



# NZOIA WATER SERVICES COMPANY LIMITED

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## Water Disinfection Experiment design Report

The investigative design was carried out at the Nzoia water and services Co ltd Regional laboratory situated at the Matisi Water Works funded by Kevin Mclean the president of Sun24 solar. This experimental design was done in two parts boiling contaminated water and mixing back with the raw contaminated water and reexamining for contamination, denying contaminated water access to light and institute follow up screens for contamination.

### Abstract

Over one billion people boil their water for disinfection, with the ever reducing forest covers, deliberate governments interventions to protect existing forest covers and increase afforestation has resulted in more than two Billion people in developing countries not to treat their water at all since they rely on forest for wood fuel exposing them to great risk of water borne diseases that consumes a lot of available resources creating a vicious poverty cycle.

There is 29% access to clean piped water in Kenyan rural settings and 46% access in urban centers, this is worsening each passing day by twinkling water availability due to population pressure destroying both riparian land and catchment areas, farming and settlement deep into riparian land has destroyed the buffer zone that used to filter most dirt into the rivers leading contamination of the available traditional water points that have primarily been used.

### Justification

This creates the need for more innovating ways of combating the disease burden by using the less expensive yet efficient methods of water disinfection that goes along way into conserving our available forest cover restoring the mother nature of environment, Kevin Mclean the president of Sun24 proposed and funded two procedures at the Nzoia Water and services Co ltd of Boiling contaminated water and mixing back with the raw contaminated



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water and reexamining for contamination, denying contaminated water access to light and institute follow up screens for contamination.

## Methodology

### B

On 4<sup>th</sup> October 2019 Water was sampled in a sterile black plastic container and taken to the laboratory for testing from Kipsongo River in the outcast of Kitale Town an agricultural town in northern Rift valley Kenya situated between Mount Elgon and the Cheringany Hills at an elevation of around 1,900 meters (6,200ft), its population is 106,187 as of 2009, Kitale is the headquarter town of trans-Nzoia county.



In the laboratory 10 mls of the water was drawn into 25 mls sterile bottles, Pathoscreen media added and incubated for screening presence of indicator Microorganisms.

Another 100 ml of the same water filters through the total, fecal coliform and E Coli membrane filtrate and too incubated

The water was covered with a blanket and placed in a dark wall cabinet, after 24 hours (5<sup>th</sup> October 2019), the sample water was withdrawn from the cabinet and samples drawn for testing in a procedure above, the test was repeated five times the last one done on 9<sup>th</sup> October 2019 The photo taken when the cabinet is open, on closing it becomes dark all over,



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## A

On 9<sup>th</sup> October 2019 Water was drawn from River Webuye in Webuye town which has an elevation of 1,523 metres (4,887ft) and has a population of 22, 507 according to the GeoNames geographical data base, the sample was obtained using sterile two 5 liter plastic container, taken to the laboratory for testing while closed.



3 litres of water drawn to an ordinary Sufuria using the 1,000 ml sterile plastic beakers and boiled, water boiled at 94<sup>0</sup> C.





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In the first Test 2.5 L of the boiling water was drawn using sterile 1,000 ml beaker measuring 1,000ml twice and 500ml ones, mixed with 2.5 litres of the confirmed contaminated water in the sampling container, closed with a heavy cardboard lid for 30 minutes monitoring the mixture temperature with a pinned thermometer for 30 minutes, there after agitated the mixture to mix thoroughly by vibration using the vortex machine and sample drawn twice, immediately after 30 minutes, cooled and 10ml drawn for screening using the Pathoscreen Presence/Absence media, 100ml of sample filtered through the Total coliform, fecal coliform and E Coli membrane filtration media, incubated for 48 hours and results recorded and after 1 hour 44 minutes for 2:2 mixture and 2 hours 19 minutes for 2:1 mixture when the water mixed had obtained the ambient water temperatures.

In the second test 2 L of boiling water was mixed with 1L of the untreated water and the procedure repeated as above both using the untreated water as the control samples

## Findings

At 0 minutes after mixing 2:1 mixture reduced temperature reading to 73C while 2:2 mixture 65C, at 27 minutes 2:1 was 63C while 2:2 was 51C, on opening the lid temperature dropped to 49C for 2:1 and 38C for 2:2, 2:1 mixture cooled to 35C after 2 hours 19 minutes and 2:2 took 1 hour 44 minute.

## B

### Screening

All the screening tests gave positive results for contamination

### Membrane filtration

The numbers below is colony forming units per 100 ml of the sample water

Days	Control	Total Coliforms	Fecal coliform	E coli
0	31	31	25	11



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1	27	33	22	09
2	27	31	17	10
3	23	29	21	10
4	24	27	18	07
5	24	27	20	07

B

Screening

Incubation Time	18	24	36	48
Control	Present	Present	Present	Present
2:2	Absent	Absent	Absent	Absent
2:1	Absent	Absent	Absent	Absent

Membrane Filtration

Incubation Time	Control	2:1	2:2
18	23	Nil	Nil
24	49	Nil	Nil
36	>100	Nil	Nil
48	>100	Nil	Nil

The scores above is in Colony forming units per 100 ml of sample water

Quality of data generated from investigation that denied exposure to light of the surface water drawn does not provide any justification for a follow up of the procedure after the 5 days of investigative design since all tests done water remained contaminated by testing positive for Total coliforms, disinfection by mixing boiling water with the contaminated one provided quality data that warrants follow up to quantify the findings for adoption and development to solve drinking contaminated water problems and safe our environment by



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less harvesting of forests and fuel release funds saved from funding medication for development since it will require less fuel to boil half of the water for disinfection.

## Conclusion.

I recommend more data be obtained on the effectiveness of water disinfection by mixing Boiling and unheated water method using wider sample pool that if proven effective be used as a better option for populations not accessible to treated water.

By accessing traditional cheaper water disinfection methods, even the less fortunate members of the public can benefit from it. Clean water will prevent the spread of waterborne diseases which are very common in tropical climates. Clean water results in improvement in standard of living of the people.

- Denied exposure to light the contaminated water is a very ineffective way of water disinfection
- Mixing equal volumes of boiled contaminated water and the raw contaminated water; 2 parts in 2 parts proved effective
- Mixing of two parts of boiled contaminated water into one part of raw contaminated water too proved disinfection effectiveness

Hillary W Simiyu

Production/Laboratory Supervisor  
Nzoia Water and Services Co Ltd



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## *Certificate of Analysis*

Serial No 9/10/2019

1. Sample Description – Raw Webuye River
2. Type of Analysis – Physio- Chemical & Bacteriological
3. Sampled by – Staff
5. Sample Point – Salvation Army Bridge
6. Nzowasco Lab Ref –9/10/2019
7. Date of Sampling – 9/10/2019
8. Date of Analysis – 9/10/2019
9. Department – Technical
10. Specification – As per KS-459-1:2007

### LABORATORY TEST RESULTS

#### SECTION 1 P/A SCREENING

Incubation Time	18	24	36	48
Control	Present	Present	Present	Present
2:2	Absent	Absent	Absent	Absent
2:1	Absent	Absent	Absent	Absent

#### SECTION 2 MEMBRANE FILTRATION



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Incubation Time	Control	2:2	2:1
18	23	Nil	Nil
24	49	Nil	Nil
36	>100	Nil	Nil
48	>100	Nil	Nil

Remarks: Disinfection effectiveness achieved

Analyzed By

Hillary W Simiyu

Production/Laboratory supervisor  
Nzoia water and services Co Ltd



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## Certificate of Analysis

Serial No 4/10/2019

1. Sample Description – Raw Kipsongo Spring
2. Type of Analysis – Bacteriological
3. Sampled by – Staff
5. Sample Point – Chetoto primary Crossway
6. Nzowasco Lab Ref –4/10/2019
7. Date of Sampling – 4/10/2019
8. Date of Analysis – 4/10/2019
9. Department – Technical
10. Specification – As per KS-459-1:2007

### LABORATORY TEST RESULTS

#### PATHOSCREEN

Days	Control	Total coliform	Fecal coliform	E coli
0	Present	Present	Present	Present
1	Present	Present	Present	Present
2	Present	Present	Present	Present
3	Present	Present	Present	Present
4	Present	Present	Present	Present
5	Present	Present	Present	Present

#### MEMBRANE FILTRATION

Days	Control	Total coliform	Fecal coliform	E coli
0	31	31	25	11
1	27	33	22	09
2	27	31	17	10



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3	23	29	21	10
4	24	27	18	07
5	24	27	20	07

Remarks: The process is insufficient for use in water disinfection

Analyzed by  
Hillary w Simiyu

Date.....

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## LABORATORY TEST RESULTS

NZOWASCO



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