

# **Water and Wastewater Quality Monitoring Guidelines for Water Utilities**

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## Contents

Contents.....	ii
Abbreviations and Acronyms .....	iv
Acknowledgement.....	v
1. Introduction .....	1
2. Monitoring of Drinking Water.....	2
2.1 Check Monitoring.....	2
2.2 Audit Monitoring .....	3
3. Allocation of Sample Numbers and Sampling Frequency .....	5
3.1 General .....	5
3.2 Microbiology.....	5
3.3 Physicochemical.....	6
4. Selection of Sample Sites and Frequencies.....	7
4.1 Selection of Sampling Sites in a Drinking Water Distribution System .....	7
4.1.1 Distribution System Type 1a: One Source to Distribution System .....	7
4.1.2 Distribution System Type 1b: One Source to Distribution System .....	8
4.1.3 Distribution System Type 2: Branch Distribution System.....	9
4.1.4 Distribution System Type 3: Loop Distribution System.....	10
4.1.5 Distribution System Type 4: Combined Branch and Loop the Systems ..	11
5. Test Methods, Preservation and Handling .....	14
6. Reporting.....	14
7. Wastewater Effluent Quality Discharges.....	16
7.1 Check Monitoring.....	16
7.2 Audit Monitoring .....	16
7.3 Sampling Locations and Sampling Frequency .....	17
7.4 Sampling and Test Methods.....	17
7.5 Reporting.....	17
Appendix 1a: Chemical and Physical Limits for Quality of Drinking Water Supplies (TZS 789:2008) .....	18

Appendix 1b: Microbiological Limits for Quality of Drinking Water Supplies (for Microbiological requirement and classification of non-chlorinated piped water supplies) (TZS 789:2008) .....	19
Appendix 1c: Radioactive Materials Limits for Quality of Drinking Water Supplies (TZS 789:2008).....	19
Appendix 2: Permissible Limits for Municipal and Industrial Wastewaters (TZS 860:2006). .....	20
Appendix 3 Summary of Water Quality Distribution System Performance Report – Check Monitoring .....	24
Appendix 4: Summary of Wastewater Quality Performance Report – Check Monitoring .....	27
Bibliography .....	29

## List of Figures:

Figure 1: One Source Entering Distribution System .....	8
Figure 2: Water from One Treatment Plant Entering Two Clear Water Tanks .....	8
Figure 3: Branch Distribution System .....	10
Figure 4: Loop Distribution System .....	11
Figure 5: Combined Branch and Loop System .....	13

## List of Tables:

Table 1: Physicochemical, Microbiological parameters and Radioactive Materials .....	4
Table 2: Recommended Minimum Sample Numbers and Sampling Frequency for Faecal Indicator Testing in Water Distribution System.....	6
Table 3: Recommended Minimum Sample Numbers and Sampling Frequency for Physicochemical Testing in Water Distribution System.....	6
Figure 1: One Source Entering Distribution System .....	8
Figure 2: Water from One Treatment Plant Entering Two Clear Water Tanks .....	8
Figure 3: Branch Distribution System.....	10
Figure 4: Loop Distribution System .....	11
Table 4: Evaluation of Sampling Locations .....	12
Figure 5: Combined Branch and Loop System.....	13

## **Abbreviations and Acronyms**

DAWASA	Dar es Salaam Water and Sewerage Authority
DAWASCO	Dar ea Salaam Water and Sewerage Corporation
Water Utilities	Means Water Supply and Sanitation Authorities, DAWASCO and DAWASA
TZS	Tanzania Standard
TBS	Tanzania Bureau of Standards
WHO	World Health Organisation

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## **1. Introduction**

The Energy and Water Utilities Regulatory Authority (EWURA) is mandated to regulate water supply and sanitation services provided by Water Supply and Sanitation Authorities (WSSAs) in regional and district headquarters, small towns, and national projects areas, and, DAWASA and DAWASCO for Dar es Salaam City and parts of Bagamoyo and Kibaha.

The overall objective of the Water Quality Monitoring Guidelines is to provide guidance to Water utilities to develop their own water quality monitoring programs for drinking water supply and wastewater effluent discharges.

Powers to regulate the water supply and sanitation service providers emanate from EWURA Act, Cap 414; Water Supply and Sanitation Act, Cap 272; and Dar es Salaam Water Supply and Sewerage Authority Act, Cap 273.

The functions conferred to EWURA in relation to water supply and sanitation services include, among other things, to monitor water quality and standards of performance for the provision of water supply and sanitation services (The Water Supply and Sanitation Act (Cap 272): Section 28(1) (e)) and DAWASA Act, CAP 273: Section 26(d).

There are two types of water and wastewater quality monitoring, namely Check Monitoring and Audit Monitoring.

- i. Check monitoring regularly provides information as to whether the water quality complies with the relevant parametric values laid down in the latest Tanzania Standard (TZS 789:2008).
- ii. Audit monitoring provides information necessary to determine whether or not all the parametric values specified in the latest Tanzania Standard (TZS 789:2008) are complied with.

The minimum requirement for monitoring the quality of water and wastewater services to consumers includes:

- i. to monitor the minimum required number of samples and tests on quality of water supplies;
- ii. to monitor the minimum required number of samples and tests on quality of wastewater effluents;
- iii. to collect data, analyse and check compliance with set standards; and
- iv. to ensure publication of test results.

## **2. Monitoring of Drinking Water**

There are thousands of substances found in natural state of water. For practical reasons, it would obviously be impossible to monitor all these substances in routine drinking water quality monitoring programs.

The assessment of the adequacy of the chemical quality of drinking-water relies on comparison of the results of water quality analysis with the corresponding parametric values of the latest Tanzania Standard, in this case the Drinking (potable) water ( latest TZS 789: 2008) specification. On the other hand, the microbiological quality requirement for drinking-water is that it should not contain any organisms of faecal origin and this compliance should always be met whenever monitoring is done.

The understanding of the Standard, Drinking (potable) water (latest TZS 789: 2008) specification is that, just like all other standards for drinking water quality, it provides parametric values for all chemical contaminants than will actually affect any particular water supply.

Therefore, judicious choices for contaminants to be monitored in any given water supply should be made prior to initiating an analytical chemical assessment. The water quality monitoring program should therefore select and focus on clearly set number of parameters. Based on this, contaminants to be monitored are primarily selected based on legislation, regulation(s), WHO Guidelines for Drinking Water Quality – 4<sup>th</sup> Edition (2011) and /or standards of Tanzania related to drinking water quality monitoring. The limits for water quality parameters to be monitored are as shown on Appendix 2.

Accordingly, water quality parameters to be monitored are split into two parts namely, Check Monitoring parameters and Audit Monitoring parameters.

### **2.1 Check Monitoring Parameters**

The purpose of Check monitoring is to regularly provide information on the overall performance of the drinking-water supply chain and safety of drinking-water supply to consumers as to whether it complies with the relevant parametric values laid down in the latest Tanzania Standard (TZS 789: 2008) for Drinking (potable) Water specification (Appendix 1).

The selection of the parameters that constitute the ‘Check’ monitoring should be made based on the latest Tanzania Standards, TZS 789: 2008..

Parameters constituting Check Monitoring are the following:

- i. Ammonium
- ii. Arsenic (Note 1)
- iii. Colour
- iv. Conductivity
- v. Faecal Coliform bacteria
- vi. Fluoride (Note 4)
- vii. Iron (Note 2)
- viii. Lead (Note 1)
- ix. Mercury (Note 1)
- x. Nitrite (Note 3)
- xi. Odour
- xii. pH
- xiii. Residual Chlorine (Note 3)
- xiv. Taste
- xv. Turbidity

#### **Notes**

- Note 1: Necessary only if the water originates from mining areas
- Note 2: Necessary only when used as flocculant
- Note 3: Necessary only when chlorination or chloramination is used as a disinfectant.
- Note 4: Necessary only in urban centres located in the Rift valley and other areas where water is suspected of having high fluoride levels

## **2.2 Audit Monitoring**

The purpose of audit monitoring is to provide information necessary to determine whether or not all the parametric values specified in the latest Tanzania Standard (TZS 789:2008 (Appendix 1) are complied with unless it can be established otherwise, that a parameter is not likely to be present in a given drinking-water supply in concentrations which could lead to the risk of a breach of the relevant parametric value. This will be the sole criteria for the selection of parameters for audit monitoring from the list of parameters for microbiology and physicochemical as shall be contained in the latest Tanzania Standard for Drinking (potable) Water (TZS 789: 2008) specification. Parameters constituting Audit Monitoring are as shown on Table 1.

EWURA or its delegated Agency will carry out audit monitoring as external auditors and water utilities will conduct audit monitoring as internal auditors.



**Table 1: Physicochemical, Microbiological parameters and Radioactive Materials**

<b><u>Impact of a Group of Parameters</u></b>	<b>Parameter</b>		
Toxic	1. Lead (Pb)	4. Chromium (6+) (Cr)	7. Barium (Ba)
	2. Arsenic (As)	5. Cyanide (CN)	8. Mercury (Hg)
	3. Selenium (Se)	6. Cadmium (Cd)	9. Silver Ag
Affecting Human Health	1. Fluoride (F)	2. Nitrate (NO <sub>3</sub> )	
Organoleptic	1. Colour	3. Taste	
	2. Turbidity	4. Odour	
Salinity and Hardness	1. pH	5. Magnesium (Mg)	
	2. Total Filterable Residue	6. Magnesium + Sodium SO <sub>4</sub>	
	3. Total Hardness (CaCO <sub>3</sub> )	7. Sulphate (SO <sub>4</sub> )	
	4. Calcium (Ca)	8. Chloride (Cl)	
Less Toxic Metals	1. Iron (Fe)	3. Copper (Cu)	
	2. Manganese (Mn)	4. Zinc (Zn)	
Organic Pollution of Natural Origin	1. BOD (5 days at 30°C)	3. Cadmium	5. Total Nitrogen (Excluding NO <sub>3</sub> )
	2. PV (Oxygen abs KMN04)	4. Ammonium, (NH <sub>3</sub> + NH <sub>4</sub> )	
Organic Pollution Introduced artificially	1. Surfactants (Alkyl Benzyl Sulphonates)	2. Organic Matter (as carbon in Chloroform extract)	3. Phenolic Substances (As Phenol)

**Microbiological Parameters:**

Faecal Coliform

Total Coliform

**Radioactive Materials:**

Gross alpha activity

Gross beta activity

### 3. Allocation of Sample Numbers and Sampling Frequency

#### 3.1 General

The objective of water sampling program within the scope of water quality monitoring program is for regulation and process control of the entire water supply chain. Whereas regulation is in terms of verification of compliance to set standards, process control is for the purpose of operational quality control.

Allocation of sample numbers and sampling frequency to be followed in any drinking (potable) water quality monitoring program should comply with the minimum requirements of the latest Tanzania Standard for Drinking (potable) Water (TZS 789)-specification. Currently, the latest standard being followed is Tanzania Standard for Drinking (potable) Water, TZS 789:2008. The relevant clauses of the Standard that specifies sample numbers and sampling frequency are the following:

**Clause 5.4.4.2:** Frequency of sampling: Irrespective of the size of the population, all types of water should be tested **at least two times per year – once under dry conditions and once under rainy conditions.**

**Clause 6(b):** Frequency of sampling should be based on:

- i. size of the population served,
- ii. risk of pollution i.e. distance from and nature of pollution source, and
- iii. nature and extent of sanitary protection of the source.

**Clause 6(d):** The minimum number of samples to be taken from a distribution system is calculated at **the rate of one sample per 5000 population** in addition to the intake or source.

The proposed guidelines are inclusive of the minimum requirements of the legislation, regulations and standards related to drinking water quality monitoring.

#### 3.2 Microbiology

The allocation of microbiological sample numbers and frequency of sampling is based on the total population served.

Table 2 shows recommended minimum sample numbers and sampling frequency for faecal indicator testing in water distribution systems. The basis for the allocation of sample numbers and the frequency of sampling is based on the existing Tanzania

Standard for Drinking (potable) Water, TZS 789:2008. The Guideline emphasizes that, Table 3 refers to those water supplies, which on previous examination showed total absence of faecal coliform. If the result of bacteriological examination indicates faecal pollution, the water supply in question should be re-examined within a fortnight, at the latest, irrespective of the type of source or population served.

**Table 2: Recommended Minimum Sample Numbers and Sampling Frequency for Faecal Indicator Testing in Water Distribution System**

<b>Population served</b>	<b>Check monitoring</b> Minimum number of samples per year (wet and dry season)	<b>Audit monitoring</b> Minimum number of samples per year (wet and dry season)
< 5000	12 (1 sample per month)	2 (i.e. one sample for each of the seasons wet and dry respectively)
≥ 5000	12 per 5000 population ( <i>i.e. 1 sample per 5000 population per month</i> )	2 per 5000 population ( <i>i.e. 1 sample per 5000 population per 6 months</i> )

### 3.3 Physicochemical

The recommended minimum sample numbers and frequency of sampling for physicochemical tests shown in Table 3 are based on the total population served as prescribed by the current Tanzania Standard for Drinking (potable) Water, TZS 789:2008.

**Table 3: Recommended Minimum Sample Numbers and Sampling Frequency for Physicochemical Testing in Water Distribution System**

<b>Population served</b>	<b>Check monitoring</b> Minimum number of samples per year (wet and dry season)	<b>Audit monitoring</b> Minimum number of samples per year (wet and dry season)
< 5000	12 (1 sample per month)	2 (i.e. one sample for each of the seasons wet and dry respectively)
≥5000	12 per 5000 population ( <i>i.e. 1 sample per 5000 population per month</i> )	2 per 5000 population ( <i>i.e. 1 sample per 5000 population per 6 months</i> )

## 4. Selection of Sample Sites and Frequencies

The number and location of sampling sites should be:

- i. representative of each different water source entering the system, and
- ii. representative of conditions within the system, such as dead ends, loops, storage facilities and pressure zones.

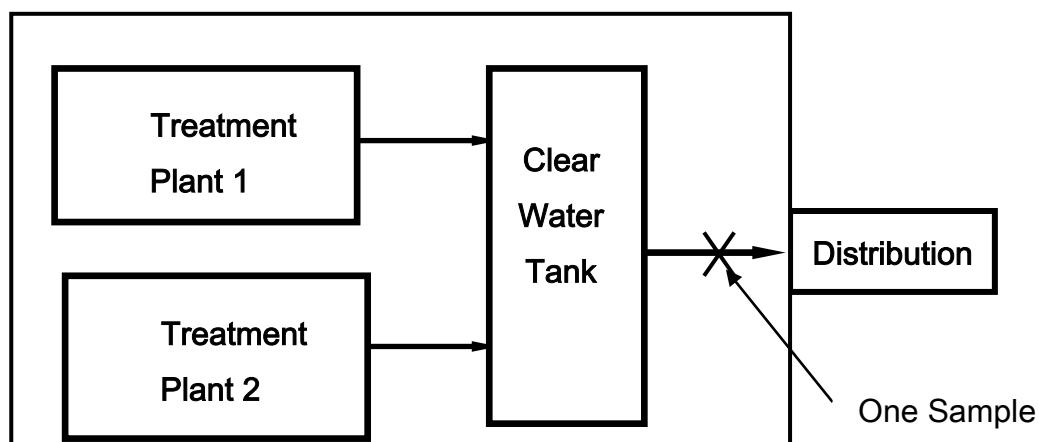
Identification of the sampling points within the distribution system will be carried out by the Water Utility and verified by EWURA. However, general guidelines for selection are the following (*Adopted from Handbook for Sampling and Sample Preservation of Water and Wastewater – (EPA – 600/4-82-029)*);

- i. distribute the Sampling points uniformly throughout the system,
- ii. locate the sample points in both types of distribution system configurations which are loops and branches and also in proportion to the relative number of loops and branches,
- iii. locate adequate representative sample points within each zone if there is more than one pressure zone,
- iv. locate points so that water coming from storage tanks can be sampled, and sample during time of high-demand,
- v. for systems having more than one water source, locate the sample points in relative proportion to the number of people served by each source, and
- vi. check pressures during the proposed sampling times so that the source of sampled water can be determined. It is possible that excessive demand in one part of the distribution system can cause water to be brought into that area from other parts of the system and perhaps other sources.

### 4.1 Selection of Sampling Sites in a Drinking Water Distribution System

#### 4.1.1 Distribution System Type 1a: One Source to Distribution System

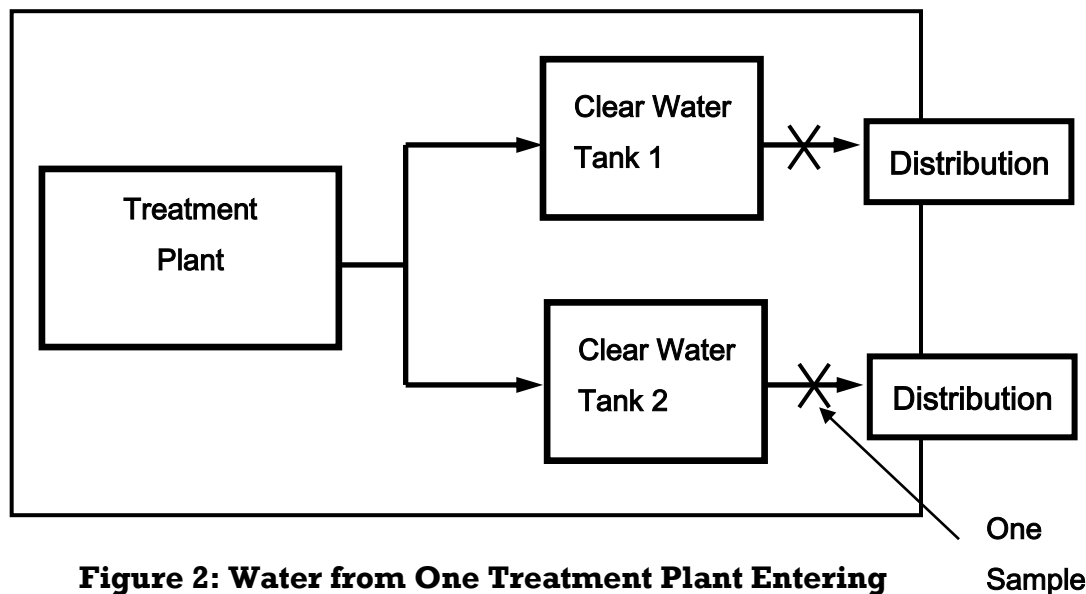
Figure 1 demonstrates one source, in this case the clear water tank effluent, entering the distribution system. Only one sampling location is needed.



**Figure 1: One Source Entering Distribution**

**4.1.2 Distribution System Type 1b: One Source to Distribution System**

Figure 2 demonstrates one source, in this case a treatment plant effluent, entering the distribution system through two clear water tanks. Only one sampling location is needed.



**Figure 2: Water from One Treatment Plant Entering Two Clear Water Tanks**

### **4.1.3 Distribution System Type 2: Branch Distribution System**

#### ***Conditions within the System***

Figure 3 demonstrates determination of representative sampling locations in a branch, dead-end or tree distribution system. Sampling location A is for the entry into the distribution, location B representative of the water in the main line, location C is representative of water in the main dead end, and location D and E are representative of the water in the branch and branch dead end, respectively. Turbidity and trihalomethanes (residual chlorine i.e. for chlorinated water) are sampled at point A whereas all other parameters as required for Check Monitoring or Audit monitoring are sampled at point B through E. The frequency of both microbiological and physicochemical sampling is proportioned to the population served.

For a population of say 10000, the required minimum number of samples per month is two for microbiological and physicochemical parameters respectively (refer Table 2 and 3). Thus the two microbiological samples could be taken at the same time from any of the designated sampling points B, C, D and E. However, representative sampling means representative in time and location.

Therefore, in the case of say Check Monitoring, for a minimum number of two samples per month, the sampling should occur at points B and E at the beginning of the month and for the month that follows next, the sampling should take place at points C and D. The same applies for physicochemical samples. Do not sample from the same site every time.

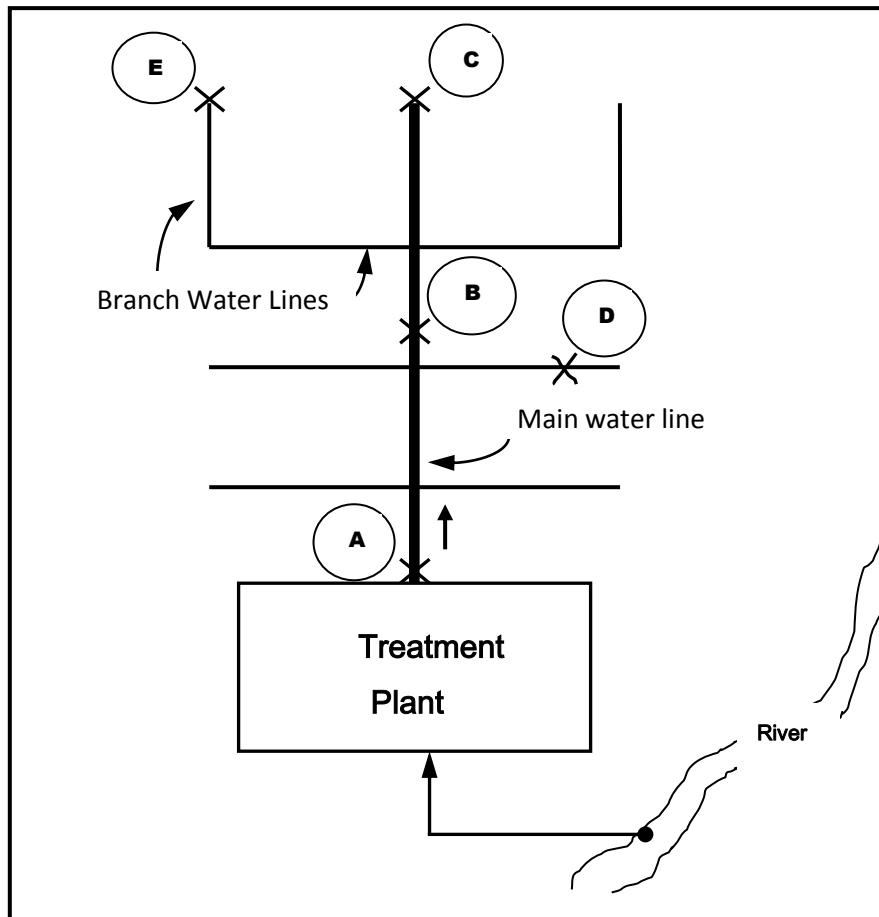
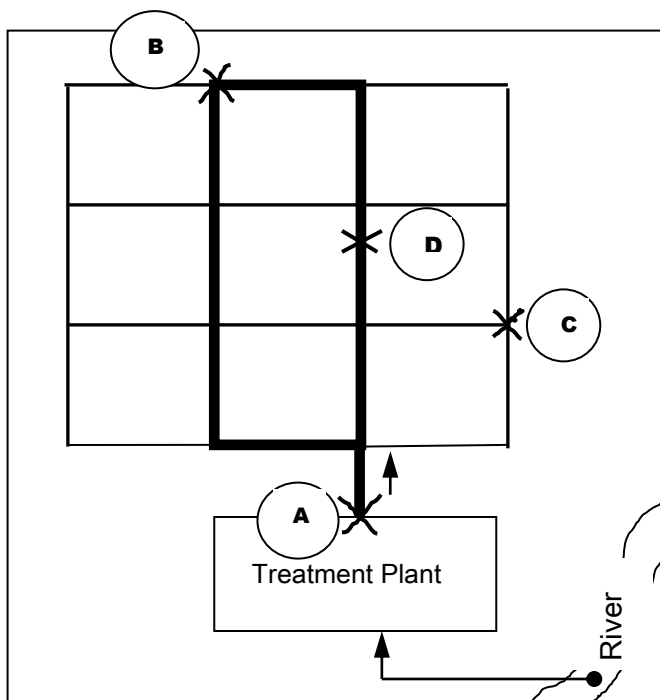


Figure 3: Branch Distribution System

#### 4.1.4 Distribution System Type 3: Loop Distribution System

##### *Conditions within the System*

Figure 4 demonstrates sampling locations for a Loop distribution system. Sampling location A represents water entering into the distribution whereas locations D and B represent water in the main line loop and location C represents water in one of the branch line loops.



**Figure 4: Loop Distribution System**

#### 4.1.5 Distribution System Type 4: Combined Branch and Loop the Systems

Table 4 shows the evaluation of sampling locations (Figure 5) for a water distribution system consisting of a combined Branch and Loop system. A demonstration of an evaluation for designating sampling locations is shown on Table 4 below



**Table 4: Evaluation of Sampling Locations**

<b>Sampling location:</b>	<b>Evaluation of Sampling Locations</b>
A	Unacceptable. Location not on the distribution system nor at its entry. Location to be maintained for operational monitoring only.
B	Acceptable. Location on main loop in high-pressure zone; should produce representative samples for that part of the system.
C	Acceptable. Location on branch loop in the high-pressure zone; serves for water flow from the storage to the system.
D	Judgemental. Many authorities advise against dead end sampling points as they do not produce representative samples. Possibly true; however, consumers do take water from branch-line dead ends. In this example there are seven branch-line dead ends, no doubt serving significant number of customers. It would be representative to have one or two sample points on these branch-lines at or near the end.
E	Acceptable. Located on the main loop of low pressure zone and representing water from treatment plant No. 2, the well, the storage tanks at F, or any combination (depending on system demand at sampling time)
F	Judgemental. Although important to sample water quality entering the water distribution system from storage, it is better to collect the sample at junction of stored water line and main loop (point F), unless consumers are served directly from storage branch.
G	Judgemental. Only one dead end need be sampled in low-pressure system. If D is selected, G not needed.

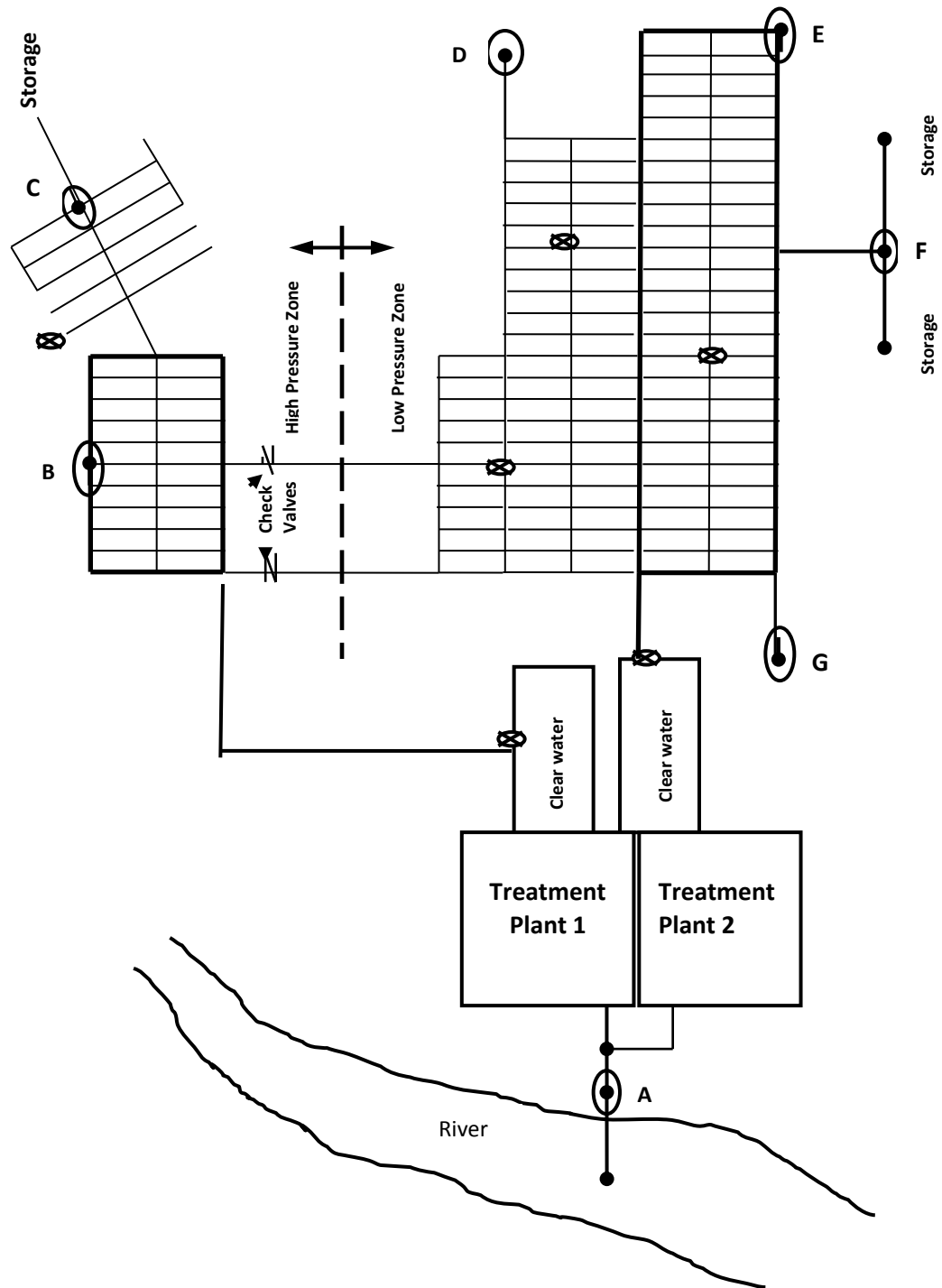


Figure 5: Combined Branch and Loop System

## 5. Test Methods, Preservation and Handling

The water sample test methods, preservation and handling may be carried out according to the following standards or any other International Standard.

- i. TZS 574:2002 Part 1 – *Method of test for the quality of drinking water – Part 1 Physical methods of test for the quality in drinking water.*
- ii. TZS 574:2002 Part 2 – *Method of test for the quality of drinking water Part 2 – Methods for biological and microbiological test for drinking water.*
- iii. TZS 574:2002 Part 3 – *Method of test for the quality of drinking water Part 3 - Methods for determining metal contaminants in drinking water.*
- iv. TZS 564: 1997 (Part 2) – *Methods of sampling water quality – Part 2 – Guidance on sampling techniques.*
- v. TZS 574:2002 Part 5 – *Method of test for the quality of drinking water Part 5 – Gases, organic compounds and radioactive tests for drinking water.*

## 6. Reporting

The essence of water quality monitoring is to detect faults of non-compliance in drinking water, and when detected, to react by solving the problem. It is obvious that proper information should be available at agreed reporting frequency.

The Water Supply and Sanitation Authorities (WSSAs) are required to report to EWURA monthly and quarterly for the conduct of Check monitoring (see Section 2.1) and annually for the internal Audit monitoring (see Section 2.2). EWURA or its delegated agency will also conduct water quality monitoring as an external auditor. The contents of reporting are shown in Appendix 3 and 4. The reporting by the WSSAs should be accompanied by a good layout of a water distribution system diagram showing and naming designated sampling locations as demonstrated in examples 1 – 5 (see Section 5.1).

The role of EWURA, among other things, is to ensure that water distributed by utilities complies to the Tanzania Standard and to report publicly on drinking water quality performance of WSSAs'. Such reporting ensures a high level of transparency and public accountability. This is done annually through published reports. The Annual Performance Review Reports produced are usually made available to consumers and stakeholders. The reports summarize drinking water quality performance over the preceding year against parametric standard values and regulatory requirements. The report includes targets for water services quality,

performance against targets, and interventions undertaken to improve water services during the reporting period.

However in case an occasional water quality monitoring detects faults of non-compliance of a parameter with respect to parametric standard value or a risk of such non-compliance is in premises where water is supplied for human consumption the water utility shall ensure that;

- i. appropriate measures are taken to reduce or eliminate the risk of non-compliance with the parametric value, including advising premises' owners affected of any possible remedial action which could be taken by them, or
- ii. other measures are taken, such as application of appropriate treatment techniques, to change the nature or properties of the water before it is supplied so as to reduce or eliminate the risk of the water not complying with the parametric value after supply, and
- iii. the consumers concerned are duly informed and advised of any possible additional remedial action that should be taken by them.

## **7. Wastewater Effluent Quality Discharges**

The wastewater effluent quality discharges should comply with the latest Tanzania Standard, TZS 860:2006, Limits for Municipal and Industrial Wastewaters. The purpose of the standard is to indicate the quality of effluents permitted to be discharged into water bodies. The use thereof is meant to promote a consistent approach towards prevention of water pollution in Tanzania. The standard prescribes the permissible limits for municipal and industrial effluents discharged directly into water bodies (i.e. receiving water bodies).

### **7.1 Check Monitoring**

The selection of parameters that constitute the Check Monitoring is to be made on the basis of the latest TZS 860:2006. The parameters proposed for regular Check Monitoring by the WSSAs are:

- i. Ammonium
- ii. Biological Oxygen Demand (BOD),
- iii. Chemical Oxygen Demand (COD),
- iv. Color,
- v. Faecal Coliform
- vi. Nitrate
- vii. pH,
- viii. Phosphorus
- ix. Total Coliform
- x. Total Suspended Solids (TSS)

The above list of parameters subjected to regular monitoring could be expanded to take into account the nature of quality of wastewater collected from industrial, commercial and residential establishments by the sewerage network or brought to the wastewater treatment plants by wastewater tankers. Chemical parameters could be added to the list for Check Monitoring in consultation with EWURA and NEMC.

### **7.2 Audit Monitoring**

The Audit Monitoring is to provide information necessary to determine whether or not all the parametric values specified in the latest TZS 860:2006 Limits for Municipal and Industrial Wastewaters of this Guideline are being complied with.

The selection of parameters that constitute the Audit Monitoring is to be made on the basis of the latest TZS 860:2006. All such parameters must be subjected to audit monitoring unless it can be established that the nature of wastewater coming from the sewerage area are not expected to contain some of the parameters to be excluded

EWURA or its outsourced Agency will carry out monitoring as external auditor and WSSAs will conduct monitoring as internal auditors.

### **7.3 Sampling Locations and Sampling Frequency**

Since the effluent standards apply to municipal and industrial effluents discharged directly into water bodies, it implies that sampling locations should be points at which the effluent leaves the wastewater treatment plants just before it enters the receiving water bodies. However, since the TZS 860:2006 Limits for Municipal and Industrial Wastewaters is silent on the frequency of sampling, this Guideline proposes that sampling frequency should be monthly and quarterly for Check Monitoring and annually for Audit Monitoring.

### **7.4 Sampling and Test Methods**

Monitoring should be done by sampling in accordance with TZS 861 (Part 10):2006 – Sampling methods or ISO standard or any other International Standard. Test methods for TZS 861 (Part 10):2006 have been identified corresponding to parameters to be analyzed.

### **7.5 Reporting**

The Water Supply and Sanitation Authorities (WSSAs) are required to report to EWURA similar to the reporting schedules for drinking-water, i.e. on monthly or quarterly for the conduct of check monitoring and annually for the internal audit monitoring. EWURA or its delegated agency will conduct wastewater quality monitoring as external auditor using expanded list of parameters. The contents of reporting are shown in Appendix 3.

## Appendix 1a: Chemical and Physical Limits for Quality of Drinking Water Supplies ( TZS 789:2008).

Impact of Group of Parameters	Substance	Unit	Lower limit	Upper Limit
Toxic	1. Lead (Pb)	mg/L	-	0.1
	2. Arsenic (As)	mg/L	-	0.05
	3. Selenium (Se)	mg/L	-	0.05
	4. Chromium (6+) (Cr)	mg/L	-	0.05
	5. Cyanide (CN)	mg/L	-	0.20
	6. Cadmium (Cd)	mg/L	-	0.05
	7. Barium (Ba)	mg/L	-	1.0
	8. Mercury (Hg)	mg/L	-	0.001
	9. Silver Ag	mg/L	-	n.m
Affecting Human Health	1. Fluoride (F)	mg/L	-	4.0
	2. Nitrate (NO <sub>3</sub> <sup>-</sup> )	mg/L	10.0	75.0
Organoleptic	1. Colour	TCU	1.5	50
	2. Turbidity	NTU	5	25
	3. Taste	-	n.o	-
	4. Odour	-	n.o	-
Salinity and Hardness	1. pH		6.5	9.2
	2. Total Filterable Residue	mg/L	500	2000
	3. Total Hardness (CaCO <sub>3</sub> )	mg/L	500	600
	4. Calcium (Ca)	mg/L	75	300
	5. Magnesium (Mg)	mg/L	50	100
	6. Magnesium + Sodium SO <sub>4</sub>	mg/L	500	1000
	7. Sulphate (SO <sub>4</sub> )	mg/L	200	600
	8. Chloride (Cl)	mg/L	200	800
Less Toxic Metals	1. Iron (Fe)	mg/L	-	1.0
	2. Manganese (Mn)	mg/L	-	0.5
	3. Copper (Cu)	mg/L	-	3.0
	4. Zinc (Zn)	mg/L	-	15.0
Organic	1. BOD (5 days at 30°C)	mg/L	-	6.0

Impact of Group of Parameters	Substance	Unit	Lower limit	Upper Limit
Pollution of Natural Origin	2. PV (Oxygen abs KMN04)	mg/L	-	20
	3. Cadmium	mg/L	-	2.0
	4. Ammonium, (NH <sub>3</sub> + NH <sub>4</sub> )	mg/L	-	1.0
	5. Total Nitrogen (Excluding NO <sub>3</sub> )	mg/L	n.m	n.m
Organic Pollution Introduced Artificially	1. Surfactants (Alkly Benzyl Sulphonates)	mg/L	-	2.0
	2. Organic Matter (as carbon in Chloroform extract)	mg/L	-	0.5
	3. Phenolic Substances (As Phenol)	mg/L	-	0.002

n.o: Not Objectionable

n.m: Not Mentioned

### Appendix 1b: Microbiological Limits for Quality of Drinking Water Supplies (for Microbiological requirement and classification of non-chlorinated piped water supplies) (TZS 789:2008)

Class of Piped Water/Type of Test Count	Coliform count per 100 ml at 37°C	E. Coli (faecal Coliform) Count per 100 ml at 44°C
Excellent	0	0
Satisfactory	1 – 3	0
Suspicious	4 -10	0
Unsatisfactory	More than 10	1 2 or more

For each individual sample coliform should be estimated in terms of the “Most Probable Number” in 100 ml of drinking water, which is often designated as MPN index or Coli index.

### Appendix 1c: Radioactive Materials Limits for Quality of Drinking Water Supplies (TZS 789:2008).

Material	Limit
Gross alpha activity	0.1 Bq/l
Gross beta activity	0.1 Bq/l



## Appendix 2: Permissible Limits for Municipal and Industrial Wastewaters (TZS 860:2006).

**Table 2a: Physical Components**

Parameter	Limit	Test Method
BOD <sub>5</sub> at 20 °C	30 mg/L	EMDC1 1173: Part 3 ± Five-day BOD Method
COD	60 mg/L	EMDC1 1173: Part 4 ± Dichromate Digestion Method
Color	300 TCU	ISO 7887: 1994, Water quality ± Examination and determination of color ± Section 3: Determination of true color using optical instruments
pH range	6.5-8.5	EMDC1 1173: Part 2 ± Electrometric Method
Temperature range	20-35°C	See Annex A
Total Suspended Solids	100 mg/L	EMDC1 1173: Part 1 ± Gravimetric Method
Turbidity	300 NTU	APHA Standard Methods:2130 B. Nephelometric Method

**Table 2b: Inorganic Components**

Parameter	Limit	Test Method
Aluminium (as Al)	2.0	EMDC1 1173: Part 7 ± Direct Nitrous Oxide-Acetylene Flame Atomic Absorption
Arsenic (As)	0.2	EMDC1 1173: Part 8 ± Manual hydride Generation-Atomic Absorption Spectrometry
Barium (Ba)	1.5	EMDC1 1173: Part 7 ± Direct Nitrous Oxide-Acetylene Flame Atomic Absorption
Cadmium (Cd)	0.1	EMDC1 1173: Part 7 ± Flame Atomic Absorption Spectrometry
Chromium (total)	1.0	EMDC1 1173: Part 7 ± Flame Atomic Absorption Spectrometry
Chromium VI	0.1	EMDC1 1173: Part 9 ± Colorimetric Method
Chlorides (Cl <sup>-</sup> )	200	APHA Standard Methods: 4110 B. Ion Chromatography with Chemical Suppression of Eluant Conductivity
Cobalt (Co)	1.0	EMDC1 1173: Part 7 ± Flame Atomic Absorption Spectrometry
Copper (Cu)	2.0	EMDC1 1173: Part 7 - Flame Atomic Absorption Spectrometry

<b>Parameter</b>	<b>Limit</b>	<b>Test Method</b>
Fluorides (F <sup>-</sup> )	8	APHA Standard Methods: 4110 B. Ion Chromatography with Chemical Suppression
Iron	5.0	EMDC1 1173: Part 7 ± Flame Atomic Absorption Spectrometry
Lead (Pb)	0.1	EMDC1 1173: Part 7 ± Flame Atomic Absorption Spectrometry
Manganese	5.0	EMDC1 1173: Part 7 ± Flame Atomic Absorption Spectrometry
Mercury (Hg)	0.005	EMDC1 1173: Part 10 ± Cold-Vapor Atomic
Nickel (Ni)	0.5	EMDC1 1173: Part 7 ± Flame Atomic Absorption Spectrometry
Nitrates (NO <sub>3</sub> <sup>-</sup> )	20	APHA Standard Methods: 4110 B. Ion Chromatography with Chemical Suppression
Phosphorus Total (as P)	6	EMDC1 1173: Part 6 ± Colorimetric-
Selenium (Se)	1.0	EMDC1 1173: Part 8 ± Manual hydride Generation- Atomic Absorption
Silver (Ag)	0.1	ISO 15586: 2003, Water quality ± Determination of trace elements using atomic absorption spectrometer with graphite furnace
Sulphate (SO <sub>4</sub> <sup>2-</sup> )	500	APHA Standard Methods: 4110 B. Ion Chromatography with Chemical Suppression
Sulphides (S <sup>-</sup> )	1	APHA Standard Methods: 4110 B. Ion Chromatography with Chemical Suppression of Eluant Conductivity
Tin (Sn)	2.0	EMDC1 1173: Part 7 ± Flame Atomic Absorption Spectrometry
Total Kjeldahl Nitrogen (as N)	15	EMDC1 1173: Part 5 ± Kjeldahl Method
Vanadium	1.0	ISO 15586: 2003, Water quality ± Determination of trace elements using atomic absorption spectrometer with graphite furnace
Zinc (Zn)	5.0	EMDC1 1173: Part 7 ± Flame Atomic Absorption Spectrometry

**Table 2c: Organic Components**

<b>Parameter</b>	<b>Limit (mg/L)</b>	<b>Test Method</b>
1, 1, 2 - Trichloroethane	0.06	GC ECD (ISO 10301: 1997, Water quality ± Determination of highly volatile halogenated hydrocarbons ± Gas chromatographic methods.)
1,1,1 - Trichloroethane	3.0	GC ECD (ISO 10301: 1997, Water quality ± Determination of highly volatile halogenated hydrocarbons ± Gas chromatographic methods.)
1,2 - Dichloroethylene	0.2	GC ECD (ISO 10301: 1997, Water quality ± Determination of highly volatile halogenated hydrocarbons ± Gas chromatographic methods.)
1,2 - Dichloroethane	0.04	GC ECD (ISO 10301: 1997, Water quality ± Determination of highly volatile halogenated hydrocarbons ± Gas chromatographic methods.)
1,3 - Dichloropropene	0.2	GC ECD (ISO 10301: 1997, Water quality ± Determination of highly volatile halogenated hydrocarbons ± Gas chromatographic methods.)
Alkyl benzene sulfonate (ABS)	0.5	ISO 7875 ± 1: 1996, Determination of surfactants ± Pat 1: Determination of anionic surfactants by measurement of the methylene blue index (MBAS)
Aromatic nitrogen containing compounds (e.g., aromatic amines)	0.001	APHA Standard Methods 6410: Liquid-liquid extraction GC/MS method
<i>cis</i> -1, 2 - Dichloroethylene	0.4	GC ECD (ISO 10301: 1997, Water quality ± Determination of highly volatile halogenated hydrocarbons ± Gas chromatographic methods.)
Dichloromethane	0.2	GC ECD (ISO 10301: 1997, Water quality ± Determination of highly volatile halogenated hydrocarbons ± Gas chromatographic methods.)
Oil and Grease (fatty maters and hydrocarbons)	10	APHA Standard methods 5520

<b>Parameter</b>	<b>Limit (mg/L)</b>	<b>Test Method</b>
Organochlorine pesticides (Cl)	0.0005	GC ECD (ISO 6468: 1996, Water quality ± Determination of certain organochlorine insecticides, polychlorinated biphenyls and chlorobenzenes ± Gas Chromatographic method after Liquid-Liquid extraction)
Other aromatic and/or Aliphatic hydrocarbons not used as pesticides	0.05	GC ECD (ISO 6468: 1996, Water quality ± Determination of certain organochlorine insecticides, polychlorinated biphenyls and chlorobenzenes ± Gas Chromatographic method after Liquid-Liquid extraction)
Pesticides other than organochlorines	0.01	GC ECD (ISO 6468: 1996, Water quality ± Determination of certain organochlorine insecticides, polychlorinated biphenyls and chlorobenzenes ± Gas Chromatographic method after Liquid-Liquid extraction)
Phenols	0.002	GC ECD (ISO 6468: 1996, Water quality ± Determination of certain organochlorine insecticides, polychlorinated biphenyls and chlorobenzenes ± Gas Chromatographic method after Liquid-Liquid extraction)
Tetrachloroethylene	0.1	GC ECD (ISO 10301: 1997, Water quality ± Determination of highly volatile halogenated hydrocarbons ± Gas chromatographic methods.)
Tetrachloromethane	0.02	GC ECD (ISO 10301: 1997, Water quality ± Determination of highly volatile halogenated hydrocarbons ± Gas chromatographic methods.)
Trichloroethylene	0.3	GC ECD (ISO 10301: 1997, Water quality ± Determination of highly volatile halogenated hydrocarbons ± Gas chromatographic methods.)

**Table 2d: Microbiological Components**

<b>Parameter</b>	<b>Limit</b>	<b>Test Method</b>
Total Coliform Organisms	10,000counts/100mL	ISO 6222:1999, Microbiological methods

## Appendix 3 Summary of Water Quality Distribution System Performance Report – Check Monitoring

Identity of Sample Location	Test parameter	Population served	Frequency (number of samples per year (refer Table 2&3))	Total number of samples planned in a year (Based on total population served-(refer Table 2&3))	Number of tests conducted in a quarter of a year	Number of tests in compliance with Tanzanian standard limits	Cause of non-compliance	Mitigation/corrective action taken (+ indicate time frame to completion)
	Ammonium							
	Arsenic (Note 1)							
	Colour							
	Conductivity							
	Feacal Coliform bacteria							
	Fluoride (Note 4)							
	Iron (Note 2)							
	Lead (Note 1)							
	Mercury (Note 1)							
	Nitrite (Note 3)							
	Odour							
	pH							
	Residual Chlorine (Note 3)							
	Taste							
	Turbidity							
	Total							

Note1 :Necessary only if water originates from mining areas

Note 2: :Necessary only when used as flocculant

Note 3: :Necessary only when chlorination or chloramination is used as a disinfectant

Note 4: :Necessary only in urban centres located in the Rift valley and other areas :where water is suspected of having high fluoride levels

<b>Sampling Schedule Network No .....</b>						
<b>Type of water distribution system</b>						
	<b>One Source Entering Distribution System</b>	<b>Water from One Treatment Plant Entering two Clear water tanks</b>	<b>Branch Distribution System</b>	<b>Loop Distribution System</b>	<b>Combined Branch and Loop System</b>	<b>Other (Describe)</b>
<b>Describe/Tick( <input checked="" type="checkbox"/> the applicable drinking-water system</b>						

**Designated Sampling Location: Monthly Sampling Schedule for Water Quality**

Identity of Sample Location	Month and Date	Month.....																																												
	Parameter	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31														
	Ammonium																																													
	Arsenic (Note 1)																																													
	Colour																																													
	Conductivity																																													
	Faecal Coliform Bacteria																																													
	Fluoride (Note 4)																																													
	Iron (Note 2)																																													
	Lead (Note 1)																																													
	Mercury (Note 1)																																													
	Nitrite (Note 3)																																													
	Odour																																													
	pH																																													
	Residual Chlorine (Note 3)																																													
	Taste																																													
	Turbidity																																													

Note 1 :Necessary only if water originates from mining areas

Note 2: :Necessary only when used as flocculant

Note 3: :Necessary only when chlorination or chloramination is used as a disinfectant

Note 4: :Necessary only in urban centres located in the Rift valley and other areas :where water is suspected of having high fluoride levels

## Appendix 4: Summary of Wastewater Quality Performance Report – Check Monitoring

Identity of Sample Location	Test parameter	Frequency (number of samples per year)	Total number of samples planned in a year	Number of tests conducted in a quarter of a year	Number of tests in compliance with Tanzanian standard limits	Cause of non-compliance	Mitigation /corrective action taken (+ indicate time frame to completion)
	Ammonium						
	Biological Oxygen Demand (BOD)						
	Chemical Oxygen Demand (COD)						
	Color						
	Faecal Coliform						
	Nitrate						
	pH						
	Phosphorus						
	Total Coliform						
	Total Suspended Solids (TSS)						

Note: The above list of parameters subjected to regular monitoring could be expanded to take into account of the nature of quality of wastewater



**Designated Sampling Location: *Monthly Sampling Schedule for Wastewater Quality***

Identity of Sample Location	Month and Date	January																															
	Parameter	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
	Ammonium																																
	Biological Oxygen Demand (BOD)																																
	Chemical Oxygen Demand (COD)																																
	Color																																
	Faecal Coliform																																
	Nitrate																																
	pH																																
	Phosphorus																																
	Total Coliform																																
	Total Suspended Solids (TSS)																																

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