ATHI WATER SERVICES BOARD

RUIRU II DAM WATER SUPPLY PROJECT

ENVIRONMENT AND SOCIAL IMPACT ASSESSMENT

STUDY REPORT

JULY 2016

Environmental Safeguards Consultants (ESC) Limited

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ACRONYMS AND ABBREVIATIONS

AEWA	Africa-Eurasian Water Bird Agreement
AWSB	Athi Water Services Board
BBOP	Business and Biodiversity Offset Program
CEA	Cumulative Effect Assessment
CIA	Cumulative Impact Analysis
COI	Corridor of Impact
EA	Executive Agency
EFA	Environmental Flow Analysis
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
EMCA	Environmental Management and Coordination Act
EMP	Environmental Management Plan
ESC	Environmental Safeguards Consultants
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
ESMP	Elements of Environmental and Social Management Plan
ESMP	Environmental and Social Management Plan
GDP	Gross Domestic Product
GoK	Government of Kenya
KFS	Kenya Forest Service
KTDA	Kenya Tea Development Authority
KWS	Kenya Wildlife Services
LAR	Land Acquisition and Resettlement
LARP	Land Acquisition and Resettlement Action Plan
MENR	Ministry of Environment and Natural Resources
MWI	Ministry of Water and Irrigation
NEC	National Environmental Council
NEMA	National Environmental Management Authority
NLC	National Land Commission
OPL	Official Poverty Line
PAP	People Affected Persons
PCC	Public Complaint Committee
PPE	Personal Protective Equipment
RAP	Resettlement Action Plan
RFFA	Reasonably Foreseeable Future Actions
RIS	Reservoir Induced Seismicity
ROW	Right of Way
SERC	Standard and Enforcement Review Committee
SESA	Strategic Environmental and Social Assessment
TOR	Terms of Reference
WASREB	Water Services Regulatory Board
WB	World Bank
WCMA	Wildlife Conservation and Management Act
WHO	World Health Organization

WRI	World Resource Institute
WRMA	Water Resource Management Authority
WSB	Water Services Boards
WSP	Water Services Provider
WSTF	Water Services Trust Fund
WTP	Water Treatment Plant

EXECUTIVE SUMMARY

Project Background

The RuiruII DamWaterSupplyProject wasproposedin thefeasibilitystudyandmasterllanfordeveloping newwatersourcesforNairobiandsatellitetowns carriedout byEgis/MIBPin2012.Themaster plan coversthe analysisofwater needsandinfrastructure development for Nairobi City and satellite towns including; Kikuyu, Ruiru Juja, Kiambu, Karuri, Githunguri, Mavoko, Ngong, Ongata Rongai, Thika, Limuru, Lari, Tala and Kangundo.

Therefore, to supply water to satellite towns of Kiambu and Karuri, Athi Water Services Board (AWSB) intends to implement Ruiru II Water Supply Project through the support of a consortium of firms including; *Vinci Construction Grands Project, Sogea Satom and Egis Eau.*This will be a funding, design and build project.

The proposed Ruiru II dam site is located immediately downstream of Ruiru I dam approximately 2km at the Bathi river confluence at coordinates N9885613; E252735 and at an elevation of approximately 1,835 a.m.s.l.

Project Need and Justification

The project is one of the sub projects prioritized for implementation under the Feasibility Study and Master Plan for Developing New Water Sources for Nairobi and Satellite Towns carried out by Egis/MIBP (2012). In the Master Plan Study, water demand for Kiambu and Karuri towns is 11,716m3/day and 15,348m3/day respectively for the year 2017, out of this; the towns are supplied by borehole water with estimated supply capacity of 3290m3/day for Kiambu and 2762m3/day for Karuri.In the year 2030 water demand for Karuri town was estimated to be22,900m3/day while that for Kiambu town was placed at 17,200m3/d, if the towns continue to depend on borehole for supply of water, in the year 2030, the current capacity of water supply shall still be at 3060m3/day while Karuri shall still have water supply capacity of 1,667m3/day. From the analysis above, it clear that water demand for Kaimbu and Karuri towns is growing while water supply capacity is stagnating hence the need for implementation of Ruiru II Water Supply Project.

The ESIA Study and Objective

Pursuant to the Environmental Management and Coordination Act (EMCA) 1999, dam construction projects must undertake an ESIA study prior to the commencement of construction. Therefore, as part of project preparation, an environmental and social impact assessment (ESIA) has been carried out to assess the environmental and social impacts associated with the design, the construction and operation of the project.

Project Description and Components

This project in terms of components will involve construction of an earth fill dam located downstream of the confluence of Bathi and Ruiru rivers. The dam shall allow

40,000m^3/day of water to be conveyed to the treatment plant.The project shall also involve construction of raw water gravity transmission main, construction of Water Treatment Plant (WTP) at Ndumberi Township and construction of clear water mains and terminal tanks to supply water to Kiambu and Karuri Towns. **Table 1**below summarizes specific project components in detail.

Table 1: Project Component Summary

Dam:55mheightearth filldamlocated35kmnorthofNairobi,attheconfluenceofRuiruandBathi Rivers.Themaincomponents ofthedamare:	
Dambody	▪ Height:55m ▪ Crestlength:250m ▪ ClayImperviousCore ▪ Trachyteshouldersandriprap ▪ Crestelevation:1890
Spillway	▪ Ogee Crest Open channel ▪ Stilling basin ▪ QPMF = 956 m3/s
Intake Tower and Bottom Outlet	▪ 6m x 6m culvert ▪ 65m high intake tower with 4 intakes ▪ Upstream Gate chamberwith 1000mm x1800mm roller gate and ▪ Radial Gate ▪ SCADA
Reservoir	▪ Catchment area: 131 km2 ▪ Normal water level: 1885 m.a.s.l ▪ Reservoir surface (Normal water level): 500 000 m2 ▪ Reservoir volume (Normal water level): 7 500 000 m3 ▪ Operation: the reservoir will be filled during the raining seasons andused for water supply all along the year
Instrumentation	▪ Piezometers, pressure cells, settlement extensometers.
Raw Water Gravity Main:	▪ Length 16.5km of raw water transfer ▪ Pipe size 700mm pipes from the Dam intakes to the Water Treatment Plant
WaterTreatmentPlant	▪ The plant is located at Ndumberi 1810m.a.s.l approximately 3km from Kiambu town along Kiambu Limuru road at the junction towards Githunguri town. ▪ Thewatertreatmentplantisbasedon sandfiltertechnology and is proposed to have a design capacity of 40 000m3/day. ▪ The water treatment plant shall included - Cascade aeration - Pre chlorination with Calcium hypo-chlorite - Dosing with sodium carbonate (Soda Ash) to adjust pH

	- Dosing with Aluminium Sulphate (coagulant aid) - Dosing with polyelectrolyte (flocculent aid when needed) - Clarification - Rapid gravity filtration - Disinfection with hypochlorite - Dosing with sodium carbonate (Soda Ash) to adjust pH ▪ Sludge treatment and disposal - Water recovery tank (receives sludge from clarifiers and filters) - Sludge drying beds
TreatedWaterTransfer:	▪ 5000m3 reservoir tank 2500m3 suction tank upstream Karuri pumping station ▪ 26.6km ofwatertransfer500mmpipeswith2terminaltankswithfeeder.

Project Cost

Basedonthefinancialoffersreceivedfromdesignerandcontractorsduringthebiddingprocess,theConstructionCostoftheprojectisestimated at**6,707,522,035**Kenya Shillings/**USD67,075,220.35**.This range ofpriceincludes:

- Site investigation,
- Dam construction (preliminaries and general, embankment, spillway, intake, grouting)
- Pipelines construction
- Water treatment plant construction

Table 2: Estimated Project Cost

No.	Description	Amount (USD)
1	**Ruiru Dam and Ancillary Works**	
	Embankment	15,823,453.45
	Spillway	10,090,826.29
	Intake Culvert and Tower	11,778,882.29
	Roads and Parking	1,814,911.46
2	**Raw and Treated Water Pipelines**	14,130,960.52
3	**Water Treatment Plant**	13,436,186.34
TOTAL		**67,075,220.35**

ESIA Approach and Methodology

The ESIA for the project was undertaken between February 2016 and April 2016. The selected approach wasin compliance with the applicable national rules and regulations and these are generally compatible with the procedures and guidelines of potential International Funding Institutions (IFI's) such as the World Bank and International Finance Corporation (IFC).

Public Consultation, Participation and Disclosure

Apart from the gathering of quantitative data through a household survey of the area of influence of the project and a preliminary survey of project affected people, consultation sessions (qualitative) were held with the affected persons and other local community interests to share the information about the project and record their concerns/ feedback associated with this project. The consultation was in two stages namely scoping and stakeholder's consultation. Consultative sessions discussed the topics related to land acquisition and resettlement issues, employment and livelihoods of communities, gender and women issues, contractor's camp and access to existing routes and environmental issues.

The section on stakeholder consultations provides details of outcomes of consultations and covers issues and concerns showed by the stakeholders regarding land acquisition and resettlement. To address the issues and concerns raised by the stakeholders, mitigation measures have been developed and incorporated into the ESIA.

In summary, the stakeholders generally supported the dam project and anticipated numerous benefits as a result of the project. However a few people, especially the PAPs, expressed an apprehension regarding the loss of their productive assets and livelihood as a consequence of the project. Nevertheless, to address their concerns and issues an ESIA has been developed and is included in this report.The Resettlement Action Plan (RAP) has been prepared for the project.

Policy, Legal and Administrative Framework

The Government of Kenya promulgated the 'Environmental Management and Coordination Act' (EMCA), No 3 of 1999 for environmental management and conservation in Kenya. It established National Environment Management Authority (NEMA) in 2002 to supervise and co-ordinate all matters relating to the environment, including EIAs, Environmental audits, monitoring Environmental restoration orders, conservation orders, and easements under Section 9(2) of the Act. NEMA has published a set of environmental guidelines for conducting environmental assessments and the environmental management of different types of development projects. These have been used to guide the conduct of this ESIA.

Project Impacts

The project is geared towards enhancing social and economic benefits through provision of reliable, adequate and safe water supply to residents of Kiambu and Karuri.

Anticipated Positive Impacts (Socio-Economic)

The positive impacts anticipated from the project include;

- Provision of good quality surface water to benefiting residents who currently depend on un reliable ground water
- The standard of living of the beneficiary residents in Kiambu and Karuri will improve through increased income generation and productivity, better housing

conditions, health and hygiene.

- The distance 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,
- The dam will also moderate the micro-climatic conditions of the immediate surrounding areas through increased humidity and/or cooling effects to the comfort of the residents,
- Upgrading of certain roads, necessary for the construction and maintenance of the dam, will also contribute to a better transport and travel networks in the area. This will have positive social and economic impacts in the area.
- Potential appreciation of property values including significant increase in the prices of land and associated development.
- By providing direct and indirect local employment, the project will ease the direct resource dependency pressures in the county's sectors.
- Provision of water has the potential to enhance development and growth of local markets as more economic and social interests arise. More important is the opportunity to improve sanitation and hygiene in these markets as opposed to the currently potential threat of diseases in almost all the markets.
- Reduced poverty levels, increased incomes and improved livelihoods resulting from dam construction and maintenance employment and consumption from the local markets, emergence of other associated economic opportunities and activities including transport among others. Further, these will increase the Gross Domestic Product (GDP) of the area as well as the tax base for the County government.

Adverse Project Impacts and Mitigation Measures (Biophysical and Socio-Economic)

The potential negative impacts likely to be triggered by construction of the Ruiru II Dam Water Project include;

Sedimentation

The project construction shall involve massiveearth moving within theriverflood plainsand sections of theadjoining riverbanksand lands. This loosening of thesoil and thesteep slopeterrain willcreateasituationwhereanyheavyrainswillfreelywashdownthesiltintothedownstream areas.The siltwhen washeddown maycontainhighlevelsof organic matteranddepositionof this may leadtoanoxicconditionsinthelowerwaterlevels withpotentialriskstotheassociatedaquaticlife.

MitigationMeasures

Itis recommended that construction be undertaken during the dry conditions to minimize erosion when the soil is loosened. The topsoil removed will be required to be moved to an alternative site where storm water cannot carry the soil to the streams.

- A water pan (silt trap) may be established downstream of the dam which will act as a soil trap to hold the excessive silt during construction.

- The steep slopes surrounding the dam construction should be stabilized, compacted and strengthen to reduce on erosion and potential landslides as a result of deep cutting, drainage channels should be installed only when necessary,
- Encourage re-afforestation and improved farming systems upstream of the dam,
- Local residents are using the water river as source of water (drinking water).The residents should, therefore, be provided alternative access to clean drinking water during the construction period.Such as to include additional shallow wells, access to other streams or delivery of clean water with tankers to schools and institutions,
- Erosion and sediment monitoring and control plan should be prepared for the lifetime of the project.
- Seasonal flushing of the dam should be done and should be synchronized with the Ruiru I Dam.
- There should be a progressive catchment management plan targeting Ruiru and Bathi River sub-basins. In this regard, involvement of the communities, landowners and relevant authorities will be necessary.

Water Quality Degradation

The project civil works are likely to alter the waterqualityinthelocalwatermainly due to siteclearingandthedisruption ofthe naturaldrainagepatterns. Thefarmingactivitiesandtheconstructionphase oftheprojectmay encourageincreasedwaterturbiditywithin thedam reservoiranddownstream.Therewillalsobe potentialwatercontamination fromhydrocarbonsmainlyfromthe contractor'smachineries.

Nutrients deposited into the dam may lead to eutrophication and growth of the aquatic vegetation hampering the natural flow of the river.On the other hand reduction in the flow of water downstream will consequently result to increased concentration of pollutants downstream especially during the dry season.

Mitigation Measures

- Local residents are using the river water as principal source of water (drinking water). The residents should, therefore, be provided alternative access to clean drinking water during the construction period. Such as to include additional shallow wells, access to other streams or delivery of clean water with tankers to schools and institutions,
- Define a buffer zone for reservoir protection against siltation, waste deposit and sewage, pesticide use and to reduce chances of water contamination
- Increase of aquatic macro-fauna along the periphery of the dam to ensure natural aeration of water,
- Encourage re-afforestation and improved farming systems upstream of the dam,
- Identification of point sources of water pollution for management,
- Institute a water quality monitoring system and maintaining appropriate records on water quality,
- Best management practices will be utilized during site clearing and construction to minimize erosion and sedimentation,

Water Loss

Developmentofthedammaycreatepotential microclimateduetochangesintheairmoisture,air temperatureandair movementwithinthesurroundingprojectarea. Presenceof surfacewater increasesevaporationandmayhaveamoderatingeffectontemperaturealthoughwithlittleeffec t onthelocalclimate.

The evaporation rate from existing dams (Sasumua dam, Thika dam and others research station) indicates an evaporation average rate of 1500mm/year for an open surface water.

The means daily ground evapo-transpiration is 4.3mm per day. If the ground was always wet, the equilibrium will be done between open surface water evaporation and ground evaporation of the same area (ground evaporation before reservoir created and open water surface evaporation after reservoir created). Nevertheless, the master plan shows that the water supplies of Nairobi and satellite towns are not sensitive to evaporation loss and the same was confirmed by the hydrology study, which was part of this ESIA study.

- During operation of the project there may be potential water loss at consumer points through wastage and leakage in distribution pipes. This risk has been partially considered in the dam design as the daily intake flow inside the raw pipes is 43,978m3/day for a final treatment of 40,000m3/ day.

MitigationMeasures

- Geological profiles throughout the area proposed for inundation should be continuously monitored and areas of weaknesses noted for incorporation of appropriate strengthening measures (this constituted an important part of the feasibility and design stages of the project).
- Sub-surface water infiltration trends on affected areas should be monitored over a period of time with respect to effects on houses and other structures downstream. However, it is noted that there might be no residuals on the lower zones of the dam.
- Indigenous trees and shrubs with low water dissipation capacity should be encouraged around the dam buffer zone to minimize loss of water throughevapo-transpiration processes.
- Ensure enhanced monitoring maintenance of the transmission and distribution pipelines upon commissioning to ensure minimal loss of water through leakages,
- Creation of awareness on water resource management and conservation.
- Ensure proper maintenance and monitoring of the water piping and supply system
- Introduce economic and financial initiatives towards water saving and responsible utilization at all consumer points. Water Service Providers have a significant role in this regard.

Air Quality Degradation

The main sourcesofemissionsduringconstructionincludedustrelatedtositeclearing,earthworks, trafficmovements,loading andunloadingofmaterials,stockpilingofspoil. Dusts emissions mayalso be generated at materialborrowpitsand theconcreteprocessingplant. Inaddition

exhaust emissionsfromthe contractor's machineryand vehicles could contributetoair pollution. The changestoair qualitymayaffectthe residents,agricultural cropsaswellasthenaturalflora.

MitigationMeasures

- Ensure proper maintenance of the construction equipment and machinery.
- Practice dust control measures such as water sprinkling.
- Limit speed limits for the construction machinery and contractors vehicles.
- Ensure effective scouring of the dam to reduce silt and also accumulation of benthic layers

Hydrology

Construction activities are not anticipated to manifest any impacts to the local hydrology. However, training of the river and it tributaries may have limited implications to the local flow regimes that will, only last during the construction period. Thehydrologicalimpactmainlydependsonthedesign,purpose andthedamoperation. Dam constructionmayinterrupttheriversystemresultingtodirectconsequenceofchangeintheriver flowpatterns, sediment transportas wellaschangeintheriverdischargepatterndownstream ofthe dam. Changeintheriverhydrologymayconsequentlyalsohaveaneffectontheaquatichabitat suchasanimpactof fish breedingandmigrationhencehabitatloss.

Mitigation Measures

- Ensure compliance with water resource regulation at all times,
- Maintain at least steady base flow of the stream to sustain ecological and social requirements downstream based on the ecological flow values calculated and part of this ESIA report,
- Provide mandatory buffer area for conservation of the river line and dam ecosystem through the review of riparian land ownership,

Climate Change Issues

RuiruIIdamhaslinkagestoclimatechangeaspectsjustlikeotherdamselsewhere.Theeffectsare associatedwith thefollowingissues,

- The dam construction will require removal of vegetation including tree cover affecting the carbon absorption and retention capacity for the area.
- Inundation of the dam site will create benthic conditions at the dam bed with potential for release of greenhouse gasses among them methane due to degradation of biomass.

MitigationMeasures

- Integrate a tree planting and catchment management initiative for compensation of the emissions
- Evaluate opportunities of full/partial removal of vegetation in order to limited greenhouse gas emission.

Vegetation Loss

Construction of the dam implies removal of existing vegetation while clearing the areas to be inundated and/or possibility of submerging of others potentially losing certain species. There is also potential disruption of habitats downstream of the dam area as a result of construction activities through discharge of excessive particulate matter, cement residuals and other construction materials into the river course

Earthworksandlandfragmentation duringconstructionactivitieswillcontributetoterrestrialflora disruptionthroughtotal vegetationremoval.Theentireterrestrialhabitatwillbedisturbed permanentlybecausetheprojectarea willbecoveredwithwater.Thereservoirwillaffectthe productiveagriculturallandhence affectingthegeneralbiodiversity.

The confluence point of Ruiru and Bathi Rivers shows an intensive low ground cover of various species including grasses, ferns, shrubs, etc which will be removed.Tree cover comprising of mainly exotic trees (gravellia, eucalyptus *ssp*, wattle trees) and agricultural tree species will be removed during construction. Certain fauna species exists in the river-beds for Ruiru and Bathi Rivers including small fresh water fishes, frogs and snakes. The dam development is expected to interfere with the species existence.

Terrestrial and AquaticFauna

Atthe moment,thereis nosignificant aquatic wildlifepresence reportedin theproject area. Theinfluenceofwatermayattractsomelimitedanimalsintothearea(limitationarisesfromthealt itude conditions,temperaturesandrainfallintensity).Amongtheanimals anticipated intoRuiru IIdammayincludehippos,crocodilesandsomesnakespecies.

Duetothehigh levelagricultural and settlementland usetrendsin thearea,thereis no wildlife aroundtheprojectarea.Ruiru II dammaynothaveinfluenceonattracting wildlifeintotheareaduetothehumanactivitiesintensity andalso thefactthatthedamwillbeprotected.

MitigationMeasures

- A detailed analysis of the biodiversity of the Ruiru River ecosystem and specifically the specific project location has been undertaken.
- To protect both Ruiru I and Ruiru II dams, intensive catchment management strategies will be developed among them, practicing re-afforestation, soil erosion control, land use control and settlement and urban development planning among other initiatives,
- Creation of awareness on the proper land cultivation practices to reduce soil erosion and biomass accumulation in the dam reservoir,
- Athi Water Services Board will engage the relevant authorities (KFS) in monitoring and establishing community interests and values in the new ecological setting associated with Ruiru II dam.
- Education, awareness and sensitization programmes will be prepared for the local communities with respect to biodiversity management, values and their roles in the conservation.

Cumulative Effect Assessment (CEA)

Cumulative impact is defined by the US Council on Environmental Quality as "the impacts on the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions (RFFA) regardless of what agency undertakes such other actions." Thus the practice of Cumulative Effects Assessment (CEA) of projects in a region began.

Water abstraction from the Ruiru River will marginally reduce the net water volume available in the River (because of consumptive use for domestic and agricultural purposes). The proposed location of the dam is downstream and in effect, no downstream water users are going to be impacted negatively.However, when combined with other existing and planned water abstractions from the Ruiru River, it will contribute to significant impacts on overall water availability in the sub- basin in dry years.

Abstraction of water from the Ruiru River combined with other abstraction systems within the same River will cumulatively impact on the hydrology of the river especially downstream therefore, Environmental Flows must be observed to ensure that the integrity of the river is maintained. An Environmental Flow Analysis (EFA) has been determined for this project as per the Water Resources Management Authority (WRMA) requirements.

Impacts on Downstream Users (Positive and Negative)

RuiruIIdamwillhavea cumulativeeffect ofRuiruIdamintheregulation of flowdownstreamby balancing thepeakflowduring rainfall and thelowestduring thedryconditions.

Farmers ontheriverfloodplainwillnotreceivetheusualnutrientloadsfromfloodflowssince sedimentsandsiltwillberetainedin thedamuntilthetime ofscouring(flushing). Productivity will, therefore,godown.Allactivitiesdepending onriverflowcould beaffectedbythereduction offlow, especiallylowflow. Moreover, riparianhabitats, aquatic fauna andflora couldbeaffected.

MitigationMeasures

- Define a relevant and permanent compensation flow and evaluate opportunities on adjustment of operation of the dam according to downstream status
- Define and implement a monitoring plan

Cumulative impacts

In view oftheexistingRuiruIdam,thecombinedeffectswithRuiruIIDam onadescriptive basis wouldincludethefollowing;

- The flood flow intercepted by the two dam is potentially also anticipated downstream for agricultural activities, other dams and reservoirs downstream including water supplies (Ruiru Town) as well as seasonal flushing of Ruiru downstream.

- Ruiru River is also expected to contribute to the greater flows in the Ruiru River basin into Athi River. However, this contribution is slightly altered when significant volumes of water are retained in Ruiru I and Ruiru II dams.
- The cumulative retention of silt and sediments from the upper catchments of Ruiru River would be significant. This reduces the potential degradation of the riverine system from siltation and excessive agrochemical residues transported with the sediments,
- It is observed that climate change is a critical issues leading to excessive rainfall and flooding. The combination of Ruiru I and Ruiru II dam will enhance flood control on Ruiru River basin downstream through moderation of peak flows. The quantified flow moderation would be undertaken during the detailed study of the dam.

Induced Impacts

Globally, there are over 100 identified cases of earthquakes that scientists believe were triggered by reservoirs (see Gupta 2002). The most serious case may be the 7.9-magnitude Sichuan earthquake in May 2008, which killed an estimated 80,000 people and has been linked to the construction of the Zipingpu Dam.

In a paper prepared for the World Commission on Dams, Dr. V. P Jauhari wrote thefollowing about this phenomenon, known asReservoir-Induced Seismicity (RIS): "The most widely accepted explanation of how dams cause earthquakes is related to the extra water pressure created in the micro-cracks and fissures in the ground under and near a reservoir. When the pressure of the water in the rocks increases, it acts to lubricate faults which are already under tectonic strain, but are prevented from slipping by the friction of the rock surfaces."

Given that every dam site has unique geological characteristics, it is not possible to accurately predict when and where earthquakes will occur. However, the International Commission on Large Dams recommends that RIS should be considered for reservoirs deeper than 100 meters. The Ruiru II Dam wall is less than 100 meters and the site is not prone to seismicity since the area is not a seismic active region.

Socio-Economic Adverse Impacts and Mitigation Measures

AnImpactassessmentwasconducted for Ruiru II Dam Water Project witha view of ensuringeconomic andsocial sustainabilityofthe project. The assessmentaddressed the prevailing conditions, perceived community roles duringandafter project and both positiveandadverse impacts of the proposed projectactivities.

Land Acquisition Requirements

Theselecteddamoption was55mhighataxis.The land size to be acquired is **174.30** acres for the reservoir land and 21.2 acres for the easement.Project Affected Persons are **201** for the dam reservoir area and **280** along the easement corridor.

Householdsaffectedare mainlylocalfarmers and alocal coffeecollection centre.The main households affectedbythedamconstructionaresituatedalong secondaryroadsin

therightbank,theleftbank andtheconfluenthill ofRuiruandBathiRiverinKamuchegevillage,Kamburu villagesandNgochi villages.

Others impacts which mayaffectthe local populationare:

- Social, cultural andeconomic disturbanceof thestructureof theregion,
- Potentialtemporarydisruptionof accesstowater sources
- Potential temporal disruptionof social-economicactivities that rely on the river for communitiesdownstream.
- Loss of fields, agro-forestry and natural vegetation
- The loss of community facilities as a result of temporary or permanent land take for the project (e.g.loss of coffee collection centre);
- Reduced access to water in the rivers

Mitigation Measures

- A Resettlement Action Plan has been carried out to determine fair compensation of the landacquired for the purpose of Ruiru IIDam.
- For habitants who are using the water river as principal source of water (drinking water), alternative access towater shouldbe providewithin the project implementation,
- Appropriate compensations will be done before the commencement of the project.
- Involve local labour to the extent possible to ensure for the construction and operation of the dam facility, clauses should be integrated in contractor's contract
- Apply the AWSB/CSR policy in economic welfare support for the local community. Part of this may include erection of water kiosks and pay sanitation facilities along the pipeline corridor. However, this be limited since the people live in their own homes,
- Compensate loss of agriculture activities which has been captured in the RAP report already prepared

Impacts on Livestock Farming

Fromfieldvisitinterview, animportantintegrationbetweencropsagricultureandlivestock's farming hasbeennoticed.Majorpartoftheanimals'foodcomesfromagriculture ofthenearestland.Inthe farmingscale,a balancebetweenthe land owned andtheanimal's number insurethe income ofthe farm.Thelossofagriculturallandwillhaveanindirectimpactofthelivestock'sactivities.A total of **174.30** acres of land used for livestock and farming will be affected and the RAP document already prepared has provided adequate compensation measures.

MitigationMeasures

- Most farmers practise zero grazing and hence this impact is considered insignificant and unlikely

Road and Transport

The dam will not hinder access and cut off linkages between the communities living on both sides of the river because the link road for both sides of the river is Kahuruku link road, which is not going to be affected by the dam.

Public Health

Damconstructioninvolvesimportantworkersand machineries.Accordingtothedamheight,morethan100workerswill workatthesametimeinthedamconstructionsite.Traffic ofearthworksmachineries andconcrete toolsauditionedtocommonconstructionworkersaccident (slips andfalls, injuriesofhand, eyeinfections,etc.)makethedamsiteunsafe. Adverse impacts on human health include:

- Workersinjuries fromaccidental falls, use of faulty equipment during construction,
- Respiratory problems fromdust from earth moving and construction materials, emissions from theequipment,
- Environmental pollutionfromdisposal of solid waste materials (excavated materials from pit latrinesand otherresiduesfromconstructionactivities)
- Potential health problems frompressure onhousing, sanitationand hygienefacilities,
- Increase of HIV/AIDs from interaction of workers, localcommunitiesand migrant influx
- Landslide during earthwork.
- Localresidentinjuries dueto traffic orwateraccess.
- Damreservoir provideshabitatfor waterbornediseasesaswellasparasitethrive(mosquito, snails).

MitigationMeasures

- Organizean epidemic basesurveyin theaffectedareaandperiodicevaluation
- Implement measures to assessthe presence of vectorsand controlitsand potential diseases,
- Creation ofawareness,preventionand monitoringprograms,
- Wellnesscentresandawarenesscampaigns onthesexuallytransmitted diseasesandHIV/AIDs
- Adequateprovision of personal protectiveequipmentto the workers,
- Providesanitationfacilitiesin all work areas,
- Waste generated(sanitary,rehabilitationand proper hazardwastestorage) duringthe constructionphasewill becarefullydisposed of inan environmentallysafe manner
- Implementation ofa hygieneandsafety management planaccording tointernational standards includingadequateprovision of PPEs to the workers,
- Adequatediversion of the river andprotection of the site duringconstruction,
- Management ofearthworkbytakingcare ofexcavationandslopestability
- Frequent maintenance of the machineries used

Dam Safety

WB Dam Safety Requirements

RuiruIIDamisa55mhighdam.AccordingtotheWorldBankOperationalManualOP4.37-

Safety ofDams,RuiruIIDamisalargedam.

Moreover,anydamsiteis insideariver valleywheretheriver hastobe divertedthroughchannelto keeptheconstructionsitedry.Incaseofimportantrains,theconstructionsitecouldbecomeunsafe intermsofflooding.Intheconceptualdesign,thereturnperiodusedfortheconstructionfloodflow is 50 yearswhichissafefora2-3yearsconstructionperiod.

TheRuiruandBathiriverwill jointhediversionchannelupstreamandwillgothroughthis channel throughtheleftbank ofRuiru IIriveruntil downstreamto thefuture downstreamchamber. Theconcrete gallerypre-designforthis purposehas a 3.6mdiameter.A 10m high upstream cofferdamwillprotectthesiteagainstflood andadownstreamcofferdamwillpreventanywater returnonthedamsiteincaseofflood.Apartialwatersensorsystemcouplingwithalarmwillalert anyworkers inthedamconstructionsitetoquitetheplace.

MitigationMeasures

- Adequatediversion of the river andprotection of the site duringconstruction,
- Reviewthe damdesignand dam constructionbyindependent panel ofexperts
- Design and install metrological sensors andalarm during the construction toalert workersincase ofrisk of flood

Flood Risk

Thedaminterferencewiththenaturalriverischangingtheintensityofafloodpeakinthesafeway. Inthismatter,thedamhasarealpositiveimpactonthesafetydownstreamof thedam.Moreover, installationof metrologicalsensors andalarminthecatchmentarea ofthedamwillpermittoreduce the potentialconsequenceof an important flowbywarninglocals inadvance.

DamBreakage

Thepotentialdamfailure canresult offaultinthedesign,use ofsub-standard materialduring construction,deliberatesabotage,andlandslidein thereservoir.Accordingtothedesign,thedamis design for theProbable MaximumFlood. This floodflowis 2 timesbiggerthanthefloodwith areturn periodof10,000years.Accordingtothedesignlifeofthedam,whichcanbeassumedbetween50-100years,thedesignfloodchosenmakethe damsafeagainstflood.

MitigationMeasures

- Reviewthe damdesignand dam constructionbyindependent panel ofexperts
- Preparerelevant plans (planfor constructionsupervisionand quality assurance,an instrumentationplan, an operationand maintenance plan),
- Preparean emergencypreparedness plan
- Install properinstrumentationin thedam,
- Ensurefrequent maintenance of the damstructures,
- Ensure use of highquality standard materials during constructionphase

Environmental and Social Management Plan

The environmental and social management plan (ESMP) presented is a component of the overall environmental management that is particularly important with respect to this ESIA report as it presents AWSB's commitments to address the impacts identified by the impact assessment process. Effective implementation and functioning of the ESMP depends on adequate human and financial resources, clearly defined responsibilities for environmental and social management, appropriate training and good communication. To be effective, this ESMP must be viewed as a tool reflecting to the contractors overall commitment to environmental protection.

Issues related to the environment have been embedded within the role and responsibilities of the Project proponent and contractor. The ESMP includes impact reference, description of the impact, mitigation/management measures and project phase. For the social management plan targeted residual impacts are specified.

In terms of land acquisition and resettlement impact mitigation, a comprehensive RAP of category "A" has been prepared and will be implemented in compliance with the national laws and IFC/WB safeguard policy. In addition, a Grievance Redress Mechanism will be set up for the Project to deal with both land acquisition and construction related grievances. The Project will work proactively towards preventing grievances through the implementation of impact mitigation measures (as identified by the ESIA and this ESMP) and community liaison.

The construction costs for the implementation of environmental and social mitigations are included in this ESIA. The operational cost shall be calculated before the completion of construction phase after consultation with stakeholders and the regulatory authorities.

Conclusion

The main benefit expected from Ruiru II Water Supply Project is reducing the current water demand deficit in Kiambu and Karuri Towns. The proposed Project is in accordance with the development and socio-economic needs of its citizens as a whole. Indeed, the Project has many positive environmental and socio-economic impacts locally, regionally, and nationally. In view of positive and negative environmental impacts identified, as well as public consultation conducted in the Project areas to date, with good design, it is unlikely that the proposed Project will have significant adverse residual impact either social or environmental impact.

Most adverse impacts will be of a temporary nature during the construction phase and can be managed to acceptable levels with implementation of the recommended mitigation measures for the project such that the overall benefits from the Project will greatly outweigh the few adverse impacts anticipated.

The main social issues for the Project will revolve around the displacement and relocation of people along the dam reservoir area and the acquisition of the way leave.

The proponent will compensate the PAPs with respect to adverse impacts associated with displacement and disturbance.

The assessment of environmental and social impacts of the dam indicate and conclude that the proposed Ruiru II Water Supply Project is environmentally and socially sound for as long as the mitigation measures and adhered to.

The main support for this conclusion includes the following:

- The proposed water supply project is fully embraced by authorities within Kiambu County and affected resident's locations of Kamuchege, Kamburu Ngochi and Githunguri. However, parts of the community feel they will be affected through loss of property and demand appropriate compensation; this has been addressed in the RAP report.

- Construction of access roads to the dam will also provide alternative access routes for the local communities further increasing the viability of the project. Among the desired access is the section over the dam wall if confirmed suitable and given the necessary design considerations,

- The dam development provides limited ecological challenge consisting in loss of land cover, likely immigration of new plants and animal species into the area as well as slight changes in the localized micro-climatic conditions.

- The dam shall cause land acquisition and easement corridor of approximately 46km for both raw water and clear water transmission mains. A total of **174.30**acres of land will be acquired as a result of the project based on the findings of the RAP study.

1 INTRODUCTION

1.1 Background and Context

The towns around the City of Nairobi that shares water resources from the Aberdares are among the worst hitby water scarcity resulting from the ever-increasing demand from rising population and expanding social and economic activities. Water sources supplying the Nairobi City (Sasumua dam, Thika dam, Ruiru I dam and Kikuyu Springs as well as the proposed additional sources), all outside Nairobi area are increasingly under pressure to satisfy the local requirements including the towns in the region and communities living along the transmission corridor in addition to decreasing recharge capacity. The production capacity is seems to be related to inadequate ability of the available sources to generate in addition to transmission losses, excessive abstraction along the transmission pipelines, pressure losses and illegal connections as well as other unaccounted for water. It is observed, therefore, that demand for water in the city is much higher than the production capacity.

The capacity of water resources in the Aberdares slopes has been declining with time due to a number of factors including catchment degradation from competition of land use requirements and reduced rainfall to recharge the sources as well as increasing water demand for domestic, commercial and also irrigation purposes for the urban and rural users. Illegal abstractions and wastage from the existing pipelines supplying the City of Nairobi and the other towns are also greatly affecting available water reaching the ultimate consumers. This situation is overstretching the available water for domestic supply in urban areas including to the City of Nairobi (which is the major consumer of waterfrom the Aberdares catchment) and now being felt in Kiambu, Karuri, Githunguri, Ruiru, Juja and Thika Towns and other commercial centres.

In order to reverse this situation, Athi Water Services Board has proposed to develop additional dams and other water sources to serve individual towns and their surroundings such as to release more water into the City. Among these interventions include Kiambu and Karuri that are currently inadequately served from boreholes and private sources. To achieve, Ruiru II Dam has been proposed.This intervention will also enable the surplus water be made available to supply the communities along the pipeline corridor for enhanced revenue generation for the Water Services Providers and Athi Water Services Board.

1.2 The Project

Athi Water Service Board (AWSB) endeavours to provide safe, reliable and adequate water supply to areas within its operation therefore has adopted implementation of Ruiru II Water Supply Project through model referred to as; *fund, design and build* through a consortium of *Vinci Construction Grand's Project, Sogea Satom and Egis Eau*. The project area is located downstream the confluence of rivers Ruiru and Bathi at coordinates N9885613; E252735 and at an elevation of approximately 1860m above the sea level.The project components are illustrated below.

Ruiru II Water Supply Project shall include construction of and earth Dam:55mheightlocated35kmnorthofNairobi,attheconfluenceofRuiru and Bathi Rivers.Themaincomponents ofthe projectare;

- **Dam Body:** The dam is approximately55mheightearth filldamlocated35kmnorthofNairobi,attheconfluenceofRuiru&Bathi Rivers.Themaincomponents ofthedamare. The proposed dam is a homogenous Earth fill dam (clay impervious core and trachyte shoulders and riprap) with andan average width of 250m and with a reservoir capacity of 38000 m3 constructed next to the treatment plant. The crest elevation is 1890m.a.s.l
- **Spillway:** Spillway designed is an un-gated ogee spillway centrally located. This will be expected to carry the maximum probable run off of 576m3/s
- **Intake tower & Bottom Outlet:** This shall be made of6m x 6m culvert, 65m high intake tower with 4 intakes, upstream Gate chamber with 1000mm x 1800mm rollergate and Radial Gate SCADA
- **Reservoir:** Catchment area: 131 km2, Normal water level: 1885 m.a.s.l, Reservoir surface (Normal water level): 500 000 m2, Reservoir volume (Normal water level):7,500,000m3. Operation: the reservoir will be filled during the raining seasons and used for water supply all along the year
- **Instrumentation:**Piezometers, pressure cells, settlement extensometers
- **Raw Water Gravity Main:** Length of 16.5km of raw water transfer and pipe size of 700mm pipes from the Dam intakes to the Water Treatment Plant.
- **Watertreatmentplant:** The plant is located at Ndumberi 1810m.a.s.l approximately 3km from Kiambu town along Kiambu Limuru road at the junction towards Githunguri town. TheWatertreatmentplantisbasedon sandfiltertechnology and is proposed to have a design capacity of 40 000m3/day.
- **TreatedWaterTransfer:** 5000m3 reservoir tank 2500m3 suction tank upstream Karuri pumping station and 26.6km ofwatertransferof 500mmpipeswith2terminaltankswithfeeder
- **Buffer Zone:** The dam will also be provided with a tree buffer zone all around the inundated areas spanning at least 30m from the highest water level mark. This will be in compliance with the provisions of the Water Act 2002 and the Water Rules. The buffer zone, to be planted with indigenous trees.

1.3 ESIA Terms of Reference

In accordance with the Terms of Reference (ToR), 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 and the water transmission pipeline corridor),
- 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 management and monitoring plan matrix outlaying the activities, associated impacts, mitigation measures, monitorable 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 ESIA Objectives

The objective of the study isto carry out an environmental andSocial Impact Assessment for the proposed Ruiru II dam project. In accordance with the ESIA regulations, specific objectives of the study should include the following key issues;

- A clear description of the proposed project including its objectives, design concepts, proposed water uses and anticipated environmental and social impacts.
- Description of the environment and social baseline conditions in the project areas such as to cover the physical location, environmental setting, social and economic issues,
- A description of the legal, policy and institutional framework within which the proposed dam project will be implemented,
- Description of the project alternatives and selection criteria,
- Details of the anticipated impacts to the environment, social and economic aspects of the area covered by the project.
- Appropriate mitigation and/or corrective measures,
- Develop an environmental and Social management plan (ESMP) presenting the project activities, potential impacts, mitigation actions, targets and responsibilities, associated costs and monitoring indicators

The scope of the Environmental and Social Impact Assessment (ESIA) was to develop suitable recommendations to be integrated in the project design and implementation for mitigation of anticipated adverse impacts to the environment and social setting the project and service areas. An evaluation of public opinions and stakeholders' attitude towards the project was captured through interviews. Consultative forums will be conducted throughout the project area variously during the study period. The ESIA report, therefore, is in line with the Environmental Impact Assessment and Audit Regulations of 2009 established under Environmental and Management and Coordination Act (EMCA), 1999.

1.4.1 The Approach

The ultimate goal of this approach was to identify impacts resulting from the proposed project to be determined on the basis of the baseline conditions established during the field work and information obtained from the documents reviewed. For subjective predictions of the impacts, the site area was subjected to environmental scoping process. This was a process of evaluating the significance of the project impacts and possibilities of handling the same that lead to this report.

Detailed evaluation of the project area is being undertaken to focus on any significant environmental issues.The communities living within the proposed dam coverage area wereinterviewed during consultation and participation process during the detailed study process. Among the tools that was used include questionnaires, self-writing forms, photographs, etc. Overall, the study was undertaken through the following stages:

1.4.2 Scoping Process

The project is classified as **Category A,**this was determined the proposed project components were subjected to a scoping process by the ESIA team. This involved checking the impacts of the proposed project both during construction and operation, the impacts included land acquisition leading to the resettlement of more than 200 persons and the expected impacts on the natural environment.

The Environmental Impact Assessment Regulation as outlined under the Gazette Notice No. 56 of 13th June 2003 established under the Environmental Management and Coordination Act (EMCA), 1999 was followed for the scoping process of NEMA in defining the defining the TOR for the detailed ESIA.

1.4.3 Documentary Review

The ESIA study team reviewed various relevant documents prepared for the project. This was done in order to have a clear understanding of the terms of reference, environmental status of the project area and the target river systems, data on demographic trends (for the project area, the beneficiary areas and the adjoining districts), land use practices in the affected areas (either as catchments, dam location or the beneficiary areas), development strategies and plans (local and national) as well as the policy, legal and institutional documents.Some of the documents reviewed include:

- Water Supply Master plan Report for Nairobi and Satellite towns -Egis andMangat
- Kiambu County Integrated Development Plan
- Feasibility Study Reports
- Conceptual Design Report - Vinci Construction Grands Project, Sogea Satom and Egis Eau
- Preliminary ESIA prepared for Ruiru II Water Project – Norken and Acquaclean
- Legislative frameworks in Kenya on environment and resettlement
- IFC Performance Standards
- World Bank policies

1.4.4 Field Assessment

The study involved extensive fieldwork visits to all components of the project; field assessment was designed to address the physical, social and biological environment as well as the project affected persons (PAPs). Determination of the affected environmental and social features would not only be felt within the dam area but also in the neighbouring districts (upstream, around the dammed area and downstream). The field work session was, therefore, focused on establishing the anticipated positive and negative impacts in terms of physical and biological environment i.e. (hydrology, climatic patterns and water resources related aspects), social and economic trends, (population trends, settlement trends, economic patterns, cultural setting and linkages, land ownership issues, etc. This was done through:

- Obtaining any available information and data from the local public offices including environment, water, lands and agriculture. Public consultations were also organized with the stakeholders.

- Public meetings were held on site at market centre called Kahuruku on 21st of February 2016 and follow up meeting at Kamuchege and Githunguri Location Chief Camp as well as Komothai and Ngewa Locations on 19th March 2016.

- Institutional consultations have also been on-going throughout the study. Specific institutions consulted include; Kiambu County Government, Deputy County Commissioner for Githunguri Sub County, Water Resources Management Authority (WRMA), Kiambu Water and Sanitation Company, Githunguri Water and Sanitation Company and Location Administration officers for Kamuchege, Komothai, Ngewa, Ndumberi, Karuri and Githunguri.

- Evaluatingthe environmental setting around the proposed site. General observations were focused on the topography, land use trends, surface water sources, public amenities, land cover, climate, settlements, forests, soils, etc.Evaluate social, economic and cultural settings in the entire project areas,

1.4.5 Detailed ESIA Study Activities

This assignment involved a series of activities carried out in liaison with the client, relevant government departments, local authorities, community groups and other organizations in the area with a view to sharing their experiences and information with respect to environmental resources and social aspects. Effective evaluation of the social baseline status achieved through interviews (consultative meetings and discussions) and physical inspection of the entire project area. The baseline conditions provided the starting point for the impacts predictions and benchmark for the mitigation measures.Details of the activities are listed under the terms of reference, and the outputs for each activity are outlined in the sub-sections below;

- Review of the proposed dam project details to understanding of the dam project magnitude and the overall implementation plan by the client.
- Establishment of the current baseline conditions to provide a documented

foundation for the impact predictions and a benchmark for the development of mitigation measures

- Update of the legislative and regulatory requirements as a basis for drawing a compliance monitoring protocol for the construction and commissioning phases.
- Environmental and social impacts assessments for the identification of significant impacts to the environment and the nearby communities. Types and levels of impacts as well as criteria for developing suitable mitigation measures and an environmental management plan.
- Environmental management plan on mitigation measures, responsibilities, timeframes, environmental costs and a comprehensive environmental management plan.

1.4.6 Public and Stakeholder Consultations

Interaction with the stakeholders and communities living around the project area was a continuous process at scoping, and findings of detailed ESIA study was also presented to stakeholders for their feedback. Among the interactions include informal contacts on basic inquiries and engaging local youth in the study activities.Among the formal forums undertaken were sensitization and stakeholder feedback sessions involving all levels of stakeholders, social and economic surveys at household levels and public participation forums that were open to all residents.Additional sessions involved the PAPs who were interviewed for purposes of compensation on land acquisition.**Table 3**below presents a matrix of Stakeholders consulted during the study

Table 3: Stakeholder Mapping

Primary Stakeholders		
No	**Name**	**Category**
1.	Athi Water Services Board	Project Proponent
2.	Project Affected Persons	Project Affected Persons
3.	Governor Kiambu County	County Government
4.	Members of County Assembly	
5.	County Commissioner Kiambu	National Government Administration
6.	Deputy County Commissioners from Lari and Githunguri Sub-Counties	
7.	Members of Parliament from Kiambu County	National Legislature
8.	Water Resources Management Authority	Water Regulatory Body
9.	Githunguri Water and Sanitation Company Limited	Project beneficiaries
	Kiambu Water and Sanitation Company Limited	
	Karuri Water and Sanitation Company Limited	
10.	Water Users Association	Water Users of Bathi and Ruiru Rivers
Secondary Stakeholders		
•	Coffee Drying Centre	Large Water Consumers
•	Sub-County Water Officer	National Government Agencies and Ministries
•	Physical Planning Office	
•	Public Health Officers	
•	NEMA County Officer in Kiambu	
•	Department of gender and social development	
•	Agriculture Officers – Sub-county Agriculture Officer and Sub-county Livestock Development	

Primary Stakeholders		
No	**Name**	**Category**
	Officer	
•	Sub-county Lands Registrar;	
Tertiary		
1.	Non Governmental Organizations operating in the project site	In the following sectors: • Environmental Management;Water;Rural and Community Development; Vulnerable Groups

1.5 Format and Content of the Report

The introduction in this section provides the project background, purpose and need and the scope and objectives of the ESIA. Section 2 presents a comprehensive description of the dam development together with possible development options in terms of Project design, technology and management. Section 3 gives an overview of relevant national environmental policies, legislation and environmental and social standards that are to be considered in developing the Project. As the ultimate financing institution is not yet known a brief summary of the environmental standards of international funding institutions (IFIs) is also presented.

The process of public participation is key to a successful ESIA.The approaches followedin consulting with the public and informing stakeholders and project affected people aswell as a summary of meetings held and concerns raised at these occasions is presented inSection 4. Section 5 puts the current environmental setting and environmental receptorsin the project's potential area of influence. The socio-economic baseline is covered insection 6 addressing such factors as administrative set up, demography and socioeconomicactivities, poverty, facilities and a gender analysis.A preliminary assessment of potential significant adverse impacts is presented in section7 (environment and socio-economics). This includes a discussion of possible positiveand negative impacts during construction or operation and recommendations on how toavert or mitigate any negative impacts. The main ESIA report closes with conclusionsand recommendations provided in section 9.

1.6 ESIA Study Team

The ESIA study team comprised of the following professionals:

- Tito Kodiaga; ESIA Lead Expert,
- Liya Mango Masiga –Environmental Specialist
- Maushe Kidundo-Natural Management Specialist (Ecologist)
- Musau Kimeu-Hydrologist and Dam Expert
- Kefa Abok-Valuation Expert
- Collins Nyonje-Surveyor
- Dickens Odeny-GIS and Biodiversity Specialist
- Mark Owuondo-Social Specialist and RAP Expert
- Godwin Sakwa-Environmental Specialist
- James Nginya-Social Specialist

2 PROJECT DESCRITION

2.1 Background Information

Water sourcesfor NairobiandSatelliteTownscarriedoutbyEgis/MIBP (2012).TheMasterPlancoverstheanalysis ofwater needandinfrastructuredevelopment in thewhole AWSB area.

Themainexistinginfrastructureswerebuiltbetween1900and 1994andareundersizedtoinsurethe actualandfuturewater demandof Nairobi.Existingwatersourcesandbulkingwaterfacilitiesare summarized;

- Kikuyu Springs
- Ruiru Dam
- SasumuaDam
- Thika Dam-MwaguIntakeSystem

Waterfromthe abovesourcesistreatedat3Water TreatmentPlants. Theseare:

- NgethuTreatmentWorks-460,000m^3/day(5.3m^3/s)
- Sasumua TreatmentWorks- 63,700m^3/day(0.74m^3/s)
- KabeteTreatmentWorks-20,000m^3/day(0.23m^3/s)

ThissectionoutlinesthedifferentOptionsinvestigatedfordevelopmentofWaterSupplyInfrastructure forSatelliteTownsto meettheir waterdemandsuptoYear 2035.ThreeOptions weredevelopedas possible strategiesfor augmentingwater supplytothe satellitetowns. Theseare:

Box 1: Water Supply Options for Augmenting Water to Satellite Town

- **IndependentWaterSupplyOption**:Eachsatellitetownwillhaveitsownindependentwater supplysystem.Thecurrentstatusquowillremain for operationand managementoftheWater SupplySystemsfortheSatelliteTowns.
- **StrategicBulkWaterSupplyOption**:ThefocusofWaterSupplyisNairobiCitywithofftakesfor en-route SatelliteTowns. Satellite Towns downstream of Nairobi City Water Supply willbe suppliedthroughextensionsfrom theNairobiWaterSupplySystem.A Bulk WaterProvidercanbe appointedunderthis Optiontherebyreducingtheoperationandmanagement costs.
- **Mixed Water Supply Option**: Thisis ahybridof theIndependent andStrategic Bulk Supply Option.TheSatelliteTownswillbesuppliedfromacombinationofIndependentWaterSources andfromtheNairobiCityBulkWaterSupply.Thisoptionwillbemanagedpartiallybyabulk WaterProviderandIndependent ServiceProviders.

The overalltheresults ofthe leastcostanalysisclearlyshowthatthemixedsupplyoptionisthe most favourable.TheRuiru IIdamis partof thisoption.

2.2 Project Overview

2.2.1 Components of Ruiru II Water Supply Project

ThemaincomponentsoftheRuiru IIWater Supply Projectaresummarized below;

Table 2: Ruiru II Dam Water Project Components

Dam:55m-heightearth filldamlocated35kmnorthofNairobi,attheconfluenceofRuiruandBathi rivers.Themaincomponents ofthedamare	
Dambody	▪ Height:55m ▪ Crestlength:250m ▪ Clayimpervioussore ▪ Trachyteshouldersandriprap ▪ Crestelevation:1890
Spillway	▪ Ogee crest open channel ▪ Stilling basin ▪ QPMF = 956 m3/s
Intake Tower and Bottom Outlet	▪ 6m x 6m culvert ▪ 65m high intake tower with 4 intakes ▪ Upstream gate chamber with 1000mm x1800mm roller gate and radial gate ▪ SCADA
Reservoir	▪ Catchment area: 131 km2 ▪ Normal water level: 1885 masl ▪ Reservoir surface (Normal water level): 500 000 m2 ▪ Reservoir volume (Normal water level): 7 500 000 m3 ▪ Operation: the reservoir will be filled during the raining seasons andused for water supply all along the year
Instrumentation	▪ Piezometers, pressure cells, settlement extensometers
Raw Water Gravity Main:	▪ Length 16.5km of Raw water transfer ▪ Pipe size 700mm pipes from the Dam intakes to the Water Treatment Plant
WaterTreatmentPlant	▪ The plant is located at Ndumberi 1810m.a.s.l approximately 3km from Kiambu town along Kiambu-Limuru road at the junction towards Githunguri town. ▪ TheWatertreatmentplantisbasedon sandfiltertechnology and is proposed to have a design capacity of 40 000m3/day. ▪ The water treatment plant shall included - Cascade aeration - Pre chlorination with calcium hypo chlorite - Dosing with sodium carbonate (Soda Ash) to adjust pH - Dosing with Aluminium Sulphate (coagulant aid) - Dosing with polyelectrolyte (flocculent aid when

	needed) - Clarification - Rapid gravity filtration - Disinfection with hypochlorite - Dosing with sodium carbonate (Soda Ash) to adjust pH ▪ Sludge treatment and disposal - Water recovery tank (receives sludge from clarifiers and filters) - Sludge drying beds
TreatedWaterTransfer:	▪ 5000m3 reservoir tank 2500m3 suction tank upstream Karuri pumping station ▪ 26.6km ofwatertransfer 500mmpipeswith2terminaltankswithfeeder.

2.3 Project Location

TheforecastedRuiruII damsiteislocated immediatelydownstream ofRuiruand Bathi riverconfluence approximatelyatSurveyof KenyacoordinatesN9885613;E252735.Thedamislocatedapproximately35 kmfromNairobi intheNorth Westregion.

Figure 1. Map of Project Location

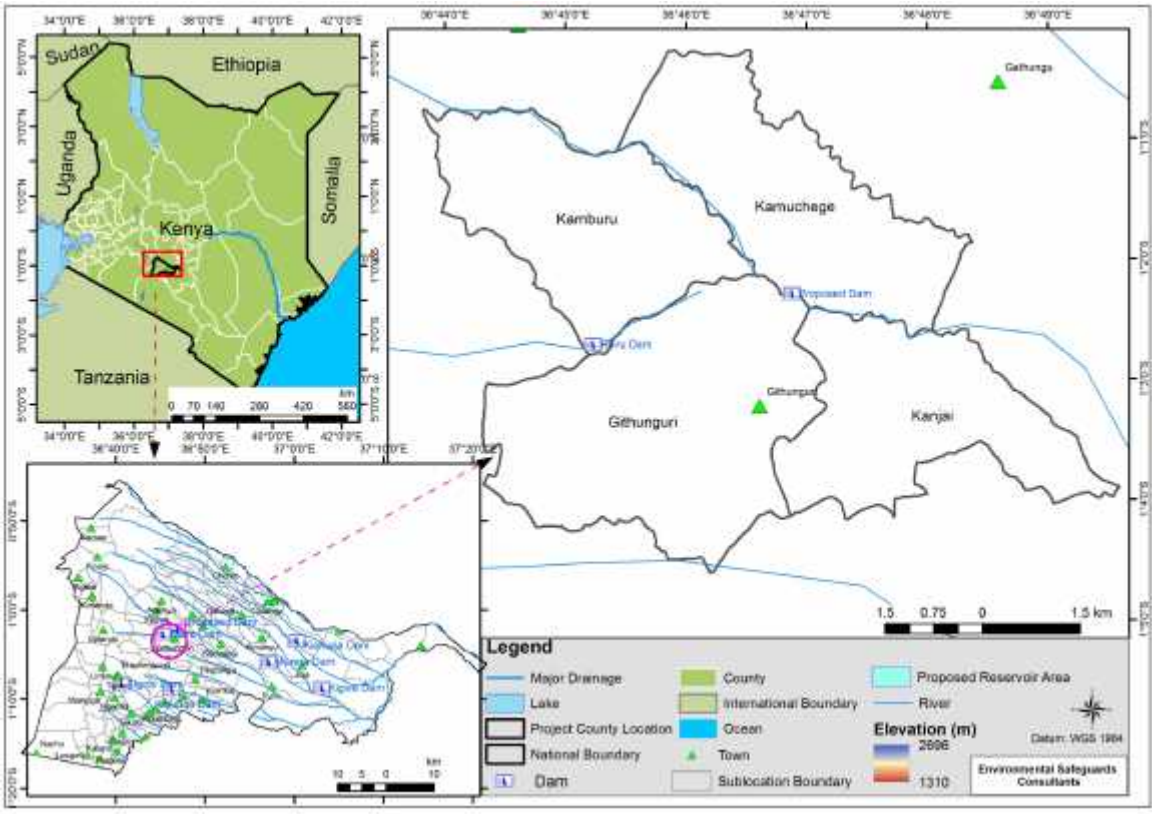

Sudan
Ethiopia
Uganda
Somalia
Kenya
Tanzania
Kamburu
Kamuchege
Githunguri
Kanjai
Githunga
1.5 0.75 0 1.5 km
Legend
Major Drainage
Lake
Project County Location
National Boundary
Dam
County
International Boundary
Ocean
Town
Sublocation Boundary
Proposed Reservoir Area
River
Elevation (m)
2696
1310
Datum: WGS 1984
Environmental Safeguards Consultants

Figure 2. Map of Project Location

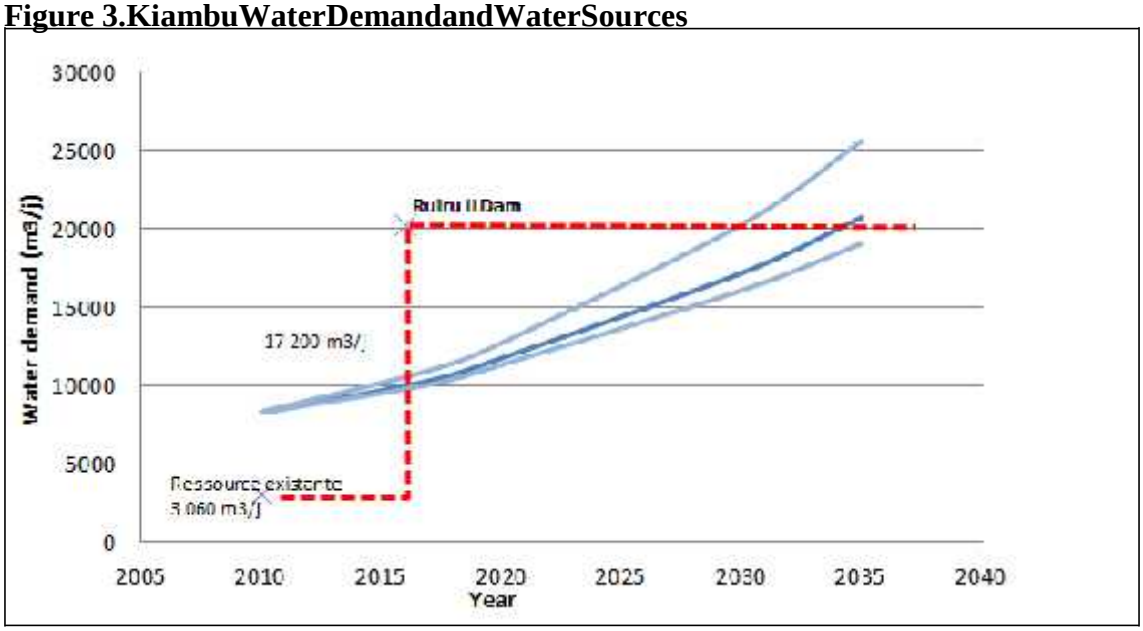
2.4 Project Justification

Inthe Master Plan Study,the year 2030 water demand forKaruri townwas estimatedto be22,900m3/dayand for Kiambu town 17,200m3/d. The present supplies to the twotowns are2,762m3/dayand 3,290m3/dayrespectively.**Table 5**below givesthewater demandandsupply situationinthetwo towns.Thisisexpected to meetthe forecast year 2030 water demand for the two towns.Thesize ofthe damand itsreservoir shall beadapted to meet thosewater demand requirements.

Table 5: WaterDemandand Supply-KiambuandKaruriTowns

Town	PresentWaterSources		Present WaterDemand, m3/d	Year 2030 Water Demand, m3/d
	Source	**Capacity**		
Karuri	Groundwater	1,667	12,700	22,800
	NCWSC(Sasumua)	1,100		
	Total	**2,767**		
Kiambu	Groundwater	3060	9700	17,200
	NCWSC(Ng'ethu)	230		
	Total	**3290**		
Total Water Supply		**6057**	**22,400**	**40,000**

Figure 3.KiambuWaterDemandandWaterSources



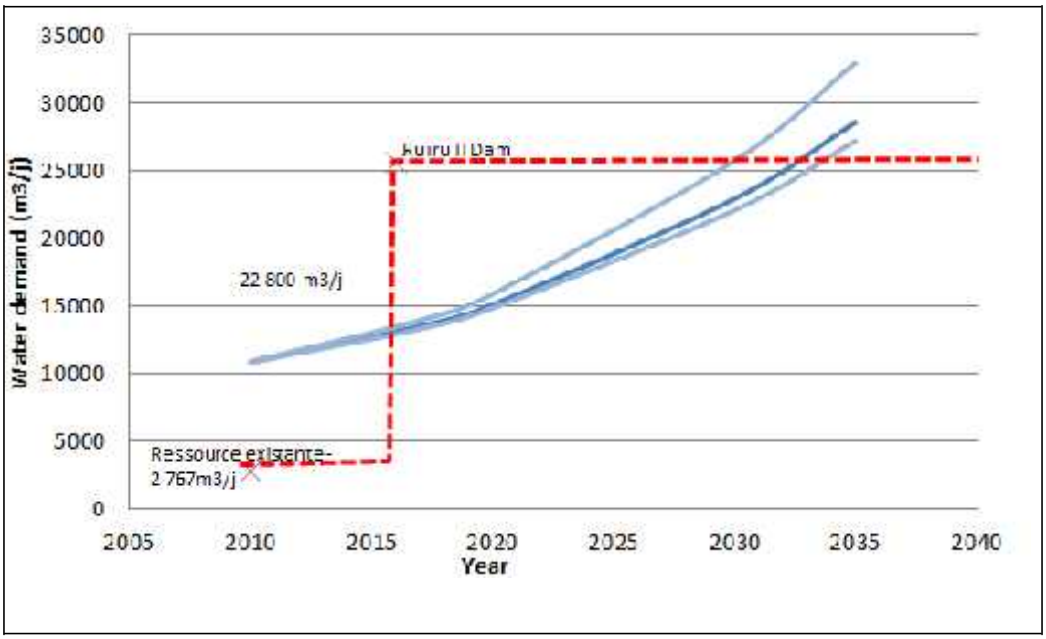


Figure4:KaruriWaterDemandandWaterSource

2.5 Dam Description

Thefollowingdescriptionisgivenaccordingtoconceptual designperformedduringtenderprocess.Dimensions, lengths,orthepositioningofparticular structures,technical characteristicof equipment, can be subject to change for adaptationtoparticular site conditions, contractor detailedconstruction studiesand contractormethodsof construction.Thefinaldamdesign willbe performedduringthefirststage of thebuilding,designandbuildcontract.

2.5.1 Overview

TheRuiruIIDamislocatedonRuiruRiverabout3kmdownstreamofRuiruIDam.Thecatchment areaof thedamis131km^2.Theprojecteddamisan earth fill damof55mhigh.Keycomponentsoftheproposed damwillinclude:

- Animperviouscoremade of clayishmaterial
- Shoulderzones upstreamanddownstreamofthecore
- Filteranddrainagelayers
- Substratumgrouting
- Spillway
- Towerwaterintakeandculvert

2.5.2 Hydrological Design

Atthisstage, apreliminaryhydrologicaldesignpermits tosizethedamheight.Theresults of the hydrological designshowthata netdamheight of50mmeetswith theprojectrequirementof 43,956m^3/dayatsupplyreliabilitiesgreaterthan 90%.Therefore,consideringafreeboard of5m,thedam heightshouldbeatleast55m.

2.5.3 Geological and Geotechnical Dam Design

Main Geotechnical dam data

Box 2: Below presents the main geotechnical information determined for the identified site.

Box 2: Geotechnical Dam Design Data

RuiruIIRock fillDam data Sheet

- Type Rockfill/earthfilldam withan inclinedclay core
- Foundation rock..... Tvtf2(Kerichwa Tufs)/ Plh1 (LimuruTrachyte's)
- Maximum height (including stripping depth) 55m
- Crest length 256m
- Crest width 12m
- Maximal width at the bottom 260m
- Upstream slope..... 2.5 H/1V
- Downstream slope..... 2 H/1V
- Crest elevation..... 1890 mSL
- Total volume of the dam body..... 920 000m3
- Clay core..... 65 000m3
- Weathered soil..... 72 000m3
- Riprap..... 20 000m3
- Shoulder..... 606 000m3
- Filters & drain..... 157 000m3

2.5.4 Sourcing of Materials – Earthwork Hauling

CoreZone: Redsoilsavailable onsitearesuitableforcorezone.Accordingtotheavailable data,the maximum distancetoprovidethedamwithclayisestimated less than1km.

ShoulderZone:
Shoulderzonecanbemadeofthetransitionlayerbetweentheredclaysoilsandtherock,orfrom therockitself. Ifhardtuffs arenotfoundundertheclays,manysmallquarriesafewkilometresfrom thedamcanprovideit.Theavailabilityofthematerialatamaximumdistanceof3kmlooksa cautious assumptionatthisstage.

RipRapandFilterMaterial: Ruirudamtrachytesarefoundinthetail ofthereservoir area ontheRuiruRiver.Theyare knownto behave quitesimilarly as NairobiTrachytes that are used for aggregates (even as concrete aggregates).Acliffaround8misvisible.Twowaterfallsaround5mhighwerealsofound.Distance todamsiteislessthan3km.Somelaboratorytestshavebeencarriedoutonsamplescollectedjust after thesitevisittocheckif this rockis adequateforRipRap andfiltermaterial.

2.5.5 Main Annexes and Building Description

Thecivilcomponentsofthedamaresummarizedbelow.

Table 6: Summary of Dam Civil Components

Summary of Dam Civil Components	
Diversion channel	
Type	DiversionConduitandcofferdams
Designdischarge	Up to the1:50yearsflood(50m^3/s)
Bottom outlet	
Type	Outletincorporatedinrockfilldam
Elevation/ slope	1837m(upstreamside)/slope: 0.0055
Dimension(hydraulic section)	6x2.6
Gate	Radial
Maximumreleaseddischarge	Rapidreservoirdraw down: 18m^3/s
Water Intake	
Type	Tower intakewith4gatevalves
Dimensions	Octagonaltower: 8x8x61m
Spillway	
Type	Creage
Location	Right
Dimension	Total lengthfor concretepart:342m
Maximumreleaseddischarge(probable maximumflood)	995m^3/s

Figure5: 3DviewofCofferdam,diversionculvert,bottomoutletandfoundationofintaketower

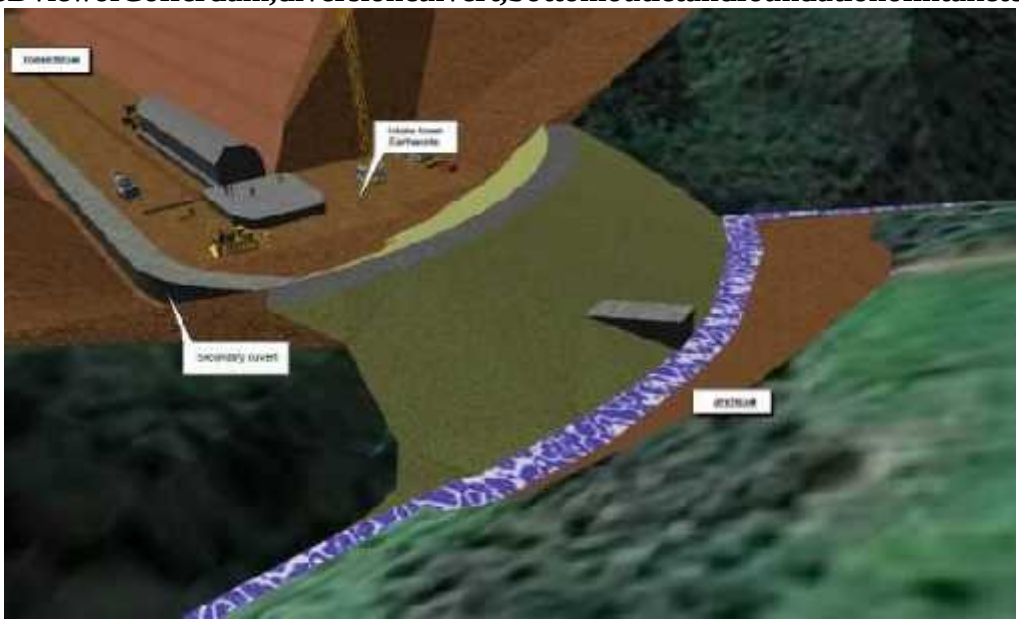
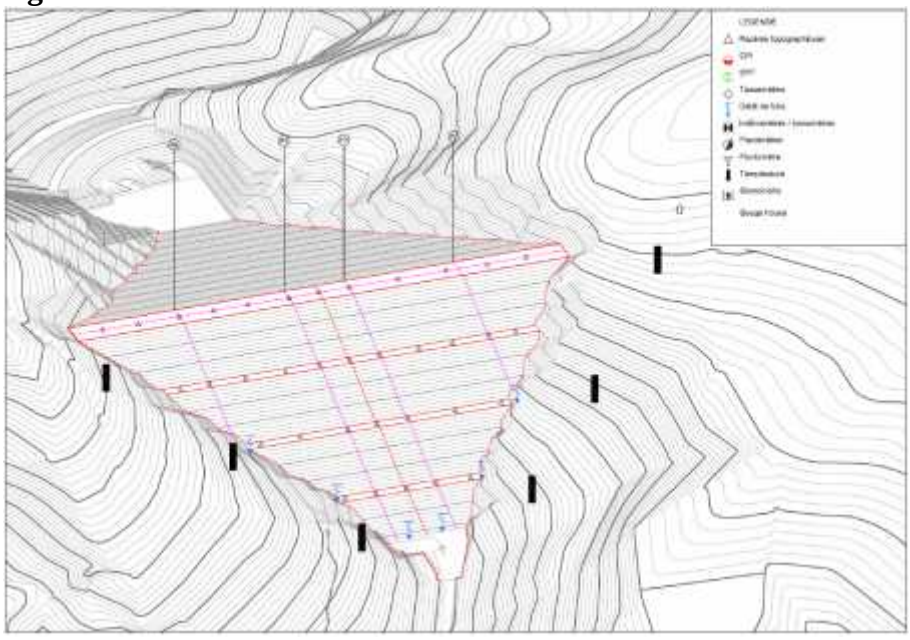


Figure6:3DViewofthespillway

The construction of the dam, fillingandlife of thedam,the behaviour of the dam willbe closely monitored with a widerange of instrumentation:inclinometers,piezometers,porepressure measurements,totalstresscells,settlementcellandtopographicmeasurements.Themainfeature of theproposed instrumentationprogramisgiven hereafter.

Figure7:DamInstrumentation–IsometricView

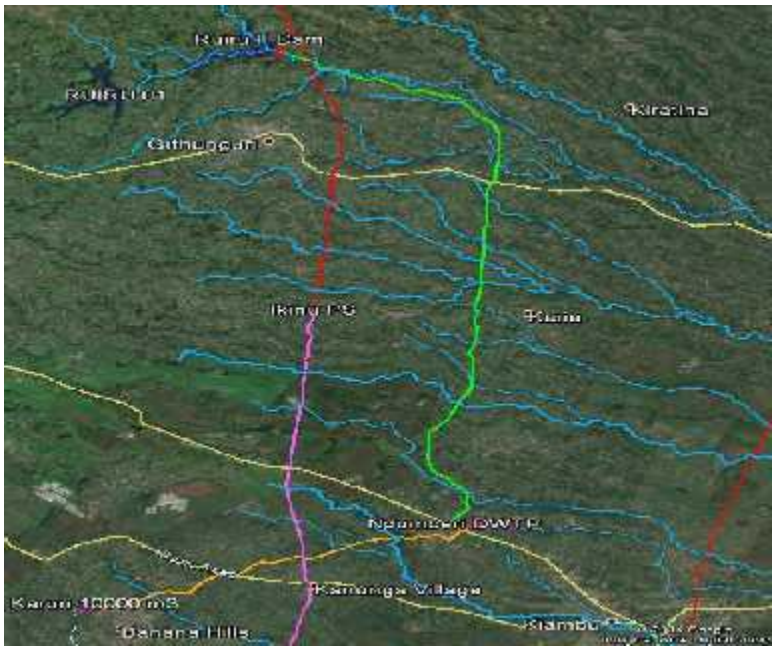


2.6 Raw Water Transfer

The watertransmissionrouteandspecifications have been derived from theconceptualprojectlayout plan. The rawwaterwillbetransferredfrom thedamtotheWaterTreatmentPlantlocatedatNdumberi3kmnorth ofKiambu.Therawwater transferwillbedonewithductileironpipesDN700andPN16.Thetotallengthofthetransferwillbe16.5 km.Theexactpiperoutehas been identified and shape file produced, theraw watertransmission main willfollowtheRuiruRivervalleyoverapproximately4kminSouth-eastern direction,beforechangingtoSouth inordertoreachNdumberi town as straightas possible from Ting'ang'a shopping centre along Kiambu Githunguri road.

The pipeline will traverse severalvalleysand cross twomainriverscalledMukuyuandtheKamitirivers.
Themainriversandtheirtributarieswillbepassed throughinarealmanner on metallicbridges oronpiersfollowingthetopographicencounteredsite conditions. Piperoutewill followas muchaspossibleexistingtracksandroadreserves.Theground slopes over25%willbealsoavoided asmuch as possible. Theroughplanviewofpiperouteis shownonthefollowing**Figure 8** below.

Figure8:RawWaterGravityMainingreen,TreatedWaterPumpingMaininorange



2.7 Water Treatment Plant

The proposedwatertreatment workssiteisat Ndumberi, which isapproximately 3km North ofKiambu.

Figure 9: Water Treatment Plant in blue square box at Ndumberi

Thewatertreatment process proposed shall compriseof thefollowing;

- CascadeAeration
- Pre-chlorinationwithcalciumhypochlorite
- Dosingwith SodiumCarbonate (Soda Ash),toadjustthepH
- Dosingwith aluminiumsulphate (alum),as coagulantaid,
- DosingwithPolyelectrolyte, asflocculentaid (when necessary)
- Clarification
- RapidGravityFiltration
- Disinfectionwithcalciumhypochlorite
- Dosingwith SodiumCarbonate (Soda Ash),toadjustthepH forcorrosioncontrol

Sludgetreatmentanddisposal process comprisesof thefollowing:

- Waterrecoverytank- ToreceiveSludgefromClarifiers andfilters
- Sludge DryingBeds

Thetreatedwater shall complywith theguidelines valuesdefinedinthe"*GuidelinesforDrinkingWaterqualityRecommendations*"oftheWorld Health Organization(WHO)1984.Further, a5000m^3reservoirtank willbebuiltinthecompoundoftheWatertreatmentto distribute watertoKiambutownthroughgravitydistributionpipes, which currently exist.

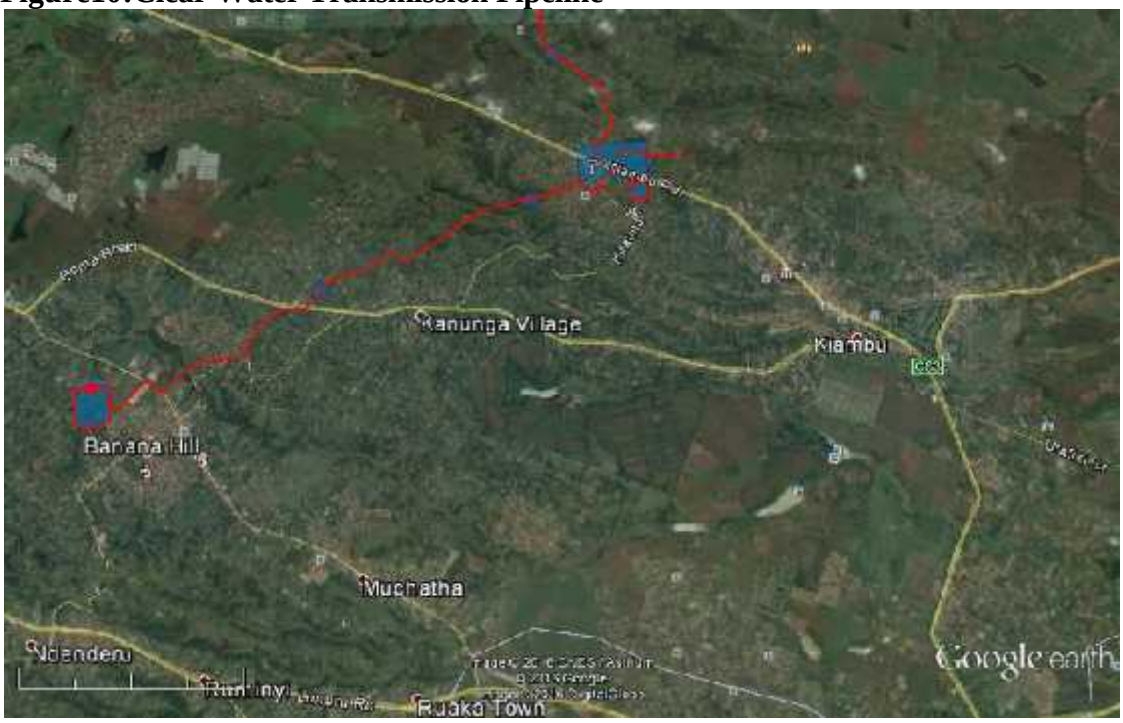
2.8 Treated Water Transfer and Reservoirs

Thetreatedwatertransfer system shall involve transfer of treated water from the treatment plant to the storage reservoir locatedin Karura town onGashorue hill. The elevation at the reservoir tank in Karuri is 1921 m.a.s.l while the elevation at the Water Treatment Plant in Ndumberi is approximately 1810 m.a.s.l, therefore this implies that the clear water

shall be pumped fromthe Water Treatment Plantandtransferthrougha DN500iron ductile pipe.

Thetotallength ofthistransferis2km, the pipe routewillcrossthe mainroadat NdumberiWater Treatment Plantexitand gothroughan urban area uptotheeasterntop side ofRiaraValley.The pipeswill beinstalled onspan metallic bridge overRiaraRiver.The other smallerriverswill becrossedthrough protectivesleeves ortrenchedif ground geologyallows. The piperoutewill followas muchas possibleexistingtracksand roadreserves.The groundslopes over25%will beavoidedas muchas possible.**Figure 10** below shows the clear water transmission pipeline from Water Treatment Plant at Ndumberi to the planned reservoir tank in Karuri. The tanks are designed to be a 10000m³reservoirsbuildinKaruriinconcretetostorehalfdayofthefinalwater demand.

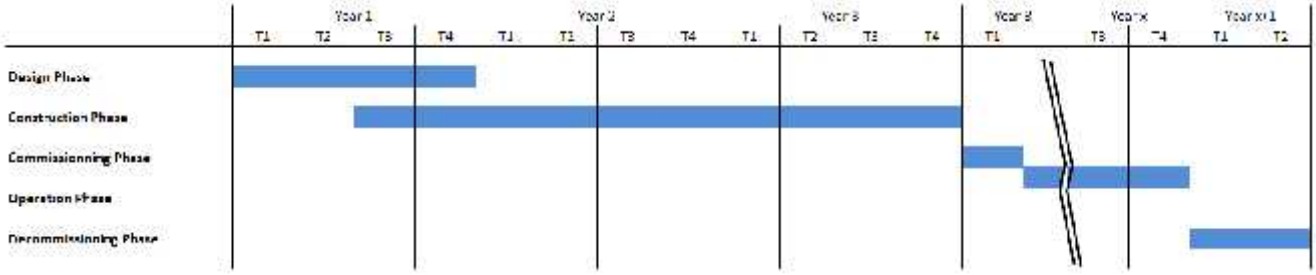
Figure10:Clear Water Transmission Pipeline



2.9 Project Implementation Schedule

Theoverall projectimplementationis expected to be 3years as shown inthe followingschedule:

Figure 11: Indicative Project Implementation Schedules derived from the conceptual design



2.10 Project Cost Estimate

Basedonthefinancialoffersreceivedfromdesignerandcontractorsduringthebiddingprocess,theConstructionCostoftheprojectisestimated at**6,707,522,035**Kenya Shillings/**USD67,075,220.35**.This range ofpriceincludes:

- Site investigation,
- Dam construction (preliminaries and general, embankment, spillway, intake, grouting)
- Pipelines construction
- Water Treatment Plant construction

Table 7: Estimated Project Cost

No.	Description	Amount (USD)
1	**Ruiru Dam and Ancillary Works**	
	Embankment	15,823,453.45
	Spillway	10,090,826.29
	Intake culvert and tower	11,778,882.29
	Roads and parking	1,814,911.46
2	**Raw and Treated Water Pipelines**	14,130,960.52
3	**Water Treatment Plant**	13,436,186.34
TOTAL		**(USD)67,075,220.35**

3 POLICY LEGAL AND INSTITUTIONAL FRAMEWORK

The following chapter provides the relevant policy, legal and institutional framework governing the upstream component. The ESIA was carried within the Kenyan legislative and regulatory framework and in line with the IFC Performance Standards on Environmental and Social Sustainability (2012) and IFC's General Environmental, Health and Safety (EHS) Guidelines (2007), World Bank safeguards policies.

3.1 Context

Kenya has undergone regulatory reforms over the past two decades, culminating in the enactment of a new constitution in 2010 replacing that of 1969. This has in turn driven new policies and strategies relating amongst others to environmental management and conservation (including Environmental Impact Assessments), and more generally to the water sector.

The new constitution establishes the structure of the Kenyan government, the Bill of Rights, and provides the basic and comprehensive principles for environmental protection and management in the country. Under Chapter 5 (Part 1) of the constitution (Land and Environment), it requires that land be used and managed in *"a manner that is equitable, efficient, productive and sustainable, and in accordance with the following principles: (a) equitable access to land; (b) security of land rights; (c) sustainable and productive management of land resources; (d) transparent and cost effective administration of land; (e) sound conservation and protection of ecologically sensitive areas; (f) elimination of gender discrimination in law, customs and practices related to land and property in land; and (g) encouragement of communities to settle land disputes through recognised local community initiatives consistent with this constitution".* Furthermore, Part 2 of Chapter 5 is dedicated to environment and natural resource utilisation, management and conservation, with reference to the establishment of EIA, environmental audit and monitoring of the environment.

The constitution also stipulates that all minerals and mineral oils shall be vested in the national government in trust for the people of Kenya. The constitution also specifies the devolution of powers from the central government to the newly established 47 Counties. County governments are in charge of planning and development among other services, and can enact legislation with possible implications to planned and current projects. Other recent reforms include the establishment of key administrative and legislative organisations that regulate water sector development in Kenya.

3.2 Governance and Administrative Structure

The following key administrative agencies regulate water and sanitation development and its environmental implications in Kenya and have a key role in the EIA authorisation process:

3.2.1 *Ministry of Environment, Natural Resources and Regional Development Authorities*

The Ministry of Environment and Natural Resources (MENR) mission statement and key objective is to facilitate good governance in the protection, restoration, conservation, development and management of the environment and natural resources for equitable and sustainable development.

3.2.2 *Ministry of Water and Irrigation*

The Ministry of Water and Irrigation (MWI) mission statement is to contribute to national development by promoting and supporting integrated water resource management to enhance water availability and accessibility. The MWI has the following technical departments: Water Services, Water Resources, Water Storage and Land Reclamation, and Irrigation and Drainage.

3.2.3 *National Environment Management Authority*

NEMA is the administrative body that is responsible for the coordination of the various environmental management activities in Kenya. NEMA is also the principal government authority for implementing all environmental policies. NEMA is also responsible for granting EIA approvals and for monitoring and assessing activities in order to ensure that the environment is not degraded by such project activities.

3.2.4 *Water Resources Management Authority*

WRMA is a state corporation, established under the Water Act 2002 and charged with being the lead agency in water resources management. Among other functions, WRMA is responsible for issuing permits for water use.

3.2.5 *Water Services Regulatory Board (WASREB)*

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

- 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.

3.2.6 *Water Services Trust Fund (WSTF)*

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

- 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 services

3.2.7 Water Services Boards

The WSBs are responsible for the efficient and economical provision of water and sewerage services in their areas of jurisdiction.Under the Act they are 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;
- Appointing and contracting Water Service Provider
- Asset holding of Central Government facilities

3.2.8 Water Services Providers

Water Service Providers are the utilities or water companies. They are state owned but have been commercialized to improve performance and run like business within a context of efficiency, operational and financial autonomy, accountability and strategic, but minor investment. Under this project relevant Water Services Providers are Kiambu Water and Sewerage Company and Karuri Water and Sanitation Company.

3.2.9 Other Government Agencies

Relevant government agencies to the Project at the national level include:

- Kenya Forest Services;
- Kenyan Wildlife Services;
- National Land Commission;

Table 8, 9 and 10below provide a summary of Kenyan legislation and policy documents respectively, which are applicable to the ESIA.

Table 8: Key Kenyan Policy Documents

Policy	Description
■ The National Water Policy (2012)	The National Water Policy includes details of the national government's policies and plans for the mobilisation, enhancement and deployment of financial, administrative and technical resources for the management and use of water resources.
■ The Wildlife Policy (2012)	The Wildlife Policy makes provision for an overarching framework for the prudent and sustainable conservation, protection and management of wildlife and wildlife resources in Kenya, with incidental provision on access and the fair and equitable distribution of

Policy	Description
	benefits accruing there-from, and its alignment with other sector-specific laws and the environment policy.
Kenya Vision 2030 (2010)	Kenya Vision 2010 is a national long-term development blue-print to create a globally competitive and prosperous nation with a high quality of life by 2030. The vision is anchored on three key pillars; economic, social and political governance.
National Land Policy (2009)	The Policy was a key component towards addressing questions in the previous regulatory framework and contained the vision to provide Kenyans with "sustainable and equitable" access to and use of land.

Table 9: Relevant National Legislation

Name of Legislation	Description	Relevance to Project
Environmental Management and Coordination Act (EMCA) (1999) and Amendments (2013), and the subsidiary Regulations notably:	The EMCA and its subsidiary regulations set out requirements and procedures for conducting EIAs, auditing and environmental monitoring in Kenya. Furthermore, they establish environmental standards for water quality, noise, fossil fuel emission, and waste management. It also regulates activities impacting wetlands, riverbanks, lake/sea shores, and the conservation of biological diversity.	According to the second schedule of EMCA, the construction of a dam requires a full ESIA study in order to determine the adverse impacts. The proponent has complied with this requirement by preparing ESIA report for the same.
The EMCA (Impact Assessment and Audit) Regulations (EIAAR) (2003)	These Regulations contain rules relative to the content and procedures of an EIA, to environmental audit and to monitoring and strategic environmental assessment. These rules regulate other matters such as the appeal for, and registration of, information regarding EIA.	According to the second schedule of EMCA, the construction of a dam requires a full ESIA study in order to determine the adverse impacts. The proponent has complied with this requirement by preparing ESIA report for the same. The ESIA report has been prepared in accordance with the EIA/EA regulations
The EMCA (Wetlands, River Banks, Lake Shores and Sea Shore Management Plan) Regulations (2009)	These Regulations require the protection of wetlands, riverbanks, lakeshore and sea shore areas which provide ecological habitats.	The project is implemented along a river and hence the regulation is relevant. The proponent has taken measures to ensure that the ecology of

Name of Legislation	Description	Relevance to Project
		the river will be protected by adopting adequate mitigation measures
The EMCA-(Fossil Fuel Emission Control) Regulations (2006)	These Regulations set emission standards for internal combustion engines, provide for the licensing of persons responsible for treating fuel, provide for the appointment of environmental inspectors required to inspect emissions, and authorise the NEMA to enter into partnerships in order to conduct emission inspections.	During construction, there will be use of machinery which utilise fossil fuel. In keeping with this regulation, the proponent will ensure that all machinery are frequently serviced and maintained to keep with the emission standards as per the regulation
The EMCA (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations (2006)	These regulations ensure that activities do not have an adverse impact on any ecosystem.	The project is implemented along a river and hence the regulation is relevant. The proponent has taken measures to ensure that the ecology of the river will be protected by adopting adequate mitigation measures
The EMCA (Water Quality) Regulations (2006)	These Regulations outline the water quality standards that should be met for different uses including effluent discharge. The following schedules in the Water Quality Regulation set out the relevant standards and monitoring requirements: First Schedule: Quality Standards for Sources of Domestic Water; Second Schedule: Quality Monitoring for Sources of Domestic Water; Third Schedule: Standards for Effluent Discharge into the Environment; Fourth Schedule: Monitoring Guide for Discharge into the Environment; Fifth Schedule: Standards for Effluent Discharge into Public Sewers; and Sixth Schedule: Monitoring for Discharge of Treated	The project is expected to distribute water to the local communities. Proponent must adhere to water quality standards. Water effluent standards will adhered to in the campsites

Name of Legislation	Description	Relevance to Project
	Effluent into the Environment. The Water Resource Management Authority and NEMA are key administering authorities.	
The EMCA (Noise and Excessive Vibration Pollution) Control Regulations (2009)	This regulation establishes environmental standards that should be met for noise. NEMA is a key administering authority. The following schedules in the Noise and Excessive Vibration Pollution Control Regulation set out the relevant standards and monitoring requirements: First Schedule – Maximum Permissible Intrusive Noise Levels. Second Schedule – Maximum Permissible Noise Levels for Construction Sites. Third Schedule – Maximum Permissible Noise Levels for Mines and Quarries. Fourth Schedule– Application for a License to Emit Noise/Vibrations in Excess of Permissible Levels. Fifth Schedule–License to Emit Noise/ Vibrations in Excess of Permissible Levels. Sixth Schedule – Application for a Permit to Carry out Activities. Seventh Schedule - Permit to Emit Noise in Excess. Eighth Schedule - Minimum Requirements for Strategic Noise and Excessive Vibrations Mapping. Ninth Schedule – Minimum Requirements for Action Plans. Tenth Schedule – Improvement Notice.	During construction, noise and vibration impacts will be generated by heavy equipment and machinery. Similarly, there is likelihood of blasting to obtain construction material in quarries. The proponent will have to adhere with the said regulations in order to keep with the law and ensure compliance.
The EMCA (Waste Management) Regulations (2006)	These Regulations set rules for general waste management and for the management of solid waste, industrial waste,	Proponent will have to adhere to these regulations because of the fact that during construction, hazardous wastes

Name of Legislation	Description	Relevance to Project
	hazardous waste, biomedical waste, radioactive waste, pesticides and toxic waste. These Regulations prohibit the pollution of public places, provide for the granting of licences for waste transportation and waste disposal facilities, and require an EIA to be undertaken on any site disposing of or generating biomedical waste.	will be generated and will require disposal in accordance with the regulations.
The Water Act, (2002) and subsidiary legislation contained including the Water Resource Management Rules (2007)	This Act provides for the management, conservation, use and control of water resources and for the acquisition and regulation of rights to use water; to provide for the regulation and management of water supply and sewerage services. The Rules implement the Act.	The proponent will need to get a WRMA permit for water abstraction
The Wildlife Conservation and Management Act (WCMA) (2013)	An Act of Parliament to provide for the protection, conservation, sustainable use and management of wildlife in Kenya and for connected purposes. It also regulates wildlife conservation and management in Kenya, through the protection of endangered and threatened ecosystems. Specifically, it prohibits the disturbance or harm of flora and fauna within public places, community and private land, and Kenyan territorial waters. The Act also establishes Kenya Wildlife Service (KWS) as the implementing agency.	The project area is not considered a protected area and hence this legislation does not apply. However, in the event that wild animal colonise the dam (e.g. hippos and crocodiles) which is mostly the case, then the proponent will adhere to the legislation with respect to protection of the wildlife and the habitat. Any critically endangered, vulnerable, nearly threatened or protected species found within the project area will have to be managed in line with this Act. The project is not located in a wildlife sensitive area. However, in the whole lifecycle of the project actions the Proponent will ensure as much as possible not to jeopardize the wellbeing of wildlife, (if any) which are

Name of Legislation	Description	Relevance to Project
		one of Kenya's greatest heritage. Failure of which will attract the consequences enumerated in section 56 of the Act which include a fine not exceeding forty thousand shillings
The National Museums and Heritage Act (2006)	An Act of Parliament to consolidate the law relating to national museums and heritage; to provide for the establishment, control, management and development of national museums and the identification, protection, conservation and transmission of the cultural and natural heritage of Kenya. The Act also establishes a notification of discovery requirement, and sets restrictions on moving objects of archaeological or paleontological interest.	This legislation is not applicable since there are no know heritage sites in the area. However, due to the possibility of chancing on such sites, the proponent has prepared a sample chance find procedure that will be used in such eventualities.
Physical Planning Act (2012)	An Act of Parliament to provide for the preparation and implementation of physical development plans and for connected purposes.	The proponent will be required to obtain the necessary permits related to planning for the dam and other infrastructures like camp sites etc.
Occupational Health and Safety Act (2007), and subsidiary legislations and rules.	An Act of Parliament to provide for the safety, health and welfare of workers and all persons lawfully present at workplaces, to provide for the establishment of the National Council for Occupational Safety and Health and for connected purposes. This Act includes requirements for the control of air pollution, noise and vibration in every workplace where the level of sound energy or vibration emitted can result in hearing impairment, be harmful to health or otherwise dangerous.	The proponent will have to adhere to this legislation due to the fact that there will be employment of personnel for construction and operation and hence need to observe this law. The proponent should appoint a reputable contractor who will be responsible for enforcing the requirements during construction and subsequent repairs and maintenance after project completion. They should make provision for the health, safety and

Name of Legislation	Description	Relevance to Project
		welfare of persons employed in construction activities and other places of work. Ensure that every work place shall be kept in a clean state and free from effluvia, arising from any drain, sanitary convenience or nuisance. Avail fire extinguishers, which shall be adequate and suitable in case of fire out breaks. Provide adequate means of escape in case of fire outbreak for the employees. Ensure construction workers are in any process involving exposure to wet or to any injurious or offensive substance wear suitable protective clothing.
Factories and Other Places of Work (Noise Prevention and Control) Rules, 2005	These rules require that where the noise level is above ninety dB(A), the employer shall post conspicuous signs reminding employees that hearing protection must be worn, supply hearing protection and ensure all employees wear hearing protection.	The proponent will have to adhere to this legislation due to the fact that there will be employment of personnel for construction and operation and hence need to observe this law.
Prevention, Protection and Assistance to Internal Displaced Persons and Affected Community Acts (2012)	An Act of Parliament on internal displacement in Kenya that includes vital provisions to secure the participation of displaced people in decision-making that affects them.	A Resettlement Action Plan report has been prepared to compensate for impacts associated with displacement. The communities in the area are not internally displaced and they will not be evicted.
Agriculture, Fisheries and Food Authority Act (2013)	The Agriculture, Fisheries and Food Authority Act consolidate the laws on the regulation and promotion of agriculture and makes provision for the respective roles of the national and county governments in agriculture and related matters.	The rivers where the dam will be constructed has fish resources and therefore the proponent will observe this law with respect to protection of fisheries resources
Traffic Act (2014)	The Traffic Act relates to traffic on all public roads.	The proponent is expected to use the public roads during construction and will have an obligation to adhere to the

Name of Legislation	Description	Relevance to Project
		relevant act at all times as provided by this law.
Kenya Roads Act (2007)	An Act of Parliament to provide for the establishment of the Kenya National Highways Authority, the Kenya Urban Roads Authority and the Kenya Rural Roads Authority, to provide for the powers and functions of the authorities and for connected purposes.	The proponent is expected to use the public roads during construction and will have an obligation to adhere to the relevant act at all times as provided by this law.
The Land Act 2012 Laws of Kenya	It is the substantive law governing land in Kenya and provides legal regime over administration of public and private lands. It also provides for the acquisition of land for public benefit. The government has the powers under this Act to acquire land for projects, which are intended to benefit the general public. The projects requiring resettlement are under the provision of this Act.	The project will displace local communities from their private land and will follow the laws stipulated for land acquisition in the process of acquiring the land.
Land Registration Act, 2012	The law provides for the registration of absolute proprietorship interests over land (exclusive rights) that has been adjudicated or any other leasehold ownership interest on the land. Such land can be acquired by the state under the Land Act 2012 in the project area.	The project will displace local communities from their private land and will follow the laws stipulated for land acquisition in the process of acquiring the land.
National Land Commission Act 2012	The act establishes the National Land Commission with the purpose of managing public land and carrying out compulsory acquisition of land for specified public purposes.	The project will displace local communities from their private land and will follow the laws stipulated for land acquisition in the process of acquiring the land.
The Land Adjudication Act Chapter 95 Laws of Kenya	Provides for ascertainment of interests prior to land registrations under the Land Registration Act 2012 through an adjudication committee that works in liaison with	The project will displace local communities from their private land and will follow the laws stipulated for land acquisition in the process of acquiring the land.

Name of Legislation	Description	Relevance to Project
	adjudication officers.	

Draft legislation and guidelines, which are expected to be relevant to this study, are provided in **Table 10.**

Table 10: Draft Legislation and Guidelines

Name of Legislation	Description
■ The Water Bill, 2014	The Water Bill provides for the regulation, management and development of water resources and water and sewerage services in line with the constitution. The Bill will provide for the repeal of the Water Act, 2002.
■ The Forest Conservation and Management Bill, 2014	The Bill provides for the declaration and management of forest areas and for the protection of such areas by establishing management boards to regulate all activities in such areas.
■ Draft Community Land Bill (2013)	The draft bill provides a legislative framework to give effect to Article 63 of the Constitution and makes provision for the recognition, protection, management and administration of community land. The proposed legislation allows a community to register ownership of an area of community land. The NLC administers the registration process.

3.3 IFC Performance Standards

The following international guidance, representing international best practices and standards, will be incorporated in all aspects of the EIA. More specifically, the requirements of the IFC Performance Standards and EHS Guidelines have been considered in this ESIA report.

- IFC (2012). Performance Standards for Environmental and Social Sustainability and accompanying Guidance Notes.
  - **Performance Standard 1: Assessment and Management of Environmental and Social Risk and Impacts.** This standard aims to identify and evaluate all environmental and social risks of the Project and to promote improved environmental and social performance through effective use of management systems. The standard also promotes adequate engagement throughout the Project cycle.
  - **Project triggers PS 1 due to the potential adverse impacts it has on the environment and social and associated risks hence an ESIA has been prepared.**

- **Performance Standard 2: Labour and Working Conditions.** The objectives of Performance Standard 2 are to promote the fair treatment, non-discrimination and equal opportunity of workers in accordance with national laws and international conventions and instruments, specifically the core conventions of the International Labour Organisation and United Nations conventions related to rights of the child and migrant workers.
- **Project triggers PS 2 due to the fact that there will be employment of personnel to construct and operate the dam hence international labour and working conditions hall be adhered to by the contractor and operator.**

- **Performance Standard 3: Resource Efficiency and Pollution Prevention.** The objectives of Performance Standard 3 include avoiding or minimising pollution from project activities in order to avoid or minimise impacts on human health and the environment. This performance standard aims to promote the sustainable use of resources including energy and water and to reduce project-supplied GHG emissions.
- **Project triggers PS 3 due to the fact that there is likely to be GHG emission normally associated with dams but this is going to be insignificant.**

- **Performance Standard 4: Community Health, Safety and Security.** The objectives of Performance Standard 4 include avoiding or minimising risks and impacts relating to the health and safety of the local community during the Project life cycle from both routine and non-routine circumstances. This performance standard aims to ensure that the safeguarding of people and property is conducted in a legitimate way, which avoids or minimises risks to the community's safety and security.
- **Project triggers PS 5 due to the fact that there is a likelihood of adverse risks to communities from the dam including accidents among others.**

- **Performance Standard 5: Land Acquisition and Involuntary Resettlement.** The objectives of Performance Standard 5 include the avoidance or minimisation of displacement and the avoidance of forced eviction. The responsible party should anticipate and avoid or minimise adverse social and economic impacts from land acquisition or restrictions on land use by providing compensation for loss of assets and ensuring resettlement activities are implemented with appropriate disclosure of information, consultation and the informed participation of those affected. The performance standard requires the improvement or restoration of the livelihoods and standards of living of the displaced persons. Living conditions among physically displaced persons should be improved through the provision of adequate housing with security of tenure at resettlement sites.
- **Project triggers PS 5 due to the fact that there will be land acquisition and displacement to pave way for the dam. A RAP has been prepared to minimise the impacts associated with displacement.**

- **Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources**. This standard aims to protect and conserve biodiversity. The standard promotes the utilisation of practices, which integrate conservation needs and development priorities to promote the sustainable management and use of natural resources.
- **Project triggers PS 6 due to the fact that the dam site is colonised by vegetation cover including indigenous tree species. However, these are not endangered species or found in the IUCN Red List. As a mitigation measure, off sets for destroyed biodiversity especially vegetation has been proposed.**

- **Performance Standard 7: Indigenous Peoples.** The objective of this Performance Standard is to ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture and natural resource-based livelihoods of Indigenous Peoples.
  Project does trigger PS 7 since the area does not have communities categorised as indigenous.

- **Performance Standard 8: Cultural Heritage.** This standard aims to protect cultural heritage from adverse impacts of project activities and support its preservation; and also promotes the equitable sharing of benefits from the use of cultural heritage in business activities.
  Project triggers PS 8 due to the fact that there are cultural trees (mugumo) and graves that will be affected as a result of the dam and associated facilities. The ESIA recommends adequate compensation for the losses that are unavoidable.

- IFC (2007a). EHS General Guidelines.

  - **EHS Guidelines: Wastewater and Ambient Water Quality.** These guidelines apply to projects that have either direct or indirect discharge of process wastewater, wastewater from utility operations or storm water to the environment, which may have implications for the Project's water treatment requirements. The guidelines are also applicable to industrial discharges to sanitary sewers that discharge to the environment without any treatment. The guidelines also state that if sewage from an industrial facility is to be discharged to surface water, treatment to meet national or local standards for sanitary wastewater discharges is required. In their absence, indicative guideline values are provided by the IFC for sanitary wastewater discharges.

  - **EHS Guideline: Air Emissions and Ambient Air Quality.** These guidelines apply to facilities or projects that generate emissions to air at any stage of the Project's life-cycle.

- **EHS Guideline: Occupational Health and Safety**. These guidelines apply to workers exposed to chemical and physical (i.e. noise) hazards whilst at work.

- **EHS Guideline**: **Noise.** These guidelines apply to projects that have noise impacts beyond the property boundary of the facilities. These guidelines establish noise standards that should not be exceeded, and also stipulates that noise levels should not result in a maximum increase in background levels of 3dB at the nearest receptor location offsite.

- **EHS Guidelines for Water and Sanitation**. These guidelines include information relevant to the operation and maintenance of potable water treatment and distribution systems, and collection of sewage in centralised systems, decentralised systems, and treatment of collected sewage at centralised facilities.

- Good Practice guideline, which will be referred to throughout the ESIA include but are not limited to the following:

  - Business and Biodiversity Offsets Programme (2012). BBOP Standard on Biodiversity Offsets Guidance.
  - IFC (2013). Good Practice Handbook: Cumulative Impact Assessment and Management – Guidance for the Private Sector in Emerging Markets.
  - World Resources Institute (WRI) (Landsberg F, Treweek J, Stickler MM, Henninger N and Venn 0) (2013). Weaving ecosystem services into impact assessment: A Step-By-Step Method.
  - WHO (2011). Drinking Water Quality Guidelines – 4th edition.
  - WHO (2005). Air Quality Guidelines Global. Guidelines on the standards that should be achieved for air, in the absence of national guidelines.
  - WHO (1999). Guidelines for Community Noise.

3.4 World Bank Safeguard Policies

3.4.1 OP/BP 4.01 (Environmental Assessment)

The World Bank has well-established environmental assessment procedures, which apply to its lending activities and to the projects undertaken by borrowing countries, in order to ensure that development projects are sustainable and environmentally sound. Although its operational policies and requirements vary in certain respects, the World Bank follows a relatively standard procedure for the preparation and approval of an environmental assessment study, which:

- Identifies and assesses potential risks and benefits based on proposed activities, relevant site features, consideration of natural/human environment, social and trans-boundary issues
- Compares environmental pros and cons of feasible alternatives

- Recommends measures to eliminate, offset, or reduce adverse environmental impacts to acceptable levels (sitting, design, technology offsets)
- Proposes monitoring indicators to implement mitigation measures
- Describes institutional framework for environmental management and proposes relevant capacity building needs.

The environmental assessment evaluates a project's potential environmental risks and impacts in its area of influence; examines project alternatives; identifies ways of improving project selection, siting, planning, design, and implementation by preventing, minimizing, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts; and includes the process of mitigating and managing adverse environmental impacts throughout project implementation. The assessment takes into account: the natural environment (air, water, and land); human health and safety) social aspects (involuntary resettlement, indigenous peoples, and physical cultural resources); and trans-boundary and global environmental aspects. Preventive measures are favoured over mitigation or compensatory measures, whenever feasible. This approach is universally applied in many institutional projects.

The World Bank considers environmental impact assessment (EIA) as one among a range of instruments for environmental assessment. Other instruments used by the World Bank include regional or Sectoral environmental assessment, strategic environmental and social assessment (SESA), environmental audit, hazard or risk assessment, environmental management plan (EMP) and environmental and social management framework (ESMF). The Bank undertakes environmental screening of each proposed project to determine the appropriate extent and type of environmental assessment. Proposed projects are classified into one of three categories, depending on the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts:

- **Category A:** The proposed project is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. These impacts may affect an area broader than the sites or facilities subject to physical works. For a Category A project, the Proponent is responsible for preparing an EIA report.
- **Category B:** The proposed project has potential adverse environmental impacts on human populations or environmentally important areas such as wetlands, forests, grasslands, and other natural habitats - but these are less adverse than those of Category A projects. These impacts are site-specific; few if any of them are irreversible; and in most cases, mitigation measures can be designed more readily than for Category A projects. Like Category A the environmental assessment examines the project's potential negative and positive environmental impacts and recommends any measures needed to prevent, minimize, mitigate, or compensate for adverse impacts and improve environmental performance.

- **Category C:** The proposed project is likely to have minimal or no adverse environmental impacts. Beyond screening, no further environmental assessment action is required for a Category C project.

Environmental Assessment is used in the World Bank to identify, avoid, and mitigate the potential negative environmental associated with Bank lending operations. The purpose of Environmental Assessment is to improve decision making, to ensure that project options under consideration are sound and sustainable and that potentially affected people have been properly consulted. The magnitude of the proposed Ruiru II dam falls under category A and hence full ESIA is required.

3.4.2 OP/BP 4.04 (Natural Habitats)

The policy is designed to promote environmentally sustainable development by supporting the protection, conservation, maintenance and rehabilitation of natural habitats and their functions. The policy seeks to ensure that World Bank-supported infrastructure and other development projects take into account the conservation of biodiversity, as well as the numerous environmental services and products, which natural habitats provide to human society. The policy strictly limits the circumstances under which any Bank-supported project can damage natural habitats (land and water area where most of the native plant and animal species are still present). This project has no notable interaction with notable natural habitat apart from limited localized riverine aquatic animals.

3.4.3 OP/BP 4.11 (Physical Cultural Resources)

This policy is meant to assist in preserving physical cultural resources including the movable or immovable (above or below ground, or under water) objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance including sites and unique natural values. Physical cultural resources are important as sources of valuable scientific and historical information, as assets for economic and social development, and as integral parts of a people's cultural identity and practices.

The objective of this policy is to avoid or mitigate adverse impacts on physical cultural resources from development projects.

- Identify Category A (any project involving significant excavations, demolition, movement of earth, flooding, or other environmental changes) and/or B (any project located in, or in the vicinity of, a physical cultural resources site) projects that fall under this OP policy
- Identify the likely physical cultural resources issues, if any, to be taken into account by the EA and develop the ToRs for the EA.
- If the project is likely to have adverse impacts on physical cultural resources, identify appropriate measures for avoiding or mitigating these impacts as part of the EA process. These measures may range from full site

protection to selective mitigation, including salvage and documentation, in cases where a portion or all of the physical cultural resources may be lost.

- Develop a physical cultural resources management plan that includes measures for avoiding or mitigating any adverse impacts on physical cultural resources and provisions for managing chance find.

3.4.4 OP/BP 4.12 (Involuntary Resettlement)

The policy states that "Where large-scale of population displacement is unavoidable, a detailed resettlement plan, timetable, and budget are required. Resettlement plans should be built around a development strategy and package aimed at improving or at least restoring the economic base for those relocated. Experience indicates that cash compensation alone is normally inadequate. Voluntary settlement may form part of a resettlement plan, provided measures to address the special circumstances of involuntary resettles are included. Preference should be given to land-based resettlement strategies for people dislocated from agricultural settings. If suitable land is unavailable, non-land based strategies built around opportunities for employment or self-employment may be used".

Involuntary resettlement is triggered in situations involving involuntary taking of land and involuntary restrictions of access to legally designated parks and protected areas. The objective of this policy is to avoid or minimize involuntary resettlement, though participation in resettlement planning and implementation and, where this is not feasible, to assist displaced persons in improving or at least restoring their livelihoods and standards of living in real terms relative to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher. The policy prescribes compensation and other resettlement measures to achieve its objectives and requires that borrowers prepare adequate resettlement planning instruments prior to Bank appraisal of proposed projects. There are potential displacements by sub-projects such as solid waste disposal sites, wastewater treatment plants, markets and parks that are all space intensive. RAP studies are, therefore, considered for such projects.

3.4.5 OP/BP 4.36 (Forests)

The policy on forest safeguards seeks to realize the potential of forests to reduce poverty in sustainable manner, integrate forests effectively into sustainable economic development and protect the vital local and global environmental services and values of forests. Among the principles is to screen as early as possible for potential impacts on forest health and quality and on the rights and welfare of the people who depend on them.

3.4.6 OP/BP 4.10 (Indigenous Peoples)

This policy contributes to the Bank's mission of poverty and sustainable development by ensuring that the development process fully respects the dignity, human rights, economies and cultures of indigenous peoples. For all projects that are proposed for Bank financing and affect indigenous peoples, the Bank requires the borrower to engage in a process of free, prior, and informed consultation. The broad support of the project by the affected Indigenous Peoples such as Bank-financed projects includes;

- Preventive measures to adverse effects to the indigenous cultures and practices,
- Avoid potential adverse effects on the Indigenous Peoples' communities;
- When avoidance is not feasible, minimize, mitigate, or compensate for such effects.

Bank-financed projects are also designed to ensure that the Indigenous peoples receive social and economic benefits that are culturally appropriate and gender and inter-generationally inclusive.

The objective of this policy is to design and implement projects in a way that fosters full respect for Indigenous Peoples' dignity human rights and cultural uniqueness and so that they receive culturally compatible social and economic benefits and do not suffer adverse effects during the development process. Space intensive sub-projects such as solid waste dumping sites, wastewater disposal areas and commuter rail stations has a potential for disruption of indigenous people. Improved Social and economic systems across the metropolitan leads to potential intrusion to existing cultures.

3.4.7 OP/BP 4.09 (Pests Management)

The policy is meant to minimize and manage the environmental and health risks associated with pesticides use and promote and support safe, effective and environmentally sound pest management.

3.4.8 Activities Triggering World Bank Safeguards

The schedule below justifies the extent to which the World Bank safeguards apply to the implementation of the proposed project implementation.

Table 11: Safeguards Triggering Matrix

Policy	Criteria in the Project	Discussions
Environmental Assessment (OP 4.01, BP4.01, GP 4.01)	Yes	The project components will trigger EA safeguards and is Category A due to the intense interaction with the physical, biological and social setting within the immediate surroundings and direct and indirect influence social and ecosystems
Forestry (OP4.36, GP 4.36)	No	There are no significant forested areas around the project area. Further investigation will assess the ecological value of riparian forest habitats
OP/BP 4.04 (Natural Habitats)	No	There are no notable natural habitats as per the definition of the Bank
Involuntary Resettlement (OP4.12, BP 4.12)	Yes	Families are likely to be displaced by the project. The effects of this phenomenon are likely to affect the residual settlers who may get separated with close family members or friends. World Bank Safeguards, therefore, are triggered for assessments on Resettlements.
Physical Cultural Resources (OP/BP	No	Investigations during the ESIA showed that there are no know cultural resources. However, a

Policy	Criteria in the Project	Discussions
4.11)		sample Chance find Procedure and Plan has been prepared and will be provided to the contractor.
Indigenous Peoples PolicyOP/BP 4.10	No	There are no indigenous people in the area
OP/BP 4.09 (Pests Control Management)	No	The project will not entail use of pesticides hence not triggered.
OP/BP 4.37 (Safety of Dams)	Yes	For the life of any dam, the owner is responsible for ensuring that appropriate measures are taken and sufficient resources provided for the safety of the dam. It requires that the dam be designed and its construction supervised by experienced andcompetent professionals.

3.5 International Conventions

Relevant international agreements, treaties and conventions that have a social and/or environmental aspect to which Kenya is a signatory/acceded or ratified to are detailed in**Table 12** below.

Table 12.International Conventions

Convention	Date Ratified/Acceded to
African Convention for the Conservation of Nature and Natural Resources (2003)	Ratified (12 May 1969)
Convention on Biological Diversity (1992)	Ratified (26 July 1994)
Vienna Convention for the Protection of the Ozone Layer (1985)	Acceded to (9 November 1988)
UNESCO Convention for the Protection of the World Cultural and Natural Heritage (1972)	Acceded to (1 May 1964)
■ Convention on the Conservation of Migratory Species of Wild Animals (1985) ■ The African-Eurasian Water-bird Agreement (AEWA). ■ The Agreement on the Conservation of African-Eurasian Migratory Water birds (AEWA).	Acceded to (26 February 1999)
■ Convention on International Trade in Endangered Species of Wild Fauna and Flora (1973)	Acceded to (13 December 1978)
■ Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal	Acceded to (1 June 2000)

Convention	Date Ratified/Acceded to
(1995)	
■ Convention on Biological Diversity (2006)	Ratified (26 July 1994)
■ Convention on Climatic Change and the Kyoto Protocol (1997)	Ratified (25 February 2005)
■ Lusaka Agreement on the Cooperative Enforcement Operations Directed against Illegal trade in Fauna (1994)	Ratified (17 January 1997)
■ Nile Basin Initiative (1999)	N/A

4 ENVIRONMENTAL AND SOCIAL BASELINE

4.1 Location and Size

The proposedRuiruIIdamwill be constructedacrossRuiruRiver after the confluence of Bathi River. The proposed dam project is located within Lari and Githunguri Sub Counties. The sub counties, LariandGithungurisub-countiesconstituteabout 616km2 (approximately 50%) out ofthe 1,324km2 area of the Kiambu County.Lari Divisionis mainlyin the highlands(anextension ofAberdareranges) whileGithungurilieswithinthe middle highlands ofthe district, both constitutingthe mostfertile and high potential zones of Kiambu.The area constitutes one blockwithalmost homogenous general topographical pattern; land uses practices, climatic conditions, hydrology/drainage system, demographic distribution and economicactivities.

4.1.1 Administrative Context

The proposed RuiruIIDamis administrativelylocated inGithunguri andLarisub-counties,KiambuCounty,about35 kmnorth of Nairobi. Theprojectfallswithintwolocationsand sub-locationsnamelyKamuchege (Kamuchegesub-location)tothenorthandGithunguri(Ngochisub-location)totheSouth.Itislocatedwithinthetwo villages of Ngochi(inNgochi sub-location)andKariga and Kamburu (in Kamuchegesub-location). The administrativelocationof thedamis aspresented inthe**table13**below:

Table 13: Administrativelocation of RuiruIIdam

County	Sub-County	Location	Sub-location	village
Kiambu	Githunguri	Githunguri	Ngochi	Ngochi
	Lari	Kamuchege	Kamuchege	Kariga
				Kamburu

Source: FieldAssessment, 2016

4.2 Demographics

4.2.1 Population

KenyaPopulationandHousingCensus 2009 indicateKiambuCountypopulation at 1,623,279with802,609beingmaleand820,670beingfemale.Theaveragepopulationgrowth rateintheCountyis2.81%andthesexratioisapproximately1/1.02.During the2009population census,onlyLariwasasubcountywhileGithunguriwasadivisionwithinLarisub-county.Inthe same-period, only Githunguri existed asa sub-location while Ngochi was a village. These administrativeareashavesincethereforebeensubdividedwherecurrently,the projectfallswithin twolocations andsub-locations namely;Gatamaiyu(Kamuchegesub-location)andGithunguri(Ngochisub-location).Theadministrativeunits of theprojectareasaccordingto the2009populationcensus areasillustratedinthe **table14**below:

Table 14: PopulationoftheProjectArea

SubCounty	Locations	Sub-location	Population2009		
Githunguri			**Male**	**Female**	**Total**
			28,083	29,688	57,771
	Githunguri		17,942	18,436	36,378
		Ngochi	8,882	9,030	17,912
Lari			80,682	63,263	143,945
	Gatamaiyu		20,882	21,513	143,945
	Kamuchege		2,759	2,681	5,440

Source: 2009 Population Census

4.2.2 Gender

Gendercan bedefinedasbeing a male orfemaleand translatedintothe opportunitiesenjoyedby eitherofthetwosexesasprescribedbythesocietalvaluesandnorms.Thesocietyintheproject areahasputrestrictionsontheseopportunitiesthuscausingdisparitiesbetweenmaleandfemale s. Intheproject area, gender disparitiesaremanifestedthrough school enrolment, property ownership,accesstocreditanddiscrimination onplacesofworkamong others.Thefollowing are e gender concerns intheprojectarea:

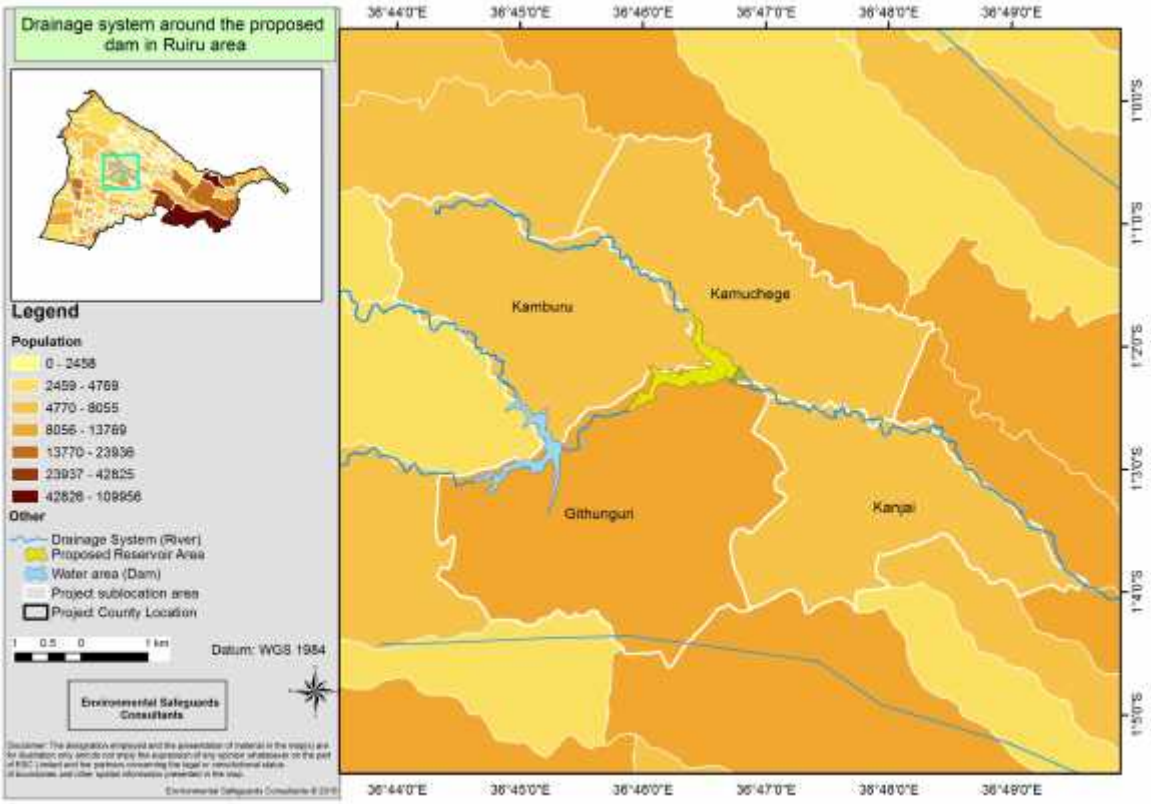
- There exits profound gender disparities in provision of education and attainment of education at all levels of schooling
- Low status of women in society due to socio-cultural practices
- Low levels of education attainment
- Inadequate awareness and understanding of gender issues
- Low participation of women in development
- Biases in property ownership/rights

Theboychildintheareaisdisadvantagedas manyofthemdrop outofschooltoworkin coffeeand teafarmsaschildlabourers.Itisestimatedthatover 3.7% ofchildrenaged10-18yearsareworking children.Ontheother side,women arechargedwith theresponsibilityof fetchingwater fromdistant points.Thisleavesthemwithlittletimetodevotetosocio-economic activities.Generally,thereis genderinequalityin termsof:

- Attitude of viewing women as labourers and not development agents
- Unequal representation in development decision making process that are male dominated
- Ownership of land that is viewed as man's property. This has tended to limit women access to productive resources

All thesecombined hasreduced womenroleandtheirparticipationin development.**Figure 12** overleaf presents population distribution in the study area.

Figure 12: Population Distribution in the Study Area.



Source: FieldAssessment, 2016

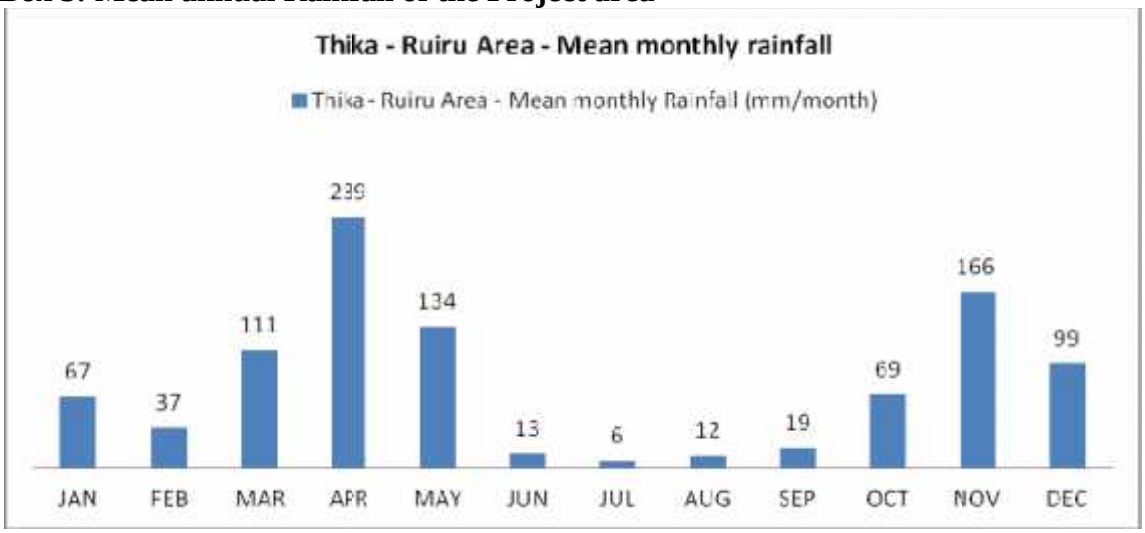
4.3 Physical Environment

4.3.1 Climatic Condition

- **Rainfall**

Theregionischaracteristic byequatorialclimatic conditionsandrainfallis highlyinfluenced by altitudeand proximity to the Aberdare forest. Rainfall in the area comesin twoseasons, long rainscome between Marchto Mayand shortrainscome between Octoberand December. The annual mean rainfall variesfrom 1070mm to 1750mm perannum. The nearest meteorologicalstationregisteredinthe Kenyan Meteorological Department istheThika meteorological station.Thedataofthis stationis summarized in **Box 3** below

Box 3: Mean annual Rainfall of the Project area



- **Temperatures**

The mean temperature in the projectareais approximately 26^0C with temperaturerangingfrom 17.1^0Cin the upper highlandsto 34^0Cin thelower midlands. JulyandAugustarethe months duringwhich thelowest temperaturesare experienced, whereas January to Marchisthehottest months.

- **Wind, Humidity and Evaporation**

Themain wind–directioniseasterly,evaporationrangingfrom100to150mmpermonthwhilethe humidityvariesfrom 50%to90%.

- **Evapo-Transpiration**

Thika meteorological station located 30km from Dam site recorded the mean daily evaporation rates as summarized below.

Box 4: Mean Daily Evaporation

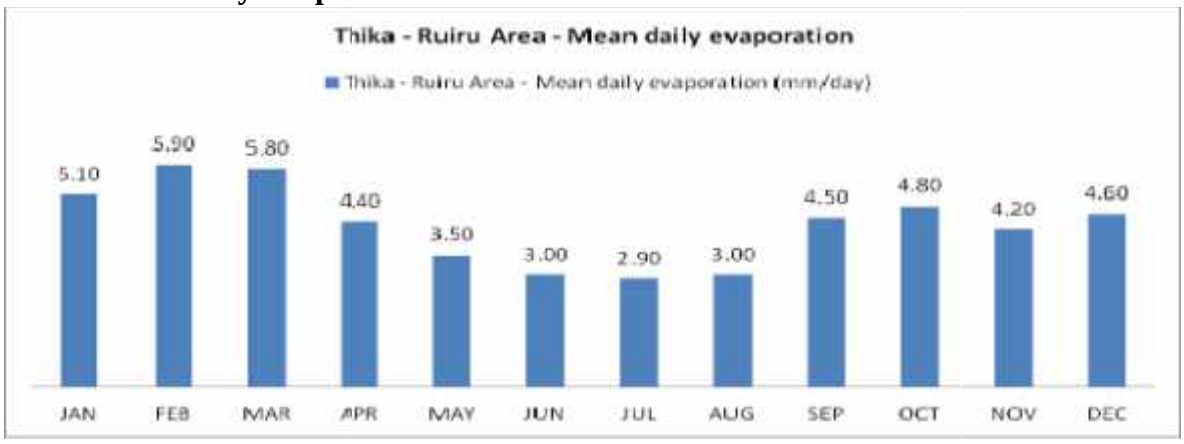
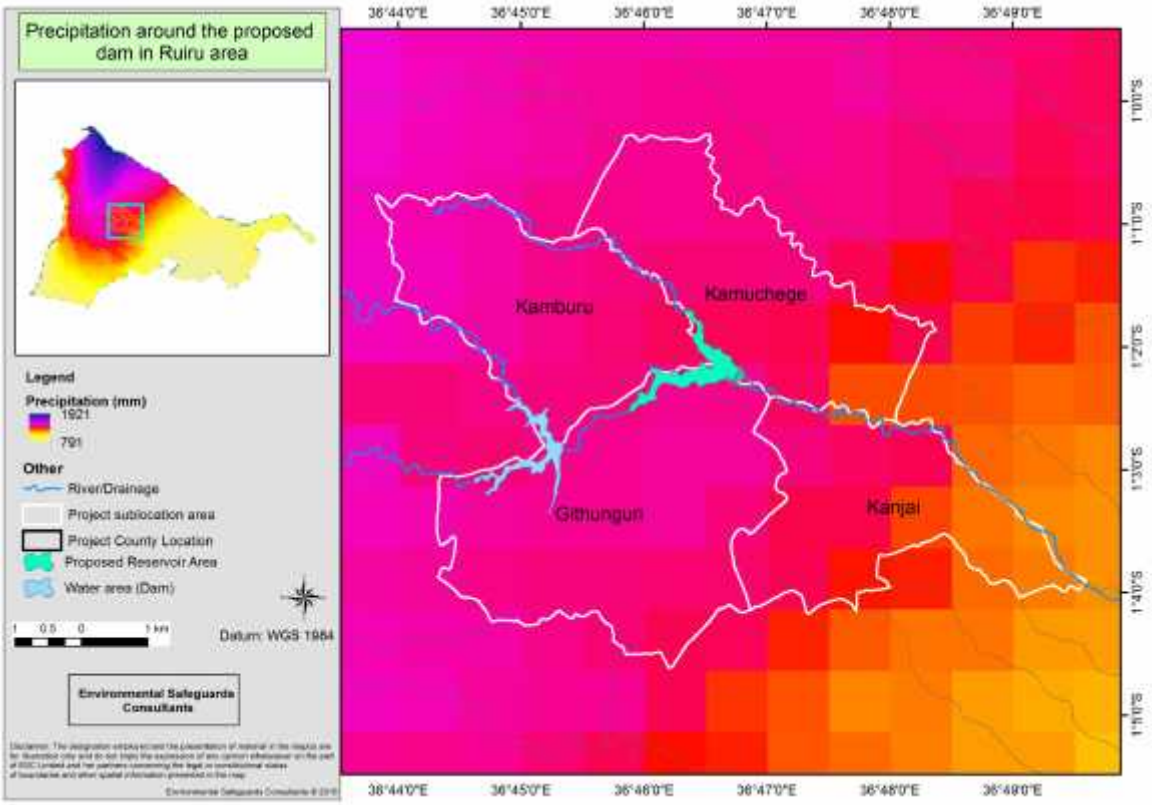


Figure 13: Precipitation in the Project Area



Source: FieldAssessment, 2016

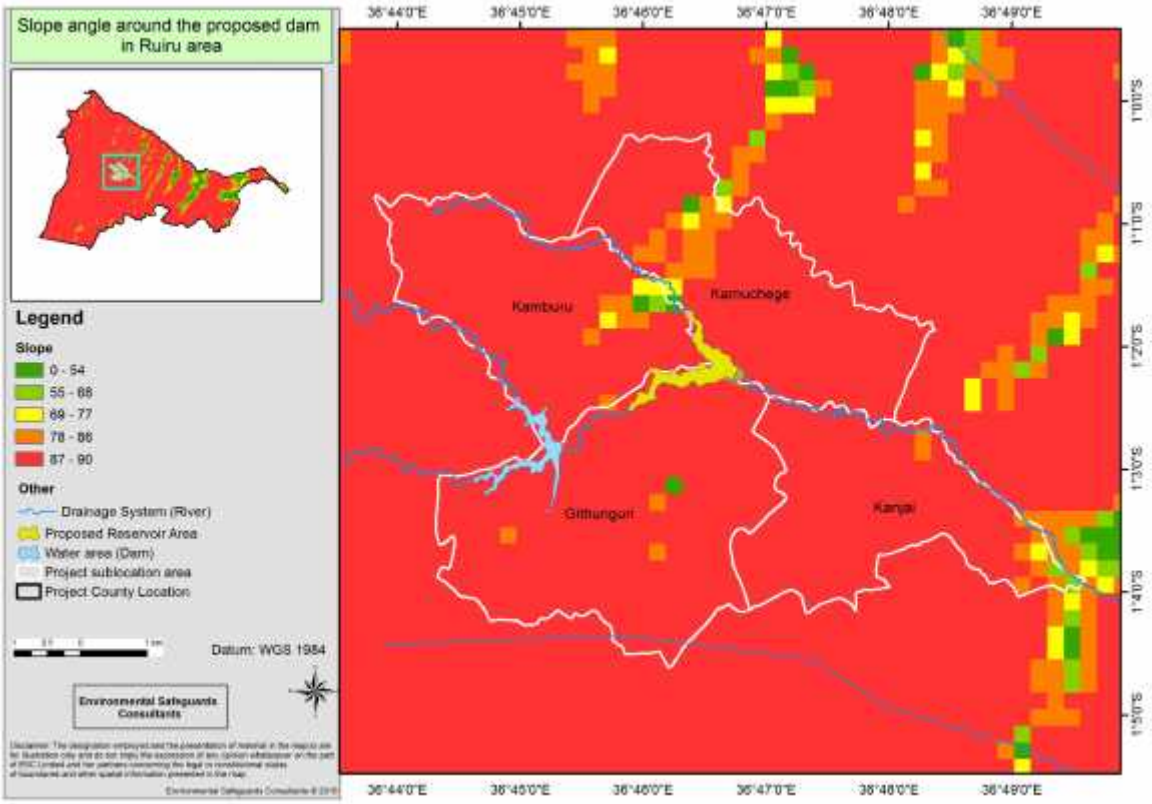
4.4 Topography and Physiography

Kiambu Countycan be dividedinto four broad topographic zones namely,Upper Highland, Lower Highland,Upper Midlandand Lower Midland.The projectarealyingat about 1889 metersabove sea levelis locatedin theUpper Highland Zone, which isan extension oftheAberdareranges.It is dominated by highly dissectedrangesand itis verywet,steep and an importantwatercatchment area. Hills, plateaus, and high-level structural plains characterize the area.

The geology oftheareais part oftheeastern border zone oftheRiftValley,filledwithkainozonicvolcanicandsediments underlyingthe upperAthi generating goodaquifers.Soils onthe other handdevelopfromweathering activitiesofthevolcanicrocksandarehighlyfertilewithhighlevelsof perforation.

The projectarea ischaracterized by steepslopesand deep valleysandin most places hassprings or streams at the lower point of the valleys. The physiographic of the projectareaisinfluenced byAberdarerangeswiththe topography varyingfrom steepslopes inwestandeast to undulatingrollinglandforms (volcanicfoothillridges)in much ofthe northern part of the Lari division.Consequently mild tosteepridgesand valleys with a general slope towards theeastand southeastare notable through most ofthe projectarea.

Figure 14: Topography of the Study Area

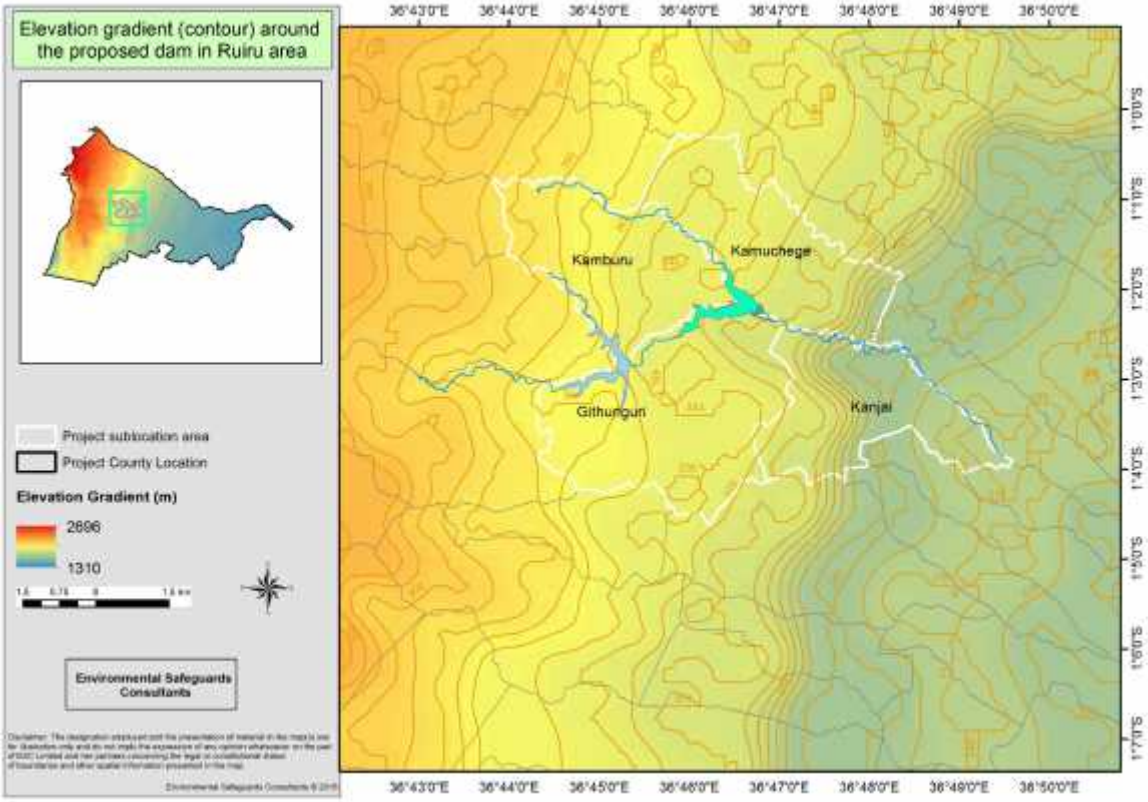


Source: FieldAssessment, 2016

Figure 15: Steep Incised Valleys with Project area

Source: FieldAssessment, 2016

Figure 16: Elevation of the Project Area



4.5 Drainage and Hydrology

The projectareaiswell drained both horizontally(duetothe many valleys)with the generalslopeinthe south-easterly directionand verticallysincethe loamy volcanicsoilsarerelatively porousallowing easy infiltration of precipitation.The drainageand hydrology of the projectareais influenced bytheAthi Catchment Basintowhich RuiruRiveris majortributary ofAthiRiver.The surface drainageisalso influenced by the steepslopes of theAberdares on the west,though towardstheeastand southeasterly direction,thesurfaceslope gets mildwithinfluencefromthe low lyingKapiti Plains ontheeastand south of the projectarea.

The projectareais drained by numerous otherriversandstreams washingthe projectareafromthe highlandstowardstheeastandsoutheast.AmongthestreamsincludeBathi,Gatamaiyu,Komothai, ThetaRivers, Thiririka and Ndarugu Rivers.Other streamsarisefromspringsatthe valley bottomscreatinga network oftributaries for the mainriversas well aswatersources forthe local communities.Due totheabsence of active hydrologicalstationsin most oftheriversandstreams, itis not possibleatthisstageto provideflow data and trends forthese surface watersources.

Figure 17: Ruiru River downstream Ruiru II Dam site

4.5.1 Water Resources

Surface WaterSources

Kiambu County is endowedwithabundantsurfacewater sources from numerous springs andstreams thatsubsequentlyconstitute part of the upperAthi RiverBasin system.Therivers provides easyaccess towater bythelocal communitiesand eveninstitutions aswellas watersupplyschemes suchas Komothai WaterSupply,GithunguriWaterSupplyandalso local commercial premises.Other sourcesarestreamsarisingfromsprings atthe valley bottoms.

WaterQuality

The assessment noted that turbidity levels of water in the Ruiru river was slightly high than water from Bathi river, however, this conditions progressivelychanges downstreamasthesourcesinteract with varyingland use activitiesincludingagriculture, urban developmentandsettlements.Among the key pollutants in surface water sources withinthe dam project location may include agrochemical residuals(from agriculturalactivities), nutrientsarisingfromlivestockkeepingan application ofthe manure onthesteepslopesaswellas domesticwastes (particularly potential seepagefrompit latrines thatis the common mode of sanitationin thearea).

Thefollowingtable presentsasample dataset ofRuiruRiver obtained duringtheconceptual design of theWaterTreatment Plant.Thisshowsfreshneutralwaterbutwithslightlyhighturbidity.Theturbiditycouldbearesul toflanduseactivities aswell as humic depositionalongtheriverfloodplains.

Figure 18: Drainage and Hydrology of the Project Area

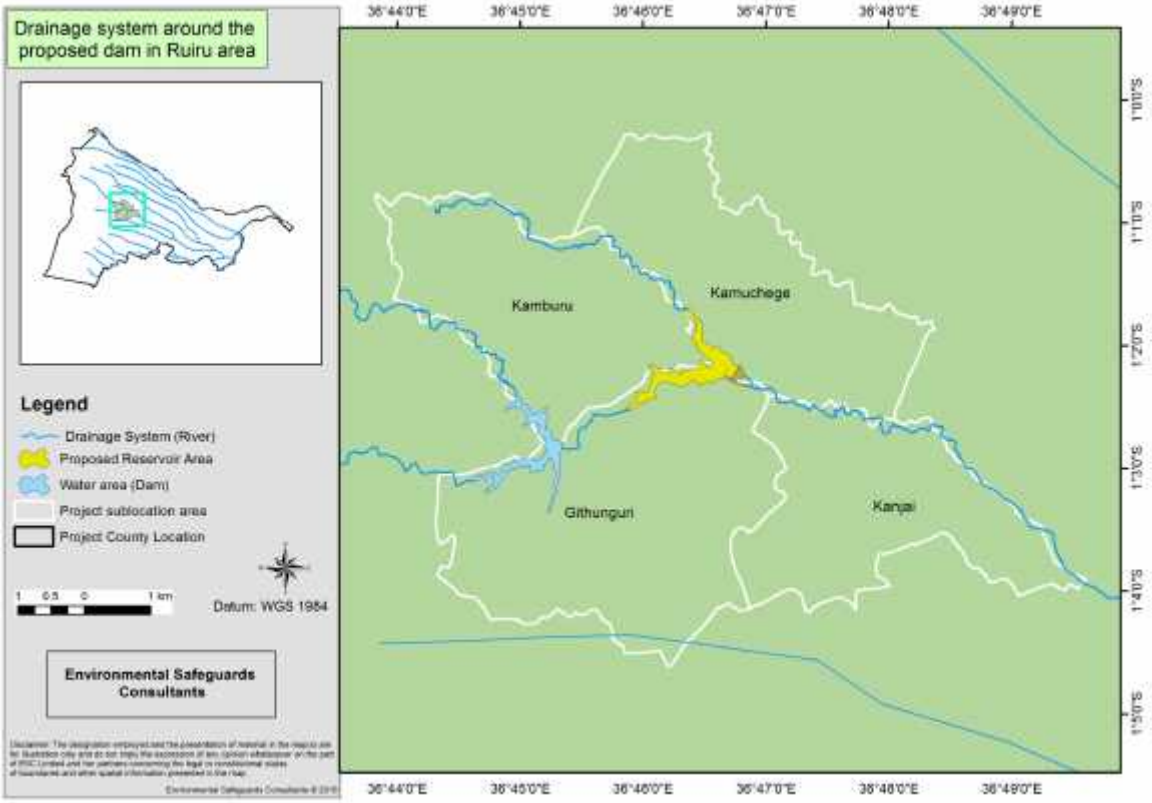


Table 15: Water Quality Parameters (recorded in the conceptual design report)

Parameter	UNITS	WATER 1	WATER 2	WATER 3
pH	-	7,72	6,5	7,1
HCO_3	mg/L	263	195	274
Conductivity	µS/cm	50	35	50
Turbidity	NTU	43,3	-	8,5
Ca	mg/L	28	2	10
Mg	mg/L	7	-	-
Na	mg/L	5	3	6
K	mg/L	1	1,6	1,8
Fe	mg/L	2	0,038	0,53
Mn	mg/L	0,059	0,2938	0,12
Cl	mg/L	4,26	0,71	7,48

Groundwater

The alternativesources ofwaterinthe projectareaare groundwaterincluding boreholesandshallow wellsandsprings.Itwas observedthatanaverage yielding deepaquifer boreholewill produce3m3/hr. with depths of ranging between 250-300m (There is an estimated 950 boreholes in Kiambu County with a significant number located within Lari and Githunguri Divisions). It is however, notedthatthedepth oftheaquifersin mostplacesisa majorconstraintintheexploitation ofgroundwater inthearea,inadditiontothemaintenance ofwellsandsprings.Twowellsfoundaroundtheproject

areawerereportedlydugtoadepthofbetween10mand20m.Nowater,however,wasfound inallthetrialpitsdugduringthegeotechnicalinvestigationsfortheproposedRuiruIIDamsite (doneupto4mdeep).Groundwaterqualityisinfluencedbypotentialinfiltratingagrochemical residuals,nutrientsfromcattlepensandapplication ofanimal manureonfarmsaswellasdischarge intotheground ofhuman wastesfrompitlatrines.

Figure 19: Shallow wells popularly used by local residents

4.6 Geology and Soils

The geology ofthe projectareais part of theeastern border zone oftheRiftValleyfilledwith Kainozonic volcanicandsediments directly underlain bythe upperAthiseries, whichconsists mainly ofsandy sedimentsand Tufts.These upperAthi series generally provide goodaquiferswith high precipitationsensuringsufficientrecharge of ground water. Soil typesare depended on underlying rockformations,surface drainageconditions andrainfall patterns.

The proposedRuiruII damsiteislocatedina denselyforested highlands varyingfrom 1470m to2610mabove sealevel.Thisregion is deeplyincised byeastflowingstreams.The valleysare narrow orV-shapedwith narrow steepslopes,characteristic of younglandscapes.The uplift,the relatively soft volcanic rocksandthe heavyrainsexplainthisrapid downcuttingandthestreamsflowin parallelcourses.The geology'sareais dominated by analkaline volcanicactivity producingalarge succession of lavas and associated tuffs(Mid-Miocene time until Upper Pleistocene,see hereafter).

- Soft rock is outcropping at the bottom of the valley. It can be Tvtf2 (Kerichwa Tufs) or Plh1 (Limuru Trachytes).
- Topsoil, consisting of red clays. They are found on the slopes. Thickness seems to be in the 25 m range, growing to more than 5 m on the plateau.
- Transition between topsoil and rock consists of weathered rock / soft rock of unknown thickness.
- Slopes: Maximum slope is 40°. Average slope on 10 to 20m elevation can be on the 30-35° range. No evidence of landslide has been found.

Atthisstage,wecanassumethattheseslopesareofredclaysoils2to5mthick.Topsoilshould be removedbeforestartingbuildingtheembankment.Thereisnovisibleinstabilityintheslopes aroundthedambutthewater inthedam willcreateinstabilitiesinthe redclays.

Figure 20: Area Rock Structure

Seismicity

The presence of part of theEastAfricanRift,whichrunsthroughtheWest of Kenya meansthatKenya is vulnerable to seismic activity.Ontheseismic zoning map oftheKenya(OCHA 2007),the damsiteissituatedinZoneVI based on theEarthquakeIntensity of damageaccordingtothe Modified MercalliScalethatcorresponds to amoderate magnitude activity and low seismic hazard.The PeakGroundAcceleration(PGA)forthe area is situated inthe low class (0.2 to 0.8m/s²).

Erosion and Sedimentation

Soils in the area aredeveloped fromweatheredvolcanic rocksandare moderatetohighfertility, well-drainedclayloams.Thisexplainsthesuitabilityofthesoilsfor majorcropssuch ascabbages,kales, carrotsandpotatoesinadditiontotea, coffeeandpyrethrum.The projectarea ischaracterised with high vegetation covercomprisingofagriculturalcrops(tea,coffee,horticulturalcrops,maizeand nappiergrass)aswellasagro-forestry(mainlybluegum,wattleandgravelliaspeciesbeingthe most common)inadditiona varietyofshrubs.Withthislevelofvegetationcover,soil erosion(andindeed risksoflandslides)isnotsignificant.However,previousstudieshaveexpressedsedimentreleas efromvarious landcovertypesas illustrated inthetablebelow;

Table 16: Vegetation Cover and Sediment Yield Rate

Vegetation Cover	Sediment Yield Rate (T/km^2/year)
Bamboo	15
Forest	20
Tea	220
Maize	2000
Pasture	110

Sediment releasefromlandcover of specific plantsis determined andis dependent ofthe

root mass per unitareaaswellas duration of growth.Bamboo hasthe lowestwith 15t/km2/yr though its presenceinthe projectis verylowwhile maize hasthe highestwith 2,000t/km2/yr(itis present aroundthe projectarea butinlow quantities).Tea isat 220t/km2/yrwhileforestcoverallows only20t/km2/yrassociatedwiththeassociated undergrowthsthat hold soil together.The projectarea has moreteabushes, mediumareas coverage for forestandlimited maize growingareas.

Figure 21: Areaswithpotentialsoilloss

Figure 22: Geology of the Proposed Project Area

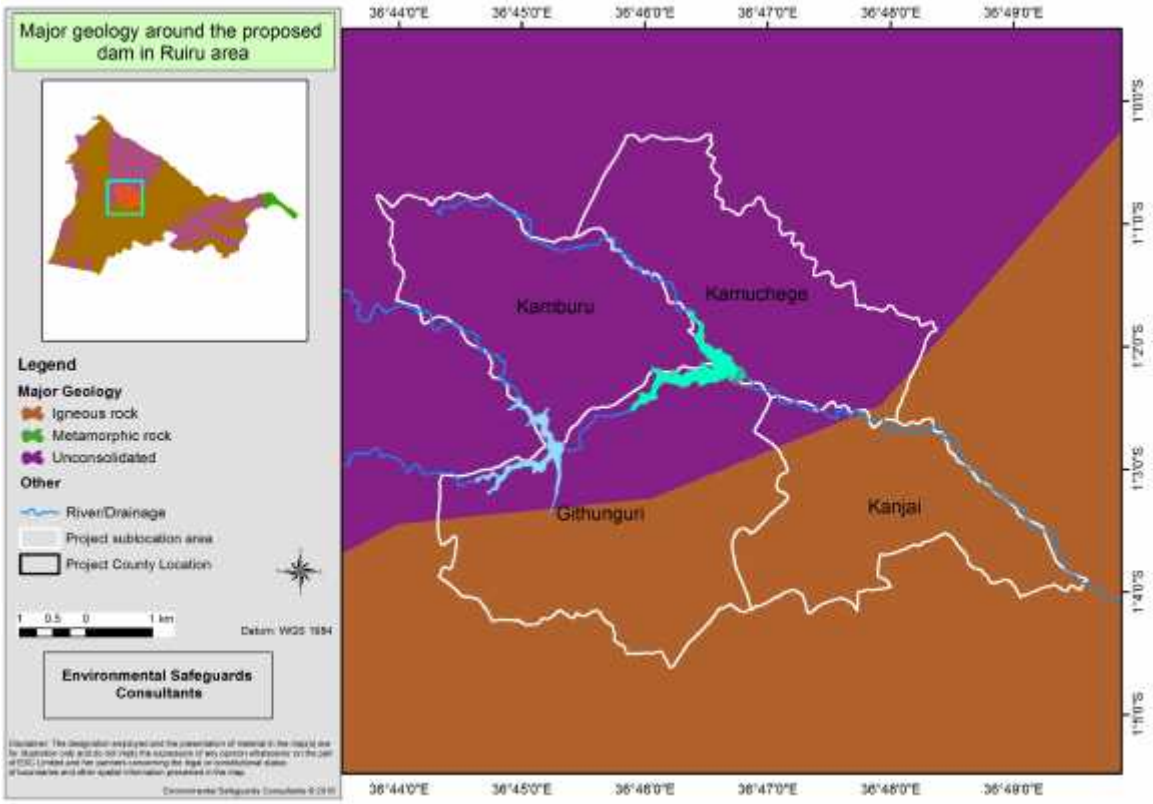
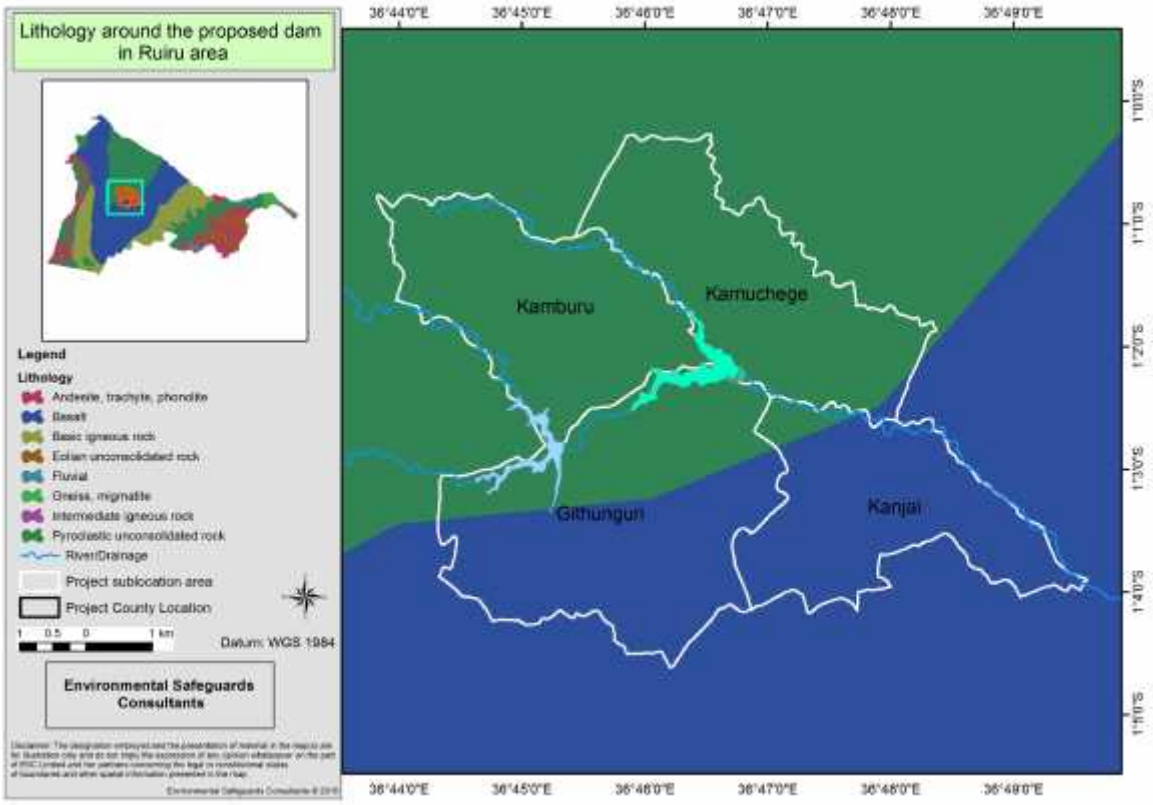


Figure 23: Soils of the Proposed Project Area



4.7 Biological Environment

Biodiversityof theprojectlocationishighlyinfluencedbytheAberdaresecosystemwithrespectto indigenousplantcoverspecies.However,duetohuman activities,theindigenousplantspecieshave beendisplacedby exoticspeciesthathavealsoacquiredeconomic valuesamongthecommunities. Suchplantspeciesinclude tea,coffee,Eucalyptus*spp*, Cypress*ssp*,Caussurina*spp*and*grevelliaspp*and wattletreesspecies. Otherplantfeaturesincludegrassspecies,ferns,nappiergrass,avocado, banana, yams(mainlyin theriverfloodplains),cassava,sugarcane,pineapple,arrowroots,and coffee).

Figure 24.Vegetation and Flora

Humanhabitationandagriculturalactivitieshavealsosignificantlyinterferedwithbothterrestrial andaquatichabitatsintheprojectareas.Thereisno terrestrialwildlife observedintheprojectareas sincemostlandisunderagriculturaluseformanyyearspushingtheanimalsintotheAberdare forest.However,limitedrodentslikesquirrels, molesanddifferentbirdspeciesamongothersare foundinthearea(specifichabitatscharacteristicswill beestablishedduringthe detailedassessment. Amongtheaquaticspecies presentincludefrogs,freshwaterfishesarefoundnaturallyinthe rivers. Livestockkeepingis significantwithdairycows,sheep,goats,poultryandhousepets(dogsandcats) mayalsoconstitutepartofthe widerbiodiversity).

4.7.1 Biological Conservation

The Ruiru II dam projectarea has beenassessed throughdifferentlistofsensitive areasand relevantinternationalconventions, the assessment revealed that the project site is not in a protected area.Land is theprimarynaturalresourceintheareaseconded bysurfaceandsub-surfacewater. Though theareadoeshavepermanentriversalargenumberofpopulationsoftheresidentsdependonraw waterfromriverssuchas BathiandRuiruaswellasboreholes.In addition,theprojectareahasforestresources, which are natural,andalsomanmadethatprovides fuel, rawmaterialsfor woodproducts,soilconservationandpreventionof watercatchmentareas.

4.8 Social Environment

4.8.1 Demographics in Project Affected Areas

The total population in the project areas where economic and physical displacement is expected has been estimated during this baseline study at **481** households estimated to beaverage of **4.2** persons per household hence approximately 2,020 PAPs.

Table 17. Affected County andLocations

County	Locations
Kiambu	Githunguri
	Kanduro
	Karinga
	Kiaduru
	Kimui
	Ngochi
	Nyamuthanga
	Nyanjogu
	Wanduru
	Gatamaiyu
	Githunguri
	Kamburu

	Ndumberi
	Karuri

Of all the respondents, 69.6 % were male while 26.5% were female.According to the survey, there are more male household members than male as shown in **table 18** below.

Table 18. Gender of Respondents

	Number of Respondents	%
Male	142	69.6
Female	54	26.5
No response	8	3.9
Total	204	100.0

Table 19. Gender of Other Household Members

	%
Male	43
Female	57
Total	100.0

According to the table below, majority of the household heads are aged above 55 years (52.9%), with those aged between 18-24 years accounting for 0.5% of the household heads.

Table 20. Age of head of household

	Number of Respondents	%
18-24 years	1	0.5%
25-35 years	6	2.9%
36-45 years	24	11.8%
46-55 years	31	15.2%
55 above	108	52.9%
No response	34	16.7%
Total	204	100.0

According to the table below, majority of the other household members are aged 18 years and below (39.9%), with those aged between 45 years and above accounting for 14.6% of the other household members.

Table 21. Age of other members of household

	%
Below 18 yrs	39.9
18-24 years	20.4
25-35 years	16.5
36-45 years	8.4
46-55 years	7.0
55 above	7.6
Total	100.0

4.8.2 Land Tenureand Agriculture

The area land tenure is under ownership of individual proprietorship with only a small percentage of land under public land.Public land is mostly land along the rivers (30m wide riparian) and land along road reserves.

Privatelyownedlandwashistoricallyowned through clans. However,this has been replaced with individual land ownership vestedto individualswhere land changes ownershipthroughinheritanceorpurchase.

Agriculture is the predominant economic activity in the county and contributes 17.4 per cent of the county's population income. It is the leading sub sector in terms of employment, food security, income earnings and overall contribution to the socio-economic well being of the people. Majority of the people in the county depend on the sub sector for their livelihood, with 304,449 directly or indirectly employed in the sector. Coffee and tea are the main cash crops in the county. The main food crops grown in the county are maize, beans, pineapples and irish potatoes. These are mainly grown in small scale in the upper highlands of Limuru, Kikuyu, Gatundu North and South Constituencies

The county has a total arable land of 1,878.4 Km2 of which a total of 21,447 Ha is under food crops and a total of 35,367.41 Ha is under cash crops. The main food crops grown in the county include maize, beans, irish potatoes and cabbages. Coffee and tea form the major cash crops grown in the county especially in the upper and lower highlands. Pineapples are also being produced in large quantities in the county especially in Gatundu North and South Constituencies.

According to 2009 Population and Housing Census, the numbers of livestock in the county were as follows: 230,294 cattle, 120,056 Sheep, and 89,817 goats. In addition, there were 2,600,837 poultry, 46,493 pigs, 13,662 donkeys and 127 camels. In the year 2010, the county produced 267.5 million Kgs of milk valued at Kshs. 5.0 billion; and 36.2 million Kgs of beef valued at Kshs. 6.5 billion. Production of mutton was at 106,686 Kgs valued at Kshs. 42.7 million. Further, the county recorded production of 266.9 million Kgs of eggs, valued at Kshs. 699.2 million; poultry meat produced was 76.2 million Kgs, valued at Kshs. 142.9 million, honey produced was 134,332 Kgs valued at Kshs. 67.2 million and 1.8 million Kgs of pork valued at Kshs. 631.1 million. Growth in this sub-sector has been encouraged by a ready urban market in Thika, Ruiru, Kiambu and Nairobi and the availability of local food processing factories such as Farmers´ Choice Ltd, Kenchic Company Limited, Brookside Dairies, Githunguri Dairies, Ndumberi Dairies, Limuru Milk and Palmside Dairies, among others.

Table 22. Type of Crops Grown

Tea	**Bananas**
Coffee	**Irish potatoes**
Maize	**Pumpkins**
Sweet potato	**Passion fruits**
Sugarcane	**Baby Marrow**
Beans	**Cabbage**

Nappier grass	**English fruits**
Peas	**Green Pepper**
Cassava	**Managu**
Arrowroots	**Kales**

Table 23. Type of Trees and Fruit Trees in Project Area

Mango	**Blue gum**
Orange	**Indigenous tree**
Guava	**Loquats**
Avocado	**Macadamia**
Eucalyptus	**Miiri**
Cypress	**Mukuhakuha**
Bamboo	**Fig Tree**
Pawpaw	**Mukurwe**
Pine	**Wattle Tree**
Grevillia	
Blue gum	

Land within the project area and its immediate neighbourhood is privately and publicly owned with the former accounting for over 90%. The publicly and government owned land in the area include the 30 meter Ruiru II riverine reserve, land constructed with roads and institutional land (schools, health centres and market areas). Privately owned land was historically owned through clans. However, this has been replaced with individual land ownership vested to individuals where land changes ownership through inheritance or purchase. Currently, majority of the people own the land on which they are settled. Those who do not have adequate land lease from others at a cost of Kshs. 70,000 (625 EUR) for one year per acre.The current cost for an acre of land in the area is currently costing Kshs.1.5 million (13 392 EUR).

Table 24. Tenure Regime

Tenure regime	Percentage
Titled property	100%
Non titled property	0%
Rental or other occupancy regime other than ownership	0%
Total	

Average Size of Household Land Holdings

With the increased population growth, there has been continuous decrease in average farm sizes. Currently the average farm size under small-scale farming is 0.36 Ha and 69.5 Ha under large-scale farming. The areas with small land holdings are mostly found in the upper parts of Gatundu North, Gatundu South, Kiambaa, Limuru and Kikuyu constituencies.

4.8.3 Land Use

The area is dominantly under mixed farming, which is influenced by agro-ecologicalzones,soilfertilityandclimateaswell asculturalpractices. Landuse inthe

projectareaisdominatedbycropgrowingwhere majority of the landisplanted with tea, coffee, vegetables,bananasandagro-forestry. Otherland useactivitiesintheareainclude: intensivedairyfarming, housing, landoccupied byinfrastructure,forestryaswellas watermasses

Figure 25: Land use Patterns

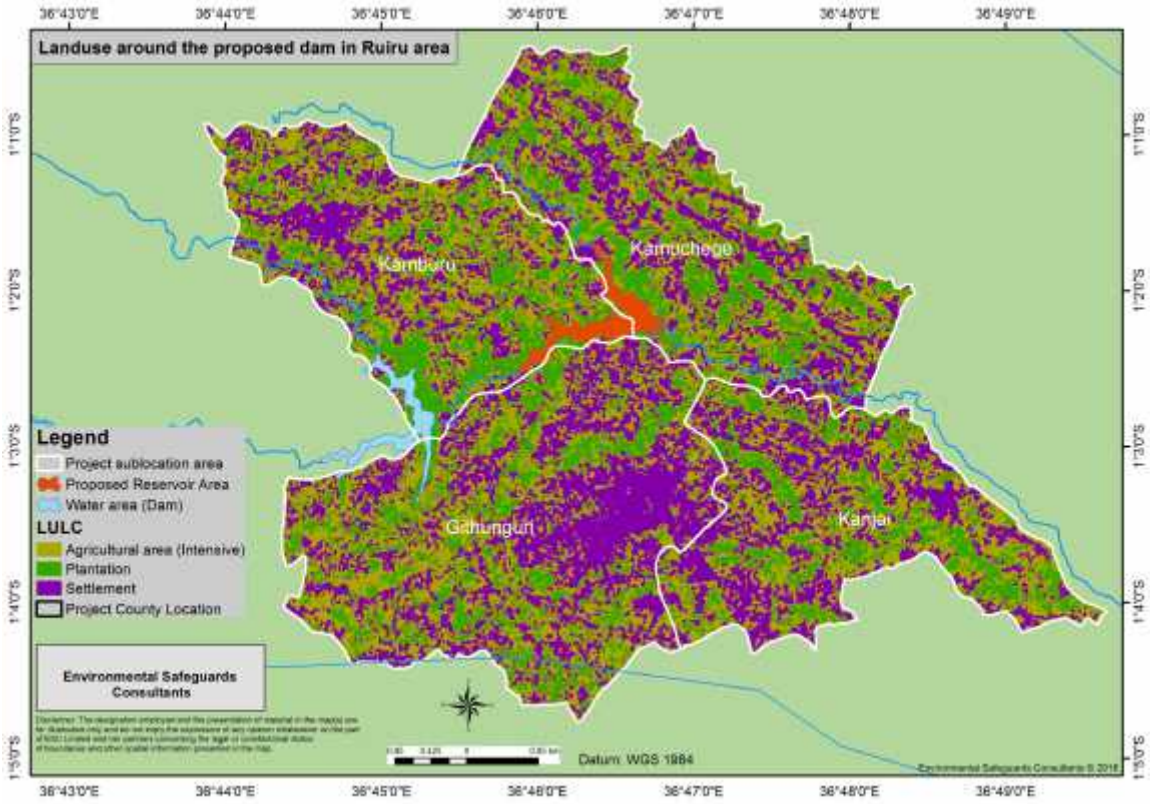


Figure 26: Sample Land Use Activities in the project area

Dairy farming

Tea buying centre

4.8.4 *Occupation*

The table below presents an overview on livelihoods in the Project area. The primary occupation of the PAPs (head of households as well as other household members) is farming (crops and livestock keeping) accounting for over 75%. There are a few PAPs who are civil servants, entrepreneurs, or self-employed.

Table 25. Primary Occupation of the Respondents

	Primary		Secondary	
	# of Respondents	%	# of Respondents	%
Subsistent trader	16	7.8%	1	0.5%
Farmer	131	64.2%	30	14.7%
Farmer-breeder	22	10.8%	64	31.4%
Builder	0	0.0%	1	0.5%
Agri worker	0	0.0%	45	22.1%
Animal breeding labor	2	1.0%	1	0.5%
Building labor	2	1.0%	0	0.0%
Self employed craftsman	6	2.9%	0	0.0%
Employment	4	2.0%	1	0.5%
Shop assistant	5	2.5%	4	2.0%
Civil servant		0.0%	1	0.5%
Other	3	1.5%	9	4.4%
Business	1	0.5%	3	1.5%
Driver			2	1.0%
No response	12	5.9%	42	20.6%
Total	**204**	**100**	**204**	**100.0**

Source: ESC 2016: RAP

Table 26. Occupation of the other members of household

	# of Respondents	%
Subsistent trader	3	1.4%
Farmer	138	66.3%
Farmer breeder	6	2.9%
Builder	1	0.5%
Agri worker	2	1.0%
Fishing/farming labour	2	1.0%
Building labor	3	1.4%
Self employed	3	1.4%
Employed	9	4.3%
Non employed home helper	1	0.5%
Shop assistant	6	2.9%
Civil servant	1	0.5%
Student	5	2.4%
Housewife	1	0.5%
Without occupation/employment	8	3.8%
Business	8	3.8%
Student	2	1.0%
Other	9	4.3%
Total	**208**	**100**

Source:ESC 2016: RAP

4.8.5 Settlement Patterns and Housing

Settlement patternsareinfluenced byecologicaland climaticfactorsincludinglandfertility,rainfall amountand type offarming practiced andcrops grownas wellasnumberandintensity of economic activitiesand access toservices(administrative, health and education). For example,cash crops such astea and coffeeattractahigh population because residents havea higher preference for cashcrops farmingcomparedto foodcrops.Anotherreasonfor clustered settlementisthe growth of market centresincludingGithunguri, KagweandNgochi among others.

Based ontheabovefactors,the projectarea hastwotypes ofsettlementsincludingclusteredand scattered settlements. Clustered settlement patternsare commonlyfound aroundthemarket centresand households with many memberswho tendtosettle oninheritedland.Scattered settlement patternsare found mostlywhereindividuals havelarger pieces of land, mainlythrough purchase or the householdcomposed of few members. Theaverage population densityin the project sublocations is 536 persons per Km2.

Generally,the projectareais densely populated which has resulted tolandsubdivisioninto uneconomically small pieces. Themaintypesofhousesintheprojectareaareindividual-ownedbungalowhouses.Thehousescan becategorized by thetypeofmaterial usednamely; wall,floor andmainroofingmaterial.

4.8.6 Education

Kiambu Countyhashigh literacylevelwhich standsat 90.1%.Theprojectareaisthuscharacterized withhighliteracylevels.ThereareanumberofECDcentres,primaryandsecondaryschoolswith in the projectareaanditsimmediateneighbourhoodaspresented below:

- NurserySchools:HosannaChildren's Home
- Schools in the area: Kamuchege Primary school, Pen Elite Academy, Kamuchege Seconday, Muthandi Primary School, Nyamuthanga, Primary, Gathima Primary, Kamburu Primary and Secondary, Kahunera Primary and Secondary school.

Figure 27: *School in the Project Area*

4.8.7 Transport Infrastructure

The projectareaisservedwith the mainGithunguri-Kagwa-KimendeandNyandumaroads linking thesame toKiambuandRuiru TownsandsubsequentlytheCity of Nairobi.Mostroadsin theareaareeither tarmackedor gravelsurfaced,though notablesections have deteriorated.Other featuresare numerous paths/tracksandroutesused bypedestrians, animalsas wellas off-road vehicles.

Thelocalpublicservicesavailableintheareaincludevansor*matatus*, minibusesandtaxisthat transportpassengerstoRuiru,Kiambu,Nakuruand Nairobicity. Motorbikesalsoknownas *"bodabodas"*transportpeopletoandfromthehinterlandthatarenotcovered bymatatus.

Figure 28: Road Network in the Project Area

	
Motorcycles	**Public Transport (matatus)**

4.8.8 Energy

Electricityis readilyavailablewith many of the marketsconnected. However,somehouseholdshave notconnecteddespiteavailabilityof theRuralElectrificationProgramme.However,somehouseholdshave notconnecteddespiteavailabilityof theRuralElectrificationProgramme.The mainsourceof energyintheareaiselectricitywhichischannelledfromThikaas the mainunitof electricitythoughthereare manyothersources ofenergysuchasfirewoodandbiogaswhich people us tocookfoodandotherhouseholdactivities.

Electricity is readily available with many of the markets connected. However, some households have not connected despite availability of the Rural Electrification Programme.

The main source of energy in the area is electricity which is channelled from Thika as the main unit of electricity though there are many other sources of energy such as fire wood and biogas which people us to cook food and other household activities.

The PAPs use electricity from the national grid for lighting (74%), followed by kerosene as shown in the table below. Other forms of lighting include, generators, candles, solar among others.

Table27. Type of Lighting in Households

	Number of Respondents	%
Electricity (public utility)	151	74.0%
Electricity (power generator)	9	4.4%
Oil lamp/lantern	14	6.9%
Kerosene lamp/lantern	111	54.4%
Wood	1	0.5%
Candle	9	4.4%
None	1	0.5%
Other	1	0.5%
Solar	2	1.0%
Total	**210**	**140.0%**

Firewood and charcoal are the most used forms of energy for cooking as shown in **table 43 below** followed by Liquified Petroleum Gas (LPG), kerosene, biogas and electricity in that order.

Table 28. Type of Cooking Energy in Households

	Number of Respondents	%
Electricity	12	5.9%
Kerosene	26	12.7%
Charcoal	102	50.0%
LPG gas	83	40.7%
Biogas	21	10.3%
Firewood	167	81.9%
Other	12	5.9%
Total	423	207%

4.8.9 Telecommunication

Onenotablepublicutilities in theareaincludetelephonelineandelectricity.Thelatteris mainlyan effortoftheruralelectrificationprogramme.Theareaiscovered wellbythelocal mobileserviceprovidersinincludingsafaricom,Orangeand Airtel.Mobilephonesarethereforecommonlyusedasthemeans ofcommunication.Therearea numberof cybercafesthatprovideinternetservices.

4.8.10 Water Supply, Sanitation and Hygiene

ManyresidentsdependonRuiru and BathiRiversfromwheretheydrawwaterfordomestic, livestock andirrigationpurposes.Anumberalsoharvestrain waterusingwatertanks,relyonnaturalsprings andwells,or areconnectedtopipedwaterwhiletheresthavedugboreholes upto 30 meters depth.

Majorityofthebenefiting residentsin theprojectareaareinrural basedsettlementcomprisingof discreethomesteadswith multiplefamilyunits.The mostcommontypes ofsanitationinthearea includeVIPlatrineswith about1%application,pitlatrineswith89%applicationandsewage connections(onlyinafew urbancenters)with7%application.Afewprivatehomesandinstitutions 3%applyseptic tanks withsoakageareas mostly onthe lowerends of thepremises. Interferenceof sanitationfacilitieswithwater sourcescannotberuled outandhenceimplications

onwaterquality.Thegeneral population seemed well educated and appreciatescleanlinessand hygieneand was observedthatresidentsarerelativelyconscious oftheirhygieneand theneed forcleanwater.Itis assumedthat significantpart ofthewatergoestowards hygieneimprovement atthehomelevel. Wastegeneratedatvariouslevelofthecommunityisgenerallyassimilatedintotheenvironment al system. Suchwasteincludes;

- Farmwastesuchas dead plant matterandlivestock manureallowedto decayinthefarms directlycontributing tosoilconditioning,
- Agro-chemicalwrappers andcontainersatthefarm level, mostlyleftto decaywhile plastics and polythene packagingare burnedatthefarms withchemicalresiduals goingintothe environment possible,
- Garbage from home levelsthat is dumped at household level, waste pits and burned whenever necessary or left to decomposetocompost manure. No materials of hazardous naturesarefound.
- Urbanwastes fromthe shoppingcenters(Kagwe, Gatamayu, Makuchege, Kanjai, Kiambururu,Kiamwangi,Kiratina, Komothai,Matati, Kibichoi, andGathuguamongother townsin theprojectarea).None ofthetownshave organizedsafewastedumpinggrounds withrespecttosources ofwaterandhavehaphazard disposal.Itwasnoted thatsignificant wastefinds itswayto thevalleybottoms especiallyduringrains.

Otherpointsof environmental degradationincludingwaterpollutionareasfollows:

- Cattle dipsat variouslocationsinthearea(mainlyalongthe mainroads)some ofwhichare servedwith waterfromKomothai water supply system(a number has been disconnected for non-payment),
- Agro-industriesincluding coffeefactories,tea factoriesand daily processing plants.Waste dischargingis directlychannelled intonaturalenvironmentsincludingrivers,
- Pesticides
- Petrolstations mostlywithintowns. Most ofthestationsare not providedwithappropriate anti-pollutionfacilities thusposing environmental hazards throughsurfacerunoff.
- Healthcenters(both publicand private)and pharmaciesin townsseem to puttogether wasteswiththe general urbanwastes for disposal. Notable centersareat Kagwe,Githunguri, KigumohealthcentreatKiratina, Kiamburu, anda host ofpharmaciesaround thearea.

4.8.11 Health

MorbidityRatesarehigherforfemalesthanmalesbuton averagestandsat28.8%.Thecommonest diseasesintheprojectareaincludemalaria (34.2%),diarrhea(29.3%)andupper/lowerrespiratory diseases(14.8%).Themaindiseasesintheprojectareaaremalaria,URTI,woundsandskindisea ses.The project area is currently served by Githunguri Hospital, whichoffers outpatient, maternity, laboratoryandpharmacyservices. Italsoserved byanumberof privateclinics.Theprevalence of diseasesistabulatedbelow:

Table: 29. Distribution of peoplesickby type ofsickness

Sickness	Prevalence	Populationcommonlyaffected		
		Men	Women	Children
Malaria	65%	X	X	X
Wounds	50%	X	X	X
UTI	30%	X	X	X
HIV/AIDS4	-	X	X	X
URTI	80%		X	X
Eyeinfections	10%			X

Source: Public Healthtechnicians

HIV/AIDS

HIV/AID isamajorhealthproblemwithaprevalencerate estimatedat4.1%.However,the prevalenceishigherinthecoffeeandteazonesand majorurbanmarkets.The maincausesofthe spreadof HIV/AIDs includeunsafesexualbehaviour, drugabuseespeciallydrinkingofillicitbrews, peerpressure, ignorance and family breakdownsamong others. The socio-economicimpact of HIV/AIDsinthecountyinclude;highschooldropout rates,increaseinfemaleandchildrenheaded families,rising povertylevels;high mortalityand morbidityratesand an increasein thenumber of OVC's inthecounty.

4.8.12 Agriculture

Theprojectareaexperiencesbimodaltypeofrainfallwherelongrainsfallbetween Mid-Marchto Mayfollowedbyacoolseasonusuallywithdrizzlesandfrostduring JunetoAugustandtheshort rainsmid-OctobertoNovember.ThusAgricultureis predominantlythe maineconomicactivityand mainsourceoflivelihoodforthemajorityofthepopulation. Itistheleadingsectoremployingover80% ofthepopulation directlyand indirectly.Theagricultural sectorin theareaisfacedwith many challengesthatincludeerraticweather,fluctuatingcommodityprices,highcost ofinputsand unexploitedpotential intradeandindustry.Theproportion ofhousehold engagedin crop growing is 75.6%.The main cropsgrownincludetea, coffee,bananasandvegetable.Themainfoodcropsgrownaremaize,beansandirishpotatoes. Othercropsgrowninclude,cabbages andavocado,treetomatoes,sugarcaneandSweetpotatoes.Crop farmersin theareahaveorganised themselvesintocoffeeandteacooperativesocieties.

Figure29: Cropsgrowninttheprojectarea

Intercroppingofmaizeandbananas

Coffeefarm

Tea farm

Treeplantation-Growingof gumtree

The mainlivestockenterprisesare dairycattle,poultry,pigsandsheep.Productiontrendsforlivestockandlivestockproductshave beenincreasing overtime.Thissub-sectorhasbeenencouragedbyareadyurbanmarketin Githunguri,KiambuandNairobioutletsandavailabilityoflocalfoodprocessingfactoriessucha s Freshmilkprocessors.Farmersintheareahave organisedthemselvesintoformidablecooperative societiessuchasGithunguri DairyFarmersCooperativeSociety.The mainconstraintstobusinessgrowthin the projectarea include,diseases,poor roadnetwork and exploitationof primaryproducersbymiddlemen.

Figure30: Livestockfarmingintheprojectarea

Sheep Rearing **Nappier Grass Cutting**

Other Economic activities

Othereconomicactivitiesin theareainclude,quarrying,firewood collection and sales,harvesting of wattlebarks,andcuttingtimber.

Figure 31: Other Economic Activities in the area

4.8.13 Poverty and Income Levels

The projectareafallswithinKiambuCountywhere absolute povertystandsat 25.08%.TheCounty's contribution to national povertyis 1.48%. Povertyin thisareais manifestedin forms ofinaccessibility to healthandeducation servicesandinadequate educationfacilities. 0.43% ofthe populationis unemployed.10%ofthepopulationin Githunguridivisionand 30%in Larilivebelowthepovertyline.

4.8.14 Trade Tourism and Industry Sector

Tradingisoneofthemaineconomicactivitiesinthe areaandisamajorsourceofemploymentand market outletforagricultural products. The marketsin theprojectareaincludeGochi,Kahunira, Githunguri, Kagwi,Kamuchenge,KahurugoandKamahindu.

4.8.15 Financial Institutions

Therearenomajorcommercialinstitutionsintheprojectareaas shown in the box below.

Box 5. Financial Institutions

1. Kenya Commercial Bank
2. Family Bank
3. Co-operative Bank of Kenya
4. Equity Bank
5. Post Bank
6. Kenya Women's Finance Trust

MICROFINANCE

1. TAI Sacco's
2. SISDO
3. MINI Savings and Loans Limited
4. Githunguri Dairy Sacco
5. K-Unity Savings and Credit Co-operative Society

6. ECLOF Kenya Microfinance
7. Faulu Kenya Limited
8. Pamoja Women Development Program

5 ANALYSIS OF ALTERNATIVES

5.1 Master Plan Alternatives

This section analyses the Project alternatives in terms of site, technology scale and waste management options. However, under this study the alternative that was considered for the project was basically as discussed in the Water Master Plan for Nairobi cityanditssatellite townsandthereforeno alternativeplans havebeen comparedunderthisstudy. The following paragraphs describethe alternativesstudiedduringthedesignlifeoftheproject.

5.1.1 Three Options of Water Supply

WithintheFeasibilityStudyand Master PlanforDevelopingNewWaterSourcesforNairobiand SatelliteTownscarried outbyEgis/MIBPin 2012,threeoptionshavebeendevelopedtoinvestigate possiblecombinationsofwatersupplysourcesand relatedinfrastructureinmeetingthegrowing waterdemandsfortheSatelliteTowns.TheseOptionsoptimisetechnicalandeconomicfactorsu nderdifferentmanagementsetups.Theoptions are defined as follows:

Table 30: Water Supply Options for Nairobi Satellite Town

Water Supply Option	Explanation
IndependentWater Supply	✓ Each Satellite Town will have its own independent water supply system. ✓ The current status quo will remain for operation and management of the ✓ Water Supply Systems for the Satellite Towns.
StrategicBulkWater Supply	✓ The focus of Water Supply is Nairobi City with off takes for en-route Satellite Towns. Satellite Towns downstream of Nairobi City Water Supply will be supplied through extensions from the Nairobi Water Supply System. ✓ A Bulk Water Provider can be appointed under this Option thereby reducing Operation and Management
MixedWaterSupply	✓ This is a hybrid of the Independent and Strategic Bulk Supply Option. ✓ The Satellite Towns will be supplied from a combination of Independent Water Sources and from the Nairobi City Bulk Water Supply. ✓ This Option will be managed partially by a Bulk Water Provider and Independent Service Providers

Threewatersupplyoptions(Independent,Bulkand Mixed supply) have been consideredand investigated to meetthe water sources development strategyfor the 13 satellite towns until 2035.

A Multi-criteriaAnalysis has beencarried outto compareandrankthe different

optionsagainstthe objectives ofthe developmentstrategy.The criteria have been selected toassessthe impact of each optionagainstthe followingsix keysustainability issues:

- Natural resources criteria
- Economic sustainability
- Technical aspects
- Operation and maintenance
- Environment sustainability: Options are compared against their downstream impacts of water quantity releases on the environment; the impact they have on water quality issues for upstream land use; and potential environmental impacts on downstream ecosystems during the construction and operational stages.
- Social sustainability: Options are compared against their potential impact on resettlement, land losses and compensation through the development of the infrastructure.

Allcriteriadonothavethe sameimportancefor therankingandaregivena weightingaccordingto theirimportancetotheassessment.Overallthenaturalresourcesaspectsareaccorded15%,economic aspects35%, technical aspects10%,operationandmanagement25%,environment10%andsocial5%.Intermsof EnvironmentandSocial sustainability,the resultswere:

Environmentconsiderations: thefourselectedcriteriaincludewaterquantity, water qualityand constructionandoperationimpacts.

- **Downstream impact (water quantity and quality):** impact of water quantity downstream on the environment: water flow patterns and water and land use. The Bulk and Mixed supply option are assessed as having some impact, while the Independent option is likely to have less impact and so scores higher.
- **Upstream impact (water quality and quantity):** impact on upstream land use, water quality, erosion, nutrients, pesticides, and runoff. The Bulk and Mixed options are assessed as having manageable issues and score midway, while the Independent option is assessed as potentially having significant issues on account of having more dams, and consequently scores lower.
- **Construction and operational impacts:** Impact on and appropriate management of downstream ecosystems during the construction and operational stages. All three options are assessed as having minimal impact and are ranked the same.

Socialcriteria: The criterion appliestoresettlement andcompensationissues andlandlostfor dam storage, pipelines,WTWsetc. retained includerelateto:

Resettlement/land losses: The Bulk and Mixed supply options are assessed as having manageable issues and are scored mid range, while the independent option is rated as having a greater risk of potential significant issues because of the greater number of dams to be constructed and associated land loss necessitating resettlement and compensation.

Afterthismulti-criteriaanalysis,theMixedWatersupplyoptionwasdefineasthemostrelevant.TheRuiru IIDam WaterSupplyProjectispartofthis optionandisgoingtobeimplementedaccordingto this conclusion.

5.1.2 Alternatives on location of Ruiru II Dam

ThefeasibilitystudyoftheRuiruIIDamwascarriedoutduringtheimplementationoftheMasterPlan. Thelocationofthe damwas optimized accordingtothe followingcriteria:

- Hydrology
- Villages and urban area
- Shape of the valley

Thehydrology ofthe northof Nairobi ismade ofparallel rivers comingfrom theAberdareranges. An importantdifferenceofwaterfallispresentbetweenNairobiand theNorthRegions. The masterplantakesintoconsideration the yield capacityof theriversandthedistancetothe distributionpoints.Theproposed damsiteislocated accordingtothese criteria.Moreover,thedamlocationisavoidinganyurbanizedarea.

Theexactlocation ofRuiruII Damdependsonthevalleyshape, whichhasadirectconsequence on theYieldcapacityofthedam.Theshapeofthevalleydetermines,firstofall,themaximalelevation ofthedam.If theriver valleyhavecrest onrightand leftbankhigh,thedamcouldbehighbut,if,in somepart ofthefuturereservoirthecrestarenotenoughhigh,thewaterwill bediverttoanothervalleyandthedamwill notbeefficient.

Furthermore,theshapeof thecrosssectionofthevalleywilldeterminethequantityof materialto installtobuildthedamandblockthewater.Morethevalleyislarge,longer willbethecrestand biggerwillbethequantityofmaterial.Ithasanimpactofconstruction costsbutalsoon environmental impactasthesurfaceofthelandrequiredforthe projectwillbelarger.Ruiru II damisplace on the mostnarrowcrosssection of the valley,justdownstreamtheBathi river and Ruiru riverjunction.

5.1.3 Alternatives studied in Conceptual Design

Thesiteselectioncriteriawerebasedonthewaterstoragecapacity,thesurfaceareacoveredand thepotentialnumber ofpeoplelikelytobedisplaced.Thesiteselectedis adeepgorgewithhigh storagecapacityand minimumeffectstosettlementswhilesectionsdownstreamalternativesare shallow valleysrequiring wideareaswithpotentialpeopledisplacementtoachievethesamestorage capacity.Severaldesignoptimizationswerecarried outduringtheConceptualDesignofRuiru II Dam.

5.1.4 Locationof the spillway

Inmanylargedams,thelocation ofthespillwaycanhavealargeimpactonEnvironmentalimpacts.

Thespillwaycouldbelocatedinanyareaaround theedgeofthedamreservoir.Insomecase,the spillwayisconnectedtoadifferentvalleythandamvalley.Thewaterisdiverted,throughthespillway inadifferentriverandthewatersurplusinthisrivercouldcauseerosionandsignificantchangeof the environment.

In Ruiru IIdam,the spillway is juxtaposed to the damand isdelivering the surplus water downstreamthedaminRuiruRiver.Thealternativeofthelocationofthespillwayistherefore relevantintermsofsocialandenvironmentalimpactsevenifthischoicewasmostlikelymotivated by thecost.

5.1.5 Internal Structure of theDam

RuiruIIDamisanearthfilldamcomposed ofclayandtuffs, whichareavailableonsiteinlarge amount.Thechoiceofthestructureofthedam,comparetoconcretedam or masonrydamiswell adaptedtotheareaandthematerialtobuilditwillnotcomefromfarplaces.

5.1.6 Alternative of "Without Project"

Thepurposeofthis projectisthesupplyofdrinkablewatertotwo satellites townsaroundNairobi.Withoutthis project,the water supplywillnotbeadequate with thewater demandandan important shortage ofwaterwillbefaced.Theactual watersupplyinKarurirepresents 20%oftheactual water demandandwillrepresent only10% ofthewaterdemandin 2030(accordingtotheMaster Plan of watersupplyofNairobi).ForKiambu,only34%ofthewaterneedissupplyanditwilldecreaseto19%in 2030.

Theshortageof waterhasimportantenvironmental andsocialimpactsonthepopulationandthe mainpurposeoftheRuiruIIDam Projectisto permittheaccess tothewatertothesatellite town KiambuandKaruri.Therefore,the "without project"alternativewill haveawideimpact onthe quality oflife on morethan 400 000people livingin Kiambuand Karuri.

6 PUBLIC PARTICIPATION

6.1 General Overview

Public participation is basically concerned with involving, informing and consulting the public in planning, management and other decision-making activities. Public participation tries to ensure that due consideration is given to public values, concerns and preferences when decisions are made. It encompasses the public actively sharing in the decisions that government and other agencies make in their search for solutions to issues of public interest.

Public consultation in this project was carried out with the following aims:

- To inform the local people, leaders and other stakeholders about the proposed project and its objectives
- To seek views, concerns and opinions of people in the area concerning the project
- To establish if the local people foresee any positive or negative environmental effects from the project and if so, how they wish the perceived impacts to be addressed

6.2 Public Consultation Methodology

The ESIA team conducted public participation within the project area in order to give the community a platform of expressing their environmental and social concerns; the team also conducted institutional consultations with all relevant lead agencies.The table below illustrates the identified stakeholders consulted.

Table 31: Stakeholder Mapping Checklist

Primary Stakeholders		
No	**Name**	**Category**
1.	Athi Water Services Board	Project Proponent
2.	Project Affected Persons	Project Affected Persons
3.	Governor Kiambu County	County Government
4.	Members of County Assembly	
5.	County Commissioner Kiambu	National Government Administration
6.	Deputy County Commissioners from Lari and Githunguri Sub-Counties	
7.	Members of Parliament from Kiambu County	National Legislature
8.	Water Resources Management Authority	Water Regulatory Body
9.	Githunguri Water and Sanitation Company Limited	Project beneficiaries
	Kiambu Water and Sanitation Company Limited	
	Karuri Water and Sanitation Company Limited	
10.	Water Users Association	Water Users of Bathi and Ruiru Rivers
Secondary Stakeholders		
•	Coffee Drying Centre	Large Water Consumers
•	Sub-County Water Officer	National Government Agencies

Primary Stakeholders		
No	**Name**	**Category**
•	Physical Planning Office	and Ministries
•	Public Health Officers	
•	NEMA County Officer in Kiambu	
•	Agriculture Officers – Sub-county Agriculture Officer and Sub-county Livestock Development Officer	
•	Sub-county Lands Registrar;	
Tertiary		
	Non Governmental Organizations operating in the project site	In the following sectors: • Environmental Management; Water, Rural and Community Development; Vulnerable Groups

6.3 Initial Interviews

Interview of the stakeholders was undertaken during the ESIA study process. The principle was to assess the initial opinions and attitude of the stakeholders to the project including all the components. Categories of stakeholders contacted include:

- Project Affected Persons, community members and opinion leaders of the project locations (Githunguri, Ndumberi, Karuri, Lari and Kamuchege)
- Members of Local Administration, County Government and Water Services Provider (Kiambu Water and Sewerage Company and Karuri Water and Sanitation Company)
- Kiambu County Government (County Executive Committee Member for Water and Environment and County Executive Committee Member for Land)

6.4 Socio-Economic Survey

This process involved an Economic and Social Surveys conducted on both the Project Affected Persons and general community through direct interactions with the local communities and other stakeholders and also through questionnaire administration. The socio-economic survey included a complete census of the PAPs in the reservoir area and random sampling for PAPs along the pipeline route.

A quantitative survey was conducted at village level using structured questionnaire and it was designed to generate the required information. The information was used to answer questions related to status of social and economic parameters within the project site including, the availability or lack of social service facilities, existing levels of access to education, health, potable water and related services, local market prices as well as agricultural production and productivity, all of which were useful in valuation of assets and computation of compensation rates.A series of consultations were held using both formal and informal meetings with carefully selected members of the communities and all PAPs.

The purpose of this survey was to identify types of impact and accordingly categorize displaced persons, develop entitlements and prepare resettlement plan for each family.The following information about each family was collected.

- Human resource base of each family.
- Economic status of each individual member of the family.
- Ownership of property – movable and immovable.
- Property including lands, structures, trees and houses either occupied or owned with tenancy rights or even as encroachers or those de-facto in possession.
- Means of livelihood due to stagnation of developmental activities soon after the project, loss of property, loss of access to clientele, loss of jobs due to physical re-location, loss of gainful employment, loss of access to income generating resources.
- Community life, community properties and resource base, community amenities and services, socio-cultural value.
- Loss of habitats and lands, degradation of land and water resources, environmental degradation, adverse impact on health etc. as an after effect of the project.

6.5 Public Consultative Forums

6.5.1 Consultation Schedules

Formal public consultations were undertaken in two sessions within the month of February and March 2016; this involved a sensitization forum followed by consultation meetings. The sensitization forum was designed in an attempt to bring the project concept down to the people and stakeholders as an initial formal contact.

This session was also held in two sub-sessions at different locations within the project area. The objective was to present the proposed project concepts and early anticipated linkages to the stakeholders. It was anticipated that the stakeholders would react and provide their views and opinions on the project to add value to the design and planning as well as enhancing social and economic benefits an as well as avoiding potential cultural conflicts.Participants to the meetings were drawn from the following groups and organizations. Table 19 overleaf indicates the schedule of meeting held in the project area during the assessment.

Table 32: Schedules of Meetings

Date	Institution / Affected Party	Meeting Agenda	Participants
19/2/2016	Pen Elite School	Planning Meeting with Dam Committee	1. Joseph Gachoka – Dam committee - Kamburu 2. KagoWainaina - Dam committee - Kamuchege 3. Simon Kiragu - Dam committee - Kamburu 4. Samuel Wainaina - Dam committee - Kamburu

Date	Institution / Affected Party	Meeting Agenda	Participants
			5. Charles Ngugi -Dam Committee - Ngochi 6. SsamuelMbuthi - Dam Committee – Kamuchege 7. Godwin Sakwa Lidahuli – Environment Safeguards Consultants 8. Peter Obiero – Environmental Safeguards Consultant
21/02/ 2016	Kahuroku Market	Public Participation	1. Joseph Gachoka Dam Committee -Secretary 2. Samuel Wainaina Dam Committee 3. .MonicahMwaura Dam Committee Treasurer 4. Hannah W.Njuki Dam Committee 5. Samuel Kaso Dam steering Committee 6. Simon T. Kirago Dam Committee Member 7. Peter Chege Dam Committee Chair Man 8. DorcusKinja Dam Committee 9. Stakeholders as per attached attendance list. 10. Godwin Sakwa Lidahuli Environment Safeguards Consultants 11. Peter Obiero - Environment Safeguards Consultants
3/3/20 16	Enumerators training meeting	Pen Elite School Githinguri	1. Mary Muthoni – Enumerator 2. Alec Muchina – Enumerator 3. Patrick Njuki – Enumerator 4. Fred Kimani – Enumerator 5. George Macharia – Enumerator 6. Simon Kamau – Enumerator 7. Simon Mwaura – Enumerator 8. Monica Wangui – Enumerator 9. EvelyneWangare – Enumerator 10. Joseph Karanja – Enumerator 11. Florence – Mburu – enumerator 12. Reagan Ayieko – Environmental Safeguards Consultant
19/03/ 2016	Komothai Chiefs Office	Public Participation	1. James G. Kimani – Assistant Chief Nyaga

Date	Institution / Affected Party	Meeting Agenda	Participants
			2. Peter Njoroge - Assistant Chief Kamburu 3. J. N Kago – Chief Komothai 4. Mark Owuondo - Environmental Safeguards Consultant 5. Reagan Ayieko – Environmental Safeguards Consultant 6. Attendance list of public participation attached
19/03/2016	Meeting at Karweti Coffee Factory	Public Participation	1. JameGitau - Chief Kamuchege 2. MilkahNnjega – Ass chief Kamuchege 3. Stephen Thinja – Chief Githunguri 4. Stehpen N Mwangi – Chief Assistant Chief Githunguri 5. Paul K Kimani – Member of county Assembly (MCA) Kamburu 6. Godwin Sakwa Lidahuli Environment Safeguards Consultants 7. Peter Obiero - Environment Safeguards Consultants 8. Attendance list of public participation attached
16/3/2016	Kiambu County Government	Institutional Consultations	1. Esther Njuguna – CECM Water Environment and Natural Resource 2. Eng. John Muhia – Chief Officer Water Environment and Natural Resource 12. Godwin Sakwa Lidahuli Environment Safeguards Consultants 13. Mark Owuondo Environment Safeguards Consultants
16/3/2016	Kiambu Water and Sewerage Company	Institutional Consultations	1. Boniface Mbugua - Ag Managing Director 2. Beth Muigai – Technical Manager 3. Godwin Sakwa Lidahuli Environment Safeguards Consultants 4. Mark Owuondo Environment Safeguards Consultants
16/3/2016	Kiambu Sub Region	Institutional Consultations	1. Pascal Njau - Water Resources Management Authority

Date	Institution / Affected Party	Meeting Agenda	Participants
			2. Joseph Mutunga - Water Resources Management Authority 3. Godwin Sakwa Lidahuli Environment Safeguards Consultants 4. Mark Owuondo Environment Safeguards Consultants
19/2/2016	Githunguri Sub County	Institutional Consultations	1. Mr. J M Mutula – Ass – Assistant County Commissioner 2. Godwin Sakwa Lidahuli Environment Safeguards Consultants 3. Mark Owuondo Environment Safeguards Consultants 4. Reagan Ayieko – Environmental Safeguards Consultant
18/2/2016	Githunguri Water and Sanitation Company	Institutional Consultations	1. KagoWainana- Githunguri Water and Sanitation Company 2. Mr.King'ori Joseph – Technical Manager Githunguri Water and Sanitation Company 3. Godwin Sakwa Lidahuli Environment Safeguards Consultants 4. Mark Owuondo Environment Safeguards Consultants 5. Reagan Ayieko – Environmental Safeguards Consultant
17/3/2016	Local Administration	Institutional Consultations	1. J.N Kago- Chief Komothai 2. M.M Mbugua- Chief Ngewa 3. B.M Njuki – Security Komothai 4. Stephen Warui- Chief Githunguri 5. James – Gitau – Chief Kamuchege 6. Godwin Sakwa Lidahuli Environment Safeguards Consultants 5. Mark Owuondo Environment Safeguards Consultants 7. Reagan Ayieko – Environmental Safeguards Consultant

6.5.2 Emerging Issues

From all the Consultation forums, various opinions and views were collected. Among the emerging issues ranged from personal linkages, community linkages to county and nations issues. The project is generally acceptable to a majority of the stakeholders and members of public but conditions of acceptance were as varying as were the stakeholder categories. The following sub-sections have presented the key perceived benefits, fears

and concerns as well as suggestions and opinions on improvements and enhanced acceptability.

6.5.3 Perceived Benefits

- The dam is expected to create significant economic and social benefits to the communities and contribute to the attainment of the country's priority goals and ongoing national efforts to accelerate economic growth and alleviate poverty.
- Construction and operation labour: Requirements of the scheme will provide employment and career opportunities for the local people. During the construction period, dam projects require a large number of unskilled workers and smaller but significant numbers of skilled personnel (though the latter may not be sufficiently available in the area). New jobs will, therefore, be created both for skilled and unskilled workers during the construction phase. The beneficial effect on local communities is often transient due to the short-lived impact of the construction economy on dam construction sites.
- The community will be assured an all year round access to water from the dam, directly or through alternative distribution systems (piped supply).

6.5.4 Fears and Concerns

The concerns listed below formed the main issues discussed during the open public meetings held with the community in the project area. Specifically the concerns were;

- The people to be displaced expressed concern on where the alternative settlements will be as a result of displacement and wanted to know there was government land available for the affected persons.
- The issue of relocating graveyards also was a great concern during the meetings held with the affected person.
- Affected persons wanted a clarification on whether the area shall benefit from the project in terms of water supply; they also wanted to know whether construction of the dam shall compromise water availability downstream.
- Landowners who do not have land ownership documents due to un-concluded land subdivisions and registration process requested to be allowed time to conclude the process before resettlement process
- The landowners in the affected areas expressed concern that the extent of the dam water and buffer area had not been marked on the ground. This makes it difficult to visualize how much land and development is likely to acquire.
- The water body will have the capacity to attract new species of animals among them crocodiles, hippos, snakes, birds and new insect types. This scenario may partly contribute to safety risks to the residents from dangerous animals such as crocodiles and hippos unless collaboration with relevant authorities (e.g. KWS) is considered during the operation stage.
- Potential damage to and loss of productive farmland. Destruction of community productive bases in agriculture, fisheries and income generating potential will give rise to food shortages, leading to hunger and malnutrition.
- Widened gender disparities will be experienced. This will be occasioned by either imposing a disproportionate share of social costs on women or through an

inequitable allocation of the benefits generated. The general impoverishment of communities and the social disruption, trauma and health impacts resulting from displacement will typically have more severe impacts on women. The employment created during the construction of large dams generally benefits men.

- The project is likely to separate kinship, disrupt social networks and interfere with traditional support systems leading to serious conflicts at various levels within the project area and at host destinations.
- A majority holds that 'real economic returns from water resource development projects may be seriously compromised by enhanced disease transmission of vector-borne diseases.
- Land acquisition is expected to lead to physical and economic displacement of people and loss of access to the land that provides for economic resources as well as shelters.The land already identified for the construction is owned by different individuals who are utilizing the pieces of land into various land uses ranging from shelter/home, livestock keeping and subsistence agriculture.

Table 33: Key Institutional Consultations Summary

Stakeholder	Persons interviewed	Objective	Response
Kiambu County Government	Esther Njuguna – CECM Water Environment and Natural Resource	To introduce the project to Kiambu County Government	Kiambu County Government support the Project. The county government emphasised on the need to be informed on the status of RAP and land acquisition process and milestone The county government emphasized the need of working together to ensure success of the project
Githunguri Sub County	Mr. J M Mutula – Ass – Assistant County Commissioner	Introduce the project to County Commissioner of Githunguri and Lari	Githunguri and Lari Sub county support the project The county commissioner will provide a coordination role during RAPimplementation
Water Resources Management Authority (WRMA)	Pascal Njau - Water Resources Management Authority	Introduce the project to WRMA Kiambu Sub region	WRMA support construction of the project Athi Water to officially apply for a water abstraction permit from WRMA as guided by the Water Act 2002 Athi Water to undertake ESIA,RAP and hydrological study, this assessments are required as in order to obtain

			water abstraction permit
Water Service Providers (Karuri, Kiambu and Githunguri)	Mr KagoWainana and Mrs Beth	Introduce the project to WSP	The WSP support the project WSP requested for timely information sharing between Athi Water Services Board and relevant WSP concerning the project WSP will support Athi Water Services Board in implementing the project
Local Administration	Mr. James Gitau Chief Kamuchege Locationn	To introduce the project to the chief Kamuchege location	The administration of Kamuchege location supports the project The chief Kamuchege location will help the consultants during identification and consultation of PAPs
Local Administration	Mr. JN Kago Chief Komothai Location	To introduce the project to the chief Komothai location	The administration of Komothai location supports the project The chief Komothai location will help the consultants during identification and consultation of PAPs
Local Administration	Mr. StephenWarui Chief Githunguri Location	To introduce the project to the chief Githunguri location	The administration of Githunguri location supports the project The chief Githunguri location will help the consultants during identification and consultation of PAPs
Kiambu County Government	Esther Njuguna – CECM Water Environment and Natural Resource	To introduce the project to Kiambu County Government	Kiambu county government Supports the Project The county government to be informed on the status of RAP and land acquisition The county government emphasized the need of working together to ensure success of the project

6.5.5 Key Suggestions and Opinions

- An appropriate information dissemination plan to be established between the all players in the project with clear flow of information

- Athi Water Services Board is working with Githunguri Water and Sanitation Company to implement several projects upstream the dam, which shall provide water to residents around the dam. Example of the project is the Githunguri water supply project and Makuyudam project
- The EMP has proposed formation and strengthening of Water Resources Users Association along Ruiru river so as to act as community watchdog and help in management of the river catchment
- A Resettlement Action Plan (RAP) is one of the major means of addressing these problems in a planned and coordinated manner.

Figure 32: Public Participation Photos

Pubic meeting at Kahuroku Market Centre


Public meeting at Karweti Coffee Drying Centre and Komothai Polytechnic


Dam Committee Meeting with (Coface and Athi Water and ESC)

7 ENVIRONMENTAL AND SOCIAL IMPACTS ASSESSMENT AND MITIGATION MEASURES

7.1 General Overview

This chapter presents the assessment of the issues likely to arise as a result of implementation of the proposed project.

Construction of large dams provides ecological as well as social challenges even though the ultimate facility is generally beneficial to the stakeholders and the country in general. Impoundment of large volumes of water has implications on the upstream systems through shifting of ecosystem boundaries upstream as a result of changes in flood regimes. At the dam site itself and the inundated areas, implications ranges from slowed silt, nutrients and pollutant transportation rate to downstream zones, potential loss and/or introduction of species (both plants and animals), displacement of social and economic features and land use changes for the residual riparian landowners.Finally, downstream impacts are associated with regulated flows of the affected rivers/streams, shifting of species to upstream areas, safety risks and land use changes due to the constant flows trends introduced by the dam.

7.2 Potential Positive Impacts

The overall impacts arising from the dam construction are positive in all respects of environmental, social and economic perspective. Once constructed, Ruriu II dam water project will supply water to Kiambu and Karuri Satellite towns. This will have major positive impacts on economic growth of the regions. More specific environment and social benefits associated with dam constructions as illustrated below;

7.2.1 Positive Environment Impacts

- The dam is expected to moderate water flows downstream of Ruiru River throughout the year with potential ecological stability and constant availability of water to the downstream dependants and ecological productivity within the river basin.
- The dam will also moderate the micro-climatic conditions of the immediate surrounding areas through increased humidity and/or cooling effects to the comfort of the residents.
- The dam water has the potential to sustain ecological habitats (particularly indigenous) including vegetation and aquatic and terrestrial wildlife (fish, crocodiles, hippos, snake species, etc.) this shall eventually increase the biological species diversity of the area.
- The general hygiene and sanitation of the project area and the service area will significantly improve as a result of readily available water, and particularly from auxiliary the treated water supply,

7.2.2 Positive Social Impacts

- The Ruiru II Dam Project will stimulate the local economy, creating job opportunities, local activities through procurement of construction material and

provision of required labour. Furthermore, the purpose of the project is water supply, which has an indirect impact on quality of life, education of girl child as it removes the burden of collecting water.

- It is expected that Ruiru II Dam Water Project will enable easy access of water for the immediate residents as an immediate social benefit. However, this would be on controlled basis. At the moment, the immediate residents have to get water from the deep valleys, shallow wells or drive to the nearest accessible Ruiru river section for bulk water requirements. The project could maximize the local use of the reservoir water.
- The standard of living of the beneficiary residents will improve such as to include income generation and productivity, housing, health and hygiene, etc.,
- The distances travelled 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,
- Overall increase of the total population and density as people are attracted by the high potential in economic production. This will provide ready markets for goods and services and reduced rural-urban migration as people are employed in the upcoming opportunities in the area.
- Raising the population growth and density resulting from natural growth and immigration that further enhances the availability of cheap labour and provision of ready markets for goods and services thereby spurring economic growth of the area.
- Upgrading of certain roads, necessary for the construction and maintenance of the dam, will also contribute to a better transport and travel networks in the area. This will have positive social and economic impacts in the area.

7.2.3 Positive Economic Impacts

- Potential appreciation of property values including significant increase the price of land and associated development.
- The project will be a major boost to realizing the vision 2030 and achievement of theSDGs through eradication of extreme poverty and hunger by enhancing income sources and food security,
- Provision of water from the proposed dam has the potential to enhance development and growth of local markets as more economic and social interests arise. More important is the opportunity to improve sanitation and hygiene in these markets as opposed to the currently potential threat of diseases in almost all the markets.
- Reduced poverty levels, increased incomes and improved livelihoods resulting from dam construction and maintenance employment and consumption from the local markets, emergence of other associated economic opportunities and activities including tourism, fishing, trade, production of high value crops and transport among others. Further, these will increase the Gross Domestic Product (GDP) of the area as well as the tax base for the government

7.3 Physical Environmental Adverse Impacts and Mitigation Measures

7.3.1 Sedimentation

Construction

The project construction shall involve massiveearth moving within theriverflood plainsand sections of theadjoining riverbanksand lands. This loosening of thesoil and thesteep slopeterrain willcreateasituationwhereanyheavyrainswillfreelywashdownthesiltintothedownstream areas.The siltsowasheddown maycontainhighlevelsof organic matteranddepositionof this may leadtoanoxicconditionsinthelowerwaterlevels withpotentialriskstotheassociatedaquaticlife.Construction ofthedamis alsoassociatedwithroads andotherinfrastructuredevelopments, which will contribute to vegetation clearance,hencecontributetosiltation tothereservoir, increasing sedimentlevels.

Operation

Generally,damsandreservoirs holdapproximately 90%ofsedimentsfromthecatchments.The sedimentsgenerated dependonthecatchmentcharacteristicsi.e.soils,topographyandvegetation cover. Theslope of theriverisestimated atlessthan1%aroundthefuture damand theflowis physicallysluggish,asituationthatindicatesahigherretentionandstorage capacityandability compared tothetransportation speed. Duetothecontinualsiltation ofthedam and the overloading of thedam, effectscouldbefeltupstreamofthe riverbasinanditstributaries.

Accordingtothe Master PlanofWatersupply ofNairobi,afirstapproximation ofthesedimentation canbedone. IntheexistingThikaDam, thedesignwasusingthefollowingcriteria:

- Sediment deposit density about 1.3 T/km3
- Annual unit sediment yield for Thika catchment about 340 T/km2/year.
- Average annual sediment volume inflow = 20,000 m3

TheAnnualunitsedimentyieldofRuirucatchmentcanbeassumedasThikacatchmentsincethe vegetationcoverissimilar.Inthiscase,theaverageannualsedimentvolumeinflowwillbeaverag e

- 35 000 m3/ year with a total reservoir volume of 7 500 000 m3. In 50 years, less than 25% of the dam will be filling by sediments.

The above estimationdoes not take intoaccounttheseasonalflushingofthedam, whichreduces the sedimentationinsidethereservoir.

MitigationMeasures

Itis recommended that construction be undertaken during the dry conditions to minimize erosion when the soil is loosened. The topsoil removed will be required to be moved to an alternative site where storm water cannot carry the soil to the streams.

- A water pan (silt trap) may be established downstream of the dam which will act as a soil trap to hold the excessive silt during construction.
- The steep slopes surrounding the dam construction should be stabilized, compacted and strengthen to reduce on erosion and potential landslides as a result of deep cutting, drainage channels should be installed only when necessary,
- Encourage re-afforestation and improved farming systems upstream of the dam,
- Local residents are using the river water as principal source of water (drinking water).The residents should, therefore, be provided alternative access to clean drinking water during the construction period. Such as to include additional shallow wells, access to other streams or delivery of clean water with tankers to schools and institutions,
- Erosion and sediment monitoring and control plan should be prepared for the lifetime of the project.
- Seasonal flushing of the dam should be done and should be synchronized with the Ruiru I dam flushing.
- There should be a progressive catchment management plan targeting Ruiru and Bathi River sub-basins. In this regard, involvement of the communities, landowners and relevant authorities will be necessary.

7.3.2 Water Quality

Construction

The project civil works are likely to alter the waterqualityinthelocalwatermainly due to siteclearingandthedisruption ofthe naturaldrainagepatterns. Thefarmingactivitiesandtheconstructionphase oftheprojectmay encourageincreasedwaterturbiditywithin thedam reservoiranddownstream.Therewillalsobe potentialwatercontamination fromhydrocarbonsmainlyfromthe contractor'smachineries.

Operation

- The project area is characterized by agricultural activities (farming and livestock keeping) with community settlements. The factors most likely to affect the water quality are biomass (crops and animal waste), agro-chemicals (pesticides, chemical fertilizer), which are used in the farms.
- As a result of these, water stored in a dam or reservoir is subject to undergo certain physical, chemical and biological transformations. These phenomena are induced by climatic conditions (heat exchanges, aeration, etc.), chemical exchanges from geological formations, aquatic chemical reactions and material degradations among others as well as biological reactions associated with the organic materials decaying (biomass andhumic matter decomposition).

- Nutrients deposited into the dam may lead to eutrophication and growth of the aquatic vegetation hampering the natural flow of the river.
- On the other hand reduction in the flow of water downstream will consequently result to increased concentration of pollutants downstream especially during the dry season.
- There are also potential risks of water quality contamination from criminal acts.

Mitigation Measures

- Local residents are using the river water as principal source of water (drinking water). The residents should, therefore, be provided alternative access to clean drinking water during the construction period. Such as to include additional shallow wells, access to other streams or delivery of clean water with tankers to schools and institutions,
- Define a 30m buffer zone for reservoir protection against siltation, waste deposit and sewage, pesticide use and to reduce chances of water contamination, but from site visit, no latrines or graves has been noticed in the reservoir area,
- Increase of aquatic macro-fauna along the periphery of the dam to ensure natural aeration of water,
- Encourage re-afforestation and improved farming systems upstream of the dam,
- Identification of point sources of water pollution for management,
- A water quality monitoring system will be institutedincluding maintaining appropriate records on water quality,
- Encourage regular maintenance and monitoring of the dam,
- Best management practices will be utilized during site clearing and construction to minimize erosion and sedimentation,

7.3.3 Water Loss

Developmentofthedammaycreatepotential microclimateduetochangesintheairmoisture,air temperatureandair movementwithinthesurroundingprojectarea. Presenceof surfacewater increasesevaporationandmayhaveamoderatingeffectontemperaturealthoughwithlittleeffec t onthelocalclimate.

- The evaporation rate from existing dams (Sasumua dam, Thika dam and others research station) indicate an evaporation average rate of 1 500mm/year for an open surface water. The means daily ground evapo-transpiration is 4.3mm per day. If the ground was always wet, the equilibrium will be done between open surface water evaporation and ground evaporation of the same area (ground evaporation before reservoir created and open water surface evaporation after reservoir created). But the climate of the area let the ground dry during the dry season. The water loss assessment over one year will should more important water loss due to constant open surface evaporation. Nevertheless, the Master Plan shows that the water supplies of Nairobi and satellite towns are not sensitive to evaporation loss and the hydrological study conducted as part of the ESIA also confirmed that losses related to evapo-transpiration are insignificant. This issue will be considering into the detailed hydrological study of the project.

- More, another important water loss of the dam system is the seepage. From preliminary design of Ruiru II dam, the seepage is assumed to be less than 10l/s. This issue will also be considering in the dam design.
- During operation of the project there may be potential water loss at consumer points through wastage, leakage in distribution pipes and overuse through irrigation. This risk has been partially considered in the dam design as the daily intake flow inside the raw pipes is 43,978m3/day for a final treatment of 40,000m3/ day.

MitigationMeasures

- Geological profiles throughout the area proposed for inundation should be continuously monitored and areas of weaknesses noted for incorporation of appropriate strengthening measures.
- Sub-surface water infiltration trends on affected areas should be monitored over a period of time with respect to effects on houses and other structures downstream. However, it is noted that there might be no residuals on the lower zones of the dam.
- Indigenous trees and shrubs with low water dissipation capacity should be encouraged around the dam buffer zone to minimize loss of water throughevapo-transpiration processes.
- Ensure enhanced monitoring maintenance of the transmission and distribution pipelines upon commissioning to ensure minimal loss of water through leakages,
- Creation of awareness on water resource management and conservation.
- Ensure proper maintenance and monitoring of the water piping and supply system
- Introduce economic and financial initiatives towards water saving and responsible utilization at all consumer points.

7.3.4 Air Quality

Construction

The main sourcesofemissionsduringconstructionincludedustrelatedtositeclearing,earthworks, trafficmovements,loading andunloadingofmaterials,stockpilingofspoil. Dusts emissions mayalso be generated at materialborrowpitsand theconcreteprocessingplant. Inaddition exhaust emissionsfromthe contractor's machineryand vehicles could contributetoair pollution. The changestoair qualitymayaffectthe residents,agricultural cropsaswellasthenaturalflora.

Theairqualitycouldchangeafterdamreservoirfillingduetohumiditypresence. Nevertheless,from experienceonotherexistingdamsonthearea,thereisnotsignificantimpactonairquality.The onlyslightimpactcouldbe:

- Limited benthic conditions in the deep levels of the dam water could emit methane and other gases arising from partial anaerobic conditions
- Presence of heavy vegetation in the area will significantly moderate effects of dam related emissions

MitigationMeasures

- Ensure proper maintenance of the construction equipment and machinery.
- Practice dust control measures.
- Limit speed limits for the construction machinery and contractors vehicles.
- Ensure effective scouring of the dam to reduce silt and also accumulation of benthic layers
- Evaluate opportunities of full/partial removal of vegetation in order to limitgreenhouse gas emission.

7.3.5 Hydrology

The proposed dam is intended to impound 7,500,000 m3 of water to meet the two towns' combined ultimate water demand of 40,100 m3 per day. As per the Water Act 2002 and WRM Rules 2007, the dam is expected to harvest floodwaters, i.e. the flow above the Q50 discharge and store it for use during the dry seasons. From the flow duration of the Ruiru and Bathi rivers, they record an annual discharge of 6.46 and 2.82 Mm3 respectively at the Q50 threshold for flood flow. These flows are sufficient to meet the dam's demand as well as other users who have been allocated floodwater from the two rivers.

Construction

Construction activities are not anticipated to manifest any impacts to the local hydrology. However, training of the river and its tributaries may have limited implications to the local flow regimes that will, only last during the construction period. Thehydrologicalimpactmainlydependsonthedesign,purpose andthedamoperation. Dam constructionmayinterrupttheriversystemresultingtodirectconsequenceofchangeintheriver flowpatterns, sediment transportas wellaschangeintheriverdischargepatterndownstream ofthe dam. Changeintheriverhydrologymayconsequentlyalsohaveaneffectontheaquatichabitat suchasanimpactof fish breedingandmigrationhencehabitatloss.

Operation

Depending on the dam design, the flow regime of Ruiru River could change for considerable distance downstream.

Flow Duration Analysis

To assess the availability of water resources for the purposes of allocation and management, flow frequency analysis establishing frequency of occurrence of specific river flows are undertaken.The Ruiru and Bathi rivers have regular gauging stations with daily discharge data for 27 and 37 years respectively though with some gaps. In order to develop the flow duration values, the data from the two stations has been used.

In flow duration analysis, naturalized or present-day historical discharge records are analyzed over specific durations to produce curves displaying the relationship between the range of discharges and the percentage of time each of them is equalled or exceeded. This analysis establishes the catchment yields at various percentage reliabilities upstream

of the gauging station with particular emphasis on the 95%, 80% and 50% reliability yields.The water resources management rules define flood flow as any flow that exceeds the Q50 flow value, i.e. the flow that is equalled or exceeded fifty percent of the time and, normal flow as that flow, which exceed the Q80 flow value. The flow duration analysis for the discharge at RGS 3BC07 and 3BC09 are depicted in following tables while the flow duration curves for the same are depicted in the figures.From the above analysis the following flows have been calculated:

Table 34: Flow Analysis

River	***Q95****(m3 per day)*	***Q80****(m3 per day)*	***Q50****(m3 per day)*
Bathi (3BC09)	1,037	3,456	10,973
Ruiru (3BC07)	2,160	4,576	28,685
Total	***3,197***	***8,032***	***39,658***

From the analysis, the following key issues are observed:

i). The Normal Flow (Q80) at the dam-site is estimated at 8,032 m3 per day and represent the net volume that is available for allocation to uses as specified in the WRM Rules 2007;

ii). The flood flow (Q50) at the dam-site is estimated at 39,658 m3 per day and represents the net volume that is available for allocation. It is this part of the flow that is normally targeted for harvesting in water storage structures;

iii). The flow duration analysis of the two rivers shows a total annual discharge of 60.6 Mm3 and 99.2 Mm3 for the Bathi and Ruiru rivers respectively.

Minimum Annual release for ecological considerations-Environmental Flows

The environmental flow (Q95) at the proposed dam-site is 3,197 m3 per day and this is not available for allocation to any use and should remain in the watercourse. This amount is the minimum that should be maintained at all times downstream of the dam.

In terms of compensation flow, the amount released should be the equivalent of the inflow into the dam during the low flow season. The amount in addition to the environmental flow has been determined by a monitoring station located just upstream of the dam (as required by Sec 63 (1) of the Water Act 2002) and will be expected to cover:

a). Downstreamdemandsfrom communities, households, agriculture (crops and livestock), and commercial or industrial requirements,

b). Environmental flows of sufficient quantity to prevent critical decline of downstream aquatic environments,

c). The maintenance of water quality (including the requirements related to sewage treatment and disposal), and

d). Flow for Satellite towns (Karuri and Kiambu) water supplies whilst taking account of available storage in reservoirs.

The dam will be constructed across the Ruiru River and will impound the water flowing into the dam.From the available water allocation data, there are some abstractors who

have been allocated water downstream of the dam and it is important that their right to water, even during the dry season is assured.To achieve this, water levels and water quality will be monitored at the RGS 3BC07 and 3BC09 and also a gauge to be installed in the dam.

Inthedesign,thecompensationflowwassetsuchthatflowbelowthedamwouldneverfallbelow the95%flowcalculatedfromadailyflowdurationanalysisforthenaturalisedflowat the diversionpoint.This isthe natural flowthatisexceededonaverage95%of thetime.

Mitigation Measures

- Ensure compliance with water resource regulation at all times,
- Maintain the required ecological flow based on the calculation and findings of the hydrological assessment study in order to sustain ecological and social requirements downstream,
- Provide mandatory buffer area (30m) for conservation of the river line and dam ecosystem through the review of riparian land ownership,
- Installing gauging stations for monitoring the river basin
- Adequate catchment protection measures be put in place to ensure the catchment is maintained in a healthy status to reduce soil erosion and sedimentation;

7.3.6 Climate Change Issues

RuiruIIdamhaslinkagestoclimatechangeaspectsjustlikeotherdamselsewhere.Theeffectsare associatedwith thefollowingissues,

- The dam construction will require removal of vegetation including tree cover affecting the carbon absorption and retention capacity for the area.
- Inundation of the dam site will create benthic conditions at the dam bed with potential for release of greenhouse gasses among them methane due to degradation of biomass.

MitigationMeasures

- Integrate a tree planting and catchment management initiative for compensation of the emissions
- Evaluate opportunities of full/partial removal of vegetation in order to limited greenhouse gas emission.

7.3.7 Noise and Vibration

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

There are several sources of noise during construction and operation. Noise may not only be a nuisance but can also be detrimental to the health of exposed persons depending on the magnitude and exposure period. In addition, excessive vibrations may be detrimental to structural integrity of nearby/affected installations. Construction related activities that will impact on environmental noise and vibration levelstypically include bulk earthworks, metal works, concrete works, traffic-generated noise andworks associated with the establishment of plant infrastructure,office buildings, campsite and support infrastructure.

However, any construction noises will be intermittent and mainly affect people working within the dam area and rarely those settled along the haulage routes. With appropriate mitigation measures for occupational exposure, the net impacts of noise and vibration are anticipated to be low - medium in magnitude.

Mitigations

- Encourage the adoption of low noise technology and practice for construction machines;
- All diesel powered construction equipment and plant vehicles must be kept at a high level of maintenance. This must particularly include the regular inspection and, if necessary, replacement of intake and exhaust silencers. Any change in the noise emission characteristics of equipment must serve as trigger for withdrawing it for maintenance;
- Limit construction activities to the day time only (indicated in NEMA license conditions to be between 0800 Hrs and 1700 Hrs) since noise impacts are most significant during the night; and
- Provide appropriate Personal Protective Equipment (PPEs) to all workers exposed to elevated noise levels and enforces usage.

7.3.8 Waste (solid and liquid)

The construction phase will generate two types of solid wastes: spoils and household refuse. Construction spoils will consist of building materials, concrete, paper and plastic (for example from packaging materials and lagging), timber, scrap metal, etc. Disposal of the same solid wastes off-site could also be a social inconvenience if done in the wrong places. The off-site effects could be aesthetic, pest breeding, pollution of physical environment, invasion of scavengers and informal recycling communities.

During construction the Contractors will setup various facilities for temporary accumulation, which have to be removed and dismantled on completion of the works. Adopt recycle and reuse measures for some of the spoils generated such as woody spoils generated from construction work will be stock piled to manageable size on regular intervals, valued and given to surrounding community as fuel wood as a cost effective measure. This will require a strategic and mutual understanding between the involved parties that is the local community and the contractor. All waste shall be removed from the site for appropriate disposal through licensed waste handlers.

Mitigation

- Identifying environmentally acceptable spoil sites for spoil materials and approval

by AWSB taking into consideration the following:

- Preferably to be located on land already cleared wherever possible.
- Diligence on the part of the Contractors during construction activities will minimise the amount of debris, and also will ensure that debris is disposed of in a sensible manner, at a specified and approved dump site.
- The tender documents should specify the proper disposal of waste during construction.
- The tender documents should also ensure that the Contractors leaves the site in a clean condition on completion of works. The Contractors should be required to restore and landscape all areas to the satisfaction of AWSB;
- All solid waste generated during construction and operation should be carefully monitored, collected, stored, and taken out of the park for disposal.
- Waste generated during the operation of the plant must be segregated at source, inventorised and appropriate methods of disposal determined.

The development and rehabilitation of spoil areas shall include the following activities:

- Stripping and stockpiling of topsoil;
- Removal (to a nominal depth of 500mm) and stockpiling of subsoil;
- Placement of spoil material;
- Contouring of spoil site to approximate natural topography and drainage and/or reduce erosion impacts on the site;
- Placement of excavated subsoil and then topsoil over spoil material;
- Contouring and re-vegetation;
- The Contractor shall ensure that the placement of spoil is done in such a manner to minimise the spread of materials and the impact on surrounding vegetation and that no materials 'creep' into 'no-go' areas.

7.3.9 Material Site Extraction Impact

Impacts associated with construction materials could not be determined by this ESIA study because they have not been identified. The works contractor will be expected to identify the material sites and prepare independent ESIA study report for approval by NEMA.

7.3.10 Workers and Accommodation Impact

Impacts associated with workers accommodation campsite could not be determined by this ESIA study because the actual sites for the facilities have not been identified. The works contractor will be expected to identify the campsites and prepare ESIA study report for approval.

The project contractor will need to establish a camp for effective management of constructionworks. A typical contractor's camp has facilities including site offices, workshops, stores, vehicle parking, and staff accommodation. The campsite is bound to have high human activity, material storage facilities, sanitary facilities,waste generation and disposal. All these are potential pollution agents that need adequate management. At worst, waste from the camp may be dispose of into the natural bush land or streams.

Recommendation / Mitigation

To mitigate on the above it is therefore proposed that:

- The contractor's camp should have a comprehensive waste management and sanitation plan and facilities commensurate with population of workers and activities in the camps;
- Any storage tanks and equipment should have correct labels and Material Safety DataSheets;
- Adequate Emergency Response Plan should be in place in the camps;
- The contractor should employ best practice management "housekeeping" (site cleanliness, waste disposal etc.) at all times;
- The contractor's facilities should be completely removed from site after use and the land restored to its previous condition or better; and
- All fuel storage and dispensing areas must be laid on hard standing.

7.4 Biological Environmental Impacts and Mitigation Measures

Construction

Construction of the dam implies removal of existing vegetation while clearing the areas to be inundated and/or possibility of submerging of others potentially losing certain species.There is also potential disruption of habitats downstream of the dam area as a result of construction activities through discharge of excessive particulate matter, cement residuals and other construction materials into the river course.

Earthworksandlandfragmentation duringconstructionactivitieswillcontributetoterrestrialflora disruptionthroughtotal vegetationremoval.Theentireterrestrialhabitatwillbedisturbed permanentlybecausetheprojectarea willbecoveredwithwater.Thereservoirwillaffectthe productiveagriculturallandhence affectingthegeneralbiodiversity.

The findings of the biodiversity survey show the following:

- The vegetation of the area is highly influenced by highland ecosystems. At the same time human activities over the time have introduced alien species in the area for varying reasons especially their economic value.
- An inventory of the vegetation present in the project area is highlighted in **table 35**below.
- The confluence point of Ruiru and Bathi Rivers shows an intensive low ground cover of various species including grasses, ferns, shrubs, etc.
- Tree cover comprising of mainly exotic trees (grevillea, eucalyptus ssp, wattle trees) and agricultural tree species will be removed during construction,
- Specific fauna species exists in the riverbeds for Ruiru and Bathi Rivers including small fresh water fishes, frogs and snakes. The dam development is expected to interfere with the species existence.

Operation

Theriparianaquatic vegetationcould develop on the newwaterlandtransition zonewith new species introducedand flourishing ofthe existingspecies. The dam project may lead

to theintroduction of newfish speciesand aquatic vegetation.It mayalsolead to introduction oflarger aquaticspeciessuchascrocodileand hippos.Damwaterwouldencouragethe breeding of vectors suchas mosquitoes andsnails.Specificanticipated impacts on aquatic and terrestrial flora and fauna is as presented below;

AquaticFlora

- New species of aquatic plants may get introduced into the project areas as a result of water stagnation.Noted in Ruiru I dam, sedges, papyrus and reeds among other wetland grasses were observed and the same may get introduced into Ruiru II
- With population characteristics changing, residents may introduce what may seem ornamental to them in their homes and subsequently through cuttings into Ruiru II dam and other surface water bodies in the area. Among such plants include the water hyacinth and water cabbage (already major problems in Lake Naivasha, Lake Victoria, Lake Nakuru, Athi River and Tana River downstream),

TerrestrialFlora

Whileappreciating thatthedamconstruction willremoveasignificantbiomass volumefromthe targetlocation,introductionofthenewterrestrialplantspeciesisnotanticipated.Forpurposesof thecatchment conservationandcompensationforthelostbiomass,itishighlylikelythatthis will involvetheexistingtreespeciesintheareasuchas toincludetypical*eucalyptusssp,grevillia*and wattletreesinadditiontoothercommercial trees dueto theireconomicvalue. A largeproportion ofthetreespeciesincludeeucalyptus*ssp*duetoitshighdemandwhile*grevillia*is alsocatchingthemarketeye.

Figure 33: Indigenous and Exotic Trees in the Project Area

Rare Mugumo tree within the project area

Sample exotic trees within the project area

Table 35. List of Common Trees in the Area

Local Name	Scientific name	Status

Local Name	Scientific name	Status
Mutati	*Polysciaskikuyensis*	Dominant
Muiri	*Prunus Africana*	Dominant
Mugumo	*Ficussycomorus*	Rare
Mukohokoho	*Monimiaceacespp*	Dominant
Mutundu	*Croton macrostachyus*	Dominant
Muirugi		Dominant
Mugaita	*Rapanearododendroides*	Dominant
Mutheoera		Rare
Muagu	*Rausonialucida*	Dominant
Muerere	*Tabernaemontanastapfiana*	Dominant
Githirathiru		Dominant
Munyawa	*Fraxinusberlandrine*	Dominant
Mukuhakuha	*Macarangakilimandscharica*	Dominant
Mutuya	*Myrianthusholstii*	Dominant
Mukurue	*Albiziagummiflora*	Dominant
Mutati	*Polysciaskikuyuensis*	Dominant
Mukoe	*Syzygiumcordatum*	Dominant
Muhehe	*Pistaciaaethiopica*	Rare
Muna	*Aningeriaadolfifriendericci*	Rare
Muthaduku	*Acacia mearnsii*	Rare
Muiruthi	*Diospyrosabyssinica*	Dominant

TerrestrialFauna

Thereis nosignificant aquatic wildlifepresence reportedin theproject area. Theinfluenceofwatermayattractsomelimitedanimalsintothearea(limitationarisesfromthealtitude conditions,temperaturesandrainfallintensity).Amongtheanimals anticipated intoRuiru IIdammayincludehippos,crocodilesandsomesnakespecies.

Duetothehigh levelagricultural and settlementland usetrendsin thearea,thereis no wildlife aroundtheprojectarea.Ruiru II dammaynothaveinfluenceonattracting wildlifeintotheareaduetothehumanactivitiesintensity andalso thefactthatthedamwillbeprotected.

MitigationMeasures

- A detailed analysis of the biodiversity of the Ruiru River ecosystem and specifically the specific project location was undertaken and biodiversity report has been prepared as part of the ESIA and includes measures proposed to mitigate biodiversity impacts. The findings of the biodiversity study show that the species of flora and fauna observed in the project area are among others:
  - Not endangered; not present in the IUCN Red List;
  - Certain species of flora are indigenous see table above
  - The project is not in a protected area (forest, national park or reserve).

- Intensive catchment management strategies will be developed among them, practicing re-afforestation, soil erosion control, land use control and settlement

and urban development planning among other initiatives to minimise impacts on flora and fauna,

- Creation of awareness on the proper land cultivation practices to reduce soil erosion and biomass accumulation in the dam reservoir,
- Athi Water Services Board will engage the relevant authorities (KFS) in monitoring and establishing community interests and values in the new ecological setting associated with Ruiru II dam.
- Education, awareness and sensitization programmes will be prepared for the local communities with respect to biodiversity management, values and their roles in the conservation.

7.5 Cumulative Effects Assessment

Cumulative impact is defined by the US Council on Environmental Quality as "the impacts on the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions (RFFA) regardless of what agency undertakes such other actions." Thus the practice of Cumulative Effects Assessment (CEA) of projects in a region began.

Water abstraction from the Ruiru River will marginally reduce the net water volume available in the River (because of consumptive use for domestic and agricultural purposes). The proposed location of the dam is downstream and in effect, no downstream water users are going to be impacted negatively. However, when combined with other existing and planned water abstractions from the Ruiru River, it will contribute to significant impacts on overall water availability in the sub- basin in dry years.

Abstraction of water from the Ruiru River combined with other abstraction systems within the same River will cumulatively impact on the hydrology of the River especially downstream therefore, Environmental Flows must be observed to ensure that the integrity of the river is maintained. An Environmental Flow Analysis (EFA) has been determined for this project as per the Water Resources Management Authority (WRMA) requirements.

7.5.1 Impacts on Downstream Users Positive impact

RuiruIIdamwillhavea cumulativeeffect ofRuiruIdamintheregulation of flowdownstreamby balancing thepeakflowduring rainfall and thelowestduring thedryconditions.According to available water abstraction records held by Water Resources Management Authority, Athi Catchment Area, there are 182 registered water abstractions from Ruiru River for both domestic and irrigation activities. The total amount authorized for abstraction from the river is 35,718.488 m3 per day, composed of 7,320.488 m3 per day from the Normal Flow for domestic use and 28,398 m3 per day from the Flood Flow for irrigation purposes.

NegativeImpact

Farmers ontheriverfloodplainwillnotreceivetheusualnutrientloadsfromfloodflowssince sedimentsandsiltwillberetainedin thedamuntilthetime ofscouring(flushing). Productivity will, therefore,godown.Allactivitiesdepending onriverflowcould beaffectedbythereduction

offlow, especiallylowflow. Moreover, riparianhabitats, aquatic fauna andflorawill beaffected.

Mitigationmeasures

- A relevant and permanent compensation flow has been defined as part of the hydrology study (**see annex 3**) and include adjustment of operation of the dam according to downstream status
- A water-monitoring plan has been proposed. From the available water allocation data, there are some abstractors who have been allocated water downstream of the dam and it is important that their right to water, even during the dry season is assured. To achieve this, water levels and water quality will be monitored at the RGS 3BC07 and 3BC09 and also a gauge to be installed in the dam.

7.5.2 Cumulative Impacts

Thestudyprocessestablishedcumulative impacts ofthe damproject. In view oftheexistingRuiruIdam,thecombinedeffectswithRuiruIIDamwillincludethefollowing;

- The flood flow intercepted by the two dam is potentially also anticipated downstream for agricultural activities, other dams and reservoirs downstream including water supplies (Ruiru Town) as well as seasonal flushing of Ruiru downstream.
- Ruiru River is also expected to contribute to the greater flows in the Ruiru River basin into Athi River. However, this contribution is slightly altered when significant volumes of water are retained in Ruiru I and Ruiru II dams.
- The cumulative retention of silt and sediments from the upper catchments of Ruiru River would be significant. This reduces the potential degradation of the riverine system from siltation and excessive agrochemical residues transported with the sediments,
- It is observed that climate change is a critical issues leading to excessive rainfall and flooding. The combination of Ruiru I and Ruiru II dam will enhance flood control on Ruiru River basin downstream through moderation of peak flows. The quantified flow moderation would be undertaken during the detailed study of the dam.

7.6 Induced Impacts

Globally, there are over 100 identified cases of earthquakes that scientists believe were triggered by reservoirs (see Gupta 2002). The most serious case may be the 7.9-magnitude Sichuan earthquake in May 2008, which killed an estimated 80,000 people and has been linked to the construction of the Zipingpu Dam.

In a paper prepared for the World Commission on Dams, Dr. V. P Jauhari wrote thefollowing about this phenomenon, known asReservoir-Induced Seismicity (RIS): "The most widely accepted explanation of how dams cause earthquakes is related to the extra water pressure created in the micro-cracks and fissures in the ground under and near a reservoir. When the pressure of the water in the rocks increases, it acts to lubricate faults which are already under tectonic strain, but are prevented from slipping

by the friction of the rock surfaces."

Given that every dam site has unique geological characteristics, it is not possible to accurately predict when and where earthquakes will occur. However, the International Commission on Large Dams recommends that RIS should be considered for reservoirs deeper than 100 meters. The Ruiru dam wall is less than 100 meters and the site is not prone to seismicity since the area is not a seismic active region.

7.7 Socio-Economic Impacts and Mitigation Measures

AnImpactassessmentwasconductedforRuiruIIDam WaterProjectwithaviewofensuringeconomic andsocial sustainabilityoftheproject. The assessmentaddressed the prevailing conditions, perceivedcommunityrolesduringandafterproject andbothpositiveandadverseimpacts ofthe proposed projectactivities.

7.7.1 Land Acquisition Requirement

Construction / Operation

Impacts on land resulting from construction are limited to the dam site. Affected land will be residential land, land used for business and areas of agricultural land. Land take will result in the permanent change of land use and the termination of the present use of the land. Land take due to construction and operation will affect a total of households as shown in **Tables 36, 37, 38, 39 and 40**.

Table 36. Summary: Project Impacts and Project Affected People at the Dam site

Description	Area (Acres)	No. of Households
Land Acquisition AlongDam Area		
Land	174.30	
Number Commercial Structures	3	
Number Residential Structures	88	

Table 37. Summary: Project Impacts and Project Affected People Along Treated Water Transmission Pipe

Description	Area (Acres)	No. of Households
Land Acquisition alongTreated Transmission Pipe		
Land	21.2	
Commercial Structures	6	
Residential Structures	102	

Table 38. Summary: Project Impacts and Project Affected People at Balancing Storage Tanks (Karuri and Kiambu)

Description	Area (hectares)	No. of Households
Land Acquisition at Balancing Storage Tanks		
Agricultural Land	0	0
Business Units	0	0

Residential Structures	0	0

Table 39. Summary: Total Land Affected

Total Land Affected	Ha
Dam/Reservoir Area	174.30
Treated Water Transmission Pipe	21.3
Storage Area	0
Total	**195.0**

Table 40. Summary: Total Structures Affected (Commercial and Residential)

Total Structures-Residential	Number of Structures
Balancing Storage Tanks	0
Treated Water Transmission Pipe	108
Dam/Reservoir Area	91
Total Structures	**199**

Mitigationmeasures

- A Resettlement Action Plan has beenprepared outlining the impacts associated with displacement and entitlement/compensation for PAPs.

7.7.2 Affected Households

Construction / Operation

Householdsaffectedare mainlylocalfarmers and alocalCoffeeCollection Centre. The main households affectedbythedamconstructionaresituatedalong secondaryroadsin therightbank,theleftbank andtheconfluenthill ofRuiruandBathiRiverinKamuchegevillage,Kamburu villagesandNgochi villages.Sincethereisequilibriumbetweentheagricultureandlivestockinthelocalfarmingcultu re,theloss oflandcouldcreatealoss oflivestockactivities.

Others impacts which mayaffectthe local habitantsare:

- Social, cultural andeconomic disturbanceof thestructureof theregion,
- Potentialtemporarydisruptionof accesstowater sources
- Potential temporal disruptionof social-economicactivities that rely on the river for communitiesdownstream.

Mitigation Measures

- A Resettlement Action Plan has been carried and a determination of compensation and entitlement for landand assets acquired for the purpose of Ruiru IIdam made.
- For habitants who are using the river water as principal source of water (drinking water), alternative access towater shouldbe providewithin the project implementation,
- Appropriate compensations shouldbe done before the commencement of the project.

7.7.3 Livelihood Impacts

Construction/Postconstruction

Thereareanumberofpotentialadverseimpactsarisingfromtheproposeddaminrespectofsocio-economic considerations.Theseinclude:

- Loss of fields, agro-forestry and natural vegetation
- The possible loss of community facilities as a result of temporary or permanent land take for the project (e.g. coffee collection centrethrough demolition);
- Reduced access to water for domestic use from the river

MitigationMeasures

- Involve local labour to the extent possible to ensure for the construction and operation of the dam facility, clauses should be integrated in contractor's contract
- Apply the AWSB CSR policy in economic welfare support for the local community. Part of this may include erection of water kiosks and pay sanitation facilities along the pipeline corridor. However, this be limited since the people live in their own homes,
- Compensate loss of agriculture activities within the RAP
- Compensation for loss of land and assets as a result of the dam and this is already addressed in the RAP study.

7.7.4 Impacts on Livestock Farming

Construction

Fromfieldvisitinterview, animportantintegrationbetweencropsagricultureandlivestock'sfarming hasbeennoticed. Majorpartoftheanimals'foodcomesfromagriculture ofthenearestland.Inthe farmingscale,a balancebetweenthe land owned andtheanimal's number insurethe income ofthe farm.Thelossofagriculturallandwillhaveanindirectimpactofthelivestock'sactivities.The RAP has addressed this by developing a livelihood restoration plan, which encourages zero grazing.

Operation

Ruiru IIDamislocated ina steep valleywherethewater isaccessible through:

- Ruiru and Bathi River by transporting the water on the steep slopes,
- Thecreation ofthereservoir willpermitabetteraccesstotheriverforall thefarmerslocated on the crestofthe hills aroundthelakeandtheaccess slopewill be lesssteep.

MitigationMeasures

- The linkage between the agriculture activities and livestock's activities was considered in the RAP and proposed livelihood restoration program to increase linkages
- A safe and easyaccess toshould be provided for farmers indifferent points for cattle.

7.7.5 Road and Transport

Construction

Thedamconstructionwill bringsignificantimprovementontheroadandtransport.Theaccessroad fromGithunguritoKamuchegewillberehabilitatedtopermitthe trafficneedfordamconstruction. Moreover,constructionaccessroadwillbecreated aroundthe site. Itwill improvethesocial inclusionandaccessibility tocommunityfacilitiesthroughtheprovision ofbetterlinkagesthrough improvedaccessroads.In anotherpointof view,thetrafficin thedamsiteregionwillmeaningfully increasewhichwillhaveimpactsonroadaccidents, noiseandair quality.

7.7.6 Occupation Health and Public Health Concerns

Construction

The construction process is estimated to take 2 years. These activities may involveemployment of hundreds of workers in site, increasing chances of workplace accidents, injuries and illnesses.

The general public using the access roads and those near borrow sites could also be exposed to accidents involving construction traffic and quarry activities respectively. However, with appropriate management policies and implementation of safe working systems, these impacts area readily manageable reducing them to insignificant levels.

Damconstructioninvolvesimportantworkersand machineries.Accordingtothedamhigh,wecan assumethatmorethan100workerscanworkatthesametimeinthedamconstructionsite.Traffic ofearthworksmachineries andconcrete toolsauditionedtocommonconstructionworkersaccident (slips andfalls, injuriesofhand, eyeinfections,etc.)makethedamsiteunsafe.

- Workersinjuries fromaccidental falls, use of faulty equipment during construction,
- Respiratory problems from dust from earth moving and constructionmaterials, emissions from theequipment,
- Environmental pollutionfromdisposal of solid waste materials (excavated materials from pit latrinesand otherresiduesfromconstructionactivities)
- Potential health problems frompressure onhousing, sanitationand hygienefacilities,
- Increase of HIV/AIDs from interaction of workers, localcommunitiesand migrant influx
- Landslide during earthwork.
- Localresidentinjuries dueto traffic orwateraccess.
- Education and sensitization of workers and the local communities on HIV/AIDs andSTIs in conjunction with Sub-County Public Health Officers;
- Provision of condoms to the construction workers, project team and the public. Thisshould be kept in places that are not locked and are accessible to the above persons;
- Where possible conduct regular sensitization campaigns and monitoring andevaluation of the modes used during course of the project;

- Formation of peer groups from among the project staff to ensure continuity in trainingand awareness raising;
- The contractor has to institute HIV/AIDS awareness and prevention campaignamongst workers for the duration of the contract e.g. erect and maintain HIV/AIDSinformation posters at prominent locations as specified by the Resident Engineer inconsultation with AWSB;
- The contractor has to ensure that staff are made aware of the risks of contracting orspreading sexually transmitted diseases;
- The contractor should ensure that the project workers are sensitised on the localculture;

Operation

Damreservoir provideshabitatfor waterbornediseasesaswellasparasitethrive(mosquito, snails).Mosquitoesare carriersof malaria,thereisalsothelikelihoodofsnailsbreedingwhicharecarriersof*schistosomiasis*other waterbornediseasescholeraanddysentery. HIV/AIDs mayincreasefrominteraction ofthe workers,local communitiesandmigrantinflux.

MitigationMeasures

- Organizean epidemic basesurveyin theaffectedareaandperiodicevaluation
- Implement measures to assessthe presence of vectorsand controlitsand potential diseases,
- Creation ofawareness,preventionand monitoringprograms,
- Wellnesscentersandawarenesscampaigns onthesexuallytransmitted diseasesandHIV/AIDs
- Adequateprovision of personal protectiveequipmentto the workers,
- Providesanitationfacilitiesin all work areas,
- Waste generated(sanitary,rehabilitationand proper hazardwastestorage) duringthe constructionphaseshould becarefullydisposed of inan environmentallysafe manner
- Implementation ofa HygieneandSafety Management Planaccording tointernational standards includingadequateprovision of PPEs to the workers,
- Adequatediversion of the river andprotection of the site duringconstruction,
- Management ofearthworkbetakingcare ofexcavationandslopestability
- Presence of anurseryin the workercamp,
- Frequent maintenance of the machineries used.
- Contractor must develop Construction Safety and Health Policy in compliance withOSHA, IFCs Environmental, Health and Safety Guidelines among other internationalbest practices;
- Undertake comprehensive assessment for PPE requirements, provide and enforceusage of all ranges of required PPEs;
- Contractors to establish a comprehensive Health and Safety Policy which should be in compliance with AWSB's Occupation Health and Safety Policies
- Ensure compliance with all standards and legally required Safety and Healthregulations in line with OSHA;
- AWSB to include standard best practice health andsafety provisions in the construction contract. The provisions should include insuranceto enable the contractor to pay for any and all treatments required by his workersincluding

those of all sub-contractors, together with any subsequent lifelong disabilitypayments in line with WIBA;

- Employ a full time qualified Safety and Health advisor;
- Include a specific and independent task in the supervision contract concerning H&Ssupervision and compliance, together with the staff resources to carry this out;
- Establish and enforce a strict code of conduct for all project drivers including outside suppliers delivering materials. The code should focus on safety, especially speed, andloading, especially banning all carriage of staff, workers and passengers except inseats;
- Implement the specified H&S programme throughout the construction period. Thisshould incorporate but not limited to:

    a. An emergency response procedure and display at conspicuous sites in all work areas. This is likely to require one vehicle on site equipped as an ambulance and a paramedic on site at all times during construction activities;
    b. Provision of a standard first aid kit at the site office at all times;
    c. Provision of fire-fighting equipment available at the workers camp;
    d. Provision of medical facilities for staff;
    e. Installation of appropriate safety signage for all work sites;
    f. Registration of the work place;
    g. Maintain an accident register;
    h. Carry out accident and incidents investigations and implement corrective actions;
    i. Establishment of Occupational Health and Safety Committee;
    j. Staff and visitor induction;
    k. Toolbox and monthly safety meetings;
    l. Routine inspections.

7.7.7 Cultural Heritage

Thereareculturaltrees(mugumo) in the reservoir area and along the transmission route. There are also 10 graveslocated withinthearea, all which will be inundated or destroyed to pave way for the pipeline.

Table 41. Affected Graves in Dam Area

Number of Graves	Area
1	Karinga,
2	Nyamudhanga
1	Ngochi
Total 4 Graves	

Table 42. Affected Graves in Transmission Line Component

Number of Graves	Area
3	Karuri
5	Banana
2	Kanunga
10 Graves	

Table 43. Affected Graves Cultural Trees (Mugumo) in Dam Area and Transmission Line Component

Number of Tress	Area
21	

MitigationMeasures

- A RAP has been prepared and has addressed the cultural related impact of the project including proposing compensation for loss of cultural resources.
- Given absence of recorded archaeological sites or observed artefacts within the project site, no potential impacts on archaeological features are anticipated. However, a chance find procedure has been developed as a precautionary measure for use during construction excavation works (see appendix 5).

No archaeological sites have been recorded and no surface artefacts were seen on theproposed development site. However, since the absence of artifacts on the surface does not exclude the possibility existence of artifacts or features buried in the ground, there is a chance of encountering buried artefacts during excavation and other earthwork construction activities. Without proper planning in place to manage such encounters, any artefacts encountered by chance may be interfered with. The anticipated impacts are therefore rated insignificant.

Mitigation measures

- The developer shall notify NMK if any artefacts or bones are uncovered in the course of excavations. This is in accordance with the National Museums of Kenya Chance Finds Procedure which aims to minimize damage to objects accidentally uncovered during the construction phase;
- If something is discovered in the course of excavation, the exercise must be stopped to determine whether a rescue operation needs to be carried out. This requires a pause in the construction and removal of the objects in question and only then can the construction continue. Any questionable objects must be shown to the archaeologist on duty in order to determine its value, and any of the management options outlined in the procedure applied;
- Decisions regarding cultural heritage must be consistent with the requirements of IFCPerformance Standard 8 and the UNESCO 1972 World Heritage Convention.

Dam Safety

7.7.8 WB Dam Safety Requirements

RuiruIIDamisa55mhighdam.AccordingtotheWorldBankOperationalManualOP4.37-Safety ofDams,RuiruIIDamisalargedam.TheWorldBankrequirements onDamSafetyare summarized inthe followingtable:

Table 44: WorldBankOperationalManualOP4.37 Dam Safety Requirements

World Bank Requirement	Comments
Forthelifeofanydam,theowneri sresponsible for ensuringthat appropriatemeasuresare taken and sufficient resourcesprovided for the safety of the dam.	UnderAWSBresponsibility.
Itrequires thatthedambedesignedandits	Thesupervisioncompanywillbechosenaccording toitsexperience onsimilarprojectandtheresources

construction supervisedbyexperienced and competentprofessionals.	involvedwillhavetobecompetent.
Reviews by anindependentpanelof experts(thePanel)oftheinvestigation,design,andconstruction	UnderAthiWaterServicesBoardresponsibility.Anindependentpanelofexpertwillhavetovalidate
Plan for construction supervisionand qualityassurance,aninstrumentationplan,anoperation andmaintenanceplan,andanemergency	Theseplanswillbepreparedduringdesignphaseoftheprojectandwillinsurethemanagementof DamSafety.The conceptual designed has allowed for installation of dam instrumentation
Prequalificationofbiddersduring procurementandbidtendering	Thisphaseisundergoingandaproper Tenderdocumentshavebeenprepared
Periodic safety inspections of the dam aftercompletion.	UnderAthiWaterServiceBoardresponsibility.

7.7.9 Dam safety

Construction

Moreover,anydamsiteis insideariver valleywheretheriver hastobe divertingthroughchannelto keeptheconstructionsitedry.Incaseofheavy rains and floods,theconstructionsitecouldbecomeunsafe intermsofflooding.Intheconceptualdesign,thereturnperiodusedfortheconstructionfloodflow is 50 yearswhichissafefora2-3yearsconstructionperiod.

TheRuiruandBathiriverwill jointhediversionchannelupstreamandwillgothroughthis channel throughtheleftbank ofRuiru IIriveruntil downstreamto thefuture downstreamchamber. Theconcrete gallerypre-designforthis purposehas a 3.6mdiameter.A 10m high upstream cofferdamwillprotectthesiteagainstflood andadownstreamcofferdamwillpreventanywater returnonthedamsiteincaseofflood.Apartialwatersensorsystemcouplingwithalarmwillalert anyworkers inthedamconstructionsitetoquittheplace.

MitigationMeasures

- Adequatediversion of the river andprotection of the site duringconstruction,
- Reviewthe Damdesignand Dam Constructionbyindependent panel ofexperts
- Design and install metrological sensors and alarm during the constructiontoalert workersincase ofrisk of flood

Operation

Two main eventsduringthedamoperationcouldimpactthesafetyof peoplearoundthedam:

- Event ofimportantflood
- Event ofdambreak

Flood Risk

TheDaminterferencewiththenaturalriverischangingtheintensityofafloodpeakinthesafeway. Inthismatter,thedamhasarealpositiveimpactonthesafetydownstreamof thedam.Moreover, installationof metrologicalsensors andalarminthecatchmentarea ofthedamwillpermittoreduce the potentialconsequenceof an important flowbywarninglocals inadvance.

DamBreak

Thepotentialdamfailure canresult offaultinthedesign,use ofsub-standard materialduring construction,deliberatesabotage,andlandslidein thereservoir.Accordingtothedesign,thedamis design for theProbable MaximumFlood. This floodflowis 2 timesbiggerthanthefloodwith areturn periodof10,000years.Accordingtothedesignlifeofthedam,whichcanbeassumedbetween50-100years,thedesignfloodchosenmakethe damsafeagainstflood.

MitigationMeasures

- Reviewthe damdesignand dam constructionbyindependent panel ofexperts
- Preparerelevant plans (Planfor constructionsupervisionand quality assurance,an instrumentationplan, an operationand maintenance plan),
- Preparean emergencypreparedness plan
- Install properinstrumentationin thedam,
- Ensurefrequent maintenance of the damstructures,
- Ensure use of highquality standard materials during constructionphase

8 Elements of Environmental and Social Management Plan

8.1 General Overview

The project is geared towards enhancing social and economic benefits through sustainable water supply. Development of the Ruiru II dam project would be expected to comply with the environmental conservation requirements in accordance with the established Kenyan laws and regulations. To realize these goals, acceptability by a majority of the stakeholders and minimal effects to the physical environment will require to be ensured through participation in the project and continuous consultations, evaluations and review of the design aspects throughout project implementation cycles.

It isalso recommended that the environmental management guiding principles specific to this project improvement and water resources management be established to allow integration of environmental management considerations during construction and operations. Among the factors that need to be considered in this particular project implementation will include,

- Ensure control of soil erosion and siltation of the water sources (rivers and the streams),Incorporation of dam safety provisions and the associated components,
- Enhancing integration of environmental, social and economic functions in the project implementation.
- Compensation of any land or property that may be affected by the project in accordance to the laid down regulations,
- The contractors and other playersinthe project activities be prevailed upon to implement the ESMP through a sustained supervision and continuous consultation

8.2 Institutional Stakeholders

In order to implement the management plan, it is recommended that an expert be identified to oversee the environmental and social management aspects including the dam conservation, soil erosion control, re-vegetation whenever appropriate, water conservation and equity in distribution, enhanced sanitation and hygiene measures throughout project area. The expert would also be required to coordinate and monitor environmental management activities during construction and post monitoring audits. Other recommended participants include;

- Athi Water Service Board will be responsible for coordination of all the activities and liaisons, particularly in regard to the quality control of the works and social issues.
- Water service providers (local community water and sanitation company) who have the responsibility to enforce water quality monitoring and efficient maintenance systems and procedures to minimize interruptions to water supply,

- National Environmental Management authority (NEMA) through the county directors office shall be responsible of surveillance of environmental and social aspects of the project implementation
- Representatives of local administrators or base organized of PAPs

8.3 Institutional Reinforcement

In order to implement the management plan, it is recommended that the contractor identify suitable environmental expert to oversee environmental and social management performance. Uponcompletion and commissioning it will be necessary to establish appropriate operational guidelines on ESMP/RAP implementation associated with the Ruiru II dam Water Project. This will enable the management identify critical environmental and social issues and institute appropriate actions towards minimizing associated conflicts.

The guidelines will include among other areas environmental management programmes, standard operation procedures, compliance monitoring schedules and environmental audit schedules as required by the law. Social harmony of the dam and associated component will be achieved through the collaborations with the stakeholders or community management committees introduced at various water consumption points.

8.4 Environmental Education and Awareness Raising

Athi Water Service Board and the water consumers and beneficiaries need to understand the basic environmental, water use sanitation and hygiene principles. In this regard therefore the following steps may be considered;

- Creation of liaisons on all matters related to environment, health and safety,
- Encourage contribution of improvement ideas on specific issues related to the management of the facilities,
- Establish initiatives that would instil a sense of ownership of the facilities and related components to all beneficiaries,

8.5 Public Health Issues

The contractor would be expected to incorporate HIV/AIDS programmes during construction phase. Awareness, prevention and training on HIV/AIDS and other social diseases is important during project construction and operation phase. The awareness creation should be improved through putting up of banners, posters and training should be facilitated within the project area to the construction workers and the community.

8.6 ESMP Matrix

The matrix below outlines the action plans and responsibilities on key negative impacts anticipated from the project activities. It is a presentation of the main environmental issues and proposed management actions with corresponding responsibilities,implementation timeframes and costs indications where applicable. The matrix covers the construction and operation of the dam.

Table 45: Environmental and Social Management Plan

Activity	Associated Impacts	ImpactLevels	Management Actions	Target Areas & Responsibilities	Monitoring Indicator	Budget
Pre-Construction						
Seeking approvals from NEMA and County Government	Delay in implementation of the project due to objections and stop orders	Low	▪ The Contractor shall ensure that all pertinent permits, certificates and licences have been obtained prior to any activities commencing on site and are strictly enforced/ adhered to; ▪ The Contractor shall maintain a database of all pertinent permits and licences required for the contract as a whole and for pertinent activities for the duration of the contract	All the settlements <u>Responsibility</u> Contractor & AWSB	Number of approvals / permits issued	KShs. 8M
Setting up of campsites Identification of burrow areas Surveys and setting outmaterial holding sites	Environmental degradation risks and Social conflict	High	▪ Give prior notification to the community on expected activities related to the project ▪ Involvement of local authorities, project liaison committees, in the project ▪ Isolate through fencing the camp sites from accessby the public for their safety ▪ The Contractor's camp layout shall take into account availability of access for deliveries and services and any future works	Campsites Dam site Raw waterlines Clear waterlines <u>Responsibility</u> Contractor(s)	Number of public outcry due to accidents	~KShs. 5M
Land acquisition, Catchment alignment	Displacement of PAPs Interference in river flow regime	High	Preparation and implementation of RAP Ensuring environmental flows are maintained	Dam site and pipeline corridor <u>Responsibility</u> Contractor & AWSB	Numbers of satisfied PAPS State of river flows measured at river gauging stations	1,601,235,309
Access to	Environmental	Low	▪ Utilize to the extent possible the		✓ Cases of	As per BoQ

Activity	Associated Impacts	ImpactLevels	Management Actions	Target Areas & Responsibilities	Monitoring Indicator	Budget
campsites and construction sites	degradation risks		existing public roads to avoid social and economic disruption ▪ Ensure road safety measures for the construction vehicles to the extent possible by observing all traffic regulations	Access Roads Responsibility Contractor(s)	private land required ✓ Accidents occurrence incidences	
Environmental Training and Awareness	Risks of Environmental degradation risks and occupational health and safety related accidents	High	▪ The Contractor and sub-contractors shall be aware of the environmental requirements and constraints on construction activities contained in the provisions of the EMP ▪ The Contractor will be required to provide for the appropriate Environmental Training and Awareness as described in this EMP in his costs and programming ▪ An initial environmental awareness training session shall be held prior to any work commencing on site, with the target audience being all project	All Workers Responsibility Contractor(s)	✓ Number of Trainings Held ✓ Availability of Training reports ✓ Attendance list of participants during the training sessions	KShs. 2M
HIV/AIDS awareness and prevention campaign	Risks of Increased HIV and Aids transmission in the area	High	▪ The Contractor shall institute HIV/AIDS awareness and prevention campaign amongst his workers for the duration of the contract, contracting an implementing organisation, with preference for an organisation already working on this issue in the project area; ▪ The campaign shall include the training of facilitators within the workers, information posters in more frequented areas in the campsite and public areas, availability of promotional material	All Workers Responsibility Contractor(s)	✓ Number of Trainings Held ✓ Availability of Training reports ✓ Attendance list of participants during the training sessions	KShs. 2M

Activity	Associated Impacts	ImpactLevels	Management Actions	Target Areas & Responsibilities	Monitoring Indicator	Budget
			(T-shirts and caps), availability of condoms (free), and theatre groups			
Local Labour / Employment	Delay in project implementation due to opposition from aggrieved community members	High	▪ Wherever possible, the Contractor shall use local labour, and women must be encouraged to be involved in construction work ▪ The contractor shall ensure compliance to the gender balance as required by the 2/3 gender rule	All the settlements Responsibility Contractor	✓ Number of workforce employed from the local community ✓ Number of female employed	As per BoQ
EMP management records	Risks of non conforming to ISO 9001 on QMS and ISO 14001 on EMS	Medium	▪ The updated version of the EMP should be kept on site ▪ Copies of all necessary permits and licences should be kept on site ▪ All site specific plans prepared as part of the updated EMP ▪ All related environmental, social, health and safety management registers and correspondence, including any complaints ▪ A register of audit non-conformance reports and corrective actions	All the settlements Responsibility Contractor	✓ Number of available permits on site ✓ ISO audit report on non conformities ✓ Number of corrective measure adopted	Ksh 5M
Construction Activities						
Site clearing Vegetation removal, Biodiversity degradation Access to the river by community	▪ Loss of riverine vegetation ▪ Potential habitat degradation ▪ Potential soil erosion on cleared sites ▪ Siltation, turbidity and destruction of river banks	Medium	▪ Avoid unnecessary vegetation clearing ▪ Watering the construction sites ▪ Ensure proper disposal of waste generated (tea and coffee bushes/pineapple vegetation/trees species ▪ Construction activities will be limited to project sites / routes which already exist therefore limited	Dam site and pipeline corridor **Responsibility** Contractor & Athi Water	Downstream users outcry Reported cases in monthly progress reports	As per BoQ

Activity	Associated Impacts	ImpactLevels	Management Actions	Target Areas & Responsibilities	Monitoring Indicator	Budget
			destruction to vegetation cover			
	Loss of top soil	Low	▪ Stock piling of top soil, construction material and wastes should be done only at designated sites approved by the supervising engineer, erosion prevention through berming of loose soil sites should be done in all areas susceptible to agents of erosion	All work areas Responsibility Contractor(s)	✓ Soil erosion extend and intensity on site	As per BoQ
Dam Formation Earth moving andexcavations (channellingand sitepreparations)	▪ Safety risks ▪ Air pollution ▪ Social nuisance ▪ Noise pollution	Medium	▪ Provide notices, signage and information to the public for their safety at all locations ▪ Install barriers along walkways, crossings and public places affected by the works for public safety ▪ Where there are potential for nuisance from dust generation, ensure earth moving is under dump conditions (consider watering where necessary) ▪ Inform immediate communities orstakeholders of the activities	All work areas Responsibility Contractor(s)	✓ Accidents occurrence incidences ✓ Cases of respiratory complication at nearby health centre	As per the BoQ
Materials sourcing, from burrow pits and quarries delivery and storage	Environmental and Safety risks associated with burrowing and opening up of new quarry sites	High	▪ TheContractorwillberesponsiblefore nsuringthatappropriateauthorisationt ousethe proposed borrows pits and quarries has been obtained before commencing activities ▪ Topsoil shall be stripped prior to removal of borrow and stockpiled onsite. This soil shall be replaced on the disturbed areas once the operation of the borrow site or quarry is complete ▪ Construction material sources should be environmentally sustainable (approved accordingly) ▪ Delivery routes and modes of	Burrow Pits and Quarry Site **Responsibility** Contractor(s) Supervision	Environmental Status of reinstated burrow pits Complains from the community on burrow pits and material transportation	As per the BoQ

Activity	Associated Impacts	ImpactLevels	Management Actions	Target Areas & Responsibilities	Monitoring Indicator	Budget
			transport should be approved ▪ Material storage on site not to be internal or external nuisance			
Concrete / cement batching plant	Risks associated with water resource pollution and air pollution from dust this could lead to respiratory problems	Medium	▪ Where required, a concrete batching plant shall be located more than 20m from the nearest stream/river channel; ▪ Top soil shall be removed from the batching plant site and stockpiled ▪ Contaminatedstorm-waterandwastewaterrunofffromthebatchingareaandaggregate stock piles shall not be permitted to enter streams but shall be led to a pit where the water can soak away ▪ Suitablescreeningandcontainmentshallbeinplacetopreventwindblowncontamination associated with any bulk cement silos, loading and batching ▪ Cleaning of equipment and flushing of mixers shall not result in pollution of the surroundingenvironment	Concrete / cement batching plant <u>Responsibility</u> Contractor(s) Supervision	✓ Number of incidence of environment pollution around the plant	As per BoQ
Wastes removals and disposal	Risks of contaminating surface and underground water resources	High	▪ Construction wastes (residual earth, debris and scrap materials) to beremoved for safe disposal ▪ Encourage recycling where possible (concrete debris for access road surfacing), ▪ Contaminated organic matter in the work areas to be isolated for safe disposal ▪ Material residuals to be disposed off in accordance with established regulations	Construction areas <u>Responsibility</u> Contractor(s) Supervision	✓ Number of complaints from community not happy with waste managemen t of the contractor	KShs. 5M
Spoil Storage	Risks of solid waste	Medium	▪ Preferablytobelocatedonlandalready	Construction	✓ Number of	Contractor

Activity	Associated Impacts	ImpactLevels	Management Actions	Target Areas & Responsibilities	Monitoring Indicator	Budget
site	mismanagement leading to pollution		clearedwhereverpossible.Communitiesshallbe involved in the site location to avoid conflict ▪ Theneedtobemorethan20metersfrom water courses and in apposition that will facilitate the prevention of storm-water runoff from the site from entering the watercourse ▪ Contouringofspoilsitetoapproximate naturaltopographyanddrainageand/or reduce erosion impacts on the site ▪ The Contractor shall ensure that the placement of spoil is done in such a manner to minimise the spread of materials and the impact on surrounding vegetation and that no materials' creep' into' no-go' areas	areas Responsibility Contractor(s) Supervision	complaints from community not happy with waste management of spoil material	best management practice
Occupational Health and Safety	Risks of Accidents, Injuries or death of workers or community member	High	▪ Provide construction workers with personal protective gear (gloves, gum boots, overalls and helmets), ▪ Provide temporary toilets and bathrooms for the construction workers at the work sites ▪ Provide onsite first aid kit accessible by the workers on need, ▪ Isolate the site for access by the local communities during the construction for their safety and health ▪ Contractor to provide a Healthy and Safety Plan prior to the commencement of works to be approved by the resident engineer.	All work areas Responsibility Contractor(s) Supervision	Accidents occurrence incidences	KShs. 2M
Storage of fuel oils, lubricants,	Hazards of fire outbreak, oil and	High	▪ Follow specifications of the Occupational Health and Safety	All work areas	Incidence of reported cases of	As per BoQ

Activity	Associated Impacts	ImpactLevels	Management Actions	Target Areas & Responsibilities	Monitoring Indicator	Budget
chemicals and flammable materials	chemical spills.		Act, EMCA 1999 and others in the development and operation of stores.	Responsibility Contractor(s) Supervision	fuel leaks and fire incidences	
Sanitation issues resulting from both solid and liquid wastes on site.	Risks associated with water borne diseases exposed to community and workforce	Medium	▪ TheContractorshallcomplywithallla wsandanyby-lawsrelatingtopublichealthand sanitation ▪ All temporary/ portable toilets or pit latrines shall be secured to the ground to the satisfaction of the RE to prevent them from toppling over ▪ A washbasin with adequate clean water and soap shall be provided alongside each toilet.Staff shall be encouraged to wash their hands after use of the toilet, in order to minimise the spread of possible disease	All work areas Responsibility Contractor(s) Supervision	Incidence of reported cases of water related diseases among the workforce and neighbor community	Ksh 1M
Noise and Vibration control from plant and equipment	Risk to health and safety of community and workers	Medium	Contractorshallkeepnoiselevelwithinaccep tablelimitsandconstructionactivities shall, where possible, be confined to normal working hours in the residential areashospitals and other noise sensitive areas shall be notified by the Contractor at least 5 days before construction is due to commence in their vicinity. Anycomplaints receivedby theContractor regarding noise will be recorded and communicated to the RE ▪ The Contractor must adhere to Noise Prevention and Control Rules of April2005	Civil workareas and access roads Responsibility Contractor(s) Supervision engineer	Reported complaints from neighbor community and institutions	Ksh 5M
Traffic management on site	Risks of Accidents, Injuries or death of workers or community	high	▪ Strict use of warning signage and tapes where the trenches are open and active sites	.civil works areas and access roads	Accidents occurrence incidences	As per BoQ

Activity	Associated Impacts	ImpactLevels	Management Actions	Target Areas & Responsibilities	Monitoring Indicator	Budget
	member		▪ 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 resident engineer	Responsibility Contractor(s) Supervision engineer		
Air Quality Control	Air pollution causing respiratory disorders to human	High	▪ Workersshallbetrainedonmanagementofairpollutionfromvehiclesandmachinery.All construction machinery shall be maintained and serviced in accordance with the contractor's specifications ▪ The removal of vegetation shall be avoided until such time as clearance is required and exposed surfaces shall be re-vegetated or stabilised as soon as practically possible ▪ The contractor shall not carry out dust generating activities (excavation, handling and transport of soils) during times of strong winds ▪ Vehicles delivering soil materials shall be covered to reduce spills and wind-blowndust ▪ Waterspraysshallbeusedonallearthworksareaswithin200metresofhumansettlement.	All work areas Responsibility Contractor(s) Supervision	Cases of respiratory complication at nearby health centre	As per BoQ
Contractor de-mobilization and site reinstatement	Associated risks of environmental degradation	High	▪ The site is to be cleared of all construction materials, including litter prior to hand over ▪ Fences, barriers and demarcations associated with the construction phase must be removed from the site ▪ Fences, barriers and demarcations	All work areas ResponsibilityContractor(s) Supervision	Closeout audit report findings	No direct anticipated

Activity	Associated Impacts	ImpactLevels	Management Actions	Target Areas & Responsibilities	Monitoring Indicator	Budget
			associated with the construction phase must be removed from the site ▪ Rehabilitation activities of environmental cases identified must continue throughout the defect liability period			
Operation phase						
Water Abstraction and Use Sustainability and equity	▪ Potential water loss through seepage ▪ Potential water wastage and leakage along the transmission lines, ▪ Potential uneven distribution of water,	Medium	Comeupwithguidelinesregarding waterabstractionanduse, ▪ Formation of WRUA's ▪ Sensitize the community on sustainable water use, ▪ Provide dedicated points for thepublic to access water along the dam edges	**Responsibility** WRMA/AWB/Localcommunity Responsibility WRMA/AWSB/ Localcommunity	Number of recorded conflicts	To be determined at project operation stage
WaterAbstractionand Use	▪ Potential contaminationfrom construction activities, ▪ Risks from water borne diseases and vectors thrive, ▪ Potential water pollution from surrounding land-use activities (irrigation), ▪ Risk fromintroduction ofimpurity to the water reservoir		▪ Ensuring 24Hrsecuritytothedam area, ▪ Ensure regularwaterquality monitoringandmaintenanceofth e watersupplysystem, ▪ Influencethesurroundingland-use activities ▪ Creationofawareness onwater resourcemanagement and conservation, ▪ Ensureproper water treatmentplantinstallationatthe site,	Responsibility WRMA/AWSB/ Publichealth	Number of security cases reported	To be determined at project operation stage
DamOperations User Safetyand	▪ Risks of drowning, ▪ Potential dam failure,	Medium	▪ Provision of adequate PPE to dam personnel, ▪ Construction of perimeter fence	**Responsibility** AWSB/Localcommunity	Reported emergency cases	To be identified at operation

Activity	Associated Impacts	ImpactLevels	Management Actions	Target Areas & Responsibilities	Monitoring Indicator	Budget
risksdownstream	▪ Risk of wildlife attacks,		around the project area, ▪ Creation of awareness to the local communities on dam safety, ▪ Come up with clear guidelines on emergencies evacuation strategies, ▪ Carry out risk assessment strategy,			stage
DamOperations Linkage between Ruiru 1 and Ruiru II Dams	Operations in Ruiru I dam willhave significant linkage to Ruiru II dam including sharing of available flow, discharge of silt during scouring and enhanced social factors such as safety risks and climatic conditions	Medium	Synchronise the operations of Ruiru Iand Ruiru II for harmony in water flow, sediment release and social expectations.	**Responsibility** WSP	Operation manuals of the two dams	No cost associated
CatchmentManagement Pollutioncontrol, Runoffinterception efficiency	Change in land –use practices Potential contamination from agrochemicals and fertilizer input into the reservoir,	Medium	▪ Control the land-use activities surrounding the project area, ▪ Limit install of drainage channels, ▪ Creation of awareness on proper sanitation	**Responsibility** WRMA/ WRUA		Kshs 10M for catchment management

8.7 Monitoring Program

The national ESIA guidelines require the project proponent to prepare and undertake monitoring plan and regular auditing. Monitoring is needed to check if and to what extent the impacts are mitigated, benefits enhanced and new problems addressed. The key verifiable indicators, which will be used to monitor the impacts, are presented in **Table 45 below.**

Table 45: Environment and Social Monitoring Indicators

Project Activity/Aspect	Parameter	Indicator	Institutional Responsibility		Project Phase	Monitoring Cost Estimates (KES)
			Monitoring Responsibility	Frequency		
Impact of Flora	Visual Inspection	Bare soil Soil Erosion	Contractor	Daily	Construction	Included in supervision scope and costs
Air emissions and quality of Dust	TPS,SO_2,CO,H_2S,CO_2, Dust fallout	Bad odour Use of PPE Health and Safety Plan in use Record of induction for workers Active dust suppression	Contractor	Daily	Construction and operation	Included in supervision scope and costs
Worker and public safety	Visual Inspection Incident and accident records	Induction training Safety working procedure Shoring and appropriate precautions in place	Contractor and subcontractors	Daily	Construction	Included in supervision scope and costs
Occupation Health and Safety	Health and safety records Visual inspection	OHS Management system Active and passive monitoring Excellent workplace safety culture Risk management	Contractor	Daily	Operation	Included in supervision Scope and costs
Protection of Ground Water Resources		Incorporation in the Design	WRMA	Bi-monthly	Operation	Included in Supervision scope and costs
Storage of hazardous materials and chemicals	Spillages Visual inspection	MSDS for all store Chemicals Functioning storage containers Chemical usage records	Contractor	Monthly Audit Review	Construction	Included in supervision scope and costs
Traffic concerns	Visual inspection	Prepare and implement Traffic Management Plan Banks men shall be used to direct vehicle traffic	Contractor Project Manager/Supervising Engineer	Daily		Included in supervision scope and costs

		around construction sites and hazards during working hours(Health and Safety Plan) Plan approved by project Manager Barriers and signage				
Public Awareness and Community perceptions		Grievance management records Evidence of Occurrence-Event report		Monthly	Construction and operation	Included in supervision scope and costs
Noise	dB(A)	Measure included in design and procurement plans Hearing protection and PPE in use Record of plant equipment maintenance	Contractor	Daily	Construction and operation	Included in Supervision scope and Costs
Soil Erosion	Visual inspection	Bare soil Soil pillars	Contractor	Weekly	Construction	Included in Supervision scope and Cost
		Cracks across the slope Sediment fans				Scope and Costs
Solid waste management	Domestic refuse, metallic scraps, sludge	Documented Approvals for placement of wastes, Comprehensive waste management plan	Contractor	Daily	Construction	Included in Supervision scope and Costs
Water Qualitysurface and underground	Ph, BOD, Temperature, COD, Turbidity, Conductivity, Dissolved Oxygen, Nitrates	Monitoring report, Water quality report	Operator and Contractor	Monthly	Operation	

Component	**Monitoring Indicator**
Poverty	
Economy	Annual revenues generated by water supply operations compared to forecast revenues.
Environment	
Water	✓ Quality of Water based on National Standards (drinking water quality standards KS 05-459: Part 1: 1996, schedule 1-5) and WHO Standards ✓ Quality of waste water affluent based on National Standard (The Environmental Management and Co-ordination (Water Quality) Regulations, 2006, schedule 6-7) ✓ Quantity of water used compared to initial estimates
Population	
Natural Resources and Land Management	✓ Number of conflicts among water users (upstream, on site and downstream).

	✓ Presence of a water user organization, including men and women. ✓ Revenues from water fee/tariff collection and allocation
Quality of Life	✓ Level of satisfaction of beneficiaries toward water supply sources and facilities.
Health Outcomes	
Communicable diseases Non communicable diseases	✓ Prevalence rates (evolution over time) of diseases such as malaria, *schistosomiasis*, and diarrhoea ✓ Prevalence rates of poisoning and goiter
Gender	
Roles and responsibilities	✓ Time allocation of women before and after the project.
Income generating activities	✓ Proportion of household income devoted to water supply and sources of funds – men or women (before and after the project).

9 Conclusions and Recommendations

9.1 Conclusion

- The proposed water supply project is fully embraced by authorities within Kiambu County and affected resident's locations of Kamuchege, Kamburu Ngochi and Githunguri.However, part of the community feels they will be affected through loss of properties and demands appropriate compensation, this has been addressed in the RAP report
- Construction of access roads to the dam will also provide alternative access routes for the local communities further increasing the viability of the project. Among the desired access is the section over the dam wall if confirmed suitable and given the necessary design considerations,
- The dam development provides limited ecological challenge consisting in loss of land cover, likely immigration of new plants and animal species into the area as well as slight changes in the localized micro-climatic conditions.
- The dam shall cause land acquisition and loss to over **491**households. A full Resettlement Action Plan (RAP) has been prepared including provision for CSR to deal al with the residual communities,
- EMSP is designed with costing to offset the negative impacts and enhance the positive impacts of the project on the social and environmental condition of the project area.

9.2 Recommendation

- Adopt dam characteristics that will enhance enrichment of biodiversity through proliferation of appropriate vegetation and create appropriate habitats for fish as social value adding features. Facilitate the establishment of vegetated zones as compensation of the lost biomass. This will be further enhanced due to the inclusion of a 30m buffer around the dam comprising suitable tree species.
- Initiatives on the conservation and protection of the immediate catchment as formulated under the project will be implemented effectively
- To enhance social integration, the local communities and all the stakeholders involved will be sensitized on the benefits and risks of the project so that they are all on board in advance for effective participation and sustainability. A social engineering component, therefore, needs to be built into the overall project implementation. Entrench ownership of the project upon the residents through participation during construction and thereafter when they can report negative activities within the project area. In this endeavor, local sensitization committees should be developed from the communities to act as liaison between the project implementation group and the stakeholders.
- Compensation and resettlement of the project-affected persons (PAPs) will be finalized before commencement of the project to ensure minimal social conflict over the project in future. Land matters are rather sensitive and thorny issues. Acquisition and related compensation aspects should be approached with caution through a well-defined inclusive process involving identification of the true target beneficiaries, awareness creation and political will. Consultations will be undertaken especially with all affected landowners,

and household members on the, valuation processes, negotiations and, awards. Within the compensation component, there is also need to develop livelihood restoration programmes to ensure that those moved from their land will be settled near the rest of their clansmen, subject to availability of land. The PAPs would be provided an opportunity to buy alternative land of their choice

- There is need to undertake capacity building for the local communities so as to enable them to competitively exploit opportunities that arise from construction of the project (employment, supplies, etc.) as well as utilization of their resources. The Government through the Authorities in-charge of water resources should come on board to support the local communities' access water through established procedures.
- Inhabitants living around impounding water will be protected from health concern through effective implementation of designed health and hygiene plan under the project.
- For ESMP implementation a budget of Kshs8 million is allocated that need to be implemented effectively in order to minimize the negative impacts and enhance the positive impacts of the project on environmental and social condition of the project area.

10 ANNEXES

ANNEX I. PUBLIC PARTICIPATION

MINUTES OF THE PUBLIC CONSULTATION MEETING HELD AT KAHURUKO MARKET ON 21/02/2016

PRESENT.

- Godwin Sakwa Lidahuli — Consultant (ESIA,RAP Team Leader)
- Peter Obiero — Environmental Safeguard (Team Member)
- Joseph Gachoka — Dam steering Committee Secretary
- Samuel M.Wainaina — Dam steering Committee Member
- Ms.MonicahW.Mwaura — Dam Steering Committee Treasurer
- Mrs. Hannah W.Njuki — Dam Steering Committee Ass. Secretary
- Samuel MburuKaso — Dam steering Committee Member
- Simon T. Kirago — Dam Steering Committee Member
- Peter Chege — Dam Steering Committee Chair Man
- DorcusKinja — Dam Steering Committee Member

AGENDA

- Introducing the project to the public
- Seeking opinion of the people within the dam area

Min 01:

This public consultation meeting took place at Kahuruko market, Kamuchege location, Kiambu County. Diverse project stakeholders that included women, men and the youth as well as potential project affected persons and the local administration officials attended the meeting. Representatives of Members of County Assembly and Member of Parliament including representative of National Intelligence attended the meeting

The meeting began at **3:20 pm** by a word of prayer from Mr. Joseph Gachoka.

Min 02:

Mr.Gachoka introduced the area Chief (Kamuchege Location) who took the opportunity to sensitize the community on the voter registration exercise that was on going. The chief also informed the community members of the advantages of the dam and how it would help open up the area for more development projects. The Chief then introduced the Chairperson of the Dam Steering Community who in turn introduced all the members of the Committee to the gathering.

Min 03:

The Environmental Safeguards Team introduced themselves to the assembled stakeholders. They then went on to explain their presence to the community members. The public was made aware that the consultants were there to undertake an Environmental and Social Impacts Assessment and Resettlement Action Plan for the

proposed Ruiru II dam. The consultant informed the public of the processes they would follow while conducting both the ESIA and RAP exercises.

Min 04

The Community through the Dam Committee Chairman presented their grievances as detailed in the previous dam committee meeting in the area on 19th February 2015.

Min 05-Discussions

The community members present were then urged to give their views on the project, a summary of the discussion is presented in table below.

Questions/Comments	Responses
AWSB had promised to build a school and a hospital. We want this done before the project can kick off	Athi Water will provide to the community adequate reliable water as an advance benefit before construction of the dam Athi Water will address other benefits to the community progressively throughout the project period. Athi Water will liaise with other relevant agencies including county government on projects that are beyond Athi Water mandate.
What steps will you take to ensure the dam doesn't overflow to other un-acquired pieces of land?	The project design has allowed adequate buffer-zone to mitigate dam impact to people's farms. The design also has provided for spillway that will control the dam water level.
Some of us have no title deeds yet the property is ours. How do we get compensation?	The project will trigger land compensation of the affected parcels. Compensation for land will be against a title deed, which is the legal proof of ownership document in Kenya, however people without title deed were advised to commence processing of their respective titles. The expert requested the local administration office to help in facilitation of this process.
How will the value of land be determined?	The project team has a registered Land economist who will undertake the valuation of the affected assets. The basis will be on full replacement cost as required by OP 4.12
Workers from outside the community engaged in construction may bring with them alien cultures, which may corrupt our youth.	All in-migration workers will be furnished with an ethics code on how to interact with the locals in a respectable manner.
Besides compensating us for involuntary displacement, is there any other way the project will benefit us?	The proponent will come up with measures to restore livelihoods. This measures are described in the RAP report

Is there a grievance redress mechanism system in place and will it be effective?	The RAP report has prepared a grievance redress mechanism which will be used to address project related grievances

CONCLUSION

The meeting was adjourned at 5:30 pm with a word of prayer from an elder. The community resolved to support the project to its conclusion and stressed the need for them to be involved in all aspects of the project.

Sign……..Date ……..
Recorded by …….
ENVIRONMENT SAFEGUARDS CONSULTANTS

Sign……Date…….
Checked by – Environment and Social Specialist
ENVIRONMENT SAFEGUARDS CONSULTANTS

Sign……Date…….
Checked by – Chairman / Secretary
RUIRU II DAM COMMITTEE

MINUTES OF THE PUBLIC CONSULTATION MEETING HELD AT KOMOTHAI YOUTH POLYTECHNIC ON 19/03/2016

PRESENT;

- Godwin SakwaLidahuli — Consultant (ESIA,RAP Team Leader)
- Mark Owuondo — Environmental Safeguard (Team Member)

AGENDA

- Introducing the project to the public
- Seeking opinion persons along the project pipeline route

Min 01:

This public consultation meeting took place at the Komothai Youth Polytechnic Kiambu County.The meeting was attended by diverse project stakeholders from Kamuchege, Ngewa and Komothai Locations who included women, men and the youth as well as potential project affected persons, local administration officials within the raw water pipeline. The meetings was attended by representatives of Members of County Assembly and Member of Parliament including representative of National Intelligence

The meeting began at 11:20 am by a word of prayer from Mrs. Margaret Waithera who then invited the area Assistant Chief Mr. Peter Njoroge to chair the meeting. The introduced the area Chief Mr. J. N.Kago who greeted the gathering then talked briefly about the Ruiru II Dam project, he also cautioned the residence against the illicit liquor which he said was rearing its head in the Komothai and its neighboring villages.

Min 02:

Mr.Njoroge then introduced the Mr. Godwin Sakwa who talked briefly about the project. He took the chance to explain to the community members present on the importance of the dam to the locals. Mr. Sakwa also assured the gathering that everything including compensation will be done as per the law. Mr.Sakwa then opened the floor for questions and answers session and the below came up, summary of discussion is presented in the table below.

Questions/Comments	Responses
Where exactly will the pipeline pass through and how will the individuals know if they are affected? (Mr.Mbugua)	The consultants will use shape files developed by the surveyor to identify the project route. The project affected persons along the route will be enumerated
Will those affected by the pipeline and the Dam be compensated?(Charles Kinyanjui)	Yes, there will be compensation before the project kicks off.
Will compensation be done before or after the pipeline is fixed? (Dominic Njoroge)	Compensation will be done before the pipeline is fixed.
What exactly will be compensated, land?	Compensation will be both for loss of land

Crops? soil?	for the dam, right of way for the easement corridor and compensation of loss of crops and trees including any other asset likely to be affected.

Conclusion

The meeting was adjourned at 12:00 pm with a word of prayer from Margaret Waithera.The community resolved to support the project to its conclusion and stressed the need for them to be involved in all aspects of the project.

Sign……..Date ……..
Recorded by ……..
ENVIRONMENT SAFEGUARDS CONSULTANTS

Sign…….Date…….
Checked by – Environment and Social Specialist
ENVIRONMENT SAFEGUARDS CONSULTANTS

Sign…….Date…….
Checked by – Chairman / Secretary
RUIRU II DAM COMMITTEE

MINUTES OF THE PUBLIC CONSULTATION MEETING HELD AT KARWETI COFFEE DRYING CENTRE ON 19/03/2016

PRESENT:

- Godwin Sakwa Lidahuli — Consultant (ESIA,RAP Team Leader)
- Mark Owuondo — Environmental Safeguard (Team Member)
- Stakeholders as per attached attendance list.

AGENDA

- Introducing the project to the public
- Seeking opinion of the operating community amenities

Min 01:

This public consultation meeting took place at the Karweti Coffee Drying Center within Kiambu County. Farmers who use the coffee centre to dry their coffee berries attended the meeting and other persons included project-affected persons within Githunguri and Kamuchege Location. The meetings was attended by representatives of Members of County Assembly and Member of Parliament including representative of National Intelligence

The meeting began at 11:20 am by a word of prayer from Mrs.MilkaNjenga. (Area Ass.Chief. Mrs Njenga then introduced her colleague Mr. Stephen Mwangi-Ass. Chief Githunguri.

Min 02:

Mr.Mwangi then introduced the area Chief Mr. Stephen Thinja who welcomed the Environmental Safeguard team. He took the chance to explain to the community members present on the importance of the dam to the locals. He also went ahead and cautioned the youth and the general public on the consumption of the local liquor, which he said was being re-introduced.

He then invited Mr. Mark Owuondo (Environmental Safeguards Consultants) who talked to the community members gathered about the whole dam project. The floor was then left open for questions and answers. The questions and responses were as below:

Questions/Comments	Responses
What will happen to the pipes from Ruiru I Dam?-Joseph Gitau	The project will not interfered with existing raw water pipelines supplying raw water to Kabete Water Treatment Plant from Ruiru I dam.
What happens in a situation where the land owner has passed on and only the brothers are available?-MwangiWahinga	Then you are required to initiate transfer of land to the next administrator, the residents were advised to work closely with the local administration through the process
How do you determine the number or the quantity of the crops/trees on the land	Land carrying capacity method will be used by a registered Land Economist who is part

affected?-Titus Wainaina	of the team
Which documents will be used to prove ownership of the land affected?-Joseph Karanja	Land title deed will be used.
How many Kilometers does the Dam cover?	The total area covered by the dam will be known once data from the mapping team has been processed and analyzed.

Conclusion

There being no Any Other Business, the meeting ended at 12:50 pm with a word of prayer from ChegeNgumo.

Sign……..Date ……..
Recorded by ……..
ENVIRONMENT SAFEGUARDS CONSULTANTS

Sign……Date…….
Checked by – Environment and Social Specialist
ENVIRONMENT SAFEGUARDS CONSULTANTS

Sign……Date…….
Checked by – Chairman / Secretary
RUIRU II DAM COMMITTEE

ANNEX II. HYDROLOGY REPORT

ANNEX III.CHANCE FIND PROCEDURE

ANNEX IV. SOCIO-ECONOMIC ASSESSMENT QUESTIONNAIRE