THE REPUBLIC OF KENYA

(Water Services Trust Fund (WSTF) in collaboration with the World Bank)

KENYA URBAN WATER AND SANITATION –OBA PROGRAM FOR LOW INCOME AREAS

THIKA WATER AND SEWERAGE COMPANY (THIWASCO)

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT PROJECT (ESIA) REPORT FOR PROPOSED

THIKA BOREHOLES DEVELOPMENT PROJECT

VOLUME I: ESIA REPORT

Report Prepared By

Losai Management Limited

Providing viable solutions

JULY, 2017

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KENYA URBAN WATER AND SANITATION –OBA PROGRAM FOR LOW INCOME AREAS

THIKA BOREHOLES DEVELOPMENT PROJECT

EMPLOYER:

Thika Water and Sewerage Company (THIWASCO)

CONSULTANT

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DOCUMENT TITLE:
ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT PROJECT REPORT

VOLUME I: ESIA REPORT

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Disclaimer:
This Environmental and Social Impact Assessment Report is based on literature review and findings from field assessment. It is strictly confidential and any materials thereof should strictly be used in accordance with agreement from the management of Thika Water and Sewerage Company (THIWASCO). It is however, subject to conditions in the Environmental Management and Coordination Act 1999 and amendments 2015, Environmental (Impact Assessment and Audit) Regulations 2003, and triggered World Bank OP 4.01 Environment Assessment.

LIST OF ABBREVIATIONS& ACRONYMS

AWSB	Athi Water Services Board
BPT	Break Pressure Tanks
CSOs	Civil Society Organization
DCBL	Decibels
EHS	Environment Health and Safety
ESIA	Environmental and Social Impact Assessment
EMCA	Environmental Management & Coordination Act
GDP	Gross Domestic Product
ICDP	Integrated Development Plan
ILO	International Labour Organization
IFC	International Finance Agency
KeNHA	Kenya National Highways Authority
KURA	Kenya Urban Roads Authority
KeRRA	Kenya Rural Roads Authority
THIWASCO	Thika Water and Sanitation Project
MWI	Ministry of Water and Irrigation
NEMA	National Environment Management Authority
NEP	National Environment Policy
NGO	Non-Governmental Organization
OBA	Output Based Aid
OSHA	Occupational Health and Safety
OP	Operations Policy
PPEs	Personal Protective Equipment
RAP	Resettlement Action Plan
SDGs	Sustainable Development Goals
STD	Sexually Transmitted Diseases
SUP	Social Upgrading Project
WB	World Bank
WIBA	Workplace Injuries and Benefits Act
WSTF	Water Services Trust Fund
WSP	Water Services Provider
WRUA	Water Resources Users Authority
WRMA	Water Resources Management Authority
VCT	Voluntary Counselling Centres

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EXECUTIVE SUMMARY

Project Description

The Water Services Trust Fund (WSTF) has established an Output Based Aid (OBA) Fund. The fund is a performance based financing which offers subsidy of up to 65% of loans secured from commercial banks by Water Services Providers towards improving water and sanitation services to low income areas.

Thika Water and Sewerage Company (THIWASCO) under the fund, intend to implement Thika Boreholes Development Project. The Project main objective is to increase THIWASCO water production by 5,000m^3/day, extend coverage of water services to about 10,200 people in the low income and informal settlement areas and improve service hours from 18hrs to 24hrs within THIWASCO area.

THIWASCO intends to achieve this objective through development of boreholes at various existing tank sites, upgrading of an existing boreholes and connecting to the network, extension of distribution networks to low income areas, increasing water connections and installation of prepaid water meter kiosks in low income areas.

Specific Project components include;

- ✓ Sinking and equipping eight boreholes including power connection and online chlorination system to feed the existing tanks and gravitate water to consumers in the low income areas using the existing network.
- ✓ Connecting the recently completed boreholes at Thika Primary School and Kimuchu Primary School to the existing system including installation of online chlorination system and gravitate to low income areas using the existing network.
- ✓ Upgrade the existing Maguguni borehole through construction of a sump and installation of a high lift pump and chlorination system.
- ✓ Supply and installation of 42Km of HDPE assorted sizes of distribution and service lines to selected low income areas.
- ✓ Supply and installation of 1200 consumer meter connection to low income areas.
- ✓ Supply and installation of pre-paid meters in Kiandutu and Kiangombe slum.

The Project once complete will supply safe, reliable and adequate water to residents of; Kiandutu slums, Kiangombe slum, Witeithie, Athena, Makongeni (Kisii/Deacons), Kiganjo, Gachagi, Umoja Matharau, Pilot, Gatuanyaga/Munyu, Council Houses, Majengo and Kilimambogo /Maguguni

This report therefore presents environment and social risks to human and natural environment of identified Project components, appropriate mitigation measures have also been recommended in chapter 7 and 8 of this assessment.

Legal and Policy Framework

The Assessment makes reference to provisions of Kenyan Legislation and Word Bank operation Policies for Project of such nature as discussed below;

The ESIA study preparation was guided by both national and international legal and policy instruments aimed at ensuring compliance with Environmental and Social Safeguards of the World Bank. A summary of the instruments is presented box E-1 below;

Box E-1: Legal and Policy Framework

National Policies and Laws

1. Kenyan Constitution 2010
2. Kenya Vision 2030
3. Sustainable Development Goals
4. Gender Policy 2011
5. HIV and AIDS policy 2009
6. Environmental Management and Coordination Act (EMCA),1999 amended 2015 and subsequent regulations
7. Water Act 2016 and subsequent regulations.
8. County Government Act no 17 of 2012
9. Physical Planning Act 1996 (286)
10. Occupational Health and Safety Act (OSHA 2007)
11. The Public Health Act (Cap.242)
12. Workplace Injuries and Benefits Act 2007
13. Urban Cities Act

International Instruments

1. World Bank OP 4.01 on Environment Assessment
2. World Bank Group Environment Health and Safety Guidelines on Water and Sanitation
3. International Finance Cooperation (IFC) Performance Standard 2: Labour and Working Conditions
4. Guidelines on incorporating Human Rights Standards and Principles, including Gender, in Programme Proposals for Bilateral German Technical and Financial Cooperation

Stakeholder Consultations

The assessment involved consultations with relevant stakeholders in target Project area. The aim of stakeholder consultations was to give a platform for information sharing and opinion gathering in relation to the proposed Project. Consultations were done in form

of public meetings and key informant interviews. The issues were then analyzed and presented to design team for finalization of Project designs and planning on how best to implement the Project. The main meetings were held within the month of April 2017, attendance of the meetings was from diverse sectors of the society as summarized below

Table E-1: Schedule of Stakeholder Consultations

Date	Stakeholder Consulted
21st April 2017	Residents living around Gatundu/Landless tank
19th April 2017	Residents living around Githingiri tank
20th April 2017	Residents living around Kimathi Tank Kenyatta Road
20th April 2017	Residents living around Maguguni Borehole Location
19th April 2017	Residents living around Makongeni tank
19th April 2017	Residents living around Mary Hill tank
19th April 2017	Residents living around Ngoingwa tank
20th April 2017	Residents living around Sector 9 tank
20th April 2017	Residents living around Town Victory PlazaTank

Table E-2: Schedule of Public Consultation Meetings

Date	Meeting Venue	Meeting Participants	Attendance
22ndApril 2017	Ngoliba Shopping Centre	✓ Chief Ngoliba location ✓ chief Kilimambogo location ✓ THIWASCO distribution manager ✓ THIWASCO technical manager ✓ THIWASCO project inspector ✓ Project Affected Persons.	28

Summary of Issues from Public and Institutional Consultations is presented in table E-3 below

Table E-3: Summary of Issues Discussed

No	Issues	Response and Discussions
1	The residents wanted to know what measures the company (THIWASCO) is planning to put in place in order to bring down cost of water.	The technical manager informed residents that the water tariffs are provided by WASREB basing on various factors. Residents suggested that the company should incorporate technology in its operations for instance use of solar powered pumps. This will significantly reduce cost of pumping water which will lead to a reduction in water tariffs.
2	Residents wanted to know how the company is	Residents were informed that according to the design the pipes will be laid in road reserves thereby avoiding

	planning to ensure the pipeline is secure.	private property. The way leave will clearly be marked to keep off encroachers. Also the pipes will be buried deep enough to avoid breakages which might occur when the pipes are on the surface.
3	Residents wanted to know if they will get any employment opportunities during project implementation	ESIA team informed residents that during construction phase, the contactor will source some skilled and semi skilled labour from the community to supplement his staff when such opportunities are available. Residents were further advised to liaise with the office of the chief and present their request for jobs in an orderly manner for consideration.
4	Resident wanted to know the expected commencement date of the project.	Resident residents were informed that the project will commence immediately after all the necessary designs have been done and required licenses issued including the NEMA license. They were further informed that the project was urgent and should start this year (2017)
5	The community wanted to know what the company does to residents of Thika as part of the corporate social responsibility (CSR).	The commercial manager informed residents that the company normally organizes tree planting campaigns mostly during the rainy seasons. Residents were further informed that during end period the company usually visits various children homes and provide food stuffs and other personal effects.
6	Residents requested for more water kiosks to be constructed.	Residents were informed that water kiosks are being proposed at all the borehole sites. They were further informed that the primary objective of the company is to provide clean safe drinking water hence water kiosks will only be provided where the water has fully been treated.

Details of stakeholder consultations are presented in Chapter 6 of this Report.

Potential Impacts and Mitigation Measures

The Project is a Socially Uplifting Project (SUP) and it's envisaged to have more positive impacts after completion of the civil works and commissioning. The main anticipated positive impacts associated with the Project include;

- Increased access to clean drinking water for the residents thus improving their hygiene and sanitation conditions.
- Reduced distances and travel time spent in search for water. The beneficiaries (especially women and children) will use that energy and time on economically and socially viable activities for the families.
- Supporting and strengthening the participation of local communities in improving water and sanitation management in the project area

- Employment opportunities for the local community during the construction and operation phases of the project (e.g. masons, carpenters, cooks and indirect spins-off etc.);
- The Project will help develop the human capital in the country through transfer of skills to young engineers, environmental specialists and plumbers among others.

Against the above positive benefits brought about by the project, there will be some negative impacts emanating from both the construction and operation activities of the proposed project. The proposed project triggers Bank safeguards policies on Environmental Assessment (OP 4.01). The following negative impacts are likely to occur during various stages of the project:

1. **Increased soil erosion:-**Increased soil erosion is likely to occur in the project area during the excavation and construction of new water pipelines. The presence of loose earth (resulting from the above activities) coupled with prevailing strong winds and occasional rains could lead to acute and chronic soil erosion problems in the project area;
2. **Debris:-**Some of the excavated sediments from the project site and the construction spoils emanating from excess excavated material and construction debris are likely to impact negatively on the environment of the project area
3. **Ponding: -**Borehole drilling and testing may lead to creation of stagnant water bodies in quarries; borrow pits and depressions created during the construction works. The resultant stagnant water bodies are likely to be suitable habitats for the breeding of mosquitoes and snails that are disease vectors for malaria and bilharzias respectively;
4. **Terrestrial flora and fauna:** This project may have minimal impact on the terrestrial fauna due to the general scarcity of fauna in the area. Trees must be planted after completion of construction activities while farmers must be compensated for their crop loss where applicable.
5. **Increased noise levels:-**Noise levels are likely to increase in the project but only during construction of the proposed project.
6. **Air emissions:-**Pollution through air emissions in the project area will emanate from construction activities especially from exhaust pipes for vehicles and machinery used.
7. **Dust pollution:-**Construction activities have the potential to generate levels of dust in the project area especially where construction is taking place.
8. **Social Impacts:-**encompass the likely increase in incidences of HIV/AIDS and increased cultural contamination among the local communities in the project area including potential for child labour.

Table E-4: Below outlines the mitigation measures proposed and which are considered adequate.

Project Impacts on Biophysical Environment

The project impacts on Biophysical environment setting of the Project area identified during the assessment is presented in Table E.4 below.

Table E.4: Negative Impacts on Biophysical Environment and Mitigation Measures during Construction

Impacts	Proposed Mitigation Measures
Destruction of Vegetation in the Project Areas	• Site Clearance and Construction activities will be limited to available reserves within which the pipelines are to be laid so as to minimize destruction to vegetation cover • Reinstatement of the project sites to their original state to be carried out once construction works are completed to allow growth of vegetation.
Contamination of Surface Water Sources by Effluents from Construction Plant and Equipment	• Ensure Construction Equipment is well maintained and serviced according to manufacturers' specifications to prevent oil leaks. • Cleaning / repair of Construction Plant and Equipment to be carried out at designated yards • Contractor to have designated storage areas for oils, fuels etc. that is protected from rain water and away from nearby surface water courses
Soil Erosion resulting to loss of top soil	• The risk of Soil Erosion is low as the design of the water pipelines has incorporated measures to minimize this risk through provision of Erosion prevention structures i.e. gabions in areas susceptible to Soil Erosion especially at the Banks of the rivers.
Solid Wastes Generation from Construction Activities	• Construction wastes (residual earth, debris and scrap materials) to be collected at designated points and Contractor to dispose off the waste in designated Solid Waste Dumping Sites approved by NEMA and the Kiambu County Government • Contractor's Camps and Construction Sites to have designated waste collection points, • Environmental Management, Health and Safety Training Programmes to be conducted to all Contractor's Staff to create awareness on proper solid wastes management

Social Environment Setting

The project impacts on Social environment setting of the Project area identified during the assessment are presented in Table E.5 below.

Table E.5: Negative Impacts on Environment and proposed Mitigation measure during Construction

Impacts	Proposed Mitigation Measures
Loss of Temporal Assets and Sources of Livelihood	Not triggered due to the following • All the proposed borehole sites are located within existing facility that has adequate land for expansion • Proposed clear water distribution line will utilize existing road reserve that is free from encroachment
Disruption of Public Utilities	• Contractor to carry out piloting to locate services such as pipes and cables along the Pipeline Route before commencing excavation works. • The relevant Services Providers and Agencies to be notified prior to commencement of Works so that any relocation works can be carried out before the Pipeline Construction Works begin. • Length of excavation to be restricted to sections that can be reinstated within the shortest period possible to minimize time of disruption of services
Increased Transmission of HIV/AIDS	• HIV/AIDS Awareness Program to be instituted and implemented as part of the Contractor's Health and Safety Management Plan and to be enforced by the Supervising team. This will involve periodic HIV/AIDS Awareness Workshops for Contractor's Staff • Access to Contractor's Workforce Camps by outsiders to be controlled • Contractor to provide standard quality condoms to personnel on site
Labour Influx and sexual offences	• Effective community engagement and strong grievance mechanisms on matters related to labour. • Prepare and implement Child Protection strategy which should provide guidance on measures that will be adopted to protect children from being engaged, early pregnancies and school dropout • Effective contractual obligations for the contractor to adhere to the mitigation of risks against labour influx • Proper records of labour force on site while avoiding child and forced labour • Fair treatment, non-discrimination, and equal opportunity of workers. • Comply to provisions of WIBA 2007 and IFC PS 2 on labour and Working Conditions, and ILO Conventions 87, 98, 29,105,138,182,100,111

Impacts	Proposed Mitigation Measures
	• Develop and implement a children Protection Strategy
Human Rights and gender inclusivity	• Mainstream Gender Inclusivity in hiring of workers and entire Project Management as required by Gender Policy 2011 and 2/3 gender rule. • Comply to provisions of guidelines on incorporating Human Rights Standards and Principles, including Gender, in Programme Proposals for Bilateral German Technical and Financial Cooperation • Protecting Human Risk areas Associated with, Disadvantaged Groups, Interfering with Participation Rights, and interfering with Labour Rights
Increased Crime and Insecurity	• Contractor and Supervision Team to liaise regularly with the Local Administration and Police Service to address any security and crime arising during project implementation. • Contractor to provide 24 hours security to Workforce Camps, Yards, Stores and to the Supervising Team's Offices

Occupational Health and Safety Setting

The project impacts on Social Economic environment setting of the Project area identified during the assessment is presented in Table E.6 below

Table E.5: Negative Impacts on Occupational Health and Safety Setting and Proposed Mitigation Measures during Construction

Impact	Proposed Mitigation Measures
Noise and Excessive Vibrations.	• Contractor will comply with provisions of EMCA 1999 and 2015 amendments (Noise and Excessive Vibrations Regulations of 2009) • The Contractor shall keep noise level within acceptable limits (60 Decibels during the day and 35 Decibels during the night) and construction activities shall, where possible, be confined to normal working hours in the residential areas • Hospitals and other noise sensitive areas such as schools shall be notified by the Contractor at least 5 days before construction is due to commence in their vicinity
Air Pollution and Dust Generation.	• The contractor shall comply to the provisions of EMCA 1999 amended in 2015 (Air Quality Regulations 2014) • Workers shall be trained on management of air pollution from vehicles and machinery. All construction machinery shall be maintained and serviced in accordance with the contractor's specifications • Water sprays shall be used on all earthworks areas within 200 metres of human settlement especially during the dry season.
Risk of Accidents at Work Sites	• Contractor to provide a Healthy and Safety Plan prior to the commencement of works to be approved by the Supervising Engineer.

Impact	Proposed Mitigation Measures
	• Provide Personal Protective Equipment including gloves, gum boots, overalls and helmets to workers, use of PPEs to be enforced by the Supervising Engineer. • Fully stocked First Aid Kits to be provided within the Sites, Camps and in all Project Vehicles
Risk of Traffic Accidents along the Pipeline Route	• Strict use of warning signage and tapes where the trenches are open and at other active construction sites • Contractor to Employ and train Road Safety Marshalls who will be responsible for management of traffic on site • Contractor to provide a Traffic Management Plan during construction to be approved by the Supervising Engineer

Negative Impacts and Mitigation Measures During Project Operation Period

Table E-7 presents a summary of potential negative impacts likely to be experienced by the THIWASCO during operation of the project.

Table E-7:Potential Negative Impacts and Proposed Mitigation Measures During Operation

Potential Impact	Proposed Mitigation Measures
Risk of Encroachment and Construction of Structures on the Pipeline Way Leave	• Arrest and prosecution of encroachers as required by Kiambu County By laws on Way Leaves and Road Reserves • THIWASCO to undertake awareness campaigns aimed at preventing encroachment
Risk of Pipeline Bursts / boreholes breakdown Leading to Water Loss (Non-Revenue Water)	• The risk of pipeline bursts and borehole breakdown is low as the pipeline design, including the selection of pipe material and pipe pressure classes, has been carried out so as to minimize this risk. • This risk will be further minimized through regular inspection, repair and maintenance of the pipeline and borehole by the Operator, THIWASCO
Risk of Illegal Connections and Vandalism of the borehole	• Regular inspection by THIWASCO of the pipeline corridor and borehole for illegal connections • Prosecution of encroachers as required by Kiambu County By laws on Way Leaves and Road Reserves • THIWASCO will undertake awareness campaigns to prevent illegal connection to the water lines

Environmental and Social Management/Monitoring Plan

Environmental and Social Management Plan (ESMMP), including monitoring plan, has been identified as an important process in the protection of environment of the project area. The monitoring program will involve the following:

- Collection and analysis of appropriate environmental data;
- Preparation of periodic reports including an annual environmental and social performance report and liaison with other relevant bodies such as NEMA and the County Government;
- Identification of unexpected environmental and social impacts; and
- Formulation of mitigation measures for the unexpected negative impacts.
- Key environmental and social variables to be regularly monitored include resource utilization, waste generation, incidences of accidents due to open trenches, ponding, soil erosion and siltation, noise levels, increase incidence of STDs and changes in socio-economic status of affected communities among other variables.
- The overall responsibility for the implementation of the ESMMP lies with the water Service Provider (THIWASCO).

Conclusions

- The major positive impacts of this Project will include improved access to clean drinking water thereby improving hygiene and sanitation conditions as well as mitigating related diseases for the residents.
- The Project activities are likely to cause, albeit on a small scale, soil erosion, disturbance of vegetation, ponding, risk of accidents, emission of dust, and increase in noise.
- The study has proposed several measures to reduce negative impacts including amelioration of social negative impacts, noise abatement, waste management, reduction of visual intrusion, reduction of soil erosion, prevention of accidents and health hazards.
- Monitoring has been identified as an important process in the protection of environment of the project area since it will reveal changes and trends brought about mainly by construction activities.

Recommendations

- The proponent needs to support the implementation of environmental and social management plan (including mitigation plan and monitoring) in order to protect the environment of the project area from the negative impacts of project implementation.

- Priority for employment should be given to the local community including women and youth. This will enhance social economic and capacity building.
- The proponent should adopt a participatory and collaborative approach during all the phases of the project. This will ensure active participation of all key stakeholders towards success and sustainability of the project.

1 INTRODUCTION

1.1 Background and Context

The Water Services Trust Fund (WSTF) has established an Output Based Aid (OBA) Fund (the OBA Fund) with the objective of facilitating access to water and sanitation services for the urban low income communities subsiding sub projects developed and implemented by Water Service Providers (WSPs) and financed through commercial lending loans. Through the OBA fund, administered by the Water Services Trust Fund (WSTF), the project will provide subsidies to subprojects financed by commercial lenders and implemented by WSPs to provide water and/or sanitation services in low-income areas identified in the Government's poor areas mapping database referred to as MajiData.

The OBA Fund has received initial funding through the Global Partnership on Output based Aid (GPOBA), a trust administered by the World Bank. It is expected that the programme will support WSPs to access US$ 16 million of the debt finance from market based lenders and provide water and sanitations services to 30,000 households or approximately 150,000 people. To do so GPOBA is contributing US$ 11.7 million to be used in the following components: The grant consists of USD 2.335 million for implementation support activities and USD 9.5 million for output-based aid (OBA) subsidies – total US$11.835 million. Participating WSPs will deliver results, which must be independently verified to access the OBA subsidy

Under the fund, Thika Water and Sewerage Company (THIWASCO) intend to implement Thika Boreholes Development Project. The Project main objective is to increase THIWASCO water production by 5,000m3/day, extend coverage of water services to about 10,200 people in the low income and informal settlement areas and improve service hours from 18hrs to 24hrs within THIWASCO area.

THIWASCO intends to achieve this objective through development of boreholes at various existing tank sites, upgrading of an existing boreholes and connecting to the network, extension of distribution networks to low income areas, increasing water connections and installation of prepaid water meter kiosks in low income areas. The Project once complete will supply safe, reliable and adequate water to residents of; Kiandutu slums, Kiangombe slum, Witeithie, Athena, Makongeni (Kisii/Deacons),

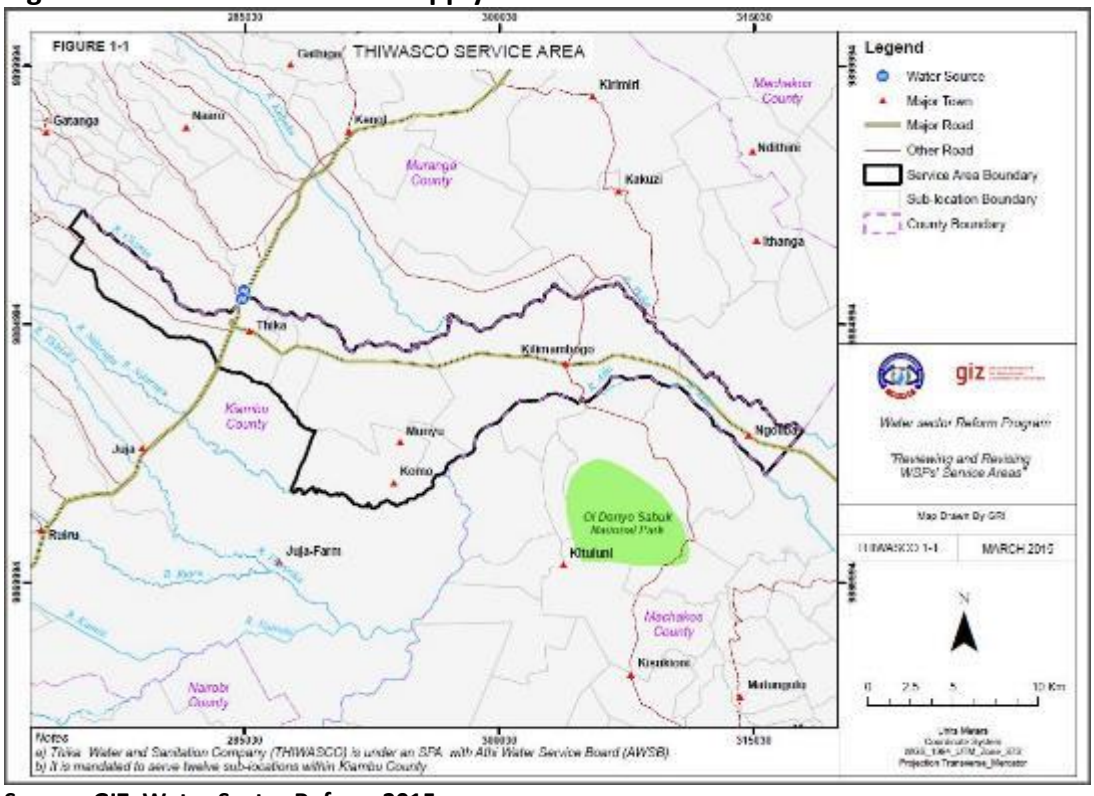
Kiganjo, Gachagi, Umoja Matharau, Pilot, Gatuanyaga/Munyu, Council Houses, Majengo and Kilimambogo /Maguguni

1.2 Project Proponent

The project proponent is the Thika Water and Sewerage Company (THIWASCO), the company was registered in the year 2009 as a water and sewerage services providing Company. However, the company operated as a water project commissioned in 1956 and later operated as one of the departments of the Municipal Council of Thika covering an area of 93 km2 until 7th September 2009 when it started operation as a Company under Athi Water Services Board (AWSB) after its incorporation in July 2009 within expanded mandate to serve the entire Thika Sub-county and parts of Juja Sub county with an area of approximately 254 km^2.

Thika town is one of the main commercial and industrial towns of Kiambu County of Kenya and according to the National Statistical 2009 population census the area of jurisdiction had a total population of about 357,316 with an average growth rate of 2.5% per annum. In addition to this population, Thika Water & Sewerage Company Ltd supplies water to some areas outside its boundaries like Githingiri and Mwanawi Kio in Muranga County. Figure 1-1 below illustrates THIWASCO area of operation.

Figure 1-1: THIWASCO Water Supply Jurisdiction



Source: GIZ, Water Sector Reform 2015

1.3 Objectives and Benefits

The drilling, equipping and rehabilitation of the boreholes at unidentified sites will significantly reduce; acute shortage of portable water for domestic use and health risks posed due to unsanitary water sources available in the area.

The borehole once constructed will uplift the Social and Economic well being of the communities residing in the project target areas. Specific benefits associated with the Project Include;

- Realization of THIWASCO strategic goals of improving water and coverage in its area of jurisdiction.
- Sustainable Development Goal (6) which is the new 2030 agenda and expands Millennium Development Goal as guided by resolutions of Rio+20 conference. The goal focuses more on investment in adequate infrastructure in water sanitation, Hygiene, water quality, waste Water Management, water scarcity and use efficiency, integrated water resource management and protection of water related ecosystems.
- The Project is directly linked to Kenya's Vision 2030 related project which endeavours to contribute to improved water supply to Thika Town. Once commissioned, the project will contribute towards achieving the 10% economic growth for the next 25 years.

1.4 ESIA Objectives, Terms of Reference and Study Methodology

The objective of the study is to carry out an environmental and social impact assessment for the proposed Activities. In accordance with the Terms of Reference, the following scope has been defined for this ESIA.

- Clear description of the physical location and linkages of the Project including the baseline conditions of the project area;
- A description of the Project characteristics including Project objectives, Project design, activities, technology, procedures and processes, materials to be used, Products, by-products and waste generated, during the project construction, operation and de-commissioning phases;
- A description of the national environmental legislative and regulatory framework, baseline information and any other relevant information related to the project.
- Description of the recipient environment (baseline environment and social setting of the project area),
- The potential environmental effect of the project, including the social and cultural effects and the direct, indirect, cumulative, irreversible, short-term and

long-term effects anticipated;

- An environmental and Social management and monitoring plan matrix outlaying the activities, associated impacts, mitigation measures, monitor able indicators, implementation timeframes, responsibilities and cost;
- An Action Plan for the prevention and management of foreseeable accidents and hazardous activities in the cause of carrying out activities or major industrial and other development projects:
- Measures to prevent health hazards and to ensure security in the working environment for the employees and for the management of emergencies;
- Conclusions, recommendations and identification of gaps and uncertainties which were encountered in compiling the report

1.4.1 Environment and Social Screening Stage

Screening was carried out within the Month of April 2017 with an aim of determining the category of Project Impacts on Environment and Social Setup as per schedule 2 of EMCA 1999 now amended in 2015, and the Environmental (Impact and Audit) Assessment Regulation Legal Notice 101 of 2003, and World Bank OP 4.01 on Environment Assessment.

The project was found to qualify for a project report and categorized as a medium risk project according to NEMA categorization and Category B as per World Bank Categorization. This implies that potential environment and social risks likely to be triggered by the Project are less significant and can easily be mitigated.

1.4.2 Environment and Social Scoping Stage

Scoping was undertaken to decide on the critical issues of focus during the assessment. This stage mainly involved review of relevant data and identification possible area of impacts and recipients, project alternatives methodologies relevant to the project as well as who to consult. Accordingly, existing data including borehole records, geological maps and reports and any other relevant information were reviewed. The identified issues were scrutinized against the available data.

1.4.3 Desktop Study

This included documentary review on the nature of the proposed activities, project documents, designs policy and legislative framework as well as the environmental setting of the area among others.

1.4.4 Fieldwork/Impact Assessment Stage

A site visit to the project area was undertaken to assess site characteristics and the environmental status of the surrounding areas to validate the baseline information obtained at scoping stage and determine the anticipated impacts. The existing water supply situation with respect to demand, current land uses, alternative water sources

and the general set up of the proposed drill site were evaluated. The key impacts considered relevant to this project included:

- Impacts on Soil and Land,
- Impacts on Water Resources,
- Impacts on Biodiversity,
- Socio-Economic Impacts,
- Impacts on Air Quality,
- Impacts on Public Health and safety.
- Visual Impacts

1.4.5 Environmental Management Planning Stage

Recommendations on appropriate mitigation measures were drawn, based on the key impacts identified, through discussion, experiences from past similar projects, assessment of land-use and socio-economic factors. An environmental and social management and monitoring plan (ESMMP) was developed outlining key environmental and social aspects, appropriate action plans, responsibilities, time frames and monitoring indicators.

1.4.6 Public Participation

Legislation on ESIA processes requires that members of the public be adequately consulted. To ensure adequate public participation in the ESIA process, semi-structured questionnaires were administered to the sites neighbours within a one Kilometre radius and the information gathered was subsequently synthesised and incorporated into the ESIA project report. Details of stakeholder Engagement are presented in Chapter 6 of this assessment.

1.4.7 Reporting

In addition to constant briefing of the client, this Environmental and Social Impact Assessment project report was prepared. The contents were presented for submission to NEMA as required by law.

2 PROJECT DESCRIPTION

2.1 Project Area Description

The Project will include development of Boreholes in various Water Tanks locations within Thika Town as discussed in sub Chapter below.

2.1.1 Gatundu Landless Borehole Tank Site

Gatundu/Landless tank is located within kiambu county Thika Sub County. The tank has a capacity of 192 cubic metres but currently it is operating below capacity. It is located along Kamagambo road which is off Garissa road within happy valley estate. GPS coordinates for the site are UTM 0294251E and 9881999N

The area residents had goodwill for the project, the acknowledged the fact that water supply has been dropping over the years reaching an all time low this year (2017) due to the drought that was experienced across the country and also as a result of the growth rate which is rampant within the area. They were optimistic that drilling a borehole at the proposed site will normalize water supply even when the rains fail.

There were no serious concerns about the bio physical environment degradation since the site selected for the borehole drilling has limited vegetation mainly short grass and residential houses are at a significant distance away from the proposed site.

Photo Plate 2-1: Gatundu Landless Borehole Site

	
An elevated steel water tank at the site	General view of the area

	
A sign post showing directions to the tank	A Pump house within the premises.

2.1.2 Githingiri Borehole Tank Site

Githingiri tank is located within kiambu county Thika Sub County. The tank has a current capacity of 100 cubic metres. It is located along Mathioya drive which is off Kimathi road. GPS coordinates for the site are UTM 0284329E and 9888816N.

The area residents had goodwill for the project, the acknowledged the fact that water supply has been dropping over the years reaching an all time low this year (2017) due to the drought that was experienced across the country. They were optimistic that drilling a borehole at the proposed site will normalize water supply even when the rains fail.

Photo Plate 2-2: Githingiri Borehole Tank Site

	
Githingiri elevated steel water tank	General view of Githingiri estate

	
An example of roads within the estate	A water point within a home in Githingiri.

2.1.3 Kimathi Borehole Tank Site

Kimathi tank is located within kiambu county Thika Sub County. The twin tanks have a capacity of 448 cubic metres. It is located off Kenyatta Avenue. Gps coordinates for the site are 0287781 and 9884703.

The area residents had goodwill for the project, the acknowledged the fact that water supply has been dropping over the years reaching an all time low this year (2017) due to the drought that was experienced across the country. They were optimistic that drilling a borehole at the proposed site will normalize water supply even when the rains fail.

Photo Plate 2-3: Kimathi Water Tank Borehole Site

	
An elevated water tank at the site	General view of the area

	
A control valve for the tank	A section of Kenyatta avenue.

2.1.4 Maguguni Borehole Tank Site

Maguguni borehole is located within kiambu county Maguguni location. The proposal is to upgrade the existing Maguguni borehole through construction of a sump and installation of a high lift pump and chlorination system to increase production to 100m^3/day of water. It is located off Garissa Road near Ngoliba market. GPS coordinates for the site are UTM 0308522E and 9883637N

The area residents had goodwill for the project, the acknowledged the numerous challenges they go through in trying to find water. The current water from the borehole is saline and not sufficient since residents have to walk for long periods of time to the only water point within the area. Residents were happy that the proposed upgrade will enable water to be piped to their homesteads.

Photo Plate 2-4: Maguguni Borehole Tank Site

	
Existing borehole at Maguguni	A sample road within Maguguni

	
Vegetation cover within maguguni	Matathia primary within maguguni.
	
Water kiosk at a Maguguni	Pump house at the Maguguni borehole.

2.1.5 Makongeni Borehole Tank Site

Makongeni tank is located within kiambu county Thika Sub County. The tank has a capacity of 224 cubic metres. It is located off Garissa road opposite BAT leaf processing plant. GPS coordinates for the site are UTM 0289214E and 9883492N.

The area residents had goodwill for the project, the acknowledged the fact that water supply has been dropping over the years reaching an all time low this year (2017) due to the drought that was experienced across the country. They were optimistic that drilling a borehole at the proposed site will normalize water supply even when the rains fail.

There were no serious concerns about the bio physical environment degradation since the site selected for the borehole drilling has limited vegetation mainly short grass and residential houses are at a significant distance away from the proposed site.

Photo Plate 2-5: Makongeni Borehole Tank Site

	
An elevated water tank at the site	General view of the area
	
A control valve for the tank	Main gate to the tank site.

2.1.6 Mary Hill Borehole Tank Site

Mary hill tank is located within kiambu county Thika Sub County. The tank has a capacity of 700 cubic metres but currently it operates below capacity. It is located off Thika-Mang'u highway adjacent to Mary hill Girl's school. Gps coordinates for the site are 0275513 and 9889607.

The area residents had goodwill for the project, the acknowledged the fact that water supply has been dropping over the years reaching an all time low this year (2017) due to the drought that was experienced across the country. They were optimistic that drilling a borehole at the proposed site will normalize water supply even when the rains fail.

There were no serious concerns about the bio physical environment degradation since the site selected for the borehole drilling has limited vegetation mainly nippier grass and residential houses are at a significant distance away from the proposed site.

Photo Plate 2-6: Mary Hill Tank Borehole Site

	
A concrete water tank at the site	General view of the area
	
A control valve for the tank	A cultivated section of the tank site land.

2.1.7 Ngoingwa Borehole Tank Site

Ngoigwa is located within kiambu county Thika Sub County. The tank has a capacity of 15970 cubic metres. The water is from Chania River which is treated at Thika water and sewerage company premises. From the tank water is then channeled to other reservoir tanks within Thika. It is located off Thika-Mang'u highway adjacent to Braeburn schools. Gps coordinates for the site are 0280838 and 9885240.

The area residents had goodwill for the project, the acknowledged the fact that water supply has been dropping over the years reaching an all time low this year (2017) due to the drought that was experienced across the country. They were optimistic that drilling a borehole at the proposed site will normalize water supply even when the rains fail.

There were no serious concerns about the bio physical environment degradation since the site selected for the borehole drilling has limited vegetation mainly nippier grass and residential houses are at a significant distance away from the proposed site.

Photo Plate 2-7: Ngoingwa Borehole Tank Site

	
A concrete water tank at the site	Main gate to the site
	
A pump house within the premises	An office block within the premises.
	
A cultivated section within the premises	A storage area within the premises

2.1.8 Sector 9 Borehole Tank Site

Sector 9 tank is located within Kiambu county Thika Sub County. The tank has a capacity of 48 cubic metres. It is located along Quia road which is off Mgoko road. GPS coordinates for the site are UTM 0285039E and 9885050N

The area residents had goodwill for the project, the acknowledged the fact that water supply has been dropping over the years reaching an all time low this year (2017) due to the drought that was experienced across the country. They were optimistic that drilling a borehole at the proposed site will normalize water supply even when the rains fail.

Photo Plate 2-8: Sector 9 Borehole Tank Site

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>elevated concrete water tank at the site</td><td>General view of the area</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>housing structures within the estate</td><td>Road network within the estate</td></tr>
</table>

2.1.9 *Thika Tank Mama Ngina Street behind Vision Plaza*

Town tank is located within kiambu county Thika Sub County in the CBD. The tank has a capacity of 35 cubic metres but currently it is obsolute. It is located along Mama Ngina drive behind Victory. GPS coordinates for the site are UTM 0285681E and 9885401N.

Business people operating around the tank had goodwill for the project, they acknowledged the fact that water supply has been dropping over the years reaching an all time low this year (2017) due to the drought that was experienced across the country. They were optimistic that drilling a borehole at the proposed site will normalize water supply even when the rains fail.

There were no serious concerns about the bio physical environment degradation since the site selected for the borehole drilling has limited vegetation mainly short grass. However residents proposed the contractor to minimize noise during drilling process because too much noise might disturb their customers.

Photo Plate: Thika Town Tank

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Tank elevated concrete water tank</td><td>General view of the tank site</td></tr>
<tr><td> 
</td><td> 
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</table>

Main gate to the town tank site	A sign post to the tank site

2.1.10 Extension of Water Distribution Network

THIWASCO intends to extend water distribution network in low income area of Kiganjo, Kiandegwe, Makongeni, Gachagi and Witeithie, THIWASCO has designed the pipelines within existing road reserves which are free from encroachment hence eliminating possible triggers of resettlement impacts. Table 2-1 below presents a summary of proposed water distribution scope of work

Table 2-1: Proposed Water Distribution Extension

Area	Pipe size (HPDE)	Distance(Km)
Kiganjo and Kiandegwa	OD 110 mm	4
	OD 90 mm	3
	OD 63 mm	3
Makongeni	OD 110 mm	3.5
	OD 90 mm	3
	OD 63 mm	4
Gachagi	OD 93 mm	2
	OD 63 mm	2
Witeithie	OD 110 mm	4
	OD 90 mm	2
	OD 63 mm	2

2.1 Project Process Description

The borehole drilling process follows four main steps outlined in table 2-2 below;

Table 2-2: Borehole Development Phases

Step 1.	Step 2	Step 3	Step 4
Hydro-geological Survey to locate drilling site.	Drilling, casing and well development	Test Pumping to determine output discharge capacity	Pump installation electrical works and borehole commissioning

2.1.1 Drilling

Drilling is expected to commence upon approval of the present project by relevant statutory authorities, including issuance of an ESIA licence and WRMA approval. The process will involve the use of a Down the Hole Rotary Drill System, which is suitable for the geological terrain. The borehole will be drilled at 8" diameter (minimum), to a maximum depth of 100m to 250m depending on the recommendation of the hydro geological report for each proposed borehole site, as per the recommendation of the hydro-geologist presented in volume II of this assessment.

Drilling will be carried out with an appropriate tool - either percussion or rotary machines will be suitable, though the latter are considerably faster and have a low noise level. Geological rock samples will be collected at 2 metre intervals. Struck and rest water levels and if possible, estimates of the yield of individual aquifers encountered, will also be noted.

2.1.2 Well Design

For monitoring of ground water abstraction and static water level measurements, a water meter and an airline respectively will be installed. An airline consists of an open tube or several pipes. These pipes are connected together and are normally attached to the pump drop pipes. A water meter and an airline are required for determining the relationship between the rate of ground water abstraction and the static or dynamic water level in the borehole at any given time.

The design of the well will ensure that screens are placed opposite the optimum aquifer zones. The final design should be left in the hands of an experienced driller or hydro-geologist.

2.1.3 Casing and Screens

The well will be cased and screened with appropriate steel casings and screens as per the design report presented in volume II of this assessment. In comparatively shallow wells, uPVC casing and screens of 5" or 6" diameter may be adequate. Slots should be 1 mm in size.

2.1.4 Gravel Pack

The use of gravel pack is recommended within the aquifer zone, because the aquifer could contain sands or silts which are finer than the screen slot size. An 8" diameter borehole screened at 6" will leave an annular space of approximately 1", which should be sufficient. Should the slot size chosen be too large, the well will `pump sand', thus damaging pumping plant, and leading to gradual `siltation' of the well. The grain size of the gravel pack will be an average 2-4 mm.

2.1.5 Well Construction

Once the design has been agreed upon, construction can proceed. In installing screen and casing, centralizers at 6metre intervals should be used to ensure centrality within the borehole.

This is particularly important if an artificial gravel pack is to be installed as it ensures an approximately even annular space. If installed, gravel packed sections should be sealed off top and bottom with clay. It is normal practice nowadays to gravel pack nearly the total length of the borehole but seal off the weathered/topsoil zone at the top. The remaining annular space should be backfilled with an inert material, and the top five

metres grouted with cement to ensure that no surface water at the wellhead can enter the well bore.

2.1.6 Well Development

Once the screen, gravel pack, seals and backfill have been installed, the well will be developed. Development has two broad aims:

a) It repairs the damage done to the aquifer during the course of drilling by removing clays and other additives from the borehole walls, and
b) It alters the physical characteristics of the aquifer around the screen and removes fine particles.

The project does not advocate the use of over pumping as a means of development since it only increases permeability in zones, which are already permeable. Instead, we would recommend the use of air or water jetting, which physically agitates the gravel pack and adjacent aquifer material. This is an extremely efficient method of developing and cleaning wells.

Well development is an expensive element in the completion of a well but it is usually justified in longer well life, greater efficiencies, lower operational and maintenance costs and a more constant yield.

2.1.7 Well Testing

After development and preliminary tests, a long-duration well test will be carried out. Well tests have to be carried out on all newly completed wells, because not only does this give an indication of the success of the drilling, design and development, but it also yields information on aquifer parameters which are vital to hydro-geologists.

A well test consists of pumping a well from a measured start level (SWL) at a known or measured yield, and recording the rate and pattern by which the water level within the well changes. Once a dynamic water level is reached, the rate of inflow to the well equals to the rate of pumping. Towards the end of the test a water sample of at least two litres should be collected for chemical analysis.

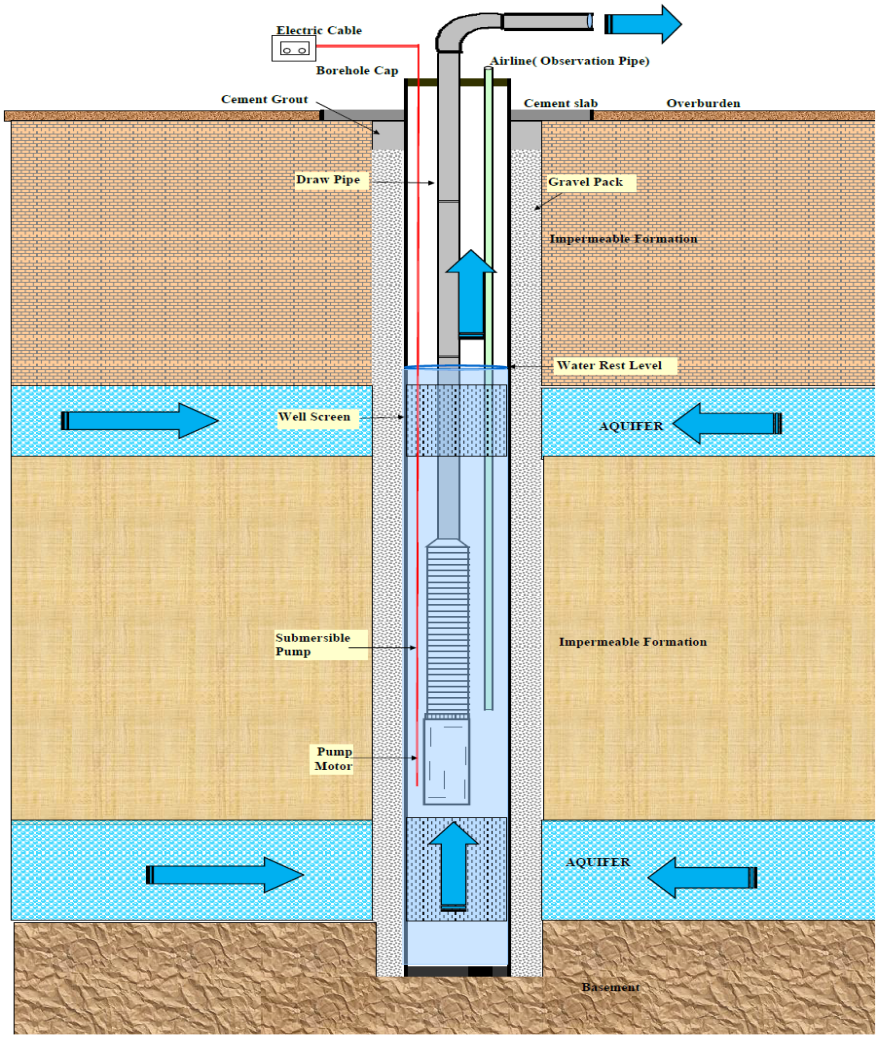
The duration of the test should be 24 hours, with a further 24 hours for a recovery test (during which the rate of recovery to SWL is recorded). The results of the test will enable a hydro-geologist to calculate the best pumping rate, the pump installation depth, and the drawdown for a given discharge rate.

2.1.8 Well Maintenance

Once the well has been commissioned and a pump installed at the correct depth, the maintenance schedule should be established. Checks on discharge (m3/day), pumping water level (metres below a leveled and immovable bench mark), and static water level

(if for any reason the well is not used for a 24-hour period) should be taken as part of a regular, routing process.

Figure 2-1 presents the complete structure of the borehole



2.1.9 Materials

Both temporary and permanent materials will be used in drilling. Temporary materials are those materials, which get used up, in the drilling process, while permanent materials are those installations that remain in place after completion of the drilling. **Table 2-3,** outlines the materials, the purpose and expected impact on the environment.

Table 2-3: Materials input of the project and their anticipated impact on the environment

Materials	Purpose	Anticipated Impact
1) Temporary Materials		
a) Water	Cooling of drill bit and uplifting of drill cuttings	Drilling water not expected to have any impact on the environment.
b) Drill Form	Uplifting of drill cuttings, cooling and reduction of friction	Not expected to have any impact. it is biodegradable and will be flushed out during the development process
c) Lubricants, oils and diesel	For lubricating and running of machinery	Spillages can adversely affect the environment, both flora and fauna.
2) Permanent Materials		
a) Casing and Screens	Provide support to borehole wall and avoid caving in.	Corrosion of metal casings from reaction with water may contaminate water. Casings and screens should be installed upon water quality analysis.
b) Gravel pack	Annular filling between the casings and the borehole.	Gravel pack is generally inert as it is composed of quartz. It should be washed to remove the fines, which may lead to clogging in the submersible pump.
c) Bentonite	Sealing off of the upper part of the borehole for sanitary purposes.	None
d) Cement	Construction of a concrete slab around the borehole.	None
e) Dipper line	Plastic PVC 2mm pipe for monitoring of the water level in the borehole	None
f) Submersible Pump	Pumping water from the borehole	None
g) GI pipes	For lifting of water from the borehole.	Corrosion of metal pipes may result if water is reactive, thus contaminating water. Type of Pipes to be installed based on water quality analysis
h) Water Monitoring Meter	Monitor abstraction level	None

2.1.10 Well Site Requirements

Drill Area

The designated drill site, which will cover about 10m x 10m area, will be cleared for the drill rig and associated equipment. A small drain channel will be constructed to control surface runoff from the drill site.

Access Track

An access track will be required to allow access of the drill rig to the site. The site is easily accessible without any difficulty.

Water

About 15,000 litres of water will be required for the drilling operations. As there is no reliable source of water in the area, the contractor will be required to truck in his own water.

Toilet Facilities

The drill crew will use toilets facilities that are used by the Institution.

2.2 Project Estimated Cost

The Project Cost estimate is Kshs 119,151,900million estimated as presented in summary of Bills of Quantities in table 2-4 below

Table 2-4: Project Cost

Item	Description	unit	Qty	Rate (Ksh)	Amount
Works					
1	**Borehole Development**				
1.1	Construct boreholes complete with site works and head works	No.	8	3,500,000	28,000,000
1.2	Supply and install pump, switch box and control panel, electrical cables etc for the boreholes	No.	8	2,000,000	16,000,000
1.3	Installation of online chlorination system c/w mixing and solution tank, stirrers, electrical panels and associated pipework	No.	8	1,200,000	9,600,000
1.4	Installation of production electromagnetic flow water meters	No.	12	310,000	3,720,000
1.5	Three phase electricity installation.	No.	5	500,000	2,500,000
	Sub- Total				**59,820,000**
2	**Laying of distribution pipelines (HPDE)**				-
2.1	Supply & install OD 110 mm HDPE pipes in Kiganjo and Kiandegwa	m	4,000	1,200	4,800,000
2.2	Supply & install OD 90 HDPE pipes in Kiganjo and Kiandegwa	m	3,000	850	2,550,000

2.3	Supply & install OD 63 HDPE pipes in Kiganjo and Kiandegwa	m	3,000	650	1,950,000
2.4	Supply & install OD 110 mm HDPE pipes in Mkongeni	m	3,500	1,200	4,200,000
2.5	Supply & install OD 90 mm HDPE pipes in Makongeni	m	3,000	850	2,550,000
2.6	Supply & install OD 63 mm HDPE pipes in Makongeni	m	4,000	650	2,600,000
2.7	Supply & install OD 90 mm HDPE pipes in Gacagi	m	2,000	850	1,700,000
2.8	Supply & install OD 63 mm HDPE pipes in Gacagi	m	2,000	650	1,300,000
2.9	Supply & install OD 110 mm HDPE pipes in Witeithie	m	4,000	1,200	4,800,000
2.10	Supply & install OD 90 mm HDPE pipes in Witeithie	m	2,000	850	1,700,000
	Supply & install OD 63 mm HDPE pipes in Witeithie	m	2,000	650	1,300,000
					29,450,000
3	**Rehabilitations and upgrading**				-
3.1	Upgrading Maguguni borehole System	sum	1	2,000,000	2,000,000
3.2	Install 100M^3 Elevated steel tanks at the existing Maguguni borehole.	No.	1	5,000,000	5,000,000
3.3	Supply & install OD 63 mm HDPE pipes in Maguguni	m	4,000	650	2,600,000
3.4	Supply and Installation of prepaid meters in Kiandutu and Kiang'ombe slums. **Note:** 1 meter has 250 Token gadgets	No.	2	3,500,000	7,000,000
	Sub- Total				**16,600,000**
	Works Sub- Total				**105,870,000**
Goods					
4	**Metering**				
4.1	Supply 1/2" cold water consumer meters.	No.	1,200	4,000	4,800,000
4.2	Supply 1/2" Gate valves	No.	1,200	750	900,000
4.3	Supply 1/2" GI Class B bends 90 deg	No.	2,400	120	288,000
4.4	Supply 1/2" GI union	No.	2,400	75	180,000
4.5	Supply 1/2" Class B GI pipes	m	7,200	200	1,440,000
	Goods Sub- Total				**7,608,000**
	Total				**113,478,000**
6	Provide for 5% contingency				5,673,900
	Grand Total				**119,151,900**

3 POLICY LEGAL AND INSTITUTIONAL FRAMEWORK

The following chapter provides the relevant policy, legal and institutional framework governing the upstream component. The ESIA has been carried within the Kenyan legislative and regulatory framework and in line with the World Bank standards and policies.

3.1 Context

Development of infrastructure projects is dealt with under several Laws, By-laws, Regulations and Acts of Parliament, as well as Policy Documents and it is not possible to bring all those statutes under one heading. This section is therefore aimed at assessing the existing policies and legislative framework, economic tools and enforcement mechanisms for the management of infrastructure projects at different stages.

3.2 Policy Provision

3.2.1 Constitution of Kenya

Article 42 of Bill of Rights of the Kenyan Constitution provides that every Kenyan has a right to a clean and healthy environment, which includes the right to have the environment protected for the benefit of present and future generations through legislation and other measures.

Part II of Chapter 5 of the Constitution (Environment and Natural Resources), (I) the State clearly undertakes to carry out the following:

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

Part (II) "Every person has a duty to cooperate with State organs and other persons to protect and conserve the environment and ensure ecologically sustainable development and use of natural resources. Chapter 5 on Land and Environment emphasizes on the following:

- ✓ Land use and management shall by law benefit local communities
- ✓ Community land is protected from encroachment by State.
- ✓ Law shall protect Rivers, forests and water bodies.
- ✓ Equitable access to land.
- ✓ All lawful land rights are secured; only someone who has stolen land needs to worry.
- ✓ County governments will manage land in trust of the people in accordance with the constitution.

Relevance

The constitution of Kenya provides for sound management and sustainable development of all of Kenya's Projects, both public and private investments. It also calls for the duty given to the Project proponent to cooperate with State organs and other persons to protect and conserve the environment as mentioned in Part II.

3.2.2 Kenya Vision 2030

Kenya Vision 2030 is the current national development blueprint for period 2008 to 2030 and was developed following on the successful implementation of the Economic Recovery Strategy of Wealth and Employment Creation which saw the country's economy back on the path to rapid growth since 2002. GDP growth rose from 0.6% to 7% in 2007, but dropped between 1.7% and 1.8% in 2008 and 2009 respectively.

The objective of the vision 2030 is to "transform Kenya into a middle income country with a consistent annual growth of 10% by the year 2030". One of this aims is to make Kenya to be a nation that has a clean, secure and sustainable environment by 2030. This will be achieved through promoting environmental conservation to better support the economic pillar.

Kenya's transformation in to a middle income country will be achieved by bringing and improving basic infrastructure and services namely: roads, street lights, storm water drains, footpaths, and water and sanitation facilities among others. This Project aims at improving the Water supply in Thika town through the construction of Boreholes Development Project for Thika Town.

3.2.3 National Environment Policy (NEP)

Sessional Paper No. 6 of 1999 on Environment and Development since adoption by parliament in 1999 has been in use and influenced the formation of EMCA in 1999 now

2015 but has since been surpassed by time and is therefore under revision to comprehensively cover areas that were previously left out to augment it.

The revised draft of the National Environmental Policy, dated April 2012, sets out important provisions relating to the management of ecosystems and the sustainable use of natural resources, and recognizes that natural systems are under intense pressure from human activities particularly for critical ecosystems including forests, grasslands and arid and semi-arid lands. The objectives of the Policy include developing an integrated approach to Environmental management, strengthening the legal and institutional framework for effective coordination, promoting environmental management tools.

Relevance
The Project shall implement the Environmental and Social Management and Monitoring Plan (ESMMP) to mitigate the impacts of the resulting impacts during the construction and operational phases of the Project; this will ensure that the ecosystems are not destabilized by the subsequent Project activities.

3.2.4 National Land Policy

Chapter 2 of the policy is linked to constitutional reforms; regulation of property rights is vested in the government by the Constitution with powers to regulate how private land is used in order to protect the public interest. The Government exercises these powers through compulsory acquisition and development control. Compulsory acquisition is the power of the State to take over land owned privately for a public purpose. However, the Government must make prompt payment of compensation.

Chapter 4 of the land policy under Environmental Management Principles, The policy provides actions for addressing the environmental problems such as the degradation of natural resources, soil erosion, and pollution.

For the management of the urban environment it provides guidelines to prohibit the discharge of untreated waste into water sources by industries and local authorities; it also recommends for appropriate waste management systems and procedures, including waste and waste water treatment, reuse and recycling. This Project aims at improving physical infrastructure within the Project area.

The policy goes further to advocate for environmental assessment and audit as a land management tool to ensure environmental impact assessments and audits are carried out on all land developments that may degrade the environment and take appropriate actions to correct the situation. Public participation has been indicated as key in the monitoring and protection of the environment.

Chapter 4 further advocates for the Implementation of the polluter pays principle which ensures that polluters meet the cost of cleaning up the pollution they cause, and encourage industries to use cleaner production technologies.

3.2.5 HIV and AIDS Policy 2009

The proposed project is to be implemented in the rural area, this areas have high freelance cases of HIV and Aids. This policy shall provide a framework to both the project proponent and contractor to address issues related to HIV and Aids. In Summary the policy provides a mechanism for:

- ✓ Setting Minimum Internal Requirements (MIR) for managing HIV and AIDS
- ✓ Establishing and promoting programmes to ensure non-discrimination and non-stigmatization of the infected;
- ✓ Contributing to national efforts to minimize the spread and mitigate against the impact of HIV and AIDS;
- ✓ Ensuring adequate allocation of resources to HIV and AIDS interventions;
- ✓ Guiding human resource managers and employees on their rights and obligations regarding HIV and AIDS.

Relevance

The Policy will be complied with during implementation of the Project; the Contract will in cooperate in tender document and implement HIV awareness initiatives during construction of the Project.

3.2.6 Gender Policy 2011

The overall goal of this Policy Framework is to mainstream gender concerns in the national development process in order to improve the social, legal/civic, economic and cultural conditions of women, men, girls and boys in Kenya

The policy provides direction for setting priorities. An important priority is to ensure that all ministerial strategies and their performance frameworks integrate gender equality objectives and indicators and identify actions for tackling inequality. In addition, each program will develop integrated gender equality strategies at the initiative level in priority areas. Within selected interventions, the policy will also scale-up specific initiatives to advance gender equality

Relevance

This policy will be referred to during Project implementation especially during hiring of staff to be involved in the project, procuring of suppliers and sub consultants and sub-contractors to the project

3.2.7 The Sustainable Development Goals (SDGs)

The 2030 Agenda comprises 17 new Sustainable Development Goals (SDGs), or Global Goals, which will guide policy and funding for the next 15 years, beginning with a historic pledge to end poverty.

The concept of the SDGs was born at the United Nations Conference on Sustainable Development, Rio+20, in 2012. The objective was to produce a set of universally applicable goals that balances the three dimensions of sustainable development: environmental, social, and economic.

The Global Goals replace the Millennium Development Goals (MDGs), which in September 2000 assembled the world around a common 15-year agenda to tackle the indignity of poverty.

Sustainable Development Goal (6) which is the new 2030 agenda and expands Millennium Development Goal as guided by resolutions of Rio+20 conference. The goal focuses more on investment in adequate infrastructure in water sanitation, Hygiene, water quality, waste Water Management, water scarcity and use efficiency, integrated water resource management and protection of water related ecosystems. Thika Boreholes Development Project will directly contribute towards achieving this goal.

3.3 Kenyan Legislations

3.3.1 The Environmental Management and Coordination Act (EMCA), 1999 amended in 2015.

The Act provides for the establishment of a legal and institutional framework for the management of the environment and for matters connected therewith and incidental thereto. Just as in the New Constitution, Part II of EMCA confers to every person the right to a clean and healthy environment and to its judicial enforcement.

The new Constitution and EMCA therefore obligates the project's Executing Agency and Contractor to work in a clean environment and not to contravene the right of any person within its zone of influence, to this entitlement. EMCA has provided for the development of several subsidiary legislations and guidelines which govern environmental management and are relevant to the project implementation.

These include:

- ✓ The Environmental (Impact Assessment and Audit) Regulations, 2009 Legal Notice No. 101;
- ✓ The Environmental Management and Coordination (Waste Management) Regulations, 2006 Legal Notice No. 121;

- ✓ The Environmental Management and Coordination (Water Quality) Regulations, 2006 Legal Notice No. 120;
- ✓ The Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009 Legal Notice No. 61;
- ✓ The Environmental Management and Coordination (Air Quality Regulations 2014)
- ✓ The Environmental Management and Coordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006 Legal Notice No. 160;
- ✓ Environmental Management and Coordination (Wetlands, River Banks, Lake Shores and Sea Shore Management) Regulation, 2009.
- ✓ The Environmental Management and Coordination (Controlled Substances) Regulations, 2007 Legal Notice No. 73.

Relevance to the Project

EMCA 1999 with 2015 amendments and above listed regulations will form the main statutory instruments which will guide the implementation of the project so that any likely adverse impacts that could be caused by the project are promptly mitigated as recommended in this study.

3.3.2 Water Act 2016.

The Water Act 2002 was amended in the year 2016 to align to the Kenyan Constitution 2010, the Act vest the responsibility of developing water and Sanitation infrastructure (sewerage and water supply) to Water Services Development Board (Athi Water Services Board)AWSB while the ownership of the assets is the responsibility of County Government of Kiambu.

The County Government Act of 2012 allows the Water Services Providers to Source for own funds to develop infrastructure, in this case THIWASCO has approached a commercial Bank with the intention of implementing the Thika Boreholes Development Project through the OBA subsidy Program of WSTF.

Section 73 of the Water Act allows a person with a license to supply water (licensee) to make regulations for purposes of protecting against degradation of sources of water which he is authorized to take. Under the Act, the licensee could be a local authority, a private Trust or an individual and the law will apply accordingly under the supervision of the Regulatory Board.

Section 75 and sub-section 1 of the Water Act allows a licensee for water supply to construct and maintain drains, sewers and other works for intercepting, treating or disposing of any foul water arising or flowing upon land for preventing water belonging to the licensee or which he is authorized to take for supply from being polluted. However, if the proposed works will affect or is likely to affect any body of water in the

catchment, the licensee shall obtain consent from the Water Resources Management Authority.

Section 76 states that no person shall discharge any trade effluent from any trade premises into sewers of a licensee without the consent of the licensee upon application indicating the nature and composition of the effluent, maximum quantity anticipated, flow rate of the effluent and any other information deemed necessary. The consent shall be issued on conditions including the payment rates for the discharge as may be provided under section 77 of the same Act.

Relevance to the Project

This Act will be relevant during construction of the project whereby the contractor will be required from time to time ensure that Project activities do not pollute water resources in the project area.

The Contractor will also be required to comply with the effluent discharge requirements during construction of the project which will require that the contractor obtain relevant permits from Water Resource Management Authority (WRMA) on case by case basis when required.

3.3.3 County Government Act No. 17 of 2012

Part II of the Act empowers the county government to be in charge of function described in Article 186 of the constitution, (county roads, water and Sanitation, Health), Part XI of the Act vest the responsibility of planning and development facilitation to the county government with collaboration with national government, this arrangement has been adopted for interventions in order not to conflict with provisions of the Kenyan Constitution.

Relevance to the Project

The project once commissioned will be operated by THIWASCO which is a water utility, wholly owned by Kiambu County Government for operation and maintenance.

3.3.4 Physical Planning Act 1996 (286)

Section 29 of the said Act empowers the local Authorities (now county governments) to reserve and maintain all land planned for open spaces, parks, urban forests and green belts as well as land assigned for public social amenities. The same section allows for prohibition or control of the use and development of an area.

Section 30 states that any person who carries out development without development permission will be required to restore the land to its original condition. It also states that no other licensing authority shall grant license for commercial or industrial use or

occupation of any building without a development permission granted by the respective local Authority.

Relevance to the Project

Thus the Act directs, regulates and harmonizes development and use of land over the Country, the entire Project has been designed within the reserve land stipulated as road reserve land under this Act, this was in an effort to avoid cases of acquisition of private property and resettlement complications.

3.3.5 Occupational Health and Safety Act (OSHA 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. The ESMMP prepared under this assessment has provided for specific health and safety aspects to be complied with during implementation of the project.

Relevance to the Project

The Act provides EHS guidelines which shall be followed by both the contractor and supervising consultant during implementation of the project in order to avoid injuries and even loss of life to workers and neighbouring community.

3.3.6 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 likely to harbour rats or other vermin.

Relevance to the Project

The Act provides guideline to the contractor on how he shall manage all wastes (Liquid and Solid Wastes) emanating from the project in a way not to cause nuisance to the community, this Act during construction shall be read alongside the waste management regulations of EMCA 2015 for utmost compliance.

3.3.7 Work Injury Benefits Act, (WIBA 2007)

This is an Act of Parliament to provide for compensation to employees for work related injuries and diseases contracted in the course of their employment and for connected purposes. An employee is a person who has been employed for wages or a salary under a contract and includes apprentice or indentured learner.

The proposed project will adhere to the provisions of this act throughout the construction period of the project.

3.4 Institutional Structure of the Water Sector

The Water Act 2002 has repealed and replaced by Water Act 2016, this Act now aligns Water Services Management to the Kenyan Constitution 2010.

The Ministry of Environment, Water 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 executes its mandate through the following sector institutions:

3.4.1 Water Services Regulatory Board (WASREB)

Section 70 of the Water Act 2016 provides for establishment of Water Services Regulatory Board, this assessment assumes that the current Water Services Regulatory Authority (WSREB) will assume the roles proposed in the Water Act 2016.

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:

- ✓ Regulating the provision of water and sewerage services including licensing, quality assurance, and issuance of guidelines for tariffs, prices and disputes resolution.
- ✓ 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,
- ✓ Monitoring the performance of the Water Services Boards and Water Services Providers,
- ✓ Establish the procedure of customer complaints,
- ✓ Inform the public on the sector performance,
- ✓ Gives advice to the Minister in charge of water affairs.

3.4.2 Water Resources Management Authority (WRMA)

Section 11 of the Water Act 2016 provides for establishment of Water Resources Management Authority, this assessment assumes that the current Water Resources Management Authority (WRMA) will assume the roles proposed in the Water Act 2016.

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

- ✓ Implementation of policies and strategies relating to management of water resources, Develop principles, guidelines and procedures for the allocation of water,
- ✓ Development of Catchments level management strategies including appointment of catchments area advisory committees,
- ✓ Regulate and protect water resources quality from adverse impact
- ✓ Classify, monitor and allocate water resources.

3.4.3 Water Services Trust Fund (WSTF)

Section 113 of the Water Act 2016 provides for establishment of Water Sector Trust Fund, this assessment assumes that the current Water Services Trust Fund (WSTF) will assume the roles proposed in the Water Act 2016.

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:

- ✓ Capital investment to community water schemes in underserved areas
- ✓ Capacity building activities and initiative among communities
- ✓ Water services activities outlined in the Water Services Strategic Plan as prioritized by the Government
- ✓ Awareness creation and information dissemination regarding community management of water services
- ✓ Active community participation in the management of water service

3.4.4 Water Services Boards (WSBs)

Section 65 of the Water Act 2016 provides for establishment of Water Works Development Agencies, this assessment assumes that the current Water Services Boards (WSB) will assume the roles proposed in the Water Act 2016.

The WSBs are responsible planning and development of water and sewerage services infrastructure in their areas of jurisdiction. In Kiambu, the relevant Water Services Board is the Athi Water Services Board, this Board is mandated to

- ✓ Develop the facilities, prepare business plans and performance targets
- ✓ Planning for efficient and economical provision of Water and sewerage services within their areas of jurisdiction;

3.4.5 Water Services Providers

The Kenyan Constitution Article 186 and 187 and corresponding further schedule item 11(b) mandates the county government to be in charge of Water and Sanitation in their respective counties. The County Government Act of 2012 part II provides more elaborate interpretation of the function.

They have vested this mandate to Water Service Providers which are utilities or water companies. They are County Government 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 Kiambu, THIWASCO is mandated to provide water and sewerage services to Thika Town and Environs

3.5 NEMA Compliance

The government established the National Environmental Management Authority (NEMA) as the supreme regulatory and advisory bodies on environmental management in Kenya under EMCA 1999 and amendments 2015. NEMA is charged with the responsibility of coordinating and supervising the various environmental management activities being undertaken by other statutory organs. NEMA also ensures that environmental management is integrated into development policies, programmes, plans and projects.

3.6 Sectoral Integration

This integration encourages provision of sustainable development and a healthy environment to all Kenyans. The key functions of NEMA through the NEC include policy direction, setting national goals and objectives and determining policies and priorities for the protection of the environment, promotion of cooperation among public departments, local authorities, private sector, non- governmental organizations and such other organizations engaged in environmental protection programmes and performing such other functions as contained in the act.

3.7 Project Implementation Institutional Structure

THIWASCO has an established implementation system that has clear provisions for environmental and social integration through the Environmental Division. An ideal project management structure proposed for the organization in this project has the following components:

3.7.1 The Contractor

The contractor will be required to establish an environmental office to continuously advise on environmental components of the project implementation. Elements in the

environmental and social management plan are expected to be integrated in the project with appropriate consultations with THIWASCO through the supervising environmental expert. The environmental officer of the contractor is also expected to fully understand the engineering and management aspects of the project for effective coordination of relevant issues.

3.7.2 The Supervisor

The supervisor will be engaged by THIWASCO (as the project proponent) to ensure effective implementation of the environmental and social management and monitoring plan. It is expected that supervisor engages the services of an environmental expert who should in return understand the details of the recommendations on environment management and especially the proposed action plans, timeframes and expected targets of the management plan. The environmental supervisor expert should also be the liaison person between the contractor and THIWASCO on the implementation of environmental concerns as well as issues of social nature associated with the Project.

3.8 World Bank Policies

The Project will only trigger Environmental Assessment OP 4.01 as discussed below. Other Operational Safeguard Policies of the World Bank as illustrated by table 3-1 below are not triggered.

Table 3-1: Analysis of potential triggers to World Bank Safeguards Policies

World Bank Operation Policy	Applicability to the Project
Environmental Assessment OP 4.01	Applicable. As a result of environmental and social screening, the project was identified as a Category B
Natural Habitats OP 4.04	Not applicable - there no natural habitats at the project site
Pest Management OP 4.09	Not applicable- the project will not involve any pest management
Indigenous Peoples OP 4.10	Not applicable- there are no indigenous people at the site or project area
Physical Cultural Resources OP 4.11	Not applicable. Site inspections and literature searches have not indicated the presence of any cultural (historical, archaeological) sites in the construction area. However, to manage "chance finds" an appropriate procedure is included in this ESIA. Such procedure to be followed by contractors during the construction phase.
Involuntary Resettlement OP 4.12	Not Applicable all indentified 9 borehole sites are within existing water tanks sites owned by THIWASCO
Forests OP 4.36	Not applicable
Safety of Dams OP 4.37	Not applicable because the project will not involve construction of dams.
Projects on International Waters (OP 7.50)	Not applicable- the site does not sit on international waters
Projects in Disputed Areas (7.60)	The site is not classified as disputed in the project area.

3.8.1 Environmental Assessment OP 4.01

The Project will involve improvement Development of 9 Boreholes on existing land parcels used as water storage tanks.

All the indentified sites overtime, and due to anthropogenic activities have exerted pressure on both natural and social environment which has eventually converted the area into a human settlement area. Therefore, the Project will have less significant impact on physical, biological and social setting within the immediate surroundings. However OP 4.01 will be triggered.

This policy requires Environmental Assessment (EA) of Projects proposed for Bank

financing to help ensure that they are environmentally sound and sustainable, and thus to improve decision making. The EA is a process whose breadth, depth, and type of analysis depend on the nature, scale, and potential environmental impact of the proposed investment. The EA process takes into account the natural environment (air, water, and land); human health and safety; social aspects (involuntary resettlement, indigenous peoples, and cultural property) and Trans-boundary and global environmental aspects.

Operational Policy 4.01 further requires that the ESIA report must be disclosed as a separate and stand-alone document by the Government of Kenya and the World Bank. The disclosure should be both in Kenya where it can be accessed by the general public and local communities and at the World Bank Website and the date for disclosure must precede the date for appraisal of the Project.

The proposed improvement of the proposed project has been classified as environmental category B and hence requirement for this Project Report.

3.8.2 Harmonization of both WB and GOK requirements for Social and Environmental Sustainability

The World Bank (WB) and Government of Kenya (GoK) require that Projects of such nature are subjected to environmental and social impact assessment as stipulated under EMCA 2015 and its tools; the same process simultaneously fully resolves requirements of OP 4.01. Generally, both requirements are aligned in principle and objective in that:

- ✓ Both require Environmental Assessment before project implementation leading to development of comprehensive Environmental and social Management plans to guide resolution of social and environmental impacts as anticipated.
- ✓ Both require public disclosure of Project Report and stakeholder consultation during preparation,
- ✓ While OP 4.01 of World Bank stipulates different scales of Project Report for different category of projects, EMCA requires Project Report for all sizes of projects, which are required to be scoped as relevant
- ✓ Where EMCA requires consultation of Lead Agencies comprising of relevant sectors with legal mandate under GoK laws, the WB has equivalent safeguards for specific interests.
- ✓ The Bank requires that stakeholder consultations be undertaken during planning, implementation and operation phases of the project which is equivalent to the statutory annual environmental audits at the operation phase of projects in Kenya.

- ✓ The understanding of this Project Report study is that, pursuit of an in-depth Project Report process as stipulated by EMCA 1999 and amendments 2015 is adequate to address all World Bank requirements for environmental and social assessment. This is a major guiding principle in this study.

Therefore, in keeping with this trend, public consultation has been done to the stakeholders, and their comments have been incorporated in the final Environmental Assessment and final design of the project. In addition, the Environmental and Social Assessment report will be made publicly available to all stakeholders through disclosure at the project's proponent website, NEMA, and WB website, as well as copy of the report available at the project site.

3.9 World Bank Group Environmental Health and Safety Guidelines on Water and Sanitation

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry- specific examples of Good International Industry Practice. When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as required by their respective policies and standards. These industry sector EHS guidelines are designed to be used together with the General EHS Guidelines which provides guidance to users on common EHS issues potentially applicable to all industry sectors

The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the establishment of site -specific targets, with an appropriate timetable for achieving them.

Relevance to the Project

The EHS Guidelines for Water and Sanitation include information relevant to the operation and maintenance of (i) potable water treatment and distribution systems, and (ii) collection of sewage in centralized systems (such as piped sewer collection networks) or decentralized systems (such as septic tanks subsequently serviced by pump trucks) and treatment of collected sewage at centralized facilities.

The Guidelines present Environmental Health issues on water distribution and the maintenance of adequate pressure to protect water quality in the system as well as sizing and adequate maintenance to assure reliable delivery of water of suitable quality.

The most significant environmental issues associated with operation of water distribution systems include: Water system leaks, loss of pressure and Water discharges. The design for the project has ensured these environment risks are mitigated

4 ENVIRONMENTAL AND SOCIAL BASELINE

4.1 Climatic Conditions

Thika Town lies so close to the Equator but being 1680m above the sea-level, its temperatures are altitude-modified tropical, but not torrid. The mean annual Temperature is 17˚C and the mean daily maximum and minimum are 23^0C and 12^0C respectively, (Chandler, 1971). On the other hand, the mean annual rainfall is 1080mm falling in two distinct seasons: The short rains fall between October and December while the long rains fall between March and May. Annual rainfall is influenced by altitude. The highest area, especially on the Northern and the Western Areas receive high amounts of rainfall, while the low lying areas on the eastern and the southern parts receive low amounts of rainfall.

4.2 Hydrological Systems

The drainage system in Kenya is generally dominated by the Great Rift Valley, which runs in an approximately north-south direction, with water flowing from its flanks westwards to Lake Victoria and eastwards to the Indian Ocean. The project area has very well drained soils and there was no possibility of ponding observed. The land surface area the particular site slopes towards the west and there are no anticipated risks of flooding.

4.3 Humidity

Because of Thika Town location just south of the equator in combination with humid air pumped in from the Indian Ocean, the humidity values for each day are generally on the higher end. This is not to say that values are always high, since the easterly winds coming off the Indian Ocean tend to keep the temperatures standard throughout the country; therefore the “warm sticky” feeling is usually not associated with Thika as much as one would think. In the summer to autumn months of January to April, relative humidity values have been known to plummet to anywhere from 10% to 20%. The typical day, humidity-wise, starts off with nearly saturated in the morning hours, and steadily decreases throughout the remainder of the day.

4.4 Infrastructure

Due to rapid urban growth, provision of basic infrastructure for all has become an important concern of development planners in Thika Town. Basic infrastructural services that have deteriorated due to such rapid increase in population include: Solid Waste Management (SWM) system; Water and Sewerage Systems; Drainage and flood

protection; Roads; Mass transportation; Electric installations; and telecommunications. Greater environmental pollution, congestion and problems have been the result of under-provision of such basic services.

4.5 Population

Thika Town hosts over 1.2 million inhabitants while the annual growth rate is estimated at 4.5% and a density of 2079 persons per sq. Km as per 2009 Kenya National Bureau of Statistics (KNBS). Thika records one of the highest urban population densities in the country. The current population of the proposed project area is mainly for business to effluent communities with a bigger percentage comprising of the Asians since there are many facilities that suit their culture and religion though the project is bound to bring an increase in population during construction and also after occupation of the proposed offices.

4.6 Economic Activities

The major economic activities in Thika Town include businesses in informal and formal lines. Some of the investments in the city are industries, farming and office complexes. Due to its population, Thika provides numerous opportunities for trade at various scales. Because of these characteristics, Because of these characteristics, it is considered the commercial centre for Kiambu County. Owing to its huge economic potential, Economic activities within the proposed project site are Insurance brokers, Media Consultancy, Estate holdings, and Academic Institutions.

5 ANALYSIS OF ALTERNATIVE

5.1 No Action Alternative

No Action Alternative implies that the drilling will not take place. This is highly undesirable because the present project is supposed to provide a reliable water source to the local community. If the status quo is maintained, the locals will continue to suffer from the persistent water problems currently experienced. The 'No Action' alternative is therefore ruled out.

5.2 Project Site Alternatives

There are a number of scenarios that may lead to consideration of an alternative drill site. These may include collapse of the present site during drilling leading to abandonment, or sinking of a dry borehole and due to architectural considerations. The indentified site does not pose the mentioned characteristics.

5.3 Survey Design Alternative Technologies

Drilling should be carried out with an appropriate tool-either percussion or rotary machines will be suitable, though the latter are considerably faster and higher overheads.

Wells drilled by the cable tool or 'wire line' method is constructed with a drilling rig, a string of tools (cable, rope socket, set of jars, drill stem and drilling bit), and a bailer or a sand pump.

Drilling is accomplished by regularly lifting and dropping the string of tools. The bit, at the end of the rope, with its sharp "chisel" edge loosens the material. The bit rotates a few degrees between each stroke so that the cutting face of the bit strikes a different area of the hole-bottom with each stroke.

The reciprocating action of the tools mixes the loosened particles with water to form slurry at the bottom of the borehole (water may need to be added to form this slurry). Slurry accumulation increases as drilling proceeds and eventually it reduces the drilling efficiency.

When the penetration rate becomes unacceptably low, slurry is removed at intervals from the borehole by the sand pump or bailer. Though this method is cheap compared to the rotary method, it is extremely slow and especially in hard rock terrain like in the study area.

6 PUBLIC PARTICIPATION

6.1 Stakeholder Mapping and Consultations

Consultative Public Participation (CPP) as an ESIA procedure is an aid to project management. It is a useful tool for gathering local environmental information by understanding anticipated impacts from local people who have lived and understand their environment better. Consultation also gives a chance to the local community to participate in the determination of project alternatives regarding designing and citing viable and sustainable mitigation and compensation plans. The consultation is best carried out during the project design so that the stakeholders' views are incorporated in the plan as this is the requirement stated in EMCA 1999 amended in 2015 and EIA/EA Regulations of 2003.

The objectives of public consultations were to:

- Inform representatives of the local people about the details of the proposed projects which entails; sinking of 8 boreholes, connecting the recently completed bores at Thika and Kimuchu primary schools to the existing system, upgrading of Maguguni borehole, supply and installation of 42Km HDPE assorted size of distribution lines to selected low income areas and installation of prepaid meters
- Ask local residents about the environmental and social problems they anticipate with the commencement of the proposed project and seek their views on how these can be avoided, mitigated and whether these mitigation measures can be included in the contract document and the ESMMP and form the basis for the projects monitoring and information.
- Promote social acceptance of the project to the local community so as to avoid costly modifications or abandonment of the project at a later stage.
- The consultation helped in obtaining additional information to the local community and in giving them a chance to contribute to the management of their environment

6.2 Stakeholder Mapping

The main key informants targeted in the consultations were Government Institutions within which the Project is proposed as well as general residents residing around the institutions Table 5-1 and 5-2 below presents specific stakeholders consulted during the assessment.

Table 5-1: Stakeholder Consultation Details

Date	Stakeholder Consulted

21st April 2017	Residents living around Gatundu/Landless tank
19th April 2017	Residents living around Githingiri tank
20th April 2017	Residents living around Kimathi Tank Kenyatta Road
20th April 2017	Residents living around Maguguni Borehole Location
19th April 2017	Residents living around Makongeni tank
19th April 2017	Residents living around Mary Hill tank
19th April 2017	Residents living around Ngoingwa tank
20th April 2017	Residents living around Sector 9 tank
20th April 2017	Residents living around Town Victory Plaza Tank

Table 5-2: Schedule of Public Consultation Meetings

Date	Meeting Venue	Meeting Participants	Attendance
22ndApril 2017	Ngoliba Shopping Centre	✓ Chief Ngoliba location ✓ chief Kilimambogo location ✓ THIWASCO distribution manager ✓ THIWASCO technical manager ✓ THIWASCO project inspector ✓ Project Affected Persons.	28

6.3 Consultations Outcome

The approach involved guided consultations by use of questionnaires administered to the selected relevant respondents; ultimately, the data was analyzed and presented to design team for finalization of Project designs and planning on how best to implement the Project.

6.3.1 Availability of a reliable water source water

The County authority's water supply system in this neighbourhood within the jurisdiction is evidently unreliable, the residents experience unreliable water supply round the year, and the situation as per the interviewed people seems to worsen with time. This therefore forces people to seek to alternatives sources like the proposed boreholes. Developers should be encouraged to invest in water projects so as to relieve city water supply mains.

6.3.2 Air quality degradation

Drilling sites are associated with dust emissions and exhaust emissions from drilling machinery, which affect the air quality within the subject site and the environs. The reference site as per the interviewed people will not be an exceptional. Adequate mitigation measures should be put in place to maintain the workplace air quality within acceptable standards as provided for by Air Quality Regulations 2014.

6.3.3 Noise Pollution and excessive Vibrations due to drilling equipment

Drilling is a noisy exercise and it was recommended that the proponent ensure that adequate measures are in place to eliminate noise or otherwise contain noise within

site to acceptable limits as provided in Noise and excessive Vibrations Regulation of 2009 with 2015 amendments which provides for such a work place to emit a maximum of noise levels to 60 decibels during the day and 35 decibel during the night.

Drilling machineries are associated with vibration and since this is a constructed area more effects will be felt, which may also disrupt normal learning/workings within the institution and the environs. Adequate mitigation measures should be put in place to maintain the vibrations within acceptable standards

6.3.4 Reduce Cases of Water Borne Diseases

The project once commissioned will eliminate cases of water borne related diseases such as; amoeba, typhoid, cholera and diarrhoea which are associated with unsanitary or contaminated water sources.

6.3.5 Employment

They local residents emphasized that they should be considered for jobs and especially unskilled employment. There is also need to sub-contract locals who have skills or companies to undertake some activities instead of bringing outside sub-contractors for minor works. Skilled jobs should be advertised locally to give community members with such skills an opportunity to apply.

Table 5-3 below presents a summary of interactions during stakeholder consultations including Public meeting held on 22nd April at Ngoliba Shopping Centre

Table 5-3: Summary of Issues Discussed

No	Issues	Response and Discussions
1	The residents wanted to know what measures the company (THIWASCO) is planning to put in place in order to bring down cost of water.	The technical manager informed residents that the water tariffs are provided by WASREB basing on various factors. Residents suggested that the company should incorporate technology in its operations for instance use of solar powered pumps. This will significantly reduce cost of pumping water which will lead to a reduction in water tariffs.
2	Residents wanted to know how the company is planning to ensure the pipeline is secure.	Residents were informed that according to the design the pipes will be laid in road reserves thereby avoiding private property. The way leave will clearly be marked to keep off encroachers. Also the pipes will be buried deep enough to avoid breakages which might occur when the pipes are on the surface.
3	Residents wanted to know if they will get any employment opportunities during project implementation	ESIA team informed residents that during construction phase, the contactor will source some skilled and semi skilled labour from the community to supplement his staff when such opportunities are available. Residents were further advised to liaise with the office of the chief and

		present their request for jobs in an orderly manner for consideration.
4	Resident wanted to know the expected commencement date of the project.	Resident residents were informed that the project will commence immediately after all the necessary designs have been done and required licenses issued including the NEMA license. They were further informed that the project was urgent and should start this year (2017)
5	The community wanted to know what the company does to residents of Thika as part of the corporate social responsibility (CSR).	The commercial manager informed residents that the company normally organizes tree planting campaigns mostly during the rainy seasons. Residents were further informed that during end period the company usually visits various children homes and provide food stuffs and other personal effects.
6	Residents requested for more water kiosks to be constructed.	Residents were informed that water kiosks are being proposed at all the borehole sites. They were further informed that the primary objective of the company is to provide clean safe drinking water hence water kiosks will only be provided where the water has fully been treated.

6.4 Consultations beyond ESIA Process

In order to ensure that the development runs smoothly, consultations should be structured to aid the completion of the Design and narrow down on key issues. These consultations should therefore be preceded by further engagement of various stakeholders under the following stages:

- Construction phase and reported through the Initial Environmental Audit; and
- Operation phases and reported through the Statutory Environmental Audit of the Project.

The consultation should address pertinent issues including the sustainability and suitability of the operation and maintenance to ensure acceptable standards in both Water and Sanitation Project.

7 ENVIRONMENTAL AND SOCIAL IMPACTS ASSESSMENT AND MITIGATION MEASURES

7.1 Introduction

This chapter presents the assessment of the issues likely to arise as a result of implementation of the proposed project. For each issue, the analysis is based on its nature, the predicted impact, extent, duration, intensity and probability, and the stakeholders and/or values affected. In accordance with best practice, the analysis includes issues relating to the project's environmental and social sustainability. The anticipated positive and negative impacts associated with the different phases of proposed borehole project are outlined below:

Table 7-1: Summary of anticipated impacts, their respective ratings and development stage

Impact	Impact Rating	Development Stage
Impacts on Soil and Land	Low	Construction Phase
Impacts Water Resources	Low	Operation Phase
Impacts on Biodiversity	Low	Construction Phase
Socio-Economic Impacts	High-Positive	Construction Phase
Impacts on Air Quality	Low	Construction Phase
Impacts on Public Health and safety	Potentially High	Construction Phase
Visual Impacts	Low	Construction Phase

7.2 Positive/Beneficial Impacts

- Increased access to clean drinking water for the residents thus improving their hygiene and sanitation conditions.
- The distances traveled and time spent in search of water will be reduced hence the beneficiaries (especially women and children) using the energy and time on economically and socially viable activities for the families.
- Supporting and strengthening the participation of local communities in improving water and sanitation management in the project area
- Employment opportunities for the local community during the construction and operation phases of the project (e.g. masons, carpenters, cooks and indirect spins-off etc.);
- The project will help develop the human capital in the country through transfer of skills to young engineers, environmental specialists and plumbers among others.

7.3 Adverse/Negative Impacts

7.3.1 Vegetation Loss

The proposed borehole site and a walk over inspection of the potential site confirmed that very little vegetation will be destroyed or damaged. This is due to anthropogenic impacts which have led to people clearing vegetation to provide land for housing.

An unavoidable part of any development in general is the clearance and loss of areas of vegetation, which currently characterize the site of the development area. Not only may vegetation be lost, but also faunal habitats may 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.

No significant impact is expected on biodiversity since drill site is devoid of significant animal and plant life, and the chemicals to be used are biodegradable and environmental friendly. Minimal effect expected from the drain channel that will be excavated to drain the drilling fluids.

Mitigation Measures

- Retention of vegetation where possible, only site pegged for drilling should be cleared.
- Timely clearing, reinstatement and re-vegetating of the area after drilling and equipping.

7.3.2 Solid Waste Generation

Solid wastes include drill cuttings, solid containers such as cement, bentonite and gravel bags and other packets from materials used during implementation of the project. Drilling foam will be primarily be used to enhance the rate of cutting removal by preventing them from aggregating so that they can be lifted more easily to the surface, cool the drilling tools and to reduce friction. The foam is a multifunctional synthetic, biodegradable drilling liquid and is mixed with water in drilling process to uplift drilled cuttings. It can cause foaming effect in water if released in large amount.

Spillage of oil and grease from machines used in borehole drilling, construction, repair and maintenance and transportation activities, which can have negative impact on microbial life. The occurrence of these wastes is expected to be minimal. Highly flammable fuels can cause destructive fire at project site

Mitigation Measures

- Wastes such as papers or polythene containers, cement, bentonite and gravel bags, should be disposed in a NEMA approved sanitary dumpsite after completion of drilling.
- Excavated drill cuttings will be used to backfill the borehole annular space and the drain channel.
- Drilling foam is biodegradable and is not harmful to plants or animal species; however a draining channel will be constructed to drain the drilling fluid and waters away from the operation site. Minimal drilling foam should be used and only when necessary to minimize foaming effect.
- Avoid water wastage and all the drilling foam remaining in the borehole will be pumped out during development of the borehole and test pumping.
- Avoid any form of ignition at the project site during operation to prevent fire outbreaks.
- Keep all fuels in secluded sections with clearly marked “Danger” or” Hatari” tags in place. They should be stored, properly handled and their wastes disposed safely during construction.
- Repair and maintenance of vehicles and plants must be carried out at petrol station or garage to avoid fuels and lubricants spills at the project site.
- In case of oil spills, the drilling contractor should keep rain or other water off the soil area if possible by covering the ground using tarps or polyethylene sheets.

7.3.3 Impacts to Water Resources

The proposed project is anticipated to impact on water resources during construction, operation and decommissioning phases.

The projected average abstraction from the boreholes is about 40m^3/day and the actual available amount will only be accurately determined during the test pumping. This abstraction is not expected to impact negatively on other boreholes considering the large distance between the boreholes. The anticipated negative impacts include;

Water quantity may be affected by over-abstraction, excess demand from increased population (both human and livestock) and water wastage through spillage. Both the workers and the construction works will create an increased demand for water in addition to the existing demand, though this will be for a short period.

Weaker capacity of the water pumps may also lead to low volume of water as observed in some boreholes within the area. Water quality will be dependent on the borehole completion measures implemented to prevent any pollution from the surface flows.

Construction Phase Impacts

The potential impacts to water resources during construction phase are:

- Inadequate penetration of aquifers and poor construction-
- Creation of new pathways between pollutants and water resources; and
- Introduction of contaminants and pollutants to the groundwater through drilling machinery or uncontrolled leaks and spills

Significance of the impact

Poor construction of the borehole may result in inadequate penetration of the aquifer, which would result in a low yield. A low yield would have a direct impact on the ability of users to access sufficient water supply.

It is considered that poor construction of the borehole would result in a ***medium significant impact***, as there would be a direct impact on the supply of water to the residents.

Borehole construction may result in creation of new permanent or temporary pathways between pollutant sources and the aquifers. Should this occur, there could be a secondary impact on the water abstraction source by affecting the water quality of an aquifer that is used in the locality.

Similarly, installation of the borehole could potentially result in drilling fluids, oils and lubricants used in the process to contaminate groundwater and surface water. This could impact both directly and indirectly on potential domestic and non domestic water sources, as well as nearby water bodies. If any drilling fluids are used, there is a potential risk of spillage; there is also a potential risk of leaks from machinery. This could result in temporary contamination of local and regional water resources.

Groundwater contamination through the above sources could have a ***moderate/major significant impact*** on the local water resources in the area. Consequently, an impact on the groundwater could harm ecosystems, including flora and fauna, and human health.

Table7-2: Impact on Water Resource during construction phase

Impact source(s)	**Construction and installation of borehole**	**Status**	-
Nature of impact	Inadequate penetration of aquifers and contamination of ground and surface water resources		
Reversibility of impact	The following measures will be implemented to mitigate against ground and surface water contamination: ✓ *Appropriate construction methodology will be applied to ensure that groundwater mixing does not occur; and borehole construction equipment will be suitably maintained and spent fluids handled and disposed of in an appropriate manner.*		

	✓ International best practice borehole construction methodologies will be applied to mitigate against impacts of inadequate penetration of aquifers and poor borehole construction	
Degree of irreplaceable loss of resource	N/A	
Affected stakeholders	Local residents	
Magnitude	*Extent*	Footprint – 1 (for inadequate penetration of aquifers) Regional- 3 (for ground and surface water contamination)
	Intensity	High – 5(for inadequate penetration of aquifers and poor construction of borehole) Medium-3(for ground and surface water contamination)
	Duration	Long-term -4(for inadequate penetration of aquifers and poor construction of borehole) Short-medium term - 2(for ground and surface water contamination)
	Probability	Possible – 2 (for all the impacts identified above)
Significance	*Without mitigation*	*(Extent + Intensity + Duration + Probability) x WF* (1+5+4+2) x 5 = 60Medium to high**(**for inadequate penetration of aquifers and poor construction of borehole) (3+3+2)x2=16 low(for ground and surface water contamination)
	With mitigation	*WOM x ME = WM* 60 x 0.2 = 12 Low **M (**for inadequate penetration of aquifers and poor construction of borehole) *WOM x ME = WM* 16 x 0.2 = 3.2Low **M (**for inadequate penetration of aquifers and poor construction of borehole)

Mitigation measures

- Appropriate construction methodology will be applied to ensure that groundwater mixing does not occur; and
- Borehole construction equipment will be suitably maintained and spent fluids handled and disposed of in an appropriate manner, and
- International best practice borehole construction methodologies will be applied
- A qualified hydro geologist should supervise the drilling, construction and test pumping of the proposed borehole.
- The supervising engineer in collaboration with the contractor should provide an appropriate casing and screening design in order to optimize exploitation of the aquifers.
- That aquifer(s) struck at less than 5 metres below ground level should be sealed off completely with neat cement grout and/or bentonite to prevent surface seepage
- Test pumping should be conducted and abstraction levels set and implemented as required by law.
- Unwanted liquids and/or solids should not be introduced in the borehole during

drilling.

- Samples taken during test pumping must be submitted to a recognized laboratory for full physical, chemical and bacteriological analyses to determine whether it is potable as per World Health Organization (WHO) guidelines before use. In case of contamination, drinking water should be treated before use.
- The borehole should be fitted with a water master meter to monitor ground water abstraction and an airline for monitoring of the water levels.
- Water conservation measures should be encouraged during the existence of the project.

During operation phase the potential impacts of the project will be related to utilization of groundwater abstracted from the borehole. These impacts are:

- ✓ Siltation of borehole; and
- ✓ Water supply conflicts resulting from ground water resource depletion

Impact Significance

There is the potential for gradual siltation of the abstraction system, with fine sands and silts being pumped through the screening filters. This could result in damage to the pumping equipment and consequently affect the supply of water to the community. In such a situation, it would require the pumping system to be cleared and be a temporary impact on the supply of water to the community.

Siltation of the borehole is, considered to be a medium significant impact. The likely result of this would be the inability of the local community to access water for their domestic uses.

There will be potential for water supply conflict if the water balance available from the aquifer that will be exploited for the provision of domestic water is not sufficient. The impact of water supply conflict is considered to be of medium significance (this should be confirmed after reviewing data capacity and yields of the aquifer).

Table 7-3: Water Impacts during Borehole Operation

Impact source(s)	**Abstraction of groundwater**	**Status**	-
Nature of impact	Siltation and water supply conflict		
Reversibility of impact	✓ Water quality monitoring will be carried out to ensure that there is no pollution of the groundwater ✓ Appropriate screening filters should be installed in the pumping system during construction of the borehole		
Degree of irreplaceable loss of resource	N/A		
Affected stakeholders	Water quality/water users		

	Extent	Footprint – 1
Magnitude	*Intensity*	Medium-3
	Duration	Short-medium term - 2
	Probability	Possible – 2
Significance	*Without mitigation*	*(Extent + Intensity + Duration + Probability) x WF* (3+3+2)x2=16 low
	With mitigation	*WOM x ME = WM* 16 x 0.2 = 3.2Low **M**

Mitigation Measures

- ✓ Water quality monitoring will be carried out to ensure that there is no pollution of the groundwater
- ✓ Appropriate screening filters should be installed in the pumping system during construction of the borehole

7.4 Impacts on Soils and Geology

The borehole drilling and construction activities are anticipated to impact on soil and geology of the project site in several ways including: disturbances to soil subsequently resulting in erosion, soil contamination by oil leaks from drilling and construction equipment. Impact on soil and geology is not anticipated during operation and decommissioning phases as there will be no activities that will result in soil disturbance.

Significance of Impact

The impact on soil and geology is regarded as low even without mitigation and limited within the footprint. Table **7-4** below presents a summary of significance of impacts on soil and geology.

Table 7.4: Impact to Soils and Geology during Drilling.

Impact source(s)	Borehole drilling and construction equipment	Status	-
Nature of impact	✓ Erosion ✓ Disturbance of natural state ✓ Contamination of soil from leakages		
Reversibility of impact	Good maintenance of the vehicles and equipment to avoid oil leaks, Proper storage of all fluids, oils and fuels		
Degree of irreplaceable loss of resource	N/A		
Affected stakeholders/area	Soil Quality/Land Suitability		

	Extent	Footprint - 1	
Magnitude	*Intensity*	Low – 1	
	Duration	Medium - 3	
	Probability	Definite – 5	
Significance	*Without mitigation*	*(Extent + Intensity + Duration + Probability) x WF* (1+1+3+5) x 1 = 10 low	**Low**

Mitigation

The potential impacts on soil and geology can be mitigated by:

- ✓ Minimizing oil leaks from vehicles by ensuring they are properly and timely maintained prior to use in the survey;
- ✓ Availing spill kits and drip trays to contain any fugitive spills during in-field refuelling;

7.5 Impacts to Air Quality

Drilling and borehole construction equipment will generate combustion/exhaust emissions. Potential pollutants from diesel combustion include nitrogen oxides (NOX) (which comprises of nitrogen dioxide (NO2) and nitric oxide (NO), sulphur dioxide (SO2), carbon monoxide (CO), carbon dioxide (CO2), and particulate matter smaller than 10 and 2.5 microns (PM10 and PM2.5respectively).

During operation phase, the combustion emissions from the operation of the borehole will be restricted to occasional use of maintenance vehicles. As such, it is considered that the potential impact on people living and working in the surrounding area from combustion emissions will be negligible.

Significance of Impact during construction and operation phases

The gaseous pollutants from combustion emissions are considered minor and are almost impossible to quantify, therefore they are not assessed and do not attract specific management actions.

Decommissioning the borehole is unlikely, if the resource conditions are still favourable, water supply equipment such as pumps can be refurbished at the end of their design life to upgrade and repair equipment to enable operation and water supply to continue.

For the Project, it is assumed that design practices will allow for the full decommissioning of the borehole and its associated infrastructure should that be required at the end of its design life, or before if unforeseen conditions make the development unsustainable.

Emissions generated by activities during the decommissioning and reclamation phase will include dust emissions from land clearing, structure removal, backfilling, dumping, and reclamation of disturbed areas (grading, seeding, and planting).

Significance of Impact

The impact on air quality is regarded as low even without mitigation and limited within the footprint. Table **7-5** below presents a summary of significance of impacts on soil and geology.

Table 7-5: To Air Quality during Drilling

Impact source(s)	Borehole drilling		Status	-
Nature of impact	✓ Dust generation ✓ Combustion emissions			
Reversibility of impact	✓ Implementation of best practice measures to minimize the potential for nuisance dust to be generated and escape off-site; ✓ Implementation of dust management techniques such as water suppression (if required)			
Degree of irreplaceable loss of resource	N/A			
Affected stakeholders/area	Air quality			
	Extent	Footprint - 1		
Magnitude	Intensity	Low – 1		
	Duration	Short-term - 2		
	Probability	Definite – 5		
Significance	Without mitigation	(Extent + Intensity + Duration + Probability) x WF (1+1+2+5) x 1 = 9 low		**Low**

Mitigation Measure

- ✓ Implementation of best practice measures to minimize the potential for nuisance dust to be generated and escape off-site; and
- ✓ Implementation of dust management techniques such as water suppression (if required)

7.6 Noise and Vibration Impact

During drilling and borehole construction phase, noise sources will include, drilling rig, and vehicles used to transportation of materials and equipment to the site. Noise from

drilling rig will be continuous over 12 hour period while noise from vehicles will be transient, limited to period the vehicles are in operation.

During operation phase, the only primary noise source will be water pump. While during decommissioning phase, the source will include; demolition works and vehicles carting away materials.

Minimizing Noise and Excessive Vibrations

Significance of noise impacts depends on whether the project would increase noise levels above the existing ambient levels by introducing new sources of noise. Noise impacts would be considered significant if the project would result in the following:

- Exposure of persons to, or generation of, noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies.
- Exposure of persons to, or generation of, excessive ground-borne vibration or ground-borne noise levels.
- A substantial permanent increase in ambient noise levels (more than five decibels) in the project vicinity above levels existing without the project.
- A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project.

The proponents shall put in place several measures that will mitigate noise pollution arising during drilling of the wells.

The following noise-suppression techniques will be employed to minimize the impact of noise and excessive vibrations at the project site.

- Make sure all machinery and vehicles are fitted with appropriate mufflers, and that all mufflers and acoustic treatments are in good working order;
- Make sure all machinery and vehicles are regularly maintained and broken parts (such as mufflers) are replaced immediately
- Make sure that activities likely to cause adverse noise impacts are timed to have least impact on surrounding land users and other site activities (such as the schools and the hospitals)
- Make sure all personnel are issued with hearing protection and are advised of its proper use
- Consultation of earthwork hours with affected residents and nearby sensitive receivers

Significance of Noise and Vibrations Impacts during construction phase

Noise generated during borehole drilling and construction is considered to moderate to high significance on ambient noise quality. The levels at the nearby sensitive receptors are not expected to exceed the regulatory limits set by Environmental Management and

Coordination (Noise and Excessive Vibration (Control) Regulations, 2009 with 2015 amendments. The regulation set permissible noise levels to be 60 decibels for a construction site during the day and 35 decibels during the night. Table 7-6 below presents noise and excessive vibrations impacts rating during Project construction phase.

Table 7-6: Noise and Vibrations –Construction Phase

Impact source(s)	Borehole drilling and construction		Status	-
Nature of impact	Noise generation			
Reversibility of impact	✓ Adherence to Good International Industry practices for noise and vibration control as described in IFC EHS guidelines which include: ○ Selecting equipment with lower sound power levels ○ Limiting the hours of operation for specific pieces of equipment or operations, especially mobile sources operating through community areas ○ Developing mechanism to record and respond to complaints			
Degree of irreplaceable loss of resource	Low if the above mitigation measures are implemented			
Affected stakeholders	Noise quality and nearby sensitive receptors (residential areas)			
	Extent	Site - 2		
Magnitude	Intensity	Medium- 3		
	Duration	Short term – 2		
	Probability	Definite - 5		
Significance	Without mitigation	(Extent + Intensity + Duration + Probability) x WF (2+3+2+5) x 2 = 24 Low to medium		**Low to medium**
	With mitigation	24*0.2 = 4.0 Low		**Low**

Significance of Noise and Vibrations Impacts during operation phase

Noise generated during operation phase is considered to be of low significance on ambient noise quality. The levels at the nearby sensitive receptors are expected not to exceed the regulatory limits set by Environmental Management and Coordination (Noise and Excessive Vibration (Control) Regulations, 2009 with 2015 amendments. The regulation provides for 50 decibels for an outdoor residential level during the day and

35 decibels during the night. Table 7-7 below presents noise and excessive vibrations impacts rating during Project operation phase.

Table7-7: Noise and Vibrations –Operation Phase

Impact source(s)	**Water Pump**		**Status**	**-**
Nature of impact	Noise generation			
Reversibility of impact	✓ Selecting equipment with lower sound power levels ✓ Developing mechanism to record and respond to complaints			
Degree of irreplaceable loss of resource	Low if the above mitigation measures are implemented			
Affected stakeholders	Noise quality and nearby sensitive receptors (residential areas)			
	Extent	Site - 2		
Magnitude	Intensity	Low- 1		
	Duration	Long term – 5		
	Probability	Definite - 5		
Significance	Without mitigation	(Extent + Intensity + Duration + Probability) x WF (2+1+5+5) x 2 = 26Low to medium		**Low to medium**
	With mitigation	26*0.2 = 5.2 Low		**Low**

Significance of Noise and Vibrations during decommissioning phase

Noise generated during decommissioning phase is considered to be of low significance. The levels at the nearby sensitive receptors are not expected to exceed the regulatory limits set by Environmental Management and Coordination (Noise and Excessive Vibration (Control) Regulations, 2009 with 2015 amendments. Table 7-8 below presents noise and excessive vibrations impacts rating during Project decommission phase.

Table7-8: Noise and Vibrations –Decommissioning Phase

Impact source(s)	Demolition works and vehicles carting away materials	Status	-
Nature of impact	Noise generation		
Reversibility of impact	Adherence to Good International Industry practices for noise and vibration control as described in IFC EHS guidelines which include: ○ Selecting equipment with lower sound		

	power levels ○ Limiting the hours of operation for specific pieces of equipment or operations, especially mobile sources operating through community areas ○ Developing mechanism to record and respond to complaints		
Degree of irreplaceable loss of resource	Low if the above mitigation measures are implemented		
Affected stakeholders	Noise quality and nearby sensitive receptors (residential areas)		
	Extent	Site - 2	
Magnitude	Intensity	Low- 1	
	Duration	Short term – 1	
	Probability	Definite - 5	
Significance	Without mitigation	(Extent + Intensity + Duration + Probability) x WF (2+1+1+5) x 2 = 18Low	**Low**
	With mitigation	18*0.2 = 3.6 Low	**Low**

Mitigation

- ✓ The proponent and contractor should adhere to Good International Industry practices for noise and vibration control as described in IFC EHS guidelines which include:
  - Selecting equipment with lower sound power levels
  - Limiting the hours of operation for specific pieces of equipment or operations, especially mobile sources operating through community areas
  - Developing mechanism to record and respond to complaints
  - All workers exposed to noise should have appropriate PPEs

7.7 Visual Impacts

The drill rig will be at site only during the implementation of the project, and thus any visual obstruction by it is expected to be only temporary. The well head will be cemented and painted in colours compatible with the surrounding environment.

7.8 Impacts to Occupational Health and Safety

Borehole drilling, construction, operation and decommissioning involve some inherent dangers related to exposure to noise, operation of equipment, demolition and handling of materials. In the absence of sufficient management of Health and Safety (H&S) issues, the workforce may suffer injury or death.

Significance of Occupational Health and Safety Impacts

- Occupational health and safety impacts during the project cycle are considered to be of low significance. It is expected that experienced and trained personnel will be engaged in operating equipment, construction and demolition activities.

Table 7-9 below presents occupational Health and Safety impacts rating during Project construction phase.

Table 7-9: Occupational Health and Safety during Construction

Impact source(s)	Equipment operation, borehole construction activities and demolition and carting away of materials		Status	-
Nature of impact	Injuries to workers/visitors arising from project operations Exposure to nuisance noise, dust, vibrations and emissions			
Reversibility of impact	Formulation and implementation of health and safety plan			
Degree of irreplaceable loss of resource	Low, if health and safety plan is implemented			
Affected stakeholders	Workers and visitors to the site			
	Extent	Site - 2		
Magnitude	Intensity	Low - 1		
	Duration	Medium - 3		
	Probability	Possible - 2		
Significance	Without mitigation	(Extent + Intensity + Duration + Probability) x WF (2+1+3+3) x 3 = 27 Low to Medium		**L -M**
	With mitigation	WOM 27 * ME 0.2 = 5.4		**Low**

Mitigation Measures

Formulation and implementation of health and safety plan which include the following:

- ✓ Adherence to standard operating procedures
- ✓ Use of proper and appropriate PPE
- ✓ Crew supervisor to ensure that safety standards are maintained and safe working practices are adhered to by all members of the crew
- ✓ Formulate and implement emergency preparedness and response plan

- ✓ A First Aider must be appointed, trained and equipped with adequate equipment for handling first aid incidents

7.9 Impacts to Water Supply and Quantity

The proposed project will result to increased and improved water supply in the project area. This will consequently, minimise exposure to unsafe water and reduced associated water related health risks.

Significance of Impact

Improvement in water supply and water quality is considered positive impact of high of high significance. Implementation of the proposed project will enable the local community to access clean and improved water supply. Table 7-10 below presents employment impacts rating during Project construction phase.

Table7-10: Employment/Business Creation

Impact source(s)	Availability of sufficient and good quality water		Status	+
Nature of impact	✓ Minimization of exposure to unsafe water and attendant health risks ✓ Increase water supply to the local community			
Reversibility of impact	N/A			
Degree of irreplaceable loss of resource	N/A			
Affected stakeholders	Local community			
	Extent	Regional -3		
Magnitude	Intensity	Medium – 5		
	Duration	Long term – 5		
	Probability	Definite – 5		
Significance	Without mitigation	(Extent + Intensity + Duration + Probability) x WF (3+5+5+5) x 5 = 90 Low- Medium		**H**
	With mitigation	Positive impact		**N/A**

7.10 Social Impacts

The Project will trigger less significant negative social impacts due to the fact that all indentified 9nr sites are sites with existing water tanks belonging to THIWASCO, all the sites are secured with either chain link or vegetation fences. The assessment also indentified that the sites are free from encroachment therefore no Resettlement

Impacts will be triggered by the Project. Detailed description of the other social parameters is presented in table 7-11 below

Social Environment Setting

The project impacts on Social environment setting of the Project area identified during the assessment is presented in Table E.5 below.

Table 7.1: Negative Impacts on Social Environment and proposed Mitigation measure during Construction

Impacts	Proposed Mitigation Measures
Loss of Temporal Assets and Sources of Livelihood	Not triggered due to the following • All the proposed borehole sites are located within existing facility that has adequate land for expansion • Proposed clear water distribution line will utilize existing road reserve that is free from encroachment
Disruption of Public Utilities	• Contractor to carry out piloting to locate services such as pipes and cables along the Pipeline Route before commencing excavation works. • The relevant Services Providers and Agencies to be notified prior to commencement of Works so that any relocation works can be carried out before the Pipeline Construction Works begin. • Length of excavation to be restricted to sections that can be reinstated within the shortest period possible to minimize time of disruption of services
Increased Transmission of HIV/AIDS	• HIV/AIDS Awareness Program to be instituted and implemented as part of the Contractor's Health and Safety Management Plan to be enforced by the Supervising engineer. This will involve periodic HIV/AIDS Awareness Workshops for Contractor's Staff. • Access to Contractor's Workforce Camps by outsiders to be controlled • Contractor to provide standard quality condoms to personnel on site
Labour Influx and sexual offences	• Effective community engagement and strong grievance mechanisms on matters related to labour. • Prepare and implement Child Protection strategy which should provide guidance on measures that will be adopted to protect children from being engaged, early pregnancies and school dropout • Effective contractual obligations for the contractor to adhere to the mitigation of risks against labour influx • Proper records of labour force on site while avoiding child and forced labour • Fair treatment, non-discrimination, and equal opportunity of workers. • Comply to provisions of WIBA 2007 and IFC PS 2 on labour and Working Conditions, and ILO Conventions 87, 98, 29,105,138,182,100,111

Impacts	Proposed Mitigation Measures
	• Develop and implement a children Protection Strategy
Human Rights and gender inclusivity	• Mainstream Gender Inclusivity in hiring of workers and entire Project Management as required by Gender Policy 2011 and 2/3 gender rule. • Comply to provisions of guidelines on incorporating Human Rights Standards and Principles, including Gender, in Programme Proposals for Bilateral German Technical and Financial Cooperation • Protecting Human Risk areas Associated with, Disadvantaged Groups, Interfering with Participation Rights, and interfering with Labour Rights
Increased Crime and Insecurity	• Contractor and Supervision engineer to liaise regularly with the Local Administration and Police Service to address any security and crime arising during project implementation. • Contractor to provide 24 hours security to Workforce Camps, Yards, Stores and to the Supervising Team's Offices

7.11 Decommissioning Impacts

Abandonment of a borehole may results from a number of reasons including; inadequate water or dry borehole, poor water quality, defective construction and legal implications. Upon decommissioning of the proposed project, rehabilitation of the project site will be carried out by disconnection of power supply, removal of the submersible pump, sealing the bored hole and re-sealing of the area, which will lead to improved visual quality of the area.

7.12 Materials and Methods

Aggregates

These should consist of inert sand, gravel or crushed stones. These materials eliminate the physical hazard and open space of the borehole but do not prevent the flow of water through the well bore. They should be uncontaminated and of consistent size to minimize bridging during placement. The aggregate should be no more than fourth of the minimum wall, diameter through which it must pass during placement. Aggregate or sealant is usually poured from the top of the borehole; hence care must be taken to prevent bridging by slowly pouring the aggregate and monitoring the progress with frequent depth measurement.

Aggregate will be filled to the level of the last top most screens according to the original design to ensure that natural hydrogeological process is maintained. There is no need to seal fractures, joints, or other opening in the interval to be filled. The aggregate must be consistent with the future land use.

Sealants

Sealants will be used to provide watertight barrier to infiltration of the water into the well bore, in the annular space, fracture or openings adjacent to the bore. Sealing mixtures should be formulated to minimize shrinkage and ensure compatibility with the chemistry of groundwater in the well.

Concrete apron slab

A watertight concrete apron slab should be constructed. The topsoil around the borehole should be excavated at a radius of one metre from the borehole to a depth of at least three metres and filled with watertight concrete to a minimum thickness of one metre. After grouting, the pit can then be backfilled or concreted to the top depending on the intended future use of the land.

8 ENVIRONMENTAL AND SOCIAL MANAGEMENT & MONITORING PLAN

Table 8-9 provides the Environmental Social, Management and monitoring Plan (ESMMP) for the Borehole Water Project. The ESMMP provides a logical framework within which identified negative environmental and social impacts can be mitigated and monitored. Overall the ESMMP outlines the potential safety, health and environmental and social risks associated with the project and detail all the necessary mitigation measures as well as the person(s) responsible and the budgetary element for implementing and monitoring such measures. The ESMMP will be used as a reference point in annual environmental audits and success of the mitigation measures will be realized if project participants duly comply with the ESMMP.

Table 8-1: Environmental and Social Management and Monitoring

Impact	Proposed Mitigation and Monitoring	Responsibility	Impact Rating	Monitoring Indicators	Frequency of monitoring	Budget Ksh.
Impacts on Land and Soil- *Mainly Oil and grease spills, and soil excavations*	- Ensure management of excavation and drilling activities. - Proper refilling of the excavated cuttings pit and power cables. - Proper storage, handling and disposal of oil and oil wastes during construction - Any maintenance of construction vehicles should be carried out in the contractor's yard or at a petrol station.	Project Contractor	Low	-Oil and grease spills on the ground -Excavated channel	Throughout drilling operation	Part of the drilling execution
Impact on Air Quality - *Mainly dust and fumes from machinery*	- Ensure proper working conditions of exhaust systems of the borehole drilling and construction machines. - Water earth stockpiles. - Provide drill crew with dust masks. - Use water spray when the work area becomes dusty	Project Contractor	Low	Level of dust in the vicinity of project site. Level of fumes in the vicinity of the project site.	Throughout drilling operation	150,000
Impacts on Water Resources- Quality and Quantity	- Proper maintenance of water structure - Strengthen water user associations - Management of water extraction through capacity building of management committees - Avoid entry of any undesirable material into the borehole. - Construct a proper sanitary seal and wellhead - Management of water usage to avoid unnecessary wastage of water. - Installation of uPVC deeper line for water level monitoring	Project Contractor	Low	-Water quality analysis -Water level fluctuation in the borehole. -Frequency of breakdowns of the structure	Periodically	Part of the drilling execution
Impacts on Public health and occupational	- Provide proper protective gears to all workers - Ensure that there are no spills of petroleum, no smoking, no source of ignition and - Appropriate use of warning signs in explosive	Project Contractor	Low, but potentially high	-Number of accidents/injuries recorded -Response time incase	Daily - throughout drilling	150,000

Impact	Proposed Mitigation and Monitoring	Responsibility	Impact Rating	Monitoring Indicators	Frequency of monitoring	Budget Ksh.
safety	environment. - Provide insurance cover to all project participants - There should be a standby vehicle incase of any medical emergency - Provide fully equipped first aid kit at site. - Provide Emergency contacts for police - Emergency plans should be communicated and well understood.			of emergencies -Frequency of water related illnesses among the community	operation	
Impacts on Biodiversity	- Avoid cutting and destruction of trees and shrubs during the drill process.	Project Contractor	Low	- Number of trees/ vegetation cover in the project site	After construction	Part of the drilling execution
Visual Impact	- Minimize implementation period - Clearance of site after decommissioning - All temporary works should be removed from site	Contractor	Low	Number community complains on aesthetics	After construction	Part of the drilling execution
Social Impacts	- Loss of Temporal Assets and Sources of Livelihood – Not Triggered - Increased Transmission of HIV/AIDS (HIV prevention campaigns to be initiated by Contractor) - Labour Influx and sexual offences – measures to be adopted as described in section 7-10 - Human Rights and gender inclusivity - measures to be adopted as described in section 7-10 - Increased Crime and Insecuritymeasures to be adopted as described in section 7-10	Contractor	Low	-Number of HIV training done -Records of workers on site -Number of workers complaints recorded - cases of crime incidence recorded - gender balance data of worker employed	During and After construction	Part of the drilling execution
	Total Cost of ESMMP					**300,000**

Table 8-2: Environmental and Social, Management and Monitoring during Operation

Project Activities `	Possible Negative Impacts	Proposed Mitigation Measures	Monitoring indicators	Responsible body	Time Frame
Water supply to the Proponent.	-Disposal of wastes near the borehole and misuse of water	-Monitor water quality and ensure good waste water disposal -Create awareness among users on importance of ensuring facilities cleanness	Presence of litter pits, water quality reports, and state of the borehole site.	THIWASCO	During operation phase
	-Possible overexploitation of ground water.	-Monitor water levels -Ensure efficiency in water use -Encourage rain water harvesting to reduce pressure on ground water	Water level monitoring method, water use management strategy, the extraction volumes Rain water harvesting techniques	Proponent, WRMA, THIWASCO	Throughout operation phase
	-Possible conflicts among other borehole owners over interference with yields.	-Ensure adequate consultations and negotiations -Adhere to provisions contained in the license in accordance with Water Act 2002 revised in 2015 and Water Use Rules and Regulations - All aquifers within radius of 160M should be sealed with plain casings and screens.	Number of consultation meetings held, status of surrounding aquifers	THIWASCO	During design phase and throughout the project period
Risk of Encroachment and Construction of Structures on the Pipeline Way Leave, including vandalism	-Possible damage and vandalism of the infrastructure - lack of access road necessary during operation and maintenance	- Regular inspection by THIWASCO of the pipeline corridor and borehole sites for illegal connections -Arrest and prosecution of encroachers as required by Kiambu County By laws on Way Leaves and Road Reserves --THIWASCO to undertake awareness campaigns aimed at preventing encroachment	Number of associated cases reported	THIWASCO	During design phase and throughout the project period

9 CONCLUSIONS AND RECOMMENDATIONS

- Overall the project aims at providing the local community with a reliable source of water and the borehole is expected to enhance accessibility to water by target local community.

- The project activities are likely to cause albeit on a small scale soil erosion, disturbance of vegetation, ponding, risk of accidents, emission of dust, and increase in noise.

- The study has proposed several measures to reduce negative impacts including amelioration of social negative impacts, noise abatement, waste management, reduction of visual intrusion, reduction of soil erosion, prevention of accidents and health hazards.

- Monitoring has been identified as an important process in the protection of environment of the project area since it will reveal changes and trends brought about mainly by construction activities.

- Priority for employment should be given to the local community including women and youth. This will enhance social economic and capacity building.

- The proponent should adopt a participatory and collaborative approach during all the phases of the project. This will ensure active participation of all key stakeholders towards success and sustainability of the project.

- The proponent needs to support the implementation of environmental and social management and monitoring plan (including mitigation plan and monitoring) in order to protect the environment of the project area from the negative impacts of project implementation.

It is in the opinion of the consultant that the few anticipated negative impacts can readily be mitigated and that the proposed project does not pose any threat to the environment.

10 REFERENCE

1. Canter, L., 1996, Environmental Impact Assessment, McGraw-Hill Science.
2. Government of Kenya (GOK), 1999. The Environmental Management and Co-ordination Act, 2015. Government printer.
3. Government of Kenya (GOK), 2003. The Environmental (Impact Assessment and Audit) Regulations, 2003.
4. Government of Kenya (GOK). The Public Health Act Chapter 242 Laws of Kenya.
5. Government of Kenya (GOK), 2002. The Water Act 2002. Government Printer, Nairobi, Kenya.

ANNEX: VOLUME II

Annex1: Public Participation Questionnaires, Minutes and List of Attendance

Annex 2: Designs, Layout Plans and Bills of Quantities

Annex 3: Hydro-geological Survey Report and WRMA Permits

Annex 5: Land Ownership Documents