E2905 V14

ATHI WATER SERVICES BOARD

# WATER AND SANITATION SERVICES IMPROVEMENT PROJECT ADDITIONAL FINANCING (WaSSIP AF)

# ENVIRONMENTAL IMPACT ASSESSMENT STUDY REPORT FOR AUGMENTATION AND REHABILITATION OF GATANGA WATER SUPPLY


**SEPTEMBER 2014**

## Report Submission Details

**CLIENT** Athi Water Services Board

**ASSIGNMENT** Augmentation and Rehabilitation of Gatanga Water Supply
**REPORT TITLE:** Environmental Impact Assessment Study Report

**REPORT PREPARED BY**

Signed: _____ Date: _____
Eunice Cherutich
Lead EIA/EA Expert NEMA Reg. Cert. No. 8025

**Client:**
Athi Water Services Board
Po Box 45283-00100
Nairobi

Eng. Malaquen Milgo
Chief Executive Officer
Athi Water Services Board
**NAIROBI**

Signed: _____ Date: _____

**Disclaimer:**
This Environmental Impact Assessment Project Report is based on literature review and findings from field assessment. It strictly confidential to Athi Water Services Board and any materials thereof should strictly be used in accordance with agreement from the management. It is however, subject to conditions in the Environmental (Impact Assessment and Audit) Regulations, 2003

## Contents

***List of Appendices***

**List of Acronyms**

| | |
|---|---|
| AWSB | Athi Water services Board |
| CLTS | Community Led Total Sanitation |
| EA | Environmental Audit |
| EIA | Environmental Impact Assessment |
| EMCA | Environmental Management and Coordination Act |
| EMP | Environmental Management Plan |
| ESIA | Environmental and Social Impact Assessment |
| GoK | Government of Kenya |
| ITCZ | Inter Tropical Convergence Zone |
| KFS | Kenya Forest Service |
| MDG | Millennium Development Goal |
| MWI | Ministry of Water and Irrigation |
| NEMA | National Environment Management Authority |
| ODF | Open Defecation Free |
| PAP | Project Affected Person |
| PPE | Personal Protective Equipment |
| RAP | Resettlement Action Plan |
| ToR | Terms of Reference |
| VCT | Voluntary Counseling and Testing |
| WASREB | Water Services Regulatory Board |
| WRMA | Water Resources Management Authority |
| WSS | Water Supply and Sanitation |
| WSB | Water Services Board |
| WSP | Water Service Provider |

# EXECUTIVE SUMMARY

## 1. Introduction

Kenya is among the countries considered to be water scarce countries in Africa. The access to clean water in the country is estimated to be at 90% in urban areas, 44% in the rural areas and overall national average stands at about 57%. To increase the access to clean water and improved sanitation provision in rural areas within its area of jurisdiction, Athi Water Services Board has identified the need to improve the water supply in Gatanga District by rehabilitating and expanding the water supply system in the district. The project will cover areas whose residents are not currently connected and will involve revitalizing the existing connections. This thereafter, is expected to address the water demand in the region, which has been on the rise due to population increase and weather variability.

Gatanga was formerly a division under the greater Thika district but recently elevated to district in 2007. It's located in Gatanga Division, former Gatanga District which comprise of Kirwara, Gichumbu, Rwegetha, Chomo, Mabae, Ngungungu, Gakurari, Ithangarari, Giatutu, Kigio, Mabanda, and Gatunyu locations. The administrative structure of Gatanga was formerly a division under the greater Thika district but recently elevated to district in 2007. The administrative structure of Gatanga District is as illustrated in the project description section.

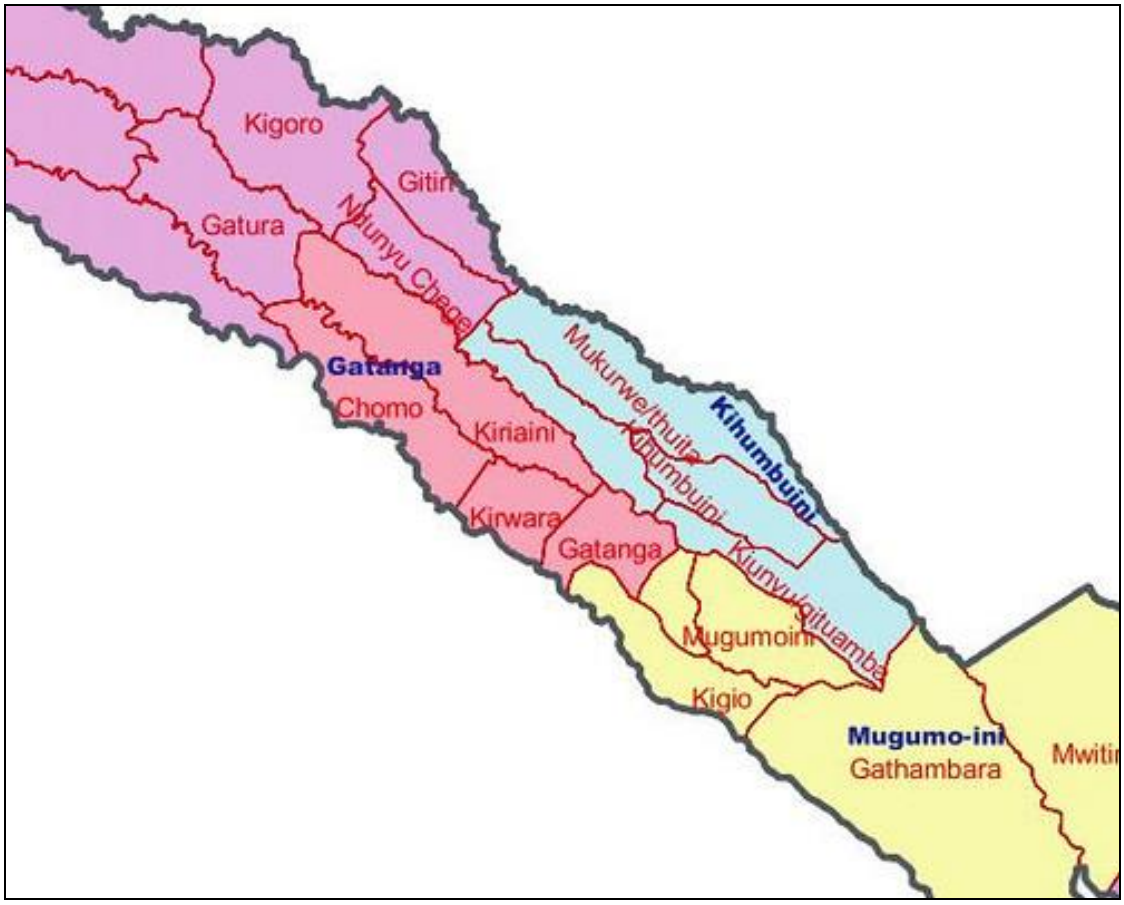


**Figure 1: Map showing administrative locations within Gatanga constituency**

## 2. Project Description

### i. Proposed interventions

**Conventional Treatment Systems**

a. Kiama 3000m3/day treatment plant at GPS coordinates S 000 48'50.244'' and E 0360 46' 57.456'' elevation 2266.26m
b. Kimakia 4000m3/day at GPS coordinates S 000 48'51.870'' and E 0360 46' 57.23'' elevation 2256.89m
c. Kiama and Kimakia 3000 m3/day combined system the treatment plant will be located 8km from from Kiama intake and 3 Km from Kimakia intake at GPS coordinates S 000 55'04.986''and E 0360 55' 48.970'' at 1797.07m elevation at a place called Rwegetha.

**Break Pressure Tanks / Storage Tanks (Ground Masonry Tanks)**

d. Gatanga Water Tank Capacity 150m$^3$ at Gatanga Catholic Mission Premises coordinates S 00$^0$ 56' 17.7''and E 036$^0$ 57' 39.9'' at 1700.30m elevation.
a. Gakurari Shopping Centre Tank Capacity 150m$^3$ to located within Gakurari Sec. School coordinates S 00$^0$ 57' 17.202''and E 036$^0$ 57' 30.384'' at 1660.11m elevation.

b. Kirwara Tank Capacity 150m$^3$ to be located in Kirwara Primary school coordinates S 00$^0$ 55' 46.854''and E 036$^0$ 56' 34.962'' at 1728.66m elevation.
c. Gatura tank of capacity 225m$^3$ coordinates S 00$^0$ 52' 35.56''and E 036$^0$ 56' 52.26.136'' at 1910.92m elevation.
d. Proposed Ndakaini 225m3 tank at Gitiri, 150m3 tank at Mukurwe and 150m3 at Gitemu. The proposed works will be at S 00$^0$ 47'19.080'' and E 036$^0$ 47' 35.362'' at elevation 2283.10m

### ii. Project Justification

The projected water demand is estimated at 9880m3/day while the current system has a capacity of 6,310 m3/day creating a deficit of 3,570m3/day. The increase in population (now standing at 130,000 according to the census report of 2009), damages on the existing water line and limited connections has further constrained the water supply in the district. Presence of Coliform in the partially treated and borehole/well water together with limitations indicated earlier justifies the need to establish treatment plants and improve provision of safe water for domestic purposes.

### iii. Project cost

**Table 1: Project cost**

| Bill | Summary Sheet – Augmentation of Gatanga Water Supply | Bill amount (KShs.) |
|---|---|---|
| | | |
| 2A | Source works and Treatment Water Site - Gatura Intakes 2000m3/day | 13,098,665.50 |
| 2B | Source works and Treatment Water Site - Chomo Intakes 1000m3/day | 13,148,440.50 |
| 3.00 | Mixing chambers | 3,620,040.00 |
| 4.00 | Sedimentation basins | 19,929,037.64 |
| 5.00 | Filters | 48,225,234.00 |
| 6.00 | Chlorination buildings | 6,209,356.00 |
| 7.00 | Pump houses | 9,368,626.00 |
| 8.00 | Electrical works | 8,932,982.00 |
| 9.00 | Transmission pipelines | 91,347,212.00 |
| 10.00 | 150 m3 Tanks | 6,559,702.00 |
| 11.00 | 48m3 Elevated Backwash Tanks | 6,487,732.00 |
| 12.00 | Interconnecting pipeworks at treatment works site | 19,919,301.78 |
| | **Total** | **246,846,329.42** |

## 3. Policy and Legal Framework

This report has been prepared as per the legal requirement of the Environmental Management and Coordination Act and the Environment Impact Assessment and Audit regulations 2003 as well as the World Bank Operation Policies.Other laws reviewed include;

a. The Constitution of Kenya;
b. Water Act, 2002
c. Water Resources Management Rules 2007
d. The Public Health Act (Cap 242)
e. The Physical Planning Act, 1996
f. Kenyan Land Policy
g. Land Acquisition Act, Cap 295 and
h. Occupation Health and Safety Act 2007

## 4. Public consultation and participation

Public and stakeholder consultations were held both during the scoping studies and full ESIA studies as shown in chapter 6. Some of the used raised were:

- That the water project is long overdue. More water should be provided to the community since they are currently receiving very little water;
- The community is not taking water during the rainy season as the water becomes turbid and smelly. This is because the water is not treated;
- There is constant blockage of meters and the service lines due to the turbid water being supplied;
- The water pressure is low;
- The water is expensive considering that it was started as a community project in 1973;
- The project has taken too long to commence since valuation of the affected persons were undertaken a while back;
- People who are not connected with the current system requested for connections;
- The youth should be considered for employment during the construction phase;
- The community insisted that water should not be taken to Nairobi who are being given first priority;
- Ensure that the project has enough storage tanks;
- More community sensitization should be undertaken so that the whole community can support the project.

## 5. Potential Impacts and Mitigation Measure

The main objective of this assessment was to identify significant potential impacts anticipated from the proposed Augmentation and Rehabilitation of Gatanga Water Supply to the environment and social aspects with a view to establishing appropriate recommendations on ensuring that the proposed project takes into

consideration appropriate measures to mitigate any adverse effects to the environment. The following table is summary of the anticipated environmental impacts.

**Table 2: Summary of environmental impacts for Gatanga Water Supply**

| Environmental and social impact | Positive/ negative | Direct / indirect | Temporary /permanent | Major / Minor | Occurrence | |
|---|---|---|---|---|---|---|
| | | | | | Design and Construction | Operation |
| Employment opportunities | Positive | Direct/Indirect | Permanent/ Temporary | Major | ✓ | ✓ |
| Stimulation of local economy | Positive | Direct | Permanent | Minor | ✓ | ✓ |
| Increased water quality and quantity | Positive | Direct | Permanent | Major | - | ✓ |
| Improved living standards of Gatanga residents | Positive | Direct | Permanent | Major | - | ✓ |
| Reduced exposure to health risks | Positive | Direct | Permanent | Major | - | ✓ |
| Improved food security and nutrition | Positive | Direct | Permanent | Minor | - | ✓ |
| Sustainability of Gatanga Community Water and Sanitation Company | Positive | Direct | Permanent | Major | - | ✓ |
| Enhanced gender and participation in employment | Positive | Direct | Permanent | Minor | - | ✓ |
| Education benefits to girl child | Positive | Direct | Permanent | Minor | - | ✓ |
| Vegetation loss | Negative | Direct | Permanent- | Major | ✓ | - |
| Soil loss | Negative | Direct | Permanent | Minor | ✓ | - |
| Air quality issues | Negative | Direct | Temporary | Minor | ✓ | - |
| Noise and vibration | Negative | Direct | Temporary | Minor | ✓ | ✓ |
| Generated wastes | Negative | Direct | Temporary | Minor | ✓ | ✓ |
| Visual impacts | Negative | Indirect | Permanent | Minor | ✓ | ✓ |
| Potential impact on traffic | Negative | Direct | Temporary | Minor | ✓ | - |
| Accidental spills & leakages | Negative | Direct | Temporary | Minor | ✓ | - |
| Surface water run-off | Negative | Direct | Temporary | Minor | ✓ | - |
| Occupational Health and Safety Risks | Negative | Direct | Temporary | Major | ✓ | ✓ |
| Requirement and use of local building materials | Negative | Direct | Temporary | Minor | ✓ | - |
| Land take | Negative | Direct | Permanent | Major | ✓ | - |
| Environmental Pollution | Negative | Direct | Permanent | Minor | - | ✓ |

| Environmental and social impact | Positive/ negative | Direct / indirect | Temporary /permanent | Major / Minor | Occurrence | |
|---|---|---|---|---|---|---|
| | | | | | Design and Construction | Operation |
| from Gray water | | | | | | |
| Impacts on drainage and hydrology | Negative | Direct | Permanent | Major | - | ✓ |
| Solid waste generation and disposal | Negative | Direct | Temporary | Minor | - | ✓ |
| Sludge management | Negative | Direct | Permanent | Minor | - | ✓ |
| Backwash water | Negative | Direct | Permanent | Minor | - | ✓ |
| Chemical handling | Negative | Direct | Permanent | Minor | - | ✓ |
| Emergency preparedness | Negative | Direct | Permanent | Minor | - | ✓ |

A range of mitigation measures in chapter seven have been proposed to mitigate against each of the anticipated negative impacts.

## 6. Environmental Management Plan

Best practice in construction environmental management will be achieved through implementation of a detailed Environmental and Social Management Plan (ESMP). The Supervising Engineer for the project will be responsible for environmental management and related social components.

The ESMP covers all necessary steps to mitigate negative impacts. These include measures during construction to: a) mitigate risks of erosion and sedimentation around watercourses; b) restrict water and soil contamination on work sites and around work camps (including littering and waste disposal); c) restrict generation of dust during construction; d) reduce risk of fire, cutting of trees for firewood, and trapping by construction workers; and, e) minimize risk of accidents and ensure occupational safety of workers on construction sites.

The contractor will also undertake environmental monitoring during construction. Some of the parameters to be monitored includes air, noise, soil erosion, water quality and vegetation clearance.

Construction related costs for mitigation of environmental impacts will be included in the Bill of Quantities (BoQ) as part of the design and tender documentation for the water supply.

# 1. INTRODUCTION

The Government of Kenya (GoK) National Water Policy (1999) envisages 100% access to safe water for the country's population by 2010. The millennium development goals (MDGs) envisage access to safe water and improved sanitation of 70% and 93% respectively by 2015. Current coverage figures are 49% and 86% respectively. During the 1980's and 1990's Kenya made large investments in water supply and sewerage (WSS) production and treatment capacities, but these did not result in efficient and sustainable service distribution. WSS operations were not transparent, unsustainable and ill-suited to respond to consumer needs. There was widespread collapse of infrastructure due to under-investment in operations and maintenance. To address the deteriorated situation and the previously fragmented water supply and sanitation (WSS) delivery responsibilities, GoK commenced a comprehensive sector reform in early 2003.

Water Act 2002 was enacted with an aim of harmonizing the management of water resources and WSS. The Act necessitated for separation of functions between each aspect of service delivery - policy making, regulation, asset ownership / control and service delivery operations. The consequent formalization of relationships between these functions is expected to reduce conflicts of interest and increase transparency and accountability. Consistent with this tenet, the GOK (i) is reorganized the Ministry of Water, Environment and Natural Resources into a body focused on policy issues, (ii) established a Water Services Regulatory Board (WASREB), and (iii) established seven Water Services Boards (WSBs). Each WSB is mandated to appoint Water Services Providers (WSPs), which are legal entities contracted by WSBs to be responsible for service

Kenya is classified as a water scarce country with a limited natural endowment of water of only 647m3 per capita and this is projected to fall down to 245m3 per capita by the year 2025, well below the internationally recommended minimum of 1,000m³/capita/year. Furthermore, Kenya's Water resources are highly vulnerable to climate variability often resulting into floods and drought with inadequate storage capacity which limits the ability to buffer against the water shortage shocks.

The development and management of water resources in Kenya is based on the view that water is a social good and is a catalyst for economic development. The current access to clean water in the country is estimated at about 90% in urban areas and approximately 44% in the rural areas while the national average stands at about 57%. At the same time, provision for safe sanitation stands at a national average of 80% (95% urban and 77% rural). To achieve the MDGs, that is to halve the population without access to water and sanitation by the year 2015, water supply (through increased household connections and developing other sources) and sanitation requires to be improved in addition to interventions in capacity building and institutional reforms.

The Government of Kenya (GoK) has recognized the need for comprehensive institutional reform and increased investment in the water and sanitation sector in

order to remove bottlenecks in its programme to alleviate poverty, employment and wealth creation. Recent GOK efforts aimed at formulating a clear policy strategy has culminated in the enactment of a new legislation on water management. The Water Act 2002 is aimed at harmonizing and streamlining the management of water resources, water supply and sanitation services.

## 1.1. PROJECT JUSTIFICATION

The water supply in Gatanga District currently under serves the community because of the following reasons: population increase, limited water pipeline network, damages on the existing water lines and lack adequate investment in water investment in the region.

The current population is estimated at 130,000 from the 2009 census report which is way beyond the existing system design. The projected water demand stands at 9880$m^3$/day while the system in place has a capacity of producing 6,310$m^3$/day, leaving a shortfall of 3570 $m^3$/day.

The current water schemes (Thika, Kimakia and Kiama) serving Gatanga District tap raw water from the Aberdare forest and distribute the raw water with partial treatment and in some instances without treatment, it therefore implies that, water currently consumed within Gatanga Sub-county may be contaminated.

To address the above problems urgent intervention are required through rehabilitation and argumentation of Gatanga water supply to ensure that residents get adequate ,safe and clean water as now required by Kenyan new constitution.

The current water supply serves only 45% of Gatanga population, thus the need to construct additional water lines and extensions to areas that were not connected initially and whose residents entirely depend on roof catchments and raw water from nearby streams.

## 1.2. SCOPE OF THE ASSIGNMENT

The scope of the study includes the following aspects:

a. An outline of the project background and implementation;
b. Baseline conditions of the project area and review of available information and data related to the project;
a. Key areas of environmental, Health and safety concerns and impacts associated with the proposed project implementation and commissioning;
b. Public Participation sessions including questionnaire administration;
c. Comprehensive environmental management plan outline covering the construction, operation and decommissioning phases of the project;

d. Comprehensive EIA report in accordance with the EIA regulations as outlined in the Kenya Gazette Supplement No. 56 of 13th June 2003 and submissions to NEMA for further instructions and/or approval;
e. Reporting, review and submission to the National Environment Management authority.

## 1.3. PURPOSE OF THE REPORT

The main purpose of this report is to evaluate the projected environmental, health and safety aspects related to the project activities.

Development activity at any part of the ecosystem is bound to cause changes in the economic, social and environmental spheres of life. As much as there is ever growing need to spur economic growth through diverse development projects, the concept of sustainability remains a vital complementary tool. Exploitation of available resources must not compromise the ability of future generations to utilize the same for their need.

Environmental and Social Impact Assessment (ESIA) aids in evaluating and predicting possible impacts of development activities, providing an opportunity to mitigate against negative impacts whilst enhancing the positive impacts.

In recognition of the possible impacts of water projects to the environment, The Government of Kenya, through section 4 of the second schedule in the Environmental Management and Coordination Act of 1999, categorized dams, rivers and water resources among development projects that need a full Environmental and Impact Assessment study before commencement.

Moreover, section 58 (1) of the Environmental Management and Coordination Act of 1999, states*" ...any person, being a proponent of a project, shall, before financing, commencing, proceeding with, carrying out, executing or conducting or causing to be financed, commenced, proceeded with, carried out, executed or conducted by another person any undertaking specified in the Second Schedule to this Act, submit a report to the Authority, in the prescribed form, giving the prescribed information and which shall be accompanied by the prescribed fee."*

Also, section 58 (2) of the same Act states that*" The proponent of a project shall undertake or cause to be undertaken at his own expense an Environmental Impact Assessment study and prepare a report thereof where the authority, being satisfied, after studying the project report under sub-section (1), that the intended project may or is likely to have or will have a significant impact on the environment, so directs."*

In compliance with the said sections of the afore-mentioned Act of Parliament, a project report was prepared after reconnaissance, scoping and screening visits to the proposed project area, and the same submitted to the National Environment Management Authority for approval and further direction. Subsequently, a full

Environmental and Social Impact Assessment study was carried out in August 2014. It is on this basis that this report is produced.

## 1.4. OBJECTIVES OF THE ESIA

The Environmental and Social Impact Assessment (ESIA) study was carried out to deliver on the following objectives:

- To identify and assess all potential significant environmental and social impacts of the proposed project and recommend appropriate mitigation and enhancement measures.
- To evaluate potential impacts of engineering and design activities during site preparation, construction and operational phases of the project;
- Verification of compliance of the project with stipulated national and international environmental standards and regulations;
- Generation of baseline data for monitoring and evaluation of how well the mitigation measures will be implemented during the project cycle;
- Foster public involvement and participation throughout the major project phases;
- Recommendation of environmentally sound, cost effective measures to be implemented in the entire course of the proposed project, and
- To prepare an ESIA report compliant with the relevant national environmental legislation and World Bank safeguard environmental policies and the standard international treaties and conventions on environment and biodiversity.

## 1.5. TARGET GROUP FOR THE ESIA REPORT

This Environmental and Social Impact Assessment Report has been prepared for use by different stakeholders to be involved in the project, both at national and county level. The report contains useful information on policies and procedures to be adhered to, implementation modalities, analysis of potential environmental and social impacts and suggested mitigation measures at various stages of the project activities. The information will be useful in planning, implementation, management and maintenance of the facility and buildings.

In this regard, the report will be useful to the following stakeholders:

- Athi Water Services Board;
- The NEMA monitoring and compliance section;
- World Bank;
- Contractors engaged in the construction works for the project;
- The project affected persons (PAPS) living within the project area;
- Beneficiaries of the project both at local and regional levels.

## 1.6. STUDY METHODOLOGY

The approach to this exercise was structured such as to cover the requirements under the environmental management and coordination act (EMCA), 1999, as well as the EIA regulations as stipulated under the Gazette Notice No. 56 of 13th June 2003. The study involved understanding of the project background, the designs, interaction of the Project with the Aberdare forest, downstream compensation at existing weirs on Rivers Kiama, Kimakia and Thika rivers and the implementation plan as well as commissioning.

### 1.6.1 Scoping studies

Scoping process involved the identification of significant environmental and social issues associated with the proposed improvement works for Gatanga water Supply. Through reviews of the historical documents and available data supported with field evaluations, it was possible to estimate the current status of the intakes (Kiama, Kimakia and Thika intake weirs), implications of additional water into the system including waste water disposal, the capacity and integrity of the distribution network and the consumers' locations.

Baseline information was obtained through physical investigation of the site and the surrounding areas including the sites proposed for treatment plants adjacent to the Aberdare forest and intake weirs within the Aberdare forest.

Interviews with a sample of surrounding community through circulated questionnaire, photography and most important discussions with the client and the design team. Questionnaires were administered in the following markets; Gatanga Shopping Centre, Ndakaini, Gitemi, Gitiri,Gatuka, Gathaithi, Rwegetha, Chomo, Gatura and Kariara.

Interviews and discussions with stakeholders and project beneficiaries were applied in the determining the aspects such as adequacy of the supply, awareness and ownership, willingness to pay for water and general opinions of the people. Significant issues identified through this process were applied in drawing up the impacts as well as the management plan.

This culminated in the submission of a project report to NEMA where initial review recommended undertaking full ESIA studies (see letter in Appendix 1). The terms of reference were developed and approved by NEMA on 30$^{th}$ July 2013 (see Appendix 2).

### 1.6.2 Full ESIA studies

With all the aforementioned foundational information, a field study was undertaken in the month of August to evaluate the specific projected effects and impacts, both favourable and detrimental to the project beneficiaries. This included analysis of water points, wetlands, drainage structures, health and safety issues as

well as general restructuring of the physical environment. Public and stakeholder consultations were also undertaken. A total of three public were held in the project area.

## 1.7. STRUCTURE OF THE ESIA REPORT

This report has been prepared under the following chapters:

**Executive summary:** This chapter presents a summary of the significant findings and recommended actions, with an emphasis on expected impacts.

Chapter 1: **Introduction:** This chapter gives description of the project background, location, purpose, objectives, NEMA reporting requirements, study methodology and the structure of the report.

Chapter 2: **Project Description:** This chapter gives a description of the status of the project in the project cycle, specifically during construction, operation and decommissioning.

Chapter 3: **Environmental Setting:** 'This chapter gives description of the environmental setting of proposed project and surrounding areas, e.g., climate, soils, geology, vegetation, fauna, land use, human populations, socio-economics, cultural heritage.

Chapter 4: **Policy, legal and institutional / administrative framework**: This chapter outlines the overview of legislative framework, regulatory, international guidelines and conventions relevant to this project.

Chapter 5: **Analysis of Alternatives:** 'This chapter gives a description of the project details of the proposed project, alternative options, designs and implementation strategies.

Chapter 6: **Public Consultation Programme:** 'This chapter gives description of the objectives, methods used and summary of results of the public consultation activities undertaken during the ESIA'.

Chapter 7: **Assessment of Environmental impacts and mitigation measures:** This chapter presents the analysis of beneficial and adverse impacts of the project on the biophysical and human (social, cultural and economic) environments. The analysis covers anticipated impacts during the construction, operation phases and decommissioning phases and also describes the enhancement and mitigation measures proposed to enhance benefits or prevent, minimize, mitigate or compensate for adverse impacts as well as the estimated cost of mitigation.

Chapter 8: **Environmental Management and Monitoring Plan:** This chapter presents the proposed Environmental and Social Management and Monitoring Plan prepared for the project. Also included is the management of waste.

Chapter 9: **Conclusion and Recommendations:** The conclusion briefly presents the environmental and social acceptability of the project, taking into account the impacts, measures and recommendations identified during the assessment process.

# 2. PROJECT DESCRIPTION

## 2.1. PROPOSED INTERVENTIONS

### 2.1.1 Conventional Treatment Plants

a. The proposal is to set up a partial water treatment plant (water from Kiama) of 3000$m^3$/day at the periphery of the Kimakia forest at the point where there is an existing 150$m^3$ at GPS coordinates S 000 48'50.244'' and E 0360 46' 57.456'' elevation 2266.26m
b. 2000$m^3$/day of treated water will be conveyed to Ndakaini Shopping centre via an 8inch already existing GI pipe while 1000$m^3$/day will convey to existing 225$m^3$ at coordinates S 000 48'51.870'' and E 0360 46' 57.23'' elevation 2256.89m
c. The proposal is to set up a full conventional water treatment plant (water from Kimakia) of 4000$m^3$/day at the periphery of the Kimakia forest at the point where there is an existing 150$m^3$ at GPS coordinates S 000 48'51.870'' and E 0360 46' 57.23'' elevation 2256.89m
d. Kiama and Kimakia combined system with intake at Chomo Gigoro for Kiama river and at Gatura Kiarutara road for Kimakia river , the treatment plant will be located 8km from Kiama intake and 3Km from Kimakia intake at GPS coordinates S 000 55'04.986''and E 0360 55' 48.970'' at 1797.07m elevation at a place called Rwegetha (see figure 2-1 for the map showing the proposed project).

### 2.1.2 Break Pressure Tanks / Storage Tanks (Ground Masonry Tanks)

a. Gatanga Water Tank Capacity 150$m^3$ at Gatanga Catholic Mission Premises coordinates S $00^0$ 56' 17.7''and E $036^0$ 57' 39.9'' at 1700.30m elevation.
b. Gakurari Shopping Centre Tank Capacity 150$m^3$ to located within Gakurari Sec. School coordinates S $00^0$ 57' 17.202''and E $036^0$ 57' 30.384'' at 1660.11m elevation.
c. Kirwara Tank Capacity 150$m^3$ to be located in Kirwara Primary school coordinates S $00^0$ 55' 46.854''and E $036^0$ 56' 34.962'' at 1728.66m elevation.
d. Gatura tank of capacity 225$m^3$ coordinates S $00^0$ 52' 35.56''and E $036^0$ 56' 52.26.136'' at 1910.92m elevation.
e. Proposed Ndakaini 225$m^3$ tank at Gitiri, 150m3 tank at Mukurwe and 150m3 at Gitemu. The proposed works will be at S $00^0$ 47'19.080'' and E $036^0$ 47' 35.362'' at elevation 2283.10m

## 2.2. EXISTING WATER INTAKE WEIRS

### 2.2.1 Partial Treatment 6000m$^3$/day

The intake works for 6000 m3/ day already exists on Thika River built in 1974 through the support of German Government and Kenya Government, the site is located at Partial treatment plant for 6000m3/day of already existing system on Thika Wanyaga at GPS coordinates S 000 46'21.102''and E 0360 46' 32.586'' at 2298.81m elevation within the Gatere forest (Aberdare forest) the inlet works have been approved by both the Water Resources Management Authority (WRMA) and Kenya Forestry Service (KFS).

The design of the weir allows for adequate downstream compensation as per the attached flow measurement report prepared by the WRMA. The proposal is to retain the intake works and set up a bigger storage tank of 225m$^3$ at Ndakaini Shopping centre to serve the areas of Kahunyu, Gatunguru, kiriane and Mureke within Gatanga District. Chlorine will be dozed at the tank to treat the water of coli forms and other bacteria.

### 2.2.2 Kiama 3000m$^3$/day

The inlet works exist within the Kiamakia forest and was approved to be constructed by WRMA in 2010 as well as KFS, the capacity of the weir is 3000m$^3$/day. Distribution line for the water already exists therefore no new distribution line will be constructed under this project. The design of the weir allows for adequate downstream compensation as per the attached flow measurement report prepared by the WRMA. The intake is planned to serve the proposed partial treatment for Kiama 3000m$^3$/day.

### 2.2.3 Kimakia 3000 m3/day

The intake weir exists within the kimakia forest (constituent of Aberdare forest ) The intake weir is designed for 3200m3/day with an existing 12inch raw water main to the distribution network. The intake weir is planned to serve Kimakia 4000m$^3$/day.

## 2.3. PROJECT COST

From the detailed design of the project, the proposed intervention for Augmentation of Gatanga Water Supply is envisaged to cost **KES 246,846,329.42.**

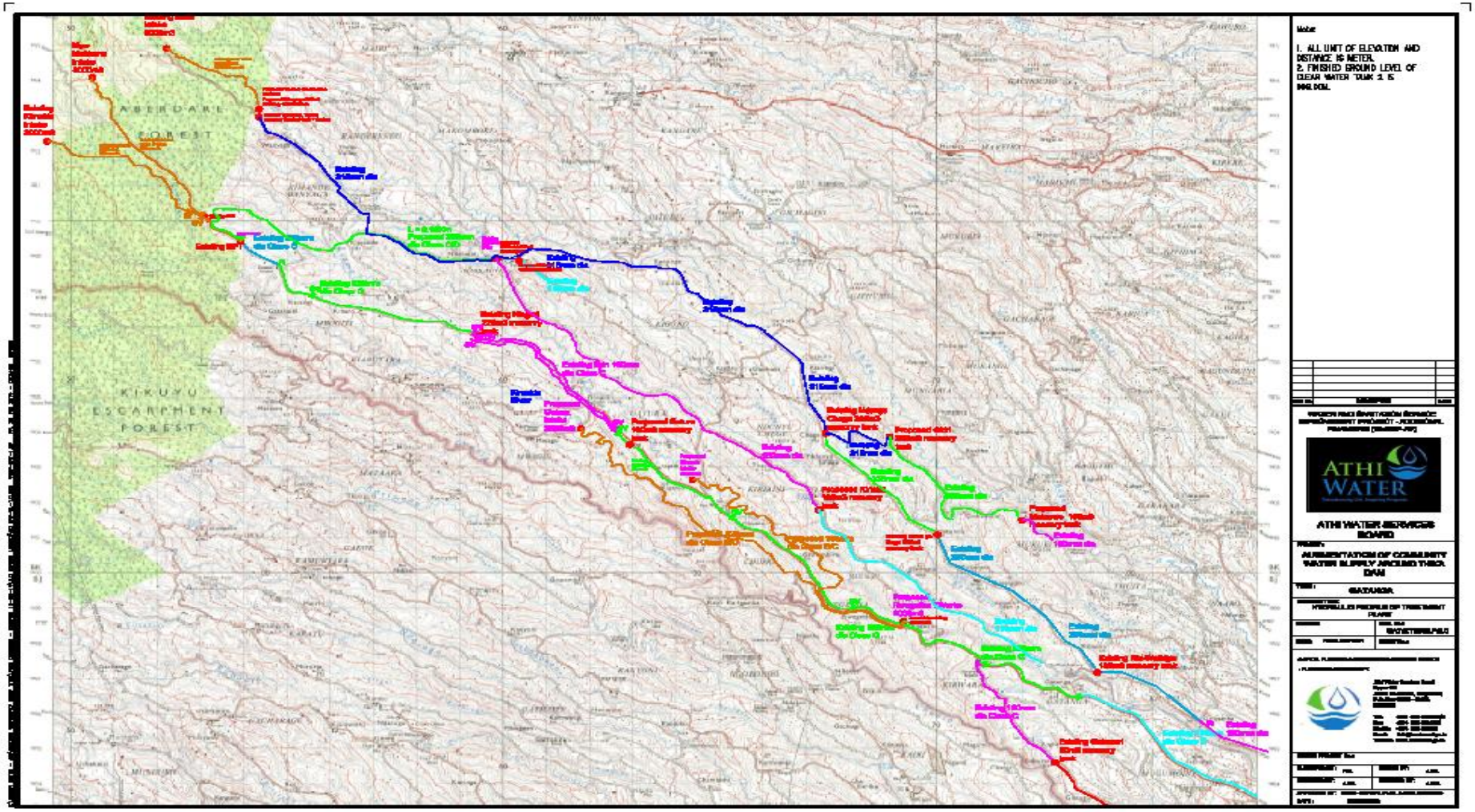


**Figure 2-1: Topo-map showing the proposed Gatanga Water Supply**

# 3. ENVIRONMENTAL SETTING

## 3.1. PHYSICAL ENVIRONMENT

### 3.1.1 Climate

The seasonal distribution of rainfall is dominated by the movement of the Inter Tropical Convergence Zone (ITCZ) which separates the North eastern and South eastern trade wind systems and the belt of maximum rainfall follows the position of the overhead sun with a time lag of about 4 to 6 weeks.

The two rainy seasons are therefore centred around April-May (Long Rains) and October-November (Short Rains). During the intervening dry seasons monsoonal systems bring rather dry air masses. From December to March the persistent North easterly monsoon brings clear sunny weather with only occasional showers. During the period of South easterly monsoon from June to October the weather is duller and cooler with occasional drizzle which is more persistent at higher elevations.

The highest annual rainfall totals of over 2,600 mm occur on the windward side of the summit of the Aberdares and there is a decline with elevation which is more rapid on the leeward slope towards the Rift Valley than on the windward side. Further south in the headwaters of the Thiririka and Ruiru rivers the rainfall divide is towards the east of the topographic divide. There is also a decreasing rainfall towards the South.

Other climatic elements have a significant influence on water resources, especially in their effect on the rate of evapotranspiration loss. Throughout the area mean daily temperature varies little with season and the diurnal variation is generally greater than the seasonal variation. With increasing altitude, daily minimum temperature values decrease more rapidly than the daily maximum. Typically the annual average diurnal range at elevations of 1,500 metres is 13°C to 25°C whilst at 2,500 metres the range is from 6°C to 22°C.

Mean annual relative humidity values range from 65% at lower elevations to 80% or more above 2,500 metres. Humidity is greatest at dawn and lowest in the early afternoon when the temperature reaches the diurnal maximum.
Below 1,500 metres the mean daily duration of bright sunshine ranges from 4 hours during July and August to 9 hours during the Northern Monsoon season with an annual mean of 6.8 hours. Sunshine decreases with altitude, with an annual mean of 5 hours at 2,500 metres.

Mean annual free water surface evaporation as calculated by Woodhead ranges from around 1,800 mm in the piedmont zone to less than 1,400 mm in the Aberdares Range. Potential evapotranspiration is estimated to be about 75% of free water evaporation in the highlands and 80% or more in dryer areas.

### 3.1.2 Temperatures

Temperature is also influenced by altitude due to the Aberdare ranges. Mean annual temperature varies from low in higher regions to high in lower region between 17 and 25 degrees Celsius.

### 3.1.3 Topography and Drainage

The highest point of central Kenya is the region around the Aberdare Mountain Range with elevations of over 3,500 metres. From the vicinity of Mt. Kinangop within the Aberdare, the highest point, rise four major tributaries of the River Tana; the most Southerly, the River Chania, this provides the greater part of Nairobi's present water supply, and the Rivers Thika, Maragua and Mathioya.

The rivers within both the Tana and Athi drainage basins form a parallel series, largely oriented in a south-easterly direction, following the dip of the underlying lava flows. They form deeply incised valleys in long narrow catchments with steep slopes. There is generally a thick mantle of weathered rock and soil and bedrock is rarely exposed except within the river channel.

This weathered mantle and the forest vegetation which covers elevations above 2,200 metres dampen the flood response of the rivers to intense rainfall and also sustain dry weather flows. The rivers emerge from these incised valleys onto a flat piedmont zone at an elevation of approximately 1500 metres, without significant perennial tributaries, and join the main Athi and Tana rivers.

The rivers of interest to this study rise in the moorlands and forests of the Aberdare Mountain Range. The highest peak in the southern Aberdares is Kinangop Peak, at 3,906 masl. The upper drainage is within the National Park and comprises undulating moorland with swamps and patches of Hagenia woodland and Ericaceous heath. The Eastern Aberdare Rivers formed within the high altitude moorland, flow eastwards into deeply incised forest-clad valleys within the Forest Reserve surrounding the National Park. The upper forest zone is typically bamboo, changing to forest in the lower slopes. The Forest Reserve boundary, at about 2,200 masl, is demarcated by an electric fence, 420 km long, which surrounds the Aberdare Conservation Area (ACA). Below the Forest Reserve boundary of the Eastern Aberdares lies a zone of smallholder tea plantations on the slopes of the deeply incised valleys.

The forested catchment area is protected, as it lies within the National Park and adjacent Forest Reserve. The forests play an important role in maintaining dry season flow by stabilizing the soils, maintaining infiltration rates and reducing wet season water runoff. The importance of the forests to the catchment hydrology has long been recognised, and the Government is committed to forest conservation.

Demand for water has been increasing because of increases in population and growing needs for irrigated agriculture, urban and rural populations, industries, livestock, and hydropower. There is concern that water sources in the country are degraded as a result of: excessive abstraction of surface waters and groundwater;

soil erosion and resultant turbidity and siltation, high nutrient levels, causing eutrophication of water bodies; as well as toxic chemicals, including agricultural pesticides and heavy metals.

### 3.1.4 Geology

The geology of this area comprises of basement systems which are mainly grits, sandstones, shales and limestones that have been metamorphosed by heat and pressure or by impregnation by pervading fluids. Other types are derived from lavas and volcanic fragmental rocks. The variety of rocks is extensive and includes mica and mica hornblende gneisses and schists, pyrexinite, granulites quartzites and marbles. There is also a considerable development of migmatites.

### 3.1.5 Soils

The predominant soils are black clays (grumosolic soils) which consist of black cotton and include the calcareous and non-calcareous variants. The adjacent area has rock outcrops that have been subjected to geological and accelerated erosion to an extent that they have lost their original characteristics.

## 3.2. BIOLOGICAL ENVIRONMENT

The vegetation within Gatanga Sub-County is largely transformed due to agricultural activities. The most dominant tree species is Eucalyptus which is found within farmlands and along the rivers and streams.

The area is dominated by indigenous vegetation and trees which commonly grow in areas with high rainfall. Most common trees in the area are as shown in Table 3-1. Also found in the area are different species of fern and bamboo.

**Table 3-1: List of tree species found in the project area**

| Scientific name | Local name |
|---|---|
| *Tabernaemontana stapfiana* | Mwerere |
| *Ocotea usambarensis* | Muthaiti |
| *Prunus africanum* | Muiri |
| *Croton macrostacheus* | Mutundu |
| *Syzygium Guineense* | Mukoe |
| *Ochna Holstii* | Mungirima |
| *Aristotelia serrata* | Makomako |
| *Albizia schimperiana* | Mukurue |
| *Vernonia auriculifera* | Muthakwa |
| *Garcinia gerrardii* | Munyawa |
| *Rapanea rhododendoides* | Mugaita |
| *Podocarpus falcutus / latifolias* | Muthengera |
| *Makaranga kilimadscharica* | Mukuhakuha |
| *Aningeria adolfi- friederichii* | Muna |

The proposed project area is near the Aberdare forest. Kiama and Kimakia intakes are approximately 10km from the Aberdare forest.

The Aberdare Range is a 160 km long mountain range of upland, north of Kenya's capital Nairobi with an average elevation of 3,500 metres (11,480ft). It is located in Nyandarua County, west central Kenya, northeast of Naivasha and Gilgil and just south of the Equator.

The main ecosystems within the mountain range are rainforest giving way to dense bamboo forests and then moorland. The steep western edges of the hillside are sparsely inhabited by wildlife compared to the forested gentle slopes to the east, which are home to a wide variety of wildlife. There are multitudes of elephant, buffalo, giant forest hog as well as the endangered Black Rhino. A variety of cats including leopards and the rare African Golden Cat. Other threatened species including the Jackson mongoose, the black and white Colobus monkey and Sykes monkey are plentiful, as are waterbuck, reedbuck, duikers, serval cats and bushbuck.

The Aberdares contain a rich diversity of vegetation. There are 778 vegetation and plant species, subspecies and varieties found in the Aberdare National Park, due to the park's altitude and rainfall. Hardwood trees include camphor, Cedar, Podo and Hagenia.

The range attracts large numbers of hikers and climbers operating out of the main centers of Naivasha and Gilgil. The lower slopes are farmed, higher areas are known for their wildlife. The Rhino Charge is an annual event run by conservationists in Kenya to pay for fencing of the Aberdare National Park as a means of protecting East Africa's largest indigenous forest from destruction.

Within the project area cultivation has led to less bushy areas and natural vegetation and this has in turn displaced many animals that would usually inhabit such areas. However there are still few large and small animals which include and a variety of birds.

## 3.3. SOCIO-ECONOMIC ENVIRONMENT

### 3.3.1 Project Location

The project falls within Gatanga sub-county in Muranga County. Gatanga sub-county is located in the formerly Central Province with a total land area of 3,304Km$^2$. It lies between latitude 0˚8’ North and 0˚50’ South and between longitudes 38˚24’ East and 32˚41’ West. The Sub-County borders Thika East Sub-County to the South, Kigumo Sub-County to the North, Kandara Sub-County to the East and Mangu Sub-County to the West. It is approximately 42km from Nairobi City. The Sub-County is divided into five (5) administrative divisions namely Gatanga, Kariara, Kigoro, Kihumbu-ini and Samuru Divisions.

The area is predominantly agricultural based with small shopping centres. With the implementation of the proposed project, it is not anticipated that the project area will significantly change. This is supported by the fact that the water distribution infrastructure is already in existing and being used with the limitation being that the water being supplied is raw. The proposed project will ensure that the residents of Gatanga receive good quality water.

### 3.3.2 Administrative structure and population

Gatanga sub-county has a population density of 362 persons per square kilometre with a total population of 113,094 persons. It's mainly inhabited by the Kikuyu community. The administrative structure and population distribution in the locations covered by the project is shown in Table 3-2 below.

**Table 3-2: Administrative Structure and population within the project area**

| Sub-County | Division | Location | Population | Households |
|---|---|---|---|---|
| Gatanga | Gatanga | Mugumo-ini | 10,797 | 3,055 |
| | | Kigio | 7,951 | 1,976 |
| | | Gatanga | 13,445 | 3,459 |
| | | Kiriaini | 8,104 | 1,966 |
| | | Samuru | 7,494 | 2,788 |
| | Kariara | Gambuya | 6,896 | 1,720 |
| | | Kariara | 11,384 | 3,097 |
| | | Kigoro | 12,568 | 3,248 |
| | | Ndaka-ini | 7,324 | 2,039 |
| | Kiumbu-ini | Kiunyu | 8,461 | 2,212 |
| | | Kiumbu-ini | 9,483 | 2,485 |
| | | Mukarara | 9,187 | 2,166 |
| **Total** | | | **113,094** | **30,211** |

*Source: 2009 Kenya population and Housing Census.*

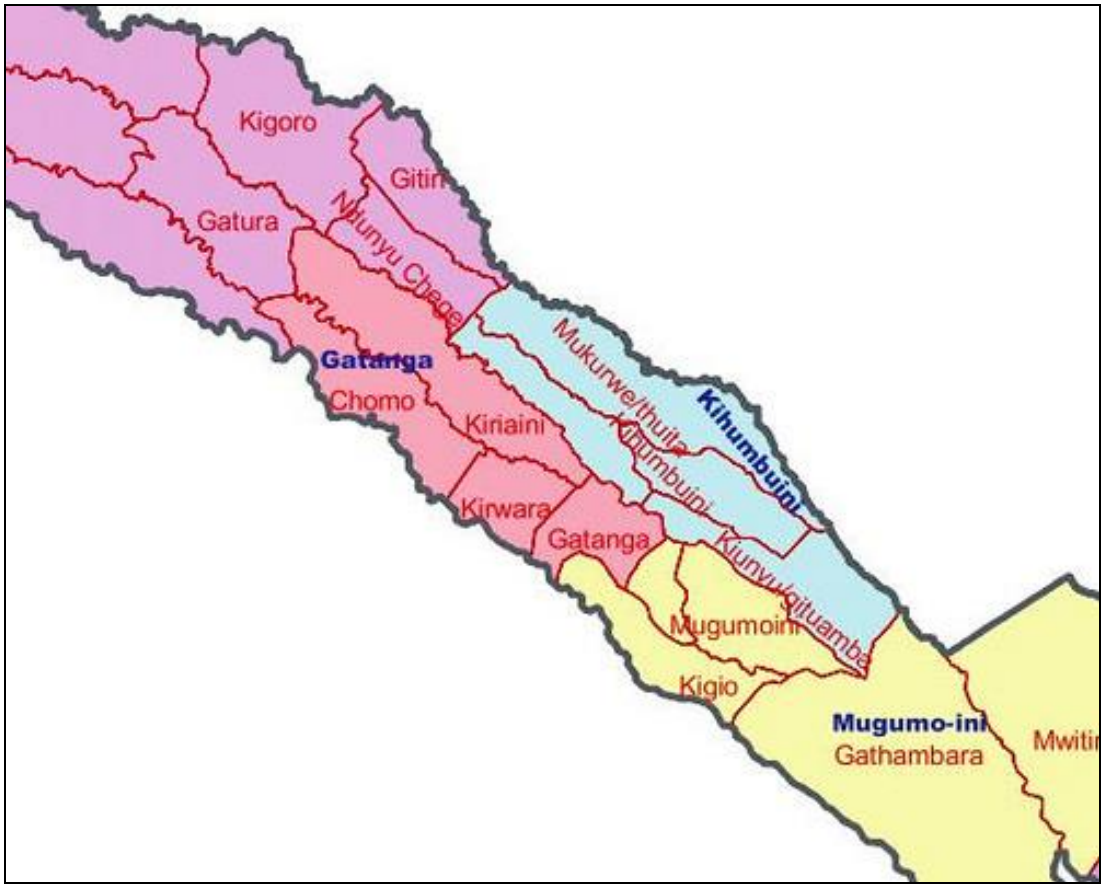


**Figure 3-1: Administrative Map of Gatanga**

### 3.3.3 Water and Sanitation

#### a. Gatanga Water Trust

Gatanga water Trust forms part of the original Kandara water project which was constructed in the early seventies. The project was a community initiative with the then local leaders spearheading the sourcing for funds. The Gatanga water trust was formed as a result of the water sector reforms initiated in 2002. It is run by a board of trustees drawn from Gatanga Division representing individual locations. The scheme is wholly gravity serving a rural set up. It is served by two water intakes constructed inside the Kimakia forest. The intakes draw water from the Kimakia and Thika rivers.

The current water production stands at 7000$m^3$ per day. It is serving approximately 4000 active consumers and already 1600 have meters. The water is tapped at the Kimakia forest (Aberdares) and flows down through gravity to reach Kiunyu, Gatunyu and Mununga.

#### b. Borehole Water

The area has boreholes drilled by National Water Corporation and Pipeline in mid 90s. The boreholes include; Kimata, Matunda, Kiganjo, Kiawaihiga, Gakurari and Mwana wi kio.

### c. North of Kiama River system

North of Kiama River system-It gets its water from the old intake constructed on the Thika River. It serves Kigoro,Mukarara,Kiriaini and Kihumbuini locations. The laid pipeline stretches from the forest edge to Wanyaga-Kimandi-Ndakaini-Ndunyu chege-Mukarara,Gitiri-Mukurwe –Jasho

### d. South of Kiama River system

South of Kiama River system-gets water from the newly constructed intake on the Kimakia River. It serves Kariara,Gatanga and Mugumoni locations. The pipe network stretches from Kinguri -Gatura-Chomo- kirwara-kigio and Gatunyu

### e. Sanitation Situation

The area is large rural with majority of homes on septic and pit latrines, markets like Ndakaini, Gitemi, Gitiri,Gatuka, Gathaithi, Rwegetha, Chomo, Gatura and Kariara are on pit latrines as well but the drainage system is will defined and managed by the county Council of Thika

## 3.3.4 Social and Physical Infrastructure

### a. Agriculture and Rural Development

The district is predominantly agricultural based and therefore agriculture is the mainstay of the economy and livelihood of the people, with 80 percent directly or indirectly employed in the sector. Coffee, tea, horticulture and dairy farming are the main agricultural activities. The major horticultural crops are pineapples and passion fruits and vegetables. The main food crops grown are maize, beans and Irish potatoes. The co-operative movement in the district is well established with societies being well distributed in various sub-sectors of the economy. There are 32 registered cooperatives, 21 being active and 11 are dormant with a total membership of 31,549. Predominant SACCO in the area is the Muramati and Chai Sacco.

### b. Trade, Tourism and Industry

The district is predominantly agricultural and therefore has quite a number of agricultural based industries. Both wholesale and retail businesses mostly dealing with household items are thriving in the district. There are three commercial banks operating in the district and two micro finance institutions. The district has a lot of potential in industries, which is not fully utilized, especially in value addition of horticultural, Tea, Coffee and milk products. The tourism sub-sector is also well developed in the district due to Aberdare Game Reserve within the Aberdare forest.

### c. Transport

The district has a fair coverage of classified roads, with 95.2 km of bitumen standard. However, the earth-surfaced roads are also properly maintained by the CDF fund, some of the roads that have been earmarked for repair include; Junction – Hamukundi, Junction- Macvast Rubiru, Junction- Kirathani, Mabanda-Ngangaini- Kimatu, Mwania Mbogo, Junction- Ithanga Sec. sch., Junction CDF Office – Kanduri, Jn. Ithanga- kawethei, Jn .Ithanga- Ndithini, Jn.Hamboi, Jn Kirwara -Jn Bluepost, Kirwara-Mabae-Rwegetha, Jn.Kiganjo-Jn Mwagu, Jn.Chomo-Rwegetha-Chania River, Jn.Nagara- jn.Ndiara, Gituamba-Karingaini-Thika river, Jn.Kiunyu, Jn Kiunyu - Hakinyungu- Jn Rukoroi, Jn.Macvast- Kambi Mawe, Kirwara- Gathanji – kimemu, Jn Kimata, Jn.Kiunyu- Jn.Rugaita, Jn.Kiahuria-Jn Gakurari, Landless- Thika River- Mwana wi kio, Jn.Kahunyo-Ndia tea Buying Centre, Jn.Ndunyu chege- Njaini - Thika River, Jn.Gikingi-Jn.Kiunyu and Jn.Itugi ithatu-Kiriaini- Mbari ya Ruga

### d. Power Supply

The district has benefited a lot from the rural electrification program being run by the Ministry of Energy, majority of the markets and homesteads are connected to the electricity grid, the areas which benefitted from the electrification program include: Kahuruko and Junction markets, Mukurwe market, Giteme Market, Nyaga Market, Kanunga, Kiganjo, Gituatu Market, Rwegetha, Gathanji, Matunda, Ngelelya, kirathani, Ithangarari, Manunga Market. From the literature review of development reports of the area and general observation indicates that the area is properly networked to the electricity grid.

## 3.3.5 Education

The district has over 15 education institutions with a total population of 3221 boys and 3054 girls as illustrated in the table below.

**Table 3-3: Education status**

| Sub-County | Division | Location | Boys | Girls | Total |
|---|---|---|---|---|---|
| Gatanga | Gatanga | Gatanga | 229 | 238 | 467 |
| | | Kirwara | 142 | 140 | 282 |
| | | Gichumbu | 172 | 190 | 362 |
| | | Rwegetha | 295 | 261 | 556 |
| | | Chomo | 325 | 303 | 628 |
| | | Mabae | 213 | 177 | 390 |
| | | Ngungugu | 145 | 128 | 273 |
| | | Gakurari | 165 | 175 | 340 |
| | | Ithangarari | 225 | 189 | 414 |
| | | Giatutu | 210 | 196 | 406 |
| | | Kigio | 320 | 271 | 591 |
| | | Rwaitira | 185 | 178 | 363 |
| | | Gatunyu | 425 | 433 | 858 |

| Sub-County | Division | Location | Boys | Girls | Total |
|---|---|---|---|---|---|
| | | Mabanda | 170 | 175 | 345 |
| | | | **3221** | **3054** | **6275** |

*Source: Gatanga Constituency webpage*

### 3.3.6 Health

Since the introduction of the CDF, several dispensaries have been constructed and therefore reducing the distance travelled to health facilities. The Ministry of Health has also increased the number of trained medical personnel in all health facilities.

The health facilities in the district are as follows; one district hospital, four (4) GOK health centers and one (1) Private health centre, nine (9) GOK dispensaries and 27 private clinics and mission hospitals. Examples of the dispensary include; Kirwara Health centre, Kiarutara, Kagio Community dispensary, Ithang'arari Community dispensary, Mbuguti Community dispensary, wanyaga Community dispensary, Mukarara Community dispensary, kiria-ini Gathanji Community dispensary.

# 4. POLICY, LEGAL AND REGULATORY FRAMEWORK

## 4.1. INTRODUCTION

Environmental Impact Assessment is a tool for ensuring new projects and programmes incorporate appropriate measures to mitigate adverse impacts to the environment and peoples' health and safety as well as enhancing sustainable operations with respect to environmental resources and co-existence with other socio-economic activities in their neighbourhood.

According to the Kenya National Environment Action Plan (NEAP, 1994) the Government recognized the negative impacts on ecosystems emanating from industrial, economic and social development programmes that disregarded environmental sustainability. Following on this, establishment of appropriate policies and legal guidelines as well as harmonization of the existing ones have been accomplished and/or are in the process of development. The NEAP process introduced environmental assessments in the country with the key stakeholders being industrialists, business community and local authorities. This culminated into the development of the Policy on Environment and Development under the Sessional Paper No. 6 of 1999.

## 4.2. POLICY PROVISIONS

### 4.2.1 The Constitution

In the Constitution of Kenya, 2010, the State clearly undertakes to carry out the following:

a) Ensure sustainable exploitation, utilization, management and conservation of the environment and natural resources, and ensure the equitable sharing of the accruing benefits;
b) Work to achieve and maintain a tree cover of at least ten per cent of the land area of Kenya;
c) Protect and enhance intellectual property in, and indigenous knowledge of, biodiversity and the genetic resources of the communities;
d) Encourage public participation in the management, protection and conservation of the environment;
e) Protect genetic resources and biological diversity;
f) Establish systems of environmental impact assessment, environmental audit and monitoring of the environment;
g) Eliminate processes and activities that are likely to endanger the environment; and
h) Utilise the environment and natural resources for the benefit of the people of Kenya.

"Every person has the right to a clean and healthy environment, which includes the right—

(a) to have the environment protected for the benefit of present and future generations through legislative and other measures, particularly those contemplated in Article 69; and

(b) to have obligations relating to the environment fulfilled under Article 70" reads the excerpt from section 42 of the Constitution of Kenya, 2010.

Thus, every activity or project undertaken within the republic must be in tandem with the state's vision for the national environment as well as adherence to the right of every individual to a clean and healthy environment. The proposed irrigation project is a central development activity that utilizes sensitive components of the physical and natural environment hence need for clearly spelt out environmental management plan to curb probable adverse effects to the environment.

### 4.2.2 National Environment Action Plan (NEAP)

According to the Kenya National Environment Action Plan (NEAP, 1994) the Government recognized the negative impacts on ecosystems emanating from economic and social development programmes that disregarded environmental sustainability. In this regard, establishment of appropriate policies and legal guidelines as well as harmonization of the existing ones have been accomplished and/or are in the process of development. Under the NEAP process, EIA was introduced and among the key participants identified were the District Development Committees under the District Commissioner.

### 4.2.3 National Policy on Water Resources Management and Development

The National Policy on Water Resources Management and Development (1999) enhances a systematic development of water facilities in all sectors for promotion of the country's socio-economic progress, it also recognizes the by-products of this process as waste water. It, therefore, calls for development of appropriate sanitation systems to protect people's health and water resources from institutional pollution.

Development projects, therefore, should be accompanied by corresponding waste management systems to handle the waste water and other waste emanating there from. The same policy requires that such projects should also undergo comprehensive EIAs that will provide suitable measures to be taken to ensure environmental resources and people's health in the immediate neighbourhood and further downstream are not negatively impacted by the emissions.

In addition, the policy provides for charging levies on waste water on quantity and quality (similar to polluter-pays-principle) in which case those contaminating water are required to meet the appropriate cost on remediation, though the necessary mechanisms for the implementation of this principle have not been fully

established under the relevant Acts. However, the policy provides for establishment of standards to protect the water bodies receiving waste water, a process that is ongoing.

### 4.2.4 Sessional Paper No. 6 of 1999 on Environment and Sustainable Development

Among the key objectives of the Sessional Paper No. 6 of 1999 on Environment and Sustainable Development (1993) are: -

a. To ensure that from the onset, all development policies, programmes and projects take environmental considerations into account,
b. To ensure that an independent environmental impact assessment (EIA) report is prepared for any development before implementation,
c. To ensure that effluent treatment standards which will conform to acceptable health standards?

The policy recommends the need for enhanced re-use/recycling of residues including wastewater and increased public awareness raising and appreciation of clean environment as well as the participation of stakeholders in the management of wastes within their localities. Regarding human settlement, the paper encourages better planning in both rural and urban areas and provision of basic needs such as water, drainage and waste disposal facilities among others for decent housing of every family.

### 4.2.5 Vision 2030

Vision 2030 is divided into three fundamental pillars: Economic, Social and Political pillars. The social pillar aims at realizing a just and cohesive society enjoying equitable social development in a clean and secure environment.

Social Strategy, paragraph 5.4 of the strategy envisions Kenya becoming a nation that has a clean, secure and sustainable environment by 2030. So as to realize this strategy, provision of clean safe drinking water to the residents of Gatanga one of the stepping stones needed for realization of the strategy.

## 4.3. LEGAL FRAMEWORK

The key national laws that govern the management of environmental resources in the country have been briefly discussed below. It is noteworthy that wherever any of the laws contradict each other, the Environmental Management and Co-ordination Act 1999 prevails.

### 4.3.1 The Environment Management and Co-Ordination Act, 1999

According to the Environmental Management and Co-ordination Act (EMCA, 1999, Second Schedule Part XII) and subsequent Environmental (Impact and Audit) Regulations, 2003, it is mandatory to get environmental clearance for certain development projects. Generally, EMCA Act of 1999 regulates all other

interactions of development projects, water projects included, with the environment. It also paves the way for establishment of area-specific legislation to protect and conserve individual components of the environment.

**Relevance**

This applies in all aspects of the intervention project Augmentation and Rehabilitation of Gatanga water Supply. The Project shall maintain a clean and healthy environment and has a duty to safeguard and enhance environmental management, in operational phase, the project shall ensure that conservation of biological diversity (Aberdare) shall be observed. It will also ensure that air quality standards and be maintained as per NEMA's Standard and Enforcement Review Committee requirements. The proponent shall adhere to the disposal of wastes requirement in such a manner as not to cause pollution to the environment or ill health.

### 4.3.2 The Environmental (Impact Assessment and Audit) Regulations, 2003

This is a supplementary legislation to the EMCA Act of 1999. It gives additional "punch" to the essence of conducting Environmental Impact Assessments and Audits. It offers guidance on the fundamental aspects on which emphasis must be laid during field study and outlines the nature and structure of Environmental Impact Assessments and Audit reports. The legislation further explains the legal consequences of partial or non-compliance to the provisions of the Act.

**Relevance**

Water projects as an activity is listed on section 4 of the second schedule of the EMCA Act as among projects that require full Environmental Impact Assessments before commencement. The project cannot start before the license is granted, upon conducting the EIA. For this reason, this report has been drafted and forwarded to provide the legal satisfaction to the requirements of the Act.

### 4.3.3 The Environmental Management and Coordination (Wetlands, River Banks, Lake Shores and Sea Shore Management) Regulations, 2009

This is a supplementary legislation to the EMCA Act of 1999 with particular emphasis on management of wetland and wetland resources, river banks, lake shores and Sea shore.

Sections 4 and 5 of Part II as well as sections 16, 17, 18 of part III of the legislation provide guidelines for conservation and sustainable use and conservation of the said environmental components, and enhance them where necessary when carrying out any activity therein.

**Relevance**

The water project shall, in operation, abstract 3000m³/d of water from Kiama and Kimakia rivers thus affecting the characteristics of these rivers. It is thus

paramount that this legislation be integrated during planning, construction and operation of the project.

### 4.3.4 The Environmental Management and Coordination (Water Quality) Regulations, 2006

This subsidiary EMCA regulations apply to drinking water, water used for industrial purposes, agricultural purposes, recreational purposes, fisheries and wildlife, and any other purposes. It stipulates quality standards for sources and discharge of water to any environmental receptors within an activity area.

Section 6(c) of Part II of the legislation limits development activity to "…within full width of a river stream or a minimum of six metres and a maximum of thirty metres on either side of based on the highest flood level."

**Relevance**

The proposed Gatanga water project will abstract significant quantities of water from Rivers Kiama and Kimakia rivers. It is thus fundamental to regularly analyze water qualities at the intake points and check for conformity to stipulated legal standards in this supplementary legislation

### 4.3.5 The Environmental Management and Coordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006

This legislation aims at enhancing preservation of biodiversity and safeguarding of endangered and rare plant and animal species within any human activity area.

Section 4 of the legislation expressly prohibits any activity which may have adverse effects on any ecosystem, lead to introduction of alien species in a given area or result in unsustainable utilization of available ecosystem resources.

**Relevance**

Introduction of water infrastructure in the proposed area will result in removal of the existing natural vegetation. For this to occur, the relevant authority, NEMA in this case, will require a detailed EIA on the proposed project and projected impacts before issuing a license for commencement.

### 4.3.6 Environmental Management and Co-ordination (Waste Management) Regulations 2006

These are described in Legal Notice No. 121 of the Kenya Gazette Supplement No. 69 of September 2006. These Regulations apply to all categories of waste as provided in the Regulations. These include industrial wastes, hazardous and toxic wastes, pesticides and toxic substances, biomedical wastes and radio-active substances.

These Regulations outline requirements for handling, storing, transporting, and treatment/disposal of all waste categories as provided therein. Wastes contaminated with petroleum product are considered to be hazardous. The project will have to abide by these regulations in dealing with waste management especially the provisions of Industrial, Hazardous and toxic wastes which may be generated during operations.

**Relevance**

The proponent should ensure that waste is handled, stored, transported and disposed as per this regulation.

### 4.3.7 Environmental Management and Coordination (Noise and Excessive Vibration Pollution) Control Regulations, 2009

These Regulations prohibit making or causing any loud, unreasonable, unnecessary or unusual noise which annoys, disturbs, injures or endangers the comfort, repose, health or safety of others and the environment. It also prohibits the Contractor from excessive vibrations which annoy, disturb, injure or endanger the comfort, repose, health or safety of others and the environment or excessive vibrations which exceed 0.5 centimetres per second beyond any source property boundary or 30 metres from any moving source.

**Relevance**

Under the regulation the Contractor will be required to undertake daily monitoring of the noise levels within the project area during construction period to maintain compliance.

### 4.3.8 Water Act, 2002

Part II, section 3 states:" Every water resource is hereby vested in the State subject to any rights of user granted by or under this Act or any other written law. Under Section 5, the right to the use of water from any water resource is vested in the minister for the time being in charge of water resources except to the extent that it is alienated by or under the Act or any other written law. Consequently, a water permit must be obtained before using any water resource.

**Relevance**

Water is significant to the general operation of the proposed project. The construction would mean that more water would be needed for various activities. Management of this resource is therefore significant for the success of operations of the project. Pollution of water in the adjacent stream should also be avoided. Water Resources Management Authority has already approved Kimakia 3000$m^3$/day and Thika river 6000m/day

### 4.3.9 The Public Health Act (CAP. 242)

Part IX section 115 of the Act states that no person/institution shall cause nuisance or condition liable to be injurious or dangerous to human health. Section 116 requires Local Authorities to take all lawful, necessary and reasonably practicable measures to maintain their jurisdiction clean and sanitary to prevent occurrence of nuisance or condition liable for injurious or dangerous to human health. Such nuisance or conditions are defined under section 118 and include nuisances caused by accumulation of materials or refuse which in the opinion of the medical officer of health is likely to harbour rats or other vermin.

**Relevance**

**Section 115-** During construction, a nuisance is prohibited especially for all conditions liable to be injurious or dangerous to health.
**Section 118-** Outlines nuisance liable to be dealt with i.e. accumulation or deposit of refuse, offal, manure or any other which is offensive or injurious or dangerous to health and an accumulation of stone, timber or other machine likely to harbor rats or rodents.
**Section 126 rule 62 – Drainage & latrine rules-** It is a statutory requirement that drainage, latrines, septic and conservancy tanks and any other pre-treatment methods of sewerage effluents seek written permission or/and approval from the local authority and be built in conformity to provisions of sub-rules (a) to (e) of this section.

**Sections 136 – 143 Breeding places of mosquitoes-**The civil and building contractors will ensure that during construction, breeding places of mosquitoes and nuisance yards are kept free from bottles, whole or broken. The project area shall not be overgrown by grass, the wells etc to be covered together with the less pits. The gutters may be perforated; larva destroyed to eradicate mosquitoes completely as mere presence of mosquito larvae is an offence.

**Section 163 – Powers of entry and inspection -**It should be noted that a medical officer, health inspector or a police officer above the role of an inspector shall enforce compliance and offences are punishable by law.

### 4.5.10 Physical Planning Act (CAP 286)

Section 24 of the Physical Planning Act gives provision for the development of local physical development plan for guiding and coordinating development of infrastructure facilities and services within the area of authority of County, municipal and town council and for specific control of the use and development of land. The plan shows the manner in which the land in the area may be used. Section 29 of the physical Planning Act gives the county councils power to prohibit and control the use of land, building, and subdivision of land, in the interest of proper and orderly development of its area. The same section also allows them to approve all development applications and grant development permissions as well as to ensure the proper execution and implications of approved

physical development plans. On zoning, the act empowers them to formulate by-laws in respect of use and density of development.

Section 30 states that any person who carries out development within an area of a local authority without development permission shall be guilty of an offence and the development shall be invalid. The act also gives the local authority power to compel the developer to restore the land on which such development has taken place to its original conditions within a period of ninety days. If no action is taken, then the council will restore the land and recover the cost incurred thereto from the developer. In addition, the same section also states that no person shall carry out development within the area of a local authority without development permission granted by the local authority. At the same time, sub-section 5, re-enforce it further that, no licensing authority shall grant under any written law, a license for commercial use for which no development permission had been granted by the respective local authority.

Section 36 states that if in connection with development application a local authority is of the opinion that, the proposed activity will have injurious impact on the environment, the applicant shall be required to submit together with the application an Environmental Impact Assessment report. The environmental impact assessment report must be approved by the National Environmental Management Authority (NEMA) and followed by annual environmental audits as spelled out by EMCA 1999. Section 38 states that if the local authority finds out that the development activity is not complying to all laid down regulations, the local authority may serve an enforcement notice specifying the conditions of the development permissions alleged to have been contravened and compel the developer to restore the land to its original conditions.

**Relevance**

The Act is relevant during the operation of the facility which will be a responsibility of Gatanga Community Water and Sanitation Company which took over the responsibility of the local Authorities after the enactment of Water Act 2002.

### 4.3.11 Occupational Health and Safety Act 2007

This legislation provides for protection of workers during construction and operation phases. It is tailored at implementation of the EHS plan in compliance with the relevant sections of this Act.

**Subsection 17 - Drainage of floor-** Where any process is carried on which renders the floor liable to be wet to such an extent that the wet is capable of being removed by drainage, effective means shall be provided and maintained for draining off the wet.

**Subsection 18 - Sanitary conveniences -** Sufficient and suitable sanitary conveniences for persons employed in the factory/ work places shall be provided, maintained and kept clean, and effective provision shall be made for lighting the

conveniences and where persons of both sexes are, such conveniences shall afford proper separate accommodation for persons of each sex.

**Subsection 21 – Prime movers -** Every flywheel directly connected to any prime mover and every moving part of any prime mover, shall be securely fenced, whether the flywheel or prime mover is to be situated in an engine –house or not

a. Head and tailrace of every water wheel and of every water turbine shall be securely fenced.
b. Every part of electric generators, motors and rotary converters and every flywheel directly connected thereto shall be securely fenced unless it is in such a position or of such construction as to be safe to every person employed or working in the premises as it would be if securely fenced.

**Subsection 22 -Transmission Machinery-** Every part of transmission machinery shall be securely fenced unless it is in such a position or of such construction as to be safe to every person employed or working in the premises, as it would be if securely fenced. Efficient devices or appliances shall be provided and maintained in every room or place where work is carried on by which the power can promptly be cut-off from transmission machinery in that room or place.

Every machine intended to be driven by mechanical power shall be provided with an efficient starting and stopping appliance, the control of which shall be in such a position as to be readily and conveniently operated by the person operating the machine.

**Subsection 25 - Construction and maintenance of fencing**
All fencing or other safeguards provided in pursuance of the a foregoing provisions shall be of substantial construction, constantly maintained, and kept in position while the parts required to be fenced or safe guarded are in motion or in use except when any such parts are necessarily exposed for examination and for any lubrication or adjustments shown by such examination to be immediately necessary.

**Subsection 13 – Cleanliness -**Every factory/work place shall be kept in a clean state and free from effluent arising from any drain, sanitary convenience or nuisance.

**Subsection 14 – Overcrowding -**A factory/ work place shall not while work is carried on be so overcrowded as to cause risk of injury to the health of the persons employed therein. Standard cubic space allowed for every person in a workroom should not be less than three hundred and fifty cubic feet.

**Section 51 Air pollution -** Preventive measures shall be put in place during operation of the project to prevent fumes and exhaust gases from entering into the atmosphere.

**Relevance**

The Act is relevant both during construction and operation phases of the project due to the fact that the project will involve workers at all stages. Various health hazards are likely to emanate from the proposed project's activities such as workplace accidents. Health issues will therefore be integrated into the project to ensure safety of workers.

### 4.3.12 The Land Planning Act (CAP. 303)

Section 9 of the subsidiary legislation (The development and use of land regulations 1961) requires that before the local authorities submit any plans to the Minister for approval, steps should be taken as may be necessary to acquaint the owners of any land affected by such plans. Particulars of comments and objections made by the landowners should also be submitted. This is intended to reduce conflict with other interests such as settlement and other social and economic activities.

## 4.4. WORLD BANK OPERATIONAL POLICY

### 4.4.1 Environmental Assessment Operational Policy OP 4.01

Environmental Assessment is used in the World Bank to identify, avoid, and mitigate the potential negative environmental impacts associated with Bank lending operations, Augmentation and Rehabilitation of Gatanga Water Supply will result to numerous mild negative impacts to the environment which will be mitigated as the proposed project is categorized under category B under World Bank Categorizations criteria

**Category A**: A proposed project is classified as Category A if it is likely to have significant adverse impact on the environment. A project with complicated impact or unprecedented impact which are difficult to assess is also classified as Category A. The impact of Category A projects may affect an area broader than the sites or facilities subject to physical construction.

**Category B:** A proposed project is classified as Category B if its potential adverse environmental impact is less adverse than that of Category A projects. Typically, this is site-specific, few if any are irreversible, and in most cases normal mitigation measures can be designed more readily.

**Category C:** A proposed project is classified as Category C if it is likely to have minimal or no adverse environmental impact. Projects that correspond to one of the following are, in principle, classified as Category C,

Augmentation and Rehabilitation of Gatanga Water Supply is a project whose impacts to the environment are less adverse to the environment and can be

mitigated as they are site specific. The project does not traverse in any protected habitat, international water way, indigenous persons regions.

### 4.4.2 Natural Habitats OP 4.04

This policy seeks to ensure that World Bank-supported infrastructure and other development projects take into account the conservation of biodiversity, as well as the numerous environmental services and products which natural habitats provide to human society. The policy strictly limits the circumstances under which any Bank-supported project can damage natural habitats (land and water areas where most of the native plant and animal species are still present).

Specifically, the policy prohibits Bank support for projects which would lead to the significant loss or degradation of any Critical Natural Habitats, whose definition includes those natural habitats which are either:

- legally protected,
- officially proposed for protection, or
- unprotected but of known high conservation value.

In other (non-critical) natural habitats, Bank supported projects can cause significant loss or degradation only when there are no feasible alternatives to achieve the project's substantial overall net benefits and acceptable mitigation measures, such as compensatory protected areas, are included within the project.

### 4.4.3 Water Resources Management OP 4.07

This deals with water resources management in terms of provision of portable water, sanitation facilities, flood control and water for productive activity. It calls for economical viability, environmental sustainability and social equitability. The policy is relevant to the project because of sound management of water resources. This policy is triggered by the use of water resources for provision of safe drinking water.

### 4.4.4 Physical Cultural Resources OP 4.11

This directive defines the cultural property as having archaeological, palaeontological, historical, religious and unique natural values. There are no known physical cultural resources within the proposed site thus this policy may be not be triggered.

### 4.4.5 Involuntary Resettlement OP 4.12

The Bank's OP 4.12 is triggered in situations involving involuntary taking of land and involuntary restrictions of access to legally designated parks and protected areas. The policy aims to avoid involuntary resettlement to the extent feasible, or to minimize and mitigate its adverse social and economic impacts.

It promotes participation of displaced people in resettlement planning and implementation, and its key economic objective is to assist displaced persons in their efforts to improve or at least restore their incomes and standards of living after displacement.

The policy prescribes compensation and other resettlement measures to achieve its objectives and requires that borrowers prepare adequate resettlement planning instruments prior to Bank appraisal of proposed projects.

### 4.4.6 Operational Policy/Bank Procedure 4.36: Forests

The Bank's current forests policy aims to reduce deforestation, enhance the environmental contribution of forested areas, promote afforestation, reduce poverty, and encourage economic development.

Combating deforestation and promoting sustainable forest conservation and management have been high on the international agenda for over two decades. However, little has been achieved so far and the world's forests and forest dependent people continue to experience unacceptably high rates of forest loss and degradation. The Bank is therefore currently finalizing a revised approach to forestry issues, in recognition of the fact that forests play an increasingly important role in poverty alleviation, economic development, and for providing local as well as global environmental services.

Success in establishing sustainable forest conservation and management practices depends not only on changing the behavior of all critical stakeholders, but also on a wide range of partnerships to accomplish what no country, government agency, donor, or interest group can do alone.

The new proposed Forest Strategy suggests three equally important and interdependent pillars to guide future Bank involvement with forests:

- Harnessing the potential of forests to reduce poverty,
- Integrating forests in sustainable economic development, and
- Protecting vital local and global environmental services and forest values.

This policy may not be triggered since the nearest forest which is Aberdare forest is not within the project area.

## 4.5. INTERNATIONAL CONVENTIONS AND TREATIES

### 4.5.1 Convention on Biological Diversity

This global convention was held to foster conservation and sustainable use of biological resources, so as to preserve their diversity for posterity. Kenya is a signatory to this convention, having ratified it in 1994. The provisions of this Convention have since been integrated in the laws of Kenya, climaxed by the

development of the Kenya National Biodiversity Strategy and Action Plan in 2000 by the then Ministry of Environment and Natural Resources.

In line with the spirit of the convention, there is need to integrate biodiversity consideration in to the proposed water project as the associated activities will impact on the plant species in the area.

### 4.5.2 African Convention on the Conservation of Nature and Natural Resources

It was held on 15th September, 1968 in Algiers. The convention sought to awaken the continent on the need to preserve natural ecosystems and employ sustainable used of natural resources of economic importance, particularly the soil, water, flora and fauna.

The proposed water supply project should therefore be carried out in conformity to the inter-governmental agreement at the convention, of which Kenya is a signatory.

### 4.5.3 The 1992 United Nations Framework Convention on Climate Change (UNFCCC)

The primary purpose of the convention is to establish methods to minimize global warming and in particular the emission of the greenhouse gases. The UNFCCC was adopted on 9th May 1992 and came into force on 21st March 1994. The Convention has been ratified by 189 states. Kenya ratified the Convention on 30th August 1994.

**Kyoto Protocol to the United Nations Framework Convention on Climate Change**

The Kyoto Protocol requires signatories to the United Nations Framework Convention on Climate Change to reduce their green house emissions levels to 5% below 1990 levels by the year 2012. The Protocol came into force on 16th February 2005, after it received the pre-requisite signatures. However, major countries like United States, China, India, and Australia are not signatories to the Protocol.

Compliance with this convention will largely inform the technical and environmental evaluation of the project if any additional funding may be required in future. There is thus a necessity that proper adherence to minimal carbon emission levels be ensured during the operational phases of the project.

## 4.6. INSTITUTIONAL FRAMEWORK

The National Policy on Water Resources Management and Development and the Water Act 2002, presently guides water resources management. The overall goal

of the national water development policy is to facilitate the provision of water in sufficient quantity and quality and within a reasonable distance to meet all competing uses in a sustainable, rational and economical way. This policy separates policy formulation, regulation and services provision and defines clear roles for sector actors within a decentralized institutional framework and includes private sector participation and increased community development.

Under the policy, the Ministry of Water, Environment and Natural Resources is responsible for policy development, sector co-ordination, monitoring and supervision to ensure effective Water and Sewerage Services in the Country, sustainability of Water Resources and development of Water resources for irrigation, commercial, industrial, power generation and other uses. The Ministry of Environmemt, Water and Natural Resources executes its mandate through the following sector institutions:

### 4.6.1 Water Services Regulatory Board (WASREB)

The regulatory Board is responsible for the regulation of the water and sewerage services in partnership with the people of Kenya. The mandate of the regulator covers the following key areas;

a. Regulating the provision of water and sewerage services including licensing, quality assurance, and issuance of guidelines for tariffs, prices and disputes resolution.
b. Overseeing the implementation of policies and strategies relating to provision of water services licensing of Water Services Boards and approving their appointed Water Services Providers,
c. Monitoring the performance of the Water Services Boards and Water Services Providers,
d. Establish the procedure of customer complaints,
e. Inform the public on the sector performance,
f. Gives advice to the Minister in charge of water affairs.

### 4.6.2 Water Resources Management Authority (WRMA)

The authority is responsible for sustainable management of the Nations Water Resources;

a. Implementation of policies and strategies relating to management of Water resources
b. Develop principles, guidelines and procedures for the allocation of water,
c. Development of Catchments level management strategies including appointment of catchments area advisory committees,
d. Regulate and protect water resources quality from adverse impacts,
e. Classify, monitor and allocate water resources.

### 4.6.3 Water Services Trust Fund (WSTF)

This body assists in the financing of the provision of Water Services to areas of Kenya which are without adequate water services. This shall include providing financing support to improved water services towards;

a. Capital investment to community water schemes in under served areas
b. Capacity building activities and initiative among communities
c. Water services activities outlined in the Water Services Strategic Plan as prioritised by the Government
d. Awareness creation and information dissemination regarding community management of water services
e. Active community participation in the management of water services

### 4.6.4 Water Services Boards (WSBS)

The WSBs are responsible for the efficient and economical provision of water and sewerage services in their areas of jurisdiction. Athi Water Service Board is among the seven catchment Boards established under the Act mandated to;

a. Develop the facilities, prepare business plans and performance targets
b. Planning for efficient and economical provision of Water and sewerage services within their areas of jurisdiction;
c. Appointing and contracting Water Service Provider
d. Asset holding of Central Government facilities

### 4.6.5 Water Services Providers (WSPS)

Water Service Providers are the utilities or water companies. They are state owned but have been commercialized to improve performance and run like business within a context of efficiency, operational and financial autonomy, accountability and strategic, but minor investment. In AWSB, there are 14 WSPs among them the Nairobi Water and Sewerage Company.

### 4.6.6 National Environment Management Authority (NEMA)

The authority is mandated to carry out, among others, the following activities in the sector;

- Promote the integration of environmental considerations into development policies, plans, programmes and projects, with a view to ensuring the proper management and rational utilization of environmental resources, on sustainable yield basis, for the improvement of the quality of human life in Kenya.
- Undertake and coordinate research, investigation and surveys, collect, collate and disseminate information on the findings of such research, investigations or surveys.
- Identify projects and programmes for which environmental audit or environmental monitoring must be conducted under this Act.
- Initiate and evolve procedures and safeguards for the prevention of accidents,

which may cause environmental degradation and evolve remedial measures where accidents occur e.g. floods, landslides and oilspills.

- Undertake, in cooperation with relevant lead agencies, programmes intended to enhance environmental education and public awareness, about the need for sound environmental management, as well as for enlisting public support and encouraging the effort made by other entities in that regard.
- Render advice and technical support, where possible, to entities engaged in natural resources management and environmental protection, so as to enable them to carry out their responsibilities satisfactorily.

### 4.6.7 Provincial and District Environmental Committees

These are Government's representatives in the provincial and district level. They are mandated to perform the following functions on behalf of NEMA:

- Responsible for the proper management of the environment within the province in respect of which they are appointed.
- Perform such additional functions as are prescribed by the Act or as assigned by the Minister.

# 5. ANALYSIS OF PROJECT ALTERNATIVES

The Environmental Impact Assessment Study should identify and assesses alternatives to the proposed development/project. Only the best alternative (one with the least adverse impacts) should be selected based on less negative impacts and cost-benefit analysis. An important alternative to be analysed always is the "no project". This is a very important analysis because it helps the proponents measure the impacts from the project against those which would have taken place without the project. In this section, the alternatives to the proposed Gatanga Water Supply Project is discussed.

## 5.1. PROJECT AS DESCRIBED IN THE REPORT

The existing Gatanga Water Supply System that dates back to mid 80s and 90s when pollution was still low and available water infrastructure was adequate for the population. Other factors that have remained constant are water pipe network and lack adequate investment in water investment in the region.

The current population is estimated at 130,000 from the 2009 census report which is way beyond the existing system design. The projected water demand stands at 9880m3/day while the system in place has a capacity of producing 6,310m3/day, leaving a shortfall of 3570 m3/day.

The current water schemes (Thika, Kimakia and Kiama) serving Gatanga District tap raw water from the Aberdare forest and distribute the raw water with partial treatment and in some instances without treatment, it therefore implies that, water currently consumed within Gatanga sub-county may be contaminated.

The current water supply serves only 45% of Gatanga population, thus the need to construct additional water lines and extensions to areas that were not connected initially and whose residents entirely depend on roof catchments and raw water from nearby streams.

The project will involve augmentation of already existing systems which implies that no majority of the infrastructure will be setup in areas of already existing infrastructure and no new acquisition is envisaged. Areas where land will be acquired, proper land acquisition process as stipulated in Land Acquisition Act and World Bank OP 4.12 on Involuntary Resettlement will be adopted. To address the above problems urgent intervention are required through rehabilitation and argumentation of Gatanga water supply to ensure that residents get adequate ,safe and clean water as now required by Kenyan new constitution.

## 5.2. NO PROJECT ALTERATIVE

The no-action alternative is often defined by the baseline information and is crucial in the assessment of impact because other alternatives are weighed with reference to it. This alternative would mean that the project does not proceed.

Without the project, the environmental situation will neither improve nor can we say that it will necessarily deteriorate. Development of the project on the other hand will improve water provision to the communities living within Gatanga Sub-county. The no-project option will however lead to the following (general) major negative and long term impacts:

- The targeted populations (for water provision) will continue to use raw water which is currently being supplied;
- Increased exposure to health risks (water borne diseases);
- Threatened Food Security of the district;
- Stagnating growth of the district;
- There will be loss of productivity and reduced ability to create wealth.

This scenario is not acceptable on either social or environmental grounds.

## 5.3. LOCATION OF THE TREATMENT PLANTS

Location of the treatment plant is an important aspect considered during the preliminary design and conceptualization of the project conducted by Gatanga Community Water and Sanitation Company, a number of factors were considered to ensure proper site is selected for the treatment systems, factors considered include;

a. Elevation of the area which allows gravity flow of treated water through distribution lines to consumers the elevations are 2266.26m for Kiama partial and 2237.81m for Kimakia full treatment while downstream Rwegethe site is 1797.07m
b. To minimize resettlement and land acquisition, sites for Kiama 3000$m^3$/day and 4000$m^3$/day are all located at existing water tanks premises belonging to Gatanga Community Water Company.
c. The sites are all located outside the electric fence of the Aberdare forest an indication of zero wildlife interference

## 5.4. TECHNOLOGY CHOICE

Laboratory results of water sampled from the intake weirs of the proposed project indicate limited turbidity of ≤ 5 NTU for Kiama and slightly ≥5 but less than 6 NTU for Kimakia, therefore partial treatment for Kiama proposed while full conventional for Kimakia and Kiama Kimakia at Rwegetha is proposed. The intake weirs are located in areas with limited human activities hence the problem of siltation and turbidity is not much least for microbial due to wildlife animals drinking from the rivers.

# 6. PUBLIC CONSULTATIONS AND PARTICIPATION

## 6.1. BACKGROUND

Public consultation is useful for gathering environmental data, understanding likely impacts, determining community and individual preferences, selecting project alternatives and designing viable and sustainable mitigation and compensation plans.

Public consultation process for the Gatanga Water Supply Project took place at the scoping stage and the ESIA stage. The main objective for the consultation process was to involve the community at the very early stages so as to identify likely negative impacts and find ways to minimise negative impacts and enhance positive impacts of the project.

### 6.1.1 Objectives of the Public Consultations

The overall goal of the consultation process is to disseminate project information and to incorporate the views of the project beneficiaries and Project Affected Persons (PAPs) in the design of the mitigation measures and a management plan.

The specific aims of the consultation process are to:

- Improve Project design and, thereby, minimize conflicts and delays in implementation;
- Facilitate the development of appropriate and acceptable entitlement options;
- Increase long term project sustainability and ownership;
- Reduce problems of institutional coordination;
- Make the resettlement process transparent; and
- Increase the effectiveness and sustainability of income restoration strategies, and improve coping mechanisms.

An important element in the process of impact assessment is consulting with stakeholders to gather the information needed to complete the assessment.

The main objectives of community consultations were to:

- Provide clear and accurate information about the project to the beneficiary community;
- Obtain the main concerns and perceptions of the population and their representatives regarding the project;
- Obtain opinions and suggestions directly from the affected communities on their preferred mitigation measures; and
- Identify local leaders with whom further dialogue can be continued in subsequent stages of the project.

## 6.2. PUBLIC CONSULTATIONS DURING THE SCOPING STAGE

Public participation forums were organized through administration of an open ended questionnaire aimed at introducing the project to the residents, gathering their views and concerns related to the project and incorporating their views into the project. Questionnaires were administered in the following areas earmarked to benefit from the project; Gitemi, Ndakaini, Gitiri, Gatura, Gathaithi, Rwegetha, Chomo, Gatanga, Kariara and Gatanga. The sample questionnaires used the guiding questions below;

a. What is the integrity of the existing distribution network?
b. Is the water supply capacity adequate to provide the additional water demand to meet expanded system and expectations of the consumers?
c. How sustainable is the supply in the long run?
d. Is there a monitoring procedure and components for the water distributed and supplied to track losses and value of water supplied?
e. What is the level of ability and willingness to pay for water as a justification for the rehabilitation and expansion of the water supply?
f. What are implications to the physical environment (drainage, sanitation and hygiene) in the project area following the proposed works?
g. What are the social and economic implications of the works and the additional water supply?

The summary of comments from the respondent interviewed are summarized in Table 6-1

**Table 6-1: Summary of views of Gatanga residents concerning the project**

| Date of Questionnaire administration | Interviewee | Location Market | Comments |
|---|---|---|---|
| **01/03/2012** | Jane Njoki Kinuthia | Gitemi | • She says water borne related illness has been on the rise due to the fact that, there is no pre-treatment to some of the water they use domestically.<br>• No major effect on the current water sources if project implemented |
| | Martin Sambu | Ndakaini | • He relies on roof catchments and stream sources that are adversely affected during drought periods.<br>• This he said, resulted to poor hygiene and spent a lot of money buying water for domestic use. |
| | Samwel Chege | Gitiri | • Water rationing sometimes forces them to use untreated water that has affected them negatively.<br>• They don't have suitable chemicals for water treatment.<br>• Small tanks that they have, do not keep water for long. |
| | Njoroge Kenneth | Gatura | • He indicated that there would be no negative effect coming from the proposed project on the current water sources and the surrounding environment. |
| | Elizabeth Wanjiru | Gathaithi | • Water rationing affects her domestic operations. Therefore she wishes to have a constant supply from the water kiosks.<br>• More water kiosks to be established. |
| | Ziporah Wanjiru | Rwagetha | • She buys water expensively and sometimes is forced to walk longer distance in such of water.<br>• Adequate supply be pro |
| | Milka Wangoi | Chomo | • Proposes the project because will provide safe water for domestic uses.<br>• Enable equitable distribution to every location. |
| | Michael Mwaura | Chomo | • He buys water expensively, he proposes the project if that would reduce tariff and increase availability throughout the week. |

| Date of Questionnaire administration | Interviewee | Location Market | Comments |
|---|---|---|---|
| | Mwangi Geofrey | Gatanga | • He has small water tanks that do not sustain his family for longer period.<br>• Typhoid, Diarrhea has been on the rise for the last years |
| | Titus Njugu | Kariara | • The existing water supply does not meet his weekly demand because of rationing.<br>• He does not treat water from the roof catchments, the chemical are expensive and unavailable. |
| | Antony Karanja | Gatanga | • Water rationing affects his domestic operation and farming operations.<br>• He supports the project and confirms that there will be no environmental hazard that will arise from the proposed project. |
| | John Wainaina | Gatura | • Uses well water frequently.<br>• They don't apply chemical for pre-treatment, they are unavailable.<br>• He wishes to have a safe water supply that will improve their hygiene. |

## 6.3. CONSULTATIONS DURING THE FULL ESIA STAGE

Both stakeholder and public consultations were held during the full ESIA stage.

### 6.3.1 Stakeholder consultations

Key informant interviews were held on 28 August 2014 with several Sub-county heads within Gatanga. A summary of the discussions are as shown in Table 6-2 below. The consultation list is as shown in Appendix 3.

**Table 6-2: Summary of discussions with key stakeholders within Gatanga Sub-county**

| No. | Name | Comments |
|---|---|---|
| 1. | Margaret N Kamau – Technical Manager: Gatanga Water | • The manager acknowledged that the water provision within their area of jurisdiction will improve;<br>• Gatanga Community Water Scheme is currently providing water once in 14 days;<br>• Not all their customers are metered making it difficult to estimate their uptake volumes. AWSB should facilitate them in metering all their customers so as to enable comparison of input and output;<br>• She proposed that 5% of the water from the proposed Kigoro treatment works be reserved to serve Gatanga community. |
| 2. | Oddilliah Ndeti – Assistant County Commissioner (ACC1) | • She welcomed the project as Gatanga people have water problems;<br>• She stressed that compensation should be done at market rate;<br>• She will be available to offer any assistance during the implementation of the project. |
| 3. | Phares M Njue – Sub-county Public Health Officer | • The officer was in support of the project;<br>• Amoebiasis including typhoid and diarrhoea prevalence is very high in the sub-county. This is according to the district hospital statistics;<br>• Hygiene is low in the area. They intent to make Gatanga Sub-county Open Defecation Free (ODF). They requested AWSB to assist |

| No. | Name | Comments |
|---|---|---|
| | | in implementing Community Led Total Sanitation (CLTS) due to low latrine coverage. They have 250 villages and none is open defecation free. They suggest that each household should have a latrine and hand washing facility. The public health officer requested for assistance through training of 22 public health officers and sensitization campaign;<br>• Jiggers are also a problem in the area with about 240 households infested with jiggers. They have tried recarpeting floors of these households to reduce dust. They encourage putting gutters and buying 1000L water tanks for water harvesting. This water will be used to clean the floors;<br>• Consider solid waste management in the markets<br>• They have 17 community health units with a minimum of 20 people.<br>• Consider protection of 10 springs which help in increasing yield and diversion of surface contamination;<br>• They have a total of 37 health facilities including 23 under GoK, 4 faith-based, 8 private clinics and 2 private company clinics. |
| 4. | Titus N Mukunzi - Sub-County Agriculture Officer | • Land in Gatanga sub-county is very small with farmers owning an average of 1-11/2 acres;<br>• The project will lead to restriction of use of land;<br>• Trees that have taken long to mature will be fell thus a negative impact of the project;<br>• Soil erosion will occur due to excavations;<br>• There might be possible impact on farm structures;<br>• Coffee/tea/avocado/ macadamia /maize /beans/ bananas/vegetables are common crops in the area;<br>• What are the impacts of use of treated water by dairy cows;<br>• Solid waste such as plastic pipes and other debri should be properly managed since they can be eaten by domestic animals. |

| No. | Name | Comments |
|---|---|---|
| | | |
| 5. | Peter Gituru – Sub-county Water Officer | • He said the project is welcomed as it is long overdue;<br>• Some parts of Gatanga such as Kihubuine division and Samuru are very dry and should be considered or have a dedicated line for these areas;<br>• Other upcoming estates such as Golf View and Thika Greens will need a lot of water. |
| 6. | David Mbugua – Nairobi Water Company | • Nairobi Water Company is in support of the project and they believe it's a good idea since water supply to Ndakaini area will improve. They are currently getting water twice a week;<br>• They have initiatives such as Ndakaini Marathon where proceeds go to the community.<br>• They also give water tanks to organised groups and schools. |
| 7. | Alex Multhyoi - Sub-county Development Planning Officer | • The<br>• Water demand in the area is more than supply;<br>• The population is increasing and the system needs to be overhauled since its very old;<br>• The current water is untreated;<br>• Project will improve demand;<br>• Consider water for irrigation in future;<br>• There is problem of illegal connections and unaccounted for water;<br>• Consider improving the infrastructure for distribution as the current infrastructure is old;<br>• Githanga, Mintubioi and Kakuzi have water shortage and it's very dry. These areas should be provided with water. |

### 6.3.2 Public Sensitization

Public sensitization and inclusion meetings were held within the project area during the full ESIA study with the help of Gatanga Water as shown in Table 6-3 below. The attendance lists and minutes of meetings are presented in Appendix 4.

**Table 6-3: Public consultation meetings and clinics during ESIA**

| Date | Day | Time | Venue |
|---|---|---|---|
| 02/09/2014 | Tuesday | 10:00 am | Chomo Centre |
| 03/09/2014 | Wednesday | 10:00 am | Karangi Tea Buying Centre |
| 03/09/2014 | Wednesday | 2:00 pm | Ndakaini Centre |

Presented below are the main concerns and issues that arouse from the sensitization meetings:

- That the water project is long overdue. More water should be provided to the community since they are currently receiving very little water;
- The community is not taking water during the rainy season as the water becomes turbid and smelly. This is because the water is not treated;
- There is constant blockage of meters and the service lines due to the turbid water being supplied;
- The water pressure is low;
- The water is expensive considering that it was started as a community project in 1973;
- The project has taken too long to commence since valuation of the affected persons were undertaken a while back;
- People who are not connected with the current system requested for connections;
- The youth should be considered for employment during the construction phase;
- The community insisted that water should not be taken to Nairobi who are being given first priority;
- Ensure that the project has enough storage tanks;
- More community sensitization should be undertaken so that the whole community can support the project.

# 7. ASSESSMENTS OF ENVIRONMENTAL AND SOCIAL IMPACTS

Economic, social and environmental change is inherent to development. Whilst development aims to bring about positive change it can lead to conflicts. In the past, the promotion of economic growth as the motor for increased wellbeing was the main development thrust with little sensitivity to adverse social or environmental impacts. The need to avoid adverse impacts and to ensure long term benefits led to the concept of sustainability. This has become accepted as essential feature of development if the aim of increased wellbeing and greater equity in fulfilling basic needs is to be met for this and future generations.

Reliable water availability is considered to be critical to economic growth and poverty reduction especially in agricultural zones that support urban and industrial activities through provision of raw materials and food supply. With increasing pressure on land for agriculture and settlement, water resources come under serious threat of degradation.

Socio – economic needs of a particular community entirely require water, over abstraction from sources, infrastructure maintenance, management of related wastewater and ecological balance and sustenance is among the problems associated with public water supplies.

Augmentation and Rehabilitation of Gatanga Water Supply have far reaching social and economic implications that need to be addressed throughout the project cycle. The effects are mainly positive calling for enhancement and the negative ones calling for mitigation.

The Environmental and Social Impact Assessment (ESIA) has been systematically conducted to determine whether or not the proposed project will have a diverse impact on the environment. The EMCA No.8 of 1999 provides the legal and statutory guideline for the Environment and Social Impact Assessment process in Kenya.

Therefore this ESIA is a formal process to predict the environmental consequences of the proposed developments and to plan appropriate measures to eliminate or reduce adverse effects and to augment positive impacts:

The ESIA thus has three main functions:

- To predict problems/ impacts;
- To find ways to avoid them,
- To enhance positive effects / impacts.

This chapter will highlight significant impacts which will be induced by the proposed Gatanga Water Supply Project.

To this end, the focus of this chapter will be:

- To identify and analyze the extent of the environmental and social impacts from the project;
- To assess the environmental impacts of the operation and maintenance activities;
- To assess the social impacts from the project;
- To discuss the decommissioning of the project.

## 7.1. DEFINITION AND CLASSIFICATION OF ENVIRONMENTAL IMPACTS

An environmental impact is any change to the existing condition of the environment caused by human activity or an external influence. Impacts may be:

- Positive (beneficial) or negative (adverse);
- Direct or indirect, long-term or short-term in duration, and wide-spread or local in the extent of their effect.

Impacts are termed cumulative when they add incrementally to existing impacts. In the case of the project, potential environmental impacts would arise during the construction and the operations phases of the project and at both stages positive and negative impacts would occur.

### 7.1.1 Impact significance

The purpose of this ESIA study report is to identify the significant impacts related to the project or activity under consideration and then to determine the appropriate means to avoid or mitigate those which are negative.

Significant impacts are defined, not necessarily in order of importance, as being those which:

- Are subject to legislative control;
- Relate to protected areas or to historically and culturally important areas;
- Are of public concern and importance;
- Are determined as such by technically competent specialists;
- Trigger subsequent secondary impacts;
- Elevate the risk to life threatening circumstances; and
- Affect sensitive environmental factors and parameters.

### 7.1.2 Impact identification

The study has predicted and evaluated anticipated impacts using acceptable standard methods of impact prediction and evaluation. The significance of impacts is subjective, and expert judgments were used. Public participation and consultation with a wide sector of the community were conducted to reduce uncertainty. Table 7-1 overleaf summarizes the anticipated environmental problems observed which may be created by the project.

**Table 7-1: Summary of environmental impacts for Gatanga Water Supply**

| Environmental and social impact | Positive/ negative | Direct / indirect | Temporary /permanent | Major / Minor | Occurrence | |
|---|---|---|---|---|---|---|
| | | | | | Design and Construction | Operation |
| Employment opportunities | Positive | Direct/In direct | Permanent/ Temporary | Major | ✓ | ✓ |
| Stimulation of local economy | Positive | Direct | Permanent | Minor | ✓ | ✓ |
| Increased water quality and quantity | Positive | Direct | Permanent | Major | - | ✓ |
| Improved living standards of Gatanga residents | Positive | Direct | Permanent | Major | - | ✓ |
| Reduced exposure to health risks | Positive | Direct | Permanent | Major | - | ✓ |
| Improved food security and nutrition | Positive | Direct | Permanent | Minor | - | ✓ |
| Sustainability of Gatanga Community Water and Sanitation Company | Positive | Direct | Permanent | Major | - | ✓ |
| Enhanced gender and participation in employment | Positive | Direct | Permanent | Minor | - | ✓ |
| Education benefits to girl child | Positive | Direct | Permanent | Minor | - | ✓ |
| Vegetation loss | Negative | Direct | Permanent- | Major | ✓ | - |
| Soil loss | Negative | Direct | Permanent | Minor | ✓ | - |
| Air quality issues | Negative | Direct | Temporary | Minor | ✓ | - |
| Noise and vibration | Negative | Direct | Temporary | Minor | ✓ | ✓ |
| Generated wastes | Negative | Direct | Temporary | Minor | ✓ | ✓ |
| Visual impacts | Negative | Indirect | Permanent | Minor | ✓ | ✓ |
| Potential impact on traffic | Negative | Direct | Temporary | Minor | ✓ | - |
| Accidental spills & leakages | Negative | Direct | Temporary | Minor | ✓ | - |
| Surface water run-off | Negative | Direct | Temporary | Minor | ✓ | - |
| Occupational Health and Safety Risks | Negative | Direct | Temporary | Major | ✓ | ✓ |
| Requirement and use of local building materials | Negative | Direct | Temporary | Minor | ✓ | - |
| Land take | Negative | Direct | Permanent | Major | ✓ | - |
| Environmental Pollution | Negative | Direct | Permanent | Minor | - | ✓ |

| Environmental and social impact | Positive/ negative | Direct / indirect | Temporary /permanent | Major / Minor | Occurrence | |
|---|---|---|---|---|---|---|
| | | | | | Design and Construction | Operation |
| from Gray water | | | | | | |
| Impacts on drainage and hydrology | Negative | Direct | Permanent | Major | - | ✓ |
| Solid waste generation and disposal | Negative | Direct | Temporary | Minor | - | ✓ |
| Sludge management | Negative | Direct | Permanent | Minor | - | ✓ |
| Backwash water | Negative | Direct | Permanent | Minor | - | ✓ |
| Chemical handling | Negative | Direct | Permanent | Minor | - | ✓ |
| Emergency preparedness | Negative | Direct | Permanent | Minor | - | ✓ |

## 7.2. POSITIVE IMPACTS DURING CONSTRUCTION

The following are environmental and social benefits associated with Augmentation and Rehabilitation of Gatanga Water Supply

### 7.2.1 Employment opportunities

The construction of the proposed water project will create employment opportunities both directly and indirectly during construction phase. Most people will be employed as skilled and semi-skilled workers. This will open up new positions for both men and women.

### 7.2.2 Stimulation of the local economy

The construction phase of the project is characterised by an influx of new people into the project area. An increase population will create a corresponding increase in demand for goods and services such as food for construction workers, housing, basic items and need for transport. This need will be filled by people living within the project area where local women will provide food vending services, homes will rent out spaces for the new population and shops will also benefit from increase of sales. All these avenues are bound to stimulate the local economy.

Construction phase will also stimulate local economy through procurement of construction material and provision of labour by the locals. This will lead into increased capital flow and demand for goods and services will increase.

## 7.3. ANTICIPATED NEGATIVE IMPACTS DURING CONSTRUCTION

### 7.3.1 Anticipated loss of vegetation cover

An unavoidable part of any development in general is the clearance and loss of areas of vegetation which currently characterise the site of the development area. During construction, a small amount of vegetation will be cleared to give way for the proposed water pipelines. This is because some of the infrastructure already exists. Riverine vegetation will also be cleared around the Kiama and Kimakia intakes and proposed treatment plant area at Rwegetha. Not only may vegetation be lost, but also faunal habitats may also be lost or at least partly destroyed. In addition, the removal of areas of vegetation could mean that the same degree of interception will no longer occur, and consequently increased run-off might be expected.

The significance of the vegetation loss (where vegetation is still existing) during the site clearance (where necessary) is minimal.

***Mitigation***

- Retention of trees and shrubs, where possible on the potential sites for screening of the visual impact;
- Where the proposed route requires the removal of any vegetation, care will be taken to minimize the destruction or damage of trees.
- Re planting of destroyed trees in cleared areas where works are complete.

### 7.3.2 Soil Loss

Soil types develop over significant timescales, consequently these soils are not an unlimited resource, and could typically be lost or damaged during development activities. Soils at the development site (s) are unlikely to be adversely affected by construction activities.

As most, if not all soils in which or on which construction will take place, are disturbed already due to agricultural activities, the environmental impact of the construction activities is considered minimal.

***Mitigation***

- Pile the top soil where it can be reused;
- Program of Works should be prepared in line with Aberdare region weather pattern so as to avoid such works during rainy seasons;

- Restrict disturbance to soil structure within project site;
- Put measures for protection of soil erosion (berming of loss soil);
- Installing necessary temporary and permanent drainage works;
- Minimize excavations to only the designated sections.

### 7.3.3 Air Quality Issues

Construction unavoidably creates dust during the course of site works due to material and vehicle movement and construction activities. Fine particles may also be lifted from exposed surfaces by the action of wind, although the extent and nature of the generated dusts is dependent upon the materials to be used.

Dusts, particularly finer particulates, can present respiratory problems when inhaled, as well as potential allergic reactions. In addition, dusts can cause nuisance problems when redeposited and can hinder visibility. However it is considered unlikely that ambient air quality standards will be exceeded.

No air quality monitoring data is available for the area however, given the absence of any significant industrial and commercial processes in the area, it is considered that the air quality will be good.

Experience of construction projects suggests that, whilst dust generation will inevitably occur for short duration, its extent and impact will be minimal and of minor concern.

***Mitigation***

- Provision should be made available for water sprays to be used when dusts are being generated or at times of strong wind;
- All materials stored or stockpiled on site should be adequately covered;
- Maintain machineries at manufacturers specifications;
- Where unavoidable, construction workers working in dusty areas should be given dust masks;
- Limit removal of vegetation and a rehabilitation programme on site and associated infrastructure following construction.

### 7.3.4 Noise and Vibration

Noise can have a significant effect on the environment and on the quality of life enjoyed by individuals and communities. The perception of noise may be reflected by many factors (acoustic and non-acoustic) but in general the impact in response to a noise depends on the level of noise, the margin by which it exceeds the background level, its spectral character and temporal variation. Other factors may also be important including time of day, day of the week, duration and other acoustic features.

Vibrations, even very low magnitude, may be perceptible to people and can interfere with the satisfactory conduct of certain activities. Noise will be generated during the

construction works by both the use of machinery, movement of materials and the movement of vehicles, and could cause a nuisance to local residents. No present significant noise impacts have been identified in the area.

The works are considered not to present a significant any impact in terms of noise and vibration generation. However, short term nuisance and inconvenience will be experienced by land residents.

***Mitigation***

- Use equipment that is properly fitted with noise reduction devices such as mufflers;
- Use equipment that have low noise emissions as stated by the manufacturers;
- Standard restrictions to hours of site works;
- Workers should be provided with personal protective equipment;
- The residents will be sensitized ahead of the commencement of works.

### 7.3.5 Generated Wastes

Waste materials will inevitably be generated during the construction works. Very little vegetation wastes will be generated during the clearing works as there will be little generation of general building waste. The wastes to be generated by the works will be largely inorganic and will not be excessive. Such materials will require disposal. Illegal or uncontrolled disposal of the wastes will create environmental and potential public health concerns.

Liquid waste will also be generated including workshop wastes e.g. used oil filters, and waste concrete, various liquid wastes including used oils and solvents, grey and black water (respectively washing water and sewage), concrete washings, runoff from camp and workshop areas, and various liquid waste streams from construction processes - vehicle washing, sand and gravel processing, dewatering excavations, etc.

***Mitigation***

- A waste minimisation approach should be adopted as part of the construction works;
- Skips and bins should be strategically placed within the campsite and construction site, they should also be adequately designed and covered to prevent access by vermin and minimize odour. They should also be emptied regularly;
- Measures to ensure that waste materials from the Project are disposed at suitable sites will be taken. These will include engaging only reputable truckers and conducting appropriate spot checks to verify that disposal are done in accordance with the requirements of NEMA;
- The ultimate fate of the wastes should be monitored so that they are not illegally disposed of;
- Provide portable sanitary conveniences for the construction workers for control of

sewage waste. A ratio of approximately 25 workers per chemical toilet should be used.

### 7.3.6 Visual Impact

The removal of vegetation where this becomes inevitable and subsequent redevelopment of the site will have a negative visual impact, particularly where new pipelines are constructed. Construction of the pipeline will only impact on the visual environment where the pipeline is not buried or it is constructed on pillars. Augumentation of Gatanga water supply will not change the visual impact that the existing pipelines have had on the environment since 1973. Most of the pipeline will be installed below ground.

***Mitigation***

- Where the proposed route requires the removal of any vegetation, care will be taken to minimize the destruction or damage of trees;
- Replanting of trees will be done where appropriate or specifically stipulated by the relevant authorities such as KFS

### 7.3.7 Potential Impact of Traffic

Increased traffic movements to and from the site will be an inevitable consequence of the construction works. Such movements will be due to material delivery, waste disposal and workers going to and from work. Potential problems resulting from such increased traffic movements include congestion of the existing road network, safety risks to humans, air quality deterioration due to vehicular exhaust emissions (nitrous oxides, carbon monoxide, hydrocarbons and particulates), excessive noise affecting both humans and the fauna, as well as wider scale implications due to the emission of greenhouse and ozone depleting exhaust gases.

No traffic counts were done along the route of the pipeline. During pipeline installation, there will be minimal impact on traffic. Existing roadways and tracks, which are now being used as means of access the larger Gatanga will be used during the construction phase. It is not foreseen that there will be a major increase in traffic as a result of the proposed works. Overall however the impact is of short duration and is considered to be minor. However, where short term interruptions are expected as a result of specific types of works, appropriate traffic management will be undertaken, in keeping with an overall traffic management plan that will be prepared.

***Mitigation***

- The site should have a Construction Traffic Management Plan;
- Phasing of traffic movements to and from the site should be done so as to avoid potential convoys which could cause local scale congestion;
- Trucks should not be over laden, and should be regularly serviced;
- Good driving practices will be required from all delivery drivers;

- Wherever and whenever construction approaches on the road or potentially affects the traffic signage will have to be placed and formal flagmen / women employed in order to ensure the public safety;
- The contractor must ensure that the trucks carrying construction materials to the site are in good condition and no materials fall on the road as the truck moves around both on-site and off-site;
- The contractor should ensure that the truck drivers adhere to and obey the speed limits.

### 7.3.8 Accidental Spills or Leakages

The principal chemicals held on the site during the construction site are likely to be vehicle fuel and paints. Spillage or escape of such compounds are likely to have an immediate impact upon the local water resources and consequently on the terrestrial and aquatic flora and fauna.

***Mitigation***

- Maintain vehicles and machineries at manufacturers specifications;
- Ensure proper storage of chemicals / materials.

### 7.3.9 Surface Water Run-Off

Surface water run-off from the construction sites during all stages of the works, but particularly during the construction phase could cause potential impacts upon the local terrestrial environment. Run-off directly into the Kimakia and Kiama rivers could result in deterioration of the riverine water quality through carried sediments and/or chemical contaminants.

Where the pipeline is laid in high slope the backfill may be scoured out during heavy rain and deposit silt into natural drainage channels and hence to the river.

***Mitigation***

- During the course of the construction works, temporary drainage channels should be constructed to encourage dispersal of meteoric waters;
- Storage and stockpiling of materials on the site should be away from drainage channels;
- Backfill of trenches in or near drains should be topped with rock fill to stop scour where drains have a gradient of 5% or over.

### 7.3.10 Requirement and Use of Local Building Materials

Construction materials will be required from the local area and indeed from outside Gatanga Sub-county. Obtaining such materials can have potentially adverse

environmental effects such as dust creation, land take from quarrying works, dredging of sand, shale and gravel and the felling of trees to provide timber.

It is expected that the development will require stone, sand, concrete/blocks, steel and timber. These can largely be supplied from local sources. Obtaining the materials from appropriately managed and licensed operations will ensure that the significant environmental impacts are lessened. The sources of the local materials should not be specific to the construction of this project.

***Mitigation***

- Construction contract should stipulate that the Contractor sources materials from an approved site;
- The tender documents should specify required standards and certification for procurement of all materials and appliances;
- The sources of all required materials should be inspected prior to acquisition to confirm that they are legitimate operations;
- The contractor should ensure that he sources construction materials sustainably;
- The contractor should ensure that the storage area for materials is good so as to avoid spoils and waste.

### 7.3.11 Occupational Health and Safety Risks

Construction sites are hazardous environments due to a range of activities and works being undertaken, vehicle movements, electrical, mechanical equipment, craneage, presence of scaffolding etc. Open access to the construction site will undoubtedly result in injury and potentially fatal accidents. Potential accidents are not anticipated if the construction site is appropriately managed and controlled.

***Mitigation***

- All construction workers should be advised of the dangers associated with construction work;
- Workers should be provided with suitable foot wear, hard hats, protective glasses and generally with safety equipment where appropriate;
- Provision of adequate sanitary facilities to workers;
- Train all workers on Safety Health and Environment (SHE) with an aim of improving awareness;
- Trenches over 1.5 m deep or wherever soil conditions dictate should be shored and secured against accidental entry by public;
- Install safety signage along the work areas;
- Where construction activities interfere with the movement of traffic, the site should be signed and controlled by trained flagmen/flag women and lit by night.

### 7.3.12 Land take

The proposed project will lead to land take and subsequently compensation. The project components associated with impact to people's properties are water pipelines and site for the treatment plant. Since the area is a rural agricultural region, most of the affected properties identified were basically food crops, cash crops and trees. An easement will be acquired where the pipeline will be laid in peoples land. Land for the treatment plant will be acquired from individual persons through willing buyer willing seller arrangement. The estimated size of the land is 5acres.

The pipelines under the project are estimated to be 30km to be laid along the river riparian, road reserves and within individual land. The RAP report has estimated the properties to be affected along Kimakia Pipeline and Kiama Pipeline as summarized in Table 7-2 below.

**Table 7-2: Summary of compensation budget**

| Item | Unit | Unit Cost | Quantity | Total Cost |
|---|---|---|---|---|
| **Land** | | | | |
| Easement including crops and trees | Acres | Variable | 9.3037 | 13,194,096.00 |
| **Sub-Total 1** | | | | **13,194,096.00** |
| **Livelihood Restoration / Disturbance** | | 15% of total compensation | | 1,979,114.40 |
| **Implementation** | | | | |
| **Consultants** | | | | |
| Sociologist & Lawyer fee | PC | | | 250,000.00 |
| Surveyor & Land Economist fee | PC | | | 250,000.00 |
| **Sub-Total 2** | | | | **15,673,210.40** |
| **CONTINGENCIES 5%** | | | | 783,660.52 |
| **GRAND TOTAL** | | | | **16,456,870.92** |

***Mitigation***

- A resettlement action plan report (RAP) and valuation of assets have been undertaken. Compensation will be done before project commencement. The RAP report is attached as Annex 1.

## 7.4. POSITIVE IMPACTS DURING OPERATION

### 7.4.1 Improved water quality and quantity

Improved water quality will in turn reduce exposure to water borne diseases to the consumers. General hygiene in the served area will improve through use of acceptable

water quality. Markets and communities to benefit from the project include; Kahuruko and Junction markets, Mukurwe market, Giteme Market, Nyaga Market, Kanunga, Kiganjo, Gituatu Market, Rwegetha, Gathanji, Matunda, Ngelelya, kirathani, Ithangarari, Manunga Market.

### 7.4.2 Improved living standards of Gatanga residents

Accesses to water will in the long term result in improved income levels and health of the people, this consequently leads to poverty reduction. Reduced distances traveled and time used to collect water is then put to economic activities.

### 7.4.3 Reduced exposure to health risks

Improved water quality for domestic consumption reduces the risk to the health of the consumers and dependants of water resources that could translate into financial saving through less related expenditures

### 7.4.4 Improved food security and nutrition

It will result from saving on health and incomes and diversification of farming activities of high yield using irrigation, expansion of farming can bring back abandoned farms into profitable farming.

### 7.4.5 Sustainability of Gatanga Community Water and Sanitation Company

Increased revenue collection will help the company to be sustainable in terms of meeting their own operational cost which is currently being met by Ministry of Water, Environment and Natural Resources.

### 7.4.6 Enhanced gender and participation in development

Women form a high percentage of the project areas' population but are inadequately participating in development activities due burden of fetching water. Increased availability of water will relieve them and thereby give them an opportunity to engage in development activities.

### 7.4.7 Education benefits to girl child

Availability of water will remove the burden of collecting water for girl child leading to academic pursuits. Academic pursuit of the girl child at early stage leads to further education and competitiveness in the job market which is an exit route from poverty.

## 7.5. ANTICIPATED NEGATIVE IMPACTS DURING OPERATION

### 7.5.1 Environmental Pollution from Gray water

Introduction of more water in the system could raise the probability of increased pollution in the environment through increased waste water. Gatanga area is a peri urban region without proper conventional sewerage infrastructure, residents rely on pit latrines and septic tanks for sewer disposal and gray water through surface drain to farmland for irrigation.

***Mitigation***

- Plans should be put in place by Gatanga Community Water and Sanitation Company on how to address sewer and waste water especially in fast growing markets like Gatura and Gatanga.

### 7.5.2 Impacts on drainage and hydrology

Abstraction of more water from the river Kimakia and Kiama might reduce flow level downstream due to ineffective compensation. However, this impact is expected to be minimal because no additional abstraction will be done at the proposed intake sites.

Reduced water level will affect water temperature which may in turn affect some aquatic plants and animals as it may exceed their biologically viable temps. Lower flow levels will also mean that water will not be available for downstream users.

***Mitigation***

- There should be due adherence to the safest maximum abstractable water quantities of throughout the project life;
- Adhere to WRMA water use permits.

### 7.5.3 Solid waste generation and disposal

The operation of majorly the treatment plant will result in generation of solid waste e.g. plastics (wrappings and containers), paper, office wastes including e.g. used toner cartridges, kitchen (canteen) wastes etc. These waste can be a nuisance if not properly disposed.

***Mitigation***

- Provision of solid waste storage bins and skips;
- Monitor skips so that they do not become overfilled;
- Ensure that the solid waste collected is disposed of in an approved dumpsite.

### 7.5.4 Sludge management

One of the main by-products resulting from the treatment plant activities is sludge. This sludge will be kept on site temporarily before disposal or other uses such as use as

fertilizer. The sludge, if not properly managed can have impacts on water quality, health of people around the plant, aquatic life and the natural habitat.

Potential effects of temporary sludge storage are:

- **Risk of fire or explosion**: at this stage of the process, the sludge has been digested and the Volatile Solid content is very low and therefore such a risk is considered unlikely with proper monitoring and maintenance.
- **Odours**: as the sludge has been digested, stabilized and sun dried under aerobic conditions, it does not produce any bad odour.
- **Insects:** temporary stored sludge is not a good environment for insect growth because of its temperature, it is too hot to allow egg cycle, but it can be a food source for adult flies
- **Groundwater infiltration:** Problems could possibly arise during rainy season.

***Mitigation***

- Apply quicklime treatment to dewatered sludge in order to create a pathogen and odor free product;
- Dry sludge on the drying beds before disposing off in a dedicated disposal site;
- Preparation and enforcement of operational guidelines for sludge treatment / management.

### 7.5.5 Back wash water

Backwashing is a form of preventive maintenance to keep water treatment filters functional. Spent backwash water can either discharged without treatment to a sanitary sewer system or is treated and recycled within the plant. Used backwash water contains high concentrations of particulate material. This can have an impact on water quality and aquatic life.

***Mitigation***

- Drain the waste water into an oxidation pond / tank to allow for stabilization and neutralization;
- Pass the stabilized backwash water into a soak pit or a controlled wetland before the water diffuses underground with sand filtration;
- Recycle the treated backwash water to the channel leading to the filters;
- Carrying out water sampling tests for both bacteriological and physical element.

### 7.5.6 Chemical handling

One of the first steps in a conventional water purification process is the addition of chemicals to assist in the removal of particles suspended in water. Particles can be inorganic such as clay and silt or organic such as algae, bacteria, viruses, protozoa and natural organic matter. Inorganic and organic particles contribute to the turbidity and colour of water. Some of the chemicals to be used for water purification include

aluminum sulfate (or alum) and chlorine and will be used in the flocculation tanks. Improper use of these chemicals may have an impact on water and soil quality.

***Mitigation***

- Chemicals used for water treatment should be appropriately handled and disposed off as provided for in the material safety data sheets.
- Awareness creation amongst workers on proper handling of chemicals through training.

### 7.5.7 Emergency preparedness

Gatanga water should be prepared to handle incidents affecting drinking water and water treatment systems. Pipelines may be washed away by natural disasters such as excessive rain and landslides. Contamination of water can also occur. This should be mitigated against since it might impact the community.

***Mitigation***

- Design and implement an emergency response plan;
- Coordinate with aid organizations/agencies such as with the local fire brigade;
- Install fire hydrants within the proposed development;
- Install a fire extinguisher at the plant and train workers on how use.

## 7.6. DECOMMISSIONING PHASE

Decommissioning takes place during the final phase of a project life-cycle, but a degree of environmental planning is necessary before any decommissioning activities should be allowed to commence. The reason for this is that a project earmarked for decommissioning has in all likelihood been operational for some time, and as such, the environment within which it lies has stabilised in response to the presence of the associated infrastructure, activities and facilities. The decommissioning of one or all components of such a project would therefore have an effect on the environmental status quo, either in a positive or in a negative way.

In this respect, this section contains broad environmental guidelines which will assist decision makers to take environmentally responsible and sustainable decisions in terms of which infrastructure to retain, which to develop further (and how to do this), and which to remove completely with regard to this project. In this way, the positive aspects of decommissioning may be maximized and the negative aspects minimized or even avoided.

### 7.6.1 Purpose and objectives of decommissioning

The generally accepted purpose of decommissioning is the release of valuable assets such as machinery and sites for alternative use, recycling and reuse of materials and the restoration of environmental amenity. In all cases, the basic objective is to achieve an end-point that is sensible in technical, social and financial terms, that properly protects workers, the public and the environment and, in summary, complies with the basic principles of sustainable development. Stringent regulatory controls protect the public, the environment and workers from the hazards associated with decommissioning activities.

### 7.6.2 General requirements ahead of decommissioning

Ahead of decommissioning , sustainable environmental planning may have an impact on fundamental project decisions, such as whether or not decommissioning is the best course of action, and if so, what actions are required and when. This may in turn have an impact on the project budget as well as project programming. It is important to note the following:

- Should a decommissioning plan entail a change in land use then the project should be subjected to the requirements of the Environmental Management and Coordination Act (EMCA) of 1999 and thus obliged to follow the Environmental Impact Assessment process.
- A plan for decommissioning may entail the further development of certain infrastructure, and structures to accommodate the alternative uses decided upon during decommissioning planning. In such situations, the exercise ceases to be one of decommissioning, rather becoming a planning exercise and as such will be subjected to EIA.
- Once a Decommissioning Plan has been finalised (detailing future utilisation of buildings, structures, infrastructure and open space, as well as removal of redundant infrastructure), the planning phase of a decommissioning project is complete. The implementation of the Decommissioning Plan must then be approached as a Construction Contract.

In summary, the following should be determined ahead of the decommissioning process:

- Infrastructure, buildings, structures and land uses to be retained;
- Alternative uses and further development proposals for retained infrastructure, buildings, structures and open space;
- Infrastructure, buildings and structures to be dismantled, removed, sold for recycling and / or disposed of.

### 7.6.3 Impacts during decommissioning

The main negative impacts during the decommissioning phase are the loss of the infrastructure associated with the water supply project. The project is expected to last for

many years therefore the decommissioning is not anticipated to happen soon but should this happen all the positive impacts mentioned in this report would be reversed to be negative.

Some of the impacts that may be anticipated include:

- Positive:
✓ Employment opportunities

- Negative
✓ Loss of potable water for residents;
✓ Noise and vibration;
✓ Generation of waste;
✓ Dust emission; and
✓ Land use changes

All mitigation measures referred to under the construction phase will be applicable during decommissioning. Furthermore the following should be undertaken to restore the aesthetic value of the environment.

**a) Machinery, infrastructure and waste**

- Employ integrated solid and liquid waste management system;
- With the help of the county government, select disposal locations based on properties of particular wastes generated;
- Removal, recycling, re-use or selling of scrap materials; and
- All disposals should be done according to legal requirements.

**b) Rehabilitation of project site**

- Re-vegetation of the site to restore the aesthetic value of the environment;
- Proper erosion control measures during re-vegetation;
- Proper monitoring and inspection of the site for indications of erosion; and
- Fencing and signs restricting access to minimize disturbance.

**c) Socio-economic impacts**

- Ensure safety of workers;
- Offer advice and counseling to employees on other livelihood opportunities;
- Assist with re-employment and job-seeking of the involved workforce; and
- Compensation and suitably recommend the project workers in seeking employment opportunities elsewhere.

# 8. ENVIRONMENTAL MANAGEMENT PLAN

## 8.1. INTRODUCTION

Environmental Management Plan (EMP) has been developed to assist in prioritizing the key findings of the Environmental Impact Assessment Report, and to suggest necessary mitigation actions. From the EMP, a schedule for the operations implementation could also be drawn that takes into consideration all issues that could develop into serious risks to environment, health and safety at all times.

Environmental management plan is based on the ISO 14001 which states management principles for environmental management. Finally, management reviews and continuous improvement determines which of the activities require to be re-visited and at what schedules.

On the basis of the policy guidelines and development of the EMP, among other actions recommended to be undertaken by the management in the implementation of the latter are;

a. Develop a training plan and schedule;
b. Develop an in-house environmental audit protocol and schedule;
c. Establish a suitable and comprehensive database on environmental issues;
d. Put in place an emergency preparedness system;
e. Establish an EMP implementation schedule;
f. Establish an incident log book to manage environmental incidents;
g. Establish an environmental management committee to oversee and assist in the implementation of the EMP.

## 8.2. RESPONSIBILITIES IN THE ESMP

In order to ensure sound development and effective implementation of the ESMP, it is necessary to identify and define the responsibilities and authority of the various persons and organisations that will be involved in the project. Entities that should be involved in the implementation of this ESMP include but are not limited to the following:

- AWB;
- Gatanga Community Water Scheme;
- Contractor;
- Ministry of Environment, Water and Natural; resources;
- NEMA;
- WRMA;

- Directorate of Occupational Safety and Health;
- County government of Murang'a; and
- Local administration.

### 8.2.1 AWSB / Project Implementation Unit (PIU)

The project implementing agency is AWSB under the Ministry of Environment, Water and Natural Resources. AWSB has set up a Project Implementation Unit (PIU), with a Project Manager.

AWSB should co-ordinate all aspects of the environment during project implementation and operations (with involvement of Gatanga Water Scheme). This should include follow up during construction to monitor, review and verify the implementation of the project's ESMP.

### 8.2.2 Gatanga Community Water Scheme

Gatanga Water is a Water Service Provider formed in line with the water act of 2012 and is charged with the provision of the water and sewerage services in Gatanga. The water service provider will be responsible for operation and maintenance (O&M) of the project once commissioned. They will also help AWSB in monitoring the progress of the project during the construction phase.

AWSB signed a Service Provision Agreement (SPA) with Gatanga Community Water Scheme. SPA is a tool that is signed between the Water Services Boards (WSBs) and Water Service Providers (WSPs) as provided for in the Water Act, 2002. It sets the conditions on how Gatanga Community Water Scheme will provide water services as per the license issued by Water Services Regulatory Board (WASREB). WASREB carries out performance benchmarking and is in charge of approving SPAs. The SPA has targets, e.g. hours of supply, quality of water, and reduction of unaccounted water.

### 8.2.3 Project Contractor (s)

A project contractor will be appointed by AWSB. The contractor must be required to comply with the requirements of the ESIA, the ESMP within this report, any ESIA licences conditions as may be issued with NEMA as well as all relevant legislations.

### 8.2.4 Ministry of Environment, Water and Natural Resources

All key government environmental and water management and conservation agencies are under the Ministry of Environment, Water and Natural Resources. The ministry is responsible for overall policy direction and is hence better placed to ensure coordination of the said agencies for the conservation and management of the available natural resources within the Aberdare water tower and ensure that a clean environment is sustained throughout the project life.

### 8.2.5 Water Resources Management Authority (WRMA)

WRMA's sub regional office in Murang'a will be involved in the project through its issuance of project water rights and regulations of water abstraction, study for water resources development and coordination of water use within the Upper Tana catchment area.

### 8.2.6 NEMA

The responsibility of NEMA is to exercise general supervision and co-ordination over all matters relating to the environment and to be the principal instrument of government in the implementation of all policies relating to the environment.

Apart from the national office in Nairobi, NEMA has local offices in the project area at Murang'a town through which environmental supervision of the project will be conducted.

### 8.2.7 Directorate of Occupational Safety and Health

Directorate of Occupational Safety and Health (DOSH) will be responsible for registering the project site as a work station and subsequent enforcement of relevant provisions in occupational safety and health in line with occupational safety and Health Act, 2007.

### 8.2.8 County Government of Murang'a

Murang'a County government is responsible for various environment and public health management issues as provided for in the County Governments Act and should be incorporated to help enforcement of proposed mitigation and monitoring activities within the project.

### 8.2.9 The Local Administration

The relevant local administrators within Gatanga Sub-county should be called upon where necessary during project implementation to provide the necessary advisory services and support to the project implementers.

## 8.3. ENVIRONMENTAL MANAGEMENT PLAN: CONSTRUCTION PERIOD

The following were key environmental concerns that need to be addressed during the construction phase of the project. They include:

a. Effects on vegetation loss
b. Effects of construction the plant on wildlife and wildlife migratory routes
c. Efforts on water resources both surface and ground

d. Solid waste management issues
e. Air quality issues
f. Noise and vibrations from construction machineries
g. Visual impacts
h. Occupational Health and Safety risks

## 8.4. ENVIRONMENTAL MANAGEMENT PLAN: OPERATION

Operation phase is the most critical stage as it will have long term direct reflection on quality of environment once the project is commissioned. Main concerns during operation phase include.

- Environmental pollution from gray water;
- Impacts on drainage and hydrology;
- Solid waste management;
- Sludge management;
- Backwash water management;
- Chemical handling (Aluminum sulphate and chlorine);
- Emergency preparedness;
- Operations and maintenance.

**Table 8-1: Environmental and Social Management Plan**

| Activity | Mitigation Measure | Institutional Responsibility | Time Frame | Budget Ksh |
|---|---|---|---|---|
| **Construction Phase** | | | | |
| Anticipated loss of vegetation | • Retention of trees and shrubs, where possible on the potential sites for screening of the visual impact;<br>• Where the proposed route requires the removal of any vegetation, care will be taken to minimize the destruction or damage of trees;<br>• Re planting of destroyed trees in cleared areas where works are complete. | Contractor | Throughout construction period | *KES 3,000,000 is proposed for Management of Environmental Safeguards and Occupational Safety during construction phase.* |
| Soil loss | • Pile the top soil where it can be reused;<br>• Program of Works should be prepared in line with Aberdare region weather pattern so as to avoid such works during rainy seasons;<br>• Restrict disturbance to soil structure within project site;<br>• Put measures for protection of soil erosion (berming of loss soil);<br>• Installing necessary temporary and permanent drainage works;<br>• Minimize excavations to only the designated sections. | Contractor | Throughout construction period | |
| Air quality issues | • Provision should be made available for water sprays to be used when dusts are being generated or at times of strong wind;<br>• All materials stored or stockpiled on site should be adequately covered;<br>• Maintain machineries at manufacturers specifications;<br>• Where unavoidable, construction workers working in dusty areas should be given dust masks;<br>• Limit removal of vegetation and a rehabilitation programme on site and associated infrastructure following construction. | Contractor | Throughout construction period | |

| Activity | Mitigation Measure | Institutional Responsibility | Time Frame | Budget Ksh |
|---|---|---|---|---|
| Noise pollution and vibrations | • Use equipment that is properly fitted with noise reduction devices such as mufflers;<br>• Use equipment that have low noise emissions as stated by the manufacturers;<br>• Standard restrictions to hours of site works;<br>• Workers should be provided with personal protective equipment;<br>• The residents will be sensitized ahead of the commencement of works. | Contractor | Throughout construction period | |
| Generated wastes | • A waste minimisation approach should be adopted as part of the construction works;<br>• Skips and bins should be strategically placed within the campsite and construction site, they should also be adequately designed and covered to prevent access by vermin and minimize odour. They should also be emptied regularly;<br>• Measures to ensure that waste materials from the Project are disposed at suitable sites will be taken. These will include engaging only reputable truckers and conducting appropriate spot checks to verify that disposal are done in accordance with the requirements of NEMA;<br>• The ultimate fate of the wastes should be monitored so that they are not illegally disposed of;<br>• Provide portable sanitary conveniences for the construction workers for control of sewage waste. A ratio of approximately 25 workers per chemical toilet should be used. | Contractor | Throughout construction period | |

| Activity | Mitigation Measure | Institutional Responsibility | Time Frame | Budget Ksh |
|---|---|---|---|---|
| Visual impacts | • Where the proposed route requires the removal of any vegetation, care will be taken to minimize the destruction or damage of trees;<br>• Replanting of trees will be done where appropriate or specifically stipulated by the relevant authorities such as KFS. | Contactor, AWSB and KFS | Throughout construction period | |
| Potential impact of traffic | • The site should have a Construction Traffic Management Plan;<br>• Phasing of traffic movements to and from the site should be done so as to avoid potential convoys which could cause local scale congestion;<br>• Trucks should not be over laden, and should be regularly serviced;<br>• Good driving practices will be required from all delivery drivers;<br>• Wherever and whenever construction approaches on the road or potentially affects the traffic signage will have to be placed and formal flagmen / women employed in order to ensure the public safety;<br>• The contractor must ensure that the trucks carrying construction materials to the site are in good condition and no materials fall on the road as the truck moves around both on-site and off-site;<br>• The contractor should ensure that the truck drivers adhere to and obey the speed limits. | Contactor | Throughout construction period | |
| Accidental spills or leakages | • Maintain vehicles and machineries at manufacturers specifications;<br>• Ensure proper storage of chemicals / materials. | Contactor | Throughout construction period | |

| Activity | Mitigation Measure | Institutional Responsibility | Time Frame | Budget Ksh |
|---|---|---|---|---|
| Surface water run-off | • During the course of the construction works, temporary drainage channels should be constructed to encourage dispersal of meteoric waters;<br>• Storage and stockpiling of materials on the site should be away from drainage channels;<br>• Backfill of trenches in or near drains should be topped with rock fill to stop scour where drains have a gradient of 5% or over. | Contactor | Throughout construction period | |
| Requirement and use of local building materials | • Construction contract should stipulate that the Contractor sources materials from an approved site;<br>• The tender documents should specify required standards and certification for procurement of all materials and appliances;<br>• The sources of all required materials should be inspected prior to acquisition to confirm that they are legitimate operations;<br>• The contractor should ensure that he sources construction materials sustainably;<br>• The contractor should ensure that the storage area for materials is good so as to avoid spoils and waste. | Contactor | Throughout construction period | |

| Activity | Mitigation Measure | Institutional Responsibility | Time Frame | Budget Ksh |
|---|---|---|---|---|
| Occupational health and safety risks | • All construction workers should be advised of the dangers associated with construction work;<br>• Workers should be provided with suitable foot wear, hard hats, protective glasses and generally with safety equipment where appropriate;<br>• Provision of adequate sanitary facilities to workers;<br>• Train all workers on Safety Health and Environment (SHE) with an aim of improving awareness;<br>• Trenches over 1.5 m deep or wherever soil conditions dictate should be shored and secured against accidental entry by public;<br>• Install safety signage along the work areas;<br>• Where construction activities interfere with the movement of traffic, the site should be signed and controlled by trained flagmen/flag women and lit by night. | Contactor | Throughout construction period | |
| **Operation Phase** | | | | |
| Environmental pollution from gray water | • Plans should be put in place by Gatanga Community Water and Sanitation Company on how to address sewer and waste water especially in fast growing markets like Gatura and Gatanga. | Gatanga Comm. Water & Sanitation Co. | Throughout operation phase | *Gatanga Community Water and Sanitation Company to Maintain a running budget of estimated KES 2,000,000 for Management of Environmental Safeguards and* |
| Impacts on drainage and hydrology | • There should be due adherence to the safest maximum abstractable water quantities of throughout the project life;<br>• Adhere to WRMA water use permits. | WRMA and Gatanga Comm. Water & Sanitation Co. | | |
| Solid waste generation and disposal | • Provision of solid waste storage bins and skips;<br>• Monitor skips so that they do not become overfilled;<br>• Ensure that the solid waste collected is disposed of in an approved dumpsite. | Gatanga Comm. Water & Sanitation Co. | Throughout operation phase | |

| Activity | Mitigation Measure | Institutional Responsibility | Time Frame | Budget Ksh |
|---|---|---|---|---|
| Sludge management | • Apply quicklime treatment to dewatered sludge in order to create a pathogen and odor free product;<br>• Dry sludge on the drying beds before disposing off in a dedicated disposal site;<br>• Preparation and enforcement of operational guidelines for sludge treatment / management. | Gatanga Comm. Water & Sanitation Co. | Throughout operation phase | *Occupational Safety during operation of the Treatment Plants.* |
| Back wash water | • Drain the waste water into an oxidation pond / tank to allow for stabilization and neutralization;<br>• Pass the stabilized backwash water into a soak pit or a controlled wetland before the water diffuses underground with sand filtration;<br>• Recycle the treated backwash water to the channel leading to the filters;<br>• Carrying out water sampling tests for both bacteriological and physical element. | Gatanga Comm. Water & Sanitation Co. | Throughout operation phase | |
| Chemical handling | • Improve chemical handling, avoid leakages and spillages;<br>• Appropriate record keeping of data on chemicals and material safety data sheets;<br>• Awareness creation amongst workers on proper handling of chemicals through training. | Gatanga Comm. Water & Sanitation Co. | Throughout operation phase | |
| Emergency preparedness and response | • Design and implement an emergency response plan;<br>• Coordinate with aid organizations/agencies such as with the local fire brigade;<br>• Install fire hydrants within the proposed development;<br>• Install a fire extinguisher at the plant and train workers on how use. | Gatanga Comm. Water & Sanitation Co. | Throughout operation phase | |

| Activity | Mitigation Measure | Institutional Responsibility | Time Frame | Budget Ksh |
|---|---|---|---|---|
| Operations and monitoring | • Motivating workers with an aim of enhancing their contribution towards environmental management practices;<br>• Ensure equipment spares and protective personal equipment are available to workers;<br>• Develop a database and relevant records on environmental performance and other monitorable parameters;<br>• Activate the monitoring points as designed in the project premises and the surroundings. | Gatanga Comm. Water & Sanitation Co. | Throughout operation phase | |
| Capacity building | • Provide a forum for human resources development on environmental conservation;<br>• Establish a schedule for continuous improvement of human capacity on environmental management;<br>• Develop in-house guidelines on environment, health and safety management. | Gatanga Comm. Water & Sanitation Co. | Throughout operation phase | |
| *Gatanga Community Water and Sanitation Company to Maintain a running budget of estimated KES 2,000,000 for Management of Environmental Safeguards and Occupational Safety during operation of the Treatment Plants.* | | | | |

## 8.5. MONITORING AND EVALUATION OF COMPLIANCE TO ENVIRONMENTAL SAFEGUARDS

Monitoring is an important tool in establishing the success or failure of the in regards to compliance to environmental safeguards. Evaluation is also important in assessing the achievement of the mitigation measures set out in the Environmental Management Plan, performance and efficiency of the project in regards to EMP.

Monitoring and evaluation process will involve the assessment of the following benchmarks

- The implementation process of guidelines stipulated in the Environmental Management Plan
- Evaluate impact of the project to the environment and social setting of Gatanga District (categorize and weight positive and negative)
- Monitoring of the involvement of the community through public consultations in decision makings and the implementation of the project.

**Table 8-2: Monitoring checklist**

| Schedule | Activities | Execution | Supervision | Funding | Comments |
|---|---|---|---|---|---|
| **Year 1. Months 1-3** | Prepare site specific EMP. | Contractor | Gatanga Comm. Water Co. /consultant | Contract | Draft Plan submitted not later than 2 month after contract notification Final plan before end of month 3. |
| **Construction period** | Safe working procedures to be written and followed by contractors | Contractor | Gatanga Comm. Water Co. /consultant | Contract | Verify applicability of written safe working procedures. Regular inspection of construction works |
| | Working areas to be temporarily out of bounds to non-works personnel | Contractor | Gatanga Comm. Water Co. /consultant | Contract | Regular inspection of construction sites |
| | Construction waste to be stored in a secure, designated area prior to removal to a designated waste landfill site | Contractor | Gatanga Comm. Water Co. /consultant | Contract | Regular inspection of construction sites |
| | Daily checks of machinery for leaking oil | Contractor | Gatanga Comm. Water Co. /consultant | Contract | Regular inspection of construction sites |
| | No washing of machinery at construction site | Contractor | Gatanga Comm. Water Co. /consultant | Contract | Regular inspection of construction sites |
| | Regular monitoring of water resources both ground and surface | Contractor | GASWSCO / Consultant | Contract | Water to be analyzed for turbidity, oil and heavy metals |
| | Separation of topsoil and subsoil during excavation works, with careful replacement of topsoil after pipe is laid | Contractor | Gatanga Comm. Water Co. /consultant | Contract | Regular inspection of construction sites |

| Schedule | Activities | Execution | Supervision | Funding | Comments |
|---|---|---|---|---|---|
| | Works performed strictly during normal weekday working hours to minimize noise nuisance | Contractor | Gatanga Comm. Water Co. /consultant | Contract | Regular inspection of construction sites. See also Section Impact Monitoring: Air Quality and Noise |
| | Minimize dust and traffic emissions by good operation management and site supervision | Contractor | Gatanga Comm. Water Co. /consultant | Contract | Regular inspection of construction sites. See also Section Impact Monitoring: Air Quality and Noise |
| | Apply dust suppression measures (water sprinkling), especially during long dry periods | Contractor | Gatanga Comm. Water Co. /consultant | Contract | Regular inspection of construction sites. See also Section Impact Monitoring: Air Quality and Noise |
| | If any archaeological artefacts are found, work must stop immediately and the respective local authorities and experts informed | Contractor | Gatanga Comm. Water Co. /consultant National Museums of Kenya | Contractor | Regular inspection of construction sites |
| | Minimize time of replacement work and interruptions of water supply | Contractor | Gatanga Comm. Water Co. | | Records from water supply management Regular inspection of construction sites |
| **Operation Phase** | Sludge management | Gatanga Comm. Water Co. /consultant | AWSB | Gatanga Comm. Water Co. /consultant | Annual inspection of sludge from the flocculation chambers before disposal to landfills |
| | Backwash water management | Gatanga Comm. Water Co. /consultant | AWSB | Gatanga Comm. Water Co. /consultant | Back wash water should be directed through a wetland before release into the river. This should be monitored every time the filters are washed. |

| Schedule | Activities | Execution | Supervision | Funding | Comments |
|---|---|---|---|---|---|
| | Chemical handling chlorine and flocculants | Gatanga Comm. Water Co. /consultant | AWSB | Gatanga Comm. Water Co. /consultant | - Proper custody of chemicals according to manufactures instruction<br>- Regular training of staff on occupational health and safety issues |

# 9. CONCLUSION AND RECOMMENDATIONS

The Environment Impact Assessment for Augmentation and Rehabilitation of Gatanga Water Supply identified that the population pressure of Gatanga district is growing at a steady 2.426% per annun form the population statistics form the census report 2009 now standing at 130,000 people. The current water infrastructure can only provide 6,310 m3/day against an estimated demand of 9880m3/day leaving a deficit of 3,570m3/day. The proposed project is step towards providing water close to the people of Gatanga district.

Negative environmental impacts identified in the report can be mitigated as illustrated in the Environmental Management Plan and proper monitoring throughout construction and operation phases of the project is advised.

There is overwhelming acceptance by the project by the local community in the areas of Gitemi, Ndakaini, Gitiri, Gatur, Gathaithi, Rwagetha, Chomo and Gatanga sub locations. The areas are experiencing inadequate water supply leaving residents with the option of going for raw water plants which is not treated therefore leaving them exposed to water borne diseases such as typhoid and diarrhea.

Recommendation is therefore for implementation of the above project with compliance to recommendations outlined in the Environment Management Plan and resident and other stakeholder views as described in chapter six of the report.