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NAMIBIA

WATER QUALITY MONITORING AND TESTING NATIONAL PROGRAMME IN TERMS OF PART 9 (WATER SUPPLY, ABSTRACTION AND USE), OF THE WATER RESOURCES MANAGEMENT ACT, 2013

Draft 2 – January 2016

CONTENTS

A. DEFINITIONS

In this programme any expression to which meaning has been assigned in the Water Act and Regulations bears that meaning and, unless the context indicates otherwise:

"Early warning" means to effectively disseminate alerts and ensure there is constant state of readiness, also to actively involve the communities at risk, facilitate public education and awareness of risks.

"Local Authority" means a local authority council as defined in section 1 of the Local Authorities Act, 1992 (Act No. 23 of 1992);

"Sturdy" means something that is well-constructed and that will not easily break.

"Waterborne contaminants" means pathogenic microorganisms that most commonly are transmitted in contaminated fresh water.

"Water point" means a point in the distribution of water supplies where the consumer collect for usage or a sample is/can be collected for monitoring.

"Water quality" means the chemical, physical, biological, and radiological characteristics of water.

"Water Regulator" means the Water Regulator established by section 11 of the Water Resources Management Act, 2013 and as defined in the Regulation for Drinking Water, 2015.

1. INTRODUCTION

Historically, the water legislation in Namibia did not make provision for the water regulatory body, the Ministry of Agriculture, Water and Forestry (MAWF) to monitor the quality of drinking water provided by water utilities. Thus, there is no assurance as to whether the water supplied to the consumers is of good quality and safe for human consumption, and in accordance with set water quality standards and guidelines.

The water sector has gone through a process of reform after independence in 1992 and the legal framework was reviewed. The Water Resources Management Act, 2013 (Act No. 11 of 2013), which is emanated from the National Water Policy White Paper for Namibia (2000), was enacted in the Cabinet on 13 December 2013. The Water Act under Section 36 states that the Minister must ensure that all Namibians have access to water conforming to the prescribed quality standards from an affordable and reliable water supply that is adequate for basic human requirements. Section 35 of the Act states that the Minister of Agriculture, Water and Forestry, with the concurrence of the Minister responsible for health must, for the purpose of ensuring the supply of healthy and safe water must:

- Prescribe, water quality standards in respect of water supply for drinking and household purposes, including maximum levels of concentration of waterborne contaminants;
- Develop and prescribe a national programme for the testing and monitoring of water quality in Namibia; and
- Establish and maintain laboratories and other facilities and measures for the capacity to monitor, test and verify the quality of any water supply.

Therefore the Water Act gives adequate power to the Minister of Agriculture, Water and Forestry to ensure safe drinking water in the country. The goal of the Namibian Government through the National Development Plan 3 (NDP 3): Sub-sector water is to ensure that the potable water provided to the Namibian population at large is suitable for drinking purposes. This will be achievable through the continuous water quality monitoring of water in the country to ensure that the quality of water is within the limits as set out in the standards and guidelines as included in Appendix A herein.

Water resources management and monitoring plays a vital role in determining sustainable abstraction volumes, the feasibility of developments, and strategy for efficient overall management of the resource. Scientifically sound monitoring assesses groundwater and surface water (flow and quality) variables at carefully determined intervals. Although periodic monitoring provides some information, only long-term monitoring could provide sufficient data to determine trends and develop predictive models. In turn, the data could support informed decisions about sustainable and efficient use of water resources in the country.

Water quality monitoring is essential for the assessment of contaminants and its suitability for use. The data generated through the monitoring program may be used, by among others, national and local government, basin management committees and water boards for the purpose of decision making and recommendation as well as for further research and studies. The Water Environment (WE) Division in the Directorate of Resources Management

of the Ministry of Agriculture, Water and Forestry is tasked with the responsibility of monitoring water quality country wide. The Division is accountable for:

- Setting out and implementing water quality standards and guidelines for Namibia, and
- Monitoring and investigating the quality of the drinking water supply systems.

Thus, as a regulator, the Water Environment Division monitors water service providers to ensure that the water supplied to consumers meet the minimum set standards and guidelines, and is physically, chemically and microbiologically safe for human consumption.

2. SITUATION ANALYSIS

The current water quality status of water points in all the 13 regions of the country is illustrated in the table and figure below.

Table 1: The status of water quality at water points in Namibia for the period 2008-2015

Region	**Population per Region**	Total number of Water Point per Region	Water Point sampled by DRWSS and Namwater	Water Point sampled by DWRM	Water Point with suitable/ good water	**Water Point with unsuitable/ risky water**	**Water Point without water quality information**
Caprivi	89,125	**456**	-	6	3	**3**	**450**
Erongo	114,342	**398**	27	80	42	**65**	**291**
Hardap	72,483	**679**	28	213	148	**93**	**438**
Karas	73,630	**731**	309	171	227	**253**	**251**
Kavango West	136,830	**216**	27	31	46	**12**	**158**
Kavango East	136,829	**209**	27	19	33	**13**	**163**
Khomas	348,171	**738**	-	34	23	**11**	**704**
Kunene	77,581	**1,121**	-	130	30	**100**	**991**
Ohangwena	270,755	**836**	-	22	13	**9**	**814**
Omaheke	81,473	**519**	16	55	39	**32**	**448**
Omusati	247,948	**1,524**	-	44	14	**30**	**1480**
Oshana	180,777	**605**	-	-	-	**-**	**605**
Oshikoto	187,098	**971**	-	105	74	**31**	**866**
Otjozondjupa	167,051	**642**	12	116	88	**40**	**514**
Total	**2,184,092**	**9,645**	**446**	**1,026**	**780**	**692**	**8,173**

Source: The population data was obtained from the National Planning Commission: Central Bureau of Statistics book of Population Projections from 2001 to 2031, January 2006. The Water quality information was provided by the Directorate Rural Water Supply and Sanitation, Directorate Water Resources Management and Namibia Water Corporation.

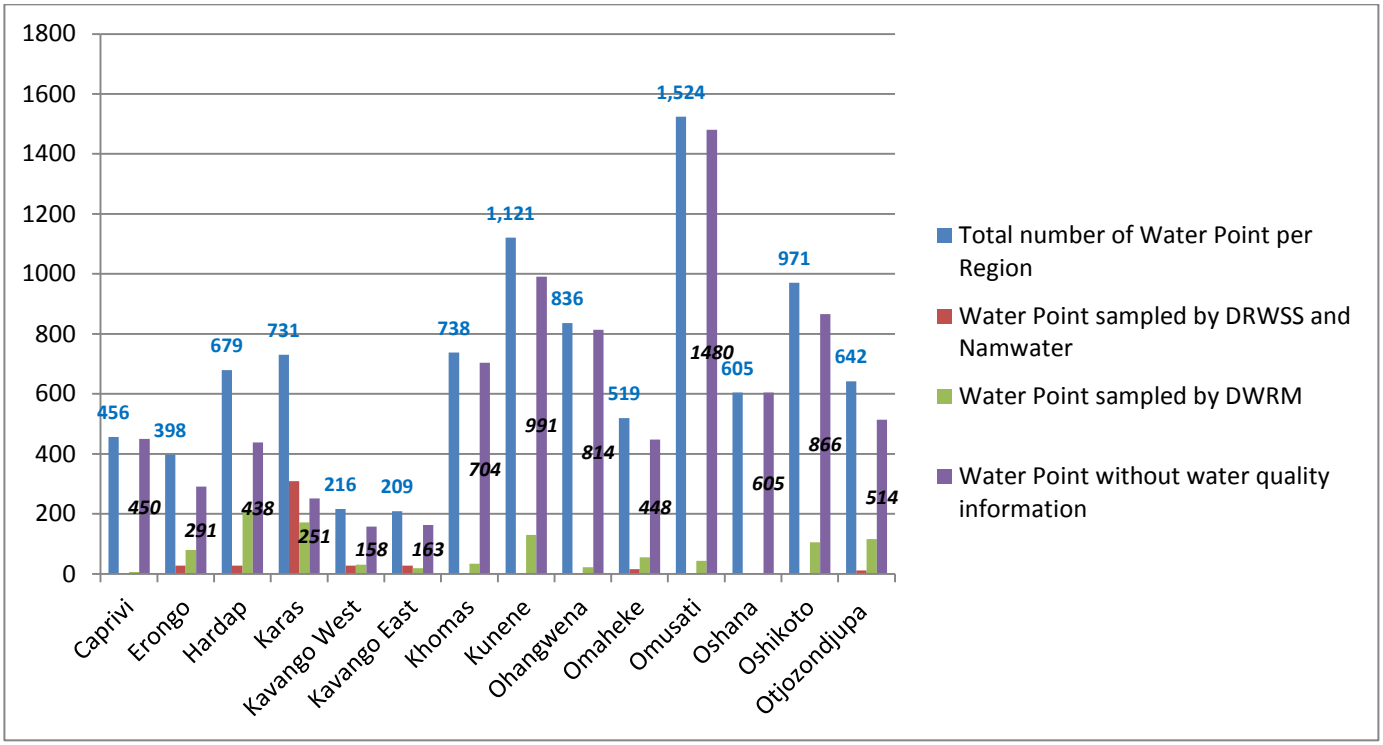

Figure 1 shows the total water points, water points sampled and water points without information recorded in Table 1 above.

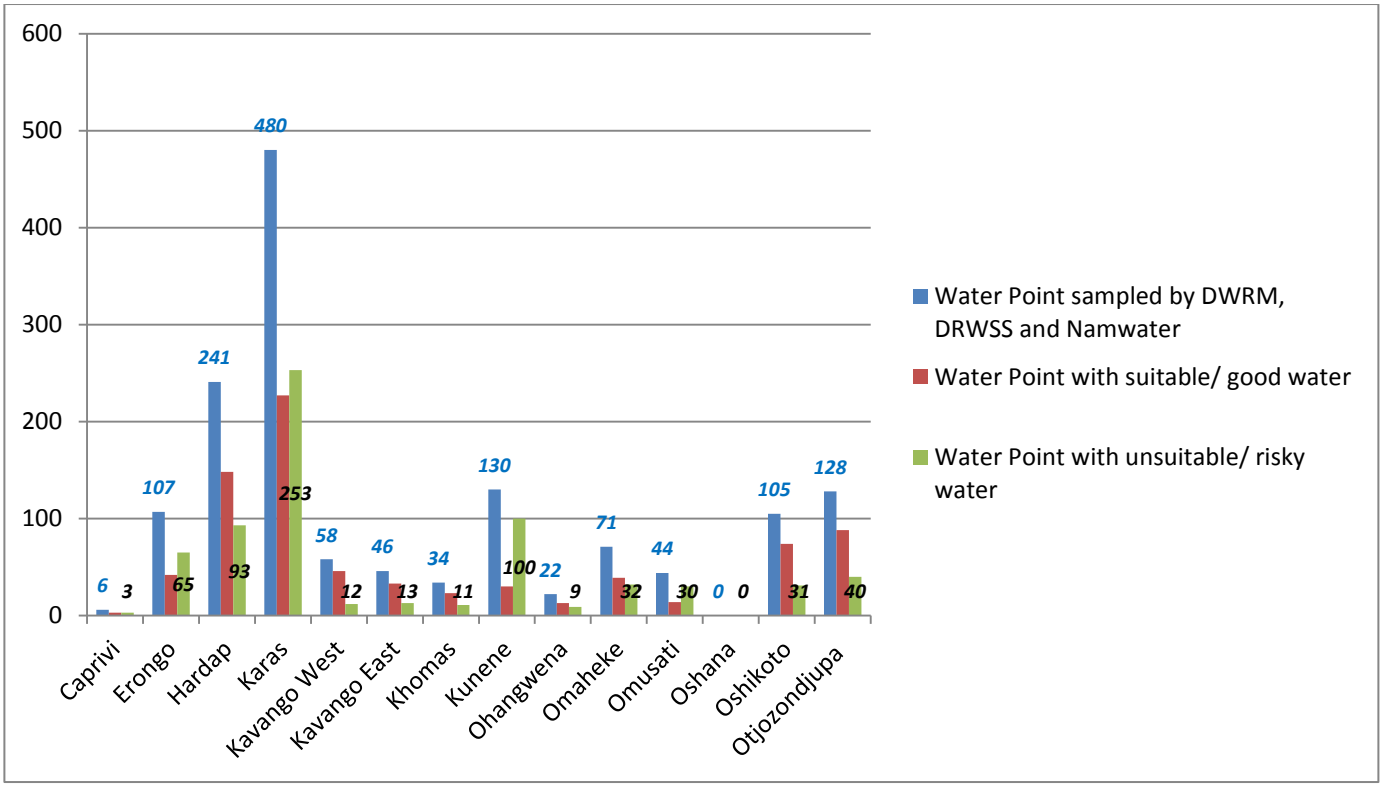

Figure 2 shows the water points sampled, water points with suitable water and water points with unsuitable water recorded in Table 1 above.

From the table and graphs above it is clear that water quality monitoring in Namibia needs improvement. There are about 9,645 number of water points in all the 14 regions of the country and approximately **85%** do not have water quality data. Only **15%** of the water points are sampled and of these; 47% are of unsuitable water quality while nearly 53% are of suitable water for human and animal consumption. Furthermore, very limited water quality information is available for all regions and the information available indicates that a considerable percentage is not suitable for human consumption.

In order to achieving the NDP 3 goal, it would require that take all stakeholders in the water sector to work together. There are various institutions in the country that have responsibilities in the water sector as indicated in the table below. The role for each institution is explained in detail below.

Table 2: Institutional Roles and Responsibilities in the Water Sub-Sector

Organizations with responsibility or some influence in the water sector	Water quality monitoring	Operation and Maintenance of the potable water and treatment facilities
Ministry of Agriculture, Water and Forestry	×	
Ministry of Health and Social Services	×	
Ministry of Urban and Rural Development	×	×
Mining Sector	×	×
Namibia Water Corporation	×	×

2.1 Institutional Functions

2.1.1 Ministry of Agriculture, Water and Forestry

The Ministry of Agriculture, Water and Forestry **(MAWF)** through the Directorate of Resource Management in the Department of Water Affairs and Forestry is the water regulatory body in the country. The Ministry has a legal responsibility to:

- Set out water quality standards and guidelines for the country and to ensure adherence thereof;
- Monitor the quality of drinking water provided to consumers from any source, whether by Namwater, Local Authorities, Mines and the Directorate Rural Water Supply and Sanitation Coordination within MAWF; and
- Communicate any health risks to consumers and appropriate authorities.

The monitoring of water supply and distribution networks are the major priority issues that need attention. The Division of Water Environment in the Directorate Resource Management needs to keep track of the water quality status of purification plants, water schemes, water points, local authorities, towns and villages' distribution networks to eliminate any possible human health risks. In addition the Division needs to monitor the quality of water resources, which includes groundwater (boreholes, well, etc.) and surface

water (dams, rivers, lakes, etc.) because many communities in the country make use of the water directly from these sources without prior treatment.

MAWF through the Directorate of Rural Water Supply and Sanitation Coordination also have the responsibilities of:

- Coordinating and participating in establishing and amending national policies impacting upon rural water supply;
- Monitoring the strategic direction for the provision of safe water to rural communities in the communal areas of Namibia;
- Developing and maintaining rural water supply infrastructure; and
- Mobilizing communities and implementing Community Base Management of Water Resources.

2.1.2 Ministry of Health and Social Services

The Ministry of Health and Social Services **(MHSS)** through its Public and Environmental Division aim to ensure that drinking water does not pose a significant risk to health over a lifetime of consumption. The Ministry also raises awareness in the communities on how to improve the quality of their drinking water.

Furthermore, the role of the MHSS in water quality monitoring is to collect information on the incidences of waterborne diseases (for example, diarrhea or cholera) and use this information to facilitate interventions. Being the lead 'early warning' authority and execution agent for medical intervention under emergency drinking water quality conditions, MHSS also takes water samples for both microbiological and chemical analysis on a routine basis or as necessary at specific points to prevent these waterborne diseases.

2.1.3 Ministry of Urban and Rural Development

The Ministry of Urban and Rural Development **(MURD)** role in the water sector is to allocate the Municipal Infrastructure Grant and a Capacity Building Grant to local authorities in order for them to put in place water supply infrastructure to improve their water quality.

The key tasks of local authorities in the water sector are to establish and maintain any water supply infrastructure within its area of jurisdiction. Local authorities also abstract and distribute water to their residents and provide water meters for the purposes of determining the quantity of water supplied to residents in their area or other persons. In addition, local authorities also monitor the quality of water, either routinely or based on complaint from the consumers, thus ensuring that the drinking water supplied to the residents is of good quality standard.

2.1.4 Mining Sector

Mines are one of the bulk water users in the water sector and their role is that most obtain water from either underground, surface, or sea for mining and domestic purposes. It is therefore vital that they monitor their annual water usage.

The mines have an important role in water quality monitoring, because through contracted companies e.g. Namwater and Aqua Services, they purify their drinking water in compliance with the National Water Quality Standards and Guidelines for Potable Water. Mines also monitor the impacts of mining activities on the environment by routinely taking water samples from monitoring boreholes for analysis, thus ensuring the status of groundwater is not altered.

2.1.5 Namibia Water Corporation

The main objective of the Namibia Water Corporation (**Namwater**) is to provide water of an appropriate quality in sufficient and sustainable quantities and in the most cost-effective way to its customers. The key tasks then are to abstract, distribute and purify water as per required national standards while planning for water demands in short, medium and long-term scenarios.

To ensure that the figures meet the annual water demand for the customers, Namwater also monitor the annual water abstraction and production figures for each scheme. Thus ensuring that short, medium and long-term planning for water demand and supply is executed and implemented.

All the above institutions in the water sector need to liaise with MAWF with regard to water quality in the country. However to date, there is no formal platform for exchanging of information. Furthermore no guidelines exist for cooperative information management or sharing. Gaps' pertaining to legal requirements and human capacity as well as inadequate monitoring programs presently hampers the effective and holistic management of water resources in Namibia. Issues related to data type and format is another challenge in the management of water resources. Although a small amount of data exists on the country's water quality, there is no single integrated data and information system that exists for all water uses throughout the country. Various institutions have implemented numerous monitoring strategies in the country; however, collection systems are inconsistent in frequency of monitoring and spatial coverage. Namibia would benefit from a more comprehensive monitoring program. The sharing of data and information should be part of an ongoing scientific and technical discussion in Namibia.

3. NATIONAL WATER QUALITY MONITORING AND TESTING PROGRAMME

3.1 Overall Objective

To ensure that Namibians are supplied with potable water conforming to the set Namibia water quality standards and guidelines as prescribed in the Water Resources Management Act, 2013.

Sub-objectives

- To identify water quality status and trends for baseline information;
- To detect any signs of water quality deterioration using applicable standards and guidelines; and
- To carry out compliance monitoring.

3.2 Description of the Programme

The drinking water quality monitoring will take place in all the fourteen (14) regions of Namibia. The Division Water Environment aims to carry out a long-term, standardized measurement and observation of the entire drinking water supply system. The drinking water supply system is everything from the point of abstraction to the consumer and these includes:

- water source (groundwater, surface water);
- storage facilities (dams, reservoirs, towers and tanks);
- drinking water treatment systems;
- pump stations;
- consumers point-of-use (e.g. taps at private houses or industrial, commercial or institution establishments).

The aim of monitoring drinking water is to define current status and trends in order to observe any signs of deterioration in the quality of water based on the set standards, and to give recommendations in order to improve the quality. The quality of water will be determined by testing **various physical, chemical, radiological and biological (micro and macro)** parameters where applicable. The sampling frequency for the monitoring programme will be at least once a year.

3.3 Field Work

A significant advantage of field analysis is that tests are carried out on fresh samples. On-site testing is common for certain variables physical, chemical or biological, especially those that may change during transport while in storage containers. This is of special importance

for samples that are to undergo microbiological analysis but cannot be transported to a laboratory within the 12 hours' time limit. The following parameters will be tested on site when possible; **turbidity, colour, conductivity, chlorine residual, nitrates, pH, temperature, total dissolved solids, dissolved oxygen, ORP, total coliform and *Escherichia coli***.

A standard fieldwork record sheet in the form of a book will be used to record measurements, observations and comments. An example of this sheet is included in Appendix B of this document.

The field work associated with the collection and transport of samples will account for a substantial proportion of the total cost of the monitoring programme. Sampling trips will, therefore, be planned and carried out in such a way that efforts are not wasted. A checklist, attached as Appendix C, will be completed before every trip to ensure all equipment and materials are prepared before a trip is undertaken.

Field staff might encounter a wide range of hazards in the course of their work, for examples, water-courses may be highly contaminated with sewage or chemicals, access to sampling stations may involve crossing dangerous terrain, and wading in streams inevitably carries the possibility of slipping and personal injury. Thus, staff will be trained to recognize and deal with as many as possible forms of the hazards they are likely to encounter. Training in various courses will also be attended by staff members to ensure their capacity development in the water quality testing and monitoring.

3.4 Laboratory Work

Currently the Ministry of Agriculture, Water and Forestry does not have a laboratory that is in operation to carry out water quality analysis. However the Ministry is in the process of upgrading its water quality (analytical) laboratory, meanwhile the Ministry will be outsourcing the water quality analysis.

The sample collection process will be coordinated with the laboratory so that analysts know how many samples will be arriving, the approximate time of their arrival and the analyses that are to be carried out, and can thus have appropriate quantities of reagent chemicals prepared.

Sample bottles will be placed in a sturdy, insulated wooden or plastic box for transport to the laboratory to protect the samples from sunlight. The samples will arrive at the laboratory and be analysed within 2 to 3 weeks.

Below is a list of parameters grouped together as group 2 for drinking water which will be analysed on a routine basis: **pH, Electric Conductivity, Total Dissolved Solids (determined), Colour, Turbidity, Sodium, Potassium, Calcium, Magnesium, Total Hardness, Iron, Manganese, Chloride, Sulphate, Fluoride, Nitrate, Total and Phenolphthalein Alkalinity, and Silica.**

Heavy metals and tracer elements (e.g. **Uranium, Titanium, Mercury, Copper, Zinc, Cadmium, Lead, Arsenic,** etc.) are site specific and will be analysed on a non-routine basis.

3.5 Classification and Evaluation of the Quality of Water

The concentration of and limits for the aesthetic, physical and inorganic parameters determines the classification of water as a whole. The water is classified ideal or acceptable depending to the parameter which least complies with the proposed National Water Quality Guidelines and Standards for potable water.

The proposed guidelines and standards are attached as Appendix A. These classify water into two categories, namely:

- Ideal guideline: Water with an excellent quality
- Acceptable Standard: Water with good quality or low health risk and acceptable for human consumption

Water should ideally be of excellent quality or good quality, however in practice many of the parameters may fall outside the limits. If water is classified as having low health risk, attention should be given to this problem, although the situation is not serious yet. If water is classified as having a higher health risk (not acceptable), urgent and immediate attention should be given to this matter. Short term exposure to parameters exceeding their limits is not necessary critical, but in the case of extremely toxic substances such as cyanide, remedial procedures should be taken immediately.

The proposed standards and guidelines also divide the bacteriological quality of drinking water into two categories, namely:

- 95 percentile: Water which is bacteriological very safe
- 1 of samples maximum: Water which is bacteriological still suitable for human consumption

The water supplied to the communities need to be within the limits as set in the Water Quality Standards and Guidelines.

4. INFORMATION MANAGEMENT AND REPORTING

The water quality results from the field and analytical laboratory will be analyzed and interpreted to find out whether water points conform to the drinking water quality standards. The reports will be made available to relevant stakeholders on request. The results will be used as basis for continuous compliance monitoring and establishment of water quality trends and status of the water points in the regions. Water quality data for each region will be stored in the Water Quality Information System (WAQIS) for future use and reference.

Compliance monitoring reports will be recorded on a monthly, quarterly and annual basis. These reports will help in meeting national development goals.

5. PROGRAM MANAGEMENT

The program will be the responsibility of the Water Environment Division: Water Quality Section and it will be part of the annual work plan of the Division.

6. FINANCIAL RESOURCES

The funds that will be used for the routine Drinking Water Quality Monitoring Programme are part of the Water Environment Division operational budget and will be allocated annually. Funds will also be used for:

- Water analysis services
- Laboratory and Field equipment
- Staff members recruitment and training

The table below illustrates the financial estimation for the Monitoring Programme.

Table 6.1: Estimate Cost (Annual)

Item	**Quantity**	**Cost in N$**
Water Analysis	-	200,000.00
Laboratory Equipment & consumable	-	9,000,000.00
Field Equipment	6	630,920.00
Staff	6	1,062,114.00
DSA	6	576,000.00
Total Cost		**11,469,034.00**

7. CONCLUSION

The aim of water quality monitoring programme is to ensure that Namibians are supplied with potable water conforming to the set Namibia water quality standards and guidelines. This will be achieved through cooperation in the water sector and continuous monitoring by the Ministry.

8. RECOMMENDATIONS

It is recommended that:

1) This report be accepted and submitted to the Permanent Secretary for approval.
2) A consultant be hired to assess the current laboratory set up and recommend further specifications.
3) Funds be made available on annual basis for planned activities of the water quality monitoring programme.
4) Funds be made available to purchase laboratory and field equipment for water analysis.

Deputy Director: Water Environment **Date:**

The recommendations in this report are supported/ not supported

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Director: Resource Management **Date:**

The recommendations in this report are supported/ not supported

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Under Secretary: Department of Water Affairs & Forestry **Date:**

The recommendations in this report are approved/ not approved

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Permanent Secretary: Ministry Agriculture Water & Forestry **Date:**

APPENDIX A: PROPOSED WATER QUALITY STANDARDS AND GUIDELINES FOR POTABLE WATER

Table 1: Water Quality Guidelines and Standards for Potable Water

Specifications for water quality intended for human consumption from the source and piped water supply					
Status				Ranges and upper limits	
Interpretation				(Ideal guideline)	(Acceptable Standard)
DETERMINANTS	Unit	Format	Concern	95 Percentile Requirement	
PHYSICAL AND ORGANOLEPTIC REQUIREMENTS					
Temperature	**° C**		**E**	**Ambient temperature**	
Colour	**PTU**	**or mg/litre**	**E**	**10**	**<15**
Taste			**O,E**	**No objectionable taste**	
Odour			**O,E**	**No objectionable odour**	
Turbidity (treated surface water)	**NTU**	**or TU**	**H,I**	**< 0,3**	**< 0,5**
Turbidity (groundwater)	**NTU**	**or TU**	**H,I**	**< 0,5**	**<2**
pH @ 20 °C	**pH**		**I**	**6.0 to 8,5**	**6 to 9**
Electric Conductivity @ 25 °C	**mS/m*** **	**E.C.**	**H,I**	**< 80**	**< 300**
Total Dissolved Solids	**mg/litre**		**H,I**	**< 500**	**< 2 000**
INORGANIC MACRO DETERMINANTS					
Ammonia	**mg/litre**	**N**	**H**	**< 0.2**	**< 0.5**
Calcium	**mg/litre**	**Ca**	**I**	**< 80**	**< 150**
Chloride	**mg/litre**	**Cl**	**H,I**	**< 100**	**< 300**
Fluoride	**mg/litre**	**F**	**H**	**< 0.7**	**< 2,0**
Magnesium	**mg/litre**	**Mg**	**H**	**< 30**	**< 70**
Nitrate	**mg/litre**	**N**	**H**	**< 6**	**< 11**
Nitrite	**mg/litre**	**NO_2**	**H**	**< 0.2**	**< 0.5**
Potassium	**mg/litre**	**K**	**H**	**< 25**	**< 100**
Sodium	**mg/litre**	**Na**	**H.I**	**< 100**	**< 300**
Sulphate	**mg/litre**	**SO_4**	**H,O**	**100**	**< 300**
Asbestos (fibres longer than 10 m)	**Fibres/litre**		**H**	**<500 000**	**< 1000 000**
INORGANIC MICRO DETERMINANTS					
Aluminium	**g/litre**	**Al**	**H**	**< 25**	**< 100**
Antimony	**g/litre**	**Sb**	**H**	**< 5**	**< 50**
Arsenic	**g/litre**	**As**	**H**	**<10**	**< 50**
Barium	**g/litre**	**Ba**	**H**	**0,5**	**< 2**
Beryllium	**g/litre**	**Be**	**H**	**< 2**	**< 5**
Bismuth	**g/litre**	**Bi**	**H**	**< 250**	**< 500**
Boron	**g/litre**	**B**	**H**	**< 300**	**< 500**
Bromide	**g/litre**	**Br**	**H**	**< 500**	**< 1 000**
Cadmium	**g/litre**	**Cd**	**H**	**< 5**	**< 10**
Cerium	**g/litre**	**Ce**	**H**	**<1 000**	**<2 000**

Specifications for water quality intended for human consumption from the source and piped water supply					
Status				Ranges and upper limits	
Interpretation				(Ideal guideline)	(Acceptable Standard)
DETERMINANTS	Unit	Format	Concern	95 Percentile Requirement	
Cesium	**g/litre**	**Cs**	**H**	**< 1 000**	**< 2 000**
Chromium Total	**g/litre**	**Cr**	**H**	**< 50**	**< 100**
Cobalt	**g/litre**	**Co**	**H**	**< 250**	**< 500**
Copper	**g/litre**	**Cu**	**H**	**< 500**	**< 2 000**

Specifications for water quality intended for human consumption from the source and piped water supply					
Status				Ranges and upper limits	
Interpretation				(Ideal guideline)	(Acceptable Standard)
DETERMINANTS	Unit	Format	Concern	95 Percentile Requirement	
INORGANIC MICRO DETERMINANTS					
Cyanide (free)	**µg/litre**	**CN^-**	**H**	**< 20**	**< 50**
Cyanide (recoverable)	**µg/litre**	**CN^-**	**H**	**< 70**	**< 200**
Iron	**µg/litre**	**Fe**	**H,E**	**< 200**	**< 300**
Lead	**µg/litre**	**Pb**	**H**	**<10**	**< 50**
Manganese	**µg/litre**	**Mn**	**H**	**< 50**	**< 100**
Mercury	**µg/litre**	**Hg**	**H**	**< 1**	**<2**
Nickel	**µg/litre**	**Ni**	**H**	**< 50**	**< 150**
Selenium	**µg/litre**	**Se**	**H**	**< 10**	**< 50**
Thallium	**µg/litre**	**Ti**	**H**	**< 5**	**< 10**
Tin	**µg/litre**	**Sn**	**H**	**<100**	**<200**
Titanium	**µg/litre**	**Ti**	**H**	**< 100**	**< 300**
Uranium	**µg/litre**	**U**	**H**	**< 3**	**< 15**
Vanadium	**µg/litre**	**V**	**H**	**< 100**	**< 500**
Zinc	**µg/litre**	**Zn**	**H**	**< 1 000**	**< 5 000**
Organo-metallic compounds	**µg/litre**	**-**	**H**	**below detection limit**	**below detection limit**
ORGANIC DETERMINANTS					
Dissolved Organic Carbon	**mg/litre**	**DOC-C**	**H**	**< 5**	**<10**
Phenol compounds	**µg/litre**	**phenol**	**H**	**< 5**	**< 10**
DISINFECTION AND DISINFECTION BY-PRODUCTS					
Bromodichloromethane (Part of THM)	**µg/litre**		**H**	**< 20**	**< 50**
Bromoform (Part of THM)	**µg/litre**		**H**	**< 40**	**< 40**
Chloroform (Part of THM)	**µg/litre**		**H**	**< 20**	**< 100**
Dibromomonochloro-methane (Part of THM)	**µg/litre**		**H**	**< 20**	**< 100**
Trihalomethanes (Total)	**µg/litre**	**THM**	**H**	**< 100**	**< 150**
Bromate	**µg/litre**		**H**	**< 5**	**< 10**
Chloramines	**mg/litre**	**Cl_2**	**H**	**< 2**	**< 4**
Chlorine dioxide	**µg/litre**		**H**	**< 400**	**< 800**
Chlorite	**µg/litre**		**H**	**< 400**	**< 4000**
Chlorate	**µg/litre**		**H**	**< 200**	**< 700**
Haloacetic acids	**µg/litre**		**H**	**not detected**	**< 60**
Chlorine, free, after 30 min; GENERAL	**mg/litre**	**Cl_2**	**H,I**	**0,1 – 0,5**	**0,1 - 3,0**
Chlorine, free, after 30 min; SPECIFIC	**mg/litre**	**Cl_2**	**Turbidity: < 0,3 NTU**	**0,1**	**0,1 - 3,0**
Chlorine, free, after 30 min; SPECIFIC	**mg/litre**	**Cl_2**	**Turbidity: > 0,3 NTU**	**0,5**	**0,1 - 3,0**
Chlorine, free,	**mg/litre**	**Cl_2**	**Turbidity:**	**1,0**	**0,1 - 3,0**

Specifications for water quality intended for human consumption from the source and piped water supply					
Status				Ranges and upper limits	
Interpretation				(Ideal guideline)	(Acceptable Standard)
DETERMINANTS	Unit	Format	Concern	95 Percentile Requirement	
after 60 min; SPECIFIC			**>1,0 NTU**		

Specifications for water quality intended for human consumption from the source and piped water supply					
Status				Ranges and upper limits	
Interpretation				(Ideal guideline)	(Acceptable Standard)
DETERMINANTS	Unit	Format	Concern	95 Percentile Requirement	
BIOLOGICAL REQUIREMENTS					
Algae					
Chlorophyll	**g/litre**		**E,O**	**< 1**	**< 2**
Blue-green algae	**cells**	**/ml**	**H,O**	**< 200**	**<2 000**
Mycrocystin	**g/litre**		**H**	**< 0.1**	**< 1**
Geosmin	**ηg/litre**		**E, H**	**< 15**	**< 30**
2-Methyl Iso Borneal (2 MIB)	**ηg/litre**		**E, H**	**< 15**	**< 30**
OTHER DETERMINANTS					
Agricultural chemical compounds			**H**	**Any organic compound recognized as an agro-chemical should be in accordance with the WHO and EPA requirements.**	
Industrial chemical compounds			**H**	**Any organic compound recognized as an industrial chemical should be in accordance with the WHO and EPA requirements.**	
Endocrine disruptive chemicals			**H**	**Any chemical compound that is suspected of having endocrine disruptive effects shall be in accordance with the WHO and EPA requirements.**	
RADIOACTIVITY				95 Percentile Requirement	
Gross alpha activity	**Bq/litre**		**H**	**< 0.2**	**< 0.5**
Gross beta activity	**Bq/litre**		**H**	**< 0.4**	**< 1.0**
If Gross alpha and beta is above specification calculate Dose based on individual radionuclide concentrations	**mSv/a**		**H**	**≤ 0.04**	**≤ 0.1**
ANALYSIS QUALITY CHECK***					
Ion balance: Total anions			**-**	**< 3 -Tolerance = 0.2 m equivalent 3-10 – Tolerance 2% on +- balance 10-800 – Tolerance 5% on +- balance**	
TDS Balance: determined / calculated	**ratio**		**-**	**~ 1**	**~ 1**
Ratio TDS / EC (EC as S/cm)	**ratio**		**-**	**~ 0,66**	**0,55 – 0,7**

"Concern" refers to impact if the limit is transgressed: H = health concern; O = organoleptic effect;
I = effect on infrastructure, structural; E = aesthetic effect

* Based on a viral cell culture-dependent method and not on cell culture-independent methods (e.g. PCR)

** Indicative of faecal pollution having occurred, even when the residual disinfectant levels are safe.

*** Comply with SANAS Guidelines

Table 2: Microbiological and Biological Requirements

MICROBIOLOGICAL REQUIREMENTS APPLICABLE TO ALL POTABLE WATER					
Microbiology	cfu			95 percentile	1 of samples maximum
Heterotrophic bacteria HPC or TCC	**counts**	**/ml**		**100 at 37⁰ C**	**1 000 at 37⁰ C**
Total Coliform	**counts**	**/100 ml**	**H**	**0**	**5**
E.Coli	**counts**	**/100 ml**	**H**	**0**	**1**
Entrerococci	**counts**	**/100 ml**	**H**	**0**	**1**
Somatic Coliphage	**counts**	**/100 ml**	**H**	**0**	**1**
Clostridium perfrigens inclusive spores	**counts**	**/100 ml**	**H**	**0**	**1**
Enteric viruses	**viral count***	**/10 L**	**H**	**0**	**1**
Parasites (Protozoa) applicable to all potable water				95 percentile	99 percentile
Giardia lamblia	**cysts**	**/100 litre**	**H**	**0**	**1**
Cryptosporidium	**oocysts**	**/100 litre**	**H**	**0**	**1**
Giardia lamblia and Giardia lamblia (Grab sample)	**cysts or oocysts**	**/10 L**	**H**	**0**	**0**

Table 3: Special Requirements for the Protection of Infrastructure

Specifications for water quality intended for human consumption from the source and piped water supply for the protection of infrastructure against corrosion					
Status				Ranges and upper limits	
Interpretation				(Ideal guideline)	(Acceptable Standard)
DETERMINANTS	Unit	Format	Concern	95 Percentile requirement	
CORROSIVE AND SCALING PROPERTIES					
Calcium Carbonate Precipitation Potential	**mg/litre**	**CCPP**	**I**	**4 - 5**	**3 - 6**
Alkalinity/Sulphate/ Chloride Ratio	**Equi-valents**	**Corrosivety Ratio**	**I**	**With SO_4 and Cl above 50 mg/litre Ratio=(Alk/50)/(SO_4/48+Cl/35.5) > 5.0 Water is Stable Ratio= (SO_4/48+Cl/35.5)/(Alk/50) > 0.2 Water is Corrosive**	
Total Hardness (Ca & Mg)	**mg/litre**	**$CaCO_3$**	**I**	**<200**	**< 400**

Table 4: Frequency of Microbiological Monitoring for Bulk Water Supply

Size of population served	**Turbidity 95%****	Frequency of sampling
> 250 000	< 0,5 NTU	**Thrice weekly *** **
100 001 – 250 000	< 1,0 NTU	**Twice weekly**
50 001 – 100 000	< 1,0 NTU	**Once weekly**
10 001 – 50 000	< 1,0 NTU	**Three times every month**
< 10 000 reticulated	< 1,0 NTU	**Once every 1 month***
< 10 000 non-reticulated	**1 – 2 NTU**	**Once every 1 month***

* Upon complaints by the consumers or of medical practitioners and after incidents such as pipe breaks, the frequency should be increased until the situation has returned to original counts and been declared safe;

** Average or 95 percentile turbidity of the water supplied

*** The frequency should be stepped up by one extra sampling per week for every 100 000 residents (including the estimated number of visitors residing within the area at any time) in the area served, over and above 250 000.

APPENDIX B: FIELD RECORD WORKSHEET

Field Record Worksheet

	Sampler Name: _____ Division: _____
A	**Sample Origin** Region, Place: _____ Source (Well, Tap): _____ GPS: S _____ E _____ Date (as dd/mm/yy): _____ Time(as 24 hours system): _____
B	**Samples collected:** Physical chemistry: Yes/No Chemical chemistry: Yes/No Microbiology: Yes/No
C	Analysis undertaken on site:

Parameters	**Units**	**Method/ Equipment used**	**Reading value**
pH	pH	pH meter	
Turbidity	FAU	Colorimeter	
Colour	Pt-Co	Colorimeter	
Conductivity	mS/m***	Conductivity meter	
Temperature	^{o}C	Colorimeter/ pH meter/ Conductivity meter	
Dissolved Oxygen (DO)	mg/litre	DO meter	
Oxidation Reduction Potential (ORP)	mV	ORP meter	
Chlorine residual	mg/litre	Silver Nitrate Titration	
Nitrates	Nitrate Nitrogen ppm	Nitrate strips	
Total coliform	counts/100 ml	Presence/Absence test or MPN count	
E. coli	counts/100 ml	Presence/Absence test or MPN count	

D	**Remarks:**

APPENDIX C: CHECKLIST FOR PREPARING FOR FIELD WORK

Field Work Preparation Checklist

No	List	Tick (✓)
Paperwork		
1	Itinerary (Inventory details of sampling stations; maps)	
2	List of samples required at each sampling station	
Co-ordination		
3	Local & Institutional co-ordination, to ensure access to sites on restricted or private land, for example, notification of Traditional authorities & private land owners	
4	Notify laboratories of expected date and time of sample arrival	
5	Check any available sources of information on local weather conditions and feasibility of travel	
For sampling		
6	Sample bottles, preservatives, labels and marker pens	
7	Sample storage/transit containers and ice packs	
8	Standard operating procedures for sampling	
9	Spares of all above items if possible and when appropriate	
For documentation		
10	Pens	
11	Field notebook	
12	Field record worksheet	
For on-site testing		
13	List of analyses to be performed on site	
14	Check stocks of consumables (including distilled water, pH buffers, standards and blanks); replenish and refresh as appropriate	
15	Check and calibrate meters (pH, conductivity, dissolved oxygen, turbidity, thermometers) and other testing equipment according to local practice	
16	Standard operating procedures and equipment manuals	
17	Accessories for equipment and meters (including cables, chargers and spare batteries) and Consumables	
Transport		
18	Does assigned vehicle have sufficient capacity for personnel, supplies and equipment?	
19	Is vehicle road-worthy? Check battery, lubrication, coolant, windshield washer	
20	Is there sufficient fuel for the trip, either in the tank, or available en route and if the petrol card is valid?	
21	Is the spare tyre inflated, is there a jack, wheel wrench and tool kit?	
22	Is e-fuel available in the area of operation?	