# Quality Assurance Plan for Potable Water Supplied by **RIWSP**

Rwanda

Rwanda Integrated Water Security Program (RIWSP)

# Quality Assurance Plan for Potable Water Supplied by RIWSP Rwanda

Funding for this publication was provided by the American people through the United States Agency for International Development (USAID) as a component of the Rwanda Integrated Water Security Program (RIWSP). The views and opinions of the authors expressed herein do not necessarily state or reflect those of the United States Agency for International Development, the United States or Florida International University.



**Global Water for Sustainability Program**

Florida International University

Biscayne Bay Campus 3000 NE 151 St. ACI-267

North Miami, FL 33181 USA

Email: glows@fiu.edu

Website: www.globalwaters.net

**For bibliographic purposes, this document should be cited as:**

GLOWS-FIU. 2012. Quality Assurance Plan for Potable Water Supplied by RIWSP, Rwanda. Global Water for Sustainability Program, Florida International University.

ISBN:

Cover Photographs:

Front cover: Left-Right – Latrine in poor state; Future sanitarily designed latrine.

Back cover: Left-Right – Latrine in poor state; Future sanitarily designed latrine.

**TABLE OF CONTENTS**

## Contents

# ABSTRACT

The primary goal of the Rwanda Integrated Water Security Program (RIWSP) is to improve the sustainable management of water quantity and quality to positively impact human health, food security, and resiliency to climate change for vulnerable populations in targeted catchments in Rwanda.

This document details the Quality Assurance plan for potable water supplied under RIWSP. In particular, it describes how RIWSP complies with USAID environmental regulations especially regarding the testing of water quality of supplies before for human consumption. The water quality plan addresses all aspects of the drinking water supply from boreholes, springs, gravity schemes and rain water harvesting systems destined for drinking water. It includes control of abstraction, treatment and delivery of drinking-water.

The Quality Assurance plan shows how RIWSP will ensure the provision of safe drinking water to communities served by the program, ensuring it meets both local and World Health Organization (WHO) water quality standards. As part of capacity building activities, RIWSP will also build capacity and establish responsibilities to provide reasonable assurance of ongoing water quality monitoring.

The standards for initial and ongoing testing of water quality -- types of contaminants for which testing should be conducted, testing methods, testing frequency, and issues such as public access to results--will comply with applicable USAID guidance, as well as local laws, regulations and policies.

Furthermore, a response protocol should be established in the event that water quality testing reveals contamination of drinking water supplies. Among the water quality tests which must be performed are tests for the presence of arsenic in accordance to the requirement that any USAID-supported activity engaged in the provision of potable water must adhere to Guidance Cable State 98 108651, which requires arsenic testing. The USAID managing team must assure that the standards and testing procedures described in the following document are met: “Guidelines for Determining the Arsenic Content of Ground Water in USAID-Sponsored Well Programs in Sub-Saharan Africa.”

## 1. LAWS, REGULATIONS AND STANDARDS

RIWSP will ensure full compliance with requirements for water quality testing of USAID-financed potable water sources (USAID Guidance cable 98 108651), including testing for arsenic, nitrates, nitrites, coliform and other standard parameters. In response to USAID regulations that require an Initial Environmental Evaluation (IEE), RIWSP will conduct an Environmental Impact Assessment to see if the proposed project interventions will have a significant effect on the environment and implement proposed measures accordingly.

The aim of the Rwandan national drinking-water laws and standards is to ensure that the consumer enjoys safe potable water. Effective control of drinking-water quality is ideally supported by adequate legislation, standards and codes and their enforcement established by **RWANDA UTILITIES and REGULATORY AGENCY** (***RURA)***. The national regulations, adjusted as necessary, are applicable to all water supplies. The supplier is responsible for continuous and effective quality assurance and quality control of water supplies, including proper supervision, preventive maintenance, routine testing of water quality and safe operation of the drinking-water system.

However, the responsibility of the supplier is normally limited to the quality of the water supplied only up to the public tap in the distribution system. The onus then switches to the community and individual households. For example, the supplier is not responsible for deterioration of water quality as a result of unsatisfactory storage tanks or plumbing problems in households and community buildings.

## 2. SURVEILLANCE OF DRINKING-WATER QUALITY

### Control and Surveillance

Rwanda Bureau of Standards (RBS), which is the control and surveillance agency, is responsible for an independent (external) and periodic review of all aspects of safety. Surveillance will contribute to the protection of public health by promoting improvement of the quality, quantity, accessibility, coverage, affordability and continuity of drinking-water supply.

## 3. SAMPLE COLLECTION AND SHIPPING

Samples shall be taken from the source or water point and tested as per standards. More complex measurements are often made in a laboratory requiring a water sample to be collected, preserved, transported, and analyzed at another location. The sample collection procedure will assure correct weighting of individual sampling times (hour and date) and locations where averaging is appropriate. Laboratory staff will follow rules and procedures to reduce/eliminate potential contamination during sample collection and shipping. The

laboratories will use the appropriated equipment to avoid contamination of samples during transportation for another location for analyses.

## 4. WATER QUALITY DATA MANAGEMENT

Water quality data for RIWSP will be documented on both paper and digital formats. Physical-chemical parameters will be measured and recorded during field trips on standardized water quality and water quantity field forms and stored in particular file folders. Analytical data will be received electronically from the laboratory. ***The consulted laboratory will save the data and provide a copy (soft and hard copy) to RIWSP.*** Reports must be internally and externally reviewed prior to approval. Below is an example format report with parameters to be analyzed.

## Proposed Reporting Format for Water Quality Test

Name of the laboratory:
Responsible: Date:
Name of the water scheme
Location of the water scheme (District, sector, cells): No:

| PARAMETER | WHO Guideline value | Reason | Result from the laboratory | comments |
|---|---|---|---|---|
| Total coliforms | 0 | Health | | |
| Thermotolerant(faecal) coliforms | 0 | Health | | |
| Faecal streptococci | 0 | Health | | |
| conductivity | 400microsec/cm | Taste | | |
| Total dissolved solid(TDS) | < 600mg/L | Taste | | |
| PH | 6.5 – 8.5 | < 8 for effective chlorination | | |
| Turbidity | <5 NTU | Health | | |
| Chlorine | 5 mg/L | (Health) | | |
| Arsenic | 10 microgram/L | Health | | |
| Fluoride | 1.5 mg/L | Health | | |
| Nitrate | 50 mg | Health | | |
| Nitrite | 3mg/L(short-term) / 0.2 mg/L(Long-term) | Health | | |
| Aluminium | 0.2 mg/L | Aesthetic | | |
| Ammonia | 35 mg/L / 1.5 mg/L | Taste/Odour | | |
| Chloride | 250 mg/L | Taste | | |
| Chromium | 0.05 mg/L | Health | | |
| Copper | 2.0 mg/L | Health | | |
| Hardness | 100 – 300 mg/L | Health | | |
| Lead | 10 microgram/L | Health | | |
| Manganese | 0.4 mg/L | Health | | |
| Nickel | 0.02 mg/L | Health | | |
| mercury | 0.001 mg/l | Health | | |

## Laboratory Interpretation and Analysis

---

---

---

---

## 5. WATER ANALYSIS PROCESS

The local laboratories that have been assessed to work with RIWSP to date include: the laboratory of the National University of Rwanda, the laboratory of quality control of Rwanda Bureau of Standards, and the laboratory of water quality control of EWSA. Laboratory staff will collect water samples for laboratory analysis at identified water sources/water points destined to be used in potable water systems in the region to be supplied.

Sampling will take place before construction activities to assess the quality of the water, and after construction activities to guarantee potable water quality. Water quality analysis will determine physical-chemical properties along with occurrence and distribution of nutrients, major ions, and trace metals and their relationship to hydrologic conditions. Measurements of pH, specific conductivity, water temperature, and salinity will be recorded at all water sources.

## 6. WATER QUALITY

Water quality includes the physical, chemical and biological characteristics of water. Its condition will be measured relative to human consumption and by reference to a set of standards established (by RBS/EAS/WHO) to assess drinking water (See Annex for more details).Through microbiological, chemical and physical tests, RIWSP will ensure that water is: free from pathogenic organisms; clear; not saline; free from compounds that may have adverse effect on human health; and free from chemicals that cause corrosion of water supply systems.

### a. Microbiological assessment

For microbial water quality, verification will include microbiological testing. In most cases, it will involve the analysis of fecal indicator microorganisms, but in some circumstances it may also include assessment of specific pathogen densities.

### b. Chemical assessment will focus on:

The following assessment will apply only for groundwater,

- Lead as ($Pb^{2+}$)**:** less than 0.1 mg/l. Lead is a toxic material that accumulates in the skeletal structure of man and animals. Pb in blood lowers mental performance, causing damage to children.
- Fluoride : less than 1.5 mg/L
- Mercury as ($Hg^{2+}$): less than 0.001 mg/l. Mercury from industrial effluents and earth's crust is transformed into methylmercury—an organic form of mercury, which presents serious hazard to humans whose diet, is rich in fish.
- Chromium (Cr): total Chromium should be less than 0.5 mg/l

- Zinc ($Zn^{++}$): Less than 5 mg/l. Zinc is relatively non-toxic to humans but is acutely and chronically toxic to aquatic organisms, particularly fish. It is widely used in industry and affects the aesthetic quality of drinking water.
- Nickel as ($Ni^{2+}$): Less than 0.02 mg/l. Any appreciable amount of nickel ions can hinder self-purification of a river.
- Copper as ($Cu^{2+}$): Less than 1.0 mg/l. High concentrations of copper restrict water use for drinking due to taste problems.
- Arsenic (As): Less than 0.01 mg/l. Arsenic may be acutely or chronically toxic to humans.
- Cyanides ($CN^{-}$): Less than 0.1 mg/l. Cyanide renders tissues incapable of oxygen exchange.
- Ammonia (NH3): Less than 0.5 mg/l
- Nitrates (N): Less than 10 mg/l. Nitrates cause eutrophication of fresh waters and methaemoglobinaemia ("blue baby syndrome") in infants.
- Phosphates as ($PO_4^{3-}$): maximum 2.2mg/l. Phosphates enrich fresh water environment with plant nutrients resulting in rapid algae growth which affect municipal, industrial and recreational uses.

### c. Physical-chemical assessment will focus on

- pH
- Temperature
- Turbidity
- Total dissolved solids (TDS)
- Conductivity

## 7. PARAMETERS TO BE TESTED / TYPE OF WATER SOURCE

| Water quality parameters | | Surface Water | Ground Water | Rain Water |
|---|---|---|---|---|
| **Physical parameters** | TDS | X | X | X |
| | Color | X | X | X |
| | Turbidity | X | X | X |
| | Odor and taste | X | X | X |
| **Chemical parameters** | pH | X | X | X |
| | Total hardness | X | X | X |
| | Nitrate ($NO_3$) | X | X | |
| | Nitrite ($NO_2$) | x | x | |
| | Iron | X | X | Not Applicable |
| | Manganese | X | X | |
| | Arsenic (As) | X | X | |
| | Ammonia ($NH_3$) | X | X | |
| | Chloride | X | X | |
| | Fluoride(F) | X | X | |
| | Free (Residual) Chlorine | X | X | Not Applicable |
| | Zinc | Not relevant | Not relevant | X |
| **Microbiological (Bacteriological) parameters** | Thermo tolerant Faecal Coliform (E.Coli) | X | x | |
| | Total coliform | Not relevant | Not relevant | Not relevant |

In the process of assessing new water sources for drinking water, RIWSP will conduct water quality testing as normal course of action. Testing will occur before developing a source and immediately after completion of the construction of work, prior to making water available to communities.

## 8. WATER QUALITY IN DISTRIBUTION NETWORK

RIWSP will use and provide in all of its water systems, products that meet customer and applicable regulatory requirements. National regulations set by RURA and national standards prepared by RBS will be met. All material to be used will be ordered and purchased from a certified supplier, and all purchased material and equipment will be checked and verified before use by the Rwanda Bureau of Standards to ensure conformity to international standards.

To maintain good quality of the water delivered by the system, RIWSP (in collaboration with partners) will ensure and/or provide:

- RIWSP will use PVC pipes and their fittings in the distribution network. PVC pipes are resistant to both chemical and electrochemical corrosion because PVC is a nonconductor

and is not damaged by aggressive waters or corrosive soils. Thus, tuberculation and galvanic effects are not observed in PVC piping. Degradation of buried PVC pipes due to biological action has not been reported yet. PVC pipe will not deteriorate as a result of microbiological activity nor serve as a nutrient to microorganisms.

- To avoid water source contamination by human activities, RIWSP will protect the catchment area of the sources (diameter of 50m) by tree fences where no human activities will be allowed inside the fenced area. The program will comply with the water source protection preventive measures according to the Rwandan law.

- Proper training of system operators and managers and, in the case of community-managed supplies, on-going support through surveillance. Notably:

    - Biannual sanitary inspection of distribution systems to identify potential leaks or parts of the system where ingress could occur.
    - Monthly monitoring at every storage reservoir and service connection throughout the system.
    - Seasonal (once in rainy season and once in dry season) sampling for microbial quality and real-time monitoring of parameters linked to microbial quality at selected locations throughout the storage and distribution system.

- Water surveillance will be done by project field staff and the district through trained environmental health officer using drinking water kits (Wagtech Kits) supplied by the Ministry of Health.

- To avoid higher microbial concentrations from rainwater harvesting generally found in the first flush of rainwater, RIWSP will make sure that a system to divert the contaminated first flow of rainwater from roof surfaces will be installed and promote the cleaning of the roof and gutters.

The storage tanks will have covers to discourage mosquito breeding or other vectors and help to prevent fecal contaminants and sunlight, which may promote algal growth. Tanks will have a mechanism, such as a tap or outlet pipe, that enables hygienic abstraction of water.

## 9. OPERATIONAL MONITORING

Operational monitoring will be conducted to assess whether the control measures in a drinking-water system are operating properly.

## 10. CAPACITY BUILDING ON WATER QUALITY

Adequate training in methods and procedures to maintain water quality will be provided to water system managers and their operators to improve knowledge, avoid potential error, ensure the quality of the data/information, and lend credibility to the data/information provided.

## 11. COMMUNICATION

Through community-level trainings and meetings, effective communication will be promoted to increase community awareness and knowledge of drinking-water quality issues. This will help consumers to understand and contribute to decisions about the service provided by a drinking water supplier or land use constraints imposed in catchment areas.

During the community sensitization meetings, people will be informed of their role in the safe-water-chain (e.g. preventing contamination of potable water between the time of collection and use at home).

Hygiene education will be promoted as means to protect quality of water at home. Consumers will be informed on point-of-use treatment options where applicable (e.g. boiling, filtration, chlorination).

Educational materials will be distributed about safe water and rainwater collection practices (e.g. first-flush systems, tank cleaning, hand washing). Community consultation will be used to gather information about how people are satisfied with the quality of water, to know if the water supplied impacts their health in a positive way.

## 12. VERIFICATION

The Quality Assurance plan incorporates a verification process to confirm proper operation of water supply scheme and maintenance of water quality. Verification will be done by: 1) conducting regular water quality testing—from the source and at the end point of the system (tap/reservoir); 2) establishing consistent procedures for evaluating results and reporting, and; 3) conducting ongoing audits and reviews of data and analysis. The verification process will be conducted by a RIWSP approved laboratory hired by the water system manager.

# ANNEX

# WATER QUALITY LABORATORIES

As RIWSP aims to improve the sustainable management of water quantity and quality to positively impact human health, it will work with local laboratories to ensure the quality of water to be supplied to the community. The contracted ***laboratory will provide to RIWSP a certificate and report for each sample tested in that laboratory***.

**List of "approved" laboratories that RIWSP will work with and their facilities**

The following certified National laboratories in Rwanda perform "water quality analysis" or work exclusively and regularly to test the quality of water resources and have the material and staff capacities to analyze and monitor the water quality.

All water samples will be analyzed by one (or more) of the following selected laboratories:

1. **The laboratory of the National University of Rwanda**: It routinely takes care of follow-up physical, chemical and bacteriological analyses of drinking water in rural areas of Rwanda.

2. **The laboratory of quality control of Rwanda Bureau of Standards** (RBS). It controls the quality and the methodologies of analyses and delivers accreditation or licenses. As an institution with a highly regarded status in terms, the laboratory of RBS is surely part of the national technical capacities concerning control and follow-up the standards of the water quality in Rwanda.

3. **The laboratories of water quality control of EWSA**. These laboratories control and conduct follow-up monitoring and analyses of the physic-chemical and bacteriological quality of water in the EWSA water network.

Analysis and Reporting will include three main tasks:

1) The initial interpretation of the field data,

2) The preparation of client reports,

3) Observations, final report writing, approval and submission

## WATER QUALITY INSTRUMENTS AND FIELD MEASUREMENTS

The physical-chemical parameters of water are subject to rapid change when removed from their source. Therefore, they are measured at the field site as the samples are collected. This will be done by the hired laboratory (from laboratories listed above). ***Laboratories will use their proper equipment and will follow approved processes for all required tests***.

**a. Equipment of water quality laboratory of the National University of Rwanda**
(Under control of Department of Science from January 2005, transferred from the water quality laboratory of the Direction of Water and Sanitation in Ministry of Lands, Environment, Forest, Water and Mines (MINITERE))

| N® | Analytical equipment | Qty | N® | | Qty |
|---|---|---|---|---|---|
| 1 | Spectrophotometer DR2000 1 | 1 | 11 | Sterilizer | 2 |
| 2 | Smart Colorimeter | 1 | 12 | Incubator | 3 |
| 3 | pH-meter HACH | 3 | 13 | Distiller | 1 |
| 4 | Digital Titration | 5 | 14 | Etuve | 1 |
| 5 | Colorimeter HACH | 1 | 15 | Refrigerator | 3 |
| 6 | Conductivity-meter HACH | 1 | 16 | Kits DelAgua (single Incubator) | 8 |
| 7 | Oxygen meter HACH | 1 | 17 | Bain-marie | 1 |
| 8 | Reactor of COD HACH | 2 | 18 | Microscope | 1 |
| 9 | BOD-meter Track HACH | 1 | 19 | Filtration ramp of 6 posts | 1 |
| 10 | Autoclave | 2 | 20 | Digesdahl | 1 |

**b. Equipment of EWSA Laboratory**

| N® | Analytical equipment | Qty | N® | Analytical equipment | Qty |
|---|---|---|---|---|---|
| 1 | Spectrophotometer HACH 2000 | 1 | 12 | Oven | |
| 2 | Spectrophotometer DR HACH 2010 | 1 | 13 | Distillate | 1 |
| 3 | Balance SARTORIUS | 1 | 14 | Electrical plate | 1 |
| 4 | pH-meter Sensor 1 | 1 | 15 | magnetic Agitator | 1 |
| 5 | pH-meter Sensor 2 | 1 | 16 | Flocculator | 1 |
| 6 | Conductivity meter | 1 | 17 | Bain-Marie | 1 |
| 7 | Senson 5 | 1 | 18 | Incubator Memmert | 1 |
| 8 | Turbidity meter 2100P | 1 | 19 | Sterilizer | 1 |
| 9 | Colorimeter | 1 | 20 | Autoclave | 1 |
| 10 | Hotter | 1 | 21 | Burette automatic | 1 |
| 11 | Ramp filtrate | 1 | | | |

## REFERENCE LIST


1. Rwanda Standards for potable water (RBS)
2. East African Standards for drinking water (EAS)
3. WHO Guidelines for Drinking Water
4. EGSSAA: Chapter 16: Water Supply and Sanitation

# Global Water for Sustainability Program
## Florida International University

Biscayne Bay Campus
3000 NE 151St. ACI-267
North Miami, FL 33181 USA

Phone: (+1-305) 919-4112
Fax: (+1-305) 919-4117

http://glows.fiu.edu