specific measuring unit has been introduced by EuroWaterNet for European countries, namely the standard river unit (SRU), which is worth 1 km.m^3/s. An SRU can represent a 1km long watercourse with a 1m^3/s outflow as well as a 0,5 km long watercourse with a 2 m^3/s outflow. This unit allows the aggregation of stretches of watercourses of different sizes.

5 National water quality monitoring programmes

The Department of Water Affairs and Forestry (DWAF) has a national monitoring programme (the Chemical or Salinity Monitoring Programme), as well as established assessment procedures for assessing the inorganic chemical water quality of surface waters. For this programme, samples are regularly collected at approximately 1 600 monitoring stations on rivers, at a frequency that varies from weekly to monthly. In addition, a Trophic Status Monitoring Programme is conducted on a much smaller scale for selected South African impoundments that are managed by DWAF. The design of a more extensive Euthrophication 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. One of its objectives is to provide information on the status and trends of the extent of faecal pollution, in terms of the microbial quality of surface water resources in priority areas. 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. A national network is not feasible at present because of the costs of sampling and analysis. Initiatives are under way to develop a National Toxicants Monitoring Programme that will include monitoring of organic and heavy metal pollutants. Radioactivity monitoring is done at regional level, only where such problems are known to exist.

The Inorganic Chemical Water Quality of Surface Water Resources in SA report by DWAF (2002) concentrates on the status of water quality in South Africa as reflected predominantly in the mineral salts composition. Mineral salts arise both naturally from soil erosion and the washout of salts naturally present in the soil, and from the contribution from human settlements and activities. Land use activities include both domestic (e.g. leading to nutrient enrichment or euthrophication) and industrial (e.g. the contamination of surface waters by acid mine drainage water containing constituents such as sulphate arising from accelerated oxidation of sulphur-bearing minerals in exposed rock consequent to mining operations). In addition to the information on the 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 trophic status of the water bodies. The 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 treated before drinking.

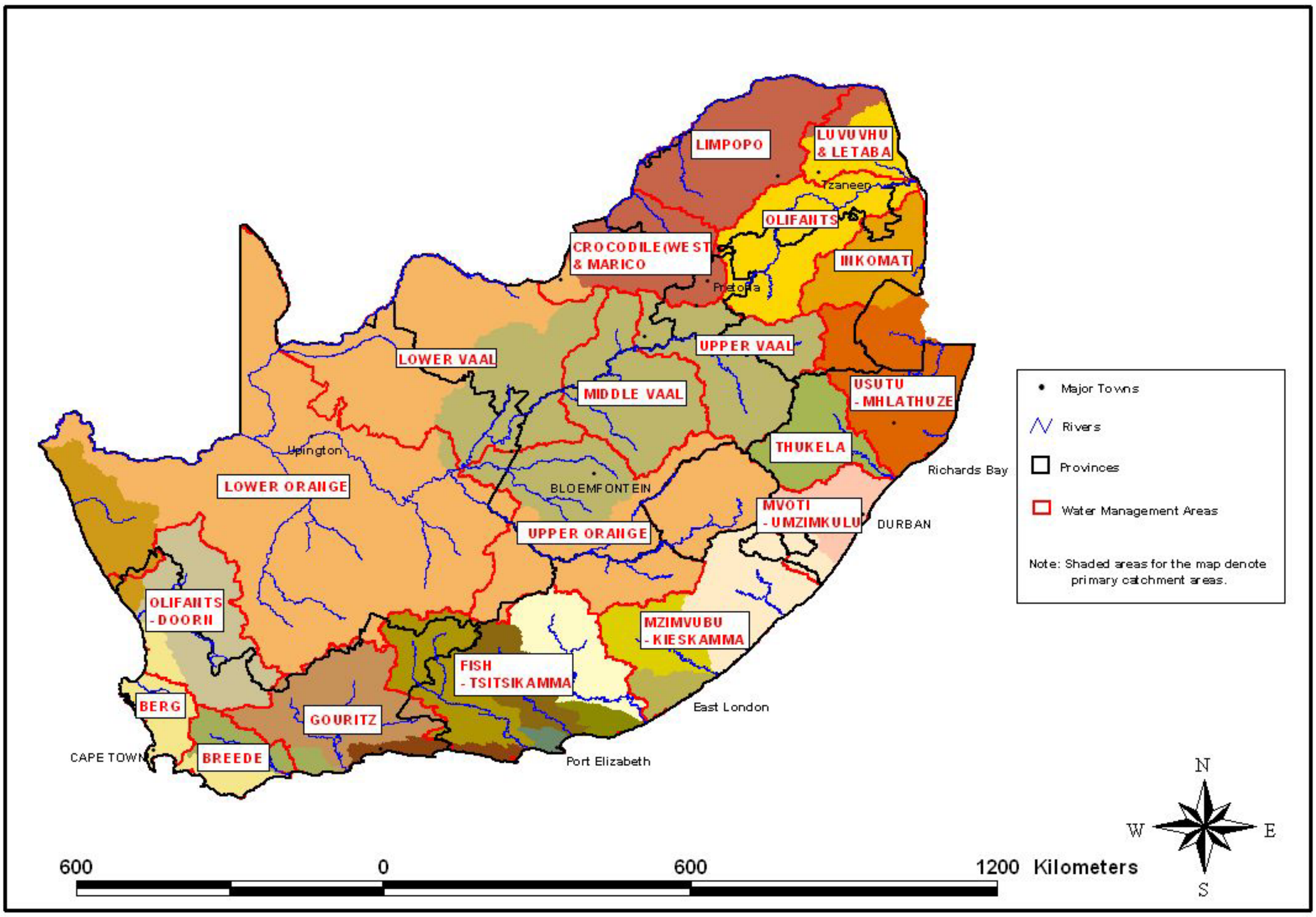
6 Assessment methodology

6.1 South Africa's water management areas

To simplify the assessment and to present the information in a way that will be useful for water resource management purposes, South Africa is divided into 19 water management areas (WMAs) as follows:

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

Figure 1: The water management areas of South Africa



Source: CSIR

6.2 Assessment basis

Two levels of sampling sites were selected from the chemical water quality database, namely:

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

The individual WMA sample site sets are based on the national set, with the addition of all other sample sites within the WMA 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.

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 analysis of the data set provides 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.

The national assessment: For the national assessment, a sample site is selected for each tertiary[3] 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.

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 be better able to link land use types and activities with the water quality sampled in the rivers.

[3] All primary regions make up a tertiary region, and all tertiary regions make up the Water Management Area

7 Typical water quality pollutants in South Africa

The greatest water quality problem in surface water in South Africa is likely to be faecal pollution, together with the associated disease-causing organisms, that occur in surface water near dense human settlements. However, total dissolved solids (TDS) in the form of elevated sodium & chloride salt concentrations are also common in many parts of the country. In groundwater the most common problems are high nitrite/nitrate and fluoride concentrations. Surface water comprises all water that flows over or is stored on the surface, for example, reservoirs, lakes and rivers. Groundwater comprises all water that collects in porous layers of underground formations known as aquifers.

7.1 Quality of surface water

Most surface water in South Africa is of good quality (Q2) and requires only clarification and disinfection (determined from the results of the chemical monitoring programme). There are, however a few notable exceptions:

Faecal pollution
High faecal pollution and total coliform counts (used as an indicator to indicate recent faecal pollution) occur in most surface water near dense human settlements.

Colour and stability
The rivers that drain the mountain catchments along the southern coastline have waters that are highly coloured due to organic acids. These waters have characteristically low total dissolved salts (TDS), electrical conductivity (EC) concentrations and a low pH. Colour removal requires precise chemical dosing, and together with the stabilisation of the water, treatment is neither cheap nor easy.

Salt concentrations (TDS or EC, sodium, chloride and sulphate)
The rivers that drain the dry interior regions carry water that may have a high TDS concentration mostly resulting from high sulphate and chloride concentrations. This means that the water is corrosive and has a distinctly salty taste. Salt removal by means of reverse osmosis or ion exchange is expensive, and most communities accept the water after clarification and disinfections. Care should be taken in areas where the TDS, sulphate or chloride concentrations are in the red[4] (poor quality) or purple (not acceptable quality) classes.

The rivers that drain the northern and eastern parts of South Africa generally carry good quality water, unless it has been contaminated due to human activity. A prime example of this is the Vaal River downstream of the Vaal Dam, which has high TDS due to effluent from the Witwatersrand area and from the gold mines. Treatment is expensive and the consumers normally accept the highly salinity.

[4] Colour tags are used during laboratory classifications.

Euthrophication (high algal concentrations)
Some reservoirs in South Africa have high algal concentrations. Water from these water bodies may have taste and colour problems. In many cases, authorities have implemented treatment options such as powdered activated carbon or processes such as dissolved air flotation, instead of the more conventional sedimentation in the clarification process. In some cases algae may produce toxins which are of concern to human health. Generally, however, the above processes also remove these toxins.

Fluoride
Fluoride concentrations in groundwater in some areas tend to be high, especially in the central and western parts of the country. In the coal-bearing regions of the country fluoride concentrations tend to be very high. Fluoride removal is expensive.

Sulphate and chloride
Water with high TDS concentrations tends to have high sulphate and chloride concentrations as well. Sulphate and chloride removal (desalination or ion exchange) is expensive and normally not considered viable.

7.2 Quality of groundwater

The quality of groundwater is measured according to three different aspects. These are salinity, calcium and magnesium concentrations, and iron and manganese concentrations.

Salinity
Groundwater commonly has high TDS concentrations, especially in the drier regions of the country where the predominant geological formations are sedimentary rocks of marine origin. The Karoo shales are a prime example of this. Salinity can be removed only at high cost and by means of, for instance, reverse osmosis, electrodialysis or deionisation.

Calcium and magnesium
The groundwater in the dolomitic areas and the northern parts of the country tends to be very hard. This usually has no health implications, except where concentrations are extremely high. It does, however, leads to clogging of pipes and scaling of elements in hot water appliances. The cost of replacement and maintenance of these appliances may make it cheaper to treat the water. For small communities, or single households, water softening by means of ion exchange is recommended. For larger communities, chemical dosing, settling and filtration would be more economical. It is important to note that water softening by means of ion exchange adds sodium to the water. This could prove problematic if the sodium concentration is already high.

Iron and manganese
Iron and manganese commonly occur in high concentrations in groundwater. Treatment for both of these problems is cheap and easy, consisting of oxidation by means of aeration, or by adding chlorine.

8 Detailed tables

Tables 1-18 illustrate the water quality indicators for South Africa for the year 2000. These tables cover all the water management areas in South Africa except the Lower Vaal. There is no information for Lower Vaal because there were no suitable sites. All sites assessed are identified by an alphanumeric code such as A2H019Q01. The tables were prepared using the water quality guidelines given in Annexures 4-6.

Table 1:Limpopo

Constituent	**Drainage region**					
	A3R003Q01	A3R003Q01	A4H013Q01	A5H006Q01	A5H008Q01	A7H001Q01
PH units 0-14	8,1	8,3	7,5	8,2	7,8	7,9
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Fluoride mg/l	0,3	0,1	0,3	0,2	0,1	0,1
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
TDS mg/l	126,6	179,0	56,0	215,1	74,0	91,0
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
$N0_3$+$N0_2$-N mg/l	0,1	0,0	0,0	0,1	0,18	0,1
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
NH_4-N mg/l	0,3	0,0	0,0	0,0	0,02	0,0
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Na mg/l	5,4	5,9	6,4	22,9	8,3	5,3
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Mg mg/l	7,1	13,4	2,4	10,9	2,8	4,6
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
SO_4 mg/l	13,6	8,9	4,4	27,4	7,2	5,6
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
CI mg/l	5,0	4,9	7,0	29,1	10,9	8,2
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
K mg/l	2,4	4,2	0,9	4,4	1,0	0,9
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Ca mg/l	14,8	16,3	4,5	20,4	7,2	10,2
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
EC mS/m	17,4	23,1	8,1	33,5	11,0	12,5
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
SAR as a ratio	0,3	0,3	0,6	1,0	0,1	0,4

Table 2: Luvuvhu and Letaba

Constituent	Drainage region			
	A9H011Q01	A9H012Q01	B8H008Q01	B9H003Q01
PH units 0-14	7,9	7,9	8,1	8,4
	Very Good	Very Good	Very Good	Very Good
Fluoride mg/l	0,1	0,4	0,2	0,2
	Very Good	Very Good	Very Good	Very Good
TDS mg/l	101,2	95,3	194,5	379,0
	Very Good	Very Good	Very Good	Very Good
$N0_3$+$N0_2$-N mg/l	0,1	0,3	0,1	0,1
	Very Good	Very Good	Very Good	Very Good
NH_4-N mg/l	0,0	0,0	0,0	0,0
	Very Good	Very Good	Very Good	Very Good
Na mg/l	9,4	7,2	24,3	35,7
	Very Good	Very Good	Very Good	Very Good
Mg mg/l	5,6	5,2	9,3	17,6
	Very Good	Very Good	Very Good	Very Good
SO_4 mg/l	5,9	4,8	10,9	10,4
	Very Good	Very Good	Very Good	Very Good
CI mg/l	11,7	6,8	28,9	19,1
	Very Good	Very Good	Very Good	Very good
K mg/l	0, 8	0,8	2,3	5,7
	Very Good	Very Good	Very Good	Very Good
Ca mg/l	7,5	8,4	15,4	31,4
	Very Good	Very Good	Very Good	Very Good
EC mS/m	14,3	12,7	28,5	44,0
	Very Good	Very Good	Very Good	Good
SAR as a ratio	0,6	0,5	1,2	1,3
	Very Good	Very Good	Very Good	Good

Table 3: Crocodile and Marico

Constituent	Drainage region					
	A2H019Q01	A2H021Q01	A2H059Q01	A2H094Q01	A2H111Q01	A2H116Q01
Ph units 0-14	8,3	8,3	8,3	8,4	8,3	8,4
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
FLOURIDE mg/l	0,4	0,5	0,4	0,3	0,5	0,5
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
TDS mg/l	429,3	420,0	481,0	414,5	302,5	497,0
	Very Good	Very Good	Very Good	Very Good	Very Good	Good
N03+N02-N mg/l	0,6	0,3	0,7	0,2	0,1	0,5
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
NH4-N mg/l	0,2	0,3	0,0	0,0	0,1	0,0
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Na mg/l	46,8	50,3	54,3	39,1	28,8	57,0
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Mg mg/l	24,4	17,9	27,0	22,2	16,9	26,6
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
SO4 mg/l	71,0	51,1	76,9	76,1	43,6	73,0
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
CI mg/l	57,9	48,6	69,1	65,1	34,3	70,5
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
K mg/l	6,4	8,6	6,0	6,4	4,7	6,9
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Ca mg/l	38,0	35,5	43,3	45,4	28,4	45,5
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
EC mS/m	61,4	56,2	68,1	61,3	43,7	69,7
	Good	Good	Good	Good	Good	Good
SAR as a ratio	1,5	1,7	1,6	1,2	1,1	1,7
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good

Table 4: Olifants

Constituent	**Drainage region**							
	B1H010Q01	B1H015Q01	B1H015Q01	B2H015Q01	B3H021Q01	B4H011Q01	B6H004Q01	B7H009Q01
PH units 0-14	8,3	8,0	7,9	8,2	8,2	8,6	8,1	8,5
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Fluoride mg/l	0,4	0,3	0,2	0,5	1,3	16,0	0,1	0,3
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
TDS mg/l	378,0	314,2	158,0	334,0	682,7	370,0	127,5	366,0
	Very Good	Very Good	Very Good	Very Good	Good	Very Good	Very Good	Very Good
$N0_3$+$N0_2$-N mg/l	0,1	0,1	0,1	0,4	0,5	1,2	0,2	0,3
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
NH_4-N mg/l	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Na mg/l	26,2	19,7	10,0	37,6	106,5	31,4	4,5	37,9
	Very Good	Very Good	Very Good	Very Good	Good	Very Good	Very Good	Very Good
Mg mg/l	25,0	22,0	8,0	17,5	32,8	26,2	8,2	22,7
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
SO_4 mg/l	155,8	133,3	38,8	101,5	126,0	27,1	10,4	52,8
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
CI mg/l	14,9	14,0	7,4	25,2	144,6	25,8	4,6	40,4
	Very Good	Very Good	Very Good	Very Good	Good	Very Good	Very Good	Very Good
K mg/l	5,7	6,6	2,9	4,7	7,9	1,1	0,5	3,0
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Ca mg/l	5,7	33,6	18,2	30,7	54,5	30,9	14,6	32,7
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
EC mS/m	55,3	46,2	23,2	47,8	100,4	48,8	17,2	51,5
	Good	Good	Very Good	Good	Fair	Good	Very Good	Good
SAR as a ratio	0,8	0,6	0,5	1,3	2,7	1,0	0.2	1,2
	Very Good	Very Good	Very Good	Very Good	Good	Very Good	Very Good	Very Good

Table 5: Inkomati

Constituent	**Drainage region**						
	X1H003Q01	X1H014Q01	X2H013Q01	X2H016Q01	X2H022Q01	X2H032Q01	X3H008Q01
PH units 0-14	8,1	7,8	8,0	8,2	8,3	7,9	7,7
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Fluoride mg/l	0,2	0,1	0,1	0,2	0,2	0,2	0,2
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
TDS mg/l	145,0	82,7	98,0	279,0	338,4	132,0	104,4
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
$N0_3$+$N0_2$-N mg/l	0,2	0,3	0,0	0,5	0,5	0,5	0,0
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
NH_4-N mg/l	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Na mg/l	16,3	7,0	4,0	28,3	26,7	8,7	15,0
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Mg mg/l	8,2	4,6	6,9	17,8	25,8	7,9	3,3
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
SO_4 mg/l	8,4	6,2	5,0	25,1	40,6	14,1	6,6
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
CI mg/l	15,6	6,4	5,0	22,7	16,5	11,0	11,8
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
K mg/l	1,2	1,0	0,8	1,4	1,1	1,1	1,1
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Ca mg/l	9,8	6,8	8,7	20,5	25,3	12,8	6,6
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
EC mS/m	20,7	11,4	12,3	37,8	44,8	18,7	14,5
	Very Good	Very Good	Very Good	Very Good	Good	Very Good	Very Good
SAR as a ratio	1,0	0,5	0,2	1,1	0,9	0,5	1,2
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good

Table 6: Usuthu to Mhlathuze

Constituent	Drainage region						
	W1R004Q01	W2R005Q01	W3H015Q01	W4H004Q01	W4H006Q01	W4H009Q01	W5H022Q01
PH units 0-14	7,8	8,4	8,2	7,8	8,4	8,2	7,9
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Fluoride mg/l	0,3	0,3	0,3	0,1	0,3	0,3	0,1
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
TDS mg/l	277,5	246,0	959,0	71,2	371,1	305,5	94,0
	Very Good	Very Good	Good	Very Good	Very Good	Very Good	Very Good
$N0_3$+$N0_2$-N mg/l	0,4	0,1	0,1	0,3	0,7	0,2	0,2
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
NH_4-N mg/l	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Na mg/l	48,7	24,9	198,3	4,7	55,9	46,7	6,7
	Very Good	Very Good	Good	Very Good	Very Good	Very Good	Very Good
Mg mg/l	10,1	13,9	40,5	3,7	20,3	14,7	4,6
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
SO_4 mg/l	39,3	21,7	31,1	8,3	19,7	19,8	9,4
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
CI mg/l	82,6	14,8	297,5	5,0	41,6	57,8	5,0
	Very Good	Very good	Fair	Very Good	Very Good	Very Good	Very Good
K mg/l	2,2	1,6	3,3	0,8	1,3	2,1	1,6
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Ca mg/l	24,8	20,0	52,3	6,5	22,0	23,6	9,1
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
EC mS/m	47,9	32,6	146,0	9,6	51,7	44,2	12,7
	Good	Very Good	Fair	Very Good	Good	Good	Very Good
SAR as a ratio	2,1	1,0	5,0	0,4	2,1	2,0	0,5
	Good	Very Good	Good	Very Good	Good	Very Good	Very Good

Table 7: Thukela

Constituent	Drainage region							
	V1H001Q01	V1H010Q01	V1H038Q01	V2H008Q01	V3H010Q01	V5H002Q01	V6H002Q01	V7012Q01
PH units 0-14	8,0	7,8	8,1	8,0	8,2	8,2	8,2	7,9
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Fluoride mg/l	0,1	0,1	0,2	0,2	0,3	0,2	0,2	0,2
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
TDS mg/l	87,5	80,0	131,0	131,5	218,0	172,0	188,0	130,0
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
$N0_3$+$N0_2$-N mg/l	0,2	0,2	0,1	0,2	0,9	0,1	0,1	0,5
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
NH_4-N mg/l	0,0	0,1	0.0	0,0	0,0	0,0	0,0	0,0
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Na mg/l	5,6	4,3	7,7	9,8	19,6	15,3	18,6	9,7
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Mg mg/l	3,7	3,0	5,7	6,6	11,2	7,8	7,9	5,5
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
SO_4 mg/l	8,1	5,4	9,9	8,7	43,5	16,0	15,8	11,6
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
CI mg/l	4,4	4,9	5,0	6,95	9,4	9,5	9,8	5,8
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
K mg/l	1,0	0,8	1,5	1,3	3,1	1,8	1,1	1,7
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Ca mg/l	9,00	8,7	13,4	11,48	20,9	17,8	17,3	12,8
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
EC mS/m	10,5	9,4	16,2	17,2	30,4	24,0	25,4	17,1
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
SAR as a ratio	0,5	0,3	0,5	0,6	0,9	0,8	0,9	0,6
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good

Table 8: Upper Vaal

Constituent	**Drainage region**							
	C2H007Q01	C2H073Q01	C2H85Q01	C4H004Q01	C4R001Q01	C4R002Q01	C6H003Q01	C7H006Q01
PH units 0-14	8,3	8,1	8,3	8,3	8,2	8,2	8,3	8,2
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Fluoride mg/l	0,3	0,3	0,2	0,3	0,3	0,3	0,3	0.2
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
TDS mg/l	451,0	644,2	574,3	407,0	155,0	165,0	296,0	277,5
	Good	Good	Good	Very Good	Very Good	Very Good	Very Good	Very Good
$N0_3$+$N0_2$-N mg/l	0,5	3,1	0,6	0,0	0,4	0,2	0,2	0,1
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
NH_4-N mg/l	0,0	0,3	0,0	0,0	0,0	0,0	0,0	0,0
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Na mg/l	42,9	57,1	35,4	54,0	15,2	13,6	29,6	28,0
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Mg mg/l	22,2	37,0	43,3	15,9	5,2	6,5	12,8	12,5
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
SO_4 mg/l	141,8	147,4	101,3	52,9	16,2	15,2	31,4	27,9
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
CI mg/l	43,4	71,1	38,0	70,8	7,1	7,1	18,4	20,6
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
K mg/l	7,6	10,4	5,1	6,8	5,1	4,8	5,9	5,5
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Ca mg/l	50,8	68,1	55,6	35,2	11,9	14,7	28,1	25,1
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
EC mS/m	66,3	88,2	73,9	60,7	18,6	21,4	38,7	36,6
	Good	Good	Good	Good	Very Good	Very Good	Very Good	Very Good
SAR as aratio	1,3	1,4	0,9	1,8	0,9	0,8	1,2	1,1
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good

Table 9: Middle Vaal

Constituent	**Drainage region**						
	C1H002Q01	C1H017Q01	C2H004Q01	C2H005Q01	C2H071Q01	C8H001Q01	C8H027Q01
PH units 0-14	8,2	8,3	8,2	7,9	7,9	8,1	8,2
	Very Good	Very Good	Very Good	Very Good	Very good	Very Good	Very good
Fluoride mg/l	0,2	0,2	0,3	0,6	0,3	0,2	0,2
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
TDS mg/l	235,9	255,0	1 052,0	641,2	589,0	144,0	202,5
	Very Good	Very Good	Fair	Good	Good	Very Good	Very Good
$N0_3$+$N0_2$-N mg/l	0,1	0,1	0,3	4,7	4,9	0,2	0,2
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
NH_4-N mg/l	0,0	0.0	0,0	1,0	0,2	0,0	0,2
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Na mg/l	15,8	20,2	119,7	58,4	64,2	10,2	16,5
	Very Good	Very Good	Good	Very Good	Very Good	Very Good	Very Good
Mg mg/l	13,3	14,3	49,9	25,6	25,0	6,1	9,4
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
SO_4 mg/l	18,3	29,1	447,2	214,2	177,4	15,3	18,4
	Very Good	Very Good	Fair	Good	Very Good	Very Good	Very Good
CI mg/l	8,7	13,6	110,0	94,0	68,9	5,6	8,8
	Very Good	Very Good	Good	Very Good	Very Good	Very Good	Very Good
K mg/l	1,9	3,1	10,4	11,0	13,9	2,3	2,7
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Ca mg/l	24,1	23,4	130,0	90,5	64,1	15,7	21,1
	Very Good	Very Good	Very Good	Good	Very Good	Very Good	Very Good
EC mS/m	30,2	33,4	140,0	98,3	87,0	18,6	26,5
	Very Good	Very Good	Fair	Fair	Good	Very Good	Very Good
SAR as a ratio	0,6	0,8	2,2	1,4	1,6	0,6	0,8
	Very Good	Very Good	Good	Very Good	Very Good	Very Good	Very Good

Table 10: Mvoti to Umzimkulu

Constituent	**Drainage region**			
	T5H007Q01	U1H006Q01	U4H008Q01	U8H003Q01
PH units 0-14	7,9	7,9	8,0	8,4
	Very Good	Very Good	Very Good	Very Good
Fluoride mg/l	0,1	0,2	0,2	0,5
	Very Good	Very Good	Very Good	Very Good
TDS mg/l	84,0	103,2	23,6	389,7
	Very Good	Very Good	Very Good	Very Good
$N0_3$+$N0_2$-N mg/l	0,2	0,2	0,5	0,6
	Very Good	Very Good	Very Good	Very Good
NH_4-N mg/l	0,0	0,0	0,0	0,0
	Very Good	Very Good	Very Good`	Very Good
Na mg/l	7,0	12,5	25,1	77,0
	Very Good	Very Good	Very Good	Very Good
Mg mg/l	3,5	4,3	6,3	14,6
	Very Good	Very Good	Very Good	Very Good
SO_4 mg/l	6,6	9,7	10,6	22,2
	Very Good	Very Good	Very Good	Very Good
CI mg/l	5,0	11,0	26,2	92,7
	Very Good	Very Good	Very Good	Very Good
K mg/l	0,8	0,8	1,9	2,1
	Very Good	Very Good	Very Good	Very Good
Ca mg/l	6,9	9,0	9,6	20,3
	Very Good	Very Good	Very Good	Very Good
EC mS/m	10,7	15,2	23,6	58,6
	Very Good	Very Good	Very Good	Good
SAR as a ratio	0,5	0,9	1,6	3,2
	Very Good	Very Good	Very Good	Good

Table 11: Mzimvubu to Keiskamma

Drainage region	**Constituents**												
	PH units 0-14	Fluoride mg/l	TDS mg/l	$N0_3$+$N0_2$-N mg/l	NH_4-N mg/l	Na mg/l	Mg mg/l	SO_4 mg/l	CI mg/l	K mg/l	Ca mg/l	EC mS/m	SAR as a ratio
R2R003Q01	8,1	0,2	276,0	0,7	0,0	53,0	10,1	21,4	68,5	3,4	15,0	42,8	2,6
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Good	Good
R3H001Q01	8,1	0,2	267,0	0,1	0,0	43,9	10,2	19,2	55,5	2,69	13,0	37,4	2,0
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
R3H003Q01	8,0	0,2	241,6	0,3	0,0	45,8	8,3	19,2	59,2	2,7	13,0	37,4	2,4
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Good
R3H004Q01	8,0	0,2	233,0	0,5	0,0	43,3	7,9	15,5	55,2	3,2	12,3	35,9	2,4
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Good
S1R001Q01	8,4	0,5	247,0	0,2	35,0	19,1	13,0	8,3	11,4	1,5	24,2	32,6	0,8
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
S3H006Q01	8,5	0,4	348,0	0,1	0,0	31,7	19,0	19,9	22,5	3,0	29,2	44,5	1,2
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Good	Very Good
S6H002Q01	8,2	0,2	172,0	0,4	0.3	17,3	8,3	9,0	15,3	1,1	15,4	24,3	0,9
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
S7H001Q01	8,4	0,3	439,0	0,9	0,0	63,7	19,5	19,6	75,6	1,9	32,2	62,2	2,3
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Good	Very Good
S7H004Q01	8,4	0,3	289,1	0,1	0,0	34,8	13,9	12,5	35,7	1,9	23, 3	40,1	1,4
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
T1H004Q01	8,1	0,2	121,0	0,3	0,0	11,1	5,7	8,8	11,0	1,1	10,2	16,5	0,8
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
T3H004Q01	8,1	0,1	108,0	0,1	0,0	7,7	5,3	5,8	5,3	1,3	9,9	14,1	0,48
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
T3H005Q01	7,9	0,1	98,8	0,3	0,0	6,6	4,4	5,2	5,0	0,9	9,9	12,1	0,5
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
T3H006Q01	7,9	0,1	90,1	0,2	0,0	8,0	3,9	5,9	5,2	0,9	8,2	11,6	0,58
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
T3H008Q01	7,9	0,2	115,5	0,1	0,0	7,7	5,1	6,41	5,0	1,5	10,7	14,6	0,5
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
T7H001Q01	8,2	0,2	187,5	0,4	0,0	22,9	9,7	7,2	22,9	1,1	13,6	25,4	1,2
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very good	Very Good

Table 12: Upper Orange

Constituent	**Drainage region**								
	D1H001Q01	D1H003Q01	D1H005Q01	D1H006Q01	D1H009Q01	D1H011Q01	D2H012Q01	D2H036Q01	D2R004Q01
PH units o-14	8,4	8,1	8,1	8,1	8,1	8,2	8,3	8,1	8,1
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Fluoride mg/l	0,3	0,1	0,1	0,1	0,1	0,1	0,2	0,2	0,2
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
TDS mg/l	517,0	140,0	138,0	148,0	128,0	181,5	256,0	145,7	142,0
	Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
$N0_3$+$N0_2$-N mg/l	0,8	0,2	0,3	0,2	0,2	0,0	0,1	0,4	0,4
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
NH_4-N mg/l	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,1
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Na mg/l	51,6	4,9	4,3	5,6	4,4	6,1	10,7	8,3	8,1
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Mg mg/l	28,0	6,6	6,6	6,6	5,9	9,5	13,0	6,1	6,0
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
SO_4 mg/l	44,2	9,5	9,0	11,1	8,7	9,6	14,9	13,0	12,6
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
CI mg/l	30,1	3,9	3,9	4,2	3,8	4,2	5,0	5,0	5,0
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
K mg/l	5,2	0,81	0,6	1,00	0,8	0,9	1,4	1,8	1,8
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Ca mg/l	48,0	19,0	19,1	20,4	17,6	24,6	33,4	17,6	16,7
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
EC mS/m	66,5	17,4	17,5	18,5	15,9	22,7	32,1	19,1	18,5
	Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
SAR as a ratio	141,0	0,2	0,2	0,3	0,2	181,5	0,4	0,4	0,4
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good

Table 13: Lower Orange

Constituent	Drainage region							
	D3H008Q01	D3R013Q01	D3R003Q01	D5H021Q01	D7H008Q01	D7H015Q01	D8H003Q01	D8H008Q01
PH units 0-14	8,2	8,1	8,2	8,6	8,3	8,3	8,4	8,4
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Fluoride mg/l	0,2	0,2	0,2	0,8	0,2	0,2	0,3	0,3
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
TDS mg/l	151,1	129,0	130,0	2660,0	194,0	240,0	279,2	265,3
	Very Good	Very Good	Very Good	Poor	Very Good	Very Good	Very Good	Very Good
$N0_3$+$N0_2$-N mg/l	0,5	0,5	0,5	0,3	0,4	0,1	0,0	0,0
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
NH_4-N mg/l	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Na mg/l	7,7	5,2	5,5	692,0	14,2	19,6	25,1	23,9
	Very Good	Very Good	Very Good	Poor	Very Good	Very Good	Very Good	Very Good
Mg mg/l	7,0	5,8	6,0	88,4	9,1	11,7	12,9	12,5
	Very Good	Very Good	Very Good	Good	Very Good	Very Good	Very Good	Very Good
SO_4 mg/l	12,1	9,5	9,4	624,1	22,8	28,6	33,6	31,6
	Very Good	Very Good	Very Good	Poor	Very Good	Very Good	Very Good	Very Good
CI mg/l	5,1	4,1	3,9	588,0	13,1	16,3	20,9	19,4
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
K mg/l	1,3	1,2	1,3	5,9	2,2	2,2	2,9	2,6
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Ca mg/l	19,6	16,8	17,1	52,8	23,4	27,0	30,7	28,9
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
EC mS/m	20,0	16,1	17,0	371,0	27,1	33,6	38,6	36,9
	Very Good	Very Good	Very Good	Poor	Very Good	Very Good	Very Good	Very Good
SAR as a ratio	151,1	0,3	0,3	12,9	0,6	0,8	1,0	1,0
	Very Good	Very Good	Very Good	Fair	Very Good	Very Good	Very Good	Very Good

Table 14: Fish to Tsitsikamma

Drainage region	Constituent												
	PH units 0-14	Fluoride mg/l	TDS mg/l	NO_3+NO_2-N mg/l	NH_4-N mg/l	Na mg/l	Mg mg/l	SO_4 mg/l	CI mg/l	K mg/l	Ca mg/l	EC mS/l	SAR as a ratio
K8h001Q01	4,8	0,1	52,0	0,0	0,0	8,4	1,7	13,9	14,1	0,8	1,8	7,7	1,1
	Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
K8H002Q01	5,1	0,1	54,0	0,0	0,1	11,2	2,0	10,8	19,3	0,6	1,5	10,0	1,4
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
L3R001Q01	8,2	0,3	574,0	0,1	0,0	109,0	17,2	91,7	149,0	8,7	39.0	91,0	3,6
	Very Good	Very Good	Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Fair	Good
L6H001Q01	8,4	0,4	2728,0	0,0	0,0	611,9	118,2	527,4	939,8	15,0	123,7	422,5	9,9
	Very Good	Very Good	Poor	Very Good	Very Good	Poor	Fair	Fair	Poor	Very Good	Good	Poor	Fair
L7H006Q01	8,0	0,2	492,1	0,0	0,0	112,2	19,8	68,4	177,9	3,4	26,3	85,9	4,1
	Very Good	Very Good	Good	Very Good	Very Good	Good	Very Good	Very Good	Good	Very Good	Very Good	Good	Good
L8H005Q01	7,3	0,1	86,4	0,0	0,0	18,9	3,2	8,5	31,5	0,7	3,9	16,2	1,7
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
N1H013Q01	8,1	0,7	3490,0	0,1	0,1	775,4	134,3	634,1	909,2	5,0	171,6	485,0	10,7
	Very Good	Very Good	Very Poor	Very Good	Very Good	Poor	Fair	Poor	Poor	Very Good	Fair	Poor	Fair
N2H007Q01	8,3	0,4	1678,0	0,0	0,0	369,7	70,2	258,7	659,1	9,1	108,8	291,0	6,3
	Very Good	Very Good	Fair	Very Good	Very Good	Fair	Good	Good	Poor	Very Good	Good	Poor	Good
N3H002Q01	8,3	0,5	983,0	0,0	0,0	181,1	39,2	86,2	289,5	289,5	70,8	155,3	4,2
	Very Good	Very good	Good	Very Good	Very Good	Good	Very Good	Very Good	Fair	Poor	Good	Fair	Good
N4H003Q01	8,4	0,8	2844,0	1,0	0,0	747,2	89,1	368,1	872,9	7,3	71,2	416,0	13,7
	Very Good	Good	Poor	Very Good	Very Good	Poor	Good	Good	Poor	Very Good	Very Good	Poor	Fair
P1H003Q01	8,5	0,8	2580,0	0,1	0,0	664,6	108,3	216,6	1018,0	6,0	55,5	396,5	11,3
	Very Good	Good	Poor	Very Good	Very Good	Poor	Fair	Good	Poor	Very Good	Very Good	Poor	Fair
P3H001Q01	8,2	0,2	3260,0	0,1	0,0	790,8	141,9	126,7	1649,0	9,0	149,7	559,0	11,1
	Very Good	Very Good	Poor	Very Good	Very Good	Poor	Fair	Very Good	Very Poor	Very Good	Good	Very Poor	Fair
P4H001Q01	8,4	0,3	1896,0	0,0	0,0	474,9	80,6	103,9	867,6	7,2	69,0	328,0	9,0
	Very Good	Very Good	Fair	Very Good	Very Good	Poor	Good	Very Good	Poor	Very good	Very Good	Poor	Fair
Q1H107Q01	8,3	0,2	202,0	0,5	0,0	18,0	8,9	18,2	10,3	1,4	20,7	27,0	0,9
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Q1H022Q01	8,3	0,0	178,0	0,4	0,0	13,3	8,2	16,1	8,0	1,4	19,9	23,7	0,6
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Q2H002Q01	8,5	0,9	968,5	1,6	0,1	178,9	31,0	39,1	29,0	1,8	40,1	106,9	5,1
	Very Good	Very Good	Good	Very Good	Very Good	Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Poor	Good
Q4H013Q01	8,5	1,8	2112,0	3,1	0,0	498,6	65,3	335,1	362,8	3,0	58,0	284,0	10,6
	Very Good	Very Good	Fair	Very Good	Very Good	Poor	Very Good	Good	Fair	Very good	Very Good	Poor	Fair
Q4R002Q01	8,4	0,4	283,4	0,1	0,0	27,0	11,8	17,3	16,7	4,5	26,7	36,5	1,2
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Q6H003Q01	8,5	0,5	745,4	0,1	0,0	120,7	31,9	26,5	103,1	3,1	46,7	97,0	3,0
	Very Good	Very Good	Good	Very Good	Very Good	Good	Very Good	Very Good	Very Good	Very Good	Very Good	Fair	Good
Q7H003Q01	8,5	0,7	815,0	1,2	0,0	162,2	30,2	103,0	118,9	2,3	37,9	108,2	4,8

Table 14: Fish to Tsitsikamma (concluded)

Drainage region	**Constituent**												
	PH units 0-14	Fluoride mg/l	TDS mg/l	$N0_3$+$N0_2$-N mg/l	NH_4-N mg/l	Na mg/l	Mg mg/l	SO_4 mg/l	CI mg/l	K mg/l	Ca mg/l	Ec mS/m	SAR as a ratio
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Poor	Good
Q8H011Q01	8,5	0,9	1090,0	0,7	0,0	246,0	34,5	138,0	227,3	3,9	43,8	162,0	6,7
	Very Good	Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Fair	Good
Q9H001Q01	8,7	0,8	1246,0	0,6	0,0	285,5	42,0	163,9	250,4	3,4	36,6	179,5	7,4
	Very Good	Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Fair	Good
Q9H002Q01	8,3	0,3	454,2	0,4	0,0	57,2	19,8	16,9	48,0	2,3	36,8	59,3	1,8
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Good	Very Good
Q9H018Q01	8,7	0,8	1112,0	0,3	0,0	250,3	38,1	142,3	249,7	3,7	35,5	166,0	6,8
	Very Good	Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Fair	Good
Q9H029Q01	8,2	0,3	260,0	0,6	0,0	37,3	10,4	18,5	37,9	2,4	20,5	37,8	1,6
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good

Table 15: Gouritz

Drainage region	Constituent												
	PH units 0-14	Fluoride mg/l	TDS mg/l	$N0_3$+$N0_2$-N mg/l	NH_4-N mg/l	Na mg/l	Mg mg/l	SO_4 mg/l	CI mg/l	K mg/l	Ca mg/l	EC mS/m	SAR as a ratio
H8H001Q01	7,4	0,1	254,0	0,2	0,0	59,7	8,4	37,3	98,4	1,6	5,9	42,1	3,7
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Good	Good
H9H005Q01	7,5	0,2	311,0	0,0	0,0	80,1	11,5	28,5	137,6	1,9	7,8	54,8	4,6
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Good	Very Good	Very Good	Good	Good
J1H019Q01	8,2	0,5	3916,0	0,0	0,0	1002,0	146,9	566,3	1541,0	9,8	142,3	610,0	14,2
	Very Good	Very Good	Very Poor	Very Good	Very Good	Very Poor	Fair	Very Good	Very Poor	Very Good	Very Good	Very Poor	Fair
J2H010Q01	8,4	0,4	599,0	0,0	0,0	87,0	22,4	64,6	108,3	5,2	53,4	86,6	2,6
	Very Good	Very Good	Good	Very Good	Very Good	Very Good	Very Good	Very Good	Good	Very Good	Very Good	Good	Good
J2H016Q01	8,4	0,3	396,0	0,5	0,0	60,4	9,5	53,7	64,0	6,0	35,7	57,9	2,4
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Good	Good
J2R004Q01	8,2	0,2	226,0	0,0	0,0	15,3	10,0	21,9	9,7	1,7	28,2	30,3	0,6
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Good	Very Good
J3H011Q01	8,2	0,5	9059,0	0,0	0,1	2423,0	249,2	1841,0	3612,0	10,9	422,6	1282,0	22,9
	Very Good	Very Good	Very Poor	Very Good	Very Good	Very Poor	Poor	Very Poor	Very poor	Very Good	Poor	Very Poor	Poor
K1H005Q01	7,3	0,1	173,3	0,0	0,0	43,4	5,7	16,7	72,3	0,9	5,2	31,5	3,1
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Good
K2H004Q01	8,0	0,4	2,7	0,0	0,1	8353,0	969,6	2057,0	1,5	298,4	329,4	3575,0	2,7
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Poor	Very Poor	Very Poor	Very Good	Poor	Poor	Very Poor	Good
K3H001Q01	5,6	0,1	96,0	0,1	0,0	20,4	3,1	16,4	38,2	0,8	2,5	16,8	2,0
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Good
K3H003Q01	6,8	0,1	274,5	0,1	0,0	66,6	7,7	29,3	129,2	1,6	7,6	47,5	4,1
	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Good	Good
K4R002Q01	7,8	0,2	8522,0	0,0	0,0	2633,0	286,5	583,5	4674,0	91,4	134,2	1340,0	28,8
	Very good	Very Good	Very Poor	Very Good	Very Good	Very Poor	Poor	Fair	Fair	Poor	Good	Very Poor	Very Poor
K7H001Q01	4,7	0,1	53,9	0,0	0,3	9,6	1,8	15,0	16,4	0,4	1,7	9,0	1,2
	Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	Very good	Very Good	Very Good	Very Good

Table 16: Olifants/Doorn

Constituent	**Drainage region**		
	E1R001Q01	E2H002Q01	E2HH003Q01
PH units 0-14	7,1	7,1	7,6
	Very Good	Very Good	Very Good
Fluoride mg/L	0,0	0,0	0,1
	Very Good	Very Good	Very Good
TDS mg/l	68,3	51,0	173,1
	Very Good	Very Good	Very Good
$N0_3$+$N0_2$-N mg/l	0,1	0,0	0,0
	Very Good	Very Good	Very Good
NH_4-N mg/l	0,0	0,0	0,0
	Very Good	Very Good	Very Good
Na mg/l	14,4	8,8	34,1
	Very Good	Very Good	Very Good
Mg mg/l	3,0	2,3	7,1
	Very Good	Very Good	Very Good
SO_4 mg/l	8,1	7,3	20,4
	Very Good	Very Good	Very Good
CI mg/l	27,7	16,1	62,9
	Very Good	Very Good	Very Good
K mg/l	0,9	0,8	1,8
	Very Good	Very Good	Very Good
Ca mg/l	3,2	3,2	10,3
	Very Good	Very Good	Very Good
EC mS/m	14,0	9,3	32,0
	Very Good	Very Good	Very Good
SAR as a ratio	1,4	0,9	2,1
	Very Good	Very Good	Good

Table 17: Breede

Constituent	Drainage region				
	G4H007Q01	H4H024Q01	H5H005Q01	H6H009Q01	H7H006Q01
PH units 1-14	6,8	7,5	8,1	7,2	7,7
	Very Good	Very Good	Very Good	Very Good	Very Good
Fluoride mg/l	0,1	0,1	0,3	0,1	0,2
	Very Good	Very Good	Very Good	Very Good	Very Good
TDS mg/l	78,0	151,0	596,0	127,0	336,0
	Very Good	Very Good	Good	Very Good	Very Good
$N0_3$+$N0_2$-N mg/l	0,3	0,2	0,1	0,1	0,1
	Very Good	Very Good	Very Good	Very Good	Very Good
NH_4-N mg/l	0,0	0,0	0,0	0,0	0,0
	Very Good	Very Good	Very Good	Very Good	Very Good
Na mg/l	14,4	32,0	144,0	29,0	78,0
	Very Good	Very Good	Very Good	Very Good	Very Good
Mg mg/l	2,7	6,2	23,6	4,4	12,7
	Very Good	Very Good	Very Good	Very Good	Very Good
SO_4 mg/l	14,6	19,3	63,0	15,8	37,2
	Very Good	Very Good	Very Good	Very Good	Very Good
CI mg/l	25,8	54,2	220,0	50,5	128,9
	Very Good	Very Good	Fair	Very Good	Good
K mg/l	1,0	1,4	3,7	1,2	2,6
	Very Good	Very Good	Very Good	Very Good	Very Good
Ca mg/l	3,6	7,0	21,1	3,7	12,5
	Very Good	Very Good	Very Good	Very Good	Very Good
EC mS/m	13,6	27,3	98,7	23,9	58,5
	Very Good	Very Good	Fair	Very Good	Good
SAR as a ratio	1,4	2,1	5,0	2,5	3,8
	Very Good	Good	Good	Good	Good

Table 18: Berg

Constituent	**Drainage region**		
	G1H031Q01	G1H036Q01	G2H015Q02
PH units 0-14	7,7	7,5	7,7
	Very Good	Very Good	Very Good
Fluoride mg/l	0,1	0,1	0,2
	Very Good	Very Good	Very Good
TDS mg/l	164,0	124,4	285,5
	Very Good	Very Good	Very Good
$N0_3$+$N0_2$-N mg/l	0,4	0,9	2,3
	Very Good	Very Good	Very Good
NH_4-N mg/l	0,0	0,0	0,0
	Very Good	Very Good	Very Good
Na mg/l	33,4	23,3	55,7
	Very Good	Very Good	Very Good
Mg mg/l	6,7	3,4	8,1
	Very Good	Very Good	Very Good
SO_4 mg/l	16,1	12,1	20,8
	Very Good	Very Good	Very Good
CI mg/l	57,7	29,3	86,9
	Very Good	Very Good	Very Good
K mg/l	2,5	2,9	86,9
	Very Good	Very Good	Fair
Ca mg/l	8,2	7,2	16,6
	Very Good	Very Good	Very Good
EC mS/m	30,1	20,5	47,7
	Very Good	Very Good	Good
SAR as a ratio	2,1	1,7	2,8
	Good	Very Good	Good

9 Data collection, availability and problems experienced

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

Further development of water quality accounts in South Africa is constrained by a severe lack of relevant information. Research indicates that international agencies are faced with the same problem and have consequently made very little progress in the construction of water quality accounts. At present, South Africa does not have information where loads (flow combined with quality) have been calculated. Therefore there are no records where quantity is linked with quality at the moment.

Flow in South African rivers is characterised by variability above all. Rainfall over most of the country is seasonal and accordingly within a year flow is low during the dry season and higher during the rainy season. Between years, flow can be even more variable, and can range from a trickle during severe droughts to raging floods in a wet year. The important point here is that the quantity information does not relate to static volumes of water that could be expected to flow in a river over a period of time. The information provided by the Inorganic Chemical Water Quality of Surface Water Resources gives only an indication of average water quality across the country, and indicates where there are problems to be addressed; it cannot be sensibly combined with water quantity information to give any meaningful result.

10 Concluding remarks

This discussion document shows the water quality indicators information obtained from the National Chemical Water Quality Monitoring Programme. The data generated by this programme were used to provide information on the status of the chemical water quality of South Africa surface water to water resource managers, scientists, decision-makers, and the public in an easy to understand way. The main water quality problems for domestic water users are high total dissolved salts and, in other places, fluoride concentrations. The sodium adsorption ratio, electrical conductivity, pH and chloride are potential problems for irrigated agriculture.

The inability to combine the quality data with quantity data is a challenge that needs to be addressed. This was the first step in attempting to compile water quality accounts. When relevant data becomes available it will be possible to follow the prescribed guidelines so that the accounts are comparable to other countries.

We invite all stakeholders to provide us with any comments and suggestions as they might have regarding the content of this discussion document. The comments and suggestions will be included in the next publication.

Comments and suggestions can be e-mailed to the following addresses:

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- EdithM@statssa,gov.za

11. Glossary

Account An account is a tool which records, for given aspects of economic life, (a) the uses and resources or (b) the changes in assets and the changes in liabilities and/or (c) the stock of assets and liabilities existing at a certain time; transaction accounts include a balancing item which is used to equate the two sides of the accounts (e.g. resources and uses) and which is a meaningful measure of economic performance in itself.

Catchment A catchment is an area on which rain falls and from which the water runs into a particular river.

Evapotranspiration Evapotranspiration is the combined loss of water by evaporation from soil or surface water and transpiration from plants and animals.

Groundwater Freshwater beneath the earth's surface (usually in aquifers) supplying wells and springs.

Mean annual runoff Average annual flow under natural conditions. (This definition is dependent on the runoff regime for each river basin).

Natural resource Accounting (NRA) Accounting system that deals with stocks and stock changes of natural assets, comprising biota (produced or wild), subsoil assets (proved reserves), water and land, with their aquatic and terrestrial ecosystems. It is frequently used in the sense of physical accounting as distinguished from monetary (environmental) accounting.

System of Integrated Environmental and Economic Accounting (SEEA) The SEEA was developed by the United Nations Statistical Division, as a satellite system to the System of National Accounts (SNA), for the incorporation of environmental concerns (environmental costs, benefits and assets) in the national accounts. The SEEA is intended to be a system with global application and standards, suitable for all countries and all aspects of the environment.

System of National Accounts (SNA)

An international accounting framework consisting of a coherent, consistent and integrated set of macro-economic accounts, balance sheets and tables based on a set of internationally agreed concepts, definitions, classifications and accounting rules. It provides a comprehensive accounting framework within which economic data can be compiled and presented in a format that is designed for the purposes of economic analysis, and decision and policy making. (UN,1993,1.1)

Water management area

A water management area is an area defined for specific water management purposes.

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Annexure 1: Water quality account for a WMA, 2000 (million cubic metres)

Drainage regions	1996					Changes by quality class					2000				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Total for WMA															

Annexure 2: Water quality account for South Africa, 2000 (million cubic metres)

	1996					Changes by quality class					2000				
Water Management Areas	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Limpopo															
Luvuvhu and Letaba															
Crodile and Letaba															
Olifants															
Upper Vaal															
Middle Vaal															
Lower Vaal															
Lower Orange															
Upper Orange															
Olifants/Doorn															
Berg															
Breede															
Gouritz															
Fish to Tsitsikamma															
Mzimvubu to Keiskamma															
Mvoti/Mzimkulu															
Thukela															
Usuthu toMhlatuze															
Inkomati															
Total for South Africa															

Annexure 3: Water quality criteria

Water quality 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 the health of aquatic ecosystems. For each water quality constituent there is a No Effect Range. This is the range of concentration or levels at which the presence of that constituent would have not known or anticipated adverse effects on the fitness of water for a particular use or on the protection of aquatic ecosystem. These ranges were determined by assuming long-term continuous use (life-long exposure) and incorporate a margin of safety. As a matter of policy, the Department of Water Affairs and Forestry (DWAF) strives to maintain the quality of South Africa’s water resources such that they remain within the No Effect Range. DWAF encourages all stakeholders concerned with the quality of South Africa’s water resources to join forces and aim to maintain water quality within the No Effect Range where and whenever possible.

For this reason, the No Effect Range in the *South African Water Quality Guidelines* (DWAF) is referred to as the Target Water Quality Range (TWQR). It is included and highlighted as such in the water quality criteria provided for each of the constituents in the guidelines. Users of the guidelines should note that an important implication of setting the Target Water Quality Range equal to the No Effect Range is that it specifies good or ideal water quality instead of water quality that is merely acceptable. Part of DWAF’s mission is to maintain the fitness for use of water on a sustained basis. The concept of fitness for use is therefore central to water quality management in South Africa and to the development and use of these guidelines. Four broad categories of use are recognised in the South African Water Act, namely:

- domestic purposes,
- industrial purposes,
- agricultural purposes, and
- recreational purposes.

DWAF’s mandate also requires it to protect the health and integrity of aquatic ecosystems. The water quality requirements of the four uses given above and those for the protection of aquatic ecosystems form the basis on which the fitness for use of water is judged.

Fitness for use

The fitness for use of water is a judgment of how suitable the use of water is for its intended use or for the health of aquatic ecosystems. To be able to make judgments about its fitness for use, one needs to:

- characterise the water and/or particular aquatic ecosystem from a water quality perspective;
- determine the quality requirements of the intended uses and/or that of aquatic ecosystems;
- obtain information on the key constituents that determine the fitness of water for its intended uses or that affect the health of aquatic ecosystems;
- establish how, and how much, the intended use or aquatic ecosystems will be affected by the prevailing water quality; and
- determine whether the undesirable effects of water quality on a particular use can be mitigated.

The fitness for use of water can range from being completely unfit for use to being 100% or ideally fit for a specific use. The narrative descriptions commonly used to express judgments about the fitness of water for use are:

- ideal; 100% fit for use; desirable water quality; target water quality range (TWQR)
- acceptable;
- tolerable, usually for a limited time period only;
- unacceptable for use; and
- completely unfit for use.

There is a need to divide water quality into classes and to define the quality classes before water quality accounts can be constructed. Generally quality is classified into five classes to describe the ecological state of a river. The five classes are:

Q1 - represents water of very good quality
Q2 - represents water of good quality
Q3 - represents water of fair quality
Q4 -represents water of poor quality
Q5 - represents water of very poor quality

Although scientific measurements are used to define the quality of water, it's not a simple thing to say that "this water is good or this water is bad". The quality of water that is required to wash a car is not the same as the quality that is required for drinking. Therefore when we speak of water quality we usually want to know if the water is suitable for its intended use, be it domestic, farming, mining or industrial purposes, or its suitability to maintain a healthy ecosystem.

This is the point where the *South African Water Quality Guidelines* prove useful. They are used as a primary source of information and decision-support to judge the fitness of water for use and for other water quality management purposes. These guidelines contain information similar to that in the international literature. They are similar to the international literature in that their aim is to provide scientific yardsticks against which the fitness for use of a particular water body for a designated use may be evaluated. However the information in the South African water quality guidelines is more detailed, and provides not only information on the ideal water quality for water uses but in addition provides background information to help users of the guidelines make informed judgments about the fitness of water use. These guidelines are being developed by DWAF as an important information resource, primarily for water quality managers. Nevertheless, educators and other interested and affected members of the general public are likely to find them a valuable source of information for many aspects of water quality and its management.

Annexure 4: Domestic 'health' set: Water quality constituents relevant to the health of domestic water users

Constituent	Range	Colour classification	Suitability for domestic use
Total dissolved salts (TDS)	0-450	Very good water quality	No health effects
	450-1000	Good water quality	Insignificant effect on sensitive groups
	1000-2400	Fair water quality	Slightly possibility of salt overload in sensitive groups and slightly salty taste.
	2400-3400	Poor water quality	Possible health risk to all individuals and salty taste
	>3400	Not acceptable water quality	Increasing risk of dehydration and a very salty taste
Fluoride (F)	<0.7	Very good water quality	No health effects
	0.7-1.0	Good water quality	Insignificant health effects on sensitive groups and insignificant tooth staining
	1.0-1.5	Fair water quality	Increasing effects in sensitive groups and tooth staining
	1.5-3.5	Poor water quality	Possible health effects in all individuals and marked tooth staining
	>3.5	Not acceptable water quality	Increasing risk of skeletal damage
pH	<3.0	Not acceptable water quality	Acid burns
	<4.0	Poor water quality	Severe irritation of mucous membranes
	4.0-4.5	Fair water quality	Irritation of mucous membranes
	4.5-5.0	Good water quality	Mild irritation of mucous membrane
	5.0-9.5	Very good water quality	No health effects
	9.5-10.0	Good water quality	Mild irritation of mucous membrane
	10.0-10.5	Fair water quality	Irritation of mucous membranes
	10.5-11.0	Poor water quality	Severe irritation of mucous membranes
	>11.0	Not acceptable water quality	Alkali burns
Nitrate+Nitrite (NO_3+NO_2)	0-6.0	Very good water quality	Negligible health effects
	6.0-10.0	Good water quality	Insignificant risk
	10.0-20.0	Fair water quality	Slight chronic risk of blue baby syndrome
	20.0-40.0	Poor water quality	Possible chronic risk to some babies
	>40.0	Not acceptable water quality	Acute health risk to babies
Ammonium (NH_4-N)	0-1.0	Very good water quality	No health or aesthatic effects
	1.0-2.0	Good water quality	Possible taste and odour complaints
	2.0-10.0	Fair water quality	Consumer complaints of objectionable taste and odour
	>10.0	Poor water quality	Danger of formation of nitrite. Chlorination severely compromised

Source: DWAF,1996a and DOH and WRC, 1998

Annexure 5: Domestic salinity set: Constituents of concern and water quality guidelines to assess the suitability for domestic use

Constituent	Range	Classification	Suitability for domestic use
Calcium (Ca)	0-80	Very good water quality	No health effects
	80-150	Good Water quality	Insignificant effect
	150-300	Water quality	Increased effects in sensitive groups only
	>300	Poor water quality	Chronic health effects in sensitive groups only
Magnesium (Mg)	0-70	Very good water quality	No health effects
	70-100	Good water quality	Insignificant health effects in sensitive
			groups only
	100-200	Fair water quality	Increasing effects in sensitive groups only
	200-400	Poor water quality	Potential diarrhoea in all new users
	>400	Not acceptable water quality	Diarrhoea in all individuals
Sulphate (SO_4)	0-200	Very good water quality	No health effects
	200-400	Good water quality	Insignificant health effects
	400-600	Fair water quality	Slight chance of diarrhoea in sensitive groups but disappears with adaption
	600-1000	Poor water quality	Possibility of diarrhoea. Poor adaption in sensitive
			individuals
	>1000	Not acceptable water quality	High chance of diarrhoea. No adaption
Chloride (Cl)	0-100	Very good water quality	No health effects
	100-200	Good water quality	Insignificant health effects
	200-600	Fair water quality	Increasing health risk to sensitive groups
	600-1200	Poor water quality	Possible long-term health effects
	>1200	Not acceptable water quality	Dehydration in infants,nausea and vomiting
Sodium (Na)	0-100	Very good water quality	Negligible health effects
	100-200	Good water quality	Insignificant health effects
	200-400	Fair water quality	Slight risk to some sensitive groups
	400-1000	Poor water quality	Possible health risk, particularly in sensitive groups
	>1000	Not acceptable water quality	Definite health risk
Potassium (K)	0-25	Very good water quality	Negligible health effects
	25-50	Good water quality	Insignificant health effects
	50-100	Fair water quality	Slight risk to some sensitive groups
	100-500	Poor water quality	Possible health effects
	>500	Not acceptable water quality	Definite health risk to all individuals

Source: DWAF, 1996a and DWAF, DOH and WRC, 1998

Annexure 6: Water quality guidelines applicable to irrigated agriculture use

Constituent	Range	Classification	Suitability
Sodium adsorption Ratio (SAR)	<2.0 TWQR	Very good water quality	Should prevent sodium toxidity from developing, provided that water is applied to the soil surface, limiting sodium uptake through the roots
	2.0-8.0	Good water quality	The most sodium-sensitive crops absorb toxic levels of sodium through roots Crops vary in sensitivity
	8.0-15.0	Fair water quality	Sodium-sensitive crops absorb toxic levels of sodium through roots
	>15.0	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 toxidity developing
Electrical conductivity (EC)	<40 TWQR	Very good water quality	Should ensure that salt-sensitive crops can be grown without yield decreases when using low frequency irrigation systems
	40-90	Good water quality	A 95% relative yield of moderately salt-sensitive crops can be maintained by using a low frequency irrigation systems
	90-270	Fair water quality	A 90% relative yield of moderately salt-tolerant crops can be maintained by using a low frequency irrigation systems
	270-540	Poor water quality	80% relative yield of moderately salt-tolerant crops can be maintained by using a low frequency irrigation system
	>540	Not acceptable water quality	These waters can still be used for irrigation of selected crops provided sound irrigation management is practiced and yield decrease are acceptable
pH Value	<6.5	Not very good water quality	Increasing problems with foliar damage
	6.5-8.4	Very good water quality	Should not cause foliar damage
	>8.4	Not very good water quality	Increasing problems with foliar damage
Chloride (Cl)	<100 TWQR	Very good water quality	Should prevent accumulation of chloride to toxic levels in all but the most sensitive plants.
	100-175	Good water quality	Crops sensitive to foliar absorption accumulate toxic levels of chloride when foliage is wetted.
	175-350	Fair water quality	Crops moderately sensitive to foliar absorption accumulate toxic levels of chloride when foliage is wetted.
	350-700	Poor water quality	Crops moderately sensitive to foliar absorption accumulate toxic levels of chloride when foliage is wetted.
	>700	Notacceptable water quality	Crops tolerant to foliar absorption increasingly accumulate toxic levels of chloride when foliage is wetted

Source: DWAF,1996b